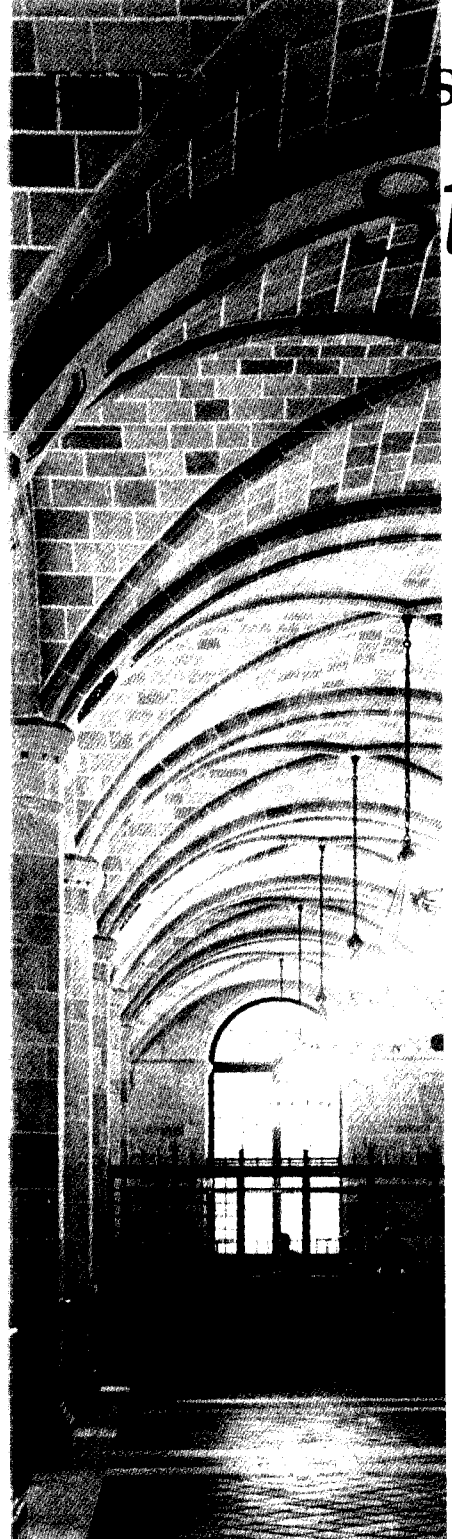

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The Relationship between Government Financial Condition and Expected Tax Rates Reflected in Municipal Bond Yields

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Abstract:

Yields on long-term municipal bonds reflect both current and expected future tax rates. This paper derives expected changes in tax rates from yields on short- and long-term municipal bonds and examines the relationship between expected changes in tax rates and the financial condition of the federal government between 1965 and 1994. My main empirical result is that a positive relationship exists between the expected tax rate and federal debt. Inflation also positively affects the expected tax rate, suggesting that investors may expect tight fiscal policies when inflation is high. Qualitative results are similar across specifications, estimators, and sample periods.

Introduction

Municipal bonds issued by state and local governments differ from other investment vehicles in that their interest income is exempt from federal taxation. This tax advantage is a major determinant of yields on these bonds relative to taxable bonds. While the tax advantage depends on the current tax rate for short-term investors, both current and future tax rates are relevant for long-term investors. Thus, yields on municipal bonds reflect an important piece of information—the long-term investor's expectation of future income tax rates—that may affect the investment decisions of households and businesses.[1]

This paper derives the expectation of future tax rates from yields on municipal bonds and examines the relationship between expected changes in tax rates and the financial condition of the federal government between 1965 and 1994, measured by outstanding debt, budget deficits, and inflation. A strong relationship between the two variables would suggest that the expectation of future tax rates is an additional channel through which fiscal policy affects economic activity. For example, a tax reduction that undermines government financial condition may cause the public to expect higher tax rates in the future, thereby failing to stimulate investment. In this

[1] Helpman (1989), who analyzes the foreign-debt problems of less developed countries, shows that large debt implies high future tax rates and therefore generally results in low investment.

case, policymakers would have to pay more attention to the indirect effect of fiscal policy through the expectation of future tax rates.

To examine this relationship, I estimate expected changes in tax rates from tax rates implied by yields on short- and long-term municipal bonds. The short-term implied tax rate is determined largely by the current tax rate, while the long-term rate reflects current *and* expected tax rates. Thus, changes in the tax-rate gap should be driven mainly by changes in expected tax rates.

Empirical results support the expected relationship. I find that federal debt has a strong positive effect on expected changes in tax rates. This finding indicates that investors expect tax rates to increase in the future when the government faces financial difficulties. Inflation also positively affects the expected tax rate. A possible interpretation is that high inflation may cause investors to expect both tight fiscal and tight monetary policies to lower inflation.

To confirm the robustness of these results, I use three estimators: OLS, an estimation with a time domain correction, and an estimation corrected for serial correlation. Results are similar across specifications and estimators. I also estimate recursive regressions to examine whether or not changes in tax regimes invalidate my results. I find that changing the sample period does not affect the main conclusion.

The paper is organized as follows: I begin by describing the tax-exempt status of municipal bonds and significant developments in the municipal bond market. Section II reviews competing hypotheses about the roles different income taxes play in determining the yield spread between taxable and tax-exempt bonds. Other factors affecting the yield spread are

discussed in Section III. Section IV analyzes the effect of the federal government's financial status on expected changes in income tax rates and presents results. The paper's findings are then summarized.

I. Tax-Exempt Status

State and local governments rely heavily on bond issuance to finance budget deficits and large-scale capital projects. Municipal bonds outstanding amounted to $964 billion at the end of 1994, or about 7.5 percent of total credit market debt.[2] The bonds can be classified into two broad categories: general obligation bonds, which are issued mostly to meet general financing needs and are backed by the issuer's full faith and credit, and revenue bonds, which are issued to finance a specific project and are secured solely by funds generated from the project. General obligation bonds are typically safer than revenue bonds because they are backed by *all* sources of revenue and assets.

Interest income earned on most municipal bonds is exempt from federal taxation. State governments also offer tax benefits to investors in municipal bonds. Currently, each of the forty-five states with income taxes allows the deduction of interest income from in-state bonds; two states also exempt income from out-of-state bonds.

Municipal bond holdings are concentrated among high-income households, which can realize more tax benefits. Feenberg and Poterba (1993), who analyze tax returns for 1987, 1988, and 1989, find that over 50 percent of tax-exempt interest income was reported by households with $100,000

[2] Credit market debt includes mortgages and consumer credit, as well as Treasury and corporate bonds.

or more of adjusted gross income. In contrast, households with less than $30,000 of income earned only about 13 percent of tax-exempt interest income.

