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The Behavior of the Interest Rate Differential Between Tax-exempt Revenue and General Obligation Bonds: A Test of Risk Preferences and Market Segmentation

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ABSTRACT

This paper presents evidence that the yield differential between revenue bonds and similar general obligation bonds varies contracyclically with the level of economic activity. The evidence also indicates that significant investor-borrower induced market segmentation exists in the municipal bond market. An increase in the relative demand by commercial banks for tax-exempt securities and/or an increase in the supply of revenue bonds relative to the supply of general obligation bonds increase the yield spread between the two classes of debt. These findings were the result of a series of empirical tests with both macroeconomic and microeconomic data.

IT IS WELL DOCUMENTED that yield differentials between bonds which differ only in default risk vary systematically over the business cycle [1, 8, 10, 13]. Evidence suggests that yield differentials widen during economic downturns and narrow during periods of economic prosperity. A similar situation should exist with the interest rate differentials between tax-exempt revenue bonds and comparable general obligation bonds. It is generally believed that revenue bonds as a class are inherently more risky than general obligation bonds and, as a result, carry relatively higher interest rates [4, 7, 11, 12, 13]. If this is true, we would expect the interest rate differentials between these two classes of debt also to vary systematically over time.

In a study especially relevant to this question, Swenson [12] concluded that even though revenue bonds carried higher interest rates than did similar general obligation bonds, their interest rate differential showed no evidence of cyclical variation. We find this result surprising given the above cited studies. We believe that in the tax-exempt bond market two underlying factors should cause cyclical variation in the interest rate differential between revenue and similar general obligation bonds. First, interest rate differentials should vary inversely with the level of economic activity as the actual and perceived default risk underlying each type of bond changes. Second, because investors and borrowers do not view revenue and general obligation bonds as close substitutes in their portfolios, interest rate differentials should vary with changes in the supply of or demand for both types of debt. Thus, the market for tax-exempt securities may be

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segmented by class of debt. The present effort attempts to resolve this controversy by clarifying the theoretical determinants of the variation in the interest rate differential. Then, a variety of empirical tests are conducted to determine whether the interest rate differential varies over the business cycle and whether significant market segmentation exists in the municipal bond market.

The paper is organized in the following manner. Section I provides background information on the markets for revenue and general obligation bonds and offers an explanation of the effects of economic activity and investor-borrower behavior on the interest rate differential between revenue and general obligation bonds. In Section II, macroeconomic data for the period 1966 through 1975 are employed in quarterly time series analyses to estimate the effects of changes in economic activity and market segmentation on the yield differential. In Section III, the same hypotheses are tested in a pooled cross section-time series analysis using a sample of nearly 21,000 individual bond issues sold competitively during the same period. The microeconomic tests examine whether the relationships are robust and whether the actual effects are obscured by aggregation. Section IV summarizes and concludes the paper.

I. Determinants of the Yield Differential between Revenue and General Obligation Bonds

Tax-exempt securities are issued by states, local governments, and their political subdivisions, and can be generally classified as either general obligation debt or revenue debt. General obligation bonds are secured by the "full faith, credit and taxing authority" of the issuer which means that the issuer has the power to levy taxes to cover debt payments. However, prior taxpayer approval is often required for tax increases, and there must be a viable tax base against which the increase can be assessed.[1] Revenue bonds, in contrast, are secured by project revenues derived from the facility financed. If no receipts are forthcoming, the issuer potentially defaults.

The primary investors in tax-exempt bonds are commercial banks, property and casualty insurance companies, and high income individuals who realize the greatest advantage of the coupon income tax exemption. Other investors pay such low effective tax rates that taxable securities typically provide a greater after-tax return. The investment in tax-exempt securities by both commercial banks and property insurance companies is not overly sensitive to movements in tax-exempt yields relative to taxable yields. These institutions pay taxes at the full corporate rate and, as such, have always found tax-exempt securities to yield more after taxes than comparable taxable securities. The fundamental determinant of tax-exempt holdings for these investors is their expected net income. In brief, profit maximizing firms invest in taxable securities until sufficient income is earned in excess of deductible expenses so that they pay taxes at the full marginal corporate rate. They then allocate additional funds among alternative tax-sheltered investments to shield the maximum proportion of net income. Small changes in relative yields do not alter anticipated expenses or the comparative

