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Reflections on and Inquiry into Unfamiliar as well as Familiar Factors that may Influence the Market for Municipal Bonds

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Abstract: This study investigates the impact of various factors on the ex-ante real interest rate yield on high grade municipal bonds. The AR/2SLS estimation implies that this ex ante real interest rate is an increasing function of the ex-ante real interest rate yield on thirty-year Treasury bonds while being a decreasing function of net capital flows. The yield in question also is found to have been negatively impacted by the Depository Institutions Deregulation and Monetary Control Act. Furthermore, the estimation finds that this interest rate measure is a decreasing function of the maximum marginal federal personal income tax rate. In addition, it is found that, in the presence of an interaction term, the ex-ante real interest rate yield on high-grade municipals is an increasing function not only of the budget deficit but also the aggregate tax gap. The policy implications of these results include the need to limit the extent of budget deficits and to also limit the extent of income tax evasion in the U.S., lest there will be significant limitations placed on the ability of towns, cities, counties, and states to create new infrastructure in response to changing demographic and economic circumstances and/or maintain existing infrastructure.
Keywords: ex ante real interest rate yield on municipal bonds, budget deficit, income tax evasion, federal personal income tax rates
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1. INTRODUCTION

Pursuant to the ratification of the 16th Amendment to the U.S. Constitution on February 3, 1913, The Revenue Act of 1913, implemented on October 3, 1913, legally codified exemption of interest on municipal bonds from federal income taxation. As a consequence of this statute, the general rule in the U.S. is that the interest income from bonds issued by one [level of] government is not taxable by another [level of] government, although the issuing government may tax the bond interest. Hence, the federal government is precluded from taxing interest on municipal bonds.

Accordingly, across the U.S., cities, counties, and states have long found the tax-free status on qualified bond issues, which enables these governmental units to borrow at a lower cost in

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financial markets, to be a key consideration in the financing of a wide variety of capital improvement projects. A multi-trillion dollar market for tax-exempt municipal bonds has evolved over time. Given the magnitude of this market, as well as the importance of tax-exempt interest rates to city, county, and state governments, this study seeks to identify key factors that influence the level of the ex antereal interest rate yield on high grade municipal bonds, with a focus on potential influences that have been largely or entirely overlooked in the published literature to date, e.g., aggregate income tax evasion (measured in this study by the aggregate tax gap) and its relationship to (interaction with) the federal budget deficit as well as the budget deficit itself, the Depository Institutions Deregulation and Monetary Control Act of 1980, international capital flows, and alternative measures of income tax rates. Focusing on high grade municipals creates a high degree of bond quality homogeneity so as to increase confidence in the estimation results because over time the bonds in each year are very comparable to those in each of the other years.

2. BACKGROUND ON THE MUNICIPAL BOND MARKET

Tax-exempt (tax-free) bonds can be characterized according to whether or not they are general obligation bonds (GOs), revenue bonds, insured bonds, pre-refunded bonds, and so forth. In part, according to such designations, their rating by Standard & Poor's, Moody's, Best and Company, and other bond rating services is determined.

From another perspective, tax-free bonds are classified as being:

1. Simply tax-exempt, i.e., not subject to federal income taxation;
2. Dual tax-exempt, i.e., not subject to federal or state income taxation;
3. Triple tax-exempt, i.e., not subject to federal or state or city/local income taxation.

In each of these three classifications, there is a simple formula to express/convert the tax-free interest rate yield in terms of it taxable equivalent yield.

For example, assume that there are two bonds that are equally rated in terms of quality, including default risk, Bond A (the interest on which is taxable by the IRS) and Bond B (the interest on which is free from taxation by the IRS). The interest rate yield on Bond A is R_A, whereas the interest rate on Bond B is R_B. The conversion of R_B in to R_A is expressed as:

(1) $R_A = R_B/(1\text{-}MAXTAXR)$

where *MAXTAXR* is the relevant marginal federal income tax rate. Clearly, the higher the pertinent marginal federal income tax rate, the higher the equivalent taxable interest rate yield. As observed in Cecchetti (2006), Madura (2008), and Cebula (2011), Equation (1) can be easily modified to reflect either dual or triple tax-exemption status, which will depend upon one's legal geographic residence and the geographic location at which a given tax-free bond was issued.

