Tax-Induced Segmentation in the Tax Exempt Securities Market

Paul A. Leonard
University at Albany, State University of New York

Differences in tax treatment create distinct classes of tax-exempt bonds. Because bonds in each class are not perfect substitutes, the tax-exempt market is segmented and permanent yield differentials exist. This paper has four purposes: (1) to replicate, using more recent data, previous studies of the effects of tax-induced segmentation due to state tax differentials and bank-qualified status; (2) to extend the literature on tax-induced segmentation to include the effects due to the federal alternative minimum tax; (3) to extend the literature by examining tax segmentation effects across the term structure; and (4) to extend the literature by examining differential tax segmentation effects for bonds sold by competitive bidding and negotiation. The empirical results show that the alternative minimum tax induces additional segmentation in the tax-exempt market that creates significant yield differentials. The findings also indicate that tax-induced segmentation effects vary by maturity and between bonds sold by competitive bidding and negotiation.

Introduction

One of the primary factors that influences the demand for tax-exempt (or municipal) securities is their tax-advantaged status. In equilibrium, the yield on tax-exempts will adjust so that for the marginal investor

(1) $Y^i_T (1 - t_T) = Y^i_E (1 - t_E)$

where:

Y^i_T = The before tax yield on a taxable security with risk i;
Y^i_E = The before tax yield on a tax-exempt security with risk i;
t_T = The marginal income tax rate on income from taxable securities; and
t_E = The marginal income tax rate on income from tax-exempt securities.

For many years there was no federal income tax on the interest income from tax-exempts and the influence of state income taxes was ignored, so t_E was assumed to be zero. The assumption of a zero tax rate resulted in the simple relationship $Y^i_T (1 - t_T) = Y^i_E$ found in most introductory textbooks.

Today, however, t_E is not zero for most tax-exempt securities and the relationship between after tax returns on taxable and equivalent risk tax-exempts is complicated. At the federal level the interest income on certain types of tax-exempt

0747-5535/98/1500/0027/$2.00

bonds is subject to the alternative minimum tax (AMT), and commercial banks are not allowed to deduct as an expense the interest paid on funds used to purchase most tax-exempt securities. At the state level many states grant an income tax exemption on the interest income from tax-exempts issued by in-state issuers, but not for interest income earned on out-of-state tax-exempts. These provisions make t_E greater than zero for most investors and cause t_E to vary widely among investors.

In theory, if bonds afforded preferential tax treatment were perfect substitutes for non-affected issues, any yield differences stemming from changes in demand by one investor group should be temporary and should induce offsetting behavior by other investors. Because differences in tax treatment create distinct classes of municipal bonds that are subject to different effective tax rates, municipal bonds in each class are not perfect substitutes for one another. As a result, the municipal market is segmented and permanent yield differentials between municipal securities may exist.

Tax-induced market segmentation is similar to that caused by issuer and investor preferences and statutory portfolio constraints such as pledging requirements. Hendershott and Kidwell (1978), Leonard (1983), and Kidwell, Koch, and Stock (1987) find empirical evidence that the municipal market is segmented geographically, so that changes in the relative supply of municipal securities has an impact on relative yields. Geographic segmentation is due partially to high information costs that result in investors having a preference for securities sold by local issuers. Kidwell and Koch (1982) hypothesize that revenue bonds and general obligation bonds (GOs) are not viewed by investors as close substitutes due to systematic differences in the underlying security pledge. They find evidence that the yield differential between revenue bonds and GOs is influenced by changes in the supply of revenue bonds relative to GO bonds and by changes in commercial bank demand for municipals. Koch (1981), Forbes and Leonard (1984), and Kidwell, Koch, and Stock (1987) hypothesize that state pledging requirements should increase commercial bank demand for in-state municipals relative to out-of-state municipals. These studies find that in states with higher pledging requirements yields on in-state municipals are lower relative to yields on out-of-state municipals.

This paper has four purposes: (1) to replicate, using more recent data, previous studies of the effects of tax-induced segmentation due to state tax differentials and bank-qualified status; (2) to extend the literature on tax-induced segmentation to include the effects due to the federal alternative minimum tax; (3) to extend the literature by examining tax segmentation effects across the term structure; and (4) to extend the literature by examining differential tax segmentation effects for bonds sold by competitive bidding and negotiation. The empirical results show that the alternative minimum tax induces additional segmentation in the tax-exempt market that creates significant yield differentials. The findings also indicate that tax-induced

segmentation effects vary by maturity and between bonds sold by competitive bidding and negotiation.

Factors Influencing Investor Demand

Commercial Bank Demand

The Tax Reform Act of 1986 (TRA) introduced a number of important changes in the federal tax code that complicated yield relationships in the tax-exempt securities market. On the supply side, TRA tightened the volume limitations on private activity bonds and expanded the types of issues subject to these limitations.[1] TRA also placed restrictions on arbitrage earnings, the number of times an issue can be advanced refunded, and the use of bond proceeds to pay issuance costs.[2] On the demand side, TRA lowered federal marginal tax rates and flattened the tax structure. The top marginal tax rate for individuals was reduced from 50 percent to 38.5 percent in 1987 and to 28 percent thereafter. Of particular interest in this study, TRA eliminated the deductibility from federally taxable income of the interest expense incurred by banks to purchase tax-exempts.

Prior to passage of TRA commercial banks could deduct 80 percent of the interest expense on funds used to purchase tax-exempts. TRA removed this deduction

> for all tax-exempts acquired after August 7, 1986, except that it is retained for purchases of governmental purpose or 501(c)(3) bonds from issuers of less than $10 million in new debt each year (Petersen and Forbes, 1988, p. 393).

Thus, TRA created two distinct classes of tax-exempt securities: bank-qualified and bank-nonqualified issues. The first hypothesis is that yields on bank-qualified issues will be less than those on bank-nonqualified issues, *ceteris paribus*. The rationale for this hypothesis follows.