The tax exemption enables state and local governments to issue debt at low costs. To prevent municipalities from abusing the privilege of issuing tax-exempt bonds, the Tax Reform Act of 1986 toughened rules governing municipal bonds. Before this Act was passed, municipalities issued large amounts of industrial development bonds to subsidize private businesses and "arbitrage bonds" to invest in securities offering higher yields. The Act made industrial development bonds ineligible for tax exemption and required municipalities to turn over profits from arbitrage activities to the federal government. As a result, municipal bonds issued for private purposes, which represented about 20 percent of all municipal bonds outstanding in 1985, dropped to only about 10 percent in 1993.

The Act also disallowed financial institutions from deducting interest paid on debt to carry tax-exempt securities.[3] Thus, banks became unable to take advantage of the tax-exempt status of municipal bonds. The Act resulted in a dramatic decline in the share of municipal bonds held by commercial banks (Table 1).

II. Relevant Tax Rate Hypotheses

The competing hypotheses about the tax rates reflected in yield spreads between taxable and tax-exempt bonds can be broadly classified into two groups: a partial equilibrium approach emphasizing investors' decisions

[3] The interest expense deductibility was 100 percent prior to 1980 and gradually declined to 80 percent before it was completely eliminated by the Act.

and a general equilibrium analysis looking at the interaction between taxable and tax-exempt bond markets. The hypotheses suggest different roles for personal and corporate tax rates. If those tax rates affect yields on short- and long-term municipal bonds differently, we must consider their different effects to accurately estimate the relationship between expected changes in tax rates and government financial condition.

A. Traditionalist View

The traditionalist view focuses on investors' selection between taxable and tax-exempt bonds. Investors will choose tax-exempt bonds if their return is greater than the after-tax return on taxable bonds. The return on municipal bonds equals the after-tax return on taxable bonds for marginal investors. Algebraically,

$$(1) \quad R_M = (1-t) \cdot R_T,$$

where R_M = rate of return on municipal bonds

R_T = rate of return on taxable bonds

t = marginal tax rate of marginal investors.

Thus, the market rate of return on municipal bonds is determined by the marginal tax rate (both current and expected rates for long-term bonds) of marginal investors. Given this relationship, the key question is, who are the marginal investors?

Historically, banks have held largely short-term municipal bonds to match their short-term liabilities, and individuals have invested mostly in long-term municipal bonds (Henderson and Koch 1977, and Mussa and Kormendi 1979). Based on this empirical regularity, the traditionalist camp argues that the municipal bond market is segmented—banks are the marginal

investors in short-term bonds, and individuals are the marginal investors in long-term bonds. Thus, the corporate income tax rate largely determines yields on short-term bonds, while the highest personal income tax rate governs yields on long-term bonds. In theory, market segmentation creates arbitrage opportunities because holding long-term bonds is equivalent to rolling over short-term bonds. The traditionalist camp responds to this by arguing that arbitrage opportunities do not exist due to high transaction costs (e.g., Poterba 1989). Transaction costs are high for municipal bonds because individual issues are relatively illiquid.

B. Miller's Hypothesis

As opposed to this partial equilibrium analysis, Miller (1977) examines yields on tax-free bonds in a general equilibrium context. He analyzes the effects of corporate and personal income taxes on corporate financing decisions and individuals' investment decisions. Corporations choose between debt financing and equity financing. Debt financing offers tax advantages through tax-deductible interest expenses. Conversely, individuals—who choose among tax-exempt bonds, taxable bonds, and corporate shares—derive the largest tax benefit from tax-exempt bonds and the smallest tax benefit from taxable bonds.[4] Thus, while corporations desire to issue more debt, individuals prefer equity shares to corporate bonds. These tax effects have to be neutralized in equilibrium.

Because of this tax disadvantage, individuals demand a higher before-

[4] The effective tax rate on income from shares is generally lower than that on interest income. Even when the tax rates are the same on interest income and capital gains, taxpayers can defer taxes on capital gains, lowering the effective tax rate.

tax return on corporate bonds than they do on equity shares. The required premium is higher for individuals in higher tax brackets. In this situation, corporations' attempts to take advantage of debt financing raise the interest rate on taxable bonds because they must attract more investors in high income tax brackets to issue a large amount of debt. The interest rate rises until the tax advantage of debt financing disappears. In equilibrium, costs of debt and equity are the same for corporations. On the demand side, tax-exempt bonds, taxable bonds, and equity shares are equally attractive to those investors whose marginal tax rate is equal to the corporate income tax rate. Therefore, corporate income tax rates determine the yield spread between taxable and tax-exempt bonds, regardless of maturity.

C. Mixed Empirical Evidence

Many studies have examined the relationship between the tax rate derived from the yield spread between taxable and tax-exempt bonds (implied tax rate) and the actual tax rate. The implied tax rate can be obtained by solving equation 1 for t,

$$(2) \quad t = 1 - R_M/R_T.$$

Empirical studies that compare this implied tax rate with corporate and individual tax rates have produced mixed results.

According to Trzcinka (1982), the yield spread adjusted for risk premiums produced implied tax rates close to corporate income tax rates in the 1970s. Poterba (1986) finds that both personal and corporate tax changes affect yields on tax-free bonds relative to those on taxable bonds. Fortune (1988) argues that Trzcinka's result does not hold when the sample period is extended to the 1980s, and that personal income tax rates more signifi-

cantly affect the yield spread. Poterba (1989) also shows that long-term implied tax rates respond to changing expectations of individual income tax rates. Given these conflicting theoretical and empirical arguments, it is difficult to single out the most relevant tax rate affecting the taxable/tax-exempt yield spread.

This paper does not test the validity of the competing hypotheses. Since the financial condition of the federal government should affect expectations of both corporate and personal income tax rates, it is not necessary to distinguish between these rates. However, there is a potential problem. The traditionalist view suggests that the municipal bond market is segmented. In that case, the difference between personal and corporate tax rates influences the spread between long-term and short-term implied tax rates, which I use as a measure of expected changes in tax rates. Furthermore, the Tax Reform Act of 1986, which reduced the role of banks significantly, may have enlarged the role of individual tax rates in determining the short-term implied tax rates after 1986. Empirical analyses in Section IV will consider these possibilities.

III. Other Determinants of Yield Spreads

Although federal tax rates are a major determinant of the yield spread between taxable and tax-exempt bonds, other factors may also influence the spread, such as risk premiums, short-term demand and supply conditions, special features of municipal bonds, state income taxes, and capital gains taxes. As some of these factors may influence either short- or long-term implied tax rates more significantly, thereby affecting the measure of expected tax changes, I examine whether or not they unevenly affect yields

on municipal bonds of different maturities.

A. Risk Premiums

Yield spreads between municipal and taxable bonds may contain risk premiums. To correctly infer tax effects from the yield spread, it is best to look at municipal and taxable bonds of comparable default risk. A sensible approach is to compare the highest quality municipal bonds with U.S. Treasury securities or the highest quality corporate bonds. Unfortunately, neither combination is immune to problems. Although general obligation bonds backed by state tax revenue have a low default risk, they are not as safe as Treasury securities because the federal government has a more stable tax base and can rely on monetary financing.