Interestingly, of the 50 states, 43 impose some form of state income taxation. In the aggregate, state income tax receipts constitute 36-37 percent of total state tax collections. Some 41 states tax wage income as well as other income, including interest, dividends, and capital gains. Of these 41 states, eight impose a flat tax rate system, whereas 33 impose a progressive tax rate system. California and Missouri have the most tax brackets (ten). The lowest positive marginal state income tax rate is 2.9 percent (North Dakota) and the highest state income tax is 13.3 percent (California).

Two states, New Hampshire and Tennessee, exclusively tax dividend and interest income, although Tennessee is phasing out the tax, with total discarding thereof being accomplished by

2022. Most states derive their "taxable income" based at least in part on Schedule 1040, inclusive of other IRS forms. Indeed, Indiana, Illinois, and Colorado impose their respective state income tax liabilities as a percentage of federal taxable income. Michigan, imposes its state income tax as a percentage of a modified federal adjusted gross income. In any case, it is clear that state income tax receipts significantly reflect the pattern of federal income tax receipts and taxable income reported to the IRS.

3. STUDY OBJECTIVES AND FRAMEWORK

Given the framework/context outlined above, it is clear that the Internal Revenue Code at least theoretically plays a key role in determining the ex ante real interest rate yield on high grade municipal bonds, hereafter, simply *EARTXFREE* (Poterba and Rueben, 1999, 2001). Moreover, given the passage of the Tax Cuts and Jobs Act in December of 2017 and its implementation beginning in 2018, it seems especially pertinent for inquiries into factors influencing the *EARTXFREE* to include key features and implications associated with most major tax cut statutes, including (a) reduced federal personal income tax rates, (b) budget deficits that typically are incurred at the outset of the implementation of the statute, and (c) changes in the degree of federal personal income tax evasion.

Accordingly, in order to provide insights into the factors influencing the real interest rate yield on tax-exempt bonds, a loanable funds model is adopted in which the ex ante real interest rate yield on municipal bonds is, assuming all other bond markets are in equilibrium, determined by:

$$(2) \qquad D + NCI/Y = S + DEFY$$

where: *D* is private domestic demand for high grade municipal bonds; *NCI/Y* is the ratio of net financial capital inflows to GDP; *S* is supply of high grade municipal bonds; and *DEFY* is the total federal budget deficit, expressed as a percent of GDP.

Before specifying the model in detail, it is observed that, following the specification in Cebula (1992), Al-Saji (1993), and Cebula and Saltz (1998), in order to convert nominal interest rate yields into ex ante real interest rate yields, this study measures the current expected future inflation variable, P^e_t, as a linear weighted average of present *actual* inflation and past *actual* inflation such that:

$$(3) \qquad P^e t = (2P_t + P_{t-1})/3$$

with P_t being the *actual* percentage inflation rate of the consumer price index (CPI) in year *t* and with P_{t-1} being the actual percentage inflation rate of the CPI in year *t-1*. Accordingly, the value of both of the ex ante real interest rate yields included in this study is simply computed as the nominal interest rate yield in question minus the expected inflation rate, P^e_t.

The demand for tax-exempt bonds is expressed as:

$$(4) \qquad D = D \, (EARTXFREE, \, EARTHIRTY, \, Y, \, MAXTAXR, \, AVETAXR)$$

such that:

$$(5) \qquad D_{EARTXFREE} > 0, \, D_{EARTHIRTY} < 0, \, D_Y > 0, \, D_{MAXTAXR} > 0, \, D_{AVETAXR} > 0$$

and the supply of high grade municipal bonds is expressed as:

$$(6) \qquad S = S \, (EARTXFREE)$$

such that:

(7) $S_{EARTXFREE} < 0$

where: *EARTXFREE* is the ex-ante real tax free interest rate yield on high grade municipal bonds; *EARTHIRTY* is the ex-ante real interest rate yield on thirty-year U.S. Treasury bonds; *Y* is the percentage increase in real GDP; *MAXTAXR* is the maximum marginal federal personal income tax rate; and *AVETAXR* is the average effective federal personal income tax rate.

