An Empirical Note on the Impact of the Federal Budget Deficit on Ex Ante Real Long-Term Interest Rates, 1973-1995

Cebula, Richard

Jacksonville University

30 January 1996

Communications

An Empirical Note on the Impact of the Federal Budget Deficit on Ex Ante Real Long-Term Interest Rates, 1973–1995

I. Introduction

The impact of the federal budget deficit on the rate of interest in the United States has been examined extensively in recent years [2; 3; 4; 5; 6; 7; 8; 9; 11; 12; 13; 14; 15; 16; 17; 19; 20; 21; 23]. Most of these studies focus on the short-term rate of interest, especially the three-month Treasury bill rate or the 4–6 month commercial paper rate. A few of these studies focus on longer-term rates, such as the ten-year Treasury note rate, various corporate bond rates, and 20- or 30- year Treasury bond rates. Those studies that focus on short-term rates generally find that the deficit exercises no significant impact, although there are exceptions [2; 3]. Those studies that focus on the longer-term rates often find that deficits do act to significantly raise those rates.

Despite the publication of numerous related empirical studies, few studies have investigated the impact that U.S. budget deficits may exercise on ex ante real long-term rates per se. This neglect is unfortunate since traditional macroeconomics generally argues that these long-term interest rates transmit the effects of budget deficits to the "real" side of the economy. This is because the interest-sensitive components of private sector spending, such as business outlays on new plant and equipment and new home construction, are most sensitive to variations in these long-term rates. Furthermore, this literature almost altogether fails to address the deficit-interest rate issue for the U.S. for the second half of the 1980s and the early 1990s.

Accordingly, this study empirically investigates the impact of federal budget deficits in the U.S. on the ex ante real long-term interest rate yield over the period 1973.2–1995.3. The study deals with quarterly data and is couched in an open-economy loanable funds model. The study period begins with 1973.2 because this quarter marks the collapse of Bretton Woods, whereas it ends with 1995.3 to make the study as current as now possible. To date, empirical studies addressing U.S. budget deficits and interest rates have largely ignored the time period after 1984 or 1985; hence, this study not only provides information on an important but largely neglected long-term U.S. interest rate measure but also information that is more updated/current than that in the existing literature.

II. Model and Data

The model examined here largely parallels the analyses in Barth, Iden, and Russek [3], Hoelscher [9], and Cebula [4]. The model adopted in this study regards the ex ante real long-term rate of interest as being determined by a loanable funds equilibrium of the following form:

$$D + C = S + B \tag{1}$$

where

D = real private sector demand for long-term bonds
C = real net capital inflows
S = real private sector supply of long-term bonds
B = real net borrowing by (budget deficits of) the government.

In this framework, it is expected that:

$$D = D(EARLR, EARSR), \quad D_{EARLR} > 0, \quad D_{EARSR} < 0 \tag{2}$$

$$S = S(EARLR, PCY), \quad S_{EARLR} < 0, \quad S_{PCY} > 0 \tag{3}$$

where

$EARLR$ = the ex ante real long-term interest rate
$EARSR$ = the ex ante real short-term interest rate
PCY = the change in per capita real GDP

and where subscripts denote partial differentiation.

It is hypothesized that, in principle paralleling Barth, Iden, and Russek [3] and Cebula [4], the real demand for long-term bonds is an increasing function of the ex ante real long-term interest rate. Paralleling Hoelscher [9] and Cebula [4], the expected sign on D_{EARSR} is negative because the higher the short-term ex ante real interest rate the greater the degree to which bond demanders/buyers substitute short-term bonds for long-term bonds.

In principle paralleling Hoelscher [9] and Cebula [4], the real supply of long-term bonds is hypothesized to be a decreasing function of the ex ante real long-term interest rate. The variable PCY is included in the bond supply function to capture any accelerator effects of real GDP changes on aggregate investment demand [9]. It is hypothesized here that, as PCY rises, the real supply of long-term bonds offered by the private sector should also rise because of rising credit demands in the business sector.

Substituting equations (2) and (3) into equation (1) and solving for $EARLR$ yields:

$$EARLR = R(PCY, EARSR, B, C). \tag{4}$$

In this system, the hypothesized signs on the partial derivatives are, as follows:

$$R_{PCY} > 0, \quad R_{EARSR} > 0, \quad R_B > 0, \quad R_C < 0. \tag{5}$$

The first two signs follow from equations (2) and (3). As for the third sign, traditional macroeconomics argues that as the government attempts to finance a budget deficit, it forces interest rates upwards as it competes with the private sector to attract funds from the financial markets. Finally, the expected sign on the capital flows variable is negative since net capital inflows absorb bond issues and, in theory, help to offset the effects of government budget deficits.

