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Using two alternative measures of expected inflation, this study investigates the impact of federal budget deficits on nominal long-term interest rate yields for the 1973.2-1995.4 period. Based on an open-economy loanable funds framework, four instrumental variable estimates in first differences are provided. In all cases, the budget deficit is found to elevate the nominal long-term interest rate.

Introduction

The potential impact of the federal budget deficit on interest rates in the United States has been examined extensively by a number of studies, including Barth, Iden, and Russek (1984, 1985), Cebula and Belton (1993), Cukierman and Meltzer (1989), Evans (1985, 1987), Feldstein and Eckstein (1970), Hoelscher (1983, 1986), Makin (1983), Mascaro and Meltzer (1983), McMillin (1986), Ostrosky (1990), Swami, Kolluri, and Singamsetti (1990), Zahid (1988), and Zelhorst and de Haan (1991). Although this literature has examined a variety of interest rates, it most commonly has focused on short-term rates, especially the three month Treasury bill rate and the four-to-six month commercial paper rate. Furthermore, most studies of federal government budget deficits and interest rates in the United States do not run beyond the early or mid-1980s, so that the second half of the 1980s and the first half of the 1990s have largely been neglected.

The purpose of this study is to examine empirically the impact of the federal budget deficit on nominal long-term interest rate yields in the United States for the

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period 1973.2-1995.4. We focus on the long-term interest rate yield for two reasons. First, this variable has received only limited attention in the literature as compared with the short-term rate. Second, we focus on the long-term rate because conventional macroeconomics generally argues that long-term (as opposed to short-term) interest rates transmit the effects of federal 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 long-term interest rates (Cebula and Belton, 1993; Hoelscher, 1986). The focus on the period 1973.2-1995.4, which makes the study "current,"also differentiates this study from others. We start the analysis with the second quarter of 1973 because that is when the system of fixed exchange rates (Bretton Woods) had effectively collapsed. While other studies beginning with the year 1971 or shortly thereafter have been undertaken (Cebula and Belton, 1993; Zahid, 1988), our ending the study period with the fourth quarter of 1995 is unique. Doing so makes the analysis as current as possible and considers recent years effectively neglected in the literature to date. And, because the most recent years that have been neglected are also years characterized by massive net capital flows into the United States, net capital inflows that may have mitigated interest-rate effects of government budget deficits, it may be especially useful to include those years in the analysis.

Section II of this study describes the model and data. The empirical findings are provided and discussed in Section III. Finally, conclusions are found in Section IV.

The Model and Data

The empirical analysis is couched within an open-economy loanable funds framework. The model adopted here regards the long-term nominal rate of interest as being determined by a loanable funds equilibrium of the following form:

$$PSD - PSS = D - M - NCI \text{ or } PSD + M + NCI = PSS + D \tag{1}$$

where:

PSD = real domestic private sector demand for long-term bonds
PSS = real domestic private sector supply of long-term bonds
D = real net borrowing by the federal government
M = real net purchases of securities by the Federal Reserve
NCI = real net capital inflows from other nations

The following conventional relationships are hypothesized:

$$PSD = PSD(LR, P, EARR),\ PSD_{LR} > 0,\ PSD_P < 0,\ PSD_{EARR} < 0 \tag{2}$$

$$PSS = PSS(LR, P, EARR),\ PSS_{LR} < 0,\ PSS_P > 0,\ PSS_{EARR} > 0 \tag{3}$$

where:

LR = the long-term nominal rate of interest
P = expected future inflation
EARR = the *ex ante* (expected) real short-term interest rate

It is hypothesized that, in accord with the conventional loanable funds model, the real private sector demand for long-term bonds is an increasing function of the long-term nominal interest rate and a decreasing function of the expected inflation rate. In addition, following Hoelscher (1986), it is argued that the higher the *ex ante* (expected) real short-term rate of interest, the smaller the real private sector demand for long-term bonds, *ceteris paribus*. That is, as EARR rises, investors more extensively wish to substitute short-term bonds for long-term bonds in their portfolios.

