DOES MORE GOVERNMENT DEFICIT LEAD TO A HIGHER LONG-TERM INTEREST RATE? APPLICATION OF AN EXTENDED LOANABLE FUNDS MODEL TO ESTONIA

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Abstract
Applying and extending the open-economy loanable funds model, this article shows that more government borrowing or debt 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 depreciation of the Estonian kroon (EEK) would increase the Estonian government bond yield, and that the negative coefficient of the percent change in real GDP has an unexpected sign. When the conventional closed-economy or open-economy loanable funds model is considered, the article finds that more government borrowing as a percent of GDP does not result in a higher government bond yield, that the positive coefficients of the real money market rate, the growth rate of real GDP, and the expected inflation are significant at the 1%, 5% or 10% level, and that the negative coefficient of the ratio of the net capital inflow to GDP in the conventional open-economy loanable funds model is significant at the 1% level.

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

JEL Classification: P43, E43, E62

Introduction

Due to the recent global financial crisis, many countries including Estonia have experienced economic slowdowns and budget shortfalls. According to the *International Financial Statistics* and the "Economic and Financial Data for Estonia" published in the Dissemination Standards Bulletin Board (DSBB) by the International Monetary Fund, during 2008.Q2 – 2009.Q2, Estonia's real GDP declined 16.1%, and manufacturing and construction were hit hardest declining 31.2% and 30.6%, respectively. Real exports and imports of goods and services decreased 22.5% and 34.7%, respectively. Total government

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debt rose from 9,380 million kroons to 13,286 million kroons during 2008.Q1 – 2009.Q1. There has been a renewed interest in examining whether more government deficit would raise the long-term interest rate, crowd out some of private investment expenditures, and hinder economic growth.

A review of previous studies indicates that the interest rate may or may not react to more government deficits. Major studies indicating that the interest rate would respond positively to the government deficit include 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). Major papers maintaining that the interest rate would not be positively associated with the government deficit include 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).

Studying the impact of the government budget deficit on the interest rate for the U.S., Hartman (2007) reveals that the crowding-in hypothesis may dominate in the short run whereas there is some support for the crowding-out hypothesis in the long run and that today's real interest rates may respond positively to an expected increase in future government deficits. Investigating the subject for ten advanced Western countries, Barnes (2008) shows that several cointegrating vectors are found for each of the countries and that the government budget deficit and the long-term interest rate have a positive relationship. Applying the VAR model, Wang and Rettenmaier (2008) find that the effects of the government deficit on the interest rate in the U.S. are positive but not permanent.

This article examines whether the long-term interest rate would respond to the government deficit in Estonia and has several different aspects. First, the theoretical model incorporates the exchange rate and the world interest rate to explain international capital flows. Second, comparative-static analysis is employed to determine the possible impact of the partial derivative of the equilibrium long-term interest rate with respect to one of the exogenous variables. Third, the sample includes the most recent data, and empircal results would have more policy implications.

1. The Model

Many studies have applied the loanable funds model to analyze the possible effect 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). The closed-economy loanable funds model is proposed by Hoelscher (1986), and the open-economy loanable funds model is developed by Cebula (1988, 1994, 1997a, 1997b, 1998, 1999, 2000, 2003) by considering the international capital flows in the supply of loanable funds.

This article uses the relative interest rate and the exchange rate to explain the behavior of net capital inflows (Devereux and Saito, 2006; De Santis and Luhrmann, 2009). When the world long-term interest rate declines relative to the Estonian long-term interest rate or when the Estonian kroon appreciates relative to other currencies, the net capital inflow to

Estonia would increase. Hence, a lower world interest rate or an appreciation of the Estonian kroon would shift the supply of loanable funds rightward and reduce the Estonian long-term interest rate, and vice versa. 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 and negatively determined by the real short-term interest rate, the expected inflation rate, the world long-term interest rate, and the expected EEK/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

$$LF^d = D(R, R^S, \pi^e, Y, B) \tag{1}$$

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

where

LF^d = the demand for loanable funds in Estonia,

LF^s = the supply of loanable funds in Estonia,

R = the long-term interest rate in Estonia,

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

π^e = the expected inflation rate in Estonia,

Y = percent change in real GDP in Estonia,

B = the government deficit in Estonia,

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

ε^e = the expected EEK/USD exchange rate. (An increase means depreciation of the Estonian kroon, EEK.)

