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2 Explaining the Yield Spread between Taxable and Tax-exempt Bonds: The Role of Expected Tax Policy

James M. Poterba

The early 1980s was a period of turbulence in the municipal bond market. Interest rates on tax-exempt securities reached record heights, both in nominal terms and relative to comparably risky taxable bonds. Between January 1980 and January 1982, the yield differential between prime long-term municipal bonds and U.S. Treasury obligations fell from 375 to 175 basis points. The yield spread on short-term bonds also declined, but by a smaller amount. The income tax rate at which an investor would be indifferent between holding long-term taxable or tax-exempt securities declined dramatically, from 35% to less than 15%. During the same period, voter resistance to higher taxes, recession-induced service demands, and reductions in federal grants increased state and local borrowing by nearly 50%, even though many jurisdictions postponed capital expenditures because of high interest rates.

The escalation of tax-exempt interest rates has been attributed to many factors. Increased municipal risk, an increased supply of tax-exempt securities such as industrial revenue bonds, falling marginal tax rates among personal investors, and changes in commercial bank behavior have all been advanced as possible explanations.[1] The shrinking yield differential between taxable and tax-exempt securities has germinated many proposals designed to reduce the real cost of debt finance by altering municipal borrowing practices. Proposals include

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increased use of short-term debt, issuing "put bonds" that grant the bondholder the right to terminate his debt contract after a fixed number of years, and use of floating-rate long-term bonds. There has also been renewed interest in the long-standing plan for replacing the current income tax exemption for municipal interest with a federal subsidy to state and local borrowing. The likely impact of these proposals on municipal interest costs is controversial, largely because of disagreement over the forces behind the recent increase in tax-exempt interest rates.

There are several competing theories of how equilibrium yields are determined in the municipal bond market. One view holds that commercial banks are the marginal holders of municipal debt, since they are the only class of investors who are able to borrow at the after-tax interest rate and invest the proceeds in tax-exempt securities. This view implies that only the tax rates facing commercial banks should affect the municipal-taxable yield spread. A second view, which has developed from research on a theory of corporate capital structure proposed by Merton Miller (1977), also relates the yield spread to corporate tax rates. In Miller's model, changes in the relative supplies of corporate debt and corporate equity ensure that the marginal investor choosing between holding taxable and tax-exempt debt faces an interest tax rate equal to the statutory corporate rate. The model predicts that changes in investor tax rates should have no effect on the relative prices of taxable and tax-exempt bonds, although they might affect the equilibrium quantities of different securities.

A third and more traditional view, described by Mussa and Kormendi (1979) and Hendershott and Koch (1977), holds that the municipal bond market is segmented by maturities. Different classes of investors hold long- and short-term bonds, with banks predominating at short maturities and households purchasing most long-term debt. Under this view, personal tax changes should affect the yield spread on long-term bonds, but should have little impact on the relative yields on short-term taxable and tax-exempt bonds.

This paper examines the impact of changing tax expectations on the taxable–tax exempt yield spread. In particular, it tests the hypothesis that downward revisions in expected personal tax rates can lower the yield spread between taxable and tax-exempt debt. Only the third model predicts that such changes should affect relative bond prices. By examining data from four events that substantially altered tax rates—the 1964 Kennedy-Johnson tax cut, the Vietnam War tax surcharge, the 1969 Tax Reform Act, and the 1981 tax cut—this study provides new evidence that *both* personal and corporate tax changes affect the relative yields on taxable and tax-free bonds. These results help distinguish among the competing models of municipal market equilibrium,

and illuminate questions about how various policy changes would affect municipal borrowing costs.

The findings also suggest that expected tax changes explain a sizable fraction of the recent narrowing in the taxable–tax exempt yield spread. The passage of the 1981 Economic Recovery Tax Act was contemporaneous with a 25% reduction in the yield spread between long-term municipal and taxable bonds. Although tax reforms cannot explain the entire increase in tax-exempt yields relative to taxable yields during the early 1980s, they appear to have had a significant effect.

This paper is divided into five sections. The first chronicles movements in municipal borrowing costs during the last three decades. The second section presents the three competing models of municipal debt pricing in greater detail and identifies the predictions of each regarding the impact of tax changes on yield spreads. The third section describes my data set and explains the procedure that was used to identify periods of changing tax expectations. The fourth section presents empirical evidence on the effects of tax changes during the last two decades on the taxable–tax exempt yield spread. The concluding section reviews the implications of my results for proposals to reform municipal borrowing policies.

2.1 Recent Movements in Municipal Borrowing Costs

This section describes recent movements in the yield spread between taxable and tax-exempt interest rates. Monthly interest rate data were obtained from Salomon Brothers' *Analytical Record of Yields and Yield Spreads*. These data, derived from yield curves for par bonds with current issue characteristics, are calculated on the first of each month. The differential between taxable and tax-exempt yields can be described by the implicit tax rate, θ^I, which would characterize an investor who was indifferent between the two yields. This tax rate is defined by $(1 - \theta^I)R = R_M$, where R is the yield on a taxable bond and R_M is the yield on a comparably risky tax-exempt security.

The implicit tax rates reported here are calculated from yields on newly issued Treasury securities and prime-grade general obligation tax-exempt bonds. Both securities are close to riskless.[2] "Prime" is the highest rating awarded to municipal bonds by Salomon Brothers. The restriction to general obligation bonds is also important, since many recent events such as the Washington Public Power Supply System default have altered the perceived riskiness of revenue bonds issued by states and localities. These developments should have had a much smaller effect on the market for general obligation bonds, which are backed by the "full faith and credit" of the issuing government.

Table 2.1 reports annual average values of the implicit tax rates on one-, five-, ten-, and twenty-year bonds for the period 1955–83. The series show pronounced declines in the implied tax rates on both long- and short-maturity bonds between 1979 and 1982. The twenty-year implied tax rate declined by more than twenty percentage points during

Table 2.1 **Tax Rates Implied by Taxable and Tax-exempt Bond Yields, 1955–83**

	Treasury bonds versus prime-grade municipals			
Year	20-year Maturity	10-year Maturity	5-year Maturity	1-year Maturity
1955	.244	.341	.406	.414
1956	.219	.279	.333	.413
1957	.151	.222	.296	.380
1958	.189	.262	.326	.412
1959	.222	.290	.376	.433
1960	.227	.293	.364	.422
1961	.190	.284	.397	.476
1962	.256	.353	.423	.468
1963	.261	.351	.412	.465
1964	.265	.327	.375	.442
1965	.264	.316	.346	.426
1966	.227	.266	.316	.336
1967	.239	.286	.325	.370
1968	.226	.282	.330	.405
1969	.133	.214	.278	.344
1970	.101	.259	.353	.387
1971	.130	.292	.390	.405
1972	.154	.331	.388	.435
1973	.282	.339	.374	.453
1974	.282	.300	.366	.424
1975	.217	.266	.364	.408
1976	.276	.361	.424	.475
1977	.322	.406	.439	.507
1978	.346	.408	.436	.493
1979	.355	.417	.429	.497
1980	.308	.400	.439	.485
1981	.229	.323	.395	.463
1982	.154	.249	.336	.424
1983	.206	.281	.372	.445
Averages:				
1955–59	.205	.279	.348	.411
1960–69	.229	.297	.357	.415
1970–79	.247	.338	.396	.448
1980–83	.224	.313	.386	.454

SOURCE: Salomon Brothers, *Analytical Record of Yields and Yield Spreads* and author's calculations.

this period. The tax rates implied by short-term yields declined less dramatically, from 50 to 42%. These changes are larger than those observed in any other three-year period in the postwar era.

The table also shows that in every year the implicit tax rate on short-term bonds was substantially higher than that on any of the long-term bonds. The divergence was most pronounced in the late 1960s and early 1980s, when the difference between the implicit tax rates on one- and twenty-year bonds exceeded twenty-five percentage points. There are also persistent differences in the *levels* of long- and short-term municipal interest rates. Throughout the postwar period, long-term tax-exempt interest rates have exceeded short-term rates, often by as much as 50%. The perennial upward slope in the tax-exempt term structure is the motivation for some recent proposals to increase state and local short-term borrowing.

Several warnings about the use of implied tax rates must be issued before drawing strong conclusions from the data in table 2.1. First, if there are differential expected capital gains on municipal and Treasury bonds, then the implied tax rates will not reflect marginal interest tax rates.[3] If the expected capital gain on a taxable bond is larger than that on a comparable tax-exempt bond, then their yields to maturity will be closer than they would be assuming equal capital gains. This will bias the implied tax rate toward zero.

Tax reforms are one source of capital gains and losses. If tax rates are expected to decline, then the value of tax exemption will diminish and the holders of tax-exempt bonds will experience capital losses. The implied tax rate on long-maturity bonds will therefore be below the current tax rates facing investors. The yield spread between short-term taxable and tax-exempt bonds should depend on current tax rules, while the spread at longer maturities depends on the expected path of tax rates over a longer horizon.

A second problem in comparing the yields on different bonds arises because long-term bonds provide their holders with the opportunity to engage in tax-trading strategies. Investors should therefore require a lower coupon yield than on short-maturity bonds of comparable risk. This contaminates inferences about the term structure of implied tax rates, and it may also contaminate the estimated yield differential between taxable and tax-exempt bonds of the same maturity. Constantinides and Ingersoll (1984) find that the tax-timing option on municipal securities is worth substantially less than the option on taxable bonds, primarily because there are no tax advantages associated with establishing an above-par basis in a municipal bond. The implied tax rate calculated from yields to maturity will therefore *underestimate* the actual tax rates on investors, with larger biases for longer-maturity

bonds. These biases can cause large errors in the levels of implied tax rates calculated from long-term yield data. However, the *changes* in implied tax rates, which I focus on, may be less subject to these biases.[4]

A third difficulty with implied tax rates is caused by differential risk. If prime municipals are riskier than Treasury bonds, then the estimated marginal tax rates are biased downward. Moreover, there may be a larger risk differential between long-term municipal and Treasury bonds than between short-term bonds of these types, implying that the bias is greater on long-maturity bonds. If the perceived riskiness of municipal securities has increased in recent years because of near-defaults or taxpayer revolts, it could account for declining implicit tax rates. However, the change in default probabilities required to explain the recent narrowing of the yield spread is implausibly large.[5]

This paper focuses on the effects of expected tax changes in explaining monthly changes in the taxable–tax exempt yield spread. The next section outlines several models with different predictions about which tax rates determine the taxable–tax exempt yield spread. Subsequent sections provide empirical evidence on how announcements of impending tax reform influence the relative yields of taxable and tax-exempt bonds.

2.2 Alternative Models of Municipal Bond Market Equilibrium

The prices of taxable and tax-exempt bonds are determined in a financial general equilibrium. Any analysis of the relative yields on taxable and municipal bonds must therefore specify the behavior of firms and governments that supply these assets as well as the investors who demand them. This section discusses three competing theories of the determination of the taxable–tax exempt yield spread. They generate different predictions regarding how changing tax expectations should affect the implied tax rates calculated from yields to maturity.

2.2.1 The Bank Arbitrage Hypothesis

The first model was developed by Eugene Fama (1977) and has subsequently received favorable empirical support from Skelton (1983). Fama noted that one class of investors, commercial banks, can operate simultaneously in both the taxable and tax-exempt bond markets. Unlike most other investors, banks are permitted to deduct interest payments from their taxable profits even while investing in tax-exempt securities. If the tax-exempt yield, R_M, exceeds the after-tax cost of bank borrowing $(1 - \tau)R$, where τ is the corporate tax rate and R is the taxable interest rate, then commercial banks will issue taxable bonds or notes and purchase municipal securities. By demanding municipal bonds, banks will drive up prices and lower yields until $R_M =$

$(1 - \tau)R$. Alternatively, if municipal yields are below this level, banks will reduce their holdings of municipal bonds and use the proceeds to extend other loans. Since banks have held large amounts of municipal debt for most of the past three decades, and currently own more than one-third of outstanding state and local debt, they have ample reserves to undertake these portfolio adjustments. This model suggests that while the yield spread between taxable and tax-exempt bonds should be stable, the monthly changes in commercial bank holdings of municipal debt could be quite volatile.