It also is expected that, in accord with the conventional loanable funds model, the real private sector supply of long-term bonds is a decreasing function of the long-term nominal interest rate and an increasing function of the expected inflation rate. Furthermore, following Hoelscher (1986), it is expected that the greater the expected real short-term interest rate, the greater the incentive for private bond suppliers to issue new long-term bonds in lieu of short-term bonds, *ceteris paribus*. Therefore, the real private sector supply of long-term bonds is an increasing function of EARR.

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

$$LR = f(P, EARR, D, M, NCI) \tag{4}$$

The expected signs on the partial derivatives in equation (4) are:

$$f_P > 0, f_{EARR} > 0, f_D > 0, f_M < 0, f_{NCI} < 0 \tag{5}$$

The first two signs in (5) are based on the behavioral assumptions underlying equations (2) and (3). Thus, it is expected that the nominal long-term interest rate is an increasing function of P since bond supply increases and bond demand decreases when expected inflation rises. Next, the sign on f_{EARR} should be positive because as the expected real short-term interest rate rises, it elicits an increase in the real long-term bond supply and a decrease in the real long-term bond demand. Also, it is expected that the long-term nominal interest rate should be, *ceteris paribus*, an increasing function of net federal government borrowing. As the conventional wisdom argues, when the federal government acts to finance a budget deficit, it presumably generates upward pressure on interest rates as it attracts funds to absorb its debt issuance (Barth et al., 1984, 1985; Cebula and Belton, 1993; Feldstein and Eckstein, 1970; Hoelscher, 1986; Zahid, 1988). Next, because Federal Reserve net purchases of securities act to offset the interest rate effects of net government borrowing, it is argued here that, *ceteris paribus*, f_M is negative (Barth et al., 1985; Cebula and Belton, 1993; Hoelscher, 1983). Finally, the expected sign on f_{NCI} is negative since net capital inflows from other nations act to absorb domestic debt issues and thereby to produce downward interest rate pressure, *ceteris paribus* (Cebula and Belton, 1993; Hoelscher, 1986; Zahid, 1988).

Based upon this framework, the following reduced-form equation is to be estimated:

$$LR_t = a + b\,P_t + c\,EARR_{t-1} + d\,D_t/Y_t + e\,M_{t-1}/Y_{t-1} + f\,NCI_t/Y_t + u \tag{6}$$

where:

LR_t = the nominal average interest rate yield on Moody's AAA-rated long-term corporate bonds (Aaa_t) or on Moody's Baa-rated long-term corporate bonds (Baa_t) in quarter t, as a percent per annum;
a = constant term;
P_t = expected price inflation in quarter t, as a percent per annum;
$EARR_{t-1}$ = the *ex ante* real average interest rate yield on 13-week U.S. Treasury bills in quarter t-1, as a percent per annum;
D_t/Y_t = the ratio of the seasonally adjusted total federal budget deficit (N.I.P.A.) in quarter t to the seasonally adjusted GDP in quarter t, expressed as a percent;
M_{t-1}/Y_{t-1} = the ratio of the seasonally adjusted net acquisition of credit market instruments by the Federal Reserve System in quarter t-1 to the seasonally adjusted GDP level in quarter t-1, expressed as a percent;
NCI_t/Y_t = the ratio of the seasonally adjusted net capital inflows in quarter t to the seasonally adjusted GDP in quarter t, expressed as a percent;
u = stochastic error term.

The model is quarterly; the study period is 1973.2 through 1995.4.

The data on AAA_t, Baa_t, and the nominal 13 week Treasury bill rate were obtained from the Board of Governors of the Federal Reserve System (1973-1996). To measure expected inflation, two different data sets were adopted. The first is the expected inflation rate based on the Livingston survey data, obtained from the Research Department of the Federal Reserve Bank of Philadelphia.[1] While a number of studies have adopted the Livingston survey data as the measure of expected inflation (Barth et al., 1985; Cebula and Belton, 1993; Hoelscher, 1986), use of the Livingston survey data to measure inflationary expectations has been seriously questioned by Swami, Kolluri, and Singamsetti (1990).[2] Accordingly, we consider as well a second measure of expected inflation, namely, a distributed lag on actual price inflation, an approach that has been described as superior to using the Livingston data (Swami et al., 1990).[3] More specifically, the second measure of expected inflation is a four-quarter distributed lag of the actual inflation rate of the CPI; the source for the CPI inflation rate data was the U.S. Department of Commerce (1997). Several alternative lag lengths for the distributed lag were examined, including three-, five-, six-, and eight-quarter lags. The results were fairly similar across these lag lengths; however, using the four-quarter lag provided the best forecasting model.[4]

