

Government Debt and the Long-Term Interest Rate: Application of an Extended Open-Economy Loanable Funds Model to Poland

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This paper examines the behavior of the long-term interest rate in Poland based on a sample during 2001.Q1–2009.Q1. Both the demand for and supply of loanable funds are considered. Extending the open-economy loanable funds model, this paper finds that more government debt as a percent of GDP leads to a higher long-term interest rate in Poland and that a higher real Treasury bill rate, more percent change in real GDP, a higher expected inflation rate, a higher world long-term interest rate, and depreciation of the zloty would increase the long-term interest rate in Poland. In the standard open-economy loanable funds model including the net capital inflow, the coefficient of the net capital inflow is positive and insignificant at the 10% level. Hence, the incorporation of the world interest rate and the nominal effective exchange rate in the model may better capture the behavior of the long-term interest rate in Poland.

Key Words: loanable funds model, government debt, long-term interest rates, expected inflation rates, nominal effective exchange rates

JEL Classification: E43, E62

Introduction

Since the global financial crisis and the worldwide economic recession, many countries have experienced declining government revenues and budget deficits. Deficit or debt financing has become an avenue to make up budget shortfalls. Poland is no exception. Net borrowing by its general government went up substantially from 20,473 million zlotys in 2007 to 47,922 million zlotys in 2008. Its central government deficit rose from 5,559 million zlotys in September 2009 to 6,541 million zlotys in October 2009. Its central government debt increased from 630,475.4 million zlotys in September 2009 to 635,753.5 million zlotys in October 2009 (International Monetary Fund 2009).

There has been renewed interest in examining whether more budget deficits would raise interest rates, crowd out part of private investment

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spending, and reduce economic growth. Previous findings of the impact of the government deficit or debt on the interest rate are inconclusive. Applying the demand for and supply of loanable funds, and based on a sample during 1953–1984, Hoelscher (1986) indicates that more government deficits in the US increase the slope of the yield curve and the long-term interest rate. Employing the instrumental variable technique, and based on a sample during 1955:Q1–1984:Q4, Cebula (1988) shows that the nominal interest rate is positively associated with the US federal government deficit. Applying the 2SLS technique, and based on a sample during 1960:Q1–1990:Q2, Al-Saji (1993) finds that the long-term interest rate and the government budget deficit in the UK have a positive relationship. Employing the techniques of cointegration and the error correction model, and based on annual data during 1950–1993, Vamvoukas (1997) finds support for the Keynesian model that more government deficits raise the interest rate in Greece. Applying the cointegration technique, and based on a sample during 1975:Q1–1990:Q1, Cebula (2003) indicates that the German government budget deficit and the long-term interest rate have a positive relationship. Other studies maintaining similar views include: Feldstein (1982), Wachtel and Young (1987), Boskin (1988), Zahid (1988), Thomas and Abderrozak (1988), Tran and Sawhney (1988), Cebula (1991, 1993, 1997a, 1997b, 1999, 2005), Miller and Russek (1991), Raynold (1994), Correia-Nunes and Stemitsiotis (1995), Ewing and Yanochik (1999), Gale and Orszag (2004), Saleh and Harvie (2005), Quayes and Jamal (2007), Barnes (2008), and Laubach (2009).

On the other hand, based on different sample periods and applying the 2SLS technique, Evans (1985) reveals that the interest rate and the government deficit in the US are not positively associated. Applying the Granger causality test and the minimum final prediction error techniques, and based on a sample during 1946–1986, Darrat (1989) considers several versions of the long-term interest rate and the government deficit and rejects the hypothesis that more government deficits in the US cause the long-term interest rate to rise. Based on quarterly data during 1973:Q1 to 1985:Q4, Gupta (1989) considers six different types of the interest rate and finds support for an inverted Fisher hypothesis and lack of evidence that more government deficits affect the interest rate in the US. Findlay (1990) confirms that more government deficits do not affect the short-term real interest rate in the US and that more real money supply and higher inflation rates reduce real interest rates. Applying and extending four major models and based on annual data during 1964–2000, Gar-

cia and Ramajo (2004) show that more government deficits in Spain do not raise the long-term interest rate. Other studies holding similar views include Plosser (1982, 1987), Kormendi (1983), Hoelscher (1983), Makin (1983), Aschauer (1989), McMillin (1986), Barro (1974; 1987), Evans (1987; 1988), and Darrat (1989).

This paper attempts to examine the impact of more government debt on the long-term interest rate in Poland and has several focuses. First, an open-economy loanable funds model is extended to explain the behavior of the international capital flow by the relative interest rate and the exchange rate. Second, comparative static analysis is applied to determine the impact of a change in one of the exogenous variables on the equilibrium long-term interest rate. Third, empirical results based on the conventional closed-economy and open-economy models are compared.

