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FEDERAL TAXATION AND THE SUPPLY OF STATE DEBT

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ABSTRACT

This paper presents a model of debt finance at the sub-national level from which municipal bond supply equations are derived. Federal tax considerations are shown to be important determinants of the price entering the bond supply equation.

Using data on 40 state governments over a seven year period in the 1980s, I show that federal tax rates have an important effect on the supply of municipal bonds - independent of the demand side effect that is usually considered in the literature. Furthermore, the effect persists after controlling for capital expenditures, thereby suggesting that municipal bond proceeds are fungible at the margin. This has implications for the measurement of the tax expenditure associated with tax exempt debt.

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I. Introduction

A longstanding debate over the right of state and local governments to issue tax exempt bonds intensified during the 1980s. Over the protests of state and municipal officials, Congress has attacked this exemption both because of perceived abuses of tax exempt bond financing and because of the need to reduce the federal budget deficit[1]. It is a remarkable fact that this policy debate has occurred without a fundamental understanding of the economic forces underlying the supply of municipal bonds. While considerable thought has been given to modeling the demand for municipal bonds (viz Poterba (1986, 1989), Fortune (1988), etc.), many of the models of municipal bond pricing have implicitly assumed that supply is price inelastic.

This paper considers how federal tax policy affects the supply of municipal bonds. Drawing an analogy to the corporate finance literature (viz Myers (1984)), there is the opportunity to substitute tax (equity) for debt finance for given projects in a community. A similar substitution was suggested by Feldstein and Metcalf (1987) between taxes deductible at the personal level and non-deductible taxes and charges. The possibility of substituting taxes for debt is important for determining the effect of eliminating tax exempt bonds on the supply of (now taxable) municipal bonds. In addition, it affects estimates of the size of the tax expenditure due to this exemption.

This paper shows that there is considerable sensitivity of bond supply to the spread between the after tax rate of return to residents in a community and the municipal bond interest rate for bonds issued by that

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1 For a discussion of the efforts over the past 10 years to curtail the use of tax exempt debt, see Davie and Zimmerman (1988).

community. Furthermore, that sensitivity imparts an upward bias to estimates of the revenue that the Treasury gains upon taxing all municipal bond income, with particular bias occurring in the first year. This conclusion has obvious implications for Congressional efforts to reduce the federal budget deficit by further limiting tax exempt financing.

The next section presents a model of debt finance from which bond supply equations are derived. Section III presents the empirical model using data from 40 state governments over a 7 year time period. State level data are used for several reasons. First, conducting the analysis at the state level limits mobility as a reason for preferring debt over tax finance. While 18% of the population moved between 1985 and 1986, only 3% moved out of state[2]. Therefore, we get a sharper test of the hypothesis that federal tax considerations affect debt supply. Second, the existence of overlapping and underlying debt creates a measurement problem at the local level which complicates the analysis. We avoid these problems at the state level. The fourth section draws some implications from the regression results for measurements of the tax expenditure associated with tax exempt debt. There is a brief conclusion summarizing the key points of the paper.

II. A Model of Debt Finance

This section develops a theoretical model of debt and tax finance[3]. I ignore deadweight costs of taxation in order to focus on federal tax policy's

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[2] Statistical Abstract of the United States: 1988, table 24.

[3] The model is similar in spirit to a model developed by Epple and Spatt (1986). In their model, communities trade off the deadweight loss of current taxes against the higher borrowing costs resulting from increasing probability of default as borrowing increases. Epple and Spatt show that, in certain circumstances, it may be optimal for the state government to limit debt finance by localities in order to reduce borrowing costs for all communities and avoid time-inconsistency problems (Kydland and Prescott (1977)).

role in affecting state and local debt policy[4]. Consider a community of N homogeneous individuals in a two period framework where the choice today is to finance spending on a first period public good (G) through lump sum taxes in either period (T_1, T_2) and current borrowing (B). There is a private budget constraint faced by each of the N individuals. The present value of lifetime income (W) is allocated between lump sum taxes and private consumption goods:

$$(1) \qquad C_1 + \frac{C_2}{1 + \rho} = W - T_1 - \frac{\alpha T_2}{1 + \rho},$$

where ρ is the after tax rate of return faced by individuals in the community and α measures the degree of capitalization of future taxes. The term α varies between 0 and 1 with full capitalization implying α equals 1. Community budget constraints require that all borrowing be repaid in the second period:

$$(2) \qquad G = B + NT_1 \text{ and}$$

$$(3) \qquad (1 + r_m)B = NT_2.$$

I also assume that the municipal borrowing rate is endogenous, and depends on the ratio of debt issued to some measure (V) of the ability to repay the debt in the future (assessed value of property, income, etc.):

$$(4) \qquad r_m = \Phi(B/V).$$

Lenders require increasing returns on their loaned funds as more borrowing occurs ($\Phi' > 0$).