There seems little doubt that banks undertake the tax arbitrage transactions described above, especially with short-term bonds.[6] Beek (1982) reports that 52% of the tax-exempt debt held by commercial banks is of less than one-year maturity,while 92% of bank holdings has maturities of less than five years. The role of banks in performing tax arbitrage with long-term bonds is more doubtful, and may be restricted by institutional limitations and other factors. Skelton notes that

> banks may deduct the interest payments on debt obligations incurred in the normal course of business while receiving tax-exempt coupon payments . . . however, liabilities with maturities in excess of three years are considered to be potential contributions to capital and as such are subject to scrutiny of the tax authorities. In addition, long term debt issues by banks must be approved by the Comptroller of the Currency and the FDIC who, as a rule, limit such financing to one third of total capital. This special opportunity for banks, therefore, is limited to the short end of the maturity spectrum. [Skelton 1983, 346]

Even if banks cannot issue long-maturity debt, of course, they should be able to undertake arbitrage in the long-term market by issuing short-term securities while purchasing long-term bonds. This exposes them to some real interest rate risk, but this is a type of risk that they are frequently called upon to hedge.

The bank arbitrage analysis implies that changes in the stock of municipal debt outstanding will have no impact on the relative yields of taxable and tax-exempt debt. Changes in security volume will require more or less borrowing or lending by banks, but the relative yields will not change. In this model, we do not have to explain the debt-supply behavior of states and localities in order to determine equilibrium prices.

Tax changes, however, can affect the yield spread. A temporary reduction in the corporate tax rate will lead to a substantial narrowing of the short-term yield spread but only a small change in long-term yields. A reduction in expected future corporate tax rates would reduce the current yield spread on long-maturity bonds, with no effect on short-

term yields. More importantly, the model suggests that personal tax rates are *irrelevant* for determining municipal interest rates.

The bank arbitrage model suggests that, absent any variation over time in expected corporate tax rates, divergences in the yields on taxable and tax-exempt bonds at varying maturities must be attributable to the risk characteristics of the different securities. Fama (1977) argues that although yields to maturity on comparably rated corporate and municipal bonds frequently imply tax rates *below* the corporate tax rate, especially at long maturities, this is due to inadequate risk comparison. He suggests that since bondholders are less able to enforce restrictive covenants against municipal than against corporate borrowers, and since local government assets are virtually impossible to seize during bankruptcy, tax-exempt bonds are riskier than corporate debt. These factors, combined with uncertainties about future political actions, induce higher yields on long-maturity municipal bonds than on top-quality corporate debt.

One piece of evidence against this explanation of long-term yield differentials was provided by Gordon and Malkiel (1981). They compared the yields on long-term corporate bonds and industrial revenue bonds that were backed by the same firms. These bonds were similar in all respects except their tax treatment, with the industrial revenue bonds providing tax-exempt interest. The yields on these securities suggested implied tax rates of about 25%, substantially lower than the prevailing corporate tax rate. Differential risk cannot explain this divergence.

The bank arbitrage model is appealing for its simple account of equilibrium pricing in the municipal bond market. However, it may be of limited relevance for describing future developments in this market. Table 2.2 shows the holdings of municipal debt by commercial banks, households, and property and casualty insurance companies during the period since 1955. Commercial banks' share of the tax-exempt market has declined in each of the last eleven years. Their holdings have declined precipitously since 1980, falling from 42% of the outstanding stock to just over 33% at the beginning of 1984. As a result, households have become increasingly important as holders of municipal debt.

The recent decline in commercial bank activity in municipal debt is attributable to three factors. First, changes in the availability of other sources of tax-sheltered income, particularly the rise in leasing since 1980, have reduced commercial banks' reliance on tax-exempt bonds as a device for lowering tax liability. Second, bank profits were depressed in 1981 and 1982; this diminished the need for tax-exempt income. Finally, the Tax Equity and Fiscal Responsibility Act of 1982 limited banks' interest deductions to 85% of the carrying costs of their municipal bond investments. This reduced the attractiveness of the tax

arbitrage described above, and led to increased investment in other assets. The future role of commercial banks in the municipal market remains uncertain.

2.2.2. The Miller Model

The second model of the municipal market was developed by Merton Miller (1977), primarily to analyze questions about corporate capital structure. It emphasizes the role of corporations as suppliers of debt and equity in determining the pattern of equilibrium yields. To highlight the role of tax clienteles, I shall present the model in a world of certainty.

First, consider the situation in which there are no municipal bonds. Firms earn a fixed pretax return R on their investments. If a firm is financed exclusively with debt, then the after-tax return received by its owners is $(1 - m)R$, where m is the investors' tax rate on interest income. Since for tax purposes interest payments are deductible from corporate profits, corporate profits tax liability equals zero. By comparison, if the firm were financed with equity, shareholders would receive an after-tax return of $(1 - \tau)(1 - \tau_e)R$, where τ_e is the effective marginal tax rate on equity income and τ is the corporate tax rate. If shareholders face different marginal tax rates, then those for whom $(1 - m) > (1 - \tau)(1 - \tau_e)$ will hold debt while those for whom $(1 - m) \leq (1 - \tau)(1 - \tau_e)$ will invest in equity. This condition can be rewritten as $\tau \gtrless (m - \tau_e)/(1 - \tau_e)$. In equilibrium, investors will be completely specialized in holding either debt or equity.

Aggregate corporate financial policy is determined by the relationship (Debt/Equity) $= \eta$, where

$$(1) \quad \eta = \frac{\text{Net Worth Held by Investors with } (m - \tau_e)/(1 - \tau_e) < \tau}{\text{Net Worth Held by Investors with } (m - \tau_e)/(1 - \tau_e) \geq \tau}.$$

The relative returns on debt and equity satisfy

$$(2) \qquad (1 - \tau_e^*)R_{eq} = (1 - m^*)R$$

where the pretax equity return is $R_{eq} = (1 - \tau)R$. The marginal tax rates facing investors who are indifferent between debt and equity are indicated by asterisks; they satisfy $(1 - \tau_e^*)(1 - \tau)R = (1 - m^*)R$. Corporations adjust their debt- equity ratios to ensure that all investors for whom $(1 - \tau_e)R_{eq}$ exceeds $(1 - m)R$ are able to hold equity, and all those for whom $(1 - m)R \geq (1 - \tau_e)R_{eq}$ can hold debt.

Tax-exempt debt, M, can be introduced into this framework.[7] If there are no taxes on equity income and there is no uncertainty, then municipal debt and corporate equity are perfect substitutes and they must have the same return. This return must equal $(1 - \tau)R$. If there are taxes on equity income, then investors who hold municipals will be

Table 2.2 **Trends in the Ownership of Municipal Bonds**

Year	Share of outstanding debt held by:			Share of net change in municipal debt absorbed by:		
	Commercial banks	Households	Property and casualty insurance companies	Commercial banks	Households	Property and casualty insurance companies
1955	.282	.422	.091	.003	.684	.160
1956	.264	.435	.099	.029	.647	.213
1957	.262	.432	.104	.248	.378	.156
1958	.282	.405	.106	.462	.146	.129
1959	.261	.430	.111	.053	.752	.183
1960	.250	.435	.114	.173	.489	.177
1961	.270	.422	.119	.463	.371	.201
1962	.316	.388	.122	1.009	−.043	.166
1963	.346	.368	.122	.809	.085	.133
1964	.362	.373	.118	.666	.385	.073
1965	.387	.363	.113	.699	.245	.056
1966	.389	.382	.114	.325	.903	.159
1967	.443	.335	.119	1.195	−.342	.199
1968	.478	.305	.117	.896	−.133	.105
1969	.447	.352	.116	.005	.993	.119

1970	.464	.340	.117	.993	−.064	.146
1971	.505	.297	.122	.721	−.001	.204
1972	.513	.277	.135	.477	.156	.297
1973	.500	.280	.147	.377	.359	.253
1974	.494	.290	.148	.305	.517	.138
1975	.472	.304	.149	.045	.434	.195
1976	.443	.303	.155	.172	−.028	.510
1977	.441	.276	.178	.361	−.115	.623
1978	.432	.255	.208	.382	−.152	.673
1979	.426	.256	.223	.320	.305	.372
1980	.420	.257	.230	.434	.217	.302
1981	.413	.265	.228	.151	.503	.178
1982	.386	.290	.215	.035	.538	.079
1983	.345	.333	.194	−.014	.609	.035
Averages:						
1955–59	.270	.425	.102	.159	.521	.168
1960–69	.369	.372	.117	.624	.295	.139
1970–79	.469	.288	.158	.415	.141	.341
1980–83	.394	.282	.219	.126	.472	.166

NOTE: The first three columns report the fraction of state and local obligations outstanding at the end of each year which are held by each class of investor. The last three columns report the ratio of the change in each investor class's holdings to the total change in debt outstanding. Data are drawn from the flow of funds accounts.

those for whom $R_M \geq (1 - m)R$ and $R_M \geq (1 - \tau_e)(1 - \tau)R$. Figure 2.1 summarizes the relationship between an investor's tax rate and his portfolio composition, assuming that equity tax rates are a linear function of those on interest income.[8] The diagram makes clear that municipal bondholders are investors who, in the absence of tax-exempt debt, would have held equity. There is a critical value of τ_e at which, given R_M, investors will be indifferent between holding tax-exempt debt and taxable equity. The value of τ_e such that $(1 - \tau_e)R_{eq} = R_M$ will be defined as τ_e^{**}; it corresponds to the "marginal investor" in municipal bonds. Given a stock of municipal debt M, the relative yield on taxable and tax-exempt debt is determined by finding τ_e^{**} such that the total wealth held by investors with $\tau_e \geq \tau_e^{**}$ and $\tau < (m - \tau_e)/(1 - \tau_e)$ equals M. Municipal and corporate bond yields are then related by

$$R_m = (1 - \tau_e^{**})R_{eq} = (1 - \tau_e^{**})(1 - \tau)R. \tag{3}$$

In this model, changes in the stock of municipal debt have two effects. First, an increase in M will lower the value of τ_e^{**}, since more investors must be induced to hold municipal debt instead of equity. This will reduce the yield spread between taxable and tax-exempt debt, since

$$R - R_M = (\tau + \tau_e^{**}(1 - \tau))R. \tag{4}$$

In addition, changing the supply of municipal debt will lead to offsetting adjustments in corporate debt-equity ratios. The precise nature of this

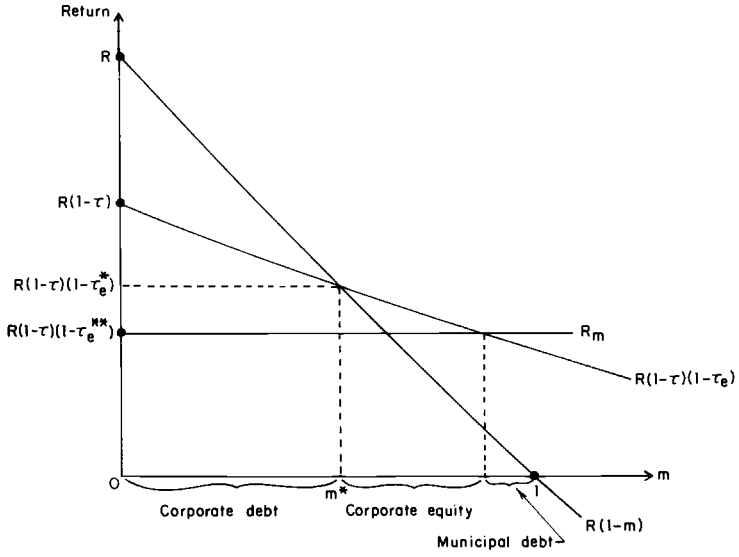

Fig. 2.1 Asset choice in the Miller Model

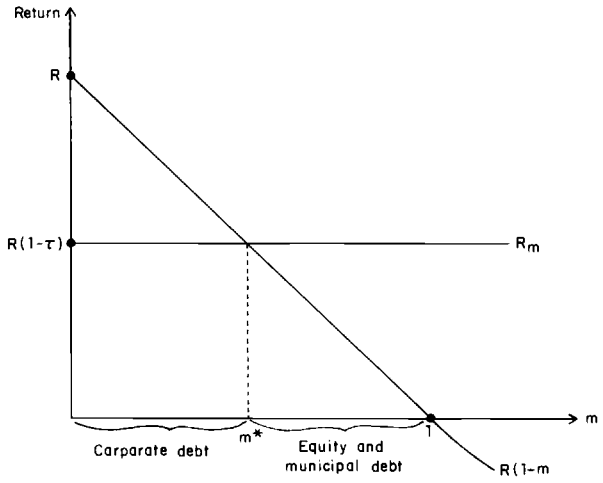

Fig. 2.2 Asset choice in the Miller Model I ($\tau_e = 0$)

effect depends crucially on whether issuing municipal bonds induces a change in the level of private savings. Assuming that total savings are unaffected by an increase in the stock of municipal debt, each dollar of municipal debt displaces one dollar of corporate equity. The corporate debt-equity ratio will satisfy

$$\frac{D}{E} = \eta\left(1 + \frac{M}{E}\right). \tag{5}$$

Increasing the stock of municipal debt will therefore raise the corporate debt-equity ratio.