According to the model, the private sector demand for high-grade tax-free municipal bonds is an increasing function of *EARTXFREE*, ceteris paribus, because rational investors (bond buyers) clearly prefer a higher real rate of return on their investment over a lower rate of return. On the other hand, bond suppliers/issuers of tax-free bonds (state, county, and municipal governments) would supply/issue fewer high-grade municipal bonds in response to a higher *EARTXFREE* since such a condition would raise the debt service costs of their bond issues, ceteris paribus, and hence the total cost of their public investment projects. Next, the higher the ex-ante real interest rate yield on thirty-year Treasury bonds (*EARTHIRTY*), the lower the private sector demand for high-grade tax-free municipal bonds, as investors substitute the thirty-year Treasuries for the tax-frees, ceteris paribus (and hence the lower the price thereof, so that the real yield on said bonds would be higher). Furthermore, the higher the percentage growth rate of real GDP (*Y*), the greater the demand for high grade tax-free municipal bonds and therefore the higher the price on said bonds, ceteris paribus (and, consequently, the lower the ex-ante real interest rate yield on those tax-exempt bonds). Next, there are the tax rates included in this model. The first of these is the maximum marginal federal personal income tax rate, *MAXTAXR*. It is hypothesized in this study that the higher the maximum marginal federal personal tax rate, the greater the demand for tax-free bonds because of the resulting greater tax benefits of those bonds; consequently, the greater the value of *MAXTAXR*, the greater the price of and, correspondingly, the lower the ex-ante real interest rate yield on those tax-exempt bonds. Finally, although the tax benefits from qualified municipal bonds are logically greater for investors in the highest tax bracket, there certainly can be tax benefits for those who are not in the highest tax bracket. Arguably then, the higher the average effective federal personal income tax rate (*AVETAXR*), the grater the demand for and hence the price of tax-exempt bonds and therefore the lower the expected real yield on those bonds, ceteris paribus.

Aside from the hypothesized relationships considered above, the model also includes a net financial capital inflows variable, *NCI/Y*. It is hypothesized, following the conventional wisdom, that the greater the extent of net capital inflows, the greater the extent to which debt issues are absorbed and hence the less the upward pressure on interest rate yields, ceteris paribus. Strong empirical support for this perspective is found in Cebula and Koch (1994).

In addition, there is the budget deficit. Following the conventional wisdom, it is hypothesized that the greater the federal budget deficit (*DEFY*), the greater the upward pressure on interest rates (including *EARTXFREE*) as a reflection of the federal government's competing with the remainder of the economy for funds, ceteris paribus (Barth, Iden, and Russek, 1984, 1985; Tanzi, 1985; Hoelscher, 1986; Swamy, Kolluri, and Singamsetti, 1990; Johnson, 1992; Cebula and Saltz, 1998; Ewing and Yanochik, 1999; Gissey, 1999; Gale and Orszag, 2003; Laubach, 2009; Cebula, 2013, 2014; Choi and Holmes, 2014). However, a unique focus of this study is on the effects of income tax evasion, reflected here by the tax gap on the interest rate.[1] It is hypothesized in this study that, ceteris paribus, the greater the extent to which the budget deficit is elevated by a

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[1] The tax gap is the lost tax revenue to the U.S. Treasury based on the size of the income gap (unreported taxable income) and the effective federal personal income tax rate (Tax Policy Center, 2017).

higher level of tax evasion, i.e., by a larger tax gap (*TAXGAP*), the greater the resulting extent to which to which the Treasury must borrow and hence the greater the additional upwards pressure on interest rates, including *EARTXFREE*, ceteris paribus.[2] However, since the presence of income tax evasion implies that the official budget deficit already reflects the tax gap, it is also necessary to include in the model an interaction term for these two variables:

(8) $INTERACT = DEFY \times TAXGAP.$

The expected sign on this interaction term is negative because the total budget deficit already includes/reflects the tax gap.

Before specifying the complete final model to be estimated, this study also endeavors to allow for the potential interest rate effects of a major banking statute that changed the landscape for the banking industry in the U.S. during 1973-2012, namely, the *DIDMCA* (Depository Institutions Deregulation and Monetary Control Act of 1980), whose objective was to reduce banking regulations (Madura, 2008). Fundamentally, numerous provisions of this statute were intended to deregulate the banking industry, as well as deregulate other depository industries, so as to increase competition and efficiency within this sector of the economy. Accordingly, it is hypothesized here that the increased competition and efficiency in the banking industry per se and in related industries would act to reduce interest rates, ceteris paribus. Alternatively stated, the implementation of the *DIDMCA* (which is reflected here by a binary/dummy variable) is expected to have reduced *EARTXFREE*, ceteris paribus.

