CREDIT ACCELERATOR, CDS RATE AND LONG TERM YIELDS: EMPIRICAL EVIDENCES FROM THE CEE ECONOMIES

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Abstract:

The study aims to investigate the mechanism by which lending to private sector may induce risks to the long-term interest rates convergence process in the new EU Member States. The added value of this approach consists of three elements. First of all, the analysis provides a quantitative mechanism for assessing the fundamental dependence of the bank portfolio quality to the dynamics of the credit accelerator, econometric results showing that about 30 percent of the squared change in the private sector credit flow is reflected in the jump of the rate of non-performing loans. Secondly, the study shows that sovereign risk premium is dependent on the stability of the banking system, considering that about 20 percent of the changes in the rate of non-performing loans are reflected in the level of the CDS rate. Third, empirical assessment highlights the importance of the sovereign risk premium transmission channel related to long-term interest rate, with approximately two thirds of the CDS rate contributing to the level of government bonds long-term yields. In this context, promoting a mix of macroeconomic policies oriented also to limiting the volatility of credit demand accompanied by poor multiplier effects in the economy becomes a fundamental requirement for ensuring a sustainable cost of financing long term public debt.

Key Words: credit accelerator, nonperforming loans, CDS rate, long term yields, nominal convergence, panel regressions, emerging economies

Introduction

The severity of the recent economic crisis in most new EU Member States shows that economic policies must be cautious in managing the process of economic catching up to euro area, in order to ensure that real convergence takes place while maintaining macroeconomic stability. Promoting pro-cyclical policies, in order to meet the population's excessive expectations related to fast increase of income, fails to yield sustainable results, especially given that the swift rise in living standards is supported by an accelerated indebtedness of real economy. Implementing lax policies during economic boom contributes

both to the accumulation of systemic vulnerabilities in the banking sector, by excessively feeding loan demand with modest multiplier effects in the economy, as well as to a considerable reduction in borrowers' repayment capacity during recession, caused by major adjustments of investment budgets and other negative fiscal impulses.

The desire to rapidly advance in increasing living standards by resorting to bank loans has proven to be part of the ingredients for an unsustainable economic growth, in the case of a significant number of CEE countries. Alternatives which are available to banks, given the capital account liberalization, provide macro-prudential policy with limited power compared to fiscal and income policies, in the process of tempering unhealthy credit expansion in the economy. Although on the short term they produced noticeable effects, many prudential measures adopted by CEE countries have lost effectiveness over time, especially in the context of financial integration after entering the EU (**Georgescu**, 2010). In addition, when credit demand is very strong, actions aiming to limit financing supply by using the solvency channel become insufficient, given the rapid growth of profitability, based on the swift increase of business volume.

Bernanke, Gertler and Gilchrist (1999) developed a general dynamic equilibrium model that includes credit market imperfections in the explanatory framework of business cycle evolution. The central piece is represented by the financial accelerator, the framework assuming that financial system is not an independent source of volatility, but acts as an amplifier of exogenous shocks. This concept reflects the role of financial markets in augmenting and spreading macroeconomic shocks (Bernanke, 2007). Furthermore, recent studies showed that one of the mechanisms of global crisis spread in CEE countries is represented by the financial channel (Becker et al., 2010). At the same time, failure to distinguish between temporary and permanent influences on budget revenues has consumed the operating space used by fiscal policy in taking actions towards stabilization (Isarescu, 2011). In addition, looming additional budgetary expenditures in order to maintain financial stability has increased the pressure on the public finance stance, in the context of increased yields required by investors for purchasing government securities. Increase of the sovereign risk premium in conjunction with the dynamic of bank loan portfolio quality has represented, along with the output gap, an important channel for the distribution of second-round effects, while the real and financial economy became more and more interdependent.

In this context, the study aims to investigate the mechanism by which acceleration of private sector lending may induce risks to long-term interest rates convergence process in the new EU Member States. The operational objective is to build a simplified financial satellite, based on three components, modelling the long-term bond yields dependence on the interaction between sovereign risk premium and the dynamic of non-performing credit loans amid material credit impulses in the economy.

The rest of the paper is structured as follows. The second section presents the methodology underlying the analytical framework for assessing risks induced by the credit accelerator to the evolution of long-term interest rate, emphasizing the main functional forms used. The third section presents the data used in the study and describes in detail both the underlying economic foundation, as well as preliminary statistical results that lead to the selection of explanatory variables. Section four provides an overview of key empirical issues

in developing a financial satellite model, which favors estimation of the impact that the private sector credit flow dynamic has on meeting the long-term interest rates convergence criterion.