The federal budget deficit, D_t, is the seasonally adjusted total N.I.P.A. federal budget deficit in quarter t, expressed in billions of current dollars. The underlying budget data for variable D_t involve budget surpluses, which are reported as a (+), and budget deficits, which are reported as a (-); before estimation, this series was multiplied by (-1) to generate the D_t series. Variable D_t consists of an exogenous component, the "structural deficit,"and an endogenous component, the "cyclical deficit."The D_t data were obtained from the Council of Economic Advisors (1973-1997). The data for the monetary policy variable M_{t-1} were obtained from the Board of Governors of the Federal Reserve System (1973-1997). In principle following certain earlier studies (Barth et al., 1985; Cebula and Belton, 1993; Hoelscher, 1983; Ostrosky, 1990), the monetary policy variable, which, as noted in Hoelscher (1983, p. 322), approximates changes in the monetary base, is lagged in order "...to allow time for changes in the monetary base to affect liquidity in the banking system and hence the supply of loanable funds [(Hoelscher, 1983: 322-323)]." The net capital inflow data, NCI_t, were also obtained from the Board of Governors of the Federal Reserve System (1973-1997) and are expressed in billions of current dollars. The variable Y_t (or Y_{t-1}) was obtained or estimated from data provided by the Council of Economic Advisors (1997, p. 300) and is also expressed in billions of current dollars. The *ex ante* real short-term interest rate is the nominal interest rate yield on 13-week U.S. Treasury bills minus the expected inflation rate. Since we examine two alternative inflation rate series, there are also two alternative measures of the *ex ante* real short-term rate. Variable EARR is lagged one period in order to allow sufficient time for funds to flow between long and short-term markets in response to changing interest rate differentials.

As shown in equation (6), we in principle follow a number of earlier studies, including Cebula and Belton (1993), Evans (1985, 1987), Hoelscher (1983, 1986), Holloway (1986), and Ostrosky (1990), and divide D_t and NCI_t by Y_t and divide M_{t-1} by Y_{t-1}. This is because it can be reasonably argued that the budget deficit, net capital inflows, and Federal Reserve System net purchases of credit market instruments should all be judged relative to the size of the economy.

Given that the long-term nominal interest rate is contemporaneous with the expected inflation, budget deficit, and net capital inflow variables, the inclusion of the latter three variables in the system introduces the possibility of simultaneity bias. Accordingly, equation (6) is estimated using instrumental variables (IV), with the instruments being the two-quarter lag of the actual inflation rate of the producer price index, p_{t-2}, the two-quarter lag of the seasonally adjusted unemployment rate of the civilian labor force, U_{t-2}, and the two-quarter lag of the nominal average interest rate yield on ten-year Treasury notes (TEN_{t-2}). The choice of instruments is based on our regression findings that p_{t-2}, U_{t-2}, and TEN_{t-2} systematically explain the expected inflation rate, the budget deficit, and net capital inflows, respectively, whereas the error terms in the system are not correlated with

U_{t-2}, p_{t-2}, or TEN_{t-2}.[5] The data on U_{t-2} and TEN_{t-2} were obtained from the Council of Economic Advisors (1973-1997).

Empirical Findings

The Augmented Dickey-Fuller (ADF) test was applied to the time series in the system. The ADF test reveals that all of the variables in the analysis are non-stationary in levels but stationary in first differences. Accordingly, the model is estimated in first differences.