Prior to TRA t_E was zero for commercial banks and t_T was the marginal corporate tax rate (46 percent) in the short-term tax-exempt market and the marginal

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[1] TRA repealed tax-exemption for industrial development bonds for pollution control, sports, convention and trade show facilities, parking facilities, and industrial park and hydroelectric-generating facilities. TRA also instituted a unified state volume cap that applied to most industrial development bonds, student loan bonds, and mortgage revenue bonds. The new cap was the greater of $75 per capita or $250 million in 1987 and $50 per capita or $150 million annually after 1987. See Petersen and Forbes (1988) for a more detailed discussion.

[2] TRA requires that all arbitrage profits be rebated to the federal government. Arbitrage profits not subject to rebate are permitted for six months after the sale date only if all bond proceeds have been expended for the intended purpose. Issues under $5 million were permitted a three-year temporary period. TRA also restricts issues sold after January 1986 to a single advance refunding. Finally, for private activity bonds TRA limits to 2 percent the amount of bond proceeds used to pay for bond issuance costs.

Table 1—Effective Tax Rates on Tax-Exempt Securities (t_E) (Assuming t_T = 34 percent)

	CF/Y_E Ratio		
IND	1.2	1.0	0.8
20%	8.16%	6.80%	5.44%
100%	40.80%	34.00%	27.20%

Y_E/Y_T Ratio	Breakeven t_E
0.50	-32.00%
0.60	-10.00%
0.66	0.00%
0.70	5.71%
0.80	17.50%
0.90	26.67%

individual tax rate in the long-term tax-exempt market.[3] For commercial banks the removal of the interest expense deductibility on nonqualified issues effectively imposed a tax on tax-exempt interest. Neubig and Sullivan (1987) and Koch (1991) show that the effective bank tax rate on tax-exempt interest income is

(2) $t_E = [(t_T)(IND)] \cdot [CF/Y_E]$

where:

IND = The percentage of interest expense that is nondeductible by banks; and

CF = The bank's cost of funds.

When a bank's cost of funds equals the yield on tax-exempt investments ($CF = Y_E$) and banks are allowed to deduct 80 percent of their interest expense (IND = 20 percent), t_E is significantly less than t_T and there is strong bank demand for tax-exempts. When the deductibility of bank interest expense is eliminated (IND = 100 percent), t_E equals t_T and banks are indifferent between equivalent risk taxable and nonqualified tax-exempt securities. Similarly, if a bank's cost of funds is greater than the yield on tax-exempt investments ($CF > Y_E$), a condition that generally exists, and the deductibility of bank interest expense is eliminated, t_E is greater than t_T and commercial banks will purchase only tax-exempts that are bank-qualified. There will be no bank demand for nonqualified tax-exempts. Effective tax rates on tax-exempts for various CF/Y_E and IND values are shown in Table 1. The stronger demand for bank-qualified issues will result in lower yields relative to yields on bank-nonqualified issues, *ceteris paribus*. The empirical findings of Forbes and Leonard (1994) and Koch (1991) are consistent with this hypothesis.

Data on overall bank demand for tax-exempts support the prediction that banks will purchase only bank-qualified issues. Table 2 summarizes net purchases of tax-exempt securities by commercial banks and commercial bank holdings of tax-

[3] Kidwell and Koch (1983) find that commercial banks represent the marginal investor for shorter-term securities while individual investors represent the marginal investor for longer-term securities.

Table 2— Commercial Bank Participation in the Tax-Exempt Securities Market, 1984-1995 (Dollar Figures in Billions of Dollars)

Year	Net Purchases	Percent of Net Total Issuance	Commercial Bank Holdings	Bank Holdings as a Percent of Total Outstanding
1984	$12.5	21.3%	$174.6	30.9%
1985	57.1	32.0	231.7	31.2
1986	-28.4	-62.1	203.4	25.8
1987	-29.1	-34.9	174.3	20.0
1988	-22.7	-42.3	151.6	16.1
1989	-17.8	-27.3	133.8	13.3
1990	-16.4	-28.6	117.4	11.1
1991	-14.2	-20.4	103.2	9.1
1992	-5.7	-8.7	97.5	8.1
1993	1.7	2.3	99.2	7.9
1994	-1.6	5.5*	97.6	7.2
1995	-4.2	10.2*	93.3	7.1

* Net issuance in 1994 and 1995 was negative

Source: Board of Governors of the Federal Reserve *Flow of Funds Accounts*, various issues

exempts from 1984 to 1995. Commercial bank net purchases of tax-exempt securities turned negative (commercial banks were net sellers of tax-exempts) beginning in 1986 after years as one of the largest investor groups. Bank holdings declined as a percent of the total stock of tax-exempts outstanding from 30.9 percent in 1984 to only 7.1 percent in 1995. Commercial bank holdings reached a peak of $231.7 billion in 1985. Beginning in 1986 commercial bank holdings of tax-exempts fell more than 50 percent to a low of $93.3 billion in 1995. Both in absolute amount and as a share of the overall stock outstanding, commercial bank investment in tax-exempt securities has fallen to levels last observed in the early 1970s.

State Income Tax Differentials

Thirty-eight states impose either an intangible personal property tax or an income tax on the interest income from out-of-state tax-exempts, while exempting interest income from in-state tax-exempts. Four states tax interest income from both in-state and out-of-state tax-exempts, and eight states either have no state income taxes or exempt income from both in-state and out-of-state tax-exempts (Brucato, Forbes, and Leonard, 1991). Thus, for investors in 38 states there is a tax advantage from owning in-state versus out-of-state tax-exempts. The magnitude of the tax advantage from owning in-state tax-exempts is directly related to both federal and state income tax rates. The equilibrium point at which wealth-maximizing risk-neutral investors are indifferent between out-of-state and in-state tax-exempts is:

(3) $Y^E_{IS}\,[1 - t_{IS}] = Y^E_{OS}\,[1 - (t_{OS} - (t_{OS} \cdot t_F))]$

where:

Y^E_{IS} = Before tax yield on in-state tax-exempts;

Y^E_{OS} = The before tax yield on out-of-state tax-exempts;

t_{IS} = The state tax rate on income from in-state tax-exempts;
t_{OS} = The state tax rate on income from out-of-state tax-exempts; and
t_F = The federal income tax rate (Brucato, Forbes, and Leonard, 1991).