Assuming that ratings for municipal and corporate bonds are equivalent, it is more appropriate to compare the highest quality municipal bonds with the highest quality corporate bonds. Mussa and Kormendi (1979) and Trzcinka (1982), however, argue that the criteria used in rating corporate and municipal bonds are not the same and are not constant over time. It is difficult to make the ratings comparable because different factors, such as the political process, affect municipal creditworthiness. Thus, the riskiness of municipal bonds differs from that of corporate bonds.

B. Demand and Supply Conditions

In the short run, the yield spread may be affected by demand and supply conditions in taxable and tax-exempt bond markets. Even if the two types of bonds were perfect substitutes, price adjustments might take time unless bond markets were perfectly liquid. Because of imperfect liquidity, large debt issuance by state governments can temporarily lower the price of

municipal bonds. Institutional changes affect the demand for municipal bonds. For example, tax law changes in the mid-1980s induced commercial banks to unload their municipal bond holdings and, hence, temporarily raised yields on them. Bond markets can also be disturbed by international capital flows, such as the large purchases of U.S. Treasury securities by Japanese investors in the 1980s.

C. Special Features of Municipal Bonds

Callability and low liquidity reduce the attractiveness of municipal bonds relative to Treasury securities. (Unlike Treasury securities, many long-term municipal bonds are callable; moreover, they are not as liquid as Treasury bonds.) Fortune (1991) attributes the lower liquidity to how municipal bonds are sold: A typical municipal bond consists of a series of small strips with differing maturities; the small size of each strip makes it more difficult to sell in secondary markets. Callability and low liquidity should result in higher yields on municipal bonds.

D. State Income Taxes

State income tax laws favor income earned on Treasury securities somewhat by exempting that income from state taxation. Although states exempt interest income earned on in-state municipal bonds, most of them tax interest income earned on out-of-state municipal bonds. Since these laws induce investors to hold in-state bonds, income earned on most municipal bonds is, in effect, exempt from state income taxes. Thus, the yield spread between Treasury and municipal bonds largely reflects federal income tax rates. Nevertheless, the tax disadvantage of municipal bonds at

the state level may offset the federal tax advantage to a certain extent.[5] State income taxes more significantly influence the yield spread between corporate and municipal bonds because income earned on corporate bonds is fully taxable.

E. Capital Gains Taxes

Unlike interest income, capital gains from municipal bonds are taxable. Thus, investors may not realize the full tax benefit if they do not hold long-term municipal bonds to maturity. Sales before maturity usually involve some capital gains or losses. Accordingly, the possibility of early sale reduces the attractiveness of long-term municipal bonds. This possibility may be a serious consideration for high-income investors who expect to move into lower income brackets in the future, such as individuals approaching retirement age.

Among the factors discussed in this section, demand and supply conditions and state income taxes should similarly affect yields on both short-term and long-term municipal bonds. Other factors may influence yields on long-term municipal bonds more significantly. For example, risk premiums might be higher on long-term municipal bonds because uncertainties are greater in the long run. In addition, callability, lower liquidity, and capital gains taxes matter largely with long-term bonds. All of these factors contribute to increasing yields on long-term municipal bonds. Empirically, the long-term implied tax rate has been lower than the short-term implied tax

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[5] Kidwell et al. (1984) find that state income tax rates influence yields on municipal bonds.

rate.[6] The discussion in this section, therefore, is consistent with this empirical regularity.

The measure of expected tax rates is influenced by variables disproportionately affecting yields on long-term municipal bonds. The next section controls for the effects of those variables to accurately analyze the effect of government financial condition on expected changes in tax rates.

IV. The Relationship between Government Finance and Expected Tax Rates

This section explores the main hypothesis that investors expect tax rates to rise when the federal government faces financial difficulties. My study employs quarterly data from 1965 to 1994. Yields on municipal bonds are obtained from Salomon Brothers's *Analytical Record of Yields and Yield Spreads* for the period examined. For early years of the sample period, Salomon Brothers provides only the average yield of the first month of each quarter. For consistency, my study uses the first-month average for the entire sample period. The same principle is applied to other variables available with monthly frequency.

A. Expected Changes in Tax Rates

Expected changes in tax rates are measured by the difference between the twenty-year implied tax rate and the one-year implied tax rate derived from

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[6] In other words, the yield curve has been more upward sloping for municipal bonds than for taxable bonds. Many studies, including Trzcinka (1982), Kochin and Parks (1988), and Fortune (1991), discuss this issue.

yield spreads between Treasury securities and municipal bonds.[7] Setting aside other factors influencing the yield spreads for the moment, the expected change in tax rates is,

$$EXPTAX = (1 - R_{M20}/R_{T20}) - (1 - R_{M01}/R_{T01})$$

where R_{T01} = yield on one-year Treasury bills

R_{T20} = yield on twenty-year Treasury bonds

R_{M01} = yield on one-year prime-grade general obligation municipal bonds

R_{M20} = yield on twenty-year prime-grade general obligation municipal bonds.

The twenty-year implied tax rate may be interpreted as the average tax rate expected by investors during the next twenty years. Thus, controlled for other factors, EXPTAX is the gap between the average tax rate during the next twenty years and the current tax rate. A large value of EXPTAX indicates that investors expect a large increase in tax rates.

B. Financial Condition of the Federal Government

I consider three variables as measures of the government's financial condition: federal debt, budget deficits, and inflation. The government must devote a large portion of its revenue to making interest payments when its debt is large. In addition to a large principal, the government may face a high borrowing cost, which makes the refinancing of existing debt and

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[7] The twenty-year maturity is the longest one available for both municipal and Treasury bonds for the entire sample period.

additional borrowing more difficult, because it has already absorbed a substantial portion of national savings. Thus, with a large amount of debt outstanding, the government needs to rely less on debt financing and more on tax financing in the future. Large government debt should therefore cause rational investors to expect higher tax rates.

For the same reason, a large budget deficit is not sustainable. Ultimately, it will force the government to reduce spending, increase taxes, or both. Thus, the effects of chronic budget deficits are similar to those of outstanding debt. The overall effects, however, may be smaller because budget deficits can be temporary.

Inflation can also affect government financial condition in various ways. For instance, the government might be able to dilute existing debt if it could unexpectedly increase inflation and sustain high inflation for a long time. High inflation can also raise effective tax rates by inflating capital gains and reducing the real value of depreciation expenses.[8] In these cases, increased inflation improves financial condition. High inflation, however, is usually followed by efforts to curb inflation because it causes both economic and political problems. Lowering inflation requires contractionary economic policies: slower money growth, lower spending, higher taxes, or any combination of these. Thus, assuming that high inflation is not sustainable, investors may expect tax rates to increase when inflation is high.