Individuals in this community maximize utility over private consumption

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4 This abstracts from tax smoothing as an important reason for debt finance (see Barro (1979)). Note that since taxes must be raised in the second period, it is not clear a priori that ignoring efficiency losses due to taxation will lead to greater uses of first period taxation.

in each of 2 periods (C_i) and the public good (G). Specifically, the model maximizes $U(C_1,C_2,G)$ subject to the constraints 1-4. Solving this model yields the usual results for private and public consumption. The marginal rate of substitution between current and future private consumption is equated to the price of future consumption in terms of forgone current consumption:

$$(5) \qquad \frac{U_2}{U_1} = \frac{1}{1+\rho} .$$

Similarly, if current taxation is used, the marginal rate of substitution between current private and current public consumption is equated to the price of the public good in terms of foregone private consumption by each of the N individuals:

$$(6) \qquad \frac{U_3}{U_1} = \frac{1}{N} .$$

By multiplying through by N, equation 6 takes the familiar form of the condition for the efficient provision of a pure public good.

When there is positive taxation in both periods and positive borrowing, combining the first order conditions for taxation and borrowing yields the supply function for borrowing in implicit form:

$$(7) \qquad 1 + r_m + (B/V)\Phi' = \alpha^{-1}(1 + \rho).$$

The left hand side of this equation is the marginal cost of an increment of borrowing. It is the direct borrowing cost $(1 + r_m)$ plus the incremental borrowing cost due to its effect on the borrowing rate ($(B/V)\Phi'$). The marginal benefit of public borrowing is the increased saving (or decreased borrowing) that is available due to a drop in current taxes adjusted by the degree of capitalization of future taxes. If there is complete capitalization ($\alpha = 1$), equation 7 can be rewritten as

$$(8) \qquad (B/V)\Phi' = r(\tau_m - \tau),$$

where τ_m is the implicit tax on municipal bonds ($r_m = (1-\tau_m)r$), the tax rate which equalizes the after tax rate of return on taxable and non-taxable bonds of equal riskiness. Totally differentiating equation 7 and rearranging yields

$$(9) \qquad \frac{dB}{d\alpha} = \frac{-(1+\rho)V}{\alpha^2(2\Phi' + \frac{B}{V}\Phi'')} \text{, and}$$

$$(10) \qquad \frac{dB}{d\tau} = \frac{-rV}{\alpha(2\Phi' + \frac{B}{V}\Phi'')} .$$

Assuming convexity of the credit rating equation ($\Phi'' > 0$), then these two derivatives are unambiguously negative. Equation 9 yields the expected result that in communities with a smaller degree of capitalization (α smaller), more bonds are issued. Equation 10 indicates that wealthier communities with high federal tax rates will prefer more tax finance while poorer communities will prefer more debt finance, *ceteris paribus.* This latter result has been noted by Adams (1977), Gordon and Slemrod (1986) and Metcalf (1989a)[5].

This model illustrates the significance of the marginal borrowing or saving status of the individual in the community. If an individual is saving at the margin, then the tax rate in equation 8 is the marginal tax rate on interest income, while if borrowing at the margin, it is the marginal effect of an additional dollar of interest costs on federal taxes paid. For a non-itemizer, τ is zero.

Before moving to the empirical model, a few comments regarding the

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5 Corner solutions are possible in this model. One feasible corner occurs with B and T_2 equal to zero. A sufficient condition for this solution is if $\tau > \tau_m$. Where individuals are heavily taxed and have access to borrowing with tax deductible interest (e.g. home equity loans), individuals can borrow more cheaply through private markets than through the municipal bond market. The other feasible corner is for T_1 to equal zero. A necessary condition for this solution is that $\tau_m > \tau$. In communities with low marginal tax rates, individuals may wish to do their borrowing through the community.

interpretation of some of the variables in the model are in order. Factors that will favor debt finance include imperfect capitalization of taxes, constraints in credit markets leading to borrowing rates being higher than lending rates, and debt illusion. The degree of capitalization depends on whether state or local taxes are being considered. If the latter, taxes should be capitalized into property values for the most part[6]. If the former, they may affect wages primarily. In this case, we might expect a state with a large fraction of elderly residents to rely more heavily on debt finance as they can avoid the tax. The credit market constraints will affect the taxable rate in ρ, the after tax rate of return. I discuss the choice of ρ below. Finally, if debt financing is perceived to be cheaper than tax financing due to debt illusion, politicians may prefer to engage in debt finance as much as possible. In many states there are constitutional restrictions placed on the issue of General Obligation debt[7]. Heins (1963) describes these restrictions and argues that they are ineffective due to the ability to issue revenue bonds, to undertake lease-purchase agreements, or other such schemes. The Tax Reform Act of 1986 may have put some bite back into those restrictions by imposing volume caps on certain types of revenue bonds as well as placing greater limits on the use of lease-purchase agreements. An additional limit on borrowing is a reluctance on the part of underwriters to back debt issues for current expenditures. In this case, communities will issue bonds for all of their capital outlays and tax finance all current expenditures. This constraint may not be binding however. Sbragia (1983) notes that by 1977 less than one-third of capital spending was

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6 Bloom, Ladd, and Yinger (1983) cite various pieces of evidence that property taxes are substantially capitalized into property values.

7 Epple and Spatt's model provides a rationale for these debt limits.

financed by borrowing. Federal aid accounted for 43 percent with own-source revenues accounting for the remainder. This suggests that the conventionally held view that capital expenditures are financed at the margin by borrowing and current expenditures by taxation may not be correct.

