Preliminary communication
UDC 332.053.23:336.748.12

Does more government deficit raise the interest rate? Application of extended loanable funds model to Slovenia*

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Abstract

Extending the open-economy loanable funds model, this paper finds that more government deficit as a percentage of GDP does not lead to a higher government bond yield. In addition, a higher real Treasury bill rate, a higher expected inflation rate, a higher EU government bond yield, or an expected depreciation of the euro against the U.S. dollar would increase Slovenia's long-term interest rate. The negative coefficient of the percentage change in real GDP is insignificant at the 10% level. Applying the standard closed-economy or open-economy loanable funds model without including the world interest rate and the expected exchange rate, we find similar conclusions except that the positive coefficient of the ratio of the net capital inflow to GDP has a wrong sign and is insignificant at the 10% level.

Key words: *government deficits, long-term interest rates, loanable funds model, expected inflation, world interest rates, expected exchange rates*

JEL classification: *P43, E43, E62*

1. Introduction

The recent worldwide recession has led many countries to experience declining business and economic activities and tighter government budgets. For example, during

* Received: 06-11-2009; accepted: 14-12-2009

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[2] The author is very thankful to two anonymous referees for insightful comments. Any errors will be the author's sole responsibility

2008.Q2 – 2009.Q2, Slovenia's real GDP and gross fixed capital formation declined 9.3% and 36.7%, respectively. Exports and imports of goods and services decreased 21.3% and 24.8%, respectively. The budget of the Slovenian central government changed from a surplus of 194.6 million euros to a deficit of 665.0 million euros. There has been a renewed interest in examining whether more government deficit would raise the long-term interest rate, crowd out some private investment spending, and impede economic growth.

Previous findings of the response of the interest rate to the government deficit are not conclusive. 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) maintain 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) hold the view that the government deficit would not raise the interest rate.

In a recent article, Hartman (2007) shows that results from the effect of government deficits on interest rates are inconclusive because there is some support for the crowding-out hypothesis, whereas crowding-in may overwhelm in the short run. He also indicates that an expected increase in future deficits could raise today's real interest rates. Barnes (2008) examines the subject for ten advanced Western countries and finds that each of the countries exhibits several cointegrating vectors and that more government budget deficits cause long-term interest rates to rise. Wang and Rettenmaier (2008) indicate that the impact of government deficits on interest rates are positive, may last up to 8 years, are not permanent, and will die out after 8 years. These previous studies have made significant contributions to the formulation of the models, test of the hypotheses, and interpretation of the results.

This paper attempts to examine the impact of the government deficit on the long-term interest rate for Slovenia. The choice of Slovenia as a case study is because it is the first East and Central European country that has adopted the euro since January 1, 2007 and because the closer economic relationship between Slovenia and the EU suggests that the EU bond market and the EUR/USD exchange rate may have more impacts on Slovenia's long-term government bond yield than its neighboring countries. The paper has several different aspects. First, the model is extended to incorporate the world interest rate and the expected exchange rate as potential variables explaining the behavior of the supply of loanable funds. Second, comparative-static analysis is applied to determine a theoretical sign of a change in one of the exogenous variables on the equilibrium long-term interest rate. Third, the data are more recent and 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. A 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 flow in the supply of loanable funds.

In this paper, the behavior of the net capital inflow is explained by the relative interest rate and the expected exchange rate (Devereux and Saito, 2006; De Santis and Luhrmann, 2009). As the world long-term interest rate rises relative to the Slovenian long-term interest rate, the net capital inflow to Slovenia would decrease. As the Slovenian currency is expected to appreciate relative to other currencies, the net capital inflow to Slovenia would increase. Hence, a higher world interest rate would shift the supply of loanable funds to the left and increase Slovenia's long-term interest rate, and an expected appreciation of Slovenia's currency would shift the supply of loanable funds to the right and reduce Slovenia's 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, inflation rate, percentage change in real GDP and government deficit, then the supply of loanable funds is positively associated with the long-term interest rate and negatively affected by the real short-term interest rate, the expected inflation rate, the world interest rate, and the expected EUR/USD exchange rate. Thus, in the extended open-economy loanable funds model, the demand for and the supply of loanable funds can be expressed as

$$LFD = F(R, R^S, \pi^e, Y, D) \tag{1}$$

$$LFS = H(R, R^S, \pi^e, R^*, \varepsilon^e) \tag{2}$$

where

LFD = the demand for loanable funds in Slovenia,

LFS = the supply of loanable funds in Slovenia,

R = the long-term interest rate in Slovenia,

R^S = the real short-term interest rate in Slovenia,

π^e = the expected inflation rate in Slovenia,

Y = percent change in real GDP in Slovenia,

D = the government deficit in Slovenia,

R^* = the world long-term interest rate, and

ε^e = the expected euro/U.S. dollar (EUR/USD) exchange rate. (An increase means the expected depreciation of the euro.)