If issuing municipal bonds induces a change in private savings, then the effect on the corporate debt-equity ratio is unclear. If all additional savings come from investors for whom $(1 - \tau) \geq (1 - m)/(1 - \tau_e)$, investors who hold equity in equilibrium, then the debt-equity ratio will rise by less than it would in the fixed-savings case. If, however, there is increased savings from individuals for whom $(1 - \tau) \leq (1 - m)/(1 - \tau_e)$, then the debt-equity ratio might decline by more than the amount predicted in (5).

In considering the effect of tax changes on the yield spread, it is helpful to distinguish between two versions of the Miller model. They will be labelled Miller Model I and Miller Model II. The first model, which was presented by Miller (1977) and subsequently supported by Trzcinka (1982) and others, holds that the effective tax rate on equity income is zero. This case, which is a special case of the $\tau_e \neq 0$ model, is shown graphically in figure 2.2. If the equity tax rate is zero, then the previous conclusions with respect to changing the stock of munic-

ipal debt no longer obtain. Provided M is less than the total wealth of individuals for whom $(1 - m) \leq (1 - \tau)$, changes in the stock of tax-exempt debt will have no effect on R_M. Since $\tau_e^{**} = 0$, $R_M = (1 - \tau) R$ regardless of relative security supplies. As in the bank arbitrage model, changes in the personal tax code will have no impact on the yield spread between taxable and tax-exempt debt. Corporate tax changes will, however, alter the yield spread between taxable and tax-exempt bonds.

The predictions of this model are therefore identical to those of the bank arbitrage model. The mechanism that ensures that $R_M = (1 - \tau) R$ is different, however. This provides one way of distinguishing between the two views. When there are changes in the tax rates or rules applying to banks, but not other firms, the bank arbitrage model predicts that there will be changes in the taxable–tax exempt yield spread. Miller Model I makes no such prediction.

The second version of the Miller model, which I have already described above, allows for the possibility that equity tax rates are positive. This view is supported by the observation that since part of the return to equity holders is through dividend payments, $\tau_e = (1 - \alpha)z + \alpha m$, where α is the firm's payout ratio, z is the effective tax rate on capital gains, and m is the dividend tax rate. In many cases the dividend and interest tax rates are equal. Even if capital gains are untaxed, therefore, the dividend tax burden should make τ_e greater than zero. Although Miller and Scholes (1978, 1982) have argued that the interaction of various tax code provisions makes the effective dividend tax rate zero, their view seems contradicted by evidence on both the tax status of investors (Feenberg 1981) and some findings on the behavior of share prices and corporate dividend decisions (Poterba and Summers 1985).

In Miller Model II, a change in either the corporate tax rate or the provisions of the personal tax code affecting the tax rate on equity income will alter the yield spread between taxable and tax-exempt bonds of comparable risk. A change in the stock of tax-exempt debt could also affect the yield spread, as described above. Increased municipal borrowing reduces τ_e^{**} and thereby narrows the yield spread.

The strict predictions described above about investor specialization in only one asset depend crucially upon that assumption of perfect certainty. When corporate debt, equity, and tax-exempt bonds are all risky assets, portfolio choices will not be determined solely by tax considerations. Auerbach and King (1983) discuss these issues in greater detail.

2.2.3 The Preferred Habitat Model

The bank arbitrage model and both Miller models ignore the agency and transactions costs associated with corporate and municipal finance.

Firms often incur costs from issuing debt rather than equity.[9] Maturity matching, in which firms, states, and localities attempt to incur liabilities with maturities roughly equal to those of their assets, also appears to be a prevalent practice. These market imperfections may restrict movement to equilibrium in the models described above.

A final view of municipal market equilibrium, the "preferred habitat" model, holds that states and municipalities have distinct maturity preferences when issuing different types of debt. Legal restrictions and other factors lead to the use of long-term bonds when financing capital expenditures, and the use of short-term debt primarily to smooth fluctuations in revenues. Other institutional constraints and a desire for maturity matching on the part of lenders lead different classes of investors to hold short- and long-term municipal bonds. Thus, the markets for short- and long-term municipal debt are not linked by any operative arbitrage mechanism, either on the part of suppliers (states and localities) or demanders of debt.

This view explains the divergence in the implied tax rate on short- and long-term bonds as due to the varying tax rates facing the demanders of municipal debt of different maturities. Mussa and Kormendi (1979) present a clear description:

> Commercial banks are the dominant holders of short-term municipal bonds and also hold short-term taxable instruments with essentially the same risk and other characteristics. The yield differential between short-term municipal bonds and comparable short-term taxable instruments is close to the corporate tax rate of 48 percent, since this is the yield differential that offsets the tax advantage of short-term municipal bonds for the dominant holder of such bonds. For long-term municipal bonds, the yield differential is not set by the tax rate for commercial banks. Banks hold long-term municipal bonds, but they do not hold any significant amount of long-term corporate bonds. Hence, the investor who is just balancing between long-term municipal bonds and long-term corporate bonds cannot be a bank but must be some other investor. For this investor, the equalizing yield differential is not 48 percent but only about 30 percent. [Mussa and Kormendi 1979, 7]

This model suggests that the short-term municipal market behaves according to the bank arbitrage model, while at long maturities Miller Model II is a more accurate description of the market.

Under this view, the effect of changing the stock of outstanding debt will depend upon the maturity at which it is issued. Short-term bond issues will not change the implied tax rate on short-maturity municipal debt, while long-term bonds may have an impact on the relative pricing of taxable and tax-exempt securities. The model's predictions with regard to tax changes are also a mix of the previous results. Corporate tax changes will affect both the short- and long-term yield spread be-

tween taxable and tax-exempt debt. The effect of personal tax changes, however, will be confined to the long-term yield spread.

The "preferred habitat" model provides an account of why the implied tax rates on long- and short-term municipal debt may differ. However, it also emphasizes our lack of understanding of municipal financial policy, since it raises a puzzle: Why do municipalities issue long-term debt? If the upward-sloping tax-exempt term structure is partly due to the maturity preference of municipal bondholders, and high tax bracket investors prefer short-maturity bonds, then states and localities could reduce their borrowing burden by issuing short-term securities. One explanation of their failure to do this is that there are substantial transactions or administrative costs associated with rolling over short-maturity debt, or raising taxes to pay off principal during a liquidity crisis. This argument is more persuasive in the case of small townships or municipalities than for cities and states with ongoing financial needs, since the latter are involved in frequent debt issues.

A second reason for the reluctance to use roll-over short-term debt may be that interest payments over the course of a year become uncertain. This could impede budgeting, create situations in which tax revenues would not fully cover expenses, or require more frequent changes in tax rates than under a system with fixed-rate long-term finance. Finally, the municipalities' fear of credit rationing cannot be ignored. Prior to the New York City crisis in 1974–75, 53% of state and local debt issues were at short maturities. This declined to 35% in 1976 and 1977, and it has not exceeded 40% since then.[10] Beek (1982) suggests that the danger of being unable to refinance a short-term bond issue is frequently a reason for issuing long-term debt.

Table 2.3 provides a summary of the three views of municipal market equilibrium that have been described in this section. It outlines their

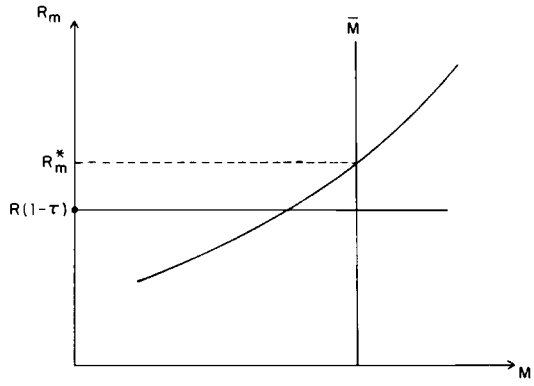

Fig. 2.3 The demand curve for municipal debt, different equilibrium models

Table 2.3 **Summary of Alternative Models of Municipal Market Equilibrium**

Equilibrium model	Effect on taxable–tax exempt yield spread (by maturity)					
	Increasing stock of municipal debt		Raising corporate tax rates		Raising personal tax rates	
	Short	Long	Short	Long	Short	Long
Bank arbitrage model	none	none	↓	↓	none	none
Miller Model I ($\tau_e = 0$)	none	none	↓	↓	none*	none*
Miller Model II ($\tau_e \neq 0$)	↑	↑	↓	↓	↓	↓
Preferred habitat model	none	↑	↓	?	none	↓

*Some personal tax changes could have an effect by eliminating the provisions of the tax code which Miller and Scholes (1978) argue permit investors to reduce their equity tax burden to zero.

predictions for how tax changes and changes in the stock of municipal debt affect yield spreads. The shape of the demand curve for municipal debt under each of the competing hypotheses is shown in figure 2.3. The horizontal demand curves for municipal securities correspond to either the bank arbitrage model or Miller Model I. The upward-sloping demand curve reflects either the preferred habitat model at long maturities or Miller Model II. The next two sections develop empirical tests that try to distinguish between these views.

2.3 Empirical Methods

The competing views of the municipal market can be tested by examining the reaction of long- and short-term yield spreads to changes in expectations about tax policy. Changes in current corporate tax rates should affect short-term yield spreads under all views. Miller Model II and the preferred habitat theory suggest that movements in expected personal tax rates should show up in long-term yield differentials, while the bank arbitrage model and Miller Model I suggest that only changes in future corporate rates should affect long-term yields. This section describes my procedure for analyzing the impact of expected tax changes on yield spreads.

2.3.1 Asset Pricing Framework

In equilibrium, newly issued T-period bonds with a par value of one dollar and a tax-exempt coupon C^m will sell at par if

$$1 = \sum_{j=0}^{T} (1 + \rho)^{-j} C^m + (1 + \rho)^{-T} \tag{6}$$

where ρ is the nominal after-tax discount rate applied to the bond's income stream. Similarly, a taxable bond selling at par must satisfy the condition

$$1 = \sum_{j=0}^{T} (1 + \rho)^{-j}(1 - \theta_j^e) C^t + (1 + \rho)^{-T} \tag{7}$$

where C^t is the taxable coupon and θ_j^e is the expected marginal tax rate of the marginal holder of this bond in period j. This tax rate could change over the life of the bond in either of two ways. The tax code might change, altering θ_j for the bond's initial owner, or the owner of the bond might change, as when a household purchases a long-term new-issue bond and sells it to a bank when its remaining maturity is five years. For bonds that are sold at par, the yield to maturity (y) equals the coupon rate, so $y^t = C^t$ and $y^m = C^m$.

