The Municipal Bond Market, Part I: Politics, Taxes, and Yields

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This article assesses recent changes in the structure of the municipal bond market. It reviews the tax legislation, judicial interpretations, and other factors that affect the yield on municipal bonds. These factors are then employed in a statistical analysis of the determinants of municipal bond yields. A companion piece will examine the public policy issues surrounding tax exemption and assess reforms of the market. The two papers represent a continuation of research at the Federal Reserve Bank of Boston on the subject (Huefner 1971; Fortune 1973; Peek and Wilcox 1986).

The first section of this article is an overview of the key features of municipal bonds, of the most significant changes in the structure of the market in recent years, and of the question of the constitutional and legislative basis for tax exemption. The second section focuses on the significant features of the income tax code that affect the municipal bond market. The third section reviews recent tax legislation affecting the market. The fourth section presents an econometric analysis of municipal bond yields, designed to determine whether the factors discussed in previous sections do, in fact, influence yields. The final section is a summary.

I. An Overview of the Municipal Bond Market

Several innovations in the nature of municipal debt have occurred in recent years. The purpose of this section is to outline the basic forms of municipal debt and to describe their yields, their exemption from tax, and their ownership. Petersen (1991) provides an excellent source for innovations in municipal financial instruments, such as variable-rate bonds and municipal commercial paper.

Forms of Municipal Debt

Municipalities issue debt in a variety of forms. State constitutions and statutes typically restrict short-term debt to purposes related to working capital, bridging the gap between expenditures and receipts. The most prominent forms of short-term debt, or notes,[1] are tax anticipation notes, revenue anticipation notes, grant anticipation notes and bond anticipation notes. Tax, revenue, and grant anticipation notes are used to provide funds for operating expenses, such as payments for wages, salaries, utilities and materials. They are repaid from anticipated tax revenues, federal or state grants, and non-grant, non-tax revenues, respectively. Bond anticipation notes are used to provide temporary financing of capital outlays, such as purchase of equipment and construction of schools and roads. They are repaid from the permanent long-term bond financing.

Long-term bonds address the problems of the lumpiness of municipal capital spending and the intergenerational nature of benefits.

Long-term bonds are issued for permanent financing of capital outlays, such as construction of bridges and roads, water and sewage systems, and schools. The purpose of long-term debt is to smooth out the path of tax revenues required to finance capital outlays and to distribute those revenues over time in conformity with the stream of benefits resulting from the project. For example, a solid waste disposal system is "too expensive" to be financed out of tax revenues in a single year, and the benefits of the disposal system occur over a long period. Therefore, financing from tax revenues would place a high burden on the current generation of taxpayers but no financial burden on future beneficiaries. Long-term bonds provide a way of addressing these problems of the lumpiness of capital spending and of the intergenerational nature of benefits.[2]

The two broad classes of long-term municipal debt differ according to the source of debt service payments (coupons plus principal). General obligations are backed by the "full faith and credit" of the community, meaning that debt service is to be paid from general tax revenues. General obligations are, other things equal, a safe form of investment for individuals and financial institutions, particularly when no limits exist on the ability of the issuer to raise the money via taxes to meet debt service requirements.[3] Only a few defaults of general obligations have occurred in this century, the most prominent being New York City in 1975 (on $2.4 billion of notes), Cleveland in 1978 (on $15.5 million of notes), and Bridgeport, Connecticut in 1991.

Revenue bonds have more limited backing—the revenues from specific projects. These bonds are issued by governmental agencies set up to finance, construct, and manage specific facilities. Examples of the hundreds of revenue authorities around the United States are the Massachusetts Turnpike Authority, the Massachusetts Port Authority, the Massachusetts Water Resource Authority and—for a national flavor—the Washington Public Power Supply System (WPPSS). If the revenues from the project (auto tolls, airplane landing fees, water and electricity billings, and the like) are not sufficient to meet debt service payments, the bonds can be defaulted and the issue goes to the courts to decide which claimants—employees, suppliers, or bondholders—will get paid. The bulk of municipal bond defaults have been revenue bonds, the most prominent in recent history being the 1983 default by WPPSS on $2.25 billion of bonds issued to finance nuclear generating facilities.[4]

Revenue bonds are the most rapidly growing form of bond indebtedness for states and local governments. This is due, in part, to restrictions in state constitutions that limit the ability of municipalities and states to issue general obligation bonds, leaving

[1] The term "notes" is usually applied when the maturity of the instrument is 12 months or less. "Bonds" refer to instruments with more than one year to maturity.

[2] This assumes that full capitalization of tax liabilities into property values does not occur. If full capitalization does exist, in which case the tax liability associated with borrowing by a state or local government is fully reflected in the value of residential and commercial property, the residents at the time of the bond issue will pay the full costs of the debt service regardless of maturity.

[3] The most default-free securities are, of course, U. S. Treasury bonds, for the government can always print the money to meet debt service payments if tax revenues are insufficient.

[4] One innovation in the past 20 years has been municipal bond insurance. About 10 percent of the WPPSS default was insured by a private company. The investors in the unit trusts that bought insurance did not lose principal or coupons as a result of the default.

the alternative of forming revenue authorities. While revenue bonds carry higher interest rates than general obligation bonds, the use of revenue bonds is the result of a mutually beneficial arrangement between issuers and investors: issuers can finance projects with revenue bonds without ransoming their taxing authority, paying the higher interest rates with fees and user charges borne by the beneficiaries of the projects, while investors can get higher rates of return in the form of a risk premium on municipal bonds.

Recent years have seen a rapid expansion of municipal bonds issued for purposes other than the traditional financing of infrastructure constructed by states and local governments. Among these are "private-activity" municipal bonds, advanced refundings, and arbitrage bonds. These will be discussed below.

Eligibility for Tax Exemption

The right to issue tax-exempt bonds is not automatic. In order to be eligible for exemption, a bond must meet standards imposed by law in section 103 of the Internal Revenue Code, as interpreted by the Internal Revenue Service. The purpose is, of course, to prevent municipalities from using tax-exempt debt to finance projects judged not to be for municipal purposes.

The problem of "private-activity" municipal bonds has grown dramatically in the last two decades (Zimmerman 1991). In the 1960s municipalities began to use their favored access to credit markets to induce businesses to locate within their jurisdiction. The device employed was the industrial development bond, issued by a municipality to finance construction of structures that were then leased to the private business, the lease payments providing the funds to meet debt service payments. In this way a business could finance its construction of factories and office space at municipal interest rates rather than at corporate bond rates.

The success of tax-exempt industrial development bonds led to a plethora of similar revenue bonds, each designed to serve a specific constituency: for example, mortgage revenue bonds, to finance loans at below-market rates to households to purchase homes; student loan bonds, to make loans to students at favorable rates; and pollution control bonds, to provide low-cost funds to corporations to acquire equipment for the reduction of water and air pollution. By the early 1980s the issuance of private-activity bonds was out of control. This can be seen in Figure 1, which shows the share of all long-term debt outstanding (corporate and foreign bonds, municipal bonds and mortgages) that is tax-exempt, whether for public or private purposes. The figure shows that total tax-exempt bonds declined as a share of all bonds and mortgages from 1960 through 1990, with a brief surge in the early 1980s. The state-local government share for public purposes declined throughout the period, while the private-activity share (issued on behalf of households and corporations) rose beginning in the early 1970s, growing to almost one-third of outstanding tax-exempt bonds by 1985.

The rapid growth of private-activity tax-exempt bonds led to the realization that those issues were having effects not intended by Congress. First, the federal taxpayer was underwriting a capital-cost subsidy for households and corporations, a subsidy never intended by Congress. Second, the competition for tax-exempt credit from private-activity bonds was forcing interest rates up for the intended beneficiaries of tax exemption—issuers of public purpose bonds.

A significant feature of the Tax Reform Act of 1986 was legislation limiting the eligibility of private-activity bonds for tax exemption. While limits had existed in earlier years, they were tightened considerably by this Act. Section 103(c), under which the private-activity definition is established, applies four different tests to determine whether a bond is private-activity. The first test—which is the most widely applied—is a joint test of uses-of-funds and of security interest: if more than 10 percent of a bond's proceeds are used for private purposes *and* if more than 10 percent of the debt service is derived, directly or indirectly, from a private use, the bond is deemed a "private-activity" bond.

A significant feature of the Tax Reform Act of 1986 limited the eligibility of private-activity bonds for tax exemption.