Setting *LFD* and *LFS* equal to the equilibrium loanable funds (*E*), we can write the equilibrium long-term interest rate as

$$\overline{R} = \overline{R}(D, R^S, Y, \pi^e, R^*, \varepsilon^e) \tag{3}$$

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

$$\partial \overline{R} / \partial D = F_D / |J| > 0 \tag{4}$$

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

$$\partial \overline{R} / \partial Y = F_Y / |J| > 0 \tag{6}$$

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

$$\partial \overline{R} / \partial R^* = -H_{R^*} / |J| > 0 \tag{8}$$

$$\partial \overline{R} / \partial \varepsilon^e = -H_{\varepsilon^e} / |J| > 0 \tag{9}$$

where $|J|$ is the Jacobian for the endogenous variables and has a positive value. Theoretically, the equilibrium long-term interest rate has a positive relationship with the government deficit, real short-term interest rate, percentage change in real GDP, expected inflation rate, world interest rate, or the expected EUR/USD exchange rate.[3]

In comparison, the equilibrium long-term interest rate in the standard closed-economy loanable funds model (Hoelscher, 1986) is given by

[3] The CDS spread for Slovenia may be considered as a relevant variable. However, due to lack of complete data, it is not included in the estimated regression.

$$\overline{R} = \overline{R}(D, R^S, Y, \pi^e) \tag{10}$$

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

$$\overline{R} = \overline{R}(D, R^S, Y, \pi^e, CF) \tag{11}$$

where CF is the net capital inflow. The sign of CF should be negative as an increase in the net capital inflow to Slovenia 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 *International Financial Statistics,* which is published by the International Monetary Fund. The dependent variable is the Slovenia's 10-year government bond yield. The real short-term interest rate is represented by the real Treasury bill rate to test a potential substitution effect. The expected inflation rate is the lagged inflation rate derived from the percentage change in the consumer price index. Y is represented by the percentage change in real GDP, which is an index number with 2005 as the base year. Year 2005 is the standard base year selected by the International Monetary Fund in estimating the index number for real GDP for all its member countries. B is represented by the ratio of the government deficit to GDP as a percent. The EU government bond yield is chosen to represent the world interest rate. The lagged euro/dollar exchange rate is used to represent the expected exchange rate. CF is represented by the ratio of the net capital inflow to GDP as a percent where the net capital inflow is the sum of the portfolio, direct and other investments in the financial account. After a lag, the sample ranges from 2002.Q2 to 2009.Q1. The selection of the begining sample period is initial mainly because of lack of data for the government bond yield before 2002.Q2.[4]

Table 1 presents the descriptive statistics for the variables including the mean, the median, minimum, maximum, standard deviation, and others. Note that the Jargue-Bera test of the normality of the residuals is for a large sample and does not apply to a relatively small sample in this study.[5]

[4] When the ARIMA model is employed to generate the expected inflation rate and the expected EUR/USD exchange rate, the results are similar.

[5] The Shapiro-Wilk test shows that the normality of the residuals cannot be rejected at the 5% level.

Table 1: Descriptive statistics of the variables

	R (Percent)	D (Percent)	R^S (Percent)	Y (Percent)	π^e (Percent)	R^* (Percent)	ε^e (Euro/USD)
Mean	5.076	0.483	3.654	0.762	1.012	4.138	0.824
Medium	4.627	0.746	3.190	0.779	0.820	4.153	0.798
Max.	9.310	6.705	7.782	8.764	2.675	5.255	1.141
Min.	3.643	-8.928	1.325	-10.318	-0.908	3.262	0.640
S.D.	1.526	3.020	1.690	4.437	0.922	0.435	0.121
Sum	142.120	13.535	102.312	21.334	28.345	115.864	23.075
Sum S.D.	62.842	246.318	77.073	531.544	22.944	5.098	0.398
N	28	28	28	28	28	28	28

Notes: R is the long-term government bond yield. D is the ratio of the government deficit to GDP. R^S is the real Treasury bill rate. Y is the percent change in real GDP. π^e is the expected inflation rate. R^* is the EU government bond yield. ε^e is the expected euro/dollar exchange rate.