For 38 states $t_{IS} = 0$ and $t_{OS} > 0$, so $Y^E_{IS} < Y^E_{OS}$. Therefore, by exempting interest income from in-state securities, states create additional demand for their bonds and create market segmentation along state lines. The second hypothesis is that the incremental demand for own-state bonds results in lower before tax yields, *ceteris paribus*, and that the magnitude of the yield effect is directly proportional to the size of the in-state tax advantage ($t_{OS} - t_{IS}$).

The relationship in equation (3) also points out the interrelationship between federal and state tax policies. The value of the in-state exemption is directly related to the federal income tax rate because state taxes are a deduction when calculating the federal tax liability. Thus, the substantial reduction in federal income tax rates contained in TRA increased the effective state tax differential and increased the importance of state tax rates in determining tax-exempt yields. For example, a federal tax rate (t_F) of 50 percent and a state tax rate of 8 percent (t_{OS}) produce a state tax differential of 4 percent; reducing the federal tax rate to 31 percent increases the state tax differential to 5.52 percent and increases the demand for in-state bonds.

Alternative Minimum Tax

TRA continued the efforts of the U.S. Treasury to limit revenue losses associated with tax-exempt interest by tightening the volume restrictions on private activity bonds, by expanding the types of bonds subject to the volume limitations, and by increasing the AMT.[4] For individuals the AMT liability was calculated by adding certain tax preference items to taxable income. Interest income on private purpose tax-exempt securities issued after August 7, 1986 was included as a source of tax preference income and this income was taxed at a rate of 21 percent. Similarly, interest income on private purpose tax-exempt securities issued after August 7, 1986 was included as preference income for corporations and taxed at a rate of 20 percent. Interest income on tax-exempt securities issued before August 7, 1986 and from new governmental purpose bonds adds to a corporation's excess

[4] TRA does not attempt to restrain the issuance of bonds used to finance essential and traditional governmental purposes. TRA defines a nongovernmental bond as one where 10 percent or more of the proceeds are used in a trade or business by persons or entities other than state and local governments and 10 percent or more of the debt service is secured by revenues or property used in such trade or business. TRA repeals tax-exemption for industrial development bonds used to finance: pollution control; sports, convention, and trade show facilities; parking facilities; and industrial park and hydroelectric generating facilities. In addition, TRA imposes a lower volume cap on private purpose bonds used to finance other activities. After 1987 the statewide cap was lowered to the greater of $50 per capita or $150 million per year. Exempt from the cap were government-owned airports, dock, wharves, and solid waste disposal facilities.

book income; one-half of a corporation's excess book income is subject to the AMT (creating an effective tax rate of 10 percent). TRA also required property and casualty insurance companies to reduce their deduction for insurance loss reserves by an amount equal to 15 percent of tax-exempt interest earnings from any types of bonds. With the new income tax rate on corporate income of 34 percent, this provision amounted to a tax of 5.1 percent on all interest from tax-exempts. Property and casualty insurance companies are also subject to the general tax provisions applicable to corporations.

The effects of the changes in the AMT were to raise the overall breakeven ratio of tax-exempt to taxable yields for bonds subject to the AMT and to create differential AMT rates for individuals, corporations, and property and casualty insurance companies. The equilibrium relationship between tax-exempt and taxable yields is:

(4) $Y^i_E / Y^i_T = (1 - t_T)/(1 - t_E)$

Increasing the AMT for private purpose bonds increased t_E and, therefore, the ratio of tax-exempt to taxable yields. The segmentation of the tax-exempt securities market increased because the AMT creating different tax rates (t_E) for public and private purpose issues and for different investor groups (individuals, corporations, and property and casualty insurance companies). The third hypothesis is that yields on bonds subject to the alternative minimum tax will be higher than yields on bonds not subject to the tax, *ceteris paribus*.

Influence of Term-to-Maturity

Prior to TRA commercial banks were the marginal investors in the short-term tax-exempt securities market (Kidwell and Koch, 1982; Kidwell, Koch, and Stock, 1987). With the elimination of the deductibility of the interest expense for funds used to purchase tax-exempts, however, banks are no longer the marginal investor group in the short-term market. With the reduced role of banks, individuals are the marginal investor group in the short- and medium-term markets, while nonbank institutions (property and casualty insurance companies) are the marginal investor group in the longer-term market. Furthermore, when they are investors, commercial banks generally purchase only short- and medium-term securities because of asset-liability considerations. In general, tax segmentation effects will be greater in markets where the marginal investor groups are most impacted by the tax differentials. Therefore, the fourth hypothesis is that the tax-induced segmentation effects due to the alternative minimum tax, bank-qualified status, and state tax rate differentials will be greater for shorter-term maturities, *ceteris paribus*.

Influence of Method of Sale

In a sale by competitive bidding, a potential underwriter will not conduct a complete search of the market for investors with the highest offer prices because the

Table 3—Comparison of the Sample and the Population of All Issues Sold During 1992

Category	All Issues*	Sample
Competitive Bid	19.1%**	19.4%
Negotiated	79.7%**	80.6%
Private Placements	1.2%**	
General Obligation Bonds	34.7%	36.5%
≤ $1 million	0.4%	0.0%
$1—5 million	3.0%	1.9%
$5—10 million	3.1%	2.8%
$10—25 million	4.1%	3.8%
$25—50 million	4.1%	3.6%
> $50 million	20.0%	24.4%
Revenue Bonds	65.3%	63.5%
≤ $1 million	0.2%	0.0%
$1—5 million	2.3%	0.5%
$5—10 million	3.4%	2.1%
$10—25 million	7.3%	5.7%
$25—50 million	10.0%	8.7%
> $50 million	42.2%	46.5%
Sample Size		2,333
Aggregate Par Value of Issues	$231.6 Billion	$79.2 Billion

* As reported by Securities Data Corporation
** As reported in 1993 Bond Buyer Yearbook

underwriter does not know whether s/he will be the winning bidder. In addition, the more limited search may focus on more easily identified tax-preferenced investors (in-state individuals and commercial banks for bank-qualified issues). In contrast, in a negotiated sale the underwriter has an exclusive underwriting contract and the underwriter can conduct a more thorough search for investors with the highest offer prices. If the more extensive search uncovers investors not in a tax-preferenced group (out-of-state individuals and noncommercial bank institutional investors), but willing to pay high offer prices, then the effects of tax differentials will be diminished. The final hypothesis is that tax-induced segmentation effects due to state tax differentials and bank-qualified status will be smaller for issues sold by negotiation, *ceteris paribus*.