Chart 1 compares the difference between the twenty-year and the one-year implied tax rate (EXPTAX) with the percentage of outstanding federal debt to GDP (FEDEBT). Federal debt is divided by GDP because tax bases

[8] The Economic Recovery Tax Act of 1981 began indexing tax brackets in 1985. Previously, inflation could also raise income-tax brackets.

and spending needs increase with GDP. The chart displays a positive relationship between the two variables, indicating that investors expect tax rates to increase when federal debt is large.

The increasing level of EXPTAX in the 1980s is consistent with large budget deficits during the period. Chart 2, however, does not show a strong relationship between EXPTAX and the ratio of federal budget deficits to GDP (DEFICT). Investors may be concerned more about FEDEBT reflecting the cumulative effect of DEFICT.

In Chart 3, EXPTAX does not appear to be closely related to inflation (INFLTN). The two variables, however, show a very strong relationship between the early 1970s and the early 1980s, when inflation was notably high. Investors might have expected that such high inflation was not sustainable.

C. Estimation

To examine expectations of tax rates more rigorously, I regress EXPTAX on variables reflecting the financial condition of the government and other relevant factors discussed in previous sections. Table 2 presents the definitions of the variables. In addition to FEDEBT, DEFICT, and INFLTN, the regression includes the default risk premium (RISKPM), the volatility of long-term interest rates (VOLATY), the yield curve (YCURVE), and the gap between the corporate and the personal income tax rate (TAXGAP).

Default risk premiums may vary with macroeconomic conditions. Holding other things constant, the yield spread between municipal and Treasury bonds may then move in the same direction as the yield spread between Baa-rated and Aaa-rated corporate bonds (Moody's ratings).

Assuming that risk premiums affect long-term yields more significantly due to more uncertainties in the long run, a large value of RISKPM reduces EXPTAX because the long-term implied tax rate decreases more than the short-term implied tax rate.[9]

When the volatility of long-term interest rates is high, callable bonds are more likely to be redeemed early. Furthermore, more income from bond holdings is likely to be in the form of capital gains. Therefore, a large value of VOLATY reduces the expected tax benefit and increases the value of the callability option. Since both factors decrease the attractiveness of long-term municipal bonds, a large value of VOLATY may increase yields on long-term municipal bonds, resulting in a low long-term implied tax rate. Thus, EXPTAX is expected to decrease with VOLATY.

Expected changes in interest rates also affect the value of the callability option and the expected tax benefit. When interest rates are expected to go up, capital gains and early redemption are less likely, making long-term municipal bonds more attractive. An expectation of higher interest rates is associated with a steep yield curve. A large value of YCURVE should increase EXPTAX.

The variable TAXGAP intends to capture the possibility of market segmentation. When marginal investors are banks in the short-term municipal bond market and individuals in the long-term municipal bond market, EXPTAX increases with the gap between the individual and the corporate

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[9] Holding the Treasury yield constant, a higher yield on municipal bonds results in a lower implied tax rate. Differentiating equation 2 with respect to R_M, $\partial t/\partial R_M = -(1/R_T) < 0$.

income tax rate. The coefficient of TAXGAP should be smaller after the Tax Reform Act of 1986, which induced banks to withdraw from the municipal bond market. Thus, the coefficient of DUMMY should be negative.

A major concern with time-series variables is stationarity. Appendix 1 presents the results of unit root and cointegration tests. All variables except for VOLATY appear to have unit roots, but they cointegrate. Thus, the error term is stationary. Still, the OLS estimator may not be efficient. To address this problem, I obtain an estimator with a time domain correction suggested by Saikkonen (1991), which is an asymptotically efficient estimator of cointegration regressions. The specification involves the differences of lead and lag terms:

$$y_t = \mathbf{x}_t \cdot \beta_1 + (\mathbf{x}_{1,t+1} - \mathbf{x}_{1,t}) \cdot \beta_2 + (\mathbf{x}_{1,t} - \mathbf{x}_{1,t-1}) \cdot \beta_3 + (\mathbf{x}_{1,t-1} - \mathbf{x}_{1,t-2}) \cdot \beta_4,$$

where $\mathbf{x}_1$ is a vector of regressors with unit roots.

To confirm the robustness of the empirical results, I also correct serial correlation by using a more conventional method. I regress the error term of each OLS regression on its lagged value and use the coefficient of the lagged value (ρ) to transform variables.[10] Every variable is transformed as $x_t^* = x_t - \rho \cdot x_{t-1}$.

In addition, there have been numerous changes in tax codes, as well as institutional developments, that may affect yields on short- and long-term municipal bonds.[11] The model considers only the effect of the Tax Reform Act of 1986 that disallowed banks from deducting interest paid on debt to

[10] The second lag is found to be insignificant.

[11] See Poterba (1986) and Fortune (1991) for detailed discussions of tax legislation.

carry tax-exempt securities. Many theoretical debates have centered around market segmentation, and Fortune (1991) empirically found the effect of the provision to be particularly significant.

Some other changes also deserve attention. The Tax Reform Act of 1976, which allowed mutual funds to pass along tax-exempt interest to investors, prompted the holding of municipal bonds by mutual funds. The emergence of mutual funds might have contributed to integrating short- and long-term municipal bond markets by reducing transaction costs. In addition, the Economic Recovery Tax Act of 1981 initiated the indexation of individual tax brackets, the Social Security Act Amendment of 1983 subjected social security benefits to federal income tax, and the Tax Reform Act of 1986 introduced the alternative minimum tax. All of these tax laws can influence demand for tax-exempt bonds.

It is impractical to incorporate all relevant changes in tax codes into regressions.[12] Instead, I run recursive regressions to examine if my key results depend on tax laws. I select the initial sample period from 1965 to 1975 and increase it by one year at a time. Before the Tax Reform Act of 1976, the effects of tax laws might have been small because there were few major changes in tax codes.

D. Results

Table 3 presents the results of the OLS estimation with various specifications. Model 02 deletes statistically insignificant variables of Model 01, and Model 03 excludes variables related to the market segmentation hypothesis.

[12] I attempted to include dummy variables representing various tax codes. Those variables turned out to be insignificant.

Both types of variables are excluded from Model 04. All variables have the expected signs, and most are statistically significant across all specifications. Among the variables representing the financial condition of the government, FEDEBT and INFLTN are highly significant, while DEFICT is insignificant. A positive sign of INFLTN suggests that investors expect tight monetary and fiscal policies to follow high inflation.

The estimations with a time domain correction show similar results (Table 4). The variables statistically significant in the OLS estimation (FEDEBT, INFLTN, RISKPM, TAXGAP, and DUMMY) continue to be significant with the same sign in the new regressions. DEFICT shows improved statistical significance. Although this estimation produces a wrong sign of YCURVE, its statistical significance is marginal.