The IV, first-differences estimates of equation (6) are provided in Table 1. As shown in Table 1, all 20 of the estimated coefficients exhibit the expected signs. In addition, 15 of the estimated coefficients are statistically significant at the one percent level, three are significant at the five percent level, and two are significant at the ten percent level. Clearly, given the high *t*-values on the variables in these estimates, multicollinearity cannot be a serious problem.

First, we consider the results for the case where the Livingston survey data were used as the measure of expected inflation. As shown in the top half of Table 1, both coefficients for the expected inflation variable are positive and statistically significant at the one percent level. Regarding the case of the *ex ante* real short-term interest rate, both coefficients are positive and significant at the one percent level. Similarly, both of the estimated coefficients on the budget deficit variable

Table 1. Results of IV Estimates, 1973.2-1995.4

	Explanatory Variables				
constant	δP_t	$\delta EARR_{t-1}$	$\delta(D_t/Y_t)$	$\delta(M_{t-1}/Y_{t-1})$	$\delta NCI_t/Y_t$
Using the Livingston Survey Data Measure of Expected Inflation					
Variable: δAaa_t					
+0.09	+0.84	+0.42	+0.99	−0.07	−0.16
(+0.26)	(+8.99)	(+7.15)	(+6.88)	(−2.90)	(−1.83)
DW = 1.98, Rho = −0.01					
Variable: δBaa_t					
+0.05	+0.99	+0.44	+0.98	−0.06	−0.22
(+0.19)	(+9.18)	(+5.55)	(+7.08)	(−2.20)	(−2.11)
DW = 2.04, Rho = −0.03					
Using Four–Quarter Distributed Lag Measure of Expected Inflation					
Variable: δAaa_t					
−0.08	+0.85	+0.40	+1.09	−0.15	−0.16
(−0.23)	(+7.63)	(+4.91)	(+5.92)	(−5.95)	(−1.72)
DW = 1.92, Rho = 0.03					
Variable: δBaa_t					
−0.06	+0.95	+0.48	+1.36	−0.14	−0.12
(−0.73)	(+8.75)	(+4.99)	(+7.02)	(−5.62)	(−1.98)
DW = 1.95, Rho = 0.02					

Note: Terms in parentheses are *t*-values; δ is the first differences operator.

are positive and significant at the one percent level. The coefficients on the monetary policy variable are both negative, with one significant at the one percent level and the other significant at the five percent level. Finally, the estimated coefficients on the capital inflows variable are both negative, with one significant at beyond the ten percent level and the other significant at the five percent level.

The results obtained using the four-quarter distributed lag on actual inflation are quite similar to those obtained using the Livingston data. In particular, as shown in the bottom half of Table 1, the estimated coefficients on the expected inflation, *ex ante* real short-term interest rate, and budget deficit variables are all positive and significant at the one percent level. Although there are modest differences between the results obtained using the Livingston data and the results obtained using the four-quarter distributed lag approach to inflationary expectations in terms of the coefficient sizes for P_t and D_t/Y_t, in principle the two sets of findings are compatible. In addition, in the bottom half of Table 1, the coefficients on the monetary policy variable are both negative and significant at the one percent level; these results are more robust than but nonetheless, in principle, compatible with those derived when using the Livingston data. Finally, the coefficients for the capital flow variable shown in the bottom half of the Table are both negative, with one significant at the ten percent level and the other significant at the five percent level. These results are very similar to those in the estimates generated using the Livingston data.

Thus, using two apparently very different approaches to the measurement of expected inflation, the following findings are generated:

(1) the nominal long-term interest rate yield (measured either as Aaa_t or Baa_t) is an increasing function of (a) expected inflation, (b) the *ex ante* real short-term interest rate, and (c) the federal budget deficit (measured as a percentage of GDP); (2) the nominal long-term interest rate yield (Aaa_t or Baa_t) is a decreasing function of expansionary monetary policy (measured in terms of net acquisitions of credit market instruments by the Federal Reserve System, as a percent of GDP); and (3) there is very limited (modest) evidence that Aaa_t may be a decreasing function of net capital inflows, whereas there is stronger evidence that Baa_t is a decreasing function of net capital inflows. Clearly, despite the influence of these various factors, federal budget deficits act to raise nominal long-term interest rate yields in the United States. Thus, despite the impact of massive net capital inflows for over more than a decade, budget deficits apparently do matter! In principle, this finding is consistent with earlier studies of budget deficits and long-term rates (Cebula and Belton, 1993; Hoelscher, 1986).