[1] The New York City fiscal crisis called both of these points into question.

yield advantage of tax-exempt securities, and thus induce only small and temporary portfolio responses.[2]

Individual investors, in contrast, are subject to a wide range of marginal income tax rates, and thus as a group are especially sensitive to changes in relative interest rates. The net effect is that individuals represent the marginal investors in tax-exempt securities. Any tax-exempt securities issued in excess of the desired holdings of fully-taxed firms must be placed with individuals. The greater is the excess, the higher must tax-exempt yields rise relative to taxable yields to induce investors in successively lower tax brackets into the market.

Historically, the ratio of pretax yields on tax-exempts to yields on similar quality and maturity taxables has ranged from 0.55 to 0.80 with the ratio lower for short-term securities. Individuals with marginal tax rates below the full corporate income tax rate have been the marginal investor in the long-term tax-exempt market. In general, as the demand for tax-exempt securities by commercial banks and property-casualty insurers rises (falls) as a proportion of total issues, tax-exempt rates fall (rise) relative to taxable rates. Because commercial banks dominate the tax-exempt market, having purchased 53 percent of the net tax-exempts issued from 1966 through 1975, variations in bank demand alone are sufficient to cause fluctuations in relative interest rates.

The Yield Differential

The yield differential between comparable revenue bonds and general obligation bonds is typically attributed to differences in default risk between the two classes of debt. In general, revenue bonds as a class are believed to be more risky due to the lack of any "full faith, credit and taxing" authority backing by the issuer. However, certain types of revenue bonds, depending upon the purpose for the bonds proceeds, are perceived by some investors to be less risky than other like-rated revenue bonds. For example, school (nonuniversity) and refunding revenue bonds often carry yields 10 to 20 basis points below similar revenue bonds with the same bond rating [4, 7, 11]. Ignoring these "low risk" revenue bonds for the moment, we believe the revenue-general obligation risk premium should vary systematically over time for two reasons. First, the default risk associated with revenue bonds is likely to increase more than that associated with general obligation bonds during an economic downturn as project revenues decrease with declines in economic activity [8]. Second, investors' utility preference may change with different economic conditions. That is, investors may be more risk averse during periods of economic decline even though actual default risk is unchanged [13]. Both reasons suggest that the risk premium component of the yield differential between general obligation and revenue bonds varies inversely with economic activity. These influences jointly will be referred to as the "default risk effect".

Another and often overlooked reason for systematic variability in the yield differential between general obligation and revenue bond stems from possible market segmentation in the market for tax-exempt securities. On the supply side,

[2] Hendershott and Koch [6] describe in detail the effect of expected income and relative interest rates on the demand for tax-exempts by financial institutions.

statutory restrictions on general obligation borrowing by states and localities play an important role. Borrowing restrictions take the form of either statutory interest rate ceilings or the need for voter approval. Many states and local governments cannot issue general obligation debt at rates above legal ceilings. When the level of tax-exempt rates rises, the ceilings must be raised or eliminated by referendum before issue. The political process is often slow and, in recent years, voter approval has not been forthcoming.[3] Even when rate ceilings are nonbinding, many government units are required to seek voter approval before general obligation bonds can be offered for sale [3]. Revenue bonds, in contrast, are generally free of political and legal encumbrances. Issues of revenue bonds do not normally require voter approval nor are they subject to interest rate ceilings. When general obligation borrowing is cancelled or postponed, revenue bonds may be substituted.

