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Sanjay Paul and Hossein Varamini

BUDGET DEFICITS, OIL PRICES AND INTEREST RATES

ABSTRACT

The study investigates the effect of budget deficits, economic growth, money supply and the price of oil on interest rates. We develop a theoretical framework to show how interest rates are determined. We test our model using quarterly data in the United States, Canada and Germany, seeking to explain both short-term and long-term interest rates. The results show that, generally, interest rates are not affected by changes in budget deficits, lending (qualified) empirical support to the Ricardian equivalence proposition. We also determine the effects of GDP growth, money supply and the price of oil on short-term and long-term interest rates in the three countries.

Key Words: budget deficit, interest rates, Ricardian equivalence

Sanjay Paul and Hossein Varamini
Elizabethtown College

Correspondence: Hossein Varamini
Department of Business, Elizabethtown College, Elizabethtown, PA 17022
E-mail: varaminih@etown.edu
Tel: 717-361-1278
Fax: 717-361-1487

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INTRODUCTION

Budget deficits in several countries have risen of late, most notably in the United States where the deficit came in at $413 billion in 2004 and $318 billion in 2005 (Congressional Budget Office 2006). In the European Union, too, budget deficits are rising, with France and Germany breaching the Maastricht criteria – deficits not to exceed 3 percent of GDP - with seeming impunity and Greece admitting that the deficit numbers submitted to the EU were inaccurate.

As budget deficits have risen, the question of their likely consequence on economic performance has become prominent once again. See, for instance, Rubin et al (2004), Gale and Orzag (2003), and Reynolds (2002).

The conventional ("Keynesian") strand of thought suggests that higher budget deficits lead to higher interest rates. As the government incurs a greater deficit, the need for additional financing arises. With the increased supply of debt in the capital markets, prices of bonds fall, which implies an increase in interest rates (Bradley 1986).

Another explanation, developed by Feldstein (1986, 1973), focuses on the "wealth effect" caused by expanding government debt. According to this view, an increase in federal debt leads to an increase in consumer wealth, since government spending raises income. Due to greater income, desired consumption, as compared to savings, increases, causing a rise in interest rates.

A rise in interest rates would crowd out private investment, as firms will tend to borrow smaller amounts in order to finance capital projects, thus impeding economic growth in the private sector (Canto and Rapp 1982). Further, if capital is perfectly mobile across countries, the higher interest rates engendered by larger deficits will tend to attract capital inflows into the country, leading to an appreciation of the domestic currency. Consequently, an increase in budget deficits would crowd out exports rather than private investment (Beck 1994).

In contrast to the conventional view, the Ricardian Equivalence Proposition states that there is no causative link between budget deficits and interest rates. As argued by Barro (1974), a wealth effect is unlikely to occur once one considers that an increase in government spending will necessitate future tax increases in order to maintain the government's budget constraint over an infinite horizon. Market participants foresee such liabilities and steer spending and saving in the present and, through bequests and generational transfers in the future, offset any effect of deficit changes on interest rates.

The evidence on the relationship between deficits and interest rates is mixed. Bradley (1983), Canto and Rapp (1982), Fackler and McMillin (1983), Feldstein and Chamberlain (1973), Frankel (1983), Plosser (1982), Motley (1983), and Miller (1982) find no significant relationship between deficits and interest rates. Lee (1991), using quarterly data beginning in 1982, also finds support for the Ricardian Equivalence Proposition.

On the other hand, deLeeuw and Holloway (1983) and Kudlow (1981) have shown the existence of a statistically significant positive correlation between federal budget deficits and interest rates. Dewald (1983), Hoelscher (1986), Tran (1988) and Domenech (2000) find that bigger deficits lead to higher long-term interest rates. Wachtel and Young (1987) looked at the effects of unanticipated movements in the budget deficits and showed that interest rates rose with forecasts of deficits. More recently, Laubach (2003), using long-term budget forecasts, showed that long-term interest rates rose by 0.25 percent in response to a percentage-point increase in the projected deficit (as a ratio of GDP).