Conclusion

The findings in this study are in sharp contrast to many earlier studies that found no significant interest-rate impact of budget deficits (Evans, 1985, 1987; Hoelscher, 1983; Makin, 1983; Mascaro and Meltzer, 1983; McMillin, 1986; Ostrosky, 1990). Based on the four IV, first-differences estimates shown in Table 1, estimates that examine two different measures of nominal long-term interest rate yields and that use two very different approaches to measuring inflationary

Table 2. Results of the ADF Unit Root Test

Variable	Levels τ_μ	First Differences τ_μ
LR_t	−2.66	−3.02*
P_t	−2.87	−6.35*
$EARR_{t-1}$	−2.86	−2.99*
D_t/Y_t	−1.35	−4.89*
M_{t-1}/Y_{t-1}	−2.78	−2.91*
NCI_t/Y_t	−1.10	−3.45*

Note: * Significant at five percent level; critical value = −2.89.

expectations, this study finds that—during the post-Bretton Woods era (1973.2-1995.4)—the federal budget deficit has acted to elevate nominal long-term interest rate yields in the United States;[6] this is in principle consistent with the earlier studies by Barth et al (1985), Cebula and Belton (1993), and Hoelscher (1986) and, potentially, with arguments in Cukierman and Meltzer (1989).[7]

According to the "conventional wisdom," long-term interest rates transmit the effects of budget deficits to the "real" side of the economic system. Thus, it follows that federal budget deficits may have potentially resulted in some degree of "crowding out"in the United States and hence in diminished capital formation and diminished long-term economic growth as well.

Notes

1. The semi-annual inflationary expectations data from the Livingston survey are taken in December and in June of each year and apply to the following six months. In this study, for the first calendar quarter of each year, the expected inflation figure from the immediately preceding December survey applies; similarly, for the third quarter of each year, the expected inflation figure from the immediately preceding June survey applies. The second calendar quarter expectations figure is the average of the first and third quarters' expectations figures; the fourth quarter expectations figure is the average of the figure for the third quarter for that year and the following first quarter's expectations figure.
2. Swamy et al. (1990, p. 1013) observe that "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..." impounded in equations such as equation (6).
3. An alternative inflationary expectations variable that could have potentially been adopted is the highly respected series developed by Thies (1986). However, this is presumably unneccesary since the results generated using the two very different inflationary expectations measures adopted in this study yield extremely similar outcomes; presumably, there is no reason to expect that the Thies series would alter our conclusions.
4. The four-quarter lag also is prescibed by the Schwarz-Bayesian Criterion (SBC).
5. Using OLS, we have found that p_{t-2} significantly explains expected inflation, U_{t-2} significantly explains the budget deficit, and TEN_{t-2} significantly explains net capital inflows:

$$P_t = +3.2 \quad + \quad 0.41\, p_{t-2},\ R^2 = 0.55$$
$$(+9.48) \quad (+9.02)$$
$$D_t/Y_t = -3.46 \quad + \quad 0.82\, U_{t-2},\ R^2 = 0.58$$
$$(-9.97) \quad (+14.82)$$
$$NCI_t/Y_t = +0.73 \quad + \quad 0.3\, TEN_{t-2},\ R^2 = 0.22$$
$$(+1.01) \quad (+4.03)$$

One-period lags of these same instruments also significantly explain expected inflation, the deficit, and net capital inflows. However, use of a two-period lag rather than a one-period lag is necessary in order to avoid having the instruments contemporaneous with any of the explanatory variables in equation (6).

6. On average, a one percent rise in the deficit-GDP ratio elicits a roughly one percent rise in the nominal long-term interest rate.
7. As observed in the text, the model is estimated in first differences. For the interested reader, the results of the ADF test are provided in Table 2.

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