Have U.S. Budget Deficits Raised the Real Interest Rate Yield on Tax-Free Municipal Bonds"

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Abstract.
Using a half century of data, this empirical study adopts a simple loanable funds to investigate the impact of the budget deficits on the *ex post* real interest rate yield on high grade municipal bonds in the U.S. Autoregressive 2SLS estimates for the 1960-2012 study period find that the *ex post* real interest rate yield on high grade municipal bonds is an increasing function of the *ex post* real interest rate yield on Moody's Baa-rated corporate bonds, the *ex post* real interest rate yield on three-year U.S. Treasury notes, the real value of the S&P 500 stock index, and the federal budget deficit (relative to the GDP level). Based on these results, it is observed that factors elevating the federal budget deficit appear to raise the *real* cost of borrowing to the cities (of all sizes), counties, and states across the U.S. Over the long run, failure to address the federal budget issue could have profound negative impacts on the finances of U.S. cities, counties, and states and their economic activities.

1 Introduction

Across the U.S., cities of all sizes, counties of all sizes and populations, and all states regardless of size and population have long found the existence of tax-free status on qualified bonds issues to be a key component of the financing of a wide variety of capital improvement projects. Such projects range from highway construction to public school construction to water and sewerage system construction. Consequently, it is of interest to identify the key factors have a statistically significant impact upon the tax-free interest rate yield on the "municipal" bonds being issued over time. Such is the essential focus of this study, a focus made all the more important because of its influence on income tax evasion (Cebula, 1997A).

One very visible public policy issue and hence one dimension of emphasis in this study is that of the magnitude of the federal government budget deficit. The impact of budget deficits on interest rates has been studied extensively (Al-Saji, 1993; Barth, Iden and Russek, 1984, 1985, 1986; Barth, Iden, Russek, and Wohar, 1989; Cebula, 1997B, 2013; Cebula and Cuellar, 2010; Choi and Holmes,

2014; Ewing and Yanochik, 1999; Findlay, 1990; Gale and Orszag, 2003; Gissey, 1999; Hoelscher, 1983, 1986; Johnson, 1992; Ostrosky, 1990; Saltz, 1998; Swamy, Kolluri, and Singamsetti, 1990, Tanzi, 1985; Zahid, 1988). Many of these studies find that budget deficits raise longer-term interest rates, such as those on U.S. Treasury notes and bonds or Moody's Aaa-rated or Baa-rated corporate bonds, while typically not significantly affecting short-term rates such as Treasury bills. Since private-sector capital formation is presumably much more affected by longer-term than by short-term rates, it has been argued that budget deficits *may* lead to "crowding out" (Carlson and Spencer, 1975; Cebula, 1997B; Ewing and Yanochik, 1999). However, the primary focus of these various studies has been on private sector or federal sector interest rate yields. Virtually no emphasis has been placed on contemporary determinants of the interest rate yield on tax-free municipals, which are so important to the infrastructure operations and activities of cities and towns, counties, and states across the U.S. Accordingly, the purpose of this study is to provide insights into the determinants of the real tax-free interest rate yield on high grade municipal bonds. In part, the emphasis in this study is on the *ex post* real interest rate yield rather than on either the *ex ante* real interest rate yield or the *nominal* interest rate yield so as to avoid issues regarding the dependability and usefulness of various *expected* inflationary measures (Swamy, Kolluri, and Singamsetti, 1990; Cebula, 1998). In addition, however, the emphasis on the *ex post* real interest rate reflects the conventional wisdom that it is the real interest rate rather than the nominal interest rate that influences investment in new plant and equipment, consumer durables purchases, and so forth (Taylor, 1999; Cicchetti, 2006; Mishkin,

2013). Finally, tax-free municipals and the interest they pay are important because they provide a legal alternative to income tax evasion (Tanzi, 1982, 1983; Feige, 1994, Cebula, 1997A), which is illegal. The existence of this legal financial investment has been shown to actually reduce tax evasion (Cebula, 2004).