Empirical Analysis

Description of the Data Sample

The sample for this study is drawn from a larger sample of 2,333 issues sold between August and December 1992. The larger sample includes all bond issues reported in the *Bond Buyer* issue briefs worksheet series between August 1 and December 31, 1992. The issue briefs provide summary information for issues of $1 million or more. The sample period was selected because a complete set of *Bond Buyer* issue briefs was available for this period, thus providing a comprehensive

Table 4—Sample Descriptive Statistics

	General Obligation Bonds Competitive Bid (N= 371)		General Obligation Bonds Negotiated (N=143)		Revenue Bonds Negotiated (N=281)	
Variable	Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation
Issue Size ($millions)	17.47	74.82	55.70	184.55	47.75	65.72
First Reoffer Yield (%)	3.30	0.54	3.17	0.57	3.36	0.61
Maturity of First Reoffer Yield (years)	1.71	0.85	1.43	0.75	1.54	0.86
Ten Year Reoffer Yield (%)	5.45	0.32	5.59	0.40	5.75	0.32
Last Reoffer Yield (%)	6.10	0.37	6.23	0.42	6.38	0.35
Maturity of Last Reoffer Yield (Years)	18.45	4.28	17.98	4.32	22.01	6.16
Per Capita Debt ($)	395.06	117.95	411.11	157.83	401.11	186.75
Effective State Tax Rate (%)	4.68	2.95	4.17	2.88	4.08	2.92
Proportion Bank-Qualified	0.57		0.34		0.10	
Rating Distribution						
Aaa-Insured	0.27		0.45		0.50	
Aaa	0.05		0.02		0.02	
Aa	0.21		0.20		0.14	
A	0.30		0.23		0.24	
Baa	0.09		0.04		0.06	
Not Rated	0.09		0.06		0.04	
Distribution by Issue Purpose						
Education	0.24		0.36		0.15	
Utility	0.15		0.08		0.24	
Health Care					0.22	
Public Facilities	0.15		0.08			
Other Purposes	0.46		0.48		0.39	

sample. A detailed description of the sample is provided in Leonard (1996) and will not be repeated here.

The distribution between general obligation and revenue bonds and competitive bid and negotiated issues in the larger sample is similar to that for the population of all issues sold during 1992. The data in Table 3 reveal that the sample underrepresents small issues and overrepresents large issues. This fact is expected because the data are from a source that only reports information for issues of $1 million or more.

Because one of the hypotheses tests whether the tax segmentation effects vary over the term structure, the analysis includes only issues with reoffer yield data across the term structure. Summary statistics for the 795 issues included in the analysis are shown in Table 4. These data show significant differences in the characteristics GOs sold by competitive bidding and negotiation. The GOs sold by negotiation are significantly larger in size, fewer are bank-qualified, and more are insured. There are also differences between general obligation and revenue bonds sold by negotiation. Negotiated revenue bonds have longer final maturities, on average, and include more healthcare issues and fewer education issues.

Methodology

A considerable body of research exists on the determinants of reoffer yields on individual tax-exempt bond issues. These studies demonstrate that reoffer yields vary with the overall level of capital market rates at the time of issuance, issue and issuer characteristics (such as issue size, maturity, and rating), and local market conditions such as state income tax rates and debt burden. The reoffer yield model used in this study is similar to that used in previous research [see, for example, Leonard (1983, 1996), Forbes and Leonard (1984), Brucato, Forbes, and Leonard (1991), Kidwell and Koch (1982, 1983), and Kidwell, Koch, and Stock (1987)]. The multiple regression reoffer yield model is:

$$(5)\ RY(i) = \alpha + \beta_1(INDEX) + \beta_2(DEBTPC) + \beta_3(LOGBIDS) + \beta_4(REFUND) + \beta_5(LOGMAT) + \beta_6(LARGE) + \sum_{7}^{11} \beta_i(RATING) + \sum_{12}^{15} \beta_i(PURPOSE) + \beta_{16}(TAX) + \beta_{17}(SMALLBQ) + \beta_{18}(AMT)$$

where:

RY(i) = Reoffer yield on the bond maturing in i years, in percent;

INDEX = Salomon Brothers index for prime grade general obligation bonds with a maturity of i years (i = 1, 10, 20), in percent;

DEBTPC = The total amount of state and local debt outstanding in the issuer's state at year-end 1991 divided by the state's population, in thousands of dollars;

LOGBIDS = Natural logarithm of the number of bids received for issues sold by competitive bid;

REFUND = 1 if the issue is a refunding sale, 0 otherwise;

LOGMAT = Natural logarithm of the number of years to maturity;

LARGE = 1 if issue size is greater than $10 million, 0 otherwise;

RATING = Bond rating specified in dummy variable form; the issue's Moody's rating was used as the primary rating; if an issue was not rated by Moody's the Standard & Poor's rating was used (A-rated bonds are the omitted category):

- AAAINS = 1 if the issue is insured and rated Aaa, 0 otherwise;
- AAA = 1 if the issue is rated Aaa, 0 otherwise;
- AA = 1 if the issue is rated Aa, 0 otherwise;
- BAA = 1 if the issue is rated Baa, 0 otherwise;
- NR = 1 if the issue is not rated by either Moody's or Standard & Poor's, 0 otherwise;

PURPOSE = Issue purpose in dummy variable form (other purpose is the omitted category):

- EDUCATION = 1 if the issue purpose is education, 0 otherwise;
- PUBFAC = 1 if the issue purpose is public facilities, 0 otherwise;
- HEALTHCARE = 1 if the issue purpose is healthcare, 0 otherwise;

	UTILITY	= 1 if the issue purpose is utility, 0 otherwise;
TAX	=	The effective tax rate differential defined as the effective state income tax rate on out-of-state tax-exempt bond interest less the effective tax rate on in-state tax-exempt bond interest, in percent;
BANKQUAL	=	1 if the issue is bank-qualified, 0 otherwise;
SMALL	=	1 if issue size is less than or equal to $10 million, 0 otherwise;
SMALLBQ	=	SMALL times BANKQUAL;
AMT	=	1 if the issue is subject to the alternative minimum tax for individual investors, 0 otherwise.