The asset pricing equations can be linearized, following standard procedures from term-structure studies, to calculate the effect of a tax change on each bond's yield to maturity. My analysis assumes that the discount rate, ρ, is unaffected by the tax change. This is an oversimplification, since major reforms in either the corporate or personal tax system are likely to affect the after-tax return available to investors.[11] The yield to maturity on a tax-exempt bond must equal ρ, so by assumption the tax change will have no effect on the required municipal coupon rate. Changes in expected tax rates will, however, affect the required coupon on taxable bonds selling at par. By differentiating (7), we find

$$\frac{dy^t}{d\theta_j^e} = \frac{dC^t}{d\theta_j^e} = \frac{(1 + \rho)^{-j} C^t}{\sum_{k=0}^{T} (1 + \rho)^{-k}(1 - \theta_k^e)} = w_j . \tag{8}$$

The change in the taxable yield to maturity from one period to the next is

$$dy^t = \sum_{j=0}^{T} w_j d\theta_j^e . \tag{9}$$

The implied tax rate computed by comparing taxable and tax-exempt yields at maturity T is defined to be θ_T^I, where

$$\theta_T^I = (y_T^t - y_T^m)/y_T^t . \tag{10}$$

Changes in the implied tax rate can be linked to changes in expected future tax rates using (9):

$$d\theta_T^t = \frac{y_T^m}{(y_T^t)^2} \cdot dy_T^t = \sum_{j=0}^{T} z_j d\theta_j^e \tag{11}$$

where

$$z_j = \frac{(1 - \theta_T^t)(1 + \rho)^{\ j}}{\sum_{k=0}^{T}(1 - \theta_k^e)(1 + \rho)^{-k}} = \frac{C^t(1 - \theta_T^t)(1 + \rho)^{-j}}{1 - (1 + \rho)^{-T}} = \frac{C^m(1 + \rho)^{-j}}{1 - (1 + \rho)^{-T}} . \tag{12}$$

In the special case of a consol, the expression for $d\theta^t$ becomes

$$d\theta_\infty^t = \rho \sum_{j=0}^{\infty} (1 + \rho)^{-j} d\theta_j^e \tag{13}$$

which is just a discounted sum of changes in expected future tax rates.

The change in the implied tax rate can also be written in terms of holding period returns on taxable and tax-exempt bonds. In the fixed discount rate case, the price of a taxable consol is $P_\infty^t = 1/y_\infty^t$ and the expression for θ_∞^t becomes

$$\theta_\infty^t = 1 - \frac{y_\infty^m}{y_\infty^t} = 1 - \frac{P_\infty^t}{P_\infty^m} . \tag{14}$$

Therefore the change in the implied tax rate is proportional to the return on the taxable consol, since

$$d\theta_\infty^t = - \frac{dP_\infty^t}{P_\infty^t} \cdot \frac{P_\infty^t}{P_\infty^m} . \tag{15}$$

where dP_∞^t/P_∞^t is the holding period return. If the discount rate were allowed to vary, $d\theta_\infty^t$ would be proportional to the difference in the holding period returns on municipal and taxable consols.

If it were possible to obtain reliable estimates of $\{d\theta_j^e\}_{j=1}^T$ then (11) would provide a basis for empirical investigation. We could estimate regression models of the form

$$\Delta\theta_T^t = \alpha + \beta \left[\sum_{j=0}^{T} z_j \Delta\theta_j^e\right] + \epsilon \tag{16}$$

to test whether changes in expected personal or corporate tax rates altered the yield spreads on taxable and tax- exempt bonds. Alternative measures of θ_j^e could be constructed from forecasts of the future course of personal, and corporate, tax policy. Evidence that changes in ex-

pected personal tax rates influenced the taxable–tax exempt yield spread would contradict the bank arbitrage model and Miller Model I.

The dependent variable in equation (16) is readily observable; it is the change in the implied tax rate between two periods. Unfortunately, the independent variable depends upon the path of tax expectations over a long horizon. These are difficult, if not impossible, to measure. Several problems are particularly acute. First, it is necessary to distinguish between permanent and temporary tax reforms. Transitory tax changes will have smaller effects on long-term yields than permanent changes, and it is therefore essential to specify the horizon over which investors expect tax reforms to persist. Second, the marginal tax rates that determine θ^I may depend on both the tax code and the *distribution of wealth* by tax brackets. Changes in the highest marginal personal tax rates, without any movement in lower bracket rates or in the distribution of wealth, might have no effect on the yield spread. Forecasting the distribution of wealth across tax rates is also rather difficult. A final problem in constructing $\Delta\theta_j^e$ is predicting the debt-supply behavior of municipal governments. A smaller yield spread between taxable and tax-exempt yields, possibly induced by tax reform, might reduce the total amount of municipal debt marketed by states and localities. In some models this could change the tax rate of the marginal investor. Since there is at present little evidence on how municipal debt supply responds to interest rates, these predictions would again be subject to great uncertainty.

Rather than trying to construct a measure of $\sum_{j=0}^{T} z_j \Delta\theta_j^e$ for each month, this paper adopts a simpler but less powerful testing strategy. By examining news accounts of tax policy debates, it is possible to identify months when investors should have revised their expectations of future tax rates. These months can be classified into those in which there would have most likely been positive and negative revisions. Indicator variables for these months are then included in regression models for the movements in implied tax rates at various maturities. If changes in expected future personal tax rates do affect the yield spread, then these indicator variables should have significant effects and their signs should accord with the direction of movement in tax expectations.

The principal empirical difficulty that arises in implementing this procedure is deciding what tax expectations were *before* news arrived. The passage of a tax bill raising interest income tax rates might increase expected future tax rates. However, if investors expected the increase in tax rates to be larger than those that were actually approved, then the final passage of a higher-taxes bill might in fact *reduce* expected future tax rates. There is no easy way to resolve problems of this type, and the results presented below should therefore be interpreted with

some caution. The remainder of this section describes how tax policy "events" were identified and their effects on expectations assessed. It then discusses the econometric specification of my estimating equations.

2.3.2 Data Description: Tax Policy Events

To identify tax policy events during the last thirty years, I searched through the annual indexes to the *New York Times* and read the sections on Federal Income Taxation and Government Bonds. My first reading was confined to items that appeared in boldface type. Whenever a potentially significant tax policy announcement was encountered, I searched backward in time to see if previous months had contained similar but less highly publicized information. My search revealed numerous events that could have changed expectations of tax rates, and it was necessary to make subjective judgements about which ones to investigate further. I pursued those that seemed most important by examining the *Congressional Quarterly Weekly Report* for each year to look for related events that might not have been reported in the *New York Times*. The resulting series of monthly tax events should provide a rough chronology of times when tax policy was expected to change.

The set of tax events I considered most significant, along with a brief description of each, is reported in table 2.4. The events vary in their character and importance. Some are proposed IRS rulings on the tax treatment of municipal interest payments, others are developments during congressional debates, and still others are announcements of plans for far-reaching changes in the tax structure. The events I consider to be of the greatest significance with respect to tax expectations are identified with an asterisk; they are the principal events I analyze in the next section. However, further results involving all of the tax events are reported in the appendix.

The important tax events divide into five major groups: those surrounding the Kennedy-Johnson tax cut; the Vietnam War tax surcharge; the 1969 Tax Reform Act's proposed changes in the tax treatment of municipal interest; the Reagan tax cut; and several changes in the tax treatment of banks. While it is difficult to obtain information on the relative importance of the different tax events, a brief account of each is provided below.

The 1964 tax cut had been discussed by officials in the Kennedy administration beginning in 1962 and was proposed in the 1963 State of the Union speech. It reduced the top marginal tax rate on individuals from 91% to 70%, although its effect on tax rates below the maximum was less dramatic. The weighted average marginal dividend tax rate series computed by Estrella and Fuhrer (1983) declined by 6.5 percentage points between 1963 and 1965. The 1964 Act also lowered corporate tax rates from 52% to 48% over a two-year period. Both

Table 2.4 **Tax Policy Events, 1955–84**

Month	Tax policy event	*Predicted effect on implied tax rate* Bank arbitrage/ Miller Model I	Preferred habitat/ Miller Model II
May 1959	Rep. Wilbur Mills proposes to hold hearings to broaden the tax base.	−	−
*May–June 1962	Treasury Secretary Dillon and President Kennedy advocate reductions in tax rates, especially at top rates.	0	−
September 1962	Keogh-Smathers bill signed into law allowing self-employed individuals to maintain tax-favored retirement plans.	0	−
*January 1963	President Kennedy proposes tax cut in State of the Union message.	−	−
January 1964	President Johnson asks Congress for urgent action to pass tax-cut proposal.	−	−
February 1964	Tax cut passes Congress and is signed into law; top marginal tax rates reduced from 91% to 70%.	−	−
*January 1967	President Johnson asks for a tax surcharge to stem inflation and finance Vietnam War.	+	+
May 1968	Surtax plan passes Congress.	+	+
*June 1968	Final passage of surtax plan.	+	+
*March 1969	Several members of House Ways and Means Committee announce intention of changing the taxation of municipal interest.	−	−
*July 1969	House Ways and Means Committee passes minimum tax provision including municipal interest in tax base.	−	−
*September 1969	Senator Russell Long and Finance Committee members express opposition to House treatment of tax-exempt interest in minimum tax provision.	+	+
December 1969	Passage of 1969 Tax Act with surtax extended for part of 1970.	+	+
July 1974	House Ways and Means Committee passes bill reducing top marginal tax rate on unearned income to 50%.	0	−

Table 2.4 (continued)

Month	Tax policy event	*Predicted effect on implied tax rate* Bank arbitrage/ Miller Model I	Preferred habitat/ Miller Model II
January 1978	Carter proposes tax reforms that would raise tax rates on high-income groups.	0	+
*June 1980	At a major press conference, candidate Reagan explains his 30% tax reduction plan with across-the-board tax cuts.	0	−
*November 1980	Election of Ronald Reagan raises the probability of major tax reductions.	0	−
*December 1980	IRS rules that commercial banks may not deduct interest expenses on borrowing used for holding municipal debt.	(−)	0
*January 1981	IRS reverses ruling on bank tax treatment regarding municipal interest.	(+)	0
*February 1981	Reagan proposes tax cut.	0	−
*August 1981	Tax cut passes with provisions for IRAs, Keoghs, and All-Savers certificates, reduces maximum marginal tax rate on unearned income to 50%.	0	−
*August 1982	TEFRA restricts access to tax-deferred savings vehicles, changes interest deduction rules on banks, makes municipal interest subject to tax for some Social Security recipients	(+)	+

NOTE: These tax events were identified by scanning the pages of the *New York Times Index* and the *Congressional Quarterly Weekly Report*. Events preceded by an asterisk are those that were considered to be most significant in their effects on tax expectations. The events in December 1980, January 1981, and August 1982 have no effect under Miller Model I, but have the effect indicated in parentheses for the bank arbitrage model.

Miller models as well as the bank arbitrage view therefore predict that these changes should have affected the relative pricing of taxable and tax-exempt debt.

President Johnson's Vietnam War surtax was first proposed in January 1967, but it did not receive congressional approval until June 1968.

There was a 5% surtax on both corporate and individual income tax liability in 1968, a 10% surtax in 1969, and a 2.5% surtax in 1970. I focus principally on the proposal of the surtax in 1967, and its effect on tax expectations. Okun (1971), in his study of consumption responses to the surtax, argues that "influenced in part by the history of the Korean war 'temporary' taxation, American citizens typically were skeptical that the tax surcharge would actually expire in a short time" (p. 178). This suggests that the surtax may have had larger effects than would ordinarily be associated with a three-year tax increase. Since the surtax altered both individual and corporate tax rates, it is again difficult to distinguish between the different models using this tax reform.