1. METHODOLOGICAL FRAMEWORK

The analytical framework used for assessing credit effects on long-term interest rates for CEE countries is based on a three components transmission mechanism. The first step is represented by the effect of credit growth on the dynamics of non-performing loans, given that the volatility of private sector credit flow has a direct proportional effect on the quality of bank portfolios. Second step is represented by the deterioration of sovereign risk due to the depreciation of bank loan quality. Step three consists in spreading the CDS rate effects to government bonds long-term yields (see Figure 1).

Figure 1: Transmission mechanism of credit accelerator to long term yields
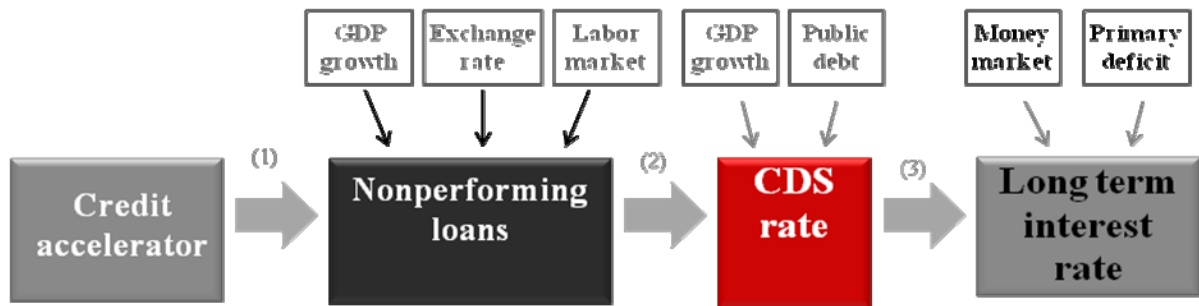
1.1 Lending impact on the quality of credit portfolio

The dynamics of non-performing loans (NPL) transmission channel is based on the premise that both strong accelerations in lending as well as sudden deceleration feed the increase of credit risk. The harmful effect of contracting financing flow on the repayment of existing loans is similar to inefficient allocation of bank resources (**Jakubik and Moinescu**, 2012), considering the intensification of the struggle for market share and excessive lending, which increases the risk of financing more unfeasible projects amid loose credit conditions.

Thus, the dynamics of non-performing loans (see equation 1) is directly proportional to the squared credit accelerator ($\alpha_1 > 0$), defined as the first order difference of the private sector credit flow, expressed as percentage of GDP.

$$d\left(NPL_t^i\right) = \alpha_1 \times \left(Credit\ Accelerator_t^i\right)^2 + \beta_1 \times Macro_t^i + \gamma_1 \times Market_t^i + C_1^i \qquad (1)$$

The conceptual model for the dynamics of non-performing loans ($d\left(NPL_t^i\right)$) assumes a linear relationship, where the set of determinants also includes macroeconomic variables ($Macro_t^i$), such as economic growth, the average gross income and number of employees in the economy.

The mentioned macroeconomic indicators influence in a positive manner the capacity for repayment ($\beta_1 < 0$). The functional form of the explanatory equation also includes financial market variables such as the exchange rate and interbank interest rate, which affects directly and proportional borrowers' financial burden ($\gamma_1 > 0$).

1.2 Loan portfolio quality impact on sovereign risk premium

Increase of the non-performing rate in loan portfolio generates the need of recapitalising banks, which is sometimes covered only from public resources, and also deteriorates investors' perception of sovereign risk, which is followed by significant upward movements of CDS rate ($\alpha_2 > 0$ – see equation 2).

$$CDS_t^i = \alpha_2 \times d(NPL)_t^i + \beta_2 \times Real\ Economy_t^i + \gamma_2 \times Public\ finance_t^i + \epsilon \quad (2)$$

The functional form of the sovereign risk premium explanatory equation also includes the inverse relationship with the stance of real economy ($\beta_2 < 0$), expressed by GDP growth and the flow of foreign direct investments. The CDS rate explanatory equation also includes positive dependence on public finance accumulated deficits ($\gamma_2 > 0$), expressed by the share of government debt and budget balance in GDP.