In this paper, we use quarterly data to examine the relationship between budget deficits and interest rates for the long- and short-term for Canada, Germany and the United States. The remainder of the paper is laid out as follows: Section II develops the theoretical framework. Section III shows the empirical results. Section IV concludes.

THEORETICAL FRAMEWORK

Consider the following model of an open economy.

$$(1) \qquad Y = C(Y\text{-}T, R - \pi^e) + I(q) + G + X(R),$$

$$(2) \qquad M/P = L(R,Y)$$

where Y is GDP, T is taxes, R is the nominal interest rate, π^e is expected inflation, q is the price of oil, C is consumption, I is investment, G is government spending, X is net exports, M is money supply, P is the price level, and L is real money demand.

Equation (1) represents equilibrium in the goods market. Consumption rises with disposable income and falls with real interest rates. Investment is affected by the price of oil in this manner: Firms use capital and energy as complements; therefore, an increase in the price of oil will result in lower use of energy leading to a decrease in investment

spending. Net exports are a function of exchange rates which in turn depend on interest rates: An increase in domestic interest rates will cause an appreciation of the domestic currency and thus a decline in net exports. Accordingly, we have:

$$C_1 > 0,\ C_2 < 0,\ I_1 < 0,\ X_1 < 0.$$

Equation (2) represents equilibrium in the money market. Money demand is negatively related to interest rates, positively to GDP:

$$L_1 < 0,\ L_2 > 0.$$

Totally differentiating (1) and (2) yields:

$$(1.1) \quad dY = C_1dY - C_1dT + C_2dR - C_2d\pi^e + I_1dq + dG + X_1dR,$$
$$(2.1) \quad d(M/P) = L_1dR + L_2dY.$$

From (2.1), we obtain

$$dY = (1/L_2)dM - (L_1/L_2)dR,$$

which after substitution in (1.1) followed by some rearrangement yields

$$A\ dR = - C_2\ d\pi^e + I_1dq + dG - (1- C_1)(1/ L_2)dM - C_1dT,$$

where $A = -(1- C_1)(L_1/ L_2) - C_2 - X_1 > 0.$
Thus we obtain the interest rate, R, as a function of π^e, G, T, q and M/P, i.e.

$$R = R(\pi^e, G, T, q, M/P)$$ with the following derivatives:
$$dR/d\ \pi^e = - C_2/A > 0,$$
$$dR/dG = 1/A > 0,$$
$$dR/dT = - C_1/A < 0,$$
$$dR/dq = I_1/A < 0,$$
$$dR/dM = - (1- C_1)/(A\ L_2) < 0.$$

The signs of the derivatives suggest that interest rates will rise with expected inflation and government spending, and fall with taxes, oil prices and money supply. We assume, further, that expected inflation is a function of GDP growth; accordingly, interest rates will rise with GDP growth.

In sum, then, the theoretical framework predicts that interest rates are an increasing function of GDP growth and budget deficits, and they will decrease as oil prices and money supply go up. We now turn to the empirical analysis.

EMPIRICAL ANALYSIS

We seek to explain interest rate changes for 3 countries - the United States, Canada and Germany. We consider both short-term and long-term interest rates. For each country, we consider the budget deficit, money supply, output, and price of oil as the explanatory variables, and estimate the following equations:

$$i_t = a + b_1 MS_t + b_2 DEF_t + b_3 GDP_t + b_4 Poil_t + e_t$$
$$R_t = \alpha + \beta_1 MS_t + \beta_2 DEF_t + \beta_3 GDP_t + \beta_4 Poil_t + u_t$$

where i is the short-term interest rate, R is the long-term rate, GDP is real gross domestic product, MS is the change in money supply, DEF is the budget deficit as a ratio of output, and Poil is the price of oil. The error terms are denoted by e and u respectively.