Reoffer yields are used as the dependent variable to investigate the influence of tax-induced segmentation effects across the term structure. Three reoffer yields are used in the analysis: the reoffer yield on the first maturity under five years (RYFIRST), the reoffer yield on bonds maturing in ten years (RY10), and the reoffer yield on the last maturity (RYLAST).

INDEX is a measure of the general level of interest rates at the time of issuance and is expected to have a positive coefficient. For the RYFIRST equation, INDEX is the Salomon Brothers index for prime grade GO issues with a maturity of one year. For the RY10 equation, INDEX is the Salomon index for issues with a ten year maturity. For the RYLAST equation, INDEX is the Salomon index for issues with a 20 year maturity. DEBTPC is a measure of total per capita in-state tax-exempt debt that is currently owned by investors. DEBTPC is expected to have a positive coefficient, indicating that additional debt issuance by issuers in high debt states is less desirable to investors holding diversified portfolios. DEBTPC reflects the fact that the market for tax-exempt securities is segmented and that local market conditions (in this case the stock of debt) may affect reoffer yields. LOGBIDS is expected to have a negative coefficient, as more bidding activity increases underwriter search for investors with the highest offer prices.

REFUND indicates whether an issue is a refunding or new money issue; REFUND is expected to have a negative coefficient because the refunding of higher cost outstanding debt reduces an issuer's debt service payments. LOGMAT is expected to have a positive coefficient, as the yield curve in the tax-exempt securities market is generally upward sloping. LOGMAT is not included in the RY10 equations because all of the bonds have the same maturity. The influence of issue size is measured with a series of dummy variables. A difficulty in measuring the effects of issue size is the fact that all bank-qualified issues are, by definition, $10 million or less in amount. Therefore, small size and bank-qualified status are strongly correlated. To overcome this problem, three dummy variables are created:

LARGE, SMALL, and SMALLBQ.[5] Because SMALL is the omitted variable, LARGE measures the differential impact of issues of more than $10 million relative to issues of $10 million or less. SMALLBQ measures the bank-qualified effect for issues of $10 million or less.[6]

AAAINS is included as a separate variable from AAA to reflect the fact that even though they both have triple-A ratings, insured bonds are not priced the same as natural triple-A rated bonds. A-rated bonds are the omitted class, so AAAINS, AAA, and AA are expected to have negative coefficients, and BAA and NR are expected to have positive coefficients. EDUCATION, UTILITY, PUBFAC, and HEALTHCARE measure differences in reoffer yields relative to issues with other purposes. HEALTHCARE is expected to have a positive coefficient, as these issues are generally considered riskier than other purposes.

The first hypothesis is that yields on bank-qualified issues will be less than yields on bank-nonqualified issues, *ceteris paribus*. Therefore, the coefficient on SMALLBQ is expected to be negative. Furthermore, if banks do not purchase long-term municipal securities, the coefficient on SMALLBQ should not be statistically significant in the RYLAST equation. The second hypothesis is that the incremental demand for own-state bonds results in lower before tax yields, *ceteris paribus*, and that the magnitude of the yield effect is directly proportional to the size of the in-state tax advantage. Therefore, TAX is expected to have a negative coefficient, indicating that a more favorable tax treatment of interest on in-state tax-exempts increases in-state investor demand and leads to higher prices and lower reoffer yields. The specification of TAX was used previously by Brucato, Forbes, and Leonard (1991). The third hypothesis is that yields on bonds subject to the alternative minimum tax will be higher than yields on bonds not subject to the tax, *ceteris paribus*. Therefore, AMT is expected to have a positive coefficient; the size of the coefficient reflects the tax yield premium demanded by individual investors to offset the additional tax imposed on private purpose issues subject to the alternative minimum tax.

The fourth hypothesis is that the tax-induced segmentation effects due to bank-qualified status, state tax rate differentials, and the alternative minimum tax will be greater for shorter-term maturities, *ceteris paribus*. Therefore, the coefficients on SMALLBQ, TAX, and AMT are expected to be relatively larger for shorter-term maturities. The final hypothesis is that tax-induced segmentation effects due to state

[5] Other specifications of issue size were tried; in general, none of the variables were statistically significant. Other specifications tried were the logarithm of issue size and size plus size squared (a quadratic specification).

[6] A measure of bank profitability also was tried as an explanatory variable, because bank demand for tax-exempts should be related to the level of bank profitability. This variable was not statistically significant in the regressions, however.

tax differentials and bank-qualified status will be smaller for issues sold by negotiation, *ceteris paribus*. Therefore, the coefficients on SMALLBQ and TAX are expected to be smaller in absolute size (but still negative) for issues sold by negotiation.

Empirical Findings

Prior to estimating the regression equation in (5), tests are performed to determine whether negotiated and competitive bid GO and revenue bonds could be combined into a single sample for analysis. Recent work by Leonard (1994, 1996) focuses on the systematic differences in issue and issuer characteristics between bonds sold by competitive bidding and negotiation. The sample descriptive statistics shown in Table 4 illustrate these differences. In addition, GO and revenue bonds are generally viewed as heterogeneous securities due to differences in the underlying security (a pledge of unlimited *ad valorem* taxes versus enterprise revenues) of the bonds and systematic differences in issue characteristics such as purpose and size. If there are systematic differences in the characteristics of GO and revenue bonds and bonds sold by competitive bidding and negotiation, combining them in a single sample may produce biased estimated regression coefficients.