1.3 Sovereign risk premium impact on long-term interest rate

The dynamics of sovereign risk premiums is subsequently reflected in the performance required for the issuance of bonds (see equation 3).

$$LTY_t^i = \alpha_3 \times CDS_t^i + \beta_3 \times MM_t^i + \delta_3 \times Public\ Finance_t^i + C_3^i \quad (3)$$

Along with sovereign risk premium, long-term interest rate explanatory equation also includes the dependence on interbank rates (MM) and on public finances stance, that captures the positive connection between the evolution of financing need and the cost of attracting resources. Structural differences between CEE economies are also captured by fixed effects of panel estimation.

2. DATA

Private sector credit variable is expressed by the indicator *private sector credit flow in % of GDP*, provisioned in the European Commission's macroeconomic imbalance procedure, while the long term interest rate variable is the *yield of long term bonds*, provided by the Maastricht criteria.

Information underlying the assessment of the impact that credit has on long-term interest rates in the CEE Member States is represented by annual frequency data covering the period 2000 to 2011. The countries under consideration are Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia.

The main source of information is represented by Eurostat, from which were extracted data on credit flow to the private sector, long-term interest rates, economic growth, the average gross income, the number of employees in the economy, foreign direct investment, exchange rate and long term interbank interest rate, the exchange rate, the average inflation rate and the primary deficit of the state budget. The data on non-performing loans rate were extracted from the International Monetary Fund reports on indicators of financial stability and sovereign risk premium was calculated based on daily information extracted from Bloomberg platform.

Preliminary empirical analysis shows that the credit acceleration in CEE countries was one of the main factors favoring the accumulation of nonperforming loans (see Chart 1).
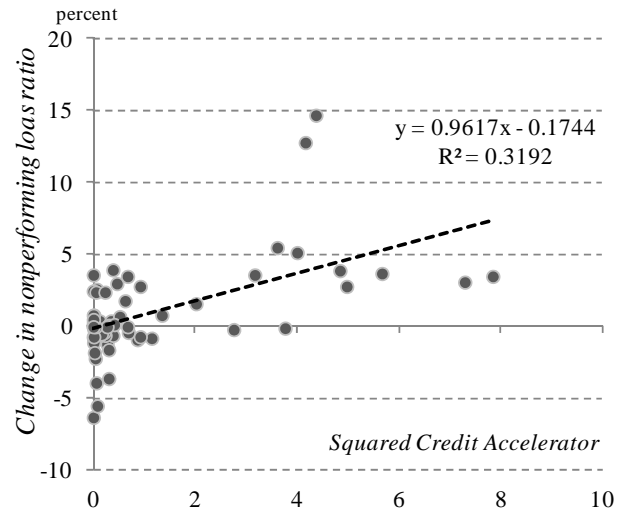
Chart no. 1 – Correlation between credit flow and   Chart no. 2 – Correlation between credit

the change in non-performing loans
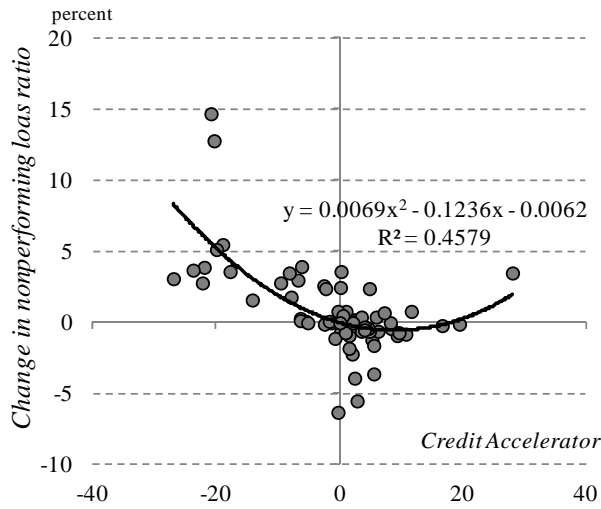
accelerator and the change in non-performing loans