On the demand side, commercial banks exhibit a well defined preference for high quality tax-exempts as they are effectively limited to investment grade securities by the regulatory agencies. This entails proportionately greater investment in the four highest rated classes of securities (Baa and above) relative to lower grade and nonrated issues. Proportionately more revenue issues than general obligation issues are nonrated and thus banks have an enforced bias for general obligation debt.[4] A further advantage is that general obligation bond contracts are more standardized and thus are easier to understand. Banks as well as other investors frequently find that there are high transaction costs involved in comprehending the complicated features of project-unique revenue bonds and shy away from such issues. Bank preferences for general obligation bonds are further strengthened by the prohibitions against underwriting revenue bonds.[5] Again, banks simply have better information regarding securities they underwrite and are more likely to purchase them for investment purposes. Finally, banks find it good business to support their local community projects, and general obligation bonds are more typically directly tied to community needs and services. Banks feel less obligation to purchase many types of revenue bonds that appear to benefit primarily industry or a narrow segment of the population. This is particularly true in the case of industrial development bonds.

If the above arguments are correct, a case can be made for market segmentation between general obligation bonds and revenue bonds. Revenue bonds are not perfect substitutes for general obligation bonds either as a source of funds for state and local government borrowers, or as an investment to commercial banks. Any shift in relative supply and/or demand schedules of these two classes of securities will produce a change in relative yields. As the supply of revenue bonds increases relative to the supply of general obligation bonds, commercial banks do

[3] In March 1979, the increase in taxable bond rates to 12%–14% put upward pressure on comparable tax-exempt rates for them to remain competitive. *The Wall Street Journal* reported that numerous state and local government borrowers were forced to withdraw planned offerings because current yields exceeded statutory limits. More recently, the state of California had to curtail the sale of debt because of a 7 percent interest rate ceiling (*Wall Street Journal*, 14 April 1980).

[4] Prior to 1972, Moody's refused to rate new revenue debt until the underlying projects had established earnings records.

[5] While commercial banks can underwrite all general obligation debt, they are eligible to underwrite only college related and housing revenue debt.

not shift their portfolios into revenue bonds and, because the demand of fully-taxed firms is interest insensitive, revenue yields must rise relative to general obligation yields to induce additional purchases from individuals. Similarly, as banks increase their proportionate investment in tax-exempts, individuals must purchase a lower proportion of general obligation issues to clear the market, so that yields on general obligation bonds are bid lower relative to yields on revenue bonds. The above segmentation effects could be offset only if other investors shifted from general obligations to revenues when relative yields change.

Thus, the combination of restrictions on the supply of and demand for general obligation and revenue bond issues may lead to a "market segmentation effect." If significant, this effect would influence the cyclical behavior of yield differentials between these two classes of debt. Specifically, during periods when banks increase their proportionate purchases of municipal bonds, the yield differential would widen, while the opposite would hold when bank purchases decrease. Similarly, an increase in the supply of revenue bonds relative to general obligation debt would cause the yield differential to increase.

II. Empirical Tests: Macroeconomic Data

The previous discussion suggests that the business cycle and market imperfections affect the yield differential between revenue bonds and general obligation bonds and that the effects are distinct. Thus, the yield differential may exhibit cyclical behavior over time because of changes in relative default risk, changes in the relative level of commercial bank activity in the municipal bond market, and changes in the supply of revenue bonds issued relative to general obligation bonds. To test these propositions, time series regression equations are estimated explaining the yield differential between a revenue bond index and a general obligation bond index.

The business cycle variable employed in the equation is the percent change in real gross national product (GNP).[6] It is expected that, *ceteris paribus*, a decrease in the percent change in gross national product will increase investor preference to hold higher grade bonds, and temporarily increase the yield differential between revenue and general obligation bonds. The bank demand variable specified is the ratio of commercial bank net purchases of municipal bonds to total net issues of municipal bonds.[7] The greater are relative bank purchases, the greater is the expected yield differential because of bank preferences for general

[6] The capacity utilization rate was also tested. In general, it did not perform as well as the percent change in real gross national product in both the empirical tests in this section and the microeconomic test presented in the next section of the paper.

[7] Previous studies that modeled the effect of commercial bank behavior on risk spreads have argued that bank demand for tax-exempts is a residual demand [1, 8]. This has led to the use of loan-to-deposit ratios and the level of interest rates as proxies for segmentation effects due to bank behavior. We believe neither measure is appropriate because in recent years bank demand has not always varied contracyclically (e.g., during 1975–76). More recently, Campbell [2] used a more direct measure of bank participation—the actual dollar value of municipal bonds purchased by banks. Though an improvement over previous measures, we believe that it is not the amount of bank purchases that matters, but the magnitude of their purchases relative to total issues.

obligation bonds. The relative supply variable is the ratio of new issues of long-term revenue bonds to all municipal bonds sold nationally. It is expected that an increase in the relative supply of revenue bonds will temporarily increase the yield differential.

