The effect of federal deficits and debt on the tax-adjusted, short-term, real interest rate

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Abstract:
The stock versus flow effect of the federal debt/deficit on a real interest rate is examined in a reduced-form equation. The evidence shows a positive and significant linkage between the federal debt and an ex-post, tax-adjusted, short-term, real interest rate.

Article:
1. Introduction
The question of whether there is a positive and statistically significant effect between federal debt/deficits and nominal and real interest rates is a hotly contested empirical issue that has important public policy implications. Evidence of a positive linkage between deficits and interest rates is presented by Barth, Iden and Russek (1985) for the structural real deficit and nominal interest rates, by Zahid (1988) for various measures of the deficit and a real short-term rate, and by Holloway (1988) for the cyclically-adjusted federal debt (but not the cyclically-adjusted deficit) and the AA bond rate. [1] On the other hand, Evans (1985, 1987a) finds no relationship between deficits and nominal and real ex-post interest rates for the U.S. and (1987b) between unanticipated deficits and nominal interest rates in six countries. Plosser (1982, 1987) also finds no positive evidence between budget deficits and nominal interest rates.

In this paper we test for the stock versus flow effect of federal debt/deficits on ex-post, tax-adjusted, short-term, real interest rates by examining the significance of coefficient estimates of the federal budget deficit versus the national debt in a reduced-form equation that is derived from an IS-LM-AS model in section 2. The results, reported in section 3, show that there is a positive and more statistically significant relationship between various measures of the national debt and the ex-post, tax-adjusted, short-term, real interest rate than for the various measures of the federal budget deficit.

2. The model
An IS-LM-AS model, employed by Allen (1989), is adapted from the Peek (1982) and Wilcox (1983a, b, c). The IS and LM schedules are in inverse form and the *t* subscripts are suppressed. The model is:

$$\text{IS:}\quad r = a_0 + a_1 D + a_2(M - P) - a_3 Q - a_4 SS + a_5 V_{\Pi}, \tag{1}$$

$$\text{LM:}\quad Q = b_0 + b_1(M - P) + b_2 i(1 - T), \tag{2}$$

$$\text{AS:}\quad P = P^e + c_1 Q + c_2 SS, \tag{3}$$

where, all the coefficients are positive, *Q*, the output gap, is defined as the log of real GNP minus the log of potential GNP, *D* is the federal debt or deficit variable, *M* is the log of Ml, *P* is the log of the price level (the GNP deflator) so that *(M — P)* are real balances, V_{Π} represents the dispersion of inflationary expectations measured by the cross-sectional variance of the expected inflation rate in period *t* from the University of Michigan's Survey Research Center data, *SS* is the external supply shock variable proxied as the log of the ratio of the GNP deflator for imports to the GNP deflator, *i* is the yield-to-maturity of one year Treasury bills, *T* is the

marginal tax rate on interest income, and P^e is the log of the expected price level in period t.[2] The ex-ante tax-adjusted real rate of interest in period t, r_t, is related to the nominal interest rate, i_t by (4):

$$i_t(1 - T) = r_t + \Pi_t^e, \tag{4}$$

where Π_t^e is a measure of inflationary expectations in period t based on the information set (Φ) in period t — 1. The reduced-form equation for the real after-tax ex-ante interest rate is:

$$r = \beta_0 + \beta_1 D + \beta_2 LIQ + \beta_3 SS + \beta_4 \Pi^e + \beta_5 V_\Pi, \tag{5}$$

where LIQ is the acceleration in nominal money supply growth, employed by Carlson (1979), Wilcox and Peek and Wilcox as a proxy variable for $(M - P^e)$ and is defined as the first difference of log M1 in period t minus the past three year average of the first difference of log M1 [3]. The dependent variable in eq. (5) is converted from the unobservable ex-ante, tax-adjusted, real rate to the ex-post, tax-adjusted, real interest rate by employing Π_t as a proxy measure for Π_t^e under the condition that Π_t^e is an unbiased predictor of Π_t [see Huizinga and Mishkin (1984) and (1986)] [4]. The Huizinga and Mishkin methodology allows one to establish correlation but not causation between the macroeconomic variables on the right-hand side of eq. (5) and the ex-ante real interest rate.

3. Empirical results

The hypothesis to be tested is whether there is a positive relationship between the real, ex-post, tax-adjusted interest rate in eq. (5) which is based on the yield to maturity (not the discount rate) of a one-year Treasury bill and the level of the net federal debt — a stock measure — or the change in the net federal debt — a flow measure. A loanable funds approach hypothesizes that the relationship is between the federal deficit and the real interest rate while a portfolio balance approach hypothesizes that the relationship is between the net Federal debt and the real interest rate.

Table 1a
Equation (5): Estimated coefficients of debt/deficit.

	Nominal debt	Real debt	Nominal debt/ potential nominal GNP	Cyclically adjusted debt
1961(I)–1985(IV)	0.004 (4.47)**	0.008 (4.42)**	23.00 (2.51)**	0.005 (4.45)**
1966(I)–1985(IV)	0.005 (3.74)**	0.008 (3.62)**	43.16 (3.30)**	0.005 (3.78)**
1971(I)–1985(IV)	0.006 (4.56)**	0.010 (4.02)**	57.19 (3.78)**	0.006 (4.67)**

[a] t-scores are in parentheses, ** significant at 1% level for a one-tailed test.