The third set of tax events that impinge upon municipal bond yields involve the Tax Reform Act of 1969. Early in 1969, several members of the House Ways and Means Committee indicated informally their intention of reforming the tax treatment of municipal interest payments. The Treasury Department proposed a plan for a minimum tax, which included interest on municipal bonds in the definition of income subject to minimum tax. The Ways and Means Committee passed legislation to this effect in July, and revised tax treatment of municipal interest seemed likely until September, when Senate hearings began and Senator Russell Long and members of the Senate Finance Committee made their intention of preserving tax-exempt interest well known. The popular wisdom at the time held that the escalation of municipal interest rates was principally due to the tax reforms. The *New York Times,* in a September 1969 article, concluded that

> some of the [increase in municipal interest rates] has been caused by the general tightness in the money and capital markets. . . . More of the increase, however, appears to result from investor worries over the possibility that municipal bonds won't carry a tax advantage as attractive as they do now. Tax reform legislation has significantly undermined the traditional method for financing state and local capital needs. [7 September 1969, p. III–12]

While the immediate prospect for tax reform declined after the final provisions of the 1969 Act became clear, there were still discussions of some reform plans for some time afterward.

The 1969 reform discussion is important because it did not propose any changes in corporate tax rates. The minimum tax was to be applied to *individuals,* not firms, and corporate tax rates were largely unaffected by the Tax Reform Act. If the Miller Model I or the bank arbitrage hypothesis is correct, then there should be no change in the implied tax rates on municipal bonds as a result of the tax proposals. Miller Model II and the "preferred habitat" model, however, would both predict substantial movements in interest rate spreads as a result of these changes.

The next major tax change is President Reagan's tax cut of 1981. Ronald Reagan had discussed tax reform during the election campaign of 1980, and in a June press conference he made clear that if elected he would introduce across-the-board cuts in marginal personal tax rates. The news media at the time concluded that, regardless of the election's outcome, some type of significant tax reduction would be likely. The final tax bill reduced the highest marginal tax rate on unearned income from 70% to 50% and instituted a tax reform plan that would reduce tax rates by 26% over three years. Two of the most important 1981 tax developments, from the standpoint of the municipal bond market, did not occur until near the time of the tax bill's passage. These changes were the extension of the IRA eligibility to individuals enrolled in private pension plans, and the one-year All-Savers program. The former altered the long-run prospects for the attractiveness of municipal bonds as a source of tax sheltered income. The latter drew short-term money from municipal bond funds into savings institutions. The importance of these events led me to focus on August 1981 in my analysis of the 1981 tax cut.[12]

The 1981 tax changes were also directed primarily at the individual tax rate, and they did not substantially affect the marginal tax rates facing firms. Both the bank arbitrage model and the Miller Model I would predict no effects from the 1981 reforms, while the Miller Model II and the preferred habitat model would predict substantial movements in implied tax rates.

The final set of tax events concerns the tax treatment of banks. The first occurred in December 1980, when the IRS issued Revenue Procedure 80–55, which stated that banks would henceforth be unable to deduct interest paid on governmental time deposits that were collateralized by tax-exempt securities. If implemented, this rule would have substantially reduced the attractiveness of holding municipal debt for commercial banks (see Madeo and Pincus 1983). The rule was subsequently reversed in January 1981 after the Reagan administration took office. These two months should be characterized by changes in short-term yield spreads under all views, and long-term responses under the preferred habitat model and the bank arbitrage hypothesis. In both Miller models, corporate financial adjustments determine the equilibrium pattern of bond prices, so the tax treatment of banks is irrelevant. A less important event affecting the attractiveness of bank participation in the municipal market occurred with the passage of TEFRA in 1982, when banks were restricted to deducting only 85% of their interest payments on borrowing used to hold municipal bonds.

Determining the magnitude and direction of expectational changes is not the only problem with an "event" study of this type. We also must measure *when* expectations changed. The equations reported in

the next section all assume that expectations change during the month I have labeled as the "tax event." An alternative approach would recognize that in many cases information builds gradually over time. This could be implemented by defining indicator variables for the month labeled as the tax event and either the month before or the month afterward. I experimented with these different approaches, and found that the qualitative character of my results was unaffected by them.

2.3.3 Econometric Specification

Subsections 2.3.1 and 2.3.2 have described how tax events affect the municipal yield spread. However, to provide reliable evidence on whether or not tax changes affect municipal yields, we must control for a variety of other factors that also induce movements in the yield spread. The relative riskiness of taxable and tax-exempt debt is the most important such factor.

Two techniques are used in controlling for changing risk. First, just as in the case of tax policy events, the *New York Times Index* was scanned for evidence of important events that would have affected the perceived riskiness of municipal securities. These events, which are detailed in table 2.5, included the New York City financial crisis of 1974–75 and the passage of Proposition 13 in 1978. For each risk event, an indicator variable was defined and included in the regression for changes in the implied tax rates. Increases in municipal riskiness should reduce θ^I, since higher tax-exempt interest rates would be demanded by investors. Many of the risk events proved insignificant when added to the regression equations, and they are not reported in the tables in the next section.

The relative riskiness of municipal securities also depends on other factors such as the economy's position in the business cycle and the share of state and local revenues provided through federal revenue sharing. The change in the unemployment rate, ΔUNEMPR, and the change in the share of federal grants in state and local expenditures, ΔFEDGRANT, were therefore included in some specifications. To allow for any systematic changes in the composition or riskiness of tax-exempt debt issued at different moments in the calendar year, I also included a set of monthly dummy variables in the regression equations. January was the only month that ever showed a substantial or significant coefficient, and since there are other anomalies of security behavior that are known to occur in January, I retained the January variable but left all other monthly variables out of the final specifications.[13]

The equations in the next section also include two other variables. The first, ΔSLSHARE, is the change in the fraction of total outstanding credit market debt that is accounted for by state and local obligations.

Table 2.5 **Events Affecting Municipal Bond Risk**

Month	Risk event	Predicted effect on implied tax rate
January 1970	President Nixon announces plan for revenue sharing in State of Union address.	+
November–December 1970	Expansion of size of proposed revenue-sharing plans (REVSHARE).	+
March 1972	House Ways and Means Committee approves revenue-sharing bill.	+
November–December 1974	First indications of financial distress by New York City (NYC1).	−
September 1975	Height of New York City financial crisis (NYC2).	−
June 1978	Passage of Proposition 13 in California.	−
March–May 1983	Rising concern over impact of WPPSS default and Washington State Supreme Court ruling absolving utilities of liability (WPPSS).	−

NOTE: These events were identified by examining the *New York Times Index* sections for government bonds. A more complete discussion of the two New York events may be found in Advisory Commission on Intergovernmental Relations (1976) and Hoffland (1977). The names in parentheses are used to describe these variables in subsequent tables that report regression results.

In Miller Model I and the bank arbitrage model, the quantity of state and local debt outstanding should have no impact on the implied tax rate, because offsetting changes should occur in corporate capital structures. In Miller Model II and the preferred habitat model, there could be an effect on the implied tax rate. The variable ΔSLSHARE is included as a test of these predictions.

The final variable I include is Δ(VOLATILITY), the change in an estimate of interest rate volatility. This is measured as the change in a thirty-six-month rolling estimate of the variance of tax-exempt interest rates at the maturity of the implied tax rate. It is designed to capture the changing value of the "tax trading" options on taxable and tax-exempt bonds.

The basic equation which I estimated for one-, five-, ten-, and twenty-year maturity bonds is:

$$\begin{aligned}\Delta\theta_t^f = {} & \beta_0 + \beta_1\Delta\text{UNEMPR}_t + \beta_2\Delta\text{FEDGRANT}_t \\ & + \beta_3\Delta\text{SLSHARE}_t + \beta_4\Delta(\text{VOLATILITY})_t + \beta_5\text{JANUARY} \\ & + \sum \delta_j\text{RISK}_{jt} + \sum \gamma_k\text{TAX}_{kt} + \epsilon_t\end{aligned} \tag{17}$$

The set of variables $RISK_{jt}$ are indicator variables for risk events, and TAX_{kt} are indicators for tax policy changes.

Before considering the results, two estimation issues should be mentioned. First, the data on yields to maturity are sometimes subject to errors of measurement. Salomon Brothers *estimates* the yield that would be required on a T year bond selling at par. The estimates are based on a yield curve calculated from actual bond sales. For municipals, which are typically sold in blocks including bonds of varying maturities, the yield curve may give slightly erroneous estimates for some yields. Since the dependent variable in (17) depends on the difference in yields in two consecutive months, errors in the yield data will induce a moving average error. The reported equations were all corrected for MA(1) errors using a maximum-likelihood procedure.

Second, the residuals from OLS estimation of (17) were clearly heteroscedastic over time. To allow for changing error variances, the sample was divided into twelve subsamples of equal length, twenty-nine months, and the error variance was assumed to be constant within each of these months but allowed to vary between them. The White Test reported in each column of the tables is a test (White 1980) against heteroscedasticity of this form; it always allows us to reject the null of homoscedasticity. The reported equations were estimated using a feasible GLS procedure.[14]

2.4 Regression Results

This section reports the results of analyzing the movements in implied tax rates for short- and long-term bonds during the months of major tax policy changes. Table 2.6a reports results for bonds with maturities of ten and twenty years. Results for one-year bonds are reported in table 2.6b. This section first analyzes which tax events appear to have affected the bond market substantially, and then returns to the question of which equilibrium model these results support. The tax policy events are discussed in chronological order, focusing on those events that were marked with an asterisk in table 2.4. Full sets of regression results for all tax and risk events are reported in the appendix.

2.4.1 Tax Policy Events

The initial discussions of a tax cut in 1962 seem to have induced little movement in the taxable–tax exempt yield spread. When President Kennedy asked for the tax cut in his State of the Union address in January 1963, however, there was a coincident decline in the implied long-term marginal tax rate of nearly four percentage points. This is evident in the implied tax rates on ten- and twenty-year bonds. By comparison, the yields on one-year bonds hardly responded to the

Table 2.6a **Changes in Implicit Tax Rates on Long-Maturity Bonds**

Variable	Twenty-year maturity			Ten-year maturity		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Constant	−0.13	−0.21	−0.21	−0.21	−0.29	−0.28
	(0.12)	(0.12)	(0.12)	(0.13)	(0.14)	(0.14)
May–June 62	−1.02	−1.00	−1.01	−1.07	−1.02	−1.01
	(0.92)	(0.93)	(0.93)	(1.35)	(1.34)	(1.34)
Jan. 63	−3.89	−3.24	−3.27	−4.49	−3.86	−3.90
	(1.36)	(1.38)	(1.38)	(1.95)	(1.95)	(1.95)
Jan. 67	4.44	4.62	4.65	6.25	6.45	6.48
	(1.29)	(1.32)	(1.32)	(1.68)	(1.69)	(1.69)
June 68	0.23	0.28	0.27	−0.10	−0.00	−0.00
	(2.48)	(2.42)	(2.42)	(2.35)	(2.33)	(2.33)
Mar. 69	−4.74	−4.50	−4.49	−3.25	−2.99	−3.00
	(2.48)	(2.43)	(2.42)	(2.35)	(2.33)	(2.33)
July 69	−6.25	−6.64	−6.60	−5.32	−5.41	−5.38
	(3.86)	(3.86)	(3.84)	(4.34)	(4.36)	(4.35)
Sept. 69	12.88	12.39	12.44	9.42	9.26	9.34
	(3.86)	(3.86)	(3.85)	(4.34)	(4.36)	(4.35)
June 80	−4.08	−3.30	−3.11	−0.03	0.81	0.97
	(1.86)	(1.84)	(1.86)	(2.15)	(2.15)	(2.18)
Nov. 80	0.11	−0.60	−0.36	−0.16	−0.74	−0.67
	(1.86)	(1.84)	(1.87)	(2.15)	(2.14)	(2.18)
Dec. 80	−3.61	−3.45	−3.26	−2.90	−2.70	−2.66
	(1.86)	(1.85)	(1.88)	(2.15)	(2.15)	(2.18)
Jan. 81	−0.42	−0.93	−0.76	−0.76	−1.02	−0.93
	(1.90)	(1.88)	(1.92)	(2.19)	(2.19)	(2.22)
Feb. 81	0.58	0.16	0.34	0.50	0.25	0.37
	(1.86)	(1.84)	(1.88)	(2.15)	(2.15)	(2.18)
Aug. 81	−6.62	−6.73	−6.24	−6.32	−6.23	−5.90
	(3.29)	(3.16)	(3.14)	(2.52)	(2.48)	(2.45)