Using annual data, this study investigates the 53-year period 1960 through 2012 in order to provide at least preliminary *contemporary* insights into whether higher federal budget deficits (and other financial market factors) have influenced *ex post* real long-term interest rate yields on high grade municipal bonds in the U.S. over an extended time period. Section 2 of this study provides the framework/model adopted, whereas Section 3 concisely defines and describes the specific variables in the empirical model (as well as the full model structure) and describes the data as well. Section 4 provides the empirical results of an autoregressive, two-stage least squares (AR/2SLS) estimation predicated on the basic model for the 1960-2012 study period. The conclusion is found in Section 5.

2 The Framework

Based extensively on Al-Saji (1993), Barth, Iden, and Russek (1984; 1985; 1986), and Hoelscher (1986), as well as Cebula (1997B), and Koch (1994), to identify the determinants of the *ex post* real interest rate yield on tax-free municipal bonds, a simple loanable funds model is adopted in which the real long-term interest rate yield is, assuming all other bond markets are in equilibrium, determined by:

$$D + MY = TDEFY + S \qquad (1)$$

where:

D = private domestic demand for high grade tax-free municipal bonds;

MY = a measure of the available domestic money supply, expressed as the ratio of the M2 money supply as a percent of GDP;

TDEFY = the federal budget deficit, expressed as a percent of GDP; and

S = public sector (state plus county plus municipal) supply of/issuance of high-grade municipal bonds.

In this framework, it is expected that:

$D = D\ (RTF, RBaa, RTHREE, RS\&P500, RGDPGR),\ D_{RTF} > 0,\ D_{RBaa} < 0,\ D_{RTHREE} < 0,$

$D_{RS\&P500} < 0,\ D_{RGDPGR} >=< 0$ (2)

$S = S\ (RTF),\ S_{RTF} < 0$ (3)

where:

RTF = the annual average *ex post* real interest rate yield on high grade tax-free municipal bonds;

RBaa = the annual average *ex post* real interest rate yield on Moody's Baa-rated corporate bonds;

RTHREE = the annual average *ex post* real interest rate yield on three-year U.S. Treasury notes;

RS&P500 = the real (2005 dollars) value S&P 500 stock index; and

RGDPGR = the annual percentage growth rate of real GDP.

According to the model, the private sector demand for tax-free municipal bonds is an increasing function of RTF, *ceteris paribus*, since bond buyers prefer a higher real rate of return on

their investment. On the other hand, bond suppliers/issuers of tax-free bonds (effectively, state, county, and municipal governments) would supply fewer high-grade municipal bonds in response to a higher RTF since such a condition would raise the debt service costs of their bond issues, *ceteris paribus*. Next, the higher the real interest rate yield on Moody's Baa-rated corporate bonds, the lower the private sector demand for high grade tax-free municipal bonds because bond buyers substitute these corporate bonds for the tax-free bonds, *ceteris paribus*. Similarly, the higher the real interest rate yield on three-year U.S. Treasury notes, the lower the private sector demand for high grade tax-free municipal bonds, as bond buyers substitute these Treasury notes for the tax-frees, *ceteris paribus*. Next, the higher the real S&P 500 stock index, the lower the private sector demand for high grade tax-free municipal bonds as bond buyers substitute equity investments for tax-free bonds, *ceteris paribus*. Finally, the higher the percentage growth rate of real GDP, the greater the demand for tax-free bonds on the one hand, *ceteris paribus*, assuming the latter are *de facto* "normal goods," but the higher also the demand for goods and services on the other hand, *ceteris paribus*. Hence, as suggested by Hoelscher (1986), the sign on the partial derivative D_{RGDPGR} is in effect *a priori* unknown.