The Model

The loanable funds model has been employed in studying the impact of the government deficit or debt on the interest rate (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) is among the first to apply the loanable funds model to study the impact of the government borrowing on the long-term interest rate. He considers both the demand for and supply of loanable funds. In the demand for loanable funds, he includes the long-term interest rate, the real short-term interest rate, the percent change in real output, the expected inflation rate, and the government borrowing. In the supply of loanable funds, he includes the long-term interest rate, the real short-term interest rate, and the expected inflation rate. However, his model is a closed economy without incorporating international capital flows. Cebula (1988; 1994; 1997a; 1997b; 1998; 1999; 2000; 2003) proposes an open-economy loanable funds model by considering international capital flows 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 exchange rate (Devereux and Saito 2006; De Santis and Luhrmann 2009). As the world long-term interest rate rises relative to the Polish long-term interest rate, the net capital inflow to Poland would decrease. As the Polish zloty appreciates relative to other currencies, the net capital inflow to Poland would increase. Hence, a

higher world interest rate would reduce the supply of loanable funds and increase Poland's long-term interest rate, and appreciation of the Polish zloty would increase the supply of loanable funds and reduce Poland's long-term interest rate.

Extending previous studies of the loanable funds model, we can express the demand for and the supply of loanable funds as

$$LF^d = V(R, R^S, \pi^e, Y, D) \quad \text{and} \quad (1)$$

$$LF^S = X(R, R^S, \pi^e, Y, R^W, E), \quad (2)$$

where LF^d is the demand for loanable funds in Poland, LF^S the supply of loanable funds in Poland, R the long-term interest rate in Poland, R^S the real short-term interest rate in Poland, π^e the expected inflation rate in Poland, Y percent change in real GDP in Poland, D government debt in Poland, R^W the world long-term interest rate, and E the nominal effective exchange rate (an increase means appreciation).

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

$$\bar{R} = \bar{R}(D, R^S, Y, \pi^e, R^W, E). \quad (3)$$

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

$$\frac{\partial \bar{R}}{\partial D} = \frac{V_D}{|J|} > 0, \quad (4)$$

$$\frac{\partial \bar{R}}{\partial R^S} = \frac{V_{R^S} - X_{R^S}}{|J|} > 0, \quad (5)$$

$$\frac{\partial \bar{R}}{\partial Y} = \frac{V_Y - X_Y}{|J|} \neq 0, \quad (6)$$

$$\frac{\partial \bar{R}}{\partial \pi^e} = \frac{V_{\pi^e} - X_{\pi^e}}{|J|} > 0, \quad (7)$$

$$\frac{\partial \bar{R}}{\partial R^W} = \frac{-X_{R^W}}{|J|} > 0, \quad \text{and} \quad (8)$$

$$\frac{\partial \bar{R}}{\partial E} = \frac{-X_{E^e}}{|J|} < 0, \quad (9)$$

where J is the Jacobian for the endogenous variables and has a positive

TABLE 1 Augmented Dickey-Fuller (ADF) unit root test

Item	Level	First difference
R	-2.494	-2.912
D	-2.502	-2.186
R^S	-1.047	-2.519
Y	-2.372	-1.497
π^e	-3.609	-3.940
R^W	-1.995	-3.237
E	-2.475	-3.348

NOTES The critical values are -3.646, -2.954, and -2.616 at the 1%, 5%, and 10% levels.

value. Note that in equation (6), if $V_Y > X_Y$, $\partial \bar{R} / \partial Y < 0$, and $V_Y < X_Y$, $\partial \bar{R} / \partial Y < 0$.

Empirical Results

The data were collected from the *International Financial Statistics* which is published by the International Monetary Fund. The dependent variable is the 10-year Polish government bond yield. The ratio of government debt to GDP as a percent is used to represent government demand for loanable funds. The Polish real Treasury bill rate is selected as a real short-term interest rate to test for a potential substitution effect. The percent change in real GDP is derived from real GDP index with 2005 as the base year. The expected inflation rate is represented by the average inflation rate of the past four quarters. The average inflation rate is the percent change in the consumer price index with 2005 as the base year. The long-term EU government bond yield is chosen to represent the world interest rate. The nominal effective exchange rate is a trade-weighted exchange rate index with 2005 as the base year. An increase in the nominal effective exchange rate means appreciation of the zloty. The linear form is chosen in empirical work. The sample ranges from 2001.Q1–2009.Q1. Earlier data for the government bond yield are not available.