The estimated equation is

$$YD_t = \alpha + \Sigma\beta_i PCGNP_{t-i} + \Sigma\gamma_i RD_{t-i} + \Sigma\Theta_i RS_{t-i} \quad (1)$$

where we expect $\beta_i < 0$, $\gamma_i > 0$, and $\Theta_i > 0$ for all i and

YD_t = yield differential in quarter t as measured by (RI-GOI) where RI and GOI are yield indexes in percentages for revenue bonds and general obligation bonds, respectively, as defined below.

$PCGNP_t$ = the percentage change in real gross national product in quarter t. GNP is in constant dollars, seasonally adjusted at annual rates.

RD_t = relative demand for tax-exempts by commercial banks defined as the ratio of commercial bank net purchases of tax-exempt securities to the total of net tax-exempts issued by states and localities in quarter t times 100, as reported in the flow-of-funds accounts, Board of Governors of the Federal Reserve System.

RS_t = relative supply of revenue debt defined as the ratio of newly issued revenue bonds to the total of newly issued revenue and general obligation bonds sold in quarter t times 100, from the *Federal Reserve Bulletin.*

Because past changes in business economic conditions, relative demand, and relative supply may have an impact upon the revenue-general obligation yield differential, lagged values of *PCGNP*, *RD*, and *RS* are included in the equation. Because the impact should dissipate over time, we expect that

$$\beta_i < \beta_j < 0;\ \gamma_i > \gamma_j > 0; \quad \text{and} \quad \Theta_i > \Theta_j > 0 \quad \text{for} \quad i < j$$

Since there are no comparable reported revenue and general obligation bond indices, we construct indices for revenue bonds (RI) and general obligation bonds (GOI) from a sample of nearly 21,000 individual bond issues sold competitively during the period 1966–75. The indices are carefully matched so that factors which affect the yields on individual bonds are held constant. Specifically, each index is constructed quarterly by taking the monthly average of ten-year maturity reoffering yields for bonds meeting the following selection criteria. The securities selected: (1) are sold within the same month; (2) have the same maturity (10 years); (3) are rated double-A by Moody's rating agency; (4) receive at least two competitive bids; and (5) are between $3 million and $15 million in issue size.[8] We

[8] We recognize that credit ratings may not be homogeneous across different types of debt. That is, an A rated general obligation bond is not necessarily viewed as carrying the same risk of default and being equally marketable as an A rated revenue bond. However, by matching on credit rating we hold constant pressures exerted by regulatory agencies on investors to hold certain quality bonds. For example, commercial banks are encouraged by regulators to hold investment grade bonds (bonds rated Baa and above).

were unable to control for the purpose of revenue issue proceeds, since this would have resulted in too few revenue bond issues. Over 200 general obligation issues and 750 revenue bond issues met the five selection criteria with a minimum of 25 and 9 individual issues, respectively, during any single quarter. These indices are displayed in the Appendix.

Equation (1) is estimated over the 40 quarters from 1966 through 1975. This sample period is selected because it corresponds with the microeconomic data employed in the next section of the paper. Over the sample period, the revenue-general obligation yield differential averaged 22 basis points and ranged from 2 to 47 basis points; the percent change in real gross national product averaged 2.6 percent and ranged from −10.0 to 10.9 percent, commercial banks' proportionate purchases averaged 53.4 percent and ranged from −55.2 percent (net sellers) to 164.1 percent, and the relative supply variable averaged 38.1 percent and varied from 24.2 to 60.9 percent.