The short-term interest rate is measured by the T-bill rate in the U.S. and its equivalent in other countries, and the long-term rate by the yield on government bonds. We use quarterly data, starting from 1980:Q1. The ending date for each country, however, is different due to varying availability of data. For the U.S., we use 94 observations spanning the period 1980:Q1-2003:Q2; for Germany, 76 observations (1980:Q1-1998:Q4); for Canada, 63 observations (1980:Q1-1995:Q3). Data were obtained from the *International Financial Statistics*.

The main reason for the selection of 1980 as the starting point for the analysis is that the beginning of the 1980s brought significant changes in the conduct of U.S. monetary policy. The Banking Acts of 1933 and 1935 had allowed the Fed to set ceilings on interest rates via Regulation Q. But, following the Depository Institutions Deregulation and Monetary Control Act of 1980, interest rate ceilings were phased out. Upon deregulation,

interest rates more accurately reflected market changes, which is vital to the testing of the variables discussed in this paper. Accordingly, we use 1980 as the initial year for our study.

Unit Root Test

We seek to ensure that the data used in the regression are stationary. Any non-stationarity in the time series will call the consistency of the estimated coefficients into question.

We apply the Dickey-Fuller (DF) unit root test to the data (Dickey and Fuller 1979; 1981). Even though perfectly stationary data do not practically exist, as long as the first difference of each variable is stationary, the results of the regression analysis will be reliable and consistent. The presence of unit roots would suggest the use of Engle and Granger (1987) in conducting the regression analysis.

Let's assume two time series x_t and y_t are non-stationary variables. If the first difference of each time series is stationary (Dx_t and Dy_t are both I(0)), the series are integrated of order 1. This will suggest the following general regression model:

$$y_t = a + bx_t + z_t,$$

where z_t is the residual of the model. The application of regression model to this equation is appropriate only if x_t and y_t are stationary or if the two series are co-integrated. In this study, we first test the existence of unit roots in the levels of the variables. If the variables are non-stationary, we then apply the DF test to the first difference of the time series to test their stationarity.

Table 1. Results of the Dickey-Fuller Unit Root Test

	United States	Canada	Germany
DEF	- 7.26 ***	- 5.08***	- 7.00***
M1	- 0.62	0.38	4. 34***
Δ M1	- 12.26***	- 13.7***	-
Real M1	- 1.26	- 0.42	2.91**
Real M2	4.70***	- 0.10	0.71
Δ Real M2	-	- 8.26***	-3.51***
GDP	5.95***	0.06	0.51
Δ GDP	-	- 4.27***	- 7.82***
Poil	- 1.60	- 2.15	- 2.09
Δ Poil	- 9.16***	- 8.05***	- 8.67***

Critical Values at 1% level: - 3.50; at 5% level: - 2.89; at 10% level: - 2.58

Table 1 reports the results of the DF test for all the variables used in the study. In cases where the levels turned out to be non-stationary, we tested for the unit root for the first differences. For each country, the deficit/GDP ratio was stationary in levels while the price oil, unsurprisingly, required first-differencing for stationarity. In the ensuing regressions we used levels (if stationary) or first differences.

Regression Results

Table 2 shows the OLS regression results for short-term interest rates. We note from the table that there is no significant link between short-term interest rates and deficits for any of the three countries studied. The only variable that significantly influences short-term rates in each country is GDP growth: higher the growth in GDP, greater is the interest rate.

In the case of U.S. and Germany, the growth of money supply also exhibits a significant impact on short-term interest rates: a rise in money growth leads to lower interest rates. The price of oil does not have a significant statistical influence on short-term rates in any of the countries.

Table 3 shows the results of the regressions pertaining to long-term interest rates. We note that there exists no significant relationship between long-term interest rates and deficits for Germany and Canada; however, for the U.S., the coefficient is statistically significant and suggests that an increase in the deficit will lead to higher long-term interest rates (The dataset uses negative numbers for the budget deficit; therefore a negative coefficient implies that a rise in DEF corresponds to a decrease in the budget deficit).