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

RTF = f (TDEFY, MY, RBaa, RTHREE, RS&P500, RGDPGR)

such that:

$$f_{TDEFY} > 0,\ f_{MY} < 0\ f_{RBaa} > 0,\ f_{RTHREE} > 0,\ f_{RS\&P500} > 0,\ f_{RGDPGR} >=< 0 \qquad (4)$$

The first of these expected signs is positive to reflect the conventional wisdom that when the government attempts to finance a budget deficit, it forces interest rate yields upwards as it competes with not only the private sector but also the market for tax-frees to attract funds, *ceteris paribus*. The expected sign on the money supply variable (MY) is negative because, in theory, the greater the available money supply relative to GDP, the greater the offset to new government debt issues, i.e., greater money supply availability arguably helps to offset the real interest-rate effects of budget deficits, *ceteris paribus*. Predicated upon equation (2), the expected signs on f_{RBaa}, f_{RTHREE}, and $f_{RS\&P500}$ should all be positive, reflecting the fact that high grade tax-free municipal bonds compete with Moody's Baa-rated bonds, three-year Treasury notes, and equities, whereas the sign on f_{RGDPGR} is *a priori* unclear.

3 Variables, Model Structure, and Data

Based on the model presented above in equation (4), the autoregressive 2SLS estimation involves the following specification:

$$RTF_t = \alpha_0 + \alpha_1 TDEFY_t + \alpha_2 MY_{t-1} + \alpha_3 RBaa_t + \alpha_4 RTHREE_t + \alpha_5 RS\&P500_{t-1} + \alpha_6 RGDPGR_{t-1} + \alpha_7 AR(1) + u_t \quad (5)$$

where:

RTF_t = the *ex post* real average interest rate yield on high grade tax-free municipal bonds in year t, expressed as a percent per annum;

α_0 = constant term;

$TDEFY_t$ = the ratio of the nominal federal budget deficit in year t to the nominal GDP in year t, expressed as a percent;

MY_{t-1} = the ratio of the nominal M2 money supply in year t-1 to the nominal GDP in year t-1, expressed as a percent;

$RBaa_t$ = the *ex post* real average interest rate yield on Moody's Baa-rated corporate bonds in year t, expressed as a percent per annum;

$RTHREE_t$ = the *ex post* real average interest rate yield on three-year U.S. Treasury notes in year t, expressed as a percent per annum;

$RS\&P500_{t-1}$ = the average real (2005 dollars) value of the S&P 500 stock index over year t-1;

$RGDPGR_{t-1}$ = the percentage growth rate of real GDP (2005 dollars) in year t-1;

AR (1) = the autoregressive term; and

u_t = the stochastic error term.

The budget deficit and M2 money supply are both scaled by GDP because the sizes of the budget deficit and money supply should be judged relative to the size of the economy (Ostrosky, 1990; Koch, 1994; Cebula, 1997B). The dependent variable in this system, RTF_t, is expressed as contemporaneous with three of the explanatory variables: the *ex post* real average annual interest rate yield on Moody's Baa-rated corporate bonds, $RBaa_t$; the federal budget deficit, as a percent of GDP, $TDEFY_t$; and the *ex post* real average annual interest rate yield on three-year Treasury notes. Given these contemporaneous components of this specification, the possibility of simultaneity bias arises,

which in turn mandates the choosing of instrumental variables. The instrument chosen for the variable $RBaa_t$ was the two-year lag of the *ex post* real average annual interest rate yield on three-month U.S. Treasury bills, $RTBR_{t-2}$; the instrument chosen for the deficit variable $TDEFY_t$ was the two-year lag of the percentage annual average civilian unemployment rate, UR_{t-2}; and the instrument chosen for the $RTHREE_t$ variable was the *ex post* real average annual interest rate on ten-year Treasury notes lagged two periods, $RTEN_{t-2}$. The choice of instruments was based on the fact that $RTBR_{t-2}$ was highly correlated with the $RBaa_t$ variable (r=0.798), the fact that UR_{t-2} was highly correlated with the $TDEFY_t$ variable (r=-0.590), and the fact that $RTEN_{t-2}$ was highly correlated with the variable $RTHREE_t$ (r=0.694), whereas these instruments were uncorrelated with the error terms in the system.