As in the corporate finance literature, bankruptcy costs are associated with debt financing. One aspect resulting from the possibility of bankruptcy is the endogeneity of the credit rating of a community. Beyond this there are monitoring and bonding costs as well as reorganization costs (see Jensen and Meckling (1976)). Monitoring and bonding costs may include the need to engage in additional disclosure and reporting of local financial information. After the difficulties experienced by New York City in 1975, accounting procedures became more important. In 1980, Standard and Poor's, one of the two major rating agencies, announced that in the future, accounting procedures would be taken into account when bond ratings were determined[8]. Reorganization costs result from the loss of local financial control during a default crisis[9]. These bankruptcy effects are captured by the lending rate function, $\Phi(B/V)$, in the model.

There have been previous attempts to measure the effects of tax rates on borrowing. Studies by Asefa, Adams, and Starleaf (AAS) (1981) and Gordon and Slemrod (1986) included measures of the tax rate of members of the community and found negative relationships between tax rates and debt levels as expected. AAS used changes in debt between 1967 and 1972 in 660 cities as their dependent variable. They used median income in the city as a proxy for the tax rate and obtained a negative relationship between income and their

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8 cited in Sbragia (1983), p. 80.

9 Leeds (1983) provides an interesting description of the reorganization costs faced by New York City during its fiscal crisis in 1975.

debt variable. However, the coefficient on their interest rate variable was insignificant and of the wrong sign. This is not surprising for several reasons. First, they are ignoring inflation in their stock and flow variables. To the extent that cities had different borrowing patterns over the five year period, inflation will add considerable noise to their data. Second, they ignore the endogeneity of the credit rating of a community. Higher borrowing levels may reflect fiscal distress of some type which leads to a higher borrowing rate through a deteriorating credit rating. Or there may be some unobserved taste for borrowing which is correlated with the credit rating of the community. In either case, OLS estimates of the coefficient on the borrowing rate variable will be biased.

Gordon and Slemrod used the debt levels at the end of fiscal year 1977 and avoided many of the problems of the AAS analysis. The omission of the municipal borrowing rate in the equation biases their results and may lead to an underestimate of the tax effect. If there is a positive correlation between income and credit rating of a community, there will be a negative correlation between the municipal borrowing rate and the tax rate in the community. This implies that the coefficient of the tax variable in the debt equation will be biased upward (in absolute value). There is an additional problem resulting from the use of a single year's cross section of data. To the extent that there are unobserved community specific "tastes" for borrowing or taxes which are correlated with tax or rate variables, the results will be misleading.

Both of these studies have used the incorrect marginal tax rate in their analysis. Calculating a tax rate as a function of median income obscures the fact that the marginal tax rate on wage income, interest income, and dividend income are all different[10]. In the empirical research proposed here, an important component will be the modeling of the appropriate after-tax rate of return.

III. Empirical Model

By taking a first order Taylor's Series approximation of the lending function ($\phi'(B/V)$) in equation 7, I can linearize the bond supply function around the mean value of B/V in the sample. It is also convenient to linearize α^{-1} around α equals 1. Letting $b = B/V$, and b_o be the mean value of b across states in the sample, I obtain:

(11) $$b_o\phi'(b_o) + (\phi'(b_o) + b_o\phi''(b_o))(b-b_o) \cong \rho - r_m + (1-\alpha)(1+\rho).$$

Rearranging (11) and adding subscripts yields

(11a) $$b_{it} = \beta_0 + \beta_1(\rho-r_m)_{it} + \beta_1 k_{it} + \varepsilon_{it},$$

where

(11b) $$\beta_0 = \frac{b_o^2\phi''(b_o)}{\phi'(b_o) + b_o\phi''(b_o)},$$

(11c) $$\beta_1 = \frac{1}{\phi'(b_o) + b_o\phi''(b_o)},$$

and where k_{it} equals $(1-\alpha_{it})(1+\rho_{it})$. The term ε_{it} in 11a captures the remainder in the Taylor's series expansions[11]. Note that both ρ and r_m vary across observations. To control for unobservable "taste" variables specific

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10 Note too that τ_m might be the appropriate tax rate in cases where individuals invest in tax exempt bonds. However, it is not clear a priori that wealthy investors (with $\tau > \tau_m$) invest in tax exempt bonds at the margin. While they may hold municipal bonds, portfolio considerations may lead to their investing in taxable securities at the margin.

11 This formulation assumes that the lending rate function, $\Phi(B/V)$, does not vary across governments. This may be a more plausible assumption after controlling for additional attributes of the communities as I do below.

to each state, I allow for a fixed effect variable (θ_i) and to control for cyclical or macroeconomic influences common to all states, I add year dummies (ξ_t). Adding those variables to the debt supply equation as well as a vector of fiscal and demographic variables, X′, produces the following supply equation for municipal bonds at the state and local level[12]:

(12) $$b_{it} = \beta_0 + \beta_1(\rho - r_m)_{it} + X'_{it}\beta_2 + \theta_i + \xi_t + \varepsilon_{it},$$

where β_0 and β_1 are defined in equations 11b and 11c and β_2 is a vector of parameters associated with the fiscal and demographic variables. The error term, ϵ, can be considered a combination of the error in the Taylor's series expansions and other unobserved characteristics. I assume that it is independent and identically distributed with mean zero. This formulation assumes that actual debt levels represent desired debt levels in each year. An alternative formulation would be a partial adjustment model (analogous to the models in the corporate sector such as Auerbach's (1985) model). Unlike physical capital, however, where there is a cost of adjustment to accumulate or decumulate capital, there are fewer impediments to changes in financial capital. There are call provisions on municipal bonds, opportunities to buy bonds in the open market and mechanisms for advance refunding of the debt.