A common method used to test for the equality of the estimated coefficients between subsamples of issues is a linear restrictions test.[7] The hypothesis tested is that the coefficients on the explanatory variables are the same for each subsample (i.e., GO and revenue bonds; competitive bid and negotiated issues). For regression equations using RYFIRST, RY10, and RYLAST as the dependent variables, the linear restrictions tests find that competitive and negotiated GOs and competitive and negotiated revenue bonds can not be pooled, nor can GO and revenue issues. Therefore, a single sample can not be used for the regression analysis. Three separate samples are used in the analyses that follow: competitive bid GOs, negotiated GOs, and negotiated revenue bonds.[8]

A regression model with a large number of independent variables increases the concern about muticollinearity. The existence of significant correlations between the independent variables is examined by calculating the tolerance for each independent variable in each equation. To calculate variable i's tolerance, variable *i* is regressed on the other (n – 1) independent variables. The variable's tolerance is defined as $(1 - R_i^2)$, where R_i is the multiple correlation coefficient when the ith independent variable is predicted from the other (n – 1) independent variables. Because R^2 measures the proportion of a variable's variance that is explained by the independent variables, tolerance measures the proportion of a variable's variance that is not

[7] This test is commonly called a Chow test (Maddala, 1977).

[8] Revenue bonds sold by competitive bid are not analyzed because the number of observations is too small.

Table 5—Regression Results: General Obligation Bonds Sold By Competitive Bidding

	RYFIRST		RY10		RYLAST	
Explanatory Variable	Estimated Coefficient	t-value	Estimated Coefficient	t-value	Estimated Coefficient	t-value
CONSTANT	2.494	7.472***	0.451	0.908	-2.585	-6.168***
Market Conditions						
INDEX	0.281	2.345**	0.995	10.883***	1.028	15.633***
DEBTPC	-4.61E-5	-0.361	1.80E-4	1.742*	6.57E-5	0.767
LOGBIDS	-0.079	-2.804***	-0.116	-5.051***	-0.099	-5.251***
Issue Characteristics						
REFUND	-0.065	-1.562	-0.075	-2.200**	-0.079	-2.794***
LOGMAT	0.879	30.120***			0.945	23.813***
LARGE	-0.027	-0.661	0.010	0.306	-0.012	-0.435
AAAINS	-0.033	-0.877	-0.086	-2.779***	-0.079	-3.103***
AAA	-0.120	-1.794*	-0.208	-3.850***	-0.165	-3.733***
AA	-0.085	-2.173**	-0.163	-5.159***	-0.146	-5.637***
BAA	0.247	4.875***	0.281	6.832***	0.180	5.301***
NR	0.472	8.721***	0.367	8.356***	0.259	7.105***
EDUCATION	-0.033	-0.906	-0.043	-1.486	-0.045	-1.885*
PUBFAC	-0.028	-0.708	-0.013	-0.393	-0.010	-0.393
UTILITY	0.119	2.948***	0.085	2.622***	0.017	0.632
Tax Effects						
TAX	-0.027	-5.362***	-0.024	-6.043***	-0.023	-7.026***
SMALLBQ	-0.171	-4.731***	-0.197	-6.695***	-0.039	-1.609
Sample Size	371		371		371	
Adjusted R^2	0.793		0.606		0.802	
Regression F Ratio	89.708		38.861		94.444	
Minimum Tolerance	0.502		0.507		0.489	

*** Significant at the 1 percent level
** Significant at the 5 percent level
* Significant at the 10 percent level

explained by the other (n – 1) independent variables. Therefore, a high tolerance (i.e., a value close to 1.0) indicates little association between that variable and the other independent variables.

The first sample consists of GOs sold by competitive bid. The regression results are shown in Table 5. Also reported is the minimum tolerance for the independent variables in each regression model. The high tolerances indicate no problems with multicollinearity. Plots of the regression residuals reveal no violations of the assumptions that the errors are normally distributed with a constant variance. In general, the estimated coefficients on the market conditions and issue characteristics explanatory variables have the expected signs and are statistically significant. The estimated coefficients indicate that reoffer yields were lower the larger the number of bids received, for refunding issues, the higher the credit rating, and the lower the general level of interest rates in the market. The coefficients on UTILITY are positive and statistically significant in the RYFIRST and RY10 equations, and the coefficient on EDUCATION is negative and significant in the RYLAST equation.

Table 6—Regression Results: General Obligation Bonds Sold By Negotiation

	RYFIRST		RY10		RYLAST	
Explanatory Variable	Estimated Coefficient	t-value	Estimated Coefficient	t-value	Estimated Coefficient	t-value
CONSTANT	2.598	5.355***	2.009	2.520**	-0.909	-1.005
Market Conditions						
INDEX	0.216	1.211	0.690	4.666***	0.860	6.212***
DEBTPC	-1.91E-4	-1.357	-5.62E-5	-0.435	5.89E-5	0.043
Issue Characteristics						
REFUND	0.015	0.328	-0.024	-0.590	-0.046	-1.024
LOGMAT	1.015	19.054***			0.714	7.388***
LARGE	-0.104	-1.300	0.064	0.884	-0.046	-0.586
AAAINS	-0.112	-2.010**	-0.071	-1.397	-0.035	-0.642
AAA	-0.086	-0.559	-0.252	-1.799*	-0.116	-0.783
AA	-0.133	-1.939*	-0.137	-2.202**	-0.105	-1.592
BAA	0.488	4.022***	0.697	6.304***	0.482	4.116***
NR	0.671	6.635***	1.034	11.389***	0.799	8.157***
EDUCATION	0.004	0.666	-0.019	-0.388	0.036	0.688
PUBFAC	-0.005	-0.617	-0.081	-1.115	-7.80E-3	-0.101
UTILITY	0.094	1.166	-0.049	-0.661	0.018	0.229
Tax Effects						
TAX	-0.016	-2.018**	-0.012	-1.647	-0.015	-1.957*
SMALLBQ	-0.210	-2.525**	-0.169	-2.237**	-0.120	-1.499
Sample Size	143		143		143	
Adjusted R^2	0.811		0.686		0.678	
Regression F Ratio	41.557		23.157		20.921	
Minimum Tolerance	0.274		0.275		0.270	

*** Significant at the 1 percent level
** Significant at the 5 percent level
* Significant at the 10 percent level

DEBTPC is significant only in the RY10 equation, and LARGE is not statistically significant in any of the equations.