Table 2. The Results of the Regression Model: Short Term Interest Rates

	United States	Canada	Germany
Intercept	4.26	13.02	5.70
	(5.14)***	(12.00)***	(12.30)***
DEF	-16.62	306.8	-19.5
	(- 0.46)	(1.27)	(- 0.93)
MS	0.014	-0.29	-0.06
	(- 1.80)*	(- 1.37)	(- 2.46)**
GDP	36.83	27.64	8.62
	(3.80)***	(2.47)**	(2.43)**
Poil	-0.15	-0.09	0.15
	(- 1.62)	(- 0.76)	(1.62)
Adjusted R^2	0.17	0.16	0.08

Numbers in parentheses are *t*-values.
***: Less than 1%; **: Between 1% and 5%; *: Between 5% and 10%

Table 3. The Results of the Regression Model: Long Term Interest Rates

	United States	Canada	Germany
Intercept	6.52	11.68	7.07
	(9.42)***	(14.21)***	(23.18)***
DEF	-75.82	78/38	-21.46
	(- 2.51)**	(0.87)	(- 1.55)
MS	-0.20	-0.02	-0.06
	(- 3.08)***	(- 0.31)	(- 3.83)***
GDP	29.12	-11.07	7.36
	(3.58)***	(-1.44)	(3.15)***
Poil	-0.14	-0.03	0.16
	(- 1.82)*	(- 0.43)	(2.62)**
Adjusted R^2	0.27	0.01	0.20

Numbers in parentheses are t-values.
***: Less than 1%; **: Between 1% and 5%; *: Between 5% and 10%

The coefficient of GDP growth is positive and statistically significant for the United States and Germany, implying that faster growth leads to higher long-term interest rates. The higher rates here may simply reflect the rise in inflation expectations engendered by faster growth in the economy (as noted in the theoretical section of the paper).

The results show that money supply has a negative and significant influence on long-term interest rates in the U.S. and Germany. Higher money growth leads to higher interest rates.

The price of oil has a significant effect on long term interest rates in the U.S. and Germany, but with opposite signs. In the theoretical section we assumed that energy and capital were complements, resulting in dR/dq being negative. This seems to be borne out in the case of the United States where the coefficient for Poil is negative. However, in Germany, the coefficient for Poil is positive, suggesting that energy and capital may be substitutes in production. In Germany, an increase in the price of oil is associated with higher interest rates.

CONCLUSIONS

The main purpose of this study was to examine the relationship between the federal budget deficits, oil prices, and interest rates. We developed a theoretical framework depicting the influence of oil prices on investment, noting the complementarity between use of energy and capital stock by firms. We tested the predictions of the model using data

for three major developed economies - U.S., Germany and Canada. Using quarterly data starting in 1980:Q1, we find that there doesn't exist a causal link between budget deficits and short-term interest rates for any of the countries. With long-term interest rates, our findings are somewhat mixed: in Canada and Germany, deficits do not affect interest rates; in the U.S., they tend to raise interest rates. Thus, our support for the Ricardian equivalence proposition is qualified, although heavily leaning toward acceptance. This dichotomy is not surprising; as our literature review shows, there exists considerable disagreement in the profession about the effects of deficits on interest rates.

We also find, in the U.S and Germany, that the growth of GDP and money supply have had a significant influence on both short-term and long-term interest rates (in the expected direction). Long-term rates are also affected by the price of oil in the U.S. and Germany, although the opposite signs for the relevant coefficient suggest differences in the nature of use of energy as an input in production in the two countries. Interestingly, for Canada, the regression analysis fails to uncover any significant relationship between the independent variables and interest rates for the period under study.

The primary implication of the study is that policy makers in the countries under study should be less concerned about the impact of deficits on interest rates. However, price of oil as the proxy for expected inflation plays a more important role in influencing long term interest rates. Further work on the channels by which oil affects both production and consumption should be useful in delineating the impact of oil price changes on interest rates. Another avenue of research is the study of factors affecting budget deficits in developing countries.

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