$$y = 0.0069x^2 - 0.1236x - 0.0062$$
$$R^2 = 0.4579$$

Credit Accelerator

$$y = 0.9617x - 0.1744$$
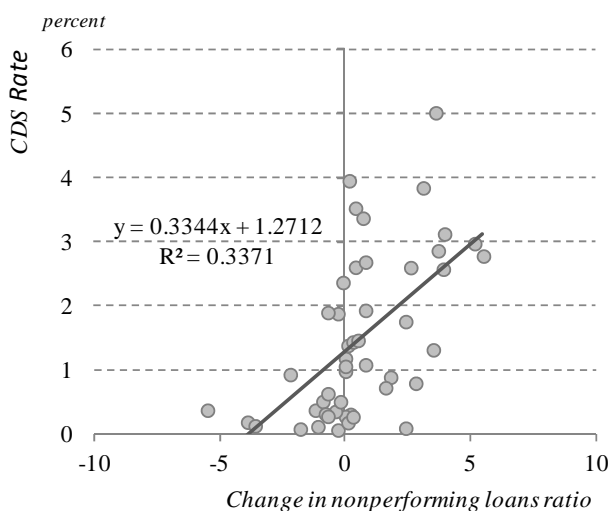$$R^2 = 0.3192$$

Squared Credit Accelerator

Data source: Eurostat, FMI, own calculations

Univariate tests show a consistent elasticity of the rate of non-performing loans to squared credit accelerator in the area of the new EU member states, given an explanatory power of functional connection of more than 30 percent (see chart 2).

At the same time, empirical evidence in CEE countries shows that deterioration of the credit portfolio quality in the region has increased sovereign risk premium, CDS rate being positively driven by increase in the rate of non-performing loans. Univariate assessment of the sovereign risk premium dependence on the evolution of non-performing loans indicates a significant causal linear form (see Chart 3), both in terms of elasticity levels (about 33 percent) as well as in the degree of determination (approximately 33 percent). The impact occurs instantaneously.

Chart no. 3 – Correlation between the rate of non-performing loans and CDS rates

Chart no. 4 – Correlation between CDS rates and long term yields

$$y = 0.3344x + 1.2712$$
$$R^2 = 0.3371$$

Change in nonperforming loans ratio

Data source: FMI, Bloomberg, own calculations

$$y = 0.9197x + 4.8891$$
$$R^2 = 0.4106$$

CDS Rate
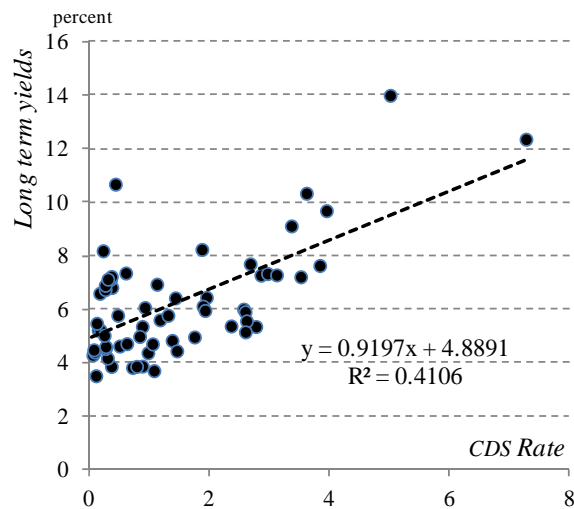
Data source: Eurostat, Bloomberg, own calculations

Subsequently, the changes in sovereign risk premium propagate almost entirely in long-term interest yields, explaining slightly more than 40 percent of its variance (see chart 3).

The candidate indicators for structuring the models and their expected impact on the dependent variables together with the applied transformation are provided in Table 1.

Table 1. The candidate explanatory variables and the corresponding equations

	Explanatory variables	Expected sign
Equation 1: Nonperforming loans ratio		
1	Squared credit accelerator	+
2	GDP growth	-
3	Earnings (log transformation)	-
4	Employment (log transformation)	-
5	Exchange rate (log transformation)	+
6	Money market interest rate (3M)	+
Equation 2: CDS rate		
1	Nonperforming loans ratio	+
2	GDP growth	-
3	Foreign direct investments (log transformation)	+
4	Private debt (as percent of GDP)	+
5	Public debt (as percent of GDP)	+
6	Primary budgetary balance (as percent of GDP)	-
7	Current account (as percent of GDP)	-
Equation 3: Long term yields		
1	CDS rate	+
2	Inflation	+
3	Money market interest rate (3M)	+
4	Primary budgetary balance (as percent of GDP)	-

Stationarity of the considered indicators was tested. All indicators were I(0) after the appropriate transformation and the first difference. Furthermore, the univariate OLS panel regression was used to make the first selection of variables based on statistical relevance. The applied procedure tested variables on one-by-one basis up to two lags, including the contemporary impact, for each explanatory variable (see Annex 1).