The best estimate of Equation (1) is

$$\begin{aligned} YD_t = {} & \underset{(1.9)}{17.96} - \underset{(-2.8)}{1.1532}\, PCGNP_{t-1} - \underset{(-1.0)}{0.4507}\, PCGNP_{t-2} - \underset{(-0.1)}{0.0517}\, PCGNP_{t-3} \\ & + \underset{(0.6)}{0.0192}\, RD_t + \underset{(0.1)}{0.0007}\, RD_{t-1} + \underset{(1.4)}{0.0445}\, RD_{t-2} + \underset{(0.6)}{0.1292}\, RS_t \end{aligned} \tag{1a}$$

where the regression coefficients are multiplied by 100, the t-ratios appear in the parentheses under the coefficients, and the summary statistics for the equation are: adjusted $R^2 = 0.163$, Durbin-Watson ratio = 2.24, and standard error of the estimate = 9.4 basis points.

The percent change GNP variable entered the equation negatively and the coefficients declined monotonically, as expected. The bank demand and relative supply variables entered the equation with the expected sign. The coefficients on the bank demand variables declined and then increased in magnitude. When additional lagged *PCGNP*, *RD*, and *RS* variables were added to the equation, they entered with the wrong signs and/or some of the previously estimated coefficients changed signs. In all instances the explanatory power of the equation is slightly reduced.[9] Because the coefficient pattern for bank demand suggests a possible permanent effect, Equation (1) was estimated employing the level of bank holdings as a fraction of total tax-exempt debt outstanding as an explanatory variable. No permanent effect was detected. Permanent effects in relative supply could not be tested because no similar relative supply data were available. Finally, Equation (1) was estimated with GOI as an independent variable to test for any

[9] Equation (1) was also estimated with weighted averages of both the GNP variable (*WTGNP*) and relative bank demand variable (*WTRD*) as regressors. The weights were derived from the coefficient estimates in Equation (1a) so that the proportionate contribution was maintained: $WTGNP = (1.1532/1.6556)PCGNP_{t-1} + (.04507/1.6556)PCGNP_{t-2} + (.0517/1.6556)PCGNP_{t-3}$, and $WTRD = (.0192/.0644)RD_t + (.007/.0644)RD_{t-1} + (.0445/.,0644)RD_{t-2}$. The regression results are:

$$\begin{aligned} YD_t = {} & \underset{(2.3)}{17.95} - \underset{(-4.3)}{1.6547}\, WTGNP + \underset{(1.8)}{0.0644}\, WTRD + \underset{(0.7)}{0.1293}\, RS \end{aligned}$$

where the adjusted $R^2 = 0.297$, Durbin-Watson ratio = 2.22, and SEE = 9.3 basis points.

effect the level of interest rates might have on the revenue-general obligation bond yield differential. In no equation estimated was GOI significant.

The Equation (1a) estimates suggest that a temporary decrease of one percentage point in real gross national product would raise the yield differential by almost 1.7 basis points over the following three quarters. The impact of the first quarter would be just over 1 basis point, decreasing to ½ basis point the following two quarters, and finally zero thereafter. Because the GNP variable had a range between −10 to 10.9 percent over the sample period, movements in this variable accounted for swings in the yield differential between the revenue-general obligation bond indexes of 35 basis points. The estimated coefficients also suggest that as commercial banks increase their proportionate purchases of tax-exempts by ten percent over a three/quarter period, the yield spread would increase by about two thirds of a basis point. Because movements in the bank demand variable ranged from −55 to 164 percent, the movement in this variable accounted for swings of as much as 14 basis points. For the supply variable, a ten percent increase in the supply of the revenue bonds relative to general obligation bonds would increase the yield differential by 1.3 basis points, and movements in this variable over the sample period accounted for changes in the rate spread of up to 5 basis points. Thus, during the 1966 to 1975 period, the impact of changes in economic conditions appears to be greater on the relative yield spread than does bank demand or relative supply.

III. Empirical Tests: Microeconomic Data

In the previous section we demonstrated with macroeconomic data that changes in real gross national product and changes in commercial bank purchases of tax-exempt securities relative to total issues affect the relative yield differential between revenue bond and general obligation bond indexes. The evidence regarding changes in the supply of revenue bonds relative to general obligation bonds was less conclusive. In this section we examine the effects of the same phenomena on the borrowing costs of individual bond issues. We do so by extending the basic model of net interest cost determination of previous studies to include the risk premium and segmentation variables described earlier.