In order to be tax-exempt, a private-activity bond must (with some exceptions) be within the state volume limit and it must satisfy certain maturity

restrictions. The state volume limit, established in 1986, is now set at the greater of $50 per capita or $150 million. Tax exemption is automatically extended to private-activity bonds within that limit. However, seven categories of private-activity bonds are excluded from the volume limit and can be issued in tax-exempt form in any amount. These are "exempt facility bonds" (airports, docks and wharves, solid waste facilities, and the like), qualified mortgage bonds, qualified veterans' mortgage bonds, qualified small-issue industrial development bonds, qualified student loan bonds, qualified redevelopment bonds, and qualified section 501(c)(3) nonprofit organization bonds.

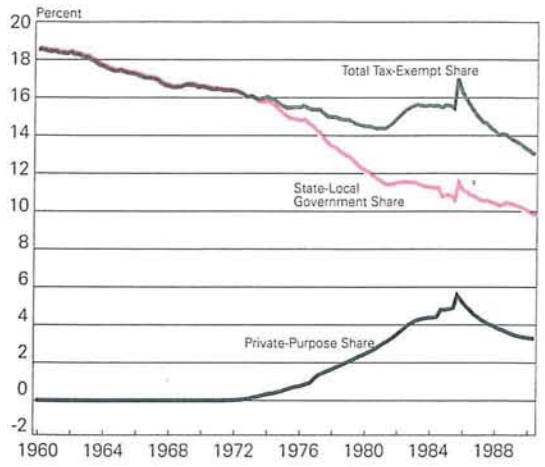
Figure 1 shows a dramatic reversal of the earlier trends after the 1986 Tax Reform Act. Following a brief surge in private-activity issues in 1985 in anticipation of the limitations imposed in the 1986 Act, the outstanding amount of tax-exempt bonds for private purposes declined sharply.

Another problem category of bonds is arbitrage bonds. In the 1960s, states and local governments became aware that tax exemption was a money machine: by issuing tax-exempt bonds at favored interest rates and investing the proceeds in taxable bonds, a municipality could earn a spread equal to the difference between the taxable and tax-exempt rates. Note that while these arbitrage profits can aid the states and local governments by providing funds to finance additional public services or to reduce tax rates, they are not necessarily in the financial interests of the taxpayers: that depends on the difference between the municipal bond rate paid and the after-tax rate of return the taxpayers earn on their investments.

In 1969, section 103(c) of the Internal Revenue Code was changed to define arbitrage bonds as bonds whose proceeds, beyond a "reasonably required" reserve, were used to invest in securities with a "materially higher yield" for more than a "temporary period." The problem of arbitrage bonds is presented most clearly when a bond is issued with the sole purpose of investing the proceeds at a higher interest rate and earning the spread over the period until the bond is repaid; this blatant use of tax exemption was clearly eliminated by the 1969 legislation. However, over the intervening 20-odd years the interpretation of section 103(c) has changed frequently. This is the result of two conflicting goals, the first being to close off the arbitrage opportunities still employed despite the regulation, and the second to allow tax exemption for bonds issued for "reasonable" uses, when the proceeds are temporarily invested in earning assets.[5] Because municipalities often find themselves in the situation of issuing a bond before the proceeds are expended, temporarily holding the proceeds, the difficulty in the arbitrage restrictions is setting standards that allow this to happen for reasonable pur-

Figure 1

Tax-Exempt Share of Outstanding Bonds and Mortgages



Source: Board of Governors of the Federal Reserve System, *Flow of Funds Accounts*.

[5] An example is advanced refunding: the issuance of a new municipal bond to pay off an outstanding bond. The proceeds of the new issue are typically placed in an escrow account that holds U.S. Treasury securities whose income is sufficient to pay the debt service on the advance refunding bonds and to yield net income. The amount of the proceeds of the advance refunding issue, plus accumulated net income, is designed to be sufficient to pay off the original bond. Clearly this must be done before the retirement of the original issue at either maturity or a call date.

The optimal timing for an advanced refunding is when interest rates are low, so the advance refunding is often done well before the actual retirement of the outstanding issue. If the delay is sufficient to arouse the interest of the Internal Revenue Service, the new issue can be interpreted as an arbitrage bond and, in order to maintain the tax-exempt status of the advance refunding issue, the municipality must rebate to the U.S. Treasury the spread between the interest earned on the Treasury securities and the interest paid on the newly issued municipal bond. If this rebate is not made, the investor will lose the tax exemption, even if he had every reason to believe that the exemption was allowed when he purchased the bond.

poses, while eliminating the abuses of tax exemption.[6]

The Question of Constitutionality

The exemption of state and local interest payments on municipal bonds from federal income taxation has a long history, originating in a question about the legality of taxation of activities of one level of government by another level of government. During the years immediately following the American Revolution, power rested in the states and the federal government was weak. Concern for the financial fragility of the new federal government, combined with several attempts by states to tax activities of the federal government, led to a series of Supreme Court decisions, under Chief Justice Marshall, that protected the central government from the taxing powers of the states. Marshall's well-known dictum that "the power to tax is the power to destroy" was, in fact, a statement designed to protect the central government, although in modern times it has been used to support protection of the states from federal taxing powers. One of the most important of these cases was *McCulloch v. Maryland* (1819), in which Marshall's court struck down a tax levied by the state of Maryland on the Bank of the United States. This was the origin of the exemption of federal activities from state taxation.

The first federal income tax was enacted during the Civil War. It taxed both salaries and interest payments by states and local governments, but in *Collector v. Day* (1871) the Supreme Court ruled that the application of the tax to the salary of a state judge was unconstitutional. This decision established the doctrine of reciprocal immunity, in which the federal government and state-local governments were protected from the tax powers of the other. The expiration of the federal income tax in 1872 meant that this decision had a limited effect, but enactment of a new federal income tax in 1894 revived the issue. The 1894 federal income tax explicitly recognized *Collector v. Day* by exempting salaries paid by state and local governments, but included interest payments by states and local governments in the tax base. The federal taxation of state and local interest payments was struck down in 1895 in *Pollock v. Farmers' Loan & Trust Company*, when the U.S. Supreme Court held that interest on a state bond should be exempted from federal taxation. This case has been central to the argument that the exemption is protected by the Constitution.

The modern federal income tax was ushered in with the Sixteenth Amendment to the Constitution in 1913. The Sixteenth Amendment gave Congress the power "to lay and collect taxes on income, from whatever source derived." In the new income tax, enacted after the Sixteenth Amendment, the question of reciprocal immunity was avoided by explicitly exempting both interest *and* salaries paid by states and local governments, thus adhering to both *Collector v. Day* and *Pollock v. Farmers'*.

Because the initial tax rates were very low, the effect of this exemption on the state-local cost of capital was small. However, as federal income tax rates rose, the exemption of municipal interest became an economic issue. The 1920s and 1930s were periods of considerable debate about the interest exemption, with parties lined up on the basis of economic self-interest. Business organizations, such as the U.S. Chamber of Commerce, private utility companies that opposed a subsidy to their public competitors, and many state governments in the industrial North joined to oppose tax exemption. On the other side, many state governments in the non-industrial South strongly supported the exemption because of the subsidy it conferred and because they had little industrial base to be harmed by the competition for funds.

A constitutional amendment to eliminate the exemption failed in 1922, but it continued to be urged by the Coolidge, Harding, and Hoover Administrations. Gradually the scope of the exemption was narrowed by judicial decision rather than legislation. In *Graves v. New York ex rel. O'Keefe* (1939) the Court upheld a state tax on a federal salary, thereby overturning *Collector v. Day*. Ultimately this paved the way to elimination of the intergovernmental exemption for salaries. However, the exemption continued for interest payments, primarily as a result of the efforts of state and local governments.[7]

Proponents of the view that the exemption is protected by the Constitution have appealed to early Supreme Court decisions, such as *Pollock v. Farmers' Loan & Trust Company*, and to the proposals in the

[6] For much of the life of the arbitrage regulations, a municipality could avoid the arbitrage bond limitations by investing no more than 15 percent of the bond proceeds in a reserve fund, and by showing "due diligence" in completing the project the bond was intended to finance, with an upper limit of five years on the temporary holding period (Buschman and Winterer 1983). This still allowed considerable leeway for earning arbitrage profits, and a part of the 1986 Tax Reform Act tightened the restrictions further.

[7] This history of the early debate is drawn from Huefner (1971).

1920s to eliminate the exemption through a constitutional amendment. A significant minority of the legal profession continues to assert that taxation of state-local interest is barred by the U.S. Constitution, even though that uncertainty was eliminated in a series of U.S. Supreme Court decisions in the 1980s. Whatever one's views of the constitutionality issue, however, legislation has clearly conferred tax exemption: section 103(a) of the Internal Revenue Code of 1954, the basis for the present tax code, specifically exempts municipal interest income from the federal income tax.