3. EMPIRICAL ANALYSIS

Multivariate empirical assessment is based on a standard backward estimation procedure using macroeconomic factors short-listed in the previous section. The analytical component consists of a set of simplified econometric models, built by panel estimations using annual data, structuring the mechanism by which credit rate affects long-term interest rates.

The first equation of the financial satellite models the dynamics of the rate of non-performing loans. Empirical results confirm that the squared credit accelerator increases credit risk, with a strictly positive coefficient, statistically significant at a probability of 93 percent (see Table 2).

Tabel 2 – Multivariate model estimation output for the non-performing loans ratio

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP growth	-0.326519	0.046012	-7.096344	0.0000
(Credit accelerator)^2	0.317049	0.170207	1.862720	0.0668
C	1.525334	0.362907	4.203099	0.0001
Fixed Effects (Cross)				
_BG--C	0.594569	_HUN--C		-0.539924
_CZ--C	-0.417393	_POL--C		-1.694735
_EE--C	-0.465320	_RO--C		0.100351
_LET--C	1.015640	_SK--C		0.253345
_LIT--C	1.343094	_SLO--C		-0.189628
Adjusted R-squared	0.597229			
Durbin-Watson stat	1.831699			

The evolution of non-performing loans rate in CEE countries depends, at the same time, on economic growth, each in a ratio of one to three. Thus, in order to prevent increase in the rate of non-performing loans by one percentage point, economic growth of about three percent would be required. These two determinant factors together explain about 55 percents of the variance of the rate of non-performing loans dynamics. Econometric estimations also suggest that there are some structural differences between countries in the sample in terms of loan portfolio quality, with statistically significant fixed effects. However, these structural differences are minor, the model estimated without fixed effects leading to a similar result, only marginally reduced in performance (from 60 to 56 percents).

The estimation result of the CDS rate equation confirms the dependence of sovereign risk premium on the banking system stability, the increase of non-performing loans through a credit impulse being accompanied by an increase in the sovereign risk premium of about 20 percent (see Table 3). The effect occurs in the same year.

Table 3 – Multivariate model estimation output for CDS rate

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GDP growth	-0.096790	0.025421	-3.807517	0.0003
Change in NPL	0.197709	0.051291	3.854668	0.0003
C	1.478602	0.144212	10.25296	0.0000
Fixed Effects (Cross)				
_BG--C	0.218462	_HUN--C		0.001077
_CZ--C	-0.616806	_POL--C		0.141473
_EE--C	-0.115022	_RO--C		0.614289
_LET--C	0.732251	_SK--C		-0.401846
_LIT--C	0.209642	_SLO--C		-0.831465
Adjusted R-squared	0.704068			
Durbin-Watson stat	1.539265			

At the same time, economic growth acts by reducing sovereign risk premium, with a negative coefficient (about -0.1) and statistically significant for a probability of one percent. The estimated multifactorial functional form manages in capturing slightly more than 70 percent of the CDS rate variance, by also taking into account, through fixed effects, structural differences in sovereign risk. A result which was less expected is the absence of public finances indicators in the final configuration. One possible reason in this respect is expressed by the relatively low level of public debt to GDP ratio in the CEE economies, which probably prompts sovereign risk insurance providers to only marginally include in its price a component related to public finance. At the same time, the basic level of sovereign risk premium is covering enough for insurance providers, with the intercept taking values of around 150 basis points, starting with Slovenia (83 basis points less than the average) and ending with Latvia (73 basis points more than the average). However, the relatively low value of the DW indicator shows the existence of significant autocorrelation between error terms, which indicates the existence of additional determinants. Their nature is most likely of regional contagion, reflecting indirect effects of the risk premium dynamics in countries such as Greece or Austria, provided that the set of macroeconomic variables included only internal sources of risk.

The multifactor configuration of the long term interest rate equation confirms its dependence on sovereign risk premium, given that the econometric estimation generated a 67 percent value for the variable coefficient associated to CDS rate (see Table 4).