Based on equations (4) and (5), the reduced-form equation to be estimated is:

$$EARLR_t = a_0 + a_1 PCY_{t-1} + a_2 EARSR_{t-1} + a_3 B_t / Y_t + a_4 C_{t-1} / Y_{t-1} + \mu \tag{6}$$

where

$EARLR_t$ = the ex ante real average interest rate yield in quarter t on (a) ten-year U.S. Treasury notes, as a percent per annum ($USTN_t$) or (b) Moody's Aaa-rated long-term corporate bonds, as a percent per annum (Aaa_t) or (c) Moody's Baa-rated long-term corporate bonds, as a percent per annum (Baa_t);

PCY_{t-1} = the change in the per capita seasonally adjusted real GDP in quarter $t-1$, expressed in 1987 dollars;

$EARSR_{t-1}$ = the ex ante real average interest rate yield in quarter $t-1$ on three-month U.S. Treasury bills, as a percent per annum;

B_t/Y_t = the ratio of the N.I.P.A. seasonally adjusted total federal budget deficit in quarter $t(B_t)$ to the seasonally adjusted GDP in quarter $t(Y_t)$, expressed as a percent;

C_{t-1}/Y_{t-1} = the ratio of the seasonally adjusted net flow of foreign capital into the U.S. in quarter $t-1(C_{t-1})$ to the seasonally adjusted GDP in quarter $t-1(Y_{t-1})$, as a percent;

μ = stochastic error term.

As indicated above, the model is to be estimated for three different measures of ex ante real long-term interest rates. The model covers the period from 1973.2 through 1995.3. We begin with 1973.2 because this is the quarter during which Bretton Woods collapsed. Stopping with 1995.3 makes the study as current/updated as possible at the present time.

A critical issue for the estimation of equation (6) is the choice of means to construct the expected inflation data. One possibility is simply to use the Livingston survey data, as in [3; 4; 8; 9]. However, as Swamy, Kolluri, and Singamsetti [18, 1013] observe, there are problems with using the Livingston survey data:

> Studies by some psychologists have shown that the heuristics people have available for forming expectations cannot be expected to automatically produce expectations that come anywhere close to satisfying the normative constraints on subjective probability judgments provided by the Bayesian theory . . . The failure of people to obey these constraints makes Livingston's survey data incompatible with the stochastic law represented by equation (1) . . .

and by equations such as equation (6) in this study. Following Swamy, Kolluri, and Singamsetti [18], we therefore do not use the Livingston survey data.[1] Rather, following the analysis in Swamy, Kolluri, and Singamsetti [18] and Thomas and Abderrezak [19], we utilize instead of the Livingston survey data a distributed lag model on actual price inflation to construct the values for the expected inflation (p_t) variable for quarter t.

Specifically, to construct the values for the expected inflation variable (p_t), a four-quarter distributed lag model of actual price inflation (measured by the annualized percentage rate of change of the CPI, 1987 = 100.0) was used.[2] The analysis also utilized five-, six-, seven-, and eight-quarter distributed lag models of actual inflation to generate the expected inflation values. The empirical results obtained using these alternative lag lengths were similar to those reported for the four-quarter lag; the latter, however, provided the best forecasting model [19]. It should be noted that using the average of actual inflation in the most recent four quarters, as suggested in Al-Saji [1] and found in Thomas and Abderrazak [20], also produces results compatible with those presented in this study.[3]

1. Interestingly, despite the flaws in the Livingston survey data, most of the results generated using the Livingston data in place of p_t are compatible with the results shown in Table I.

2. Variable p_t is estimated in a regression treating expected inflation as the dependent variable.

3. These results will be supplied upon written request.

The data for the nominal values of $USTN_t$, Aaa_t, and Baa_t and for the nominal three-month Treasury bill rate (TM_t) were obtained from the *Economic Report of the President*. The data used for computing inflationary expectations were obtained from the *Survey of Current Business*. Variable $EARLR_t$ is defined as the nominal long-term average interest rate yield in quarter t ($USTN_t$, Aaa_t, or Baa_t) minus the expected inflation rate in quarter $t(p_t)$; variable $EARSR_{t-1}$ is defined as the nominal three-month Treasury bill yield in quarter $t-1(TM_{t-1})$ minus the value of expected inflation in quarter $t-1(p_{t-1})$. The data for computing PCY_{t-1} were obtained from the *Economic Report of the President*. The data for B_t, Y_t, and Y_{t-1} were obtained from the *Economic Report of the President*. The data for C_{t-1} were obtained from the *Flow of Funds Accounts* of the Federal Reserve System. Variables B_t, Y_t, Y_{t-1}, and C_{t-1} are all expressed in billions of current dollars. The variables B_t and C_{t-1} are divided by Y_t and Y_{t-1}, respectively, so that the budget deficit and net international capital inflows can be judged relative to the size of the economy.