Sources: International Financial Statistics and author's calculation

The unit root test shows that each of the variables has a unit root in the level form and is stationary in the first difference. As shown in Table 2, based on the unrestricted cointegration rank test, there are 2 cointegrating relations. Hence, there is a long-term stable relationship among the variables.[6]

According to the serial correlation LM test with 2 lags, the test statistic is 4.06, and the critical value with F(2,19) is 3.52 at the 5% level. Thus, the lack of serial correlation cannot be rejected at the 5% level. Based on the White heteroskedasticity test, the test statistic is 3.52, and the critical value with F(12,15) is 2.48 at the 5% level. Hence, the lack of heteroskedasticity cannot be rejected at the 5% level. If the $n \cdot R^2$ test statistic is employed, similar conclusions will be reached. Hence, the Newey-West (1987) method is employed in empirical work in order to correct for both serial correlation and heteroskedasticity and yield consistent estimates for the covariance and standard errors.

[6] Due to a small sample size of 28 observations, an error correction model with a proper lag length cannot be applied to check for the direction of the linkage.

Table 2: Unrestricted cointegration rank test (maximum eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Probability**
None *	0.966827	88.55669	46.23142	0.0000
At most 1 *	0.878694	54.84540	40.07757	0.0006
At most 2	0.702574	31.52734	33.87687	0.0930
At most 3	0.610828	24.53709	27.58434	0.1170
At most 4	0.393078	12.98322	21.13162	0.4538
At most 5	0.172404	4.919975	14.26460	0.7519
At most 6	0.032864	0.868828	3.841466	0.3513

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

Source: Author's calculation

Table 3 reports the estimated regression and related statistics. As shown, 92.9% of the variation in the government bond yield can be explained by the right-hand side variables with significant coefficients. Except for the coefficients of the ratio of the government deficit to GDP and the percentage change in real GDP, all other coefficients are significant at the 1% or 5% level. The government bond yield is not affected by the government deficit and the percentage change in real GDP, and it is positively associated with the real Treasury bill rate, expected inflation rate, the EU government bond yield, and expected depreciation of the euro against the U.S. dollar. The negative sign of the growth rate of real GDP is contrary to the expected positive sign. To determine whether the estimated regression is stable, the CUSUM test is applied. The paper finds that the cumulative sum of the recursive residuals falls within the 5% critical lines, suggesting that the estimated parameter is relatively stable.

Several different versions or measures of the variables are considered to determine whether the outcomes may vary. Two separate dummy variables for Slovenia's entry into the EU and the EMU are created to test whether these major events would affect the level of the long-term government bond yield. The results show that both dummy variables are insignificant at the 10% level. If the 10-year U.S. government bond yield replaces the EU government bond yield, its coefficient is negative and insignificant at the 10% level, and the positive coefficient of the expected EUR/USD exchange rate becomes insignificant at the 10% level. Other results are similar. If the average EUR/USD exchange rate of the past four quarters replaces the lagged EUR/USD exchange rate as the expected exchange rate, its positive coefficient is insignificant at the 10% level. When the average inflation rate of the past four quarters replaces the lagged inflation rate as the expected inflation rate, its coefficient is positive and significant at the 1% level, but the positive coefficient of the real Treasury bill rate becomes 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 0.863, and the signs and significance of the coefficients for these four variables are similar to those reported in Table 3. When the standard open-economy loanable funds model in equation (11) is considered, the explanatory power of the regression is 0.857, and the positive coefficient of the ratio of the net capital inflow to GDP is insignificant at the 10% level. Other results are similar to the extended open-economy or closed-economy loanable funds model. Hence, the inclusion of the EU government bond yield and the expected exchange rate improve the theoretical model and empirical outcomes. Note that the value of the adjusted R^2 penalizes for including more right-hand side variables and will increase only if an added new variable improves the explanatory power of the regression.