The significance of FEDEBT and INFLTN still holds in regressions corrected for serial correlation (Table 5). Under this methodology, however, DEFICT shows a wrong sign with low statistical significance. Low statistical significance and inconsistent sign of DEFICT across estimators suggest that investors may not pay much attention to single-period budget deficits. Considering that FEDEBT may better reflect the overall financial strength of the government, this result is not surprising. Significance of other variables is similar to that of the OLS estimation. In sum, all three estimators show significant effects of FEDEBT and INFLTN on EXPTAX.

The variables related to government finance also show high economic significance. In Model 01, the coefficient indicates that a 1-percentage-point increase in federal debt as a percentage of GDP raises the expected tax rate by 0.69 percentage points. When the budget deficit as a share of GDP increases by 1 percentage point, the expected tax rate goes up by

0.37 percentage points. An increase in inflation by 1 percentage point results in an increase in the expected tax rate of 1.41 percentage points. The coefficients of FEDEBT and INFLTN are not so sensitive to specifications or estimators, though the coefficient of DEFICT fluctuates across estimators.

Other significant variables are RISKPM, TAXGAP, and DUMMY. Default risk appears to disproportionately affect yields on long-term municipal bonds.[13] The significance of TAXGAP and DUMMY is consistent with the market segmentation hypothesis; before the Tax Reform Act of 1986, the personal income tax rate was the main determinant of yields on long-term municipal bonds, while the corporate income tax rate determined yields on short-term municipal bonds. The coefficient of DUMMY shows a magnitude substantially larger than the theoretical prediction, which is the magnitude of the coefficient of TAXGAP. A narrowed gap between the two tax rates after the Act may have exaggerated the coefficient of DUMMY.

Table 6 shows the results of recursive regressions with three key variables: FEDEBT, INFLTN, and RISKPM.[14] The regression for the initial sample period shows high statistical and economic significance of all three variables. The extension of the sample period affects the coefficients of FEDEBT and INFLTN; the magnitude of both coefficients showed a down-

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[13] Although the coefficient suggests a very large effect of RISKPM on EXPTAX, its effect is much smaller on yields on long-term municipal bonds. From equation 2, the implied tax rate in percentage terms, $t_p = 100 \cdot (1 - R_M/R_T)$. $\partial t_p/\partial RISKPM = (\partial t_p/\partial R_M)(\partial R_M/\partial RISKPM)$. At the average value of R_T (8.18), $\partial R_M/\partial RISKPM = -5.94 \cdot (-8.18/100) = 0.49$.

[14] Results are similar with fuller specifications.

ward trend until the late 1980s and then reversed its course. The t-statistics of the three variables, however, increase with sample size. Appendix 2 shows the results of the Chow test for the equality of coefficients across two sample periods: 1965-1976 and 1977-1994. The test fails to reject the hypothesis that the coefficients are equal at the 5 percent level. The qualitative results of this paper, therefore, are valid across all tax regimes. The statistical significance of key variables is robust. Although their magnitude changes over time, the coefficients of DEBT and INFLTN are economically significant, even at their minimum values: 0.4571 for FEDEBT and 1.3283 for INFLTN.

V. Summary

The yield spread between taxable bonds and municipal bonds reflects expected tax rates, as well as current tax rates. This paper has derived expected changes in tax rates from the difference between the long- and the short-term implied tax rate reflected in yields on long- and short-term municipal bonds relative to taxable bonds.

The estimates of tax expectations have been used to examine the relationship between tax rate changes expected by investors and the financial condition of the federal government. Empirical results support the hypothesis that investors expect higher tax rates when the government faces financial difficulties. My main finding is that a positive relationship exists between the expected tax rate and federal debt. Inflation also positively affects the expected tax rate. When inflation is high, investors may expect that the government needs tight fiscal policies to lower inflation. These

results are valid across specifications, estimators, and sample periods.

Given the strong relationship between government financial condition and expected changes in tax rates, the effects of fiscal policies may be more complicated than previously thought. Fiscal policies influence the prospects of government finance. Thus, to accurately predict the consequences of fiscal policy, we must estimate the extent to which it influences expectations of future tax rates. For example, a tax reduction may fail to stimulate investment when the government is in poor financial condition. Because low tax rates may not be sustainable, investors may refrain from making long-term commitments in anticipation of higher tax rates.

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Table 1: Tax-Exempt Bond Holdings by Investors

Year	Total ($ Billions)	Commercial Banks (%)	Insurance Companies* (%)	Households (%)	Mutual Funds (%)	Other (%)
1965	100.4	38.5	11.3	36.4	0.0	13.8
1966	106.6	38.5	11.3	38.6	0.0	11.7
1967	113.8	43.9	11.9	33.6	0.0	10.6
1968	122.1	48.0	11.8	29.9	0.0	10.4
1969	133.5	44.3	11.6	27.2	0.0	16.8
1970	145.5	47.9	11.7	24.3	0.0	16.1
1971	161.7	51.0	12.7	19.7	0.0	16.6
1972	175.8	50.9	14.1	18.4	0.0	16.5
1973	192.7	49.4	14.8	20.3	0.0	15.6
1974	208.0	48.3	14.7	22.7	0.0	14.3
1975	223.0	45.7	14.9	22.6	0.0	16.8
1976	243.9	42.9	15.9	21.8	0.2	19.2
1977	273.6	41.6	18.1	20.9	0.8	18.6
1978	313.5	39.8	20.1	22.2	0.9	17.1
1979	341.5	39.3	21.3	21.8	1.2	16.4
1980	365.4	40.3	22.0	20.9	1.2	15.5
1981	398.3	38.4	21.1	23.4	1.3	15.8
1982	451.4	34.9	19.3	27.0	1.8	17.0
1983	505.7	31.9	17.1	31.0	2.7	17.3
1984	564.4	30.8	15.0	32.7	3.4	18.1
1985	744.6	31.0	11.9	34.5	4.5	18.1
1986	787.0	25.8	13.0	30.8	8.3	22.2
1987	862.5	20.1	14.5	37.4	8.2	19.8
1988	921.4	16.4	14.5	40.7	8.5	19.8
1989	991.2	13.4	13.6	43.5	9.4	20.1
1990	1,039.9	11.2	13.2	43.1	10.5	22.0
1991	1,108.6	9.3	11.4	43.6	12.4	23.3
1992	1,139.7	8.5	11.8	39.4	15.2	25.1
1993	1,217.8	8.1	12.0	35.5	17.9	26.4
1994	1,202.7	8.1	12.8	33.5	17.7	28.0

Source: Flow of Funds.

Note: Municipal debt accounted for about 80 percent of tax-exempt securities at the end of 1994.

*Property and casualty insurance companies. The holdings of life insurance companies are insignificant.