Whatever one's view of the constitutionality issue, legislation has clearly conferred tax exemption for state and local interest payments on municipal bonds.

This legislative basis for tax exemption has been weakened in recent years. The first important decision addressed the Social Security Act Amendments of 1983, which imposed a tax on Social Security benefits if the taxpayer's income was above a specified level. For the purposes of this computation, "income" was defined as including interest from municipal bonds. As a result, the amendments indirectly imposed a tax on municipal interest: sufficient municipal interest income could lead to payment of additional taxes. The Supreme Court refused to hear cases charging that this was unconstitutional, thereby allowing continuation of the indirect taxation of municipal interest.

The second important piece of legislation weakening tax exemption was the 1982 Tax Equity and Fiscal Responsibility Act (TEFRA), which limited the exemption to municipal bonds issued in registered form, forcing all bearer bonds into the taxable category.[8] The purpose of this was to allow the federal government to track municipal interest income, an objective furthered in 1987 when the federal income tax forms required the taxpayer to report his municipal interest income even though it was not subject to tax.

Just when Congress was weakening the exemption, the Supreme Court clearly rejected any constitutional foundation for it. In *Garcia v. San Antonio Metropolitan Transit Authority* (1985), the Court held that the taxation of state and local interest payments was a matter of legislation, not a constitutional issue: if Congress wished to tax municipal interest, it was free to do so. This was upheld and clarified in a 1988 Supreme Court decision, *South Carolina v. Baker*, which upheld the 1982 TEFRA removal of tax exemption for state and local bonds not held in registered form. In his majority opinion, Justice Brennan argued that "states must find their protection from Congressional regulation through the national political process, not through judicially defined spheres of unregulated state activities."

Thus, at this point no constitutional barrier to elimination of the exemption of municipal interest remains. However, Congress has given no indication of interest in including municipal interest in the federal income tax base. The reason is that tax exemption has become a very valuable subsidy for states and local governments, and states and local governments have formed a powerful lobby to protect their preferred access to credit markets.

Unusual Features of Municipal Bonds

Municipal bonds differ from corporate, U.S. Treasury, and other taxable bonds in ways other than tax exemption. Perhaps the most prominent is the serial form of municipal bond issues, which affects both the liquidity and trading costs of municipal bonds.

Corporate and Treasury bonds are typically originated as a single issue in which each certificate carries the same coupon rate, call date, and maturity date. While retirement schedules typically differ—some corporate bonds are retired in a lump sum, while others are retired gradually through sinking funds—the essential feature of a taxable security is a single issue broken up into a large number of certificates, each with the same characteristics.

Municipal bonds, on the other hand, are typically sold in a "serial" form in which each "strip" is a separate bond. This means that instead of a single large issue, the bond consists of a series of smaller issues, each with its own maturity. For example, suppose that a city wants to borrow $100 million to

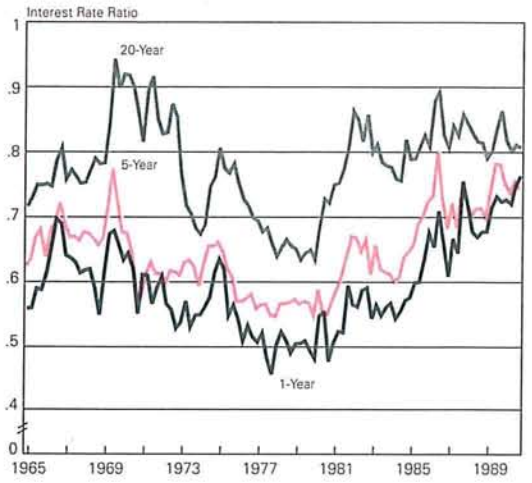
[8] A bond is held in registered form if the owner's name is recorded by a transfer agent—usually a bank—whose function it is to keep ownership records. The other form is a bearer bond, deemed to be owned by whoever holds it and for which no record of ownership is kept.

construct a sewage system. Instead of issuing one 20-year bond, which trades as a unit, it might issue 20 bonds, each having a different maturity: the first "strip" has a one-year maturity, the second strip has two years to maturity, and so on until the twentieth strip, which has 20 years to maturity. The distribution of the total amount between strips is a financial decision that the city must make at the time of the issue; for example, the city might want to retire an equal amount in each year, so each strip would have a par value of $5 million.

The serial bond is sold as a block to the winning underwriting syndicate. But when the syndicate sells the issue, it splits the issue into the individual strips, and the individual strips into certificates, which are marketed separately. The advantage of this approach is that the underwriter can typically get a higher price for the entire issue by selling each strip to investors who most want that maturity, and the issuer can tailor the retirement schedule to its needs by deciding how much of the issue will be allocated to each strip. If each strip is small, however, the cost of secondary market trading in individual strips might be higher than if the issue were traded as a unit, and this higher transaction cost will be reflected in a lower price paid by the investor.

Figure 2

Interest Rate Ratios for Selected Terms, Prime Municipal Bonds vs. U.S. Treasury Bonds



Source: Salomon Brothers, Inc.

Yields on Tax-Exempt Bonds

Exemption from federal income taxes confers an advantage upon the holder of municipal bonds. That advantage leads investors to require lower before-tax yields on municipal bonds than on taxable bonds of equivalent maturity and risk. The result is that the yield to maturity on tax-exempt bonds is less than the yield on taxable bonds with equivalent maturity and quality.

This advantage is shown in Figure 2, which reports the ratio of the yield on prime-grade municipal bonds to the yield on U.S. Treasury bonds. This "interest rate ratio" is shown for one-year, five-year and 20-year bonds.[9]

Several important observations can be drawn from Figure 2. First, for each of the three maturities shown, the interest rate ratio is less than unity, reflecting the tax advantages of municipal bonds. Second, for each maturity the interest rate ratio is highly variable: at times the advantage to the issuer of tax exemption appears to be quite small, as in 1969 when 20-year municipal bonds carried yields almost equal to 20-year Treasury bonds, while at other times the advantage is very great, as in the late 1970s when the interest rate ratio for 20-year bonds was about 0.65.[10]

Finally, the yield curve for municipal interest rates rises more rapidly than the yield curve for Treasury securities. This is evident from the fact that the interest rate ratio is higher for five-year bonds than for one-year bonds, and higher for 20 years than for five years. This phenomenon almost disappeared

[9] Prime-grade municipal and U.S. Treasury bonds are not precisely equivalent: Treasuries are of higher credit quality because the federal government can print the money necessary to repay its debt; Treasuries trade at lower transactions costs because they have a single issuer, while municipals are issued by a variety of states, local governments, and authorities whose quality is difficult to determine and whose issue sizes can be small; Treasuries are traded in a thick market while municipals have a lower level of liquidity. But these differences are (arguably) sufficiently small to allow us to use the interest rate ratio as a measure of the influence of tax exemption on municipal bond yields.

[10] The 1969 experience is an anomaly, probably due to the debate surrounding the 1969 Tax Reform Act. The House proposals would have included state-local interest in the new Alternative Minimum Tax. While the AMT was adopted, state-local interest income was not subject to the AMT. However, the prospect that these proposals would be adopted led to very high interest rate ratios in that year. For a discussion of the debate, see Huefner (1971), p. 100 ff.

in the late 1980s, especially for short- to intermediate-term bonds. Both the more rapidly rising yield curve (relative to Treasuries) of 1966–85, and the elimination of the differential for short- to intermediate-term bonds, are due to the role of commercial banks in the municipal bond market. These changes—which mean that the municipal bonds appear to trade more like taxable bonds—have been particularly marked since the Tax Reform Act of 1986.

Changes in Municipal Bond Ownership

Prior to the mid-1980s the largest holders of tax-exempt debt were financial institutions, primarily commercial banks and property and casualty insurance companies (Figure 3).[11] Indeed, from 1962 through 1980 the share held by households declined from over 40 percent to about 25 percent, with most of the market share moving toward commercial banks. State-local governments (primarily retirement funds) were significant holders of municipal bonds in the early 1960s, with about 10 percent of the outstanding stock, but this share declined thereafter. Insurance companies (primarily property and casualty insurers) have maintained a 15 to 20 percent share of outstanding state-local bonds, with a brief surge in 1975–80 and a return to their normal share by 1985.

Beginning in the mid-1980s the ownership pattern of tax-exempt bonds changed dramatically, with commercial banks sharply reducing their share from almost 55 percent in 1980 to about 25 percent by 1990. The withdrawal of commercial banks from the market was matched by an increase in the share held by households, from about 25 percent in 1980 to over 60 percent in 1990. The nature of household ownership also changed, as unit investment trusts and mutual funds provided both diversification opportunities and liquidity services not available to most households prior to the 1980s.