Previous studies [1, 4, 5, 7, 9, 11, 12] suggest that the net interest cost paid by states and local governments on their new issue long-term serial bonds sold competitively is determined by the issue size, the number of bids submitted, the credit rating, the prevailing market rate of interest, the existence of call provisions, the final (or average) maturity of the issue, the slope of the yield curve at time of sale, and whether the bonds are revenue or general obligation. In addition, the revenue bonds are divided into two groupings—high risk and low risk. Previous evidence suggests that investors price discriminate systematically among like-rated revenue bond projects according to the type of revenue project [4, 7, 11]. These variables are listed in the first column in Table I. The issue size, number of bids received, and final maturity variables are entered as natural logarithms. The slope of the yield curve at time of sale is measured by the product of the spread between the twenty and one-year Salomon Brothers' yields on Aa to A-1 bonds ($i_{20} - i_1$) in the week closest to the date of sale and the natural logarithm

Table I

Determinants of New Issue Net Interest Cost for Tax-Exempt Revenue and General Obligation Bonds (N: 20,466)

	Equation (1.1)		Equation (1.2)		Equation (1.3)	
Explanatory Variable	Coefficient	t-value	Coefficient	t-value	Coefficient	t-value
Constant	−1.011	−31.0	−1.028	−31.9	−0.951	−29.4
Ln issue size ($)	0.034	10.5	0.026	8.0	0.024	7.7
Ln number of bids	−0.158	−34.4	−0.147	−32.1	−0.143	−31.7
Aaa	−0.706	−35.6	−0.690	−35.2	−0.684	−35.5
Aa	−0.545	−48.7	−0.543	−49.1	−0.543	−50.0
A	−0.314	−34.3	−0.321	−35.5	−0.320	−35.0
Baa	−0.060	−6.3	−0.063	−6.8	−0.057	−6.1
Market interest rate (%)	1.037	253.3	1.04	257.1	1.023	245.5
Call provision dummy	0.155	24.7	0.110	16.7	0.110	17.3
Ln final maturity	0.542	69.3	0.528	68.3	0.532	69.9
$(i_{20}-i_1)\cdot$Ln final maturity	0.071	52.8	0.070	52.9	0.066	49.6
High Risk	0.119	9.5	0.059	4.7	0.065	5.2
Low Risk	−0.062	−10.2	−0.039	−6.5	−0.041	−6.9
Revenue dummy			0.202	23.7	0.073	2.4
REV·WTGNP					−0.052	−24.5
REV·WTRD*					0.080	4.0
REV·RS*					0.601	9.5
Adjusted R^2	0.838		0.842		0.848	
Equation standard error	0.406		0.401		0.394	
F-ratio	8,820.0		8,407.6		7,101.4	

* coefficients are times 10^{-2}.

of the final maturity [5]. During the test period, the spread was always positive (i.e., the yield curve sloped upward). The market rate of interest is the simple average of the Salomon Brother's reoffering yield indexes on 5, 10, and 20-year good grade (Aa to A-1) bonds. The average maturity of the constructed index approximates the average maturity of the overall sample. Each bond issue is assigned the value of the average index closest to the sale date of the issue. Moody's or Standard & Poor's credit ratings were used as the measure of default risk; the former was employed when both ratings were available. To insure an adequate number of observations in each classification, Moody's A-1 and A rated bonds were grouped, as were Baa-1 and Baa rated bonds. Bonds rated below Baa and nonrated bonds were the excluded set for the credit rate dummy variables. Similarly, zero-one dummy variables were used to distinguish between the presence of a call provision (callable bond issue: no = 0 and yes = 1) and type of bond issue (revenue bond issue: no = 0 and yes = 1). For the purpose of proceeds variables, the high risk group includes bonds issued to finance university facilities including dormitories and industrial development bonds. The low risk group includes bonds issued to finance nonuniversity school facilities and refunding (including advanced refunding) bonds. Zero-one dummy variables were used to distinguish between high risk bonds (high risk purpose = 1 and all other = 0) and low risk bonds (low risk purpose = 1 and all other = 0); all other bond issues are the excluded set. The remaining three variables listed at the bottom of the first column are measures for the default risk, bank demand, and relative supply effects. They will be discussed following the preliminary testing of our basic model.