The data for all of the variables in this analysis were obtained from the Council of Economic Advisors (2013, Tables B-1, B-2, B-4, B-42, B-64, B-69, B-73, B-79, B-95). The group unit root test reveals that the variables in this model are stationary in levels for the 1960-2012 study period.[1] Descriptive statistics for all of the variables in the model are found in Table 1.

4 Empirical Findings

The estimates provided in this study all involve an autoregressive, i.e., AR(1) process. AR(1) models are of interest as a simple process for many times-series applications, perhaps best applicable to time

[1] These test results will be supplied upon written (e-mail) request.

series that exhibit more volatile behavior, such as stock market indices, stock prices, and interest rates. In any case, adopting the Newey and West (1986) heteroskedasticity correction, the autoregressive, i.e., AR(1), 2SLS estimate of equation (5) is provided in Table 2, where coefficients, t-values, and values for "prob." are all found. In Table 2, all six of the estimated coefficients on the explanatory variables exhibit the expected signs, with two statistically significant at the 1% level (RBaa and RTHREE), one statistically significant at the 2.5% level (TDEFY), and one statistically significant at beyond the 5% level (RS&P500). The estimated coefficients on variables RGDPGR and MY fail to be statistically significant at the 10% level. The DW statistic is 1.79, so that autocorrelation is not an issue. The J-statistic is statistically significant at the 4% level, attesting to the dependability of the model.

The coefficient on the *ex post* real interest rate yield on Moody's Baa-rated corporate bonds ($RBaa_t$) is positive, as hypothesized, and statistically significant at the 1% level, implying that the higher this *ex post* real interest rate yield, the higher the *ex post* real interest rate yield on tax-free municipal bonds. This finding presumably reflects market competition between long term corporate bonds and tax-free issues. Similarly, the higher the *ex post* real interest rate yield on three-year Treasury notes, whose estimated coefficient is positive, as hypothesized, and statistically significant at the 1% level, the higher the *ex post* real interest rate yield on tax-free municipal bonds The estimated coefficient on the real S&P 500 stock index is positive and statistically significant at the 3% level, implying that the higher the value of the variable $RS\&P500_{t-1}$, the higher the *ex post* real

interest rate yield on tax-free municipal bonds. Finally, as hypothesized, the coefficient on the budget deficit variable, $TDEFY_{t-1}$, is positive, as hypothesized, and statistically significant at the 2.5% level. Thus, the higher the federal budget deficit (as a percent of GDP), the higher the *ex post* real interest rate yield on tax-free municipal bonds. This finding is consistent with a variety of empirical studies of earlier periods regarding other intermediate- to long-term interest rate yields, including Al-Saji (1993), Barth, Iden and Russek (1984, 1985, 1988), Cebula (1997, 2013), Cebula and Cuellar (2010), Hoelscher (1986), Koch (1994), Saltz (1998), Tanzi (1985), and Zahid (1988), among others.

Before closing this section of the study, the issue of multi-collinearity is addressed. The reader is referred to Table 3, where the correlation matrix for the explanatory variables is found. As shown, with the exception of the correlation coefficient of +0.558 between variables RBaa and RTHREE, there is no concern regarding multi-collinearity in the system. Moreover, even in this case, the correlation is arguably not problematic because, despite its magnitude, both explanatory variables are statistically significant at the 1% level.

Finally, for the interested reader, it is observed that a variety of alternative specifications of the basic model yield very similar results. For example, as a modest test of the consistency of the basic model results during the 1960-2012 study period, Table 4 provides an alternative AR/2SLS estimate in which the real GDP growth rate variable, $RGDPGR_{t-1}$, is replaced by the "change in per capita real GDP" (Hoelscher, 1986), $\Delta PCRGDP_{t-1}$, and the variable $RS\&P500_{t-1}$ is replaced by the "percentage growth rate of the real S&P 500," $\%\Delta RS\&P500_{t-1}$. Once again, the group unit root test

reveals that the variables in this version of the model are also stationary in levels for the 1960-2012 study period. In any case, as shown in Table 4, this estimation yields results closely paralleling those in Table 2; indeed, of interest, the coefficient of the government budget deficit variable becomes statistically significant in this case at the 1% level. Overall, the inferences from this estimation are effectively identical to those shown in Table 2.

