

SCIENTIFIC PAPERS

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## GOVERNMENT BORROWING AND THE LONG-TERM INTEREST RATE: APPLICATION OF AN EXTENDED LOANABLE FUNDS MODEL TO THE SLOVAK REPUBLIC

**ABSTRACT:** *Extending the open-economy loanable funds model, this paper finds that more government borrowing as a percent of GDP leads to a higher government bond yield, that a higher real money market rate, a higher expected inflation rate, a higher EU government bond yield, or a decrease in the Slovak nominal effective exchange rate would increase the Slovak government bond yield, and that the positive coefficient of the percent change in real GDP is insignificant*

*at the 10% level. When the standard closed-economy or open-economy loanable funds model is considered, except that the positive coefficient of the ratio of the net capital inflow to GDP is insignificant at the 10% level, other results are similar.*

**KEY WORDS:** *Government borrowing, long-term interest rate, expected inflation, world interest rate, exchange rate*

**JEL CLASSIFICATION:** E43, E62, P35

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## 1. INTRODUCTION

The recent global recession has led many countries to experience declining economic activities and government budget concerns. The Slovak Republic is no exception. According to the National Bank of Slovakia and the *Economic and Financial Data for Slovak Republic* published by the International Monetary Fund, Slovakia's real GDP at the 2000 price declined 5.32% from 12,486.89 million euros in 2008.Q2 to 11,822.5 million euros in 2009.Q2. The government budget changed from a surplus of 142.7 million euros in 2008.Q3 to a deficit of 1,108.4 million euros in 2009.Q2. Total debt of the Slovak central government rose 25.46% from 16,023 million euros in 2008.Q2 to 20,103 million euros in 2009.Q2. There has been a renewed interest in examining whether more government deficit or borrowing would raise the long-term interest rate, crowd out some of private investment expenditures, and hinder economic growth.

Previous studies suggest that more government deficit may or may not lead to a higher interest rate. Feldstein (1982), Hoelscher (1986), Wachtel and Young (1987), Zahid (1988), Thomas and Abderrozak (1988), Miller and Russek (1991), Raynold (1994), Cebula (1989, 1991, 1993, 1997, 1999, 2003), Vamvoukas (1997), Ewing and Yanochik (1999), and Saleh and Harvie (2005) hold the view that there is a positive impact of the government deficit on the interest rate. Kormendi (1983), Hoelscher (1983), Aschauer (1985), Makin (1983), McMillin (1986), Barro (1987), Evans (1985, 1987, 1988), Gupta (1989), Darrat (1989, 1990), Findlay (1990), and Ostrosky (1990) maintain the Ricardian equivalence view that more government deficit would not raise the interest rate.

Several recent articles have examined the subject. Hartman (2007) indicates that government deficits may affect interest rates differently due to the short-term crowding-in effect and the long-term crowding-out effect and that current real interest rates are also influenced by expected government deficits. Barnes (2008) reveals that cointegrating relationships are confirmed for ten Western countries under study and that long-term interest rates respond positively to government budget deficits. Wang and Rettenmaier (2008) show that the government deficits have positive and temporary effects on interest rates.

This paper attempts to examine the impact of the government deficit on the long-term interest rate for the Slovak Republic and has several different aspects. First, the model is extended to incorporate the world interest rate and the exchange rate as potential variables explaining the behaviour of international capital flows in supplying loanable funds. Second, comparative-static analysis is applied

to determine the theoretical sign of a change in the exogenous variable on the equilibrium long-term interest rate. Third, the latest available data are employed in empirical work, and the results would have more policy implications. The paper is organized in the following manner. The theoretical model is presented in the next section. Data sources, the definition and measurement of variables, and empirical results are described and analyzed in the third section. The summary and conclusions are made in the last section.

## **2. THE MODEL**

The loanable funds model has been employed in studying the impact of government deficits on interest rates (Hoelscher, 1986; Tran and Sawhney, 1988; Thomas and Abderrezak, 1988; Cebula, 1988, 1994, 1997a, 1997b, 1998, 1999, 2000, 2003, 2005; Correia-Nunes and Stemitsiotis, 1995; García and Ramajo, 2004; Quayes and Jamal, 2007; Barnes, 2008). Hoelscher (1986) develops a closed-economy loanable funds model, and Cebula (1988, 1994, 1997a, 1997b, 1998, 1999, 2000, 2003) proposes an open-economy loanable funds model by considering the net capital inflow in the supply of loanable funds.