The estimated coefficient on SMALLBQ is negative and statistically significant in the RYFIRST and RY10 equations, consistent with the first hypothesis that bank-qualified issues have lower reoffer yields. As expected, the estimated coefficient on SMALLBQ is not significant in the RYLAST equation, consistent with the hypothesis that banks do not purchase longer-term municipals. The estimated coefficient on TAX is negative and highly significant in each reoffer yield equation, consistent with the second hypothesis that higher effective state income tax rate differentials result in lower reoffer yields, *ceteris paribus*.

Table 6 presents the results for GO bonds sold by negotiation. The tolerances indicate no problems with multicollinearity; all but two of the variables have tolerances above 0.5 and most have tolerances that are above 0.7. Plots of the regression residuals reveal no violations of the assumptions that the errors are normally distributed with a constant variance. The results for the market conditions and issue characteristic variables are generally similar to those for GOs sold by competitive bid. In the negotiated GO sample, however, REFUND and the purpose

variables are not statistically significant. Another noticeable difference is the significantly larger estimated coefficients on BAA and NR in the negotiated GO sample. The larger coefficients indicate that lower-rated and unrated GOs sold by negotiation are perceived by investors as riskier than similarly rated GOs sold by competitive bidding.

As posited in the first hypothesis, the estimated coefficient on SMALLBQ is statistically significant in the RYFIRST and RY10 equations, but not in the RYLAST equation. The estimated coefficient on TAX is negative and statistically significant in the RYFIRST and RYLAST equations. This result is consistent with the second hypothesis. The coefficients on TAX are smaller for negotiated GOs than for competitive bid GOs. This finding is consistent with the fifth hypothesis that underwriters are better able to search for potential investors in negotiated sales, thereby reducing the tax segmentation effect. There is no difference in the coefficient on SMALLBQ between GOs sold by competitive bidding and negotiation.

Another possible explanation for the smaller segmentation effects for negotiated GOs may be due to their perceived lower credit quality. The estimated coefficients on BAA and NR are much larger in the negotiated sample; this difference is due to the greater perceived risk of these issues. Because both individuals and commercial banks have a preference for high credit quality, they may not be buyers of bonds they consider high risk. If this is the case, the demand shortfall will be filled by nontax-preferenced investors, and the tax-induced segmentation effect will be less.

The regression results for revenue bonds sold by negotiation are shown in Table 7. The high tolerances indicate no problems with multicollinearity. Plots of the regression residuals reveal no violations of the assumptions that the errors are normally distributed with a constant variance. The estimated coefficients on the market conditions and issue characteristic variables are consistent with expectations and are similar to those for GOs. Consistent with the first hypothesis, the coefficients on SMALLBQ are negative and statistically significant in the RYFIRST and RY10 equations, but the coefficient is not significant in the RYLAST equation. This is the same result as for both samples of GO bonds. In addition, the coefficients on SMALLBQ are similar in size to those for both samples of GO bonds. As posited in the second hypothesis, the estimated coefficient on TAX is negative and statistically significant in each reoffer yield equation. The size of the coefficients is similar to those for negotiated GOs and smaller than those for competitive bid GOs. The smaller TAX coefficients may be due to the ability of the negotiating underwriter to conduct a more thorough search or to lower preferences (lower demand) for higher risk revenue bonds. Consistent with the fifth hypothesis, the estimated coefficient on AMT is positive and statistically significant in each reoffer yield equation.

Table 7—Regression Results: Revenue Bonds Sold By Negotiation

Explanatory Variable	RYFIRST Estimated Coefficient	t-value	RY10 Estimated Coefficient	t-value	RYLAST Estimated Coefficient	t-value
CONSTANT	1.951	5.808***	0.525	1.048	-1.205	-2.270**
Market Conditions						
INDEX	0.450	3.660***	1.007	10.811***	1.025	12.315***
DEBTPC	4.02E-5	0.515	-1.63E-5	-0.241	-7.36E-5	-1.101
Issue Characteristics						
REFUND	0.022	0.682	-3.03E-3	-0.110	-0.025	-0.888
LOGMAT	1.070	32.009***			0.508	11.448***
LARGE	-0.089	-2.320**	-0.030	-0.913	-0.058	-1.734*
AAAINS	-0.162	-4.488***	-0.186	-5.965***	-0.168	-5.435***
AAA	-0.096	-0.853	-0.189	-1.961*	-0.112	-1.171
AA	-0.165	-3.478***	-0.181	-4.417***	-0.087	-2.120**
BAA	0.522	8.215***	0.422	7.696***	0.360	6.610***
NR	0.379	4.850***	0.277	4.115***	0.283	4.238***
EDUCATION	0.015	0.350	0.058	1.531	0.052	1.399
PUBFAC	0.153	3.913***	0.186	5.559***	0.144	4.343***
UTILITY	-0.079	-2.006**	-0.075	-2.227**	-0.037	-1.094
Tax Effects						
TAX	-0.013	-2.434**	-0.016	-3.481***	-0.018	-3.912***
SMALLBQ	-0.166	-2.819***	-0.243	-4.803***	-0.068	-1.353
AMT	0.284	4.737***	0.204	3.997***	0.155	3.066***
Sample Size	281		281		281	
Adjusted R^2	0.851		0.611		0.664	
Regression F Ratio	101.238		30.263		35.600	
Minimum Tolerance	0.598		0.600		0.597	

*** Coefficient significant at the 1 percent level
** Coefficient significant at the 5 percent level
* Coefficient significant at the 10 percent level