In the discussion above, it was assumed that communities were inhabited by identical individuals. The analysis is made more complicated once we assume communities with heterogeneous members. A common approach to modeling the decision making process is the median voter model.[13] This model assumes that we can order members of the community according to their desired mix of tax and debt finance (in our context) and that the preferences of the median

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[12] The capitalization variable $k = (1-\alpha)(1+\rho)$ is incorporated in X′.

[13] The median voter model has been used by Hotelling (1929), Bowen (1943), Borcherding and Deacon (1962) and Bergstrom and Goodman (1973), among others.

voter are decisive. As the model is typically applied, the median voter is assumed to have the median characteristics of the community[14].

One problem with this approach however is that we have no guarantee that the median voter is the voter with median characteristics in the community. Furthermore, factors such as log rolling, coalition building, the existence of political parties and independent bureaucratic preferences complicate the decision making process[15]. In addition, if individuals are borrowing at the margin with interest deductions possible (e.g. due to the existence of home equity loans) then identifying the median voter becomes problematic. It may be that prior to a reform eliminating tax exempt municipal bonds, a non-itemizer is the median voter. After reform, the desired supply of municipal borrowing could rise faster among itemizing voters so that an itemizer becomes the median voter. This would lead to a drop in ρ (see equation 7) and a larger change in $\rho - r_m$ than would occur if a non-itemizer was and remained the median voter. The measured bond supply response (aggregate) would exceed the bond supply response that would result if the community were homogeneous. All these various factors suggest that considerations beyond the identity of the median voter may be important in the political process. Recognizing this fact, I present results in this paper based on average marginal tax rates[16].

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14 Nowhere does the median voter model actually suggest this trait. It is merely an empirical convenience. Bergstrom and Goodman (1973) present conditions where this assumption is appropriate.

15 See Inman (1987) for a thorough discussion of these issues.

16 Clearly, the choice of the amount of debt finance is only one dimension of the social choice package facing voters. Caplin and Nalebuff (1989) present conditions whereby the mean voter's preferences are decisive according to a 64% rule in a multi-dimensional decision setting. One message to take from their paper is that there is no reason to prefer a median voter model approach to public choice problems <u>a priori</u>.

To construct distribution measures requires detailed data on tax rates within a community. I generate those data using the National Bureau of Economic Research's TAXSIM tax calculator model. In brief, TAXSIM is a set of Fortran routines which uses data from the IRS' Individual Tax Model data set to compute the federal tax liability for individual tax returns. TAXSIM can be programmed to compute marginal tax rates by simply computing the additional tax liability on an individual's tax return resulting from an additional dollar of income. More importantly, the source of additional income can be varied to compute different marginal tax rates (e.g. on wage income, interest income, capital gains, etc.). Finally, state identifiers on the tax returns allow average marginal tax rates to be computed for each state. Each year's data set contains in the neighborhood of 100,000 tax returns.

The financial data used in the analysis come from the Annual Survey of Governments data set constructed by the Bureau of the Census. Besides data on revenue and expenditures, the survey contains detailed data on outstanding debt as well as amounts of debt issued and retired each year. One advantage of this data set is that the Census Bureau makes considerable efforts to construct data records which are comparable across government units. While some care must be exercised in using these data, they provide a wealth of information about fiscal decisions. I examine data on state governments over a 7 year period (fiscal year 1980 through 1986). These data are supplemented by demographic data from the Current Population Survey (CPS) as well as Moody's Bond Record. From the latter source, I obtain generalized credit ratings for General Obligation (G.O.) debt for state governments[17]. I then

[17] General obligation debt is debt backed by the full taxing authority of the issuing jurisdiction. This is typically the safest debt issued by a government. The ratings I use to impute borrowing costs are ratings on overall state credit as opposed to a rating on a specific bond issue.

impute to each state government a borrowing cost (r_m) equal to the average borrowing cost for a 30 year G.O. bond of that rating at the beginning of the fiscal year. For a fuller discussion of my use of these data, see Metcalf (1989b). States are not included in the sample if they have no G.O. debt outstanding (typically because of a state prohibition against the issuance of G.O. debt). Alaska is also excluded given its unique financial characteristics[18].

Table 1 presents some summary data on average federal marginal tax rates constructed from TAXSIM. The unit of observation is a marginal tax rate for state i in calendar year t (corresponding to fiscal year t+1), t running from 1979 through 1985. Typically, studies have constructed a tax rate as some function of income. Since the predominant source of income is salaries and wages[19], these tax rates correspond roughly to a tax rate on wage income. However, as argued above, the appropriate tax rate is on interest income or interest deductions.

As can be seen from Table 1, the marginal tax rates on wage and interest income on average are approximately the same. However, in 1981 the marginal tax rate on interest income dropped sharply due to a one time interest exclusion which reduced many taxpayers' marginal tax rate to zero. Pooling the data over the seven year period, there is a negative correlation between wage and interest income tax rates. After controlling for across state variation, the correlation between the marginal tax rates for wage and

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[18] The excluded states are Alaska, Arizona, Arkansas, Colorado, Indiana, Iowa, Kentucky, Nebraska, South Dakota, and Wyoming.