Beginning in the mid 1980s the ownership pattern of tax-exempt bonds changed dramatically, with commercial banks sharply reducing their share and the share held by households increasing.

The tax structure provides some explanation of these changes in ownership. Until the 1982 Economic Recovery Tax Act (ERTA), households faced tax rates as high as 70 percent, while commercial banks and property and casualty insurance companies faced a tax rate of 46 to 52 percent. Furthermore, until 1982 commercial banks could deduct from their taxable income all interest paid to carry municipal securities, a tax advantage that gave them a strong incentive to hold tax-exempt debt. Thus, high-income households, commercial banks, and property and casualty insurance companies had the greatest incentives to hold tax-exempt bonds and were the dominant holders.[12]

The 1982 Tax Equity and Fiscal Responsibility Act reduced the deductibility of interest expense for banks carrying tax-exempt securities to 85 percent of the interest paid. The 1984 Deficit Reduction Act further reduced the tax advantage for banks to 80 percent of carrying costs. Finally, with some exceptions,[13] the 1986 Tax Reform Act completely eliminated any deduction by banks of interest paid to carry municipal bonds, virtually extinguishing the advantages for banks of tax-exempt securities. Figure 3 shows the banks' share of the market stabilizing in the early 1980s and falling sharply after 1985. The plunge after 1985 is the result of the sharp decline in corporate income tax rates and the elimination of banks' deduction of interest paid to carry municipal bonds.

The Effect of Future Tax Rates on Bond Yields

The bond yields that prevail at any moment will be affected by anticipations of future tax rates: if investors believe that tax rates will rise (fall) in the future, they will require a lower (higher) yield on newly issued municipal bonds, relative to the yield

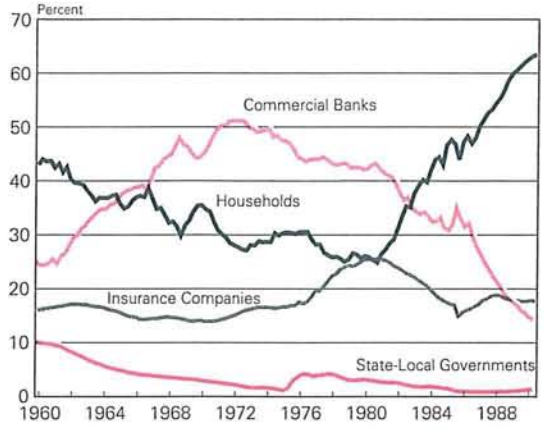
[11] Property and casualty insurance companies were by far the most important insurance companies in the municipal bond market. Until recently, life insurance companies faced relatively low tax rates, limiting their interest in municipal bonds.

[12] The property and casualty insurance sector's share of the market remained low in spite of high statutory tax rates because those companies experience a strong cycle in profitability. Thus, the tax advantages of municipals were enjoyed only during profitable years. This reduced the effective tax advantages.

[13] Municipal bonds acquired before August 16, 1986 still had deductible carrying costs. This led to a surge in bank purchases of private purpose bonds in anticipation of grandfathering of the exemption. Also, deductibility was continued for bank purchases of small local issues.

Figure 3

Shares of Outstanding State and Local Bonds Held by Selected Sectors



Source: Board of Governors of the Federal Reserve System, *Flow of Funds Accounts*, quarterly data.

on newly issued taxable bonds. It is difficult to quantify the role played by anticipations of tax rates: nobody keeps a record of what "the market" thinks tax rates will be in the future. One approach is to use "event analysis" to infer the influence of anticipated taxes. Poterba (1986) and Fortune (1988) have investigated the behavior of interest rates at times of tax policy changes, and find that the behavior of interest rates is consistent with the influence of anticipated tax rates on municipal bond yields.

Another approach is to assume that the market correctly anticipates the future and use these estimates as "actual" future tax rates to infer the effect of tax rate anticipations at any moment. However, the notion that—on average—the market is correct has received considerable attention, and very little support, from academics. For example, Fortune (1991a) surveys the evidence from the stock market, concluding that "the efficient market" is a concept worth selling short.

A third approach, adopted here, is to use market data to infer tax rate anticipations. One source for this is the yield curve on municipal and taxable securities. The implied marginal future tax rate for municipal bond investors can be derived as follows. Assume that an estimate is sought for the tax rate anticipated by the marginal investor in municipal bonds between five and ten years from now. If the interest rates are known for five-year municipal and taxable bonds that are newly issued five years from now, it is possible to estimate the implied tax rate for five to ten years in the future. Denoting $R_{M,5,10}$ as the yield on a municipal bond bought five years from now that matures ten years from now, and $R_{T,5,10}$ as the yield on an equivalent taxable bond, the implied future tax rate is $t_{5-10} = 1 - (R_{M,5,10}/R_{T,5,10})$.

Unfortunately, no direct information on future interest rates is available. The futures market in municipal bonds does not extend very far into the future and it is based on a bond yield index, not on yields for specific securities. However, indirect information can be found in the term structure of interest rates. According to the Expectations Hypothesis, the most widely held theory of the term structure, the yield to maturity on a ten-year municipal bond bought now ($R_{M,0,10}$) is mathematically related to the yield on a five-year bond bought now ($R_{M,0,5}$) and the expected yield on a five-year bond bought in five years ($R_{M,5,10}$). The equilibrium relationship is:

$$(1) \quad (1 + R_{M,0,10})^{10} = (1 + R_{M,0,5})^{5}(1 + R_{M,5,10})^{5}.$$

According to this relationship, $1 invested now in a ten-year bond will have an accumulated value in ten years equal to the accumulated value in ten years of a sequence of two investments: $1 invested now in a five-year bond, followed by investment of that accumulated value in a second five-year bond maturing five years from that date of purchase. Equation (1) assumes that the bonds are zero-coupon bonds.

The bond yields that prevail at any moment will be affected by anticipations of future tax rates.

If the relationship did not hold, investors would not diversify their portfolios by holding both five-year and ten-year bonds. Consider investors with a ten-year horizon. If the left side of equation (1) exceeds the right side, those investors would hold only ten-year bonds because the terminal value would exceed the terminal value from buying five-

year bonds and reinvesting the proceeds at maturity in five-year bonds. If, on the other hand, the left side is less than the right side, the investors would buy five-year bonds and reinvest in five-year bonds at maturity. Only when the equality in equation (1) holds will investors hold both five-year and ten-year bonds.

This relationship allows us to derive an estimate of the anticipated yield on five-year municipal bonds in five years. Solving equation (1) for $R_{M,5,10}$ gives:

$$(2) \quad R_{M,5,10} = [(1 + R_{M,0,10})^2/(1 + R_{M,0,5})] - 1.$$

Because the values of $R_{M,0,10}$ and $R_{M,0,5}$ are known right now, equation (2) can be used to calculate the value of $R_{M,5,10}$ which is implicit in the yield curve. This can also be done for taxable securities. An estimate of the tax rate expected to prevail between five and ten years in the future can then be obtained:

$$(3) \quad t_{5-10} = 1 - (R_{M,5,10}/R_{T,5,10}).$$

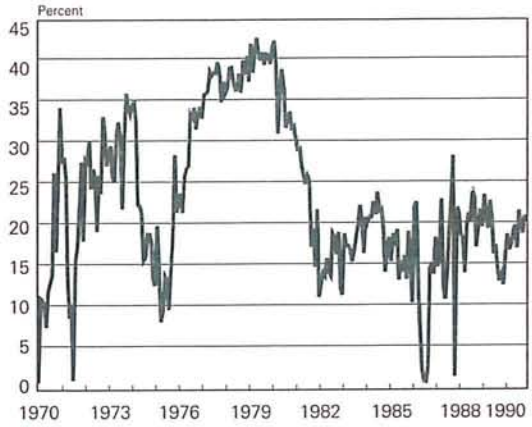
This approach is subject to a number of criticisms. First, it assumes that the taxable and tax-exempt yields used in the calculations are for securities that are equivalent in all respects except tax exemption. This is unlikely, because the issuers of taxable and tax-exempt bonds are inherently different in terms of default risk, because call features or other special features might make the bonds different, and because transactions costs can differ, with municipal bonds generally less liquid and traded in a thinner market than taxable bonds.

Second, this approach assumes that investors are indifferent to the maturity structure of their portfolio; no "market segmentation" exists. All investors care about is the expected yield on their portfolios, and market risks are irrelevant to portfolio decisions.