Substituting Equations (4) through (8) into the model in Equation (2), while at the same time allowing for the *DIDMCA* and interaction term, solving for *EARTXFREE* yields the following model:

(9) $EARTXFREE = f(EARTHIRTY, Y, MAXTAXR, AVETAXR, NCI/Y, DEFY, TAXGAP,$
          $INTERACT, DIDMCA)$

such that:

(10) $f_{EARTHIRTY} > 0, f_Y < 0, f_{MAXTAXR} < 0, f_{AVETAXR} < 0, f_{NCI/Y} < 0, f_{DEFY} > 0, f_{TAXGAP} > 0,$
         $f_{INTERACT} < 0, f_{DIDMCA} < 0$

4. THE EMPIRICAL MODEL AND FINDINGS

Based on the model provided in Equations (9) and (10), the following model is estimated:

(11) $EARTXFREE_t = a_0 + a_1 EARTHIRTY_t + a_2 Y_t + a_3 MAXTAXR_{t-1} + a_4 AVETAXR_{t-1} + a_5$
         $(NCI/Y)_{t-1} + a_6 DEFY_t + a_7 TAXGAP_t + a_8 INTERACT_t + a_9 DIDMCA_t + \varepsilon_t$

where a_0 is the constant and ε_t *is* the stochastic error term. Predicated on the form of the data available for this study, all of the data are annual. The data for computing the tax evasion variable, and hence for helping to compute the interaction term, which are currently available through 2012, were obtained from Ledbetter (2004, 2007), Foertsch (2016), Mudry and Bryan (2008), and Dungan (2015). The data for the remaining variables were obtained from the Federal Reserve Bank of St. Louis (2017) and Council of Economic Advisors (2013). The dummy (binary) variable $DIDMCA_t$ assumes a value of 0 for the years prior to 1980 and a value of 1 for 1980 and thereafter.

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[2] This hypothesis is motivated in part by the very exploratory/preliminary finding in Cebula (2018) that the larger the "income gap," i.e., the estimated percentage of AGI that is unreported to the IRS, the higher the ex post real interest rate yield.

Table 1. Auto-Regressive Two-Stage Least Squares Estimation, 1973-2012
Dependent Variable: $EARTXFREE_t$

Explanatory Variables	Coefficient	t-value	Prob.
$EARTHIRTY_t$	0.986***	15.97	0.0000
Y_t	0.105	1.26	0.2193
$MAXTAXR_{t-1}$	-0.066***	-3.81	0.0007
$AVETAXR_{t-1}$	0.227	0.91	0.3722
NCI/Y_{t-1}	-0.262***	-3.39	0.0022
$DEFY_t$	1.648***	3.86	0.0006
$TAXGAP_t$	0.039***	2.93	0.0068
$INTERACT_t$	-0.009***	-3.56	0.0014
$DIDMCA_t$	-1.462**	2.41	0.0232
Constant	-7.77*	-1.94	0.0626
AR (1)	-0.12		
DW	2.02		
Instrument Rank	20		
Inverted Root	-0.12		

*statistically significant at 10% level; **statistically significant at 2.5% level; ***statistically significant at 1% level.

Three of the explanatory variables represented in Equation (11) are lagged one year, $MAXTAXR_{t-1}$, $AVETAXR_{t-1}$, and $(NCI/Y)_{t-1}$. Disregarding the $DIDMCA_t$ variable, the remaining five explanatory variables are unlagged; thus, the latter are contemporaneous with the dependent variable, $EARTXFREE_t$, so that the possibility of simultaneity bias exists. To address this potential problem, instrumental variables for each of these explanatory variables that is contemporaneous with $EARTXFREE_t$ are adopted. The instrument for $EARTHIRTY_t$ is the ex-ante real interest rate yield on six-month Treasury bills lagged two years. The instrument for Y_t is the two year lag of the first difference of the ratio of the M2 money supply to GDP. The instrument for the variable $DEFY_t$ is the two-year lag of the unemployment rate of the civilian labor force. The instrument for the variable $TAXGAP_t$ is the two-year lag of the IRS audit rate of filed tax returns. Finally, the instrument for the interaction term $INTERACT_t$ is the ex-ante real interest rate yield on three-month Treasury bills. The data for the instruments were obtained from the Federal Reserve Bank of St. Louis (2017), Council of Economic Advisors (2002, 2010, 2013), Internal Revenue Service (2018), and the U.S. Census Bureau (1994, 1998, 1999, 2001, 2009).