In this paper, the behaviour of the net capital inflow is explained by the relative interest rate and the exchange rate (Devereux and Saito, 2006; De Santis and Luhrmann, 2009). As the world long-term interest rate rises relative to the Slovak long-term interest rate, the net capital inflow to Slovakia would decrease. As the Slovak currency appreciates relative to other currencies, the net capital inflow to Slovakia would increase. Hence, a higher world interest rate would shift the supply of loanable funds to the left and increase the Slovak long-term interest rate, and an appreciation of the Slovak currency would shift the supply of loanable funds to the right and reduce the Slovak long-term interest rate. Suppose the demand for loanable funds is negatively affected by the long-term interest rate and positively influenced by the real short-term interest rate, the expected inflation rate, the percent change in real GDP, and the government deficit and that the supply of loanable funds is positively associated with the long-term interest rate, the percent change in real GDP, and the nominal effective exchange rate and negatively associated with the real short-term interest rate, the expected inflation rate, and the world long-term interest rate. Thus, in the extended open-economy loanable funds model, the demand for and the supply of loanable funds can be expressed as

$$D = F(R, R^S, \pi^e, Y, B) \quad (1)$$

$$S = H(R, R^S, \pi^e, Y, R^*, \varepsilon) \quad (2)$$

where

D = the demand for loanable funds in Slovakia,  
 S = the supply of loanable funds in Slovakia,  
 R = the long-term interest rate in Slovakia,  
 $R^S$  = the real short-term interest rate in Slovakia,  
 $\pi^e$  = the expected inflation rate in Slovakia,  
 Y = percent change in real GDP in Slovakia,  
 B = the government deficit in Slovakia,  
 $R^*$  = the world long-term interest rate, and  
 $\varepsilon$  = the nominal effective exchange rate. (An increase means appreciation of the Slovak currency.)

Setting D and S equal to the equilibrium loanable funds, we can write the equilibrium long-term interest rate as

$$\bar{R} = \bar{R}(B, R^S, Y, \pi^e, R^*, \varepsilon) \quad (3)$$

The partial derivative of  $\bar{R}$  with respect to each of the exogenous variables is given by

$$\partial \bar{R} / \partial B = F_B / |J| > 0 \quad (4)$$

$$\partial \bar{R} / \partial R^S = (F_{R^S} - H_{R^S}) / |J| > 0 \quad (5)$$

$$\partial \bar{R} / \partial Y = (F_Y - H_Y) / |J| > \text{or} < 0 \quad (6)$$

$$\partial \bar{R} / \partial \pi^e = (F_{\pi^e} - H_{\pi^e}) / |J| > 0 \quad (7)$$

$$\partial \bar{R} / \partial R^* = -H_{R^*} / |J| > 0 \quad (8)$$

$$\partial \bar{R} / \partial \varepsilon = -H_\varepsilon / |J| < 0 \quad (9)$$

where  $|J|$  is the Jacobian for the endogenous variables and has a positive value. Note that the sign of  $H_{R^S}$ ,  $H_{\pi^e}$  and  $H_{R^*}$  is negative and that the sign of  $H_\varepsilon$  is positive. Theoretically, the equilibrium long-term interest rate has a positive relationship

with the government deficit, the real short-term interest rate, the expected inflation rate, or the world interest rate, a negative relationship with the nominal effective exchange rate, and an unclear relationship with the percent change in real GDP.

In comparison, the equilibrium long-term interest rate in the standard closed-economy loanable funds model (Hoelscher, 1986) can be written as

$$\bar{R} = \bar{R}(B, R^S, Y, \pi^e) \quad (10)$$

The equilibrium long-term interest rate in the standard open-economy loanable funds model (Cebula, 1988, 1994, 1997a, 1997b, 1998, 1999, 2000, 2003) is given by

$$\bar{R} = \bar{R}(B, R^S, Y, \pi^e, NCF) \quad (11)$$

where NCF is the net capital inflow. The sign of NCF should be negative as an increase in the net capital inflow to Slovakia would shift the supply of loanable funds to the right and reduce the equilibrium long-term interest rate.