Using the Salomon Brothers data for five-year and ten-year prime municipal bonds and U.S. Treasury bonds, the estimates of t_{5-10} have been derived (Figure 4). The implied future tax rate shows a good bit of noise in it, as one would expect because of the potential for factors such as call features to distort the yield curve relationships. But the general outlines of the series seem to fit reasonably well: the implied future tax rate fell sharply after 1979, in apparent anticipation of the tax rate reductions in the 1981 Economic Recovery Tax Act (ERTA). Furthermore, after 1982 the implied future tax rate is about 15 to 20 percent, consistent with the low tax rates introduced in the 1981 ERTA and subsequent tax acts. Also, the mid-to-late 1970s show a high anticipated future tax rate, a result not inconsistent with the discussions of the times, an example being President Carter's statement that "the tax system is a disgrace to the human race." It is no surprise that this period of high anticipated tax rates was also a period of low interest rate ratios.

Figure 4

Future Tax Rate, Five to Ten Years Out



Source: Salomon Brothers, Inc. and author's calculations.

II. The Income Tax Code and Municipal Bonds

The previous section touched on some aspects of recent tax legislation to explain major changes in the municipal bond market. This section reviews the key features of the income tax code that influence the demand for tax-exempt debt, and, therefore, help to explain municipal bond yields. This journey through the income tax code provides background essential to the formal analysis of the determination of municipal bond yields in later sections.

Taxation of Ordinary Income from Bonds

The Internal Revenue Code identifies two forms

of taxable income. The first is "ordinary income," which consists of cash payments such as coupons, interest paid, cash dividends, and original issue discounts.[14] The second is "capital gains," defined as the difference between the price at which an asset is sold and its "cost basis" at the time of sale. The code allows the holder of a tax-exempt bond to exclude ordinary income but not capital gains from taxable income.

Original issue discount is the difference between the par value of the bond—the amount paid at maturity—and the initial price at which the bond came to market. For example, suppose a bond has a par value of $1000 and was originally issued at a price of $900. The difference of $100 occurs because the coupon rate on the bond is less than the interest rate prevailing on similar securities at the time of issue. The tax code treats this as cash income even though it does not give rise to cash payment until the bond matures. If the bond is taxable, the discount is included in taxable income as it accrues; if the bond is tax-exempt, it is not included in taxable income.

The tax code does not allow the investor to wait until the bond matures before he "earns" the original issue discount. Instead, investors must amortize the discount over the life of the bond. If the bond's income is taxable, the amortized value is added to each year's taxable income; if the bond is tax-exempt, it is not added to taxable income. In either case, the amortized value of the original issue discount is added to the cost basis of the bond and becomes relevant to the calculation of capital gains.[15]

As noted above, the amortization of the original issue discount also affects the cost basis of the bond. The amount of the discount assigned to each year is added to the cost basis of the bond, so that the accumulated discount is not treated as capital gains when the bond matures or is sold. The logic is straightforward: if the discount was earned in the past, it was either taxed if the bond was taxable or treated as tax-exempt if the bond was tax-exempt. But if the cost basis is not adjusted upward to reflect the accumulated original issue discount, when the bond is sold that amount will be treated as capital gains—and capital gains are taxed whether the bond is tax-exempt or not!

Taxation of Capital Gains

The Internal Revenue Code taxes capital gains on a cash basis rather than on an accrual basis. This means that gains are taxed only when realized upon the sale of the asset, not as they accrue "on paper" over the holding period. As noted above, the amount of capital gains is defined as the difference between the price at which the asset was sold and the "cost basis" of the asset. The cost basis is usually the price (including brokerage commissions) at which the asset was purchased, but the cost basis can also reflect certain adjustments such as the original issue discount.

The effect of the opportunity to defer capital gains taxes is to reduce the effective tax rate on accrued gains. For example, suppose that during 1991 a stock in your portfolio increases by $10 per share. If capital gains were taxed on an accrual basis, you would have to include that $10 in your 1991 taxable income even though you had not sold the asset. But suppose that you do not sell the stock until 1996. Assuming a capital gains tax rate of 31 percent, you will pay a tax of $3.10 per share in 1996, but at an interest rate of 10 percent, the present value in 1991 of your 1996 capital gains tax liability is only $1.92. Thus, your effective capital gains tax rate in the year of accrual is only 19.2 percent if you defer the gains for five years.[16]

Until recently, capital gains were taxed at a lower rate than ordinary income. For example, from 1942 to 1978, the tax code allowed an investor to exclude 50 percent of capital gains from taxable income, thus setting the capital gains rate at 50 percent of the ordinary income tax rate. During much of that time, however, the maximum capital gains tax rate was set at 25 percent. From 1978 to 1986 the code allowed 60

[14] Coupons, interest, and cash dividends are, with some exceptions, defined as ordinary income and included in a taxpayer's taxable income in the year they are received unless they are explicitly excluded, as in the case of a tax-exempt bond. Among the other exceptions are return of capital dividends and a major portion of dividends received by financial institutions.

[15] After the 1982 Tax Equity and Fiscal Responsibility Act (TEFRA), original issue discount was amortized as accrued interest: the investor calculated the interest rate that would accumulate the initial price to be equal to the price at maturity, and an amount equal to that interest rate times the cost basis was treated as ordinary income in each year. Before TEFRA the amortization was constant in each year.

[16] Indeed, capital gains taxes can be avoided completely by holding assets until death, because the cost basis of assets is adjusted to the market price at the time of death, effectively eliminating any taxation of the capital gains when heirs sell the assets. However, the potential avoidance of taxation of capital gains as income does not mean that the gains are shielded from all taxation: federal estate taxes are levied if the estate is large enough. Because the estate tax liability depends upon the size of the estate, not upon the amount of the capital gains, two estates of equal size will pay the same tax even though one might have a considerably greater appreciation component than the other. Thus, the estate with the greater capital gains will not pay any additional taxes.

percent of gains to be excluded, which, because of the 50 percent maximum tax rate on ordinary income, had the effect of reducing the maximum tax rate on capital gains to 20 percent. Thus, an individual taxpayer in the highest bracket would pay 50 percent on ordinary income but only 20 percent on capital gains.[17]

The Tax Reform Act of 1986 eliminated this differential. Under that law, 100 percent of capital gains are included in taxable income and, with a 33 percent maximum tax rate on ordinary income, the maximum capital gains tax rate was also 33 percent. The Revenue Reconciliation Act of 1990 restored a slight differential in favor of capital gains by setting a maximum capital gains tax rate of 28 percent.

The effect of the opportunity to defer capital gains taxes until the sale of the asset is to reduce the effective tax rate on accrued gains.

Note that capital gains taxation makes municipal bonds selling at a discount less attractive because the investor is taxed on part of the return. To see this, assume that an investor is choosing between a newly issued taxable bond and a newly issued tax-exempt bond, each priced at par. He knows that if interest rates rise, the price of each bond will fall, and that if he sells the bond at a loss, the capital loss is deductible regardless of whether the bond is taxable or tax-exempt. But the market discount at the time of sale will expose the new buyer to capital gains taxes. Because part of the return to the municipal bond will now be taxable, the new buyer will pay a still lower price to compensate him for the capital gains taxes. The taxation of capital gains is, however, not disadvantageous for the taxable bond since the new buyer will pay taxes whether his income is in the form of coupons or capital gains.

Therefore, the prospect of price decreases should make municipal bonds less desirable than taxable bonds, inducing a higher interest rate ratio. This effect should have been greater prior to the 1986 Tax Reform Act, when capital gains were taxed at lower rates than ordinary income. Furthermore, the effect of the taxation of capital gains on municipal bonds should also be greater when interest rates and asset prices are more volatile. The econometric analysis in Section IV will employ a measure of price variability to determine whether this hypothesis is supported.

Taxation of Capital Losses

The tax treatment of capital losses is not symmetrical with the treatment of gains. While 100 percent of realized gains are included in taxable income, the tax code might not allow full deduction of losses from taxable income if losses exceed capital gains: for a married couple filing jointly, losses can be fully deducted up to the amount of capital gains plus $3,000, but any losses above that amount must be carried over to future years. Thus, while a taxpayer can ultimately deduct all losses so long as taxable income is sufficient to take the deduction, the ceiling on the loss deduction allowed in a single year reduces the present value of the tax saving by the requirement to defer the deduction to future years.

For example, consider a married person filing jointly who has taxable ordinary income of $20,000. Suppose that this person has a capital gain of $2,000 and a capital loss of $10,000. In the current tax year he can deduct $5,000 of capital losses—$2,000 against the capital gain plus the $3,000 maximum loss offset. The remaining $5,000 of capital losses can be carried over to future years: $3,000 can be deducted in the next year, and the remaining $2,000 in the following year.