5 Conclusion

Using over a half century of data, this empirical study adopts a simple loanable funds to investigate the impact of the federal budget deficits and other factors, chiefly financial-market factors, on the *ex post* real interest rate yield on high grade municipal bonds in the U.S. Autoregressive 2SLS estimates for the 1960-2012 study period reveal that the *ex post* real interest rate yield on high grade municipal bonds is an increasing function of the *ex post* real interest rate yield on Moody's Baa-rated corporate bonds, the *ex post* real interest rate yield on three-year U.S. Treasury notes, the real value S&P 500 stock index, and the federal budget deficit (relative to the GDP level).

It is observed in closing that factors elevating the federal budget deficit act to raise the *real* cost of borrowing to the cities (of all sizes), counties, and states across the U.S. Given the time period studied, 1960 through 2012, this relationship appears to be an enduring one, one that responsible policy-makers should not overlook. Over the long run, failure to address the federal budget deficit issue could have profound negative impacts on the finances of U.S. cities, counties, and states and their economic activities.

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Table 1. Descriptive Statistics, 1960-2012

Variable	Mean	Standard Deviation
Basic Equation:		
RTF	1.804	2.093
TDEFY	2.613	2.562
MY	53.72	7.433
Rbaa	4.488	2.435
RTHREE	1.993	2.136
RS&P500	622.4	402.2
RGDPGR	3.096	2.185
Instruments:		
RTBR	1.028	1.126
UR	6.077	1.599
RTEN	2.531	2.293

Table 2. Initial AR/2SLS Estimation Results, 1960-2012
Dependent Variable: RTF

Variable	Coefficient	t-value	Prob.
TDEFY	0.271**	2.36	0.0227
MY	-0.0012	-0.13	0.8967
RBaa	0.561***	3.06	0.0038
RTHREE	0.403***	2.90	0.0059
RS&P500	0.146*	2.23	0.0309
RGDPGR	0.029	0.80	0.4299
AR (1)	0.812***	7.27	0.0000
Constant	-3.31		
DW	1.79		
Rho	0.10		
Inverted Root	0.81		
J-statistic	13.04*		
Instrument Rank	14		

***Statistically significant at 1% level; **statistically significant at 2.5% level; and *statistically significant at 5% level.

Table 3. Correlation Matrix for Explanatory Variables, 1960-2012

Variable	TDEFY	MY	RBaa	RTHREE	RS&P500	RGDPGR
TDEFY	1.000					
MY	0.479	1.000				
RBaa	0.184	0.121	1.000			
RTHREE	0.299	-0.183	0.558	1.000		
RS&P500	-0.077	-0.054	0.023	-0.202	1.000	
RGDPGR	-0.283	-0.296	0.060	0.336	-0.118	1.000

Table 4. Alternative AR/2SLS Estimation Results, 1960-2012

Dependent Variable: RTF

Variable	Coefficient	t-value	Prob.
TDEFY	0.272***	3.13	0.0032
MY	-0.009	-0.61	0.5422
RBaa	0.511***	3.56	0.0009
RTHREE	0.428***	3.55	0.0010
%ΔRS&P500	1.296***	3.23	0.0024
ΔPCRGDP	1.127	0.11	0.9139
AR (1)	0.729***	5.43	0.0000
Constant	-3.84		
DW	1.83		
Rho	0.08		
Inverted Root	0.73		
J-statistic	12.77*		
Instrument Rank	14		

***Statistically significant at 1% level; **statistically significant at 2.5% level; and *statistically significant at 5% level.