Table 2.6a (continued)

Variable	Twenty-year maturity			Ten-year maturity		
	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
Aug. 82	3.71	4.38	4.04	4.10	4.74	4.58
	(3.29)	(3.16)	(3.15)	(2.52)	(2.48)	(2.43)
REVSHARE	3.99	4.76	4.77	3.79	4.31	4.29
	(2.73)	(2.74)	(2.73)	(3.07)	(3.09)	(3.08)
NYC1	−8.40	−6.51	−6.65	−3.13	−1.02	−1.17
	(3.82)	(3.80)	(3.80)	(3.62)	(3.69)	(3.71)
NYC2	−3.75	−3.87	−3.82	2.58	2.42	2.45
	(2.70)	(2.61)	(2.61)	(2.55)	(2.52)	(2.52)
WPPSS	−0.81	−0.50	−0.74	−1.32	−1.21	−1.35
	(1.90)	(1.84)	(1.83)	(1.46)	(1.45)	(1.43)
JANUARY	2.04	2.10	2.10	2.07	2.06	2.06
	(0.43)	(0.43)	(0.43)	(0.46)	(0.46)	(0.46)
ΔUNEMP	–	−1.45	−1.34	–	−1.31	−1.15
		(0.61)	(0.62)		(0.66)	(0.68)
ΔSHARESL	–	−7.27	−7.57	–	−4.48	−4.67
		(3.79)	(3.81)		(3.96)	(3.97)
ΔFEDGRANT	–	−0.11	−0.13	–	0.01	−0.00
		(0.34)	(0.34)		(0.36)	(0.36)
ΔVOLATILITY	–	–	−1.34	–	–	−1.34
			(1.98)			(2.10)
θ	0.32	0.36	0.37	0.39	0.40	0.41
	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)	(0.05)
R^2	0.23	0.25	0.25	0.18	0.20	0.20
D.W.	2.02	2.02	2.01	2.01	2.00	2.00
SEE	0.98	0.97	0.97	0.96	0.95	0.95
White Test	38.47	40.42	40.42	43.31	44.29	44.62

NOTE: All equations are estimated for the period 1955:1–1983:12, a total of 348 monthly observations. Equations are estimated allowing for a first-order moving average error structure, with MA parameter θ, with a correction for heteroscedasticity. Standard errors are shown in parentheses.

Table 2.6b **Changes in Implicit Tax Rates on One-Year Bonds**

Variable	Model 1	Model 2	Model 3
Constant	−0.15	−0.24	−0.22
	(0.16)	(0.17)	(0.17)
May–June 62	0.67	0.72	0.71
	(1.08)	(1.02)	(1.02)
Jan. 63	−0.11	−0.11	−0.66
	(1.62)	(1.57)	(1.57)
Jan. 67	10.15	10.40	10.60
	(2.03)	(2.07)	(2.08)
June 68	−1.05	−0.93	−1.10
	(2.89)	(2.94)	(2.94)
Mar. 69	−5.96	−5.42	−5.41
	(2.89)	(2.94)	(2.95)
July 69	1.93	1.86	2.20
	(3.75)	(3.67)	(3.62)
Sept. 69	4.11	3.63	4.29
	(3.75)	(3.67)	(3.63)
June 80	−3.59	−3.66	−3.09
	(2.71)	(2.82)	(2.69)
Nov. 80	0.08	−0.42	−1.25
	(2.71)	(2.82)	(2.69)
Dec. 80	−4.89	−5.56	−6.26
	(2.71)	(2.83)	(2.70)
Jan. 81	3.36	2.99	2.80
	(2.78)	(2.88)	(2.75)
Feb. 81	2.37	2.16	2.58
	(2.71)	(2.82)	(2.69)
Aug. 81	−6.46	−6.91	−6.79
	(3.06)	(3.07)	(3.05)
Aug. 82	4.26	4.34	3.19
	(3.06)	(3.07)	(3.06)
REVSHARE	1.69	2.07	1.78
	(2.65)	(2.61)	(2.58)
NYC1	0.12	−1.67	−1.23
	(5.75)	(5.92)	(5.88)
NYC2	1.21	1.06	0.47
	(4.06)	(4.09)	(4.06)
WPSS	−1.99	−1.26	0.02
	(1.77)	(1.80)	(1.85)
JANUARY	0.47	0.61	0.74
	(0.62)	(0.62)	(0.62)
ΔUNEMPR	–	0.64	1.04
		(0.87)	(0.87)
ΔSHARESL	–	−10.76	−11.30
		(5.63)	(5.62)

Table 2.6b (continued)

Variable	Model 1	Model 2	Model 3
ΔFEDGRANT	–	0.28	0.20
		(0.53)	(0.53)
ΔVOLATILITY	–	–	−8.63
			(3.70)
θ	0.38	0.38	0.38
	(0.05)	(0.05)	(0.05)
R^2	0.14	0.15	0.16
D.W.	1.93	1.94	1.94
SEE	0.97	0.97	0.97
White Test	54.47	54.43	54.94

NOTE: All equations are estimated for the period 1955:1–1983:12, a total of 348 monthly observations. Equations are estimated allowing for a first-order moving average error structure, with MA parameter θ, with a correction for heteroscedasticity. Standard errors are shown in parentheses.

proposed tax cut; the implied tax rate on one-year bonds changed by less than one percentage point. This suggests that the market reacted to changing expectations about the long-run course of tax policy, but recognized that because of implementation lags, reforms were not likely to occur immediately. The magnitude of the implied tax rate change, four percentage points, is close to the proposed change in corporate tax rates and somewhat smaller than the change in measures of personal tax burden such as weighted average dividend or interest income tax rates. Since the tax bill proposed by President Kennedy reduced both personal and corporate tax rates, all of the equilibrium models proposed in section 2.2 predict movements in implied tax rates. The finding that bond prices adjusted supports the notion that tax expectations affect the yield spread, but does not help distinguish between the competing views.

The bond price effects of the initial announcement of President Johnson's surtax plan are also pronounced. In January 1967 the implied long-term tax rate rose by over 4%. This coefficient is statistically significant at all standard levels. President Johnson's proposed surtax, in spite of its explicitly temporary nature, had as large an impact on the yield spread as the announced 1963–64 tax cut; this is somewhat puzzling. It may suggest that taxpayers perceived the far-reaching Kennedy reforms to be no more than a transitory event, or that they suspected that the surtax might last for a long while. The short-term municipal market also reacted to the tax-cut plan, again by "too much" to be explained by tax expectations alone. The implied tax rate on one-year bonds rose by more than ten percentage points in January 1967.

This may reflect the expectation of bondholders that a large tax increase would be enacted swiftly, as part of an emergency war finance program. Even if it were expected to pass immediately, however, the magnitude of the short-term yield effect is larger than can plausibly be attributed to taxes alone. Like the 1964 change, the 1967 reform affected both personal and corporate tax rates and it therefore has little power to distinguish between the different models of municipal yield determination.

The tax reform discussions of 1969 provide more convincing evidence that personal tax changes affect yield spreads in the tax-exempt bond market. The initial proposals for changing the tax status of municipal interest, in March 1969, coincided with sharp declines in the implied tax rates in all markets. The tax rate computed from twenty-year bonds fell by 4.5 percentage points, while that on ten-year bonds fell by 3%. Short bonds also responded dramatically, with the tax rate changing by almost six percentage points.[15] The subsequent action by the Ways and Means Committee in July 1969 had a pronounced effect on the long-term market, inducing between five- and seven- point reductions in the long-term implied tax rate, but had virtually no impact on one-year implied tax rates. In the short- term market, the implied tax rate actually rose by two percentage points during that month. The turnabout in expectations that occurred in September 1969 once again caused dramatic effects in the long-term bond market but only small movements in short-term yields. The implied tax rate on twenty-year municipal bonds rose by twelve percentage points in September; that on ten-year securities jumped nearly 10%. By comparison, short-term implied tax rates rose by only 4%.

Unlike the previous tax events, the 1969 legislative developments can help to resolve the differences between the competing models of municipal market equilibrium. All of the proposals to implement a minimum tax focused only on changing the *personal* tax code. In both the bank arbitrage model and Miller Model I, these proposals should have had no effect on the relative yields on taxable and tax-exempt debt. The finding of major changes in long-term yields coincident with these tax developments suggests that Miller Model II or the preferred habitat model may provide a better explanation of long-term yield determination than either of the models that focuses on the corporate tax rate.

The fourth major tax reform, the Reagan tax cut of 1980–81, also seems to have affected the yield spread between taxable and tax-exempt debt. However, relatively few of the events I identified prior to the passage of ERTA in 1981 had substantial effects. In June 1980, for example, when candidate Reagan announced his tax-reform plans at a press conference, the implied tax rate on twenty-year municipal bonds declined by nearly four percentage points. This could be at-

tributed to tax expectations; however, this explanation is weakened by the finding that ten-year implied tax rates hardly declined during that month. Similarly, the effect of Reagan's electoral victory in November 1980 is weak. The signs of the coefficients on long-term implied tax rates are mixed, and none of the coefficients is close to statistically significant. The Reagan budget proposal in February 1981 evoked a similarly small response from the long-term bond market; most of the estimated coefficients are positive, not negative, as would be predicted by either of the models that focuses on personal taxes. These insignificant results during three periods when tax expectations may have changed constitute some support for the bank arbitrage model and Miller Model I. Alternatively, they may show that bond market participants considered *passage* of a tax reform plan unlikely until President Reagan's stunning victory in the House at the end of July 1981.

Support for the importance of personal tax variables comes from the coefficients on the August 1981 indicator for the passage of ERTA. All of the long-term implied tax rates decline substantially, with twenty-year bonds showing a drop of six percentage points in the value of θ^l. Smaller but statistically significant effects are recorded on the other long-term implied tax rates. Like the 1969 discussions of minimum tax, most of the provisions of the 1981 bill were directed at personal, not corporate, tax reform. The bill cut the top marginal tax rate on unearned income from 70 to 50% and also extended access to tax-exempt saving vehicles. The finding that municipal bond yields changed therefore provides some evidence for Miller Model II and the preferred habitat view. Short-term yields also rose substantially during August 1981, reducing the implied tax rate. This was probably due to the introduction of one-year All-Savers certificates, which drew funds away from commercial banks and money market mutual funds and into savings and loan institutions. This reduced commercial banks' demand for tax-exempt bonds.

The final tax events concern the tax treatment of banks. The tax event in December 1980 is the proposed IRS ruling to disallow interest deductions for bank loans that were collateralized with municipal securities. Under the bank arbitrage hypothesis, this development should have substantially lowered the implied tax rate in both long and short-term markets, since it ended the attractiveness of this form of tax-exempt income for many banks. Under both Miller models this change should have had no effect, and under the preferred habitat model, the change should have affected only short-term yields. The evidence suggests a pronounced effect on the one-year implied tax rate, a change of between six and seven percentage points, as well as small but statistically less significant effects on longer-term implied tax rates. When

the change was rescinded in January 1981, however, only the short-term yield spread responded in any significant fashion. This suggests that bank participation in the municipal market is a more significant force in setting short- than long-term bond prices.

The evidence from the passage of TEFRA in August 1982, while more difficult to interpret, also suggests a role for banks. The 1982 law reduced the share of interest payments that banks could deduct on loans used to hold municipal bonds from 100% to 85%, lowering the attractiveness of holding municipal debt. Coincident with the law's passage is a widening of the yield spread between taxable and tax-exempt debt. The difficulty in interpretation arises because the law also instituted other changes that might have affected non–bank investors' demand for municipals. The law effectively taxed some Social Security recipients on municipal interest and placed restrictions on future issues of Industrial Revenue Bonds. This *could* have raised the expected future marginal tax rate on municipal interest and thereby raised the implied tax rate calculated on long-term bonds. These developments seem to support the importance of banks, especially at short maturities, in determining the yield spread.