Table 1 reports the results of the Augmented Dickey-Fuller (ADF) unit root test and shows that, except for π^e , each of the variables has a unit root in the level form at the 5% level. Table 2 presents the estimated regression and related statistics. The Newey-West generalized least squares method is employed in empirical work in order to yield consistent estimates for the covariance and standard errors when the forms of serial correlation and heteroskedasticity are unknown. As shown, 95.1% of the

TABLE 2 Estimated regression of the government bond yield for Poland based on the extended open-economy loanable funds model

Variable	Coefficient	Std. Error	<i>t</i> -statistic	Prob.
<i>C</i>	-0.685140	2.196741	-0.311889	0.7576
<i>D</i>	0.056514	0.031592	1.788888	0.0853
<i>R^S</i>	0.494965	0.044019	11.24445	0.0000
<i>Y</i>	0.022497	0.012999	1.730679	0.0954
π^e	0.502187	0.056152	8.943400	0.0000
<i>R^W</i>	0.667843	0.186646	3.578130	0.0014
<i>E</i>	-0.014813	0.006975	-2.123631	0.0434
Adjusted <i>R</i> ²		0.951213		
Akaike inform. criterion		1.168091		
Schwarz criterion		1.485532		
MAPE		3.646454		
Sample period		2001.Q1–2009.Q1		
Sample size		33		

variation in the government bond yield can be explained by the right-hand side variables with significant coefficients. The government bond yield is positively affected by the ratio of government debt to GDP, the real Treasury bill rate, the percent change in real GDP, the expected inflation rate, and the EU government bond yield, and it is negatively associated with the nominal effective exchange rate. The mean absolute percent error is 3.646%. To determine whether the results in table 2 may be spurious, the ADF unit root test on the residuals is performed (Gujarati and Porter 2010, 383–4). Based on the Akaike information criterion (AIC), a lag length of four is selected. The test statistic is -3.874, and the critical value is -2.650 at the 1% level. Thus, the residuals are stationary. Although individual time series may be nonstationary, their linear combination is stationary, indicating that they are cointegrated and have a long-term stable relationship.

Several different measures of the variables are tested to compare the results. If the ratio of the government deficit to GDP replaces the ratio of government debt to GDP, its coefficient is negative and highly insignificant. When the PLN/USD exchange rate is selected to represent the exchange rate, its coefficient is positive and insignificant at the 10% level, and the coefficients of the ratio of government debt to GDP and the per-

cent change in real GDP are positive and significant at the 5% level. Other results are similar. When the 10-year US Treasury bond yield is used to represent the world interest rate, its coefficient is positive and insignificant at the 10% level, suggesting that Poland's government bond yield is significantly influenced by the government bond yield of the European Union instead of the US Treasury bond yield. To save space, these results are not printed here and will be available upon request.

If the estimated regression is based on $\bar{R} = \bar{R}(D, R^S, Y, \pi^e)$, which is a standard closed-economy loanable funds model (Hoelscher 1986), all the coefficients are positive and significant at the 1% or 10% level. If the estimated regression is based on a standard open-economy loanable funds model (Cebula 1988, 1994, 1997a, 1997b, 1998, 1999, 2000, 2003), $\bar{R} = \bar{R}(D, R^S, Y, \pi^e, CF)$, where *CF* stands for the net capital inflow as a percent of GDP, the coefficients of government debt to GDP as a percent, the real Treasury bill rate, the GDP growth rate, and the expected inflation rate are positive and significant at different levels, whereas the coefficient of the net capital inflow as a percent of GDP is positive and insignificant at the 10% level. Hence, the inclusion of the world interest rate and the nominal effective exchange rate to capture the international capital flow may provide more insights into the understanding of the behavior of the long-term interest rate.

Summary and Conclusions

This paper has applied an extended open-economy loanable funds model to examine whether Poland's long-term interest rate would be affected by government debt and other selected macroeconomic variables. The results show that more government debt as a percent of GDP, a higher real Treasury bill rate, more percent change in real GDP, a higher expected inflation rate, a higher world long-term interest rate, and a lower nominal effective exchange rate (depreciation of the zloty) would raise Poland's government bond yield.

There are several policy implications. The positive significant sign of the ratio of government debt to GDP implies that continual debt-financed expansionary fiscal policy would increase the long-term bond yield and crowd out part of private spending. The results in this paper are consistent with the evaluation made by Fitch (EquityBites (M2) 2010), which indicates that the Polish government needs to pursue a credible fiscal policy in order to avoid a negative bond rating and keep the bond yield from rising. The insignificant coefficient of the ratio of the gov-

ernment deficit to GDP may suggest that a short-term increase in the deficit/GDP ratio may not raise the long-term government bond yield. The central bank needs to contain rising inflation expectations, which would raise the long-term interest rate. The world long-term interest rate or the exchange rate needs to be considered as international investors search for better returns or gains due to exchange rate appreciation in determining supplying loanable funds to Poland.

There may be areas for future research. As the Polish economy recovers from the worldwide recession and as the sample size increases, the regressions should be re-estimated to compare with the outcomes in this paper. The expected inflation rate may be constructed by more sophisticated methodologies. Other models of interest rate determination may be applied as well.

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