Setting LF^d and LF^s equal to the equilibrium loanable funds (LF), we can write the equilibrium long-term interest rate as

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

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

$$\partial \overline{R} / \partial B = D_B / |J| > 0 \tag{4}$$

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

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

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

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

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

where $|J|$ is the Jacobian for the endogenous variables and has a positive value. Note that the sign of S_{R^S}, S_{π^e}, S_{R^*} and S_{ε^e} is negative. Theoretically, the equilibrium long-term interest rate has a positive relationship with the government deficit, the real short-term interest rate, the percent change in real GDP, the expected inflation rate, the world interest rate, or the expected exchange rate.

To compare, the respective equilibrium long-term interest rates in the conventional closed-economy and open-economy loanable funds models (Hoelscher, 1986; Cebula, 1988, 1994, 1997a, 1997b, 1998, 1999, 2000, 2003) can be written as

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

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

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

2. Empirical Results

The data were obtained from IMF's *International Financial*. The dependent variable is Estonia's government bond yield. The real short-term interest rate is represented by the real money market rate to test whether there may be a substitution effect. The expected inflation rate is represented by the lagged inflation rate base on the consumer price index. Y is represented by the percent change in real GDP. Due to lack of quarterly data for the government budget deficit, B is represented by the ratio of the government borrowing to GDP. The EU government bond yield is chosen to represent the world interest rate. The expected exchange rate is represented by the lagged EEK/USD exchange rate. 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. R, R^S, R^* and ε^e are measured in the log scale. After taking a lag, the sample ranges from 2000.Q1-2009.Q1.

The unit root test shows that each of the variables has a unit root in the level form and is stationary in first difference. As shown in Table no. 1, based on the unrestricted cointegration rank test, there are 2 cointegrating relations. Therefore, there is a long-term stable relationship among the variables.

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Table no. 1: Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None *	0.895429	72.25252	46.23142	0.0000
At most 1 *	0.824165	55.62269	40.07757	0.0004
At most 2	0.578252	27.62712	33.87687	0.2313
At most 3	0.372219	14.89802	27.58434	0.7562
At most 4	0.232615	8.472553	21.13162	0.8725
At most 5	0.214276	7.716779	14.26460	0.4082
At most 6	0.097281	3.275015	3.841466	0.0703

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

Figure no. 1 plots the residual histogram and presents the normality test for the error terms. As shown, the Jarque-Bera statistic of 2.48 is much small 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.
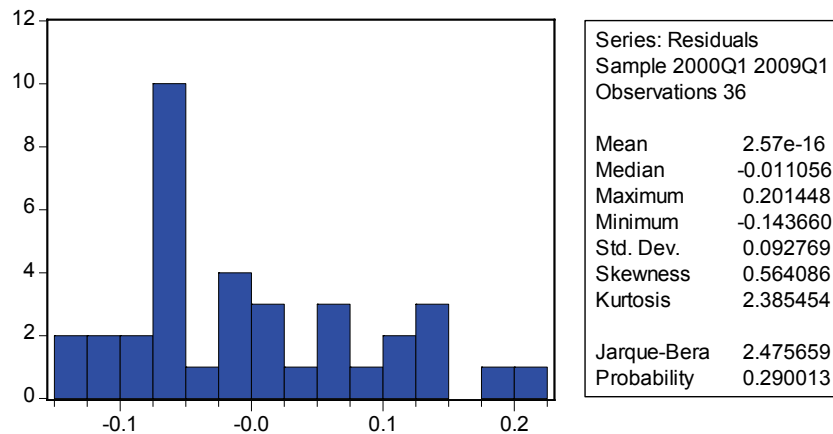

Series: Residuals	
Sample 2000Q1 2009Q1	
Observations 36	
Mean	2.57e-16
Median	-0.011056
Maximum	0.201448
Minimum	-0.143660
Std. Dev.	0.092769
Skewness	0.564086
Kurtosis	2.385454
Jarque-Bera	2.475659
Probability	0.290013

Figure no. 1: The Jargue-Bera Normality Test of the Regression Residuals

Table no. 2 reports the estimated regression and related statistics. The Newey-West (1987) GLS method is employed in order to yield consistent estimates for the covariance and standard errors. As shown, 92.3% 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 ratio of the government deficit to GDP, all other coefficients are significant at the 1% or 5% level. The government bond yield is positively associated with the ratio of the government borrowing to GDP, the real money market rate, the expected inflation rate, the EU government bond yield, and the expected depreciation of the EEK/USD exchange rate. The negative sign of the growth rate of real GDP should be positive. To determine whether the estimated regression is stable, the CUSUM and CUSUMSQ tests are applied. The study finds that the cumulative sum of the recursive residuals or the cumulative sum of the recursive residuals squared stays within the 5% critical lines, suggesting that the estimated parameter or variance is relatively stable.