[19] Wages and salaries represent roughly 60% of National Income in the National Income and Product Accounts (Statistical Abstract of the United States, 1988, Table 683). This understates the actual share as it does not include wages and salaries included in proprietors' income.

interest income falls even further. This provides striking evidence of the inappropriateness of using marginal tax rates based on wage income in a bond supply equation.

If at the margin individuals are borrowers, then the appropriate tax rate is that on interest deductions. Again, TAXSIM allows me to construct such a tax rate. The tax rate reported in Table 1 is an average of $p\tau$ where p is a dummy variable equaling 1 if the taxpayer itemizes deductions and zero otherwise and τ is the marginal tax rate on wage income.[20] The average of these tax rates across the forty states and seven years drops considerably due to the presence of non-itemizers. There is a higher correlation of the marginal tax rates on wages and interest deductions though essentially no correlation between the marginal tax rate on interest income and this variable[21].

To get an initial sense of the relative desirability of tax versus debt financing, I calculated the fraction of returns in each state where the marginal tax rate was less than the implicit municipal tax rate in that state. The municipal rate variable used to construct the implicit municipal tax rate $(1-r_m/r)$ is the imputed rate derived from the credit rating of each state at the beginning of the fiscal year discussed above. The taxable rate is the rate on 30 year U.S. Treasury bonds. Individuals with a marginal tax rate less than the implicit municipal tax rate are more likely to prefer debt to tax finance (see equation 8). The last section of Table 1 presents summary

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20 To be precise, I calculated this rate by first calculating each return's tax bill, then imputing an additional $100 in interest deductions to the return and recalculating the tax bill. The difference in tax bills is the marginal tax rate. For non-itemizers, there will be no change in the tax bill.

21 These data are for pre-Tax Reform years. Even after Tax Reform, there is still likely to be a considerable amount of interest deductions. Under current tax rules, deductible home equity loans are allowed for unrestricted purposes for amounts up to $100,000.

statistics on the fraction of returns in each state where the marginal tax rate is below the implicit municipal tax rate. There is considerable variation in these data. For the marginal tax rate on interest income, the mean fraction of returns in each state preferring debt finance is 65% and varies from 13 to 96% across the states.

Summary statistics on the data are presented in table 2. The average amount of debt outstanding per $1000 of personal income was $83.84. Variation in the amount of debt for the 40 states over the 7 year period was substantial with a standard deviation of over $50. At the state level, I use personal income as the scale variable (V) as opposed to some measure of the value of property, which would be more appropriate at the local level. The yield spread variables, $(\rho - r_m)_{it} = (1-\tau)r_t - r_{m_{it}}$, also showed substantial variation. The spread variable has three components: the tax rate, τ, the taxable interest rate, r, and the tax exempt rate, r_m. As noted above, the interest rates are rates on 30 year bonds, imputed in the case of the municipal rate from state credit ratings. The tax rate is either a tax rate on interest income or interest deductions. I assume that the municipal rate and the marginal tax rate are endogenous and employ an instrumental variable estimation technique to instrument for the spread variable.[22]

Demographic variables include the fraction of the population aged 65 and older and the fraction between ages 18 and 44. The variable measuring the fraction of the population 65 and over is included to control for capitalization. Because I linearize α^{-1} in equation 12, the capitalization

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[22] Instruments used are the percentage of tax collections represented by the largest tax and the marginal tax rate on wage income after zeroing out dividend and interest income as well as interest deductions. The first variable is calculated from ASG data, and the second is calculated from TAXSIM.

variable, k_{it}, is correlated with the error term. Assuming that $1-\alpha$ is linearly related to the elderly variable, the fraction elderly variable dominates all other instruments in explaining k. Therefore, I simply replace k by this demographic variable. Note though that the coefficient on this variable will not equal β_1 whether or not the formal instrumenting is done. To the extent that imperfect capitalization occurs, the coefficient on the elderly variable should be positive. As α approaches 1 (full capitalization), however, the coefficient should approach 0. To the extent that young residents (aged 18 to 44) expect their share of the tax burden to increase in the future, we'd expect a negative partial correlation between this variable and the debt variable. On the other hand, this group may be more likely to be constrained in credit markets which would suggest a positive estimated coefficient. A priori, it is not clear which effect will dominate. Fiscal variables include the fraction of tax collections due to severance taxes and fraction of revenues from own sources (e.g. not including federal aid). If taxes can be exported to out of state residents, then tax finance may be perceived to be more desirable than debt finance[23]. Finally the state unemployment rate at the beginning of the fiscal year is included to control for shocks specific to the local economy. It is expected that the coefficient on this variable should be positive. In addition, there are time dummies and state dummies[24].

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23 Note that the model in section II did not account for tax exporting. If we interpret N in the utility maximization problem, equations 1-4, as measuring the dispersion of tax collections across both individuals within and outside the community, it is clear that tax exporting should not affect the debt-tax choice. The choice simply affects the <u>timing</u> of the tax exporting. However, with risk averse utility, if there is uncertainty with respect to the ability to export in the future (e.g. volatility in minerals prices or fluctuating federal aid), this will lead to greater dependence on tax revenues currently.

24 Rather than construct individual state dummies, I run a fixed effects regression.

Table 3 presents regression results from the model based on equation 12. Much of the variation in the data is removed by using deviations from state means as many of the data are only slowly changing over time. Because of this, the coefficients on many of the variables in Table 3 are imprecisely estimated. However it is interesting to note that where there is an *a priori* prediction on the sign of a coefficient, the estimates are as predicted.