The net interest cost (NIC) is the dependent variable and is used as a measure of aggregate borrowing cost of a serial bond issue.[10] The individual bond data are taken from a sample of 20,466 new long-term serial bond issues sold competitively between 1966 and 1975. The data were collected from the *Daily Bond Buyer* and include all bond issues for which complete information was available. Approximately one-fifth of both the number and dollar volume of issues are revenue bonds with the remaining four-fifths general obligation bonds. The average bond issue had an average maturity of 12.6 years, totalled $4 million in size, and sold for a NIC of 5.17 percent.

Three regression equations are reported in Table I with summary statistics appearing at the bottom of the Table. The estimated coefficients of the basic model provided in Equation (1.1) are similar to those of other studies, have the

[10] NIC is the most common measure of aggregate interest cost on serial bond issues used by state and local governments to sell their new bond issues. Though it does not consider the time value of money, it is widely used in empirical studies [5, 6, 10, 15, and 16]. The equation for NIC is

$$NIC = \sum_{n=s}^{m} nA_n C_n - P / \sum_{n=s}^{m} nA_n$$

where

p = premium bid over aggregate par value for all maturities
C_n = coupon rate on bonds maturing in n periods
A_n = total par value of bonds maturing in n periods
n = number of years bond outstanding
s = years to first maturity
m = years to last maturity

anticipated sign, and are statistically significant from zero at the 1 percent probability level. The independent variables in the model explain more than four-fifths of the interissue variation in the NIC of the bond issues in the sample. Basically, the NIC of a bond issue is higher the larger the issue size, the fewer the number of bids received, the higher the general market rate of interest, the longer the issue's final maturity, the greater the slope of the prevailing yield curve, the lower the credit rating, and if the bond issue had a call provision. Also, as expected, both high risk and low risk bond issues have statistically significant higher (lower) interest cost, respectively, than comparable average risk bonds. The results indicate that the model is appropriate for testing our hypotheses.

Equation (1.2) includes all the control variables in Equation (1.1) plus a revenue bond dummy variable. The revenue variable entered the equation with the expected positive sign and was statistically significant at the 1 percent probability level. The estimated coefficient suggests that for the 1966 through 1975 test period, revenue bonds sold on the average for almost 20 basis points more than comparable general obligation bond issues.

Equation (1.3) extends the model to test for cyclical default risk and market segmentation effects. To accomplish this, three variables are added to Equation (1.2). The new variables are the product of the revenue dummy variable and each of the cyclical variables: *WTGNP*, *WTRD*, and *RS*. *WTGNP* and *WTRD* are computed as distributed lags, where equal weights are employed and the length of the lags are determined by the macroeconomic test in Section II of the paper. *RS* is as previously defined. A lagged weighting scheme as determined in the macroeconomic tests (Section II) and declining weighting schemes consistent with our theoretical expectations were also empirically tested. In general, the findings are not materially affected by the weighting scheme employed. Each bond issue is assigned the value of the cyclical variables for the quarter in which the issue was sold. The net interest cost differential is expected to widen as economic activity declines, as commercial banks increase their purchases of net tax-exempt securities, and as the supply of revenue bonds increases relative to total new tax-exempt bonds issued.

The estimated coefficients for the three cyclical variables are statistically significant at the 1 percent probability level and enter the equation with the hypothesized sign. The addition of the revenue dummy and the cyclical variables reduce the unexplained variance ($1 - \bar{R}^2$) of the basic model by 6 percent (0.010/0.162). The spread between revenue and general obligation bonds, evaluated at the means of *WTGNP*, *WTRD*, and *RS* variables, is 20 basis points. This suggests a fundamental yield differential between revenue bonds and general obligation bond issues after holding bond ratings and other factors constant. Because the default risk and segmentation variables are scaled by the revenue dummy, their estimated coefficients indicate the extent to which the NIC on a revenue bond changes relative to the NIC on a general obligation bond. In particular, a one percent decrease in real GNP would raise the NIC on revenue bonds 5.2 basis points relative to similar general obligation bonds over three quarters. This finding is more than triple the 1.7 basis point yield differential impact reported in Section II of the paper. For the bank demand variable, a ten percent increase in the relative purchases of tax-exempts by banks produces only a 0.8 basis point increase in the yield differential over three quarters. This value is nearly identical

to the 0.7 basis point change implied by our microeconomic estimate. Finally, a ten percent increase in the relative supply variable raises the yield differential 6 basis points which is over four times that implied by the macroeconomic estimates.