The coefficient estimates are reported in table la and b for four measures of the debt and the deficit. The four debt measures are the nominal net federal debt, the real net federal debt, the nominal debt divided by trend nominal GNP, the cyclically-adjusted debt [see de Leuuw and Holloway (1986, table 5)]. [5] The four deficit measures are the change in the nominal net federal debt, the change in the real net federal debt, the change in the nominal debt divided by trend nominal GNP, and the cyclically-adjusted deficit [see the Leuuw and Holloway (1986, table 3)]. The coefficient estimates in table 1 show that the estimates for the four measures of the debt are always positive and statistically significant at the one-percent level for a one-tailed test for three estimated time periods: 1961(I)-1985(IV), 1966(I)-1985(IV), and 1971(I)-1985(IV). The evidence is not as robust for the four measures of the deficit. Only the coefficient estimates of the cyclically-adjusted deficit are always significant at the five percent level for a one-tailed test.[6]

This evidence of a positive and significant debt coefficient is not inconsistent with Holloway who tested for the effect of both the cyclically-adjusted deficit to GNP and the cyclically-adjusted federal debt to GNP in a reduced-form nominal interest rate equation. He found that the coefficient of the deficit measure was insignificant, while the coefficient of the debt measure coefficient was positive and significant. Our results also suggest that the lack of a positive effect from government financing to interest rates found by Evans may be a result of his testing various measures of the deficit rather than the debt as a right-hand-side variable.

Table 1b
Changes in estimated coefficients of debt/deficit.

	Change in Nominal Debt	Change in Real Debt	Change in nominal debt/ potential nominal GNP	Cyclically adjusted deficit
1961(I)–1985(IV)	0.027	0.05	144.44	0.02
	(1.38)	(2.56)**	(2.58)**	(3.52)**
1966(I)–1985(IV)	0.010	0.04	107.42	0.03
	(0.44)	(1.81)*	(1.65)	(3.19)**
1971(I)–1985(IV)	0.009	0.04	132.15	0.03
	(0.35)	(1.82)*	(1.77)*	(3.50)**

[a] *t*-scores are in parentheses, * significant at 5% Level for a one-tailed test, ** significant at 1% level for a one-tailed test, respectively.

An estimate of eq. (5) for the 1961(I)-1985(IV) period where *D* is the cyclically-adjusted debt is provided below (t-scores in parentheses).

$$r = -2.54 + 0.005\ D - 0.68\ LIQ + 4.08\ SS + -0.35\ \Pi^e + 0.02\ V_{\Pi}\cdot$$

$$(1.10)\ (4.45) \qquad (0.04) \qquad (1.20) \qquad (1.19) \qquad (0.76)$$

$$R^2 = 0.33 \quad \text{Standard error} = 1.80 \quad D.W. = 2.07 \quad Rho = 0.31$$

The standard errors consistently range from 1.79 to 1.84 for the four measures of the debt for the three different periods. The supply shock coefficient is significant if the real debt or the nominal debt divided by trend nominal GNP is the debt measure. The other economic variables are always insignificant.

4. Conclusion

The evidence presented in this paper shows a positive and statistically significant relationship between four different measures of the federal debt and at least one measure of the deficit and an ex-post, tax-adjusted, short-term, real interest rate. The evidence shows that more statistically significant estimates of the relationship are obtained when variously defined measures of the stock of the federal debt are used rather than for measures of the change in the stock of these variously defined measures of the debt.

Notes:

[1] Feldstein and Eckstein (1970) report a positive relationship between real per-capita federal debt and long-term AAA bond rate but their results are not corrected for autocorrelation.

[2] The tax rate is the annual measure of the average marginal federal tax rate on adjusted gross individual income centered on the third quarter and interpolated for the other quarters. The data prior to 1981 is from Seater (1985, table 1) and for 1981-1985 is computed by the author.

[3] The reduced form coefficients are as follows: $\beta_0 = Z(a_0 + VWb_0)$, $\beta_1 = Za_1$, $\beta_2 = Z(a_2 + VWb_1)$, $\beta_3 =$ — $Z(VWc_1c_2 + a_2c_2 + a_4)$, $\beta_4 = (XVWb_2)$, and $\beta_5 = Za_5$, where $W = (1/1 + b_1c_1) > 0$, $V =$ —$(a_3 + a_2c_1) < 0$, and $Z = (1/(1 —\ VWb_2) > 0$.

[4] Allen (1989) tests for the necessary conditions of unbiasedness between Π_t^e and Π_t which requires the residuals, e_t, not be correlated and that $\alpha_0 = 0$ and $\alpha_1 = 1$ as a joint hypothesis test in the following equation: $\Pi_t = \alpha_0 + \alpha_1\Pi_t^e + e_t$, where Π_t^e is the University of Michigan Survey Research Center data for the expected rate of inflation for the next twelve months and Π_t is the annualized quarterly rate of inflation of the GNP deflator.

[5] The government debt measure is the nominal par value of the seasonally-adjusted net federal debt *(DEBT)* computed by the Federal Reserve Bank of St. Louis. Trend nominal GNP is calculated as the GNP price deflator times the potential real GNP series *[yp,* see Gordon (1984, table B-2)]. Thus, the real debt measure is *DEBT/ P* and the nominal debt divided by trend nominal GNP is *DEBTAP- yp).*

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