The first regression assumes that individuals save at the margin. Therefore, the appropriate tax rate to use to construct the spread variable $(1-\tau)r-r_m$ is the tax rate on interest income. The spread coefficient is 37.0, indicating that a one percentage point increase in the spread, $\rho-r_m$, should lead to $37 more debt per $1,000 of personal income in a state. This represents 44% of the mean value of debt per $1,000 of personal income over the forty states in the seven year period. With a one standard deviation change in the spread (90 basis points in the seven year sample), this represents a change equal to 40% of the mean value of debt in the sample.

A one percent increase in the percentage of taxes collected from severance taxes is associated with a $1 decrease in the use of debt per $1,000 of personal income and suggests that taxes are more attractive in those states with greater ability to levy severance taxes. The three demographic variables are completely insignificant though as noted above, the signs on the fraction elderly variable and on the unemployment rate variable are consistent with theory (both positive). Note that the insignificant coefficient estimate on the elderly variable is consistent with full capitalization of taxes at the state level.

The second regression assumes individuals borrow at the margin and uses the marginal tax rate on interest deductions. The coefficient estimates are quite similar to those in the first regression. In both regressions, the coefficient estimate on the spread variable is significant at the 5% level (in a one sided test) with a coefficient value of roughly 37.

I also ran restricted regressions where I dropped the three demographic variables which were individually insignificant. The third and fourth regressions present those results. One cannot reject the hypothesis that the three variables can be dropped. The coefficient estimates do not change appreciably and the p value on the spread variable is now less than .03.

Implicit in the regressions above is the assumption that municipal bond proceeds are fungible. That is, while municipal bonds may be linked institutionally to capital works projects, they in fact can be used as a general substitute for tax financed spending. I noted above reasons why bond proceeds are likely to be fungible. The regression framework provides us with the opportunity to test this hypothesis explicitly. If the proceeds are not fungible, we should find that the yield spread variable is insignificant and that capital expenditures per $1000 of personal income should be the only important variable in the regression explaining changes in debt levels per $1000 of personal income. In fact, the coefficient on the capital expenditure variable should be approximately one[25]. The last regression in Table 3 includes capital expenditures per $1000 of personal income (CAPY) as an explanatory variable. While CAPY is clearly endogenous, there is no reason to believe that it is correlated with the error term in the debt supply equation. As expected, the coefficient on the capital expenditure variable is roughly one and is estimated quite precisely. However, the coefficient and t statistic on the yield spread variable are virtually unchanged with the addition of the capital expenditure variable.

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25 More rigorously, the coefficient should be one after controlling for lagged debt.

While the presence of capital projects is important in explaining the supply of municipal bonds, there remains the additional tax effect working through the yield spread[26]. This effect persists in various alternative specifications of the model with a pattern of coefficient estimates similar to those reported in this regression; hence I only report the one regression.

IV. Estimating the Tax Expenditure Resulting From the Exemption of Municipal Bond Interest Income From Federal Taxation

To illustrate some of the implications of the results from the regression model, I present some suggested estimates of the tax expenditure due to the exemption from federal taxation of municipal bond interest income under the assumption that taxes substitute for a fraction of outstanding municipal debt in this section. The results from Table 3 imply that a one point decrease in the spread variable $(1-\tau)r-r_m$ leads to a decrease in the use of debt in the range of \$35 per \$1000 of personal income. If we multiply this coefficient by the mean value of the spread variable (column 2 of Table 4), we get the estimated reduction in debt (see column 3 of Table 4).

Of course, this ignores probable liquidity constraints. To be generous, assume that 80% of the taxpayers could not privately finance increased taxes (the same percentage for whom the marginal tax rate on interest deductions is less than the implicit municipal tax rate - see the bottom of Table 1). Furthermore, assume that this leads to 80% of the debt continuing to be debt financed and 20% tax financed - probably a high estimate for continued debt finance since the group that is not liquidity constrained presumably pays a higher fraction of taxes than 20%. In that case, the change in debt is (1 - 0.8) times column 3 of Table 4, which is reported in column 4. The decrease ranges from \$4.50 to \$11.74 per \$1000 of personal income. Let's

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[26] Note too that the severance tax variable continues to be important, contrary to the hypothesis that municipal bonds are not fungible.

take the lower value of 4.51, which is 5.4% of the average amount of debt outstanding per $1000 of personal income in my sample. This calculation suggests that roughly 5% of outstanding debt would be replaced by taxes.[27]

In Appendix A, I calculate the revenue gain to the U.S. Treasury under a variety of state and local government financing assumptions for 1984. If 5.4% of the outstanding debt becomes tax financed, the revenue gain (in present discounted value) to the U.S. government falls from $208 billion to $202.7 billion (.054(111) + .946(208)), a fall in revenue of some 2.5% from the estimate assuming no tax substitution. Perhaps more importantly, the first year gains are much smaller. Under debt finance, there is a constant revenue gain to the U.S. government whereas with tax finance, there is an initial <u>fall</u> in revenue followed by a constant stream of higher revenues (see Appendix A for details). The first year gain therefore is $13.3 billion, 16% less than the $21 billion gain expected in the absence of a shift to tax finance.