Table no. 2: Estimated Regression of the Long-Term Bond Yield for Estonia based on the Extended Loanable Funds Model

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	-1.940262	0.358034	-5.419205	0.0000
B	0.014096	0.005757	2.448445	0.0206
Log(R^S)	0.283238	0.083074	3.409469	0.0019
Y	-0.004004	0.002494	-1.605723	0.1192
π^e	0.158992	0.022155	7.176282	0.0000
Log(R^*)	0.925871	0.394952	2.344262	0.0261
Log(ε^e)	0.752122	0.196378	3.829979	0.0006
Adjusted R^2		0.923224		
Akaike info criterion		-1.556680		
Schwarz criterion		-1.248774		
F-statistic		71.14538		
Prob(F-statistic)		0.000000		
Sample period		2000.Q1 – 2009.Q1		
N		36		

Notes:

The dependent variable is log(R). C is the constant. B is the ratio of the government borrowing to GDP. R^S is the real money market 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 EEK/USD exchange rate.

Several different measures of the variables are considered to determine whether the outcomes may vary. If the ratio of the government borrowing to GDP is replaced by the ratio of the government debt to GDP, its positive coefficient will be significant at the 1% level, and other results will be similar. If the 10-year U.S. government bond yield replaces the EU government bond yield, its negative coefficient will be insignificant at the 10% level, and the positive coefficient of the ratio of the government borrowing to GDP will be insignificant at the 10% level. If the average inflation rate of past four quarters replaces the lagged inflation rate as the expected inflation rate, its coefficient will be positive and significant at the 1% level, and the positive coefficient of the ratio of the government

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borrowing to GDP will be significant at the 10% level. To save space, details are not printed here and will be available upon request.

When the conventional closed-economy loanable funds model in equation (10) is considered in empirical work, the value of the adjusted R^2 is 0.657, and the positive coefficients of R^S, Y and π^e are significant at the 1% or 5% level whereas the negative coefficient of B is insignificant at the 10% level. When the conventional open-economy loanable funds model in equation (11) is considered, the explanatory power of the regression is 0.768, and the negative coefficient of the ratio of the net capital inflow to GDP is significant at the 1% level. Other results are similar to the closed-economy loanable funds model. Hence, the inclusion of the EU government bond yield and the expected exchange rate would change the conclusion on the impact of the government borrowing on the government bond yield.

Conclusions

This article has applied an extended open-economy loanable funds model to examine whether the Estonian long-term interest rate would be affected by the government deficit and other relevant macroeconomic variables. The results show that more government borrowing or debt as a percent of GDP 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 expected deprecation of the kroon would raise the Estonian government bond yield. The negative coefficient of the growth rate of real GDP is insignificant at the 10% level. In the conventional closed-economy loanable funds model, except that the negative coefficient of the government borrowing to GDP is insignificant at the 10% level, the coefficients of the real money market rate, the growth rate of real GDP, and the expected inflation rate are positive and significant at the 1% or 5% level. In the conventional open-economy loanable funds model, except that the negative coefficient of the net capital inflow to GDP is significant at the 1% level, other results are similar to those found in the conventional closed-economy loanable funds model. Hence, the EU government bond yield and the expected exchange rate incorporated in this study improve the explanatory power of the regression due to a higher value of the adjusted R^2.

There are several policy implications. The significant coefficient of the ratio of the government borrowing to GDP implies that pursing expansionary fiscal policy to stimulate the economy would raise the long-term government bond yield and crowd out part of private investment expenditures. 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 supplying loanable funds to Estonia or other countries. The varying results for the percent change in real GDP suggest that its role in affecting loanable funds may need to be further studied.

When there are more sample observations, we may need to re-estimate regression parameters to see if the values, the signs, and test results may vary. We may use other techniques to estimate the expected inflation rate. Other theories of the determination of the interest rate may be considered (Romer, 2000).

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