The absence of full loss offsets leads investors to alter their portfolios to reduce their exposure to price risk. This does not mean that they should avoid risky assets, only that the absence of full loss offset provides an incentive to reduce investments in risky assets below the level that would prevail with full loss offset.

State Income Taxes

The focus of this paper is the federal income tax code, but no survey of the connection between taxation and the municipal bond market is complete without reference to state income taxation. Forty-two states levy an income tax on interest and dividends,

[17] Since 1969 an Alternative Minimum Tax has applied in unusual circumstances and can have the effect of increasing the tax rate on capital gains. The Alternative Minimum Tax does not have a substantial effect on the tax positions of most investors, and has not been considered in this overview of capital gains taxation.

with tax rates ranging from very low levels to a high of 12 percent in Massachusetts and North Dakota.[18] In addition, 36 of the states with an income tax exempt some or all interest paid by government agencies within their own jurisdiction, and tax all out-of-state municipal interest income. Thus, in most states in-state municipal bonds offer a tax advantage.

If the marginal investor in a state's bonds is a resident of the state, jurisdictions in those states will pay lower municipal bond rates than those paid in states with lower tax rates. This will occur because the intra-state investors will pay a higher price for those bonds than will investors in other states. However, if the marginal investor is out-of-state, high state income tax rates will not affect the municipal bond yields paid by jurisdictions within the state. In this case, the advantages of within-state tax-exempt bonds accrue as a "windfall" to within-state investors.

The importance of this segmentation has been examined by Kidwell, Koch and Stock (1984), who conclude that—as a generalization—a state's residents are the marginal investors in that state's state-local bonds. Therefore, they find that (other things equal) high state income taxes do confer lower borrowing costs on the state and its political subdivisions.

III. Recent Tax Legislation

The key events in legislation in recent years are summarized in the box. The most prominent change is a radical revision of tax rate schedules, with both a general reduction in tax rates and a reduction in the degree of progressivity. The rate reductions should lead to an increase in interest rate ratios, while the decline in progressivity should reduce the rate ratios. In addition, since 1985 the tax rate schedule has been indexed, thereby reducing the "bracket creep" which, slowly and over time, pushed tax rates up and reduced the interest rate ratio. Finally, specific changes have limited the desirability of municipal bonds to financial institutions and restricted the use of tax-exempt bonds for "private" purposes. These changes will be discussed in order.

Changes in Tax Rates

Federal taxation of corporate income establishes a lower tax bracket for corporations with very low net incomes, but most corporate income is taxed at the maximum statutory tax rate. That rate changed very little until 1987: the maximum tax rate on corporate income was 52 percent in the early 1960s, fell to 50 percent in 1964, to 48 percent in 1965, then to 46 percent in 1979, then to the present 34 percent in 1987. Thus, the corporate tax rate has not varied sufficiently to account for the significant variation in the interest rate ratio.

Recent changes in tax rates have been more generous for high levels of income than for low, with greater effects on securities held by upper-income groups, such as common stocks and municipal bonds.

Changes in the personal income tax rate schedule have been more dramatic. The 1981 ERTA reduced the maximum personal income tax rate to 50 percent, and reduced other personal income tax rates by 25 percent over a three-year period. The Tax Reform Act of 1986 dramatically reduced tax rates for most income levels. The maximum tax rate on personal income was reduced from 50 percent to 38.5 percent in 1987 and 33 percent for 1988 and later years. The 1986 Act also simplified the individual income tax rate schedule by cutting the number of brackets from 14 to only four (15 percent, 28 percent, 33 percent, and 28 percent), widening the income levels associated with each bracket and thus reducing the problem of bracket creep.

The most recent change—the Revenue Reconciliation Act of 1990—further reduced the number of tax brackets to three (15 percent, 28 percent, and 31 percent) for 1991 and later years, thereby eliminating the "bubble" for upper-income levels. In addition, the amount of itemized deductions was reduced by 3 percent of income over $100,000: if a taxpayer's

[18] These rates are for 1990 income. Connecticut has a 14 percent maximum rate on interest and dividends; the Connecticut tax is levied only if 1990 federal adjusted gross income exceeds $54,000.

Major Tax Legislation in Recent Years

1976	Tax Reform Act	· Lengthened holding periods for long-term capital gains from six months to one year. · Created tax-sheltered Individual Retirement Accounts (IRAs).
1978	Revenue Act	· Widened personal income tax brackets. · Reduced maximum corporate income tax rate from 48% to 46%.
1981	Economic Recovery Tax Act (ERTA)	· Cut maximum personal income tax rates from 70% to 50%. · Reduced personal income tax rates at all levels by 25% over a three-year period. · Initiated indexation of tax brackets beginning in 1985. · Introduced super-accelerated depreciation of business assets (ACRS). · Expanded tax-sheltered investment opportunities —introduced All Savers Certificates —expanded eligibility for IRAs —introduced net interest exclusion.
1982	Tax Equity and Fiscal Responsibility Act (TEFRA)	· Allowed deduction of only 80% of interest paid to carry municipal bonds. · Established 10% withholding tax on interest and dividends.
1983	Social Security Act Amendment	· Subjected Social Security benefits to federal income tax. · Formula for Social Security benefit tax led to indirect taxation of municipal interest.
1984	Deficit Reduction Act	· Postponed ERTA's interest exclusion. · Extended tax exemption for mortgage revenue bonds to 1987. · Reduced holding period for long-term capital gains to 6 months. · Limited depreciation on assets leased to tax-exempt entities.
1986	Tax Reform Act	· Reduced maximum personal income tax rate to 33% and maximum corporate income tax rate to 34%. · Replaced 14 personal income tax brackets with only four (15%, 28%, 33%, 28%). · Eliminated deduction of interest paid by commercial banks to carry municipal bonds. · Placed limits on eligibility of "private-purpose" municipal bonds for tax exemption. · Dramatically reduced the tax advantages of many "tax shelters," such as real estate.
1990	Revenue Reconciliation Act	· Established three tax brackets (15%, 28%, 31%). · Set maximum capital gains tax rate at 28%. · Reduced itemized deduction by 3% of income over $100,000, resulting in an increase in the effective ordinary income tax rate by roughly 1%.

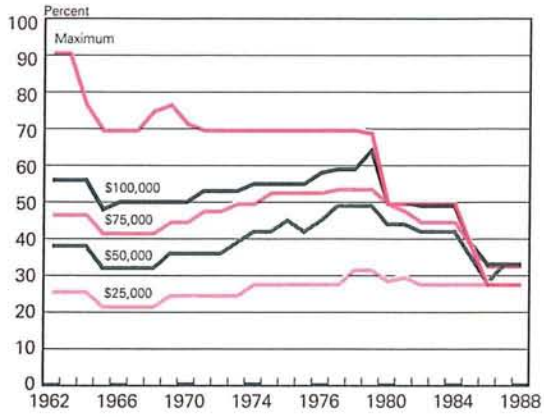
income is, say, $110,000, his itemized deductions are reduced by $300, effectively raising his marginal tax rate from 31 percent to about 32 percent.

Figure 5 reports the maximum statutory tax rate on personal income as well as the marginal tax bracket for four levels of real income between 1962 and 1990. The maximum tax rate was 91 percent in the early 1960s, then fell to 70 percent in 1965 where it stayed through 1981 with a brief period of increase (1968–70) because of a surtax levied to finance the Vietnam War. In 1982 the maximum rate was reduced to 50 percent, then to 33 percent in 1987.

The marginal tax rates for four levels of real income, measured in 1980 dollars, are also shown in Figure 5. For all real income levels, the marginal tax bracket increased from 1962 through 1981; this increase was due to bracket creep. It is clear that the changes in tax rates initiated by ERTA in 1981 and followed by the 1986 Tax Reform Act have been more generous for high levels of income than for low: the marginal tax rate at the $25,000 real income level was actually higher in 1990 than in 1962. Thus, to the extent that tax rates affect investment decisions, small effects, if any, should be seen for securities held by lower-income groups (bank deposits, corporate bonds) and the effects should be more dramatic for securities held by upper-income groups (common stocks, municipal bonds).

Figure 5

Marginal Personal Income Tax Rates at Selected Income Levels (1980 Dollars)



Source: Internal Revenue Code and author's calculations.

Indexation of the Tax System

Prior to the 1980s, the tax system was based solely on nominal income levels. This meant that the depreciation allowed businesses for plant and equipment was based on original cost, not replacement cost, and the tax rate schedule was based on the money value of taxable income. This clearly presented a problem in an inflationary environment such as that prevailing in the 1970s and early 1980s.