Table 5 presents a range of estimates of the revenue loss as a fraction of the estimated revenue loss assuming no tax substitution. The estimates indicate that the reduction in the revenue loss is sensitive to both the shift from debt to taxes as well as the relevant tax rate. Furthermore, the first year losses can be negative. For example, if individuals borrow at the margin and 60% of the desired substitution from debt to taxes is made, the revenue loss in the first year due to the tax exemption is -$5.9 billion as opposed to $21 billion. That is, nearly $6 billion would be lost in the first year due to the shift to taxation rather than gaining $21 billion, a reduction in the

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[27] Any change in the implicit municipal tax rate would undoubtedly have income effects which would affect expenditure levels and limit the amount of increased taxes. This example simply illustrates the sensitivity of the tax expenditure estimate to the substitution of tax for debt finance.

estimate of the revenue loss due to tax exemption of 128%.

V. Conclusion

Based on the model in section II, there is a theoretical basis for believing that federal tax rates affect the desired level of debt financing for state and local governments. Correct analysis and testing of this theory requires the proper specification of the marginal tax rate with which to compare the implicit municipal tax rate. The empirical estimates from the regression model suggest the importance of the tax effect. Furthermore, the effect persists after controlling for capital expenditures. This sensitivity to federal tax parameters on the supply side has implications for general equilibrium models which incorporate a municipal government financial sector. One effect is a likely overstatement of the tax expenditure associated with municipal bond interest exemption from federal taxation.

Appendix A: Calculating the Tax Expenditure Associated with Municipal Bonds[28]

Assume that taxable bonds substitute for tax exempt bonds one for one. Then for each dollar of municipal debt outstanding, $r\tau_1$ will be gained by the Treasury by the elimination of the exemption in direct tax revenue while $\tau_2(r-r_m)$ will be lost due to higher interest payments made on the taxable bonds by residents of the community.[29] The marginal tax rate, τ_1, is the marginal tax rate of a holder of the tax exempt security while τ_2 is the marginal tax rate of a taxpayer in a community (adjusted for the fact that not all taxpayers in the community are itemizers on their federal return). This is an annual payment; if we assume that all bonds as an approximation are consols, then the present discounted value of the revenue gain to Treasury by eliminating the exemption is:

$$G_b = \frac{r\tau_1 - \tau_2(r-r_m)}{\rho_f} \quad \text{(A1)}$$

If the federal discount rate (ρ_f) is equal to the taxable rate, then (A1) reduces to

$$G_b = \tau_1 - \tau_m\tau_2 \, . \quad \text{(A2)}$$

where τ_m is the implicit municipal tax rate, the tax rate for which an investor receives the same aftertax return on either taxable or tax-exempt bonds.

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[28] This exercise assumes complete elimination of the municipal bond interest exemption. Ackerman and Ott (1971) show that for a partial elimination, the revenue gains will be much smaller (even with no tax substitution) and possibly negative. This follows from the fact that the lowest marginal tax rate holders of municipal bonds will be the first to leave the tax exempt market.

[29] This calculation is a first round calculation which ignores general equilibrium reallocations of investment and saving due to the change in interest rates. It also ignores the vintage issue. Treasury makes the assumption of a fixed GNP in its first round calculation which I retain here.

If taxes substitute for debt however there are several components to the change in revenue. First at the municipal level, taxpayers get to deduct the additional taxes that are being paid at the state or local level.[30] This leads to a one time revenue loss of τ_2. If we assume that taxpayers finance the increase in municipal taxes by drawing down their stock of taxable debt, then there is a revenue loss to the Treasury of $r\tau_3(1-\tau_2)$, where τ_3 is the average marginal tax rate on interest income in the community. If the previous holders of the tax exempt debt purchase these bonds, they will pay $r\tau_1(1-\tau_2)$ in additional taxes.[31] Finally, interest payments on tax exempt bonds no longer have to be paid out of local taxes (which are deductible on federal taxes). That generates a revenue gain of $r_m\tau_2$. These last three sums are annual flows which again must be discounted. The present discounted value of the revenue gain to the Treasury is now

$$(A3) \qquad G_t = \frac{r\tau_1(1-\tau_2) - r\tau_3(1-\tau_2) + r_m\tau_2}{\rho_f} - \tau_2$$

Again, if we assume that ρ_f equals r, then (A3) collapses to

$$(A4) \qquad G_t = (1-\tau_2)(\tau_1 - \tau_3) - \tau_m\tau_2 .$$

From the point of view of the U.S. Treasury, debt substitution would be preferred to tax substitution. Ignoring terms of the second order, the difference in the gains from substituting taxable debt versus substituting taxes equals τ_3. Given the stock of outstanding municipal debt of some $542 billion (1984, Flow of Funds), the present discounted value of the gain to the

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30 This assumes that deductible taxes will be used to substitute for tax exempt debt. Feldstein and Metcalf (1987) (F&M) predict that business and income taxes will be the favored source of revenue. The Tax Reform Act of 1986 as actually passed only eliminated the deductibility of sales taxes; F&M's analysis suggests that there should be a diminished use of this tax.

31 For simplicity, assume that these higher income individuals consume τ_2 of their wealth that had been kept in tax exempt bonds.