When viewed jointly, the cumulative impact of these three effects appears reasonable. More specifically, when the percent change in real GNP was at its peak, the yield differential was zero as the segmentation effects offset the default risk effect. When the relative demand and relative supply measures were at their peaks, the yield differential totalled 40 and 61 basis points, respectively. On the other hand, when these variables were at their minimums, the yield differential was 63 basis points for *WTGNP*, 46 basis points for relative bank demand, and 11 basis points for relative supply. These findings suggest that the default risk effect has a greater impact on the NIC differential than the market segmentation effects, and that relative supply is slightly more important in influencing the spread than bank demand.

IV. Conclusion

The evidence generated in this paper suggests that the yield differential between revenue bonds and similar general obligation bonds varies contracyclically with the level of economic activity. The evidence also indicates that significant investor-borrower induced market segmentation exists in the municipal bond market. An increase in the relative demand by commercial banks for tax-exempt securities decreases the yields on general obligation relative to revenue bond issues and, thus, increases the yield differential. Similarly, an increase in the supply of revenue bonds relative to the supply of general obligation bonds increases the yield spread between the two classes of debt. These findings were the result of a series of empirical tests with both macroeconomic and microeconomic data.

The findings utilizing macroeconomic data suggest that the effects of changes in real gross national product and changes in commercial bank purchases last on the average of two quarters and three quarters, respectively. The relative supply impact finding was inconclusive. The microeconomic data tests confirm the previous findings and further suggest that increases in the relative supply of revenue bonds sold also increases the yield differential. In addition, the findings suggest that the business cycle effect has a greater influence on the yield differential between revenue and general obligation bonds than do the relative demand or supply effects, and that the supply factors seem to have slightly greater influence in the yield spread.

The public policy implications of this research for state and local government debt management are clear. Under stable market conditions the interest cost differential between issuing revenue or similar general obligation bond issues may be quite small. During these periods, state and local governments would be wise to issue revenue bond issues and keep their general obligation bond borrowing capacity intact. This would be especially true if the municipality has a constitutional debt limit ceiling or has had difficulty gaining voter approval because of excess outstanding debt. On the other hand, during unstable market conditions,

the default risk effect is large, banks typically (though not necessarily) are heavy purchasers of municipal debt, and many municipalities may be forced to issue revenue debt. All of these conditions, of course, increase the yield differential between revenue and general obligation bonds. If the municipality's legally restricted debt capacity is low, it may be able to sell general obligation bonds rather than revenue bonds, and substantially reduce its new issue borrowing costs.

APPENDIX

General Obligation and Revenue Bond Indices

	Year									
Quarter	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975
	General Obligation Bond Index (GOI)									
I	3.531	3.480	4.164	4.657	5.791	4.170	4.354	4.573	4.601	5.600
II	3.651	3.581	4.251	5.132	6.030	4.745	4.567	4.645	5.506	6.167
III	4.086	3.895	4.040	5.744	5.585	4.917	4.494	4.903	6.186	6.398
IV	3.899	4.153	4.272	6.045	4.771	4.204	4.351	4.450	5.774	6.102
	Revenue Bond Index (RI)									
I	3.656	3.638	4.410	4.789	6.040	4.409	4.508	4.678	4.728	5.801
II	3.821	3.864	4.590	5.363	6.259	4.970	4.658	4.698	5.837	6.527
III	4.256	4.208	4.215	5.938	5.959	5.016	4.527	5.064	6.530	6.417
IV	4.256	4.438	4.445	6.226	5.028	4.450	4.466	4.811	6.247	6.401

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