Tabel 4 – Multivariate model estimation result for long term interest rate

Variable	Coefficient	Std. Error	t-Statistic	Prob.
CDS rate	0.674473	0.104083	6.480127	0.0000
Money market interest rate	0.341499	0.048892	6.984724	0.0000
Primary balance	-0.125469	0.049179	-2.551257	0.0132
C	3.160937	0.300367	10.52357	0.0000
Fixed Effects (Cross)				
_BG--C	-0.325637	_HUN--C		0.455565
_CZ--C	-0.464669	_POL--C		0.263713
_EE--C	0.846987	_RO--C		-0.367869
_LET--C	-0.133740	_SK--C		-0.484542
_LIT--C	0.098006	_SLO--C		-0.149079
Adjusted R-squared	0.755169			
Durbin-Watson stat	2.044825			

Besides CDS rate, the final functional form also includes money market interest rate, which contributes to the level of long-term interest rate in a proportion of 34 percent. The multivariate configuration also captures the impact of financing need on the price asked by investors for buying long term bonds, given that slightly over 12.5 percent of the primary deficit is reflected in the increase of long-term yields. The three determinant factors together explain three quarters of the variance of long term interest rate, taking into account the slight structural differences between CEE economies in this regard. The values of individual constants are relatively low compared to the intercept of the equation (3.16).

FINAL REMARKS

The main contribution of this study is to highlight the ability of credit accelerator theory to explain a significant part of the evolution of long-term interest rates registered in the countries of Central and Eastern Europe.

The added value of this approach consists of three elements. First of all, the analysis provides a quantitative mechanism for assessing the fundamental dependence of the bank portfolio quality to the dynamics of the credit accelerator, econometric results of this study showing that about 30 percent of the squared change in the private sector credit flow is reflected in the jump of the rate of non-performing loans. Secondly, the study shows that sovereign risk premium is dependent on the stability of the banking system, considering that about 20 percent of the changes in the rate of non-performing loans are reflected in the level of the CDS rate. Third, empirical assessment highlights the importance of the sovereign risk premium transmission channel related to long-term interest rate, with approximately two thirds of the CDS rate contributing to the level of government bonds long-term yields.

At the same time, as the credit accelerator theory indicates a significant impact of credit change on economic growth, we advise on a cautious interpretation of the results. During times of financial disintermediation, non-performing loans can record jumps higher than what can be captured by the analytical framework developed in this study and thus, the

sovereign risk premium could be higher in reality. In such a challenging context, we can expect even larger deviations of bond yields from convergence tendency, especially when there are signs of consolidating the dependence of CDS rate on the non-performing loans dynamic.

Thus, promoting a mix of macroeconomic policies also oriented to limiting the volatility of credit demand accompanied by poor multiplier effects in the economy becomes a fundamental requirement for ensuring a sustainable cost of financing long term public debt.

AKNOWLEDGEMENTS

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Annex 1 – Univariate analysis results