One effect of inflation is that the cost of replacing physical assets, such as vehicles, equipment, and structures, exceeds the original cost of the assets. As a result, historical cost depreciation—based on the original cost of the depreciable asset—means that businesses cannot fully recognize the cost of replacing equipment as a deductible cost of business. The effect is to overstate business income by including in it the difference between "economic" depreciation on a replacement cost basis and historical cost depreciation. This overstatement of business profits results in higher tax payments and a deterioration of the firm's financial position.

A second effect of an inflationary environment is that it results in higher tax rates on real income because individuals moved into higher tax brackets when their money income rose, even though their real incomes remained unchanged or even declined.[19] This phenomenon, called "bracket creep," raised the effective tax rate on real income over time as inflation continued.

The 1981 Economic Recovery Tax Act introduced indexation of the personal income tax brackets, beginning in 1985. With indexation, the break points between tax brackets are increased according to a general price index. For example, in 1985 the tax rate was 28 percent for taxable income in the range $31,120 to $36,630, but in 1986 the 28 percent rate was applied to taxable personal income between $32,270 and $37,980, reflecting inflation of about 3.7 percent between 1985 and 1986. Indexation has eliminated the problem of bracket creep, at least for taxpayers

[19] This has been particularly important for personal income taxes, which, for much of this century, had a complex set of tax brackets. For example, in 1986, before the Tax Reform Act of 1986 became effective, there were 14 tax brackets: for a married taxpayer filing jointly, these ranged from 11 percent for income between $3,670 and $5,940 to 50 percent for taxable income over $175,250.

whose consumption bundle mimics the composition of expenditures that the general price index represents. For other taxpayers a weak connection between real tax rates and inflation might remain, but this has been reduced by the movement toward a flat-rate tax system in the 1986 and 1990 tax laws.

Other Aspects of the 1986 Act

As discussed in Section II, the 1986 Tax Reform Act imposed restrictions on private-activity use of tax-exempt bonds. This favored the tax-exempt bond market, forcing private borrowers back into the taxable bond market and, to the extent that relative supplies of taxable and tax-exempt debt affect relative yields, raising the spread between taxable and tax-exempt yields.

A second piece of the 1986 legislation restricted the tax advantages of a wide range of "tax shelters." For example, depreciation of real estate was dramatically reduced, raising the effective tax rate on real estate investments. This elimination of tax shelters was used as a selling point by the municipal bond industry, the claim being that municipal bonds were the sole remaining tax shelter. If this claim were true, the municipal bond rate should have fallen relative to taxable bond yields, reinforcing the effect of private-activity bond limitations.

A third non-tax-rate feature, also noted above, was the elimination of the commercial bank deduction for costs of carrying municipal bonds. The effect of this change offset, to some extent, the effect of the other two legislative changes: municipal bond yields would rise relative to taxable bond yields as nonbank sectors were induced to increase their holdings of municipal bonds.

Thus, the 1986 legislation not only dramatically changed the tax rate structure, it also introduced important non-tax-rate changes that could have, in principle, either favored or harmed the municipal bond market.

IV. The Determinants of Municipal Bond Yields

This section uses the insights developed in previous sections as the basis for a statistical analysis of municipal bond yields. The primary purpose is to test whether the recent experience for the yields on municipal bonds is, in fact, consistent with the propositions developed in the previous section. The analysis will focus on interest rate ratios, as defined in the first section and as shown in Figure 2.

The Traditional Explanation of the Interest Rate Ratio

Why do interest rate ratios vary so much over time? Why has the ratio been higher for long maturities than for short maturities? Why has the difference between the long and short maturities almost disappeared in recent years? This section presents a simple model of the municipal bond market that addresses these questions.

Assume that municipal bonds and taxable bonds are substitutes in investors' portfolios. Each investor will choose an amount of municipal bonds based on his tax rate and on his assessments of the relative liquidity of municipal bonds. For each investor, the optimal holding of municipal bonds will be that quantity for which $(R_M/R_T) = \lambda + (1 - t)$, where t is his tax rate and λ is the liquidity premium required by the investor. While the tax rate is exogenous to the investor's decision, the liquidity premium is endogenous: as an investor contemplates increasing the amount he invests in municipal bonds, he will require a higher interest rate ratio to compensate for the increased risk and lower liquidity of municipal bonds.

The liquidity premium is due to several sources of risk inherent in municipal bond ownership.

The liquidity premium is due to several sources of risk inherent in municipal bond ownership. The first is lower liquidity and higher transactions costs due to the serial form of municipal bonds: because each bond is traded in separate strips, the average transaction is often small, which leads to increased transactions costs, and investors cannot sell their municipal bonds as quickly as Treasury or corporate bonds can be sold. In addition, as shown in Section II, the tax code penalizes municipal bonds relative to taxable bonds when bond prices fall. Finally, investors are uncertain about future income tax rates and will require some premium to compensate them for this uncertainty. While the nature of each of these

risks is quite different, the term "liquidity premium" is used to describe the additional interest rate ratio required by investors to compensate for these extra risks.

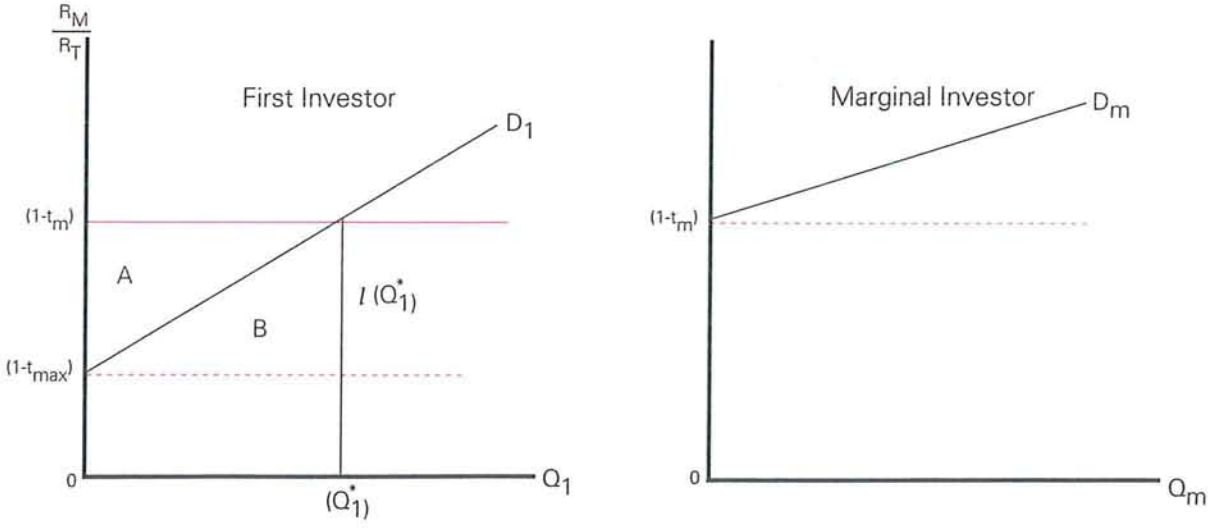
Assume that the liquidity premium is zero for the first dollar of municipal bonds held by an investor: if an investor holds no municipals, he considers the first dollar of municipals to be equivalent to a dollar of taxable bonds. This means that for intramarginal investors, the interest rate ratio will exceed the value $(1 - t)$ by the liquidity premium required to induce them to hold municipal bonds. But for the marginal investor, who holds a small amount of municipal bonds, the interest rate ratio is $(1 - t_m)$, where t_m is the marginal investor's tax rate.

Figure 6 shows the demand functions for municipal bonds of two investors, the "first investor," whose tax rate, t_{max}, is the highest, and the "marginal investor," with tax rate t_m. The quantity of municipal bonds acquired is measured along the horizontal axis. The vertical axis shows the interest rate ratio. The horizontal lines at interest rate ratios $(1 - t_{max})$ and $(1 - t_m)$, respectively, show each investor's demand function for municipal bonds if tax-exempt and taxable bonds are perfect substitutes. In that case, investors do not require a liquidity premium and only tax rates matter in determining whether to buy a tax-exempt or a taxable bond. The upward-sloping solid lines labeled D_1 and D_m are the actual demand functions, with the vertical distance to the broken line representing the liquidity premium required to induce the investor to hold each quantity of municipal bonds.