Table 2: Definition of Variables

Variable	Definition
EXPTAX	Twenty-year implied tax rate minus one-year implied tax rate
FEDEBT	Percentage of net federal debt (total liabilities minus financial assets) to GDP
DEFICT	Percentage of annualized federal budget deficits to GDP
INFLTN	Twelve-month moving average of annualized percentage changes in CPI
RISKPM	Average yield on Baa-rated corporate bonds minus average yield on Aaa-rated corporate bonds
VOLATY	Standard deviation of the monthly interest rate of twenty-year Treasury bonds
YCURVE	Yield on ten-year Treasury notes minus yield on one-year Treasury notes
TAXGAP	Highest personal income tax rate minus corporate income tax rate
DUMMY	Zero before the fourth quarter of 1986 and TAXGAP thereafter

Sources: Yields on municipal bonds are from Salomon Brothers's *Analytical Record of Yields and Yield Spreads*; yields on corporate bonds are from Moody's Investors Services's *Bond Survey*.

Table 3: OLS Estimation

Variable	Expected Sign	Model 01	Model 02	Model 03	Model 04
CONSTT	-	-43.9579 (-7.34)	-45.0775 (-7.65)	-34.8534 (-10.87)	-35.4687 (-12.27)
FEDEBT	+	0.6931 (5.69)	0.7513 (6.43)	0.5463 (7.14)	0.5780 (9.20)
DEFICT	+	0.3659 (0.65)		0.3983 (0.70)	
INFLTN	?	1.4137 (6.19)	1.2542 (6.05)	1.5800 (6.81)	1.4822 (7.14)
RISKPM	-	-5.9448 (-3.15)	-4.4110 (-3.10)	-6.4726 (-3.38)	-6.4753 (-5.86)
VOLATY	-	-0.1231 (-0.06)		-3.1828 (-1.49)	
YCURVE	+	0.6622 (0.95)		0.2633 (0.37)	
TAXGAP	+	0.2375 (2.12)	0.2236 (2.14)		
DUMMY	-	-0.8932 (-3.84)	-0.8499 (-3.95)		
Adjusted R-Squared		0.5643	0.5623	0.5136	0.5095
D-W Stat		1.3671	1.3362	1.2844	1.2047

Notes: Sample period: first quarter 1965-fourth quarter 1994; numbers in parentheses are t-statistics.

Table 4: Estimation with a Time Domain Correction

Variable	Expected Sign	Model 11	Model 12	Model 13	Model 14
CONSTT	-	-49.0692 (-5.47)	-47.8373 (-5.20)	-26.1069 (-5.33)	-26.4719 (-5.74)
FEDEBT	+	0.8089 (4.90)	0.7886 (4.69)	0.4329 (4.66)	0.4352 (4.96)
DEFICT	+	2.6494 (2.92)		2.5544 (2.62)	
INFLTN	?	0.8777 (3.09)	0.8353 (2.92)	1.4658 (5.64)	1.4857 (5.86)
RISKPM	-	-8.4984 (-2.49)	-4.1089 (-1.34)	-13.5643 (-4.35)	-11.1771 (-4.68)
VOLATY	-	-0.6945 (-0.31)		-3.6144 (-1.62)	
YCURVE	+	-1.9998 (-2.01)		-2.3193 (-2.33)	
TAXGAP	+	0.5168 (3.32)	0.4356 (2.71)		
DUMMY	-	-1.3046 (-4.34)	-1.2699 (-4.27)		
Adjusted R-Squared		0.6549	0.5998	0.5857	0.5334
D-W Stat		1.4892	1.3906	1.4111	1.2774

Notes: Sample period: first quarter 1965-fourth quarter 1994; numbers in parentheses are t-statistics; coefficients of most control variables (difference terms), which are not reported here, are insignificant.

Table 5: Estimation Corrected for Serial Correlation

Variable	Expected Sign	Model 21	Model 22	Model 23	Model 24
CONSTT	-	-30.7907 (-6.18)	-30.7010 (-6.21)	-23.9115 (-8.96)	-22.1413 (-8.62)
FEDEBT	+	0.6964 (4.66)	0.7605 (5.06)	0.5638 (5.72)	0.5823 (6.26)
DEFICT	+	-0.6620 (-1.12)		-0.7829 (-1.30)	
INFLTN	?	1.4884 (5.19)	1.2712 (4.59)	1.6553 (5.50)	1.4739 (4.95)
RISKPM	-	-4.2626 (-2.11)	-4.0826 (-2.40)	-4.5862 (-2.28)	-5.5185 (-3.67)
VOLATY	-	1.0471 (0.45)		-0.8083 (-0.34)	
YCURVE	+	1.7929 (2.50)		1.6364 (2.21)	
TAXGAP	+	0.2185 (1.60)	0.2304 (1.73)		
DUMMY	-	-0.9386 (-3.34)	-0.8677 (-3.16)		
Adjusted R-Squared		0.4252	0.3980	0.3538	0.3125
D-W Stat		1.8724	2.0566	1.8731	2.0895

Notes: Sample period: first quarter 1965-fourth quarter 1994; numbers in parentheses are t-statistics; ρ is 0.3160 for Model 21, 0.3316 for Model 22, 0.3560 for Model 23, and 0.3962 for Model 24.