Variable	Coefficient	Std. Error	t-Statistic	Prob.	Adj.-R2	DW
Nonperforming Loans						
(Credit accelerator)^2	**0.010111**	**0.001824**	**5.54222**	**0**	**0.309113**	**1.6935**
(Credit accelerator)^2	0.008329	0.002042	4.078731	0.0001	0.195519	1.940889
(Credit accelerator)^2	0.002016	0.002542	0.79302	0.4305	0.009457	1.621014
GDP growth	**-0.37577**	**0.038325**	**-9.8049**	**0**	**0.582813**	**1.74357**
GDP growth (-1)	-0.138796	0.056338	-2.46361	0.0163	0.082281	1.810661
GDP growth (-2)	0.055424	0.058816	0.942333	0.3493	0.014242	1.44969
Gross earnings	**-0.174591**	**0.036261**	**-4.8148**	**0**	**0.252648**	**1.59397**
Gross earnings (-1)	0.061813	0.040342	1.532233	0.13	0.034411	1.484915
Gross earnings (-2)	0.156779	0.036219	4.328625	0	0.214783	1.760888
Employment	**-0.482558**	**0.070252**	**-6.8689**	**0**	**0.40703**	**1.91391**
Employment (-1)	-0.081103	0.092131	-0.88029	0.3818	0.012645	1.57988
Employment (-2)	0.202004	0.09486	2.129502	0.0368	0.063129	1.528684
Change in money market IR	0.124689	0.131535	0.947954	0.3465	0.014392	1.426249
Change in money market IR (-1)	0.209245	0.124227	1.68437	0.0966	0.040988	1.718849
Change in money market IR (-2)	**0.448351**	**0.11649**	**3.848843**	**0.0003**	**0.178026**	**1.888082**
Change in Exchange Rate	**0.158267**	**0.081383**	**1.94471**	**0.0577**	**0.07901**	**1.55985**
Change in Exchange Rate (-1)	-0.020318	0.073465	-0.27657	0.7833	0.008027	1.493197
Change in Exchange Rate (-2)	-0.087752	0.069544	-1.26181	0.2131	0.038344	1.530851
CDS Rate						
Change in NPL	**0.346704**	**3.675562**	**9.43269**	**0**	**0.636369**	**1.38291**
Change in NPL (-1)	0.20301	0.053715	3.779362	0.0004	0.271692	2.253917
Change in NPL (-2)	0.121572	0.060448	2.011167	0.0498	0.160692	1.629668
GDP growth	**-0.163851**	**0.022393**	**-7.31692**	**0**	**0.51347**	**0.88701**
GDP growth (-1)	-0.097538	0.025155	-3.87742	0.0002	0.291146	1.700063
GDP growth (-2)	-0.041313	0.026472	-1.560645	0.1232	0.160539	1.308615
Foreign direct investment	**-0.052032**	**0.009368**	**-5.55409**	**0**	**0.401207**	**1.70138**
Foreign direct investment (-1)	-0.049995	0.008781	-5.693363	0	0.408689	1.801416
Foreign direct investment (-2)	-0.019761	0.010695	-1.847571	0.0693	0.152551	1.484769
Private debt (%GDP)	0.008911	0.005547	1.606367	0.1125	0.185449	0.977287
Private debt (%GDP) (-1)	0.017548	0.004925	3.56316	0.0007	0.271342	1.296305

Private debt (%GDP) (-2)	**0.024529**	**0.004455**	**5.505905**	**0**	**0.398771**	**1.60089**
Public debt (%GDP)	**0.079844**	**0.011047**	**7.227898**	**0**	**0.508441**	**1.4149**
Public debt (%GDP) (-1)	0.045255	0.014009	3.230296	0.0019	0.251108	1.340338
Public debt (%GDP) (-2)	0.007167	0.016713	0.428835	0.6694	0.133217	1.182794
Primary deficit	**-0.128946**	**0.057541**	**-2.24095**	**0.028**	**0.210937**	**0.94383**
Primary deficit (-1)	-0.145043	0.059536	-2.436231	0.0174	0.207309	1.268233
Primary deficit (-2)	-0.064638	0.065271	-0.990301	0.3255	0.143086	1.245513
Current account	0.110609	0.033369	3.314762	0.0014	0.266986	1.163738
Current account (-1)	-0.040087	0.041404	-0.968182	0.3362	0.152237	1.060357
Current account (-2)	**-0.162442**	**0.04363**	**-3.7232**	**4E-04**	**0.276299**	**1.32155**
Long term yields						
CDS Rate	**0.859373**	**0.127127**	**6.75998**	**0**	**0.557913**	**1.41086**
CDS Rate (-1)	0.151712	0.163338	0.928822	0.3568	0.33775	2.059493
CDS Rate (-2)	-0.319933	0.14312	-2.23542	0.0299	0.484513	2.598009
Inflation	0.020591	0.069357	0.296883	0.7672	0.187995	1.192446
Inflation (-1)	**0.328496**	**0.050811**	**6.46507**	**0**	**0.442556**	**1.32486**
Inflation (-2)	0.237739	0.053031	4.483034	0	0.37402	1.981305
Money market interest rate	**0.43675**	**0.076438**	**5.71377**	**0**	**0.466388**	**1.42123**
Money market interest rate (-1)	0.375622	0.066851	5.618816	0	0.460252	2.161636
Money market interest rate (-2)	0.11795	0.075958	1.552841	0.126	0.246796	1.657688
Primary deficit	**-0.30485**	**0.067166**	**-4.5387**	**0**	**0.335916**	**1.19682**
Primary deficit (-1)	-0.151356	0.074509	-2.0314	0.0451	0.221806	1.37835
Primary deficit (-2)	-0.021028	0.076361	-0.27537	0.7837	0.224949	1.437885

The variables highlighted in bold are those retained for the multivariate analysis, considering their univariate fitting performance.