Treasury from a substitution of taxable for tax exempt debt would be some $208 billion.[32] Since this is a present discounted value of a stream of revenues, it is much larger than the CBO estimate of the revenue due to this tax expenditure. It represents an annual tax expenditure of $20.8 billion which is comparable to CBO estimates.

Substituting taxes for tax exempt bonds leads to a revenue gain (in present discounted value) of $111 billion - just over half of the gain if a bond switch is made. This figure represents an immediate loss of $43 billion followed by increases in tax receipts of $15 billion each year due to changes in patterns of holdings of taxable bonds by tax groups as well as the reduced tax deductions due to interest payments on tax exempt bonds. (It assumes an average marginal tax rate on interest income of 16%.)

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[32] This is a first round estimate assuming an average municipal borrowing rate of 8 percent, a taxable rate of 10 percent, an average marginal tax rate for tax exempt bondholders of 40 percent and an average marginal tax rate for residents (weighted by frequency and itemization status) of 8 percent.

Table 1. Summary Statistics on

Marginal Tax Rates.

Marginal Tax Rate:	Mean	Standard Deviation	Min.	Max.
Wages	18.7	1.7	14.0	23.3
Interest Income	17.2	4.0	5.2	23.4
Interest Deductions	8.6	1.8	3.9	13.7

Correlations

Wages	1.00		
Interest Income	-0.12	1.00	
Interest Deductions	0.47	0.05	1.00

Fraction of Tax Returns with $\tau \leq \tau_m$	Mean	Standard Deviation	Min.	Max.
Marginal Tax Rate				
Interest Income	65.8	21.7	12.9	95.7
Interest Deductions	79.9	9.3	53.8	96.8

Statistics are on average marginal tax rates for the 40 states pooled over the seven year period. Source: Author's calculations from TAXSIM.

Table 2. Summary Statistics

Variable	Mean	Standard Deviation	Minimum	Maximum
Debt per $1000 of Personal Income	83.84	52.71	14.37	290.73
Spread (Saving)	0.63	0.90	-1.80	2.71
Spread (Borrowing)	1.61	0.66	-0.56	2.74
Severance Taxes as a Fraction of Total Taxes	4.48	8.99	0.0	35.08
Fraction Aged 18-44	42.25	1.76	36.80	46.90
Fraction Aged 65 and Over	11.45	1.76	7.50	17.62
Unemployment Rate	7.85	2.36	2.80	18.00
Capital Expenditures per $1000 of personal income	12.76	5.65	4.29	33.64

Summary Statistics are for observations on 40 states over the seven year period from 1980 through 1986.

Table 3. Regression Results with Debt
per $1000 of Personal Income as the Dependent Variable

Tax Rate In Spread	Saving	Borrowing	Saving	Borrowing	Saving
Spread	37.0 (1.79)	37.1 (1.83)	37.5 (1.94)	37.8 (2.09)	34.72 (1.77)
Severance Taxes as a Fraction of Total Taxes	-.98 (-1.88)	-1.28 (-2.38)	-1.14 (-2.40)	-1.39 (-2.86)	-.87 (-1.71)
Fraction Aged 18 to 44	-.67 (-.17)	1.07 (.25)	-	-	-.77 (.20)
Fraction Aged 65 and Over	.66 (.11)	.06 (.01)	-	-	2.46 (.42)
Unemployment Rate	.78 (.79)	.51 (.51)	-	-	1.51 (1.47)
Capital Spending per $1000 of Personal Income	-	-	-	-	1.06 (2.43)
$\bar{R}^2$	.936	.936	.937	.936	.939
W	-	-	.92	.41	-

These are instrumental variable regressions as described in the text. The spread variable is $(1-\tau)r-r_m$ where the tax rate is a rate on interest income or interest deductions. There are year dummies and individual fixed effects in these regressions.

There are 280 observations on 40 states over 7 years. Ratios of coefficient estimates to standard errors are in parentheses. W is a Wald test statistic (see Engle (1984)) distributed as Chi Square with 3 degrees of freedom testing the joint hypothesis that the three demographic variables can be dropped from the regression.

Table 4. Debt-Tax Substitution Under
Various Assumptions About Marginal Tax Rate

	(1) Estimated Coefficient	(2) Mean of Spread	(3) (1)*(2)	(4) .2*(3)	(5) (4)/(D/Y)
Tax Rate On:					
Savings	35.8	.63	22.55	4.51	.05
Borrowing	36.7	1.61	58.72	11.74	.14

Source: Column (1) is the estimated coefficient from the constrained regressions in Table 2. Column (2) gives the mean value of the spread variable, $(1-\tau)r - r_m$. The last column gives the percentage of debt that becomes tax financed if tax exempt bonds are eliminated.

Table 5. Reduction in Revenue Losses as a Percentage of
Revenue Losses Estimated Assuming No Tax Substitution

Fraction of Desired Shift Actually Occurring	Saving at the Margin		Borrowing at the Margin	
	Total Loss	First Year Loss	Total Loss	First Year Loss
.2	2.51	16.40	6.53	42.69
.4	5.02	32.79	13.06	85.38
.6	7.53	49.19	19.60	128.07
.8	10.04	65.59	26.13	170.76
1.0	12.55	81.98	32.66	213.45

See text for example of how these percentage losses are computed. Percentages greater than 100 indicate that eliminating tax exempt bonds <u>reduces</u> tax revenues for the federal government.

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