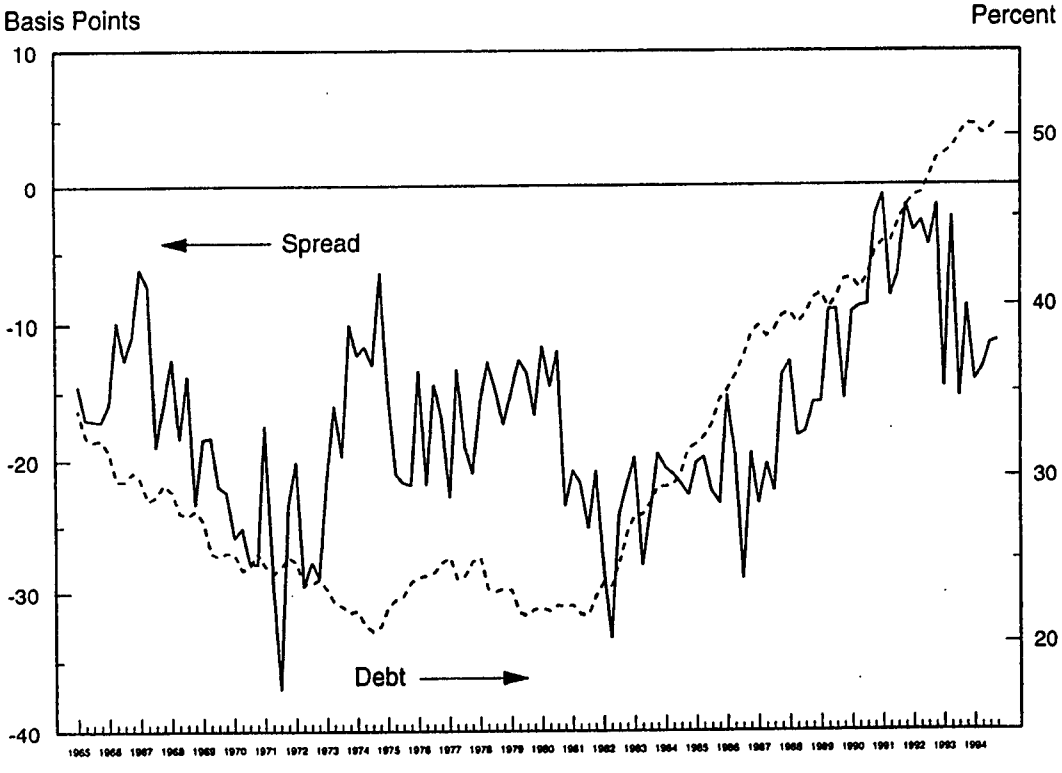
Table 6: Recursive Regressions

Sample Period	CONSTT	FEDEBT	INFLTN	RISKPM
1965 - 74	-54.3951	1.2562	2.3000	-9.7792
	(-3.13)	(2.56)	(3.84)	(-2.10)
1965 - 75	-58.9863	1.3698	2.4015	-8.3048
	(-4.73)	(3.57)	(4.88)	(-2.94)
1965 - 76	-60.9088	1.3948	2.2497	-5.4460
	(-4.78)	(3.55)	(4.48)	(-2.10)
1965 - 77	-61.0231	1.3953	2.2545	-5.4127
	(-4.92)	(3.65)	(4.64)	(-2.16)
1965 - 78	-59.0938	1.3379	2.1795	-5.4453
	(-4.94)	(3.62)	(4.72)	(-2.34)
1965 - 79	-57.0257	1.2820	2.0452	-5.4540
	(-5.01)	(3.63)	(5.09)	(-2.45)
1965 - 80	-52.1897	1.1541	1.8857	-6.3387
	(-5.30)	(3.64)	(5.59)	(-3.14)
1965 - 81	-51.0639	1.1339	1.8674	-7.0055
	(-5.39)	(3.69)	(5.66)	(-3.85)
1965 - 82	-52.9236	1.1932	1.8350	-6.4593
	(-5.63)	(3.89)	(5.78)	(-4.76)
1965 - 83	-53.5396	1.2106	1.8062	-6.0975
	(-5.80)	(4.03)	(5.83)	(-5.00)
1965 - 84	-49.0234	1.0580	1.7311	-6.4043
	(-5.85)	(3.91)	(5.75)	(-5.53)
1965 - 85	-42.3489	0.8314	1.6077	-6.6993
	(-5.77)	(3.56)	(5.54)	(-5.89)
1965 - 86	-38.3944	0.6953	1.5427	-6.8390
	(-6.06)	(3.53)	(5.46)	(-6.03)
1965 - 87	-32.4337	0.4977	1.3723	-6.7895
	(-6.27)	(3.20)	(5.29)	(-6.02)
1965 - 88	-31.2189	0.4571	1.3283	-6.7170
	(-7.14)	(3.61)	(5.56)	(-6.09)
1965 - 89	-31.3583	0.4618	1.3392	-6.7563
	(-8.24)	(4.40)	(6.08)	(-6.29)
1965 - 90	-34.3024	0.5531	1.4627	-6.8922
	(-10.07)	(6.13)	(7.03)	(-6.47)
1965 - 91	-37.6320	0.6560	1.5645	-6.8616
	(-11.81)	(8.08)	(7.55)	(-6.32)
1965 - 92	-39.3512	0.7156	1.6121	-6.9810
	(-13.09)	(9.85)	(7.89)	(-6.47)
1965 - 93	-37.2707	0.6433	1.5407	-6.7363
	(-12.69)	(9.60)	(7.47)	(-6.14)
1965 - 94	-35.4687	0.5780	1.4822	-6.4753
	(-12.27)	(9.20)	(7.14)	(-5.86)

Note: Numbers in parentheses are t-statistics.

Chart 1

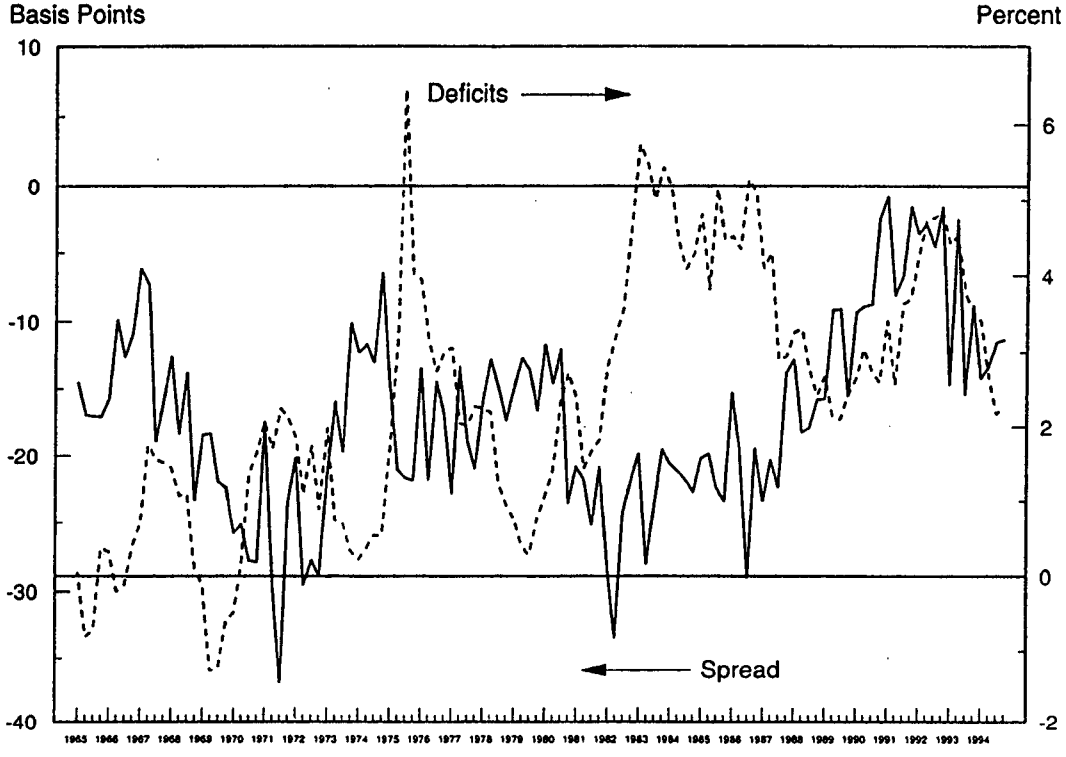
Federal Debt and Spread of Implied Tax Rates



Notes: Federal debt = percentage of net federal debt (total liabilities minus financial assets) to GDP.
Spread of implied tax rates = twenty-year implied tax rate minus the one-year implied tax rate.