The results in this section are summarized in table 2.7. They do not provide universal support for any single theory of how municipal interest rates are determined. However, the evidence from the 1969 Tax Reform hearings and the passage of ERTA in 1981 supports either Miller Model II or the preferred habitat hypothesis at long maturities. The absence of strong reactions to events during the 1980 election campaign and the subsequent introduction of the tax bill support the two views that regard personal taxes as irrelevant. The dramatic reaction in December 1980 to the changed IRS ruling on commercial bank deductability of taxable interest payments, especially at short maturities, supports the bank arbitrage and preferred habitat views. The preferred habitat model therefore receives the most widespread support in the data.[16]

The results on tax changes and long-term yield spreads can provide some information on the source of recent changes in the yield spread between taxable and tax-free securities. The implied tax rate on long-term bonds declined by over twenty percentage points between 1980 and 1982. Adding up the five coefficients on the tax events during the 1980–81 period suggests a total tax-related effect of about eight percentage points, between one-third and one-half of the total. This calculation is based on twenty-year bonds; analysis of ten-year bonds suggests that 24.5% of the decline may be attributable to taxes. These estimates are probably lower bounds for the true effect of taxes on yield spreads, since they neglect all of the changes that may have taken place between my "event months." Nonetheless, they suggest a sig-

Table 2.7 **Summary of Empirical Findings**

Tax Change	Predictions of Model for Implied Tax Rate: Bank Arbitrage Model	Miller Model I	Miller Model II	Preferred Habitat Model	Observed
1962–63 tax cut proposal					
– short term	↓	↓	↓	↓	0
– long term	↓	↓	↓	↓	↓
1967/8 surtax					
– short term	↑	↑	↑	↑	↑
– long term	↑	↑	↑	↑	↑
1969 tax act hearings					
– short term	0	0	↓	0	↓
– long term	0	0	↓	↓	↓
1981 tax cut					
– short term	?	?	↓	?	↓
– long term	0	0	↓	↓	↓
Changes in bank taxation					
– short term	↓	↓	↓	↓	↓
– long term	↓	↓	↓	0	↓

SOURCE: Results reported in tables 2.6a and 2.6b and discussed in the text.

nificant influence of tax policy on the relative yields on taxable and tax-exempt debt.

Before examining the results for other variables included in the specifications, two important caveats should be noted. First, my event variables may have dated incorrectly the points at which expectations of market participants changed. This should bias my results on tax policy effects toward zero. Secondly, however, the low power of the event-study approach and its susceptibility to spurious factors must be emphasized. I have surely not controlled for all of the nontax influences on the tax-exempt bond market, and the results should therefore be interpreted with some caution.

2.4.2 Other Explanatory Factors

Adding variables designed to measure changes in relative riskiness over time, such as the change in the unemployment rate, did not change the conclusions about tax policy at all. The estimated coefficients for the tax event months change slightly between the three different specifications that are reported for each maturity in tables 2.6a and 2.6b,

but they always suggest the same conclusions. The coefficients on the change in the unemployment rate indicate that an increase in unemployment reduces the implied tax rate on long-term bonds. If the unemployment rate rose by one percentage point during a one-month period, this would induce between a one- and two-percentage-point reduction on the implied tax rate for long-term bonds. This is consistent with the standard notion that Treasury securities are riskless but that the perceived default probability on municipal bonds, even highest-grade municipals, rises during economic downturns. This effect seems unimportant for short-maturity debt, where the coefficient on ΔUNEMPR is positive but statistically insignificant. The other variable that controls for risk, the share of state and local revenues financed through federal grants, proved insignificant in all of the estimated equations. Experiments with other risk measures, such as the yield spread between BAA and AAA corporate bonds or good- and prime-rated municipals, produced similarly insignificant results.

The indicator variables designed to measure risk events generally had their predicted signs, but most were statistically insignificant. The variable for the expansion of revenue sharing suggested a one-percentage-point reduction in the implied tax rate because of risk reduction. Both of the New York City indicator variables have statistically insignificant effects; this is not surprising given Hoffland's (1977) report that most of the municipal market jitters engendered by the New York City crisis affected state and local bonds in lower rating classes. The WPPSS default in early 1983 also had some effect on the implied yield spread, inducing a large (two-point) but statistically insignificant reduction in the implied tax rate. Again, this is not unexpected since most of the effect of the WPPSS default was on revenue bonds, not the general obligation securities used to construct my implied tax rates.

The volatility variable that was included to capture changes in tax-timing values had a negative sign in all of the estimated equations. The hypothesis that it has no effect is often impossible to reject, however, and the pattern of coefficients across different maturities is also surprising. The volatility effect through the tax-timing option should be smallest for short-maturity bonds, but the coefficient on the volatility variable is larger for short- than for long-maturity implied tax rates. Large standard errors make inferences about these coefficients difficult, however.

The final variable I included, the "supply effect" measure of the share of state and local debt in the outstanding stock of credit market debt, has a significant or nearly significant negative coefficient in nearly all of the estimated equations. This suggests that increases in the outstanding stock of municipals will lower the implied tax rate between taxable and tax-exempt bonds, providing strong evidence against both

the bank arbitrage model and Miller Model I, both of which predict the irrelevance of relative supplies. A one-percentage-point increase in the quantity of municipal debt would be predicted to reduce implied tax rate on twenty-year bonds by approximately 4.7 percentage points. The estimated effects of the same change for other maturities vary between three and seven percentage points. These results are consistent with the preferred habitat model and Miller Model II, both of which allow changes in the stock of municipal debt to change the tax rate of the marginal holder of municipal bonds. Unfortunately, the lack of data on the outstanding stock of debt at different maturities precluded testing more precise hypotheses, such as whether larger issues of short-term debt depress the short-term implied tax rate.

2.5 Conclusions

This paper provides evidence that the yield spreads between long-term taxable and tax-exempt bonds respond to changes in expected future tax rates. The finding that changes in expected tax rates on individual investors alter the yield spread casts doubt on some of the theories of municipal bond pricing that have been advanced in recent years. It supports the conclusion that the municipal market is segmented, with different investor clienteles at short and long maturities.

These results shed some light on the likely effects of two proposed changes in municipal borrowing practices. The first reform calls for increased state and local use of short-term borrowing with a concommitant reduction in long-term bond issues.[17] This proposal is motivated by the upward-sloping nominal term structure of tax-exempt interest rates. In 1983, for example, the average yield on one-year prime municipal bonds was only 60% of that on twenty-year bonds. Short-term tax-exempt rates were also lower relative to comparable taxable rates. In spite of this interest rate differential, only 31% of municipal borrowing in 1983 was at maturities of less than one year, and less than 6% of the outstanding stock of state and local debt was short-term.

The potential savings from increased short-term borrowing depend crucially upon the causes of the recent increase in, and generally elevated level of, long-term tax-exempt interest rates. If long-term yields are high because of risk, which would be the explanation of the upward-sloping term structure in either the bank arbitrage model or Miller Model I, then heavier use of short-term debt would yield little reduction in borrowing costs over the life of state and local capital projects. However, the preferred habitat theory suggests that some savings might occur. If yield differentials are due partly to different tax rates facing investors in different market segments, then increased short-term borrowing could reduce borrowing costs. The findings in this paper provide

some support for this view. Further research is needed to disentangle the contributions of risk, tax expectations, and other factors to the shape of the tax-exempt term structure, and to provide estimates of the expected savings from increased short-term borrowing.

A second reform proposal is the so- called taxable bond option, which would allow states and localities the option of issuing taxable debt while receiving a subsidy, equal to a fixed fraction of the bond issue, from the federal government.[18] Fama (1977) argued that this proposal would not be successful unless the subsidy rate equaled the corporate tax rate, since all deviations from $R_M = (1 - \tau)R$ are due to risk. The results in this paper, however, cast doubt on this conclusion. In either a preferred habitat or Miller Model II scenario, states and localities might choose to issue taxable debt at subsidy rates substantially below the corporate tax rate. Unfortunately, the estimates here do not provide direct measures of the required subsidy level.

These results also inform the debate on corporate capital structure and what determines debt-equity ratios. Evidence on the relative prices of taxable and tax-exempt debt contradicts the frequent assumption that the effective tax rate on equity income equals zero. In the capital structure model advanced by Merton Miller (1977), nonzero equity tax rates imply that few investors will choose to hold equity rather than corporate debt.[19] The observation that corporate capital structures are 75% equity is therefore difficult to explain in this framework.

This paper raises several important questions for future studies of municipal finance. First, the municipal debt supply decision has been left unspecified throughout this analysis. Little is known about how municipal finance officers choose between issuing debt of different maturities. Second, I have discussed plans to change real borrowing costs for states and localities without addressing the normative question of whether such a reduction should be a goal of public policy.[20] States' and localities' capital expenditures are twice subsidized relative to private capital, through both tax-exempt finance and the income-tax deductability of property taxes. However, many of the benefits from provision of public capital, such as schools or roads, accrue to individuals outside the jurisdiction that provides them. The optimal degree of subsidy vis-à-vis private capital may therefore be greater than, or less than, that currently provided. Finally, the evidence presented here suggests that some of the current proposals to reform municipal financing policies could affect the real cost of public borrowing. Numerical estimates of these effects are still needed.

Table 2A.1 **Regression Results Including All Tax Events**

	Maturity class			
Variables	Twenty years	Ten years	Five years	One year
Constant	−0.14	−0.22	−0.23	−0.14
	(0.12)	(0.13)	(0.14)	(0.17)
May 59	−2.34	−0.85	−0.55	−2.74
	(3.33)	(4.02)	(5.09)	(8.31)
May/June 62	−0.99	−1.10	1.44	0.66
	(0.92)	(1.38)	(1.08)	(1.09)
Sept. 62	1.02	2.10	−0.76	−1.21
	(1.29)	(1.95)	(1.52)	(1.53)
Jan. 63	−4.04	−4.77	−3.16	0.20
	(1.37)	(2.00)	(1.60)	(1.67)
Jan. 64	−0.58	−0.02	−0.60	1.14
	(1.37)	(2.00)	(1.60)	(1.67)
Feb. 64	1.37	0.23	1.93	0.86
	(1.29)	(1.95)	(1.52)	(1.53)
Jan. 67	4.32	6.00	3.67	10.39
	(1.34)	(1.72)	(2.15)	(2.09)
May 68	−1.14	−0.68	−0.33	−2.71
	(2.52)	(2.36)	(2.11)	(2.87)
June 68	0.64	0.25	0.92	0.03
	(2.52)	(2.36)	(2.11)	(2.87)
Mar. 69	−4.76	−3.28	−5.42	−5.94
	(2.52)	(2.36)	(2.11)	(2.87)
July 69	−6.35	−5.38	−5.69	1.93
	(3.94)	(4.35)	(3.73)	(3.79)
Sept. 69	12.93	9.84	11.90	4.13
	(3.94)	(4.35)	(3.73)	(3.79)
Dec. 69	−1.53	−0.56	2.79	0.77
	(3.94)	(4.35)	(3.73)	(3.79)
Jan. 70	−0.28	4.97	2.61	3.80
	(3.97)	(4.37)	(3.77)	(3.85)
REVSHARE	3.83	3.45	3.55	1.31
	(2.79)	(3.07)	(2.64)	(2.68)
Mar. 72	0.04	−0.82	1.94	8.84
	(2.79)	(2.89)	(2.51)	(3.79)
July 74	0.77	0.87	2.53	0.61
	(2.69)	(2.56)	(2.76)	(4.14)
NYC1	−8.18	−3.14	−1.02	−0.17
	(3.81)	(3.63)	(3.90)	(5.87)

Table 2A.1 (continued)

Variables	Maturity class			
	Twenty years	Ten years	Five years	One year
NYC2	−3.67	2.68	0.70	1.30
	(2.69)	(2.56)	(2.76)	(4.14)
Jan. 78	−0.91	−2.68	−3.06	−2.66
	(1.79)	(1.45)	(1.69)	(2.90)
June 78	0.30	−0.13	−0.17	2.12
	(1.74)	(1.37)	(1.61)	(2.82)
June 80	−4.07	0.01	0.77	−3.66
	(1.90)	(2.20)	(2.55)	(2.78)
Nov. 80	0.14	−0.14	0.04	0.21
	(1.90)	(2.20)	(2.55)	(2.78)
Dec. 80	−3.58	−2.96	−4.31	−5.55
	(1.90)	(2.20)	(2.55)	(2.78)
Jan. 81	1.57	1.04	1.07	3.12
	(1.95)	(2.25)	(2.60)	(2.86)
Feb. 81	0.60	0.48	0.48	2.10
	(1.90)	(2.20)	(2.55)	(2.78)
Aug. 81	−6.58	−6.29	−4.80	−6.43
	(3.36)	(2.59)	(2.78)	(3.14)
Aug. 82	3.78	4.18	6.05	4.19
	(3.36)	(2.59)	(2.78)	(3.14)
WPPSS	−0.92	−1.40	−2.17	−2.10
	(1.94)	(1.50)	(1.61)	(1.82)
JANUARY	2.21	2.30	2.12	0.21
	(0.48)	(0.50)	(0.56)	(0.71)
θ	0.34	0.40	0.49	0.39
	(0.05)	(0.05)	(0.05)	(0.05)
R^2	0.23	0.20	0.17	0.16
D.W.	2.00	2.00	1.95	1.89
SEE	1.00	0.98	0.96	1.00
White Test	33.44	40.59	43.71	54.94

NOTE: All equations are estimated for the period 1955:1–1983:12, a total of 348 monthly observations. Equations are estimated allowing for a first-order moving average error structure, with MA parameter θ, with a correction for heteroscedasticity. Standard errors are shown in parentheses. Equations reported here correspond to those in Model 1 of tables 2.6a and 2.6b in the text.