### **3. EMPIRICAL RESULTS**

The data were collected from the October 2009 edition of the *International Financial Statistics*, which is published by the International Monetary Fund. The dependent variable is Slovakia's government bond yield. Because the data for the government deficit are only available during 2006.Q1 – 2007.Q4 with 8 observations, B is represented by the ratio of government borrowing to GDP. Due to incomplete data for the Treasury bill rate, the real short-term interest rate is represented by the real money market rate to test a potential substitution effect. Y is represented by the percent change in real GDP at the 2005 price. The expected inflation rate is represented by the lagged inflation rate based on the consumer price index. To reduce multicollinearity, the lagged EU government bond yield is chosen to represent the world interest rate.  $\epsilon$  is represented by the nominal effective exchange rate. An increase in the nominal effective exchange rate means appreciation of the Slovak currency. NCF is represented by the ratio of the net capital inflow to GDP where the net capital inflow is the sum of the portfolio, direct and other investments in the financial account. The data for the government bond yield before 2000.Q3 and the data for the money market rate

after 2008.Q4 are not available. Hence, the sample ranges from 2000.Q3 to 2008.Q4.

As shown in Table 1, based on the unrestricted cointegration rank test, there are 2 cointegrating relations. Therefore, there is a long-term stable relationship among the variables.

**Table 1. Unrestricted Cointegration Rank Test (Maximum Eigenvalue)**

Hypothesized No. of CE(s)	Max-Eigen Eigenvalue	0.05 Statistic	Critical Value	Prob.**
None *	0.920727	81.11551	46.23142	0.0000
At most 1 *	0.715977	40.27837	40.07757	0.0475
At most 2	0.605054	29.72820	33.87687	0.1446
At most 3	0.504136	22.44650	27.58434	0.1984
At most 4	0.295154	11.19285	21.13162	0.6280
At most 5	0.228419	8.298043	14.26460	0.3492
At most 6	0.028020	0.909452	3.841466	0.3403

Notes:

Max-eigenvalue test indicates 2 cointegrating relations at the 5% level.

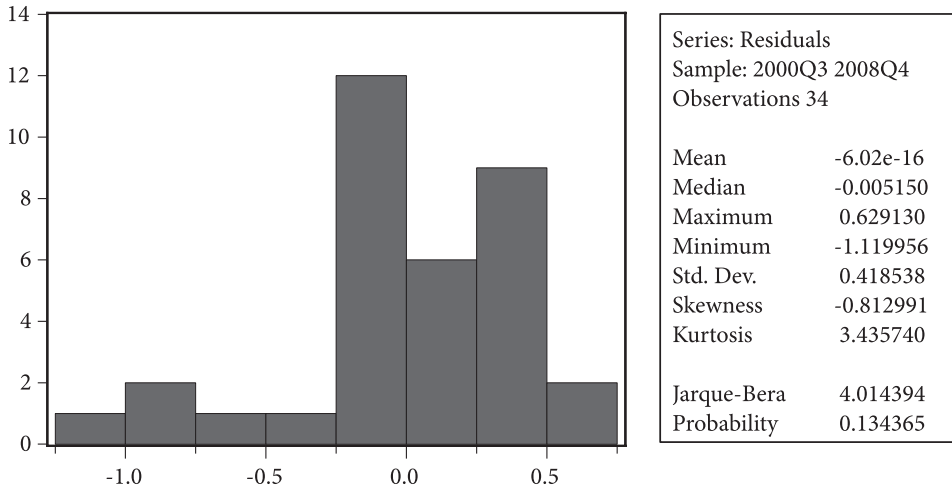
\* denotes rejection of the hypothesis at the 0.05 level

\*\*MacKinnon-Haug-Michelis (1999) p-values

Table 2 plots the residual histogram and presents the normality test for the error terms. As shown, the Jarque-Bera statistic of 4.01 is smaller than the critical value of 9.21 at the 1% level or 5.99 at the 5% level. Hence, the null hypothesis of a normal distribution of the error terms cannot be rejected.

Table 3 reports the estimated regression and related statistics. The Newey-West generalized least squares (GLS) method is employed in order to yield consistent estimates for the covariance and standard errors. As shown, 91.5% of the variation in the government bond yield can be explained by the right-hand side variables with significant coefficients. Except for the coefficient of the growth rate of real GDP, all other coefficients are significant at the 1% or 5% level. The government bond yield is positively associated with the ratio of government borrowing to GDP, the real money market rate, the expected inflation rate, the EU government bond yield, and it is negatively affected by the nominal effective exchange rate.