Table 3: Estimated regression of the long-term government bond yield for Slovenia based on the extended loanable funds model

Variable	Coefficient	Std. Error	t-Statistic	Probability
C	-3.927517	1.254324	-3.131183	0.0050
D	0.034396	0.034438	0.998782	0.3293
R^S	0.464059	0.114532	4.051787	0.0006
Y	-0.025534	0.023655	-1.079407	0.2926
π^e	0.490592	0.138611	3.539331	0.0019
R^*	1.101058	0.242369	4.542893	0.0002
ε^e	2.739280	1.314904	2.083256	0.0496
Adjusted R^2	0.928926			
AIC	1.250953			
Schwarz criterion	1.584004			
F-statistic	59.81387			
Prob (F-statistic)	0.000000			
Sample period	2002.Q2-2009.Q1			
N	28			

Notes: The Newey-West method is employed in empirical work in order to yield consistent covariance and standard errors. The dependent variable R is the long-term government bond yield. C is the constant. D is the ratio of the government deficit to GDP. R^S is the real Treasury bill rate. Y is the percentage change in real GDP. π^e is the expected inflation rate. R^* is the EU government bond yield. ε^e is the expected euro/dollar exchange rate.

Source: Author's calculation

4. Summary and conclusions

This paper has applied an extended open-economy loanable funds model to examine whether the Slovenian long-term interest rate would be affected by the government deficit and other selected macroeconomic variables. The results show that more government deficit would not raise the government bond yield and that a higher real Treasury bill rate, higher expected inflation rate, higher EU government bond yield, and expected depreciation of the euro would raise the Slovenian government bond yield. In the standard closed-economy or open-economy loanable funds model, similar results are found except that the insignificant positive coefficient of the ratio of the net capital inflow to GDP in the standard open-economy loanable funds model should be negative. Hence, the EU government bond yield and the expected exchange rate in the extended open-economy loanable funds model can explain better the behavior of the government bond yield than the ratio of the net capital inflow to GDP. In interpreting the results, caution should be exerted. Even though more government deficit as a percentage of GDP would not raise the government bond yield, it is possible that when the government deficit reaches a relatively high level, it may cause the government bond yield to rise and that a different model or estimation technique may produce different outcomes.

The results in this study may be considered by policymakers in reviewing the long-term government interest rate policy. Out of three domestic variables, more government deficit as percentage of GDP would not raise the long-term government bond yield whereas a lower inflation rate or a lower real Treasury bill rate would reduce the long-term government bond yield. Two external variables - the EU government bond yield and the expected EUR/USD exchange rate - cannot be controlled or influenced by the Slovenian government but would affect Slovenia's government bond yield. The global financial crisis is expected to reduce Slovenia's government bond yield (because the real Treasury bill rate and the EU government bond yield have declined recently) and increase Slovenia's government bond yield temporarily due to transitory increases in the expected EUR/USD exchange rate. These findings for Slovenia may or may not apply to other countries as each country has different economic and financial conditions.

There may be potential areas for future research. When the sample size increases, the regressions may be re-estimated to compare with the present study to determine whether the results may change. If the data for the government debt are available, it may replace the government deficit to determine whether similar results would be obtained. The expected inflation rate or exchange rate may be constructed by more sophisticated methodologies. Other theories of interest rate determination such as the IS-LM model may be considered, although Romer (2000, 2006) has shown issues and problems in applying the model.

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Rastu li kamate sukladno povećanju državnog deficita? Primjena proširenog modela raspoloživih sredstava na Sloveniju

Yu Hsing[1]

Sažetak

Primjenjujući model raspoloživih sredstava u otvorenoj ekonomiji, ovaj rad dokazuje da veći postotak državnog deficita u odnosu na BDP ne vodi ka većem prinosu od državnih obveznica. Također, realna stopa povećanja državnih rezervi, veća očekivana stopa inflacije, veći prinos obveznica EU-a, ili očekivana deprecijacija Eura u odnosu na američki dolar bi mogli povećati dugoročne kamatne stope Slovenije. Negativni koeficijent promjene postotka realnog BDP-a je na razini od 10% neznatan. Primjenjujući standard modela raspoloživih sredstava zatvorene ili otvorene ekonomije i očekivani tečaj, dolazimo do sličnih zaključaka osim što pozitivni koeficijent pokazatelja priljeva neto kapitala u BDP ima krivi predznak i na razini od 10% je neznatan.

Ključne riječi: *državni deficit**,** dugoročne kamatne stope, model raspoloživih sredstava, očekivana inflacija, svjetske kamatne stope, očekivani tečaj*

JEL klasifikacija: *P43, E43, E62*

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