III. Empirical Results

In this section of the study, we present the empirical results from estimating equation (6). Except for the budget deficit variable, all of the right-hand-side variables in equation (6) are lagged one quarter. This one-quarter lag allows time for the credit markets to adjust to changes in differentials between long and short term interest rate measures, to changes in the per capita real GDP over time, and to changes in the rate of net capital inflows [5; 6; 7; 17; 19]. Following earlier studies [4; 5; 11; 16], we allow for the endogeneity of the unlagged budget deficit variable by using instrumental variables (IV) estimation. In particular, the IV estimation adopts the two-quarter lag of the nominal average interest rate yield on six-month Treasury bills (SIX_{t-2}) as the instrument. The choice of instrument was based on our finding that SIX_{t-2} systematically explains the budget deficit variable whereas it is also uncorrelated with the error terms in the system. The data for SIX_{t-2} were obtained from the *Federal Reserve Bulletin*. The Augmented Dickey Fuller (ADF) test reveals that the time series listed in equation (6) are nonstationary in levels but stationary in first differences. To account for non-stationarity of these time series, the model is estimated in first-differences.[4]

The IV estimates of equation (6) in first differences are provided in Table I. All 12 of the estimated coefficients exhibit the expected signs, with five significant at the one percent level, one significant at the 2.5 percent level, and five significant at the five percent level. As shown in the table, the estimated coefficients on variable PCY_{t-1} are all positive, with two significant at the five percent level. These results imply that the higher the change in per capita real GDP, the higher the ex ante real long-term interest rate yields on Aaa-rated and Baa-rated corporate bonds. Table I also indicates that the estimated coefficients on the $EARSR_{t-1}$ variable are all positive and significant at the one percent level, implying that ex ante real long term interest rates are an increasing function of the ex ante real three-month Treasury bill rate. In addition, the table indicates that the coefficients on the net capital inflows variable are all negative and significant at the five percent level, implying that net capital inflows act to reduce ex ante real long-term interest rates. Finally, and from the perspective of this study, most importantly, the estimated coefficients on the budget deficit variable are all positive, with two significant at the one percent level and one significant at the 2.5 percent level. Thus, it appears that, over the post-Bretton Woods era, even after allowing for net international capital inflows, the budget deficit has acted to raise ex

4. Generally, the first differences of the variables assure stationary time-series.

Table I. Empirical Estimates[a]

Variable	$\delta USTN_t$	δAaa_t	δBaa_t
Constant	0.08	0.06	0.05
δPCY_{t-1}	+0.009	+0.057*	+0.0058*
	(+1.08)	(+1.99)	(+2.05)
$\delta EARSR_{t-1}$	+0.24***	+0.26***	+0.30***
	(+3.01)	(+3.31)	(+3.88)
$\delta(B_t/Y_t)$	+0.92**	+1.21***	+1.36***
	(+2.31)	(+3.25)	(+3.74)
$\delta(C_{t-1}/Y_{t-1})$	−0.016*	−0.015*	−0.016*
	(−2.11)	(−2.13)	(−2.14)
D.W.	1.87	2.00	2.02
ρ	0.05	−0.006	−0.03

a. Terms in parentheses beneath coefficients are t-values; δ is first differences operator.
*Statistically significant at the five percent level.
**Statistically significant at the 2.5 percent level.
***Statistically significant at the one percent level.

ante real long-term interest rates. In principle, the latter finding is consistent with several studies of budget deficits and long term interest rates for earlier time periods [1; 5; 9; 11; 17; 19; 21].