The regression results presented above generally support the first three hypotheses: bank-qualified bonds have lower yields, bonds issued in states with lower effective state tax rates have lower yields, and bonds subject to the individual alternative minimum tax have higher yields. The results also generally support the fifth hypothesis that tax-induced segmentation effects are smaller for issues sold by negotiation. To test the term structure hypothesis, relative tax effects are calculated. Relative tax effects are calculated by dividing the basis point tax effects by the mean reoffer yields. For example, the coefficient on SMALLBQ in the RYFIRST equation for competitive GOs is –0.171, and the mean value of RYFIRST for this sample is 3.30 percent. Therefore, the relative tax effect is 5.18 percent (0.171/3.30). The relative tax effects for all three sets of regressions are summarized in Table 8. The relative tax effects indicate that all of the tax effects are strongest for shorter-term securities. The relative tax effects for medium-term (ten-year maturity) and longer-term securities are lower and similar in magnitude for each sample. These findings are consistent with the term structure hypothesis. There is no statistically significant

Table 8—Relative Tax Effects (The relative tax effects are calculated by dividing the estimated basis point tax effects by the corresponding mean reoffer yield)

	RYFIRST	RY10	RYLAST
Competitive GO			
TAX*	3.78%	2.10%	1.80%
SMALLBQ	5.18	3.62	NS
Negotiated GO			
TAX*	2.06	0.87	0.98
SMALLBQ	6.63	3.02	NS
Negotiated Revenue			
TAX*	1.60	1.14	1.15
SMALLBQ	4.94	4.22	NS
AMT	8.44	3.55	2.43

NS: Coefficient not statistically significant

* The coefficient on *TAX* was first multiplier by the mean level of the *TAX* variable; the resulting basis point tax effect was then divided by the mean value of the reoffer yield

bank-qualified effect for longer-term bonds. This finding is consistent with the view that banks are not active investors in the long-term municipal bond market.

Conclusion

The empirical findings presented in this paper support all five of the hypotheses tested. Yield differentials caused by differential state income tax rates are present in all three samples analyzed. State tax-induced yield differentials are strongest for GO bonds sold by competitive bidding; the estimated yield differentials are 2.3 to 2.7 basis points per 1 percent state tax differential. Thus, for bonds sold in a state with a tax differential of 4.7 percent (the mean tax differential for bonds in the competitive GO bond sample), yields on in-state bonds are 10.8 to 12.7 basis points lower than those on out-of-state bonds. The state tax effects are similar to those found by Brucato, Forbes, and Leonard (1991) for a sample of competitive bid GOs sold during 1988 and Forbes and Leonard (1994) for a sample of competitive bid GOs and revenue bonds sold between 1990 and 1991. The estimates are lower than those found by Kidwell, Koch, and Stock (1984); they find that NICs are 3.6 basis points per 1 percent tax rate differential lower for small competitive bid GOs sold during 1980. The estimated state tax effects found in this study are larger than those found by Kidwell, Koch, and Stock (1987) for a sample of competitive bid GOs sold between 1978 and 1980. In that study they find tax effects of 0.5 to 1.8 basis points per 1 percent tax rate differential.

The state tax effects for GOs and revenue bonds sold by negotiation are similar in magnitude and smaller than those for GOs sold by competitive bidding. The *smaller effects for issues sold by negotiation may be due to the greater ability of* underwriters to conduct a more thorough search for investors in a negotiated sale or because of differences in the risk of, and therefore the demand for, issues sold by

competitive bidding and negotiating. The findings also indicate that the state tax effects are stronger for shorter-term securities.

The findings for bank-qualified effects are different than those found in a recent study. Forbes and Leonard (1994) find that for competitive bid GOs the bank-qualified effect is strongly related to the level of bank profitability and that there is no significant independent bank-qualified effect. The results in this study find a strong independent bank-qualified effect (SMALLBQ is statistically significant), but no influence of bank profitability. The findings also indicate that the bank-qualified effect is stronger for shorter-term securities and that there is no statistically significant impact for long-term securities.

The largest yield differentials are associated with the alternative minimum tax that imposes higher tax rates for individuals on the interest income from private purpose bonds. The higher tax burden caused by the AMT reduces individual investor demand for private purpose bonds and results in higher yields. For the sample of bonds analyzed in this paper, yields on bonds subject to the alternative minimum tax are between 15.5 and 28.4 basis points higher than yields on bonds not subject to the tax.

Implications of the Findings

The empirical findings reported in this paper highlight the significant influence federal tax policies have on state and local government borrowing costs. At the federal level, tax-exempt interest is viewed as a tax expenditure. The increase in the level and scope of the alternative minimum tax and the elimination from federal taxable income of the interest expense incurred by banks to purchase tax-exempts are examples of federal tax policy actions taken to reduce the revenue loss associated with the tax-exempt interest tax expenditure. While these actions may increase federal tax revenues, they increase borrowing costs for state and local governments. Thus, it appears that the burden of these two federal tax policies falls on state and local government taxpayers.

The empirical findings also illustrate how state-level tax policies influence state and local government borrowing costs. A state personal income tax policy that exempts interest on in-state issues but taxes interest on out-of-state issues provides a subsidy to in-state municipal borrowers. The amount of the subsidy depends on the size of the tax rate differential, not the level of state tax rates. The subsidy is paid by investors who purchase in-state bonds at lower yields. This type of differential tax policy also will impact a state's tax revenues, although the magnitude is not known *a priori*. As Kidwell, Koch, and Stock (1984) show, the impact on state tax revenues is a function of the size of the tax differential, the incremental shift of funds into in-state issues by in-state investors, the incremental shift of funds out of out-of-state issues by in-state investors, and the incremental shift of funds by in-state investors out of tax-exempts into taxable issues.

Finally, the empirical findings concerning the differential effects for negotiated and competitive bid sales provide new information in the debate over the method of sale. No previous studies of method of sale have investigated the differential effects of tax segmentation on borrowing costs. The smaller tax segmentation effects for negotiated issues found in this paper are consistent with the view that sales by negotiation allow for more thorough search by underwriters.

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