Notes

1. Arak and Guentner (1983) discuss several of these explanations.

2. Other recent studies such as Trczinka (1982) and Kidwell and Trczinka (1982) have compared the yields on prime municipals with AAA-rated corporate bonds. However, their corporate bond data are only available since 1970, and that would eliminate many interesting tax changes from the sample period. The corporate-municipal yield spread is also more sensitive to varying risk differentials than the yield spread between Treasury bonds and municipals.

3. Schaefer (1977) discusses several problems associated with yields to maturity in situations when the return on a bond is not proportional to its coupon payment.

4. Reference to tables 5 and 9 in Constantinides and Ingersoll (1984) suggests that changes in coupon rates and interest rate volatilities, while they can substantially alter the value of the tax timing option, do not lead to large changes in the relative values of the options on taxable and tax-exempt bonds.

5. Yawitz, Maloney, and Ederington (1985) estimate default probabilities for municipal debt of more than 1% per year. This is inconsistent with the history of municipal defaults, reported for example in ACIR (1976). The annual default probability on a prime municipal would have to have risen by almost 2% between 1980 and 1982 to explain the narrowing taxable–tax exempt yield spread. A newly issued twenty-year bond would therefore have had at least a 35% chance of defaulting during its lifetime; this seems implausibly large.

6. A discussion of commercial bank behavior may be found in Proctor and Donahoo (1983).

7. My discussion of municipal debt in the Miller Model draws heavily on Auerbach and King (1983) and McDonald (1983). A related discussion may be found in Buser and Hess (1984).

8. The figure assumes that $\tau_e = \gamma m$, for some γ. This would be the case if capital gains were untaxed, dividends were taxed at the interest tax rate, and γ were the dividend-payout ratio. Auerbach and King (1983) present a figure similar to my figure 2.1; an error in their diagram relating to the intersection of the tax-exempt and corporate equity return lines is corrected in my figure.

9. Jensen and Meckling (1976) and Buser and Hess (1984) discuss the agency and contracting costs associated with different financial choices.

10. Data on the fraction of tax-exempt borrowing at different maturities was obtained from the "Decade of Municipal Financing" tables published periodically in the *Weekly Bond Buyer*.

11. When the discount rate is allowed to change, the conclusion that municipal bond prices remain constant in the face of a tax change would no longer follow. If there were a fixed world pretax interest rate and the discount rate equaled $(1 - m)$ times this rate, then taxable bond prices would be unaffected by tax changes and municipal bond prices would adjust.

12. The passage of Reagan's tax bill in the House occurred on July 29, 1981. Since the bond market would not have reacted to this news until the thirtieth, and since the Salomon Brothers data would be for yields *reported* on the first of August (i.e., trades from the thirty-first), there is a substantial risk that the information associated with the tax cut is not included in the recorded August 1 yield. That is why I focus on the August event for ERTA; that is also the month during which actual passage occurred.

13. The "January effect" in the municipal bond market causes an increase in the implied tax rate; this would correspond to a decline in the relative price of municipal bonds.

14. The GLS procedure was implemented by estimating separate residual variances for each twenty-nine-month period, using the homoscedastic OLS residuals, and then dividing each observation by the square root of the estimated variance for its data period.

15. The pronounced effect of the personal tax change in the short-term market may be due to the binding nature of Regulation Q during 1969. Skelton (1983) argues that during periods when Regulation Q was binding, banks were not the marginal investors in the short-term municipal market.

16. Campbell (1980) argues against the segmentation view by claiming that bank behavior is uncorrelated with the municipal-taxable yield spread. However, he ignores the simultaneous determination of prices and quantities: under the pure Miller model, the yield spread would not vary but bank behavior would change often, leading to zero correlation!

17. This proposal for short-term borrowing and several related plans are described in Beek (1982).

18. A summary of arguments for and against the taxable bond option, along with much discussion, may be found in Mussa and Kormendi (1979).

19. The principal difficulty with the Miller model is that explaining the large outstanding stock of corporate equity is difficult when only investors for whom $(1 - \tau)(1 - \tau_e) \geq (1 - m)$ should hold equity. With $\tau = .46$ and m reaching its maximum at .50, only very low tax rates on equity are consistent with equity holding.

20. Gordon and Slemrod (1983) discuss some of the issues concerning the size of public capital stock, and assess the distributional effects of changing the tax exemption of municipal bonds.

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Comment

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The major question addressed by Poterba's paper is: Can we explain recent declines in the taxable versus tax-exempt yield spread by appealing to anticipated reductions in tax rates? The coincidence of Reagan's election and tax cut with a substantial narrowing of the yield spread is a strong temptation for the casual empiricist in us all. Further, this is an important issue from a number of perspectives. For the local public finance specialist, it addresses the efficacy of programs to reduce borrowing costs by substituting short-term for long-term debt. For the profession as a whole, it is another investigation of the importance of expectational effects; effects important to the conduct of macroeconomic policy, the design of efficient taxes over time, and numerous other issues.

To investigate this issue is, at least in principle, straightforward. "All" one need do is specify the economic actors determining demand and supply for tax-exempt debt of different maturities, formulate the mapping from past history to their expectations, and specify the relevant list of exogenous or predetermined variables. After repeating these steps for the markets of other assets (federal debt, corporate debt, equity), the researcher estimates the various supply-and-demand schedules and compares the predicted and observed changes in the yield differential. Unfortunately, this is as infeasible as it is appealing.

Alternatively, one may consult the relevant theoretical work for predictions concerning the determinants of equilibrium in the market for tax-exempt debt. The empirical counterpart is a reduced-form equation linking the yield differential with a list of relevant variables and some measure of expectations. The author follows this latter strategy, the price of which is a less powerful methodology.

The empirical work attempts to discriminate among four alternative hypotheses about the determinants of tax-exempt bond yields at varying maturities. The four theories are: the bank arbitrage model, Miller Model I, Miller Model II, and the preferred habitat model and are clearly presented in section 2.2. The main implications of the models are easily summarized.

Under the bank arbitrage model, short-term and long-term bond yields are determined by the arbitrage activities of banks. As a result, the

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yield spread depends only upon the corporate tax rate. Movements in the yield curve are the result of expected future changes in the corporate tax rate. Changes in either the personal tax rates or the supply of tax-exempt debt do not affect the yield spread. It is this prediction that is most strongly rejected by the data.

Miller Model I reaches the same conclusions as the bank arbitrage model, but instead because of the debt and equity supply decisions of corporations. Accordingly, it also is treated poorly by the data.

Miller Model II assumes that individuals are unable to circumvent taxes on equity income. As a result, the corporate tax rate, the personal tax code, and the tax-exempt debt supply all influence the equilibrium yield spread.

The final hypothesis, the preferred habitat model, combines the predictions of the previous models. In this view, commercial banks dominate the short-term market, but at longer maturities individual investors are the dominant source of demand. Just as in the bank arbitrage model, neither the personal tax code nor the tax-exempt debt supply affects the equilibrium short-term yield spread. At longer maturities, the yield spread is determined by the tax rate of the marginal investor in tax-exempt bonds. As a result, the yield spread depends directly upon the personal tax code and the municipal debt supply. The latter effect comes from the necessity of attracting investors in lower tax brackets to hold increases in debt.

What are the implications for municipal borrowing costs? If yields are determined either by the bank arbitrage or miller I models, changes in the slope of the yield curve reflect expected reductions in the corporate tax rate. In these circumstances any movement to substitute short-term finance for longer-maturity bonds will be undone by higher refinancing costs in the future. Alternatively, if the slope reflects differing tax rates of clienteles in a segmented market, then real borrowing costs may be reduced by this substitution.

What are the answers? To find out, the author tests whether changes in observed yield spreads or implicit tax rates are correlated with "tax policy events" likely to affect expectations of future personal or corporate tax rates. In doing so, he minimizes the importance of biases in the levels of implicit tax rates by focusing on the changes in the implicit tax rate. While this may reduce confounding expectational effects with either changes in differential risk or tax trading effects, it remains susceptible to changes in the after-tax discount rate. A more troubling drawback is the (unavoidable) use of dummy variables to proxy changes in the future stream of tax rates (see equation (11)). As such, they inevitably introduce a form of measurement error into the analysis. While the author is careful to stress the limitations of his results, the potential biases are worth emphasis.

The regressions argue against either the bank arbitrage or Miller I models. In my view, the strongest indication is the importance of changes in the share of state-local debt in changes in the yield spread at all maturities. Thus, it is possible to eliminate these two hypotheses without any appeal to tax events.

Still, the regressions indicate that tax events are important. The more subtle question is whether tax *expectations* are important, and here I think the results speak clearly. One, albeit crude, way of sorting out the relative importance of expectations versus actions is to compare the effects of policy announcements to those of actual implementation. Of the major tax events analyzed in table 2.6, eight were announcements and six were implementations.[1] Using model 3 results as the guide, we find significant responses to four of the announcements: the Kennedy tax cut, the Vietnam War surcharge, the March 1969 House decision, and the Long announcement opposing taxation of interest on municipal bonds. In contrast, the only policy implementation to show significant effects at all maturities is the passage of the Reagan tax cut. This is the only instance in which a policy implementation, but not announcement, changes the yield spread. It is easy *ex post* to rationalize this as reflecting uncertainty about the final form of the tax bill, but such temptations are an inherent weakness of this method.

A second weakness is apparent in the estimates. It is only a slight exaggeration to say that the evidence presented consists of essentially four episodes: the Kennedy State of the Union address, Johnson's announcement of the surcharge, the March and September 1969 flip-flop on the taxation of interest from municipal bonds, and the August 1981 passage of the Reagan tax program. By this measure, it takes a "big" tax event to move expected tax rates, and most theories that emphasize expectations suggest a continual, subtle reassessment of the future.

This paper raises the hope that it is possible to reduce municipal borrowing costs through changing the mix of debt maturities. One cannot predict the size of the savings, but this may be asking too much. The evidence in this paper supports the importance of expectations, with implications beyond the particular subject. Moreover, municipal bond market performance has been puzzling, and explicit tests of the few available explanations are welcome. Despite any limitations of the methods used, the paper makes an important contribution to testing the relevant hypotheses.

Note

1. The announcements are: May–June 1962, January 1963, January 1967, March 1969, September 1969, June 1980, November 1980, and February 1981.

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