Based on the model presented in Equation (11), the AR/2SLS estimation technique provided in this study in part involves the autoregressive process, AR(1). The AR(1) process is perhaps best applicable to time series that exhibit more volatile behavior, such as stock market indices, stock prices, and, as is the focus in the present study, interest rates (Greene, 1997; Neusser, 2016). The 2SLS dimension of the estimation addresses potential simultaneity bias.

The AR/2SLS estimation of equation (11) is provided in Table 1. As shown, seven of the nine estimated coefficients on the explanatory variables exhibit the expected signs, with six being statistically significant at the 1 percent level and one being statistically significant at the 2.5 percent level. Only the coefficients on the variables $AVETAXR_{t-1}$ and Y_t variables fail to be statistically significant at the 10 percent level. The DW statistic is 2.02. Furthermore, the inverted root is -0.12, implying that the autoregressive process is a stationary one.

The results provided in Table 1 imply that, at the 1 percent statistical significance level, the ex-ante real interest rate yield on high-grade municipal bonds, $EARTXFREE_t$, is an increasing function of the ex-ante real interest rate yield on thirty-years Treasury bonds, $EARTHIRTY_t$, as hypothesized. In addition, also as hypothesized, the ex-ante real interest rate yield on high grade municipal bonds is a decreasing function of both the maximum marginal federal personal income tax rate, $MAXTAXR_{t-1}$, and net international financial capital flows as a percent of GDP, $(NCI/Y)_{t-1}$. Moreover, at the 2.5 percent statistical significance level, the Depository Institutions Deregulation and Monetary Control Act resulted (as hypothesized) in a lower level of $EARTXFREE_t$ over the study period.

The remaining results involve the budget deficit, $DEFY_t$, and the aggregate tax gap $TAXGAP_t$, (as well as the interaction term between them, $INTERACT_t$). The latter two variables per se have not previously been considered in the context of identifying factors influencing the ex-ante real interest rate yield on municipal bonds or, for that matter, on other bonds. Proceeding, as shown in Table 1, the estimated coefficients on all three of these variables are statistically significant at the 1 percent level. Accordingly, the ex-ante real interest rate yield on high-grade municipals is an increasing function not only of the budget deficit but also of the aggregate tax gap. These results are compelling in view of the statistically significant coefficient on the interaction term between them, i.e., $INTERACT_t$.

5. CONCLUDING REMARKS

This empirical study investigates the impact of various factors on the ex-ante real interest rate yield on high grade municipal bonds, $EARTXFREE_t$, a variable critically important to cities, counties, and states and their infrastructure endeavors. The AR/2SLS estimation implies that this ex ante real interest rate is an increasing function of the ex-ante real interest rate yield on thirty-year Treasury bonds, $EARTHIRTY_t$, while being a decreasing function of net capital flows, $(NCI/Y)_{t-1}$. The yield in question is found to have been negatively impacted by the Depository Institutions Deregulation and Monetary Control Act, $DIDMCA_t$. Furthermore, the estimation finds that this interest rate measure is a decreasing function of the maximum marginal federal personal income tax rate, $MAXTAXR_{t-1}$. In addition, it is found that, in the presence of an interaction term, the ex-ante real interest rate yield on high-grade municipals is an increasing function not only of the federal government budget deficit as a percentage of GDP, $DEFY_t$, but also the aggregate tax gap, $TAXGAP_t$. The public policy implications of these results include the need to limit the relative magnitude of federal budget deficits and to limit the extent of federal personal income tax evasion in the U.S. Failure to achieve these two objectives will likely result in a higher cost of borrowing for towns, cities, counties, and states across the nation. In turn, the latter will likely impose significant practical limitations on the ability of these towns, cities, counties, and states to create new infrastructure in response to changing demographic and economic circumstances and/or maintain the full integrity of existing infrastructure.

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