Chart 2

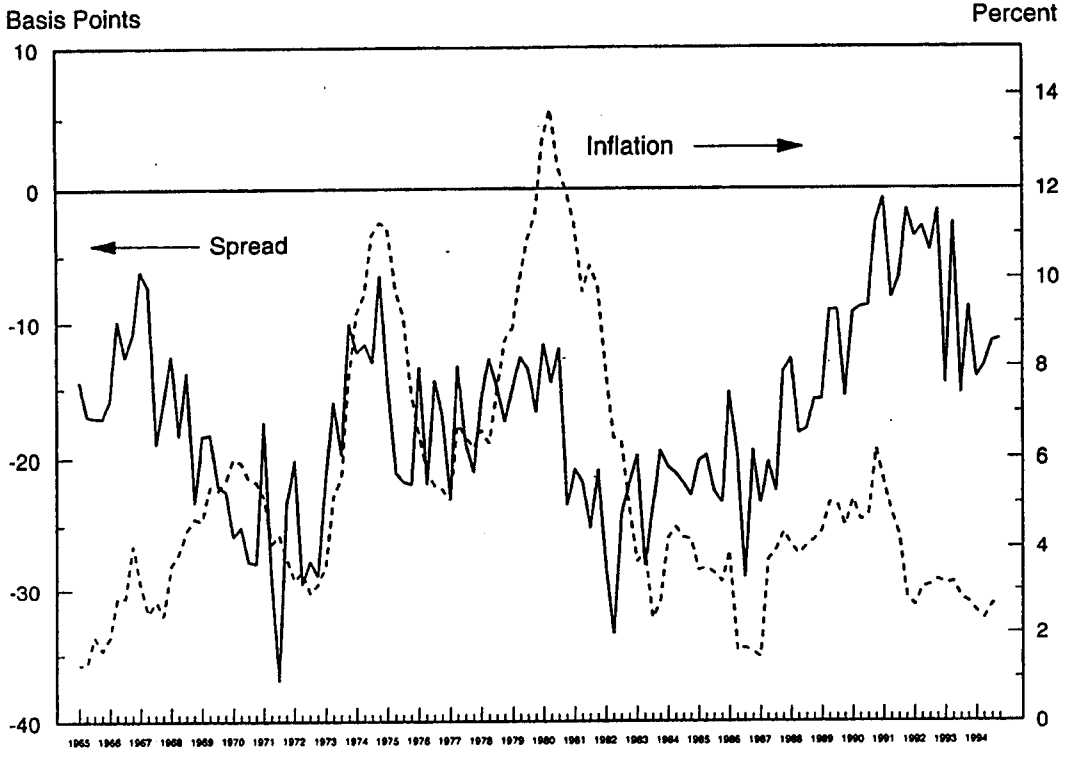
Federal Budget Deficits and Spread of Implied Tax Rates



Notes: Federal budget deficits = percentage of annualized federal budget deficits to GDP.
Spread of implied tax rates = twenty-year implied tax rate minus the one-year implied tax rate.

Chart 3

Inflation and Spread of Implied Tax Rates



Notes: Inflation = one-year moving average of annualized percentage changes in CPI.
Spread of implied tax rates = twenty-year implied tax rate minus the one-year implied tax rate.

Appendix 1: Unit Root and Cointegration Tests

The Dickey-Fuller statistic has been obtained for each variable (Y) from a regression of the following form:

$$Y_t - Y_{t-1} = \beta_1 \cdot \text{CONSTANT} + \beta_2 \cdot Y_{t-1} + \beta_3 \cdot (Y_{t-1} - Y_{t-2}) + \beta_4 \cdot \text{TREND}$$

Dickey-Fuller t-statistic:

EXPTAX	-3.2637
DEBT	-1.6011
DEFICT	-2.8524
INFLTN	-2.2790
RISKPM	-2.4268
VOLATY	-4.8786
YCURVE	-3.0855
TAXGAP	-1.8421
DUMMY	-2.3724

MacKinnon Critical Values:

1%	-4.0380
5%	-3.4481
10%	-3.1489

The cointegration test regresses EXPTAX on DEBT, DEFICT, INFLTN, and RISKPM, and applies the same regression as the one above to the residual.

Cointegration Vector:

EXPTAX	1.0000
DEBT	-0.8267
DEFICT	-1.0827
INFLTN	-2.0023
RISKPM	7.0085

Dickey-Fuller t-statistic for the residual: -5.7428

MacKinnon Critical Values:

1%	-5.4787
5%	-4.8643
10%	-4.5506

Appendix 2: Chow Test for the Equality of Coefficients

CONSTT	-35.469 (-12.3)	-60.909 (-5.4)	-38.075 (-10.8)	-41.304 (-9.0)	-37.018 (-11.1)	-36.994 (-10.6)
FEDEBT	0.578 (9.2)	1.395 (4.0)	0.652 (7.6)	0.760 (6.0)	0.608 (8.6)	0.608 (8.3)
INFLTN	1.482 (7.1)	2.250 (5.0)	1.581 (7.2)	1.636 (7.2)	1.638 (6.1)	1.513 (7.2)
RISKPM	-6.475 (-5.9)	-5.446 (-2.4)	-5.718 (-4.6)	-5.421 (-4.3)	-6.154 (-5.3)	-5.538 (-3.4)
CONST1		22.008 (1.7)	-1.705 (-1.3)			
FEDEB1		-0.772 (-2.1)		-0.086 (-1.6)		
INFLT1		-0.720 (-1.4)			-0.172 (-0.9)	
RISKP1		0.058 (0.0)				-0.829 (-0.8)
R-Squared	0.5218	0.5493	0.5285	0.5328	0.5254	0.5244
F-Stat.	42.20	19.50	32.23	32.79	32.83	31.71
SSR	2,881	2,715	2,841	2,815	2,860	2,865
Obs.	120	120	120	120	120	120

Variable Definitions:

CONST1 - Zero until the fourth quarter of 1976 and CONSTT thereafter
FEDEB1 - Zero until the fourth quarter of 1976 and FEDEBT thereafter
INFLT1 - Zero until the fourth quarter of 1976 and INFLTN thereafter
RISKP1 - Zero until the fourth quarter of 1976 and RISKPM thereafter.

The F-statistic of variables CONST1, FEDEB1, INFLT1, and RISKP1 is calculated based on the R^2's of the first two regressions.

$F_{4, 112} = [(0.5493 - 0.5218) / (1 - 0.5493)] [(120 - 8) / (8 - 4)] = 1.7088$

$F_{4, 112}$ at the 5 percent significance level ≈ 2.45

Thus, this test fails to reject the hypothesis that CONST1 = FEDEB1 = INFLT1 = RISKP1 = 0. The t-statistics of the four variables are also insignificant when they are entered separately in the last four regressions.