IV. Conclusion

In the existing literature on U.S. budget deficits and interest rate yields, emphasis has most commonly been on either nominal or real short-term interest rate yields or nominal longer-term interest rate yields, with ex ante real long-term interest rate yields most often being neglected; also, most deficit-interest rate studies for the U.S. do not go beyond the early- to mid-1980s. In order to help address these two shortcomings in this literature, this brief study investigates the impact of U.S. budget deficits on three measures of ex ante real long-term interest rates over the 1973–1995 period. The empirical results imply that the federal budget deficit exercised a positive and significant impact on the ex ante real interest rate yields on ten-year Treasury notes, Moody's Aaa-rated long-term corporate bonds, and Moody's Baa-rated long-term corporate bonds. To the extent that private capital formation is sensitive to such interest rates, our findings imply the possibility of at least some degree of "crowding out."

Richard J. Cebula
Georgia Institute of Technology
Atlanta, Georgia

References

1. Al-Saji, Amer K., "Government Budget Deficits, Nominal and Ex Ante Real Long-Term Interest Rates in U.K., 1960.1–1990.2." *Atlantic Economic Journal,* June 1993, 71–77.

2. Barth, James R., George Iden, and Frank S. Russek, "Do Federal Deficits Really Matter?" *Contemporary Policy Issues,* Fall 1984, 79–95.

3. ———, "Federal Borrowing and Short Term Interest Rates: Comment." *Southern Economic Journal,* October 1985, 554–59.

4. Cebula, Richard J., "Federal Government Budget Deficits and Interest Rates: A Brief Note." *Southern Economic Journal,* July 1988, 206–10.

5. ——— and Willie J. Belton, "Government Budget Deficits and Interest Rates in the United States: Evidence for Closed and Open Systems Put into Perspective." *Public Finance/Finances Publiques,* No. 2 1993, 188–209.

6. Evans, Paul, "Do Large Deficits Produce High Interest Rates?" *American Economic Review,* March 1985, 68–87.

7. ———, "Interest Rates and Expected Future Budget Deficits in the United States." *Journal of Political Economy,* February 1987, 34–55.

8. Hoelscher Gregory P., "Federal Borrowing and Short Term Interest Rates." *Southern Economic Journal,* October 1983, 319–33.

9. ———, "New Evidence on Deficits and Interest Rates," *Journal of Money, Credit and Banking,* February 1986, 1–17.

10. Holloway, Thomas M., "The Cyclically Adjusted Federal Budget and Federal Debt: Revised and Updated Estimates." *Survey of Current Business,* March 1986, 11–17.

11. Koch, James V. and Richard J. Cebula, "Federal Budget Deficits, Interest Rates, and Capital Flows: A Note." *Quarterly Review of Economics and Finance,* Spring 1994, 117–20.

12. Kolluri, Bharat R. and Demetrios S. Giannaros, "Budget Deficits and Short-Term Real Interest Rate Forecasting." *Journal of Macroeconomics,* Winter 1986, 109–25.

13. Mäkin, John H., "Real Interest, Money Surprises, Anticipated Inflation and Fiscal Deficits." *Review of Economics and Statistics,* August 1983, 374–84.

14. Mascaro, Angelo and Allan H. Meltzer, "Long and Short Term Interest Rates in a Risky World." *Journal of Monetary Economics,* November 1983, 151–200.

15. McMillin, W. Douglas, "Federal Deficits and Short Term Interest Rates." *Journal of Macroeconomics,* Summer 1980, 403–22.

16. Ostrosky, Anthony L., "Federal Government Budget Deficits and Interest Rates: Comment." *Southern Economic Journal,* January 1990, 802–803.

17. Saltz, Ira S., "Budget Deficits and Real Interest Rates in the United States." *Indian Economic Journal,* July–September 1993, 74–82.

18. Swamy, Paravastu A. V. B., Bharat R. Kolluri, and Rao N. Singamsetti, "What Do Regressions of Interest Rates on Deficits Imply?" *Southern Economic Journal,* April 1990, 1010–28.

19. Thomas, Lloyd B., Jr. and Ali Abderrezak, "Anticipated Future Budget Deficits and the Term Structure of Interest Rates." *Southern Economic Journal,* July 1988, 150–61.

20. ———, "Long-Term Interest Rates: The Role of Expected Budget Deficits." *Public Finance Quarterly,* July 1988, 341–56.

21. Tran, Dang T. and Bansi L. Sawhney, "Government Deficits, Capital Flows, and Interest Rates." *Applied Economics,* June 1988, 753–65.

22. White, Halbert, "A Heteroskedasticity-Consistent Covariance Matrix Estimator and a Direct Test for Heteroskedasticity." *Econometrica,* May 1980, 817–38.

23. Zahid, Khan, "Government Budget Deficits and Interest Rates: The Evidence Since 1971, Using Alternative Deficit Measures." *Southern Economic Journal,* April 1988, 725–31.