**Table 2. The Jargue-Bera Normality Test of the Regression Residuals**



**Table 3. Estimated Regression of the Government Bond Yield for Slovakia based on the Extended Loanable Funds Model**

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-0.822985	0.776459	-1.059920	0.2986
B	1.602431	0.673581	2.378974	0.0247
$R^S$	0.232864	0.072405	3.216114	0.0034
Y	0.009744	0.012127	0.803528	0.4287
$\pi^e$	0.979523	0.337383	2.903296	0.0073
$R^*$	1.479321	0.276401	5.352087	0.0000
$\varepsilon$	-0.017698	0.006003	-2.948262	0.0065
R-squared	0.930380			
Adjusted R-squared	0.914909			
Akaike inform. criterion	1.477811			
Schwarz criterion	1.792062			
F-statistic	60.13645			
Prob (F-statistic)	0.000000			
Sample period	2000.Q3 – 2008.Q4			
N	34			

Notes:

C is the constant. B is the ratio of government borrowing to GDP.  $R^S$  is the real money market rate. Y is the percent change in real GDP.  $\pi^e$  is the expected inflation rate.  $R^*$  is the EU government bond yield.  $\varepsilon$  is the nominal effective exchange rate.

Several different versions are considered to determine whether the outcomes may vary. If the 10-year U.S. government bond yield replaces the EU government bond yield, its positive coefficient will be significant at the 5% level, the positive coefficient of the nominal effective exchange rate will be insignificant, and other results will be similar. If the lagged nominal effective exchange rate replaces the nominal effective exchange rate, its negative coefficient is significant at the 10% level, and other results are similar. If the SKK/USD exchange rate replaces the nominal effective exchange rate, its positive coefficient will be significant at the 1% level, but the coefficients of the ratio of government borrowing to GDP, the real money market rate, and the expected inflation rate will be insignificant at the 10% level. To save space, details are not printed here and will be available upon request.

When the standard closed-economy loanable funds model in equation (10) is considered in empirical work, the value of the adjusted  $R^2$  is 0.845, and the sign and significance of all the coefficients are similar to those reported in Table 3. When the standard open-economy loanable funds model in equation (11) is considered, the value of the adjusted R-squared is 0.830, the positive coefficient of the ratio of the net capital inflow to GDP is insignificant at the 10% level, and other results are similar to the closed-economy loanable funds model. Hence, the inclusion of the EU government bond yield and the nominal effective exchange rate increases the value of adjusted R-squared of the regression and improves the explanatory power of the behaviour of the Slovak government bond yield.

#### **4. SUMMARY AND CONCLUSIONS**

This paper has applied an extended open-economy loanable funds model to examine whether the Slovak long-term interest rate would be affected by government borrowing and other selected macroeconomic variables. The results show that more government borrowing would raise the government bond yield and that a higher real money market rate, a higher expected inflation rate, a higher EU government bond yield, and a lower nominal effective exchange rate would raise the Slovak government bond yield. In the standard closed-economy loanable funds model without including the EU government bond and the nominal effective exchange rate, similar results for other variables are found. In the standard open-economy loanable funds model, except that the positive coefficient of the ratio of the net capital inflow to GDP is insignificant at the 10% level, other results are similar to those found in the standard closed-economy loanable funds model. Hence, the EU government bond yield and the nominal



effective exchange rate incorporated in this study increase the explanatory power of the behaviour of the government bond yield.

There are several policy implications. The significant coefficient of the ratio of government borrowing to GDP implies that pursuing expansionary fiscal policy to stimulate the economy would raise the long-term government bond yield and crowd out part of private investment expenditures. It suggests that the multiplier effect of increased government deficit spending would not change much due to crowding-out. In the open-economy loanable funds model, the world interest rate and the exchange rate need to be considered as international investors search for better returns in determining the supply of loanable funds to Slovakia or other countries. The positive insignificant coefficient of the net capital inflow to GDP suggests that its role in affecting the supply of loanable funds may need to be further examined.

Empirical results in this article should be regarded as preliminary. When more observations become available, regression parameters need to be re-estimated to determine whether the results would be robust. The expected inflation rate may be estimated by other techniques. Interest rate determination may be examined by other theories (Romer, 2000).

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