Figure 6 assumes that the bond markets have settled into an equilibrium in which the interest rate ratio is just sufficient to induce a marginal investor with tax rate t_m to buy a small amount of tax-exempt bonds. The equilibrium interest rate ratio is $(1 - t_m)$, which is high enough to induce the first investor to hold Q_1^* in tax-exempt bonds. For each investor, the interest rate ratio is composed of two parts. The first is the ratio required to give tax-exempts the same after-tax return as taxable bonds; for the first investor this is $(1 - t_{max})$. The second part is the liquidity premium required to compensate intramarginal investors for the extra risks they attach, at the margin, to tax-exempt bonds. For the first investor the liquidity component is the value of λ at Q_1^*, or $\lambda(Q_1^*)$. For the marginal investor the liquidity component is (by assumption) zero.

Figure 6

Individual Investors In the Municipal Bond Market



Following an unfortunate convention, the term "windfall income" will be used to designate any income from tax-exempts in excess of the income required to break even on an after-tax basis. For the first investor the dollar value of windfall income is measured by R_T^* (area A + area B).[20] But R_T^* area B is not really a windfall, for it is the amount of extra income required to induce the investor to hold Q_1^* of municipal bonds. The only true excess income is measured by R_T^* area A. This is the "investor's surplus," which exists because the investor earns interest on his intramarginal investment in excess of the amount required. Note that in the case of a linear demand function, the investor's surplus will be 50 percent of the investor's windfall income.

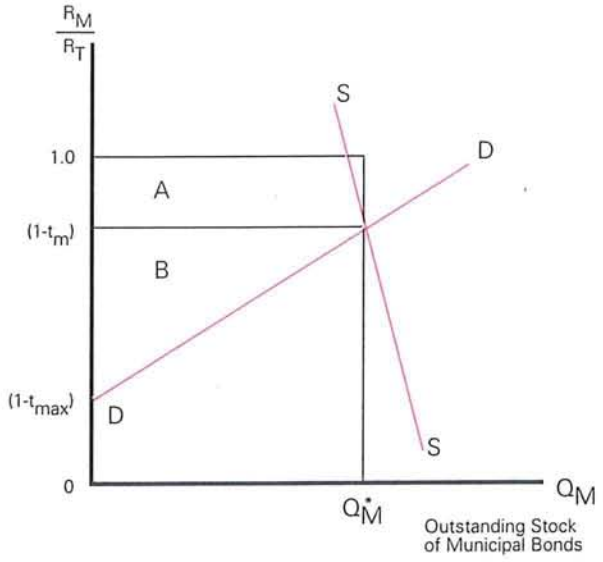
Figure 7 shows the municipal bond market under these conditions. The vertical axis represents the interest rate ratio while the horizontal axis shows the quantity of municipal bonds outstanding. The upward-sloping schedule, marked DD, is the demand function for municipal bonds: as the interest rate ratio rises, more investors are induced by tax considerations to hold municipal bonds. As the market travels up the demand schedule, the marginal tax rate of investors is falling because new investors drawn into the market have lower tax rates.

The bond supply schedule, SS, is assumed to be moderately sensitive to the municipal bond rate, hence it is downward-sloping but with a steep slope. The bond supply function will also shift with the level of the taxable bond rate. To understand this, note that the supply of municipal bonds is affected by the *municipal* bond rate, but the vertical axis in Figure 7 is the interest rate ratio, which depends on both interest rates. As a result, the position of the supply schedule will depend upon the level of the taxable bond rate: at any rate *ratio*, a higher R_T implies a higher municipal bond rate and a lower quantity of tax-exempt bonds issued. Thus, SS will shift leftward (rightward) when R_T rises (falls). For expository purposes, we will assume that R_T is at its equilibrium level and is not changing.

This model suggests two basic demand-side determinants of the municipal bond yield. The first is the maximum tax rate, t_{max}. A fall in t_{max} will make municipal bonds less attractive to the first investor, encouraging him to buy fewer municipals and shifting DD to the left.[21] The second factor is the progressivity of the federal income tax schedule: a less progressive tax rate schedule will create a flatter slope of the DD schedule so that the DD schedule rotates clockwise at the rate ratio $(1 - t_{max})$. This creates a lower rate ratio. Thus, the interest rate ratio should be inversely related to the maximum tax rate and directly related to the degree of progressivity in income tax rates. The econometric analysis in Section V will support these hypotheses.

Figure 7

The Market for Municipal Bonds



Before proceeding, it should be noted that in recent years another school of thought on municipal bond yield determination has arisen. This school, associated with Fama (1977) and Miller (1977), argues that the personal income tax rate schedule—the focal point of the traditional explanation—is irrelevant, and that the interest rate ratio is determined by the corporate income tax rate (t_c). This "New View" is described below in an appendix. Although it received some empirical support in its early years, recent changes in the structure of the market have weakened any validity of the New View.

[20] Because the vertical axis is in units of taxable interest, any area in Figure 6 is measured in units of the taxable interest rate. To convert an area to a dollar value we must multiply it by R_T. This is why the dollar value of windfall income is R_T^* (area A + area B), rather than simply area A plus area B.

[21] Note that if taxables and tax-exempts were perfect substitutes, this would not be true. High-bracket investors would invest all of their available funds in tax-exempts. A change in the tax rate they face will alter the windfall income they receive, but not the amount invested.

The Term Structure of Municipal Bond Yields

The analysis of the previous sections assumes a single type of municipal bond, and does not allow consideration of such issues as the term structure of municipal bond yields. The interest rate ratio rose sharply after 1986 for one-year and five-year terms, however, while it changed little for 20-year bonds. Figure 2 shows this clearly, and also shows that after 1986 the one-year ratio was almost equal to the five-year ratio.

The most widely held explanation of these changes in the term structure of municipal bond yields appeals to the notion of "market segmentation." For much of this century commercial banks have been important investors in the market for tax-exempt debt, and banks prefer (other things equal) to invest in securities with short to intermediate maturities. Households, on the other hand, have traditionally preferred longer-term bonds. This description of the municipal bond market certainly fit the data over the years when it was formed: the 1960s and 1970s.

However, as noted above, this picture changed dramatically in the mid 1980s when banks withdrew from investments in municipal securities. Because banks typically hold shorter maturities, the primary impact of this withdrawal was in those maturities. This meant that one or both of two things had to happen. First, municipalities had to reduce their issue of short- to intermediate-term debt; this could be accomplished by reducing capital outlays, by increasing use of tax revenues to finance capital outlays, or by substituting longer-term debt for short- to intermediate-term bonds. Second, some nonbank sectors had to be induced to acquire short- to intermediate-term debt when they would not otherwise have done so. Both of these adjustments require a rise in yields on short- to intermediate-term bonds relative to long-term yields.

The primary adjustment was of the second form: households responded by increasing their ownership of municipal bonds, much of this in the short to intermediate maturities. The shortening of average maturities held by the household sector was aided by several financial innovations that reduced the risks, and increased the liquidity, of municipal bonds. Chief among these was the formation of mutual funds specializing in municipal debt of all maturities, but particularly of short to intermediate maturities. These allowed households with small portfolios to diversify their holdings as well as to gain liquidity by check-writing privileges and by redemption of shares at net asset value. A second innovation was the development of private firms providing municipal bond insurance. While bond insurance had been first provided in the early 1970s, the explosion of the market for it in the 1980s was induced by the growing dominance of households in the municipal bond market.

V. An Econometric Analysis

In this section a model of interest rate ratios will be estimated. The variables to be explained are four interest rate ratios, the three shown in Figure 2 plus the 10-year ratio, for the period June 1970 through December 1989.

The model uses several tax rate variables to capture the effect of changes in tax rate legislation. To represent the personal income tax rate schedule, the model uses the *maximum personal income tax rate* (TMAX), and a measure of *tax rate progressivity* (PROGRSV), defined as the difference between the maximum personal tax rate and the tax rate for an individual with $25,000 of real taxable income. The maximum tax rate employed in defining these variables is the rate paid by those in the highest income bracket. Until 1987, this was also the highest rate levied, but the 1986 Tax Reform Act introduced a bubble in the tax rate schedule, so that the highest-income taxpayers paid less than the maximum tax rate. Thus, for 1988–90 the model uses 28 percent as the maximum tax rate, not the 33 percent bubble rate.

The Traditional View of municipal bond yields predicts that the first tax variable (TMAX) should have a negative coefficient, while the coefficient on the second (PROGRSV) should be positive: a more progressive tax rate schedule, given the maximum rate, should increase municipal bond yields relative to taxable bond yields. Note that because the tax rate data are available annually, the same tax rate is assigned to each month in the year.

This econometric model does not incorporate the New View, for two reasons. First, as noted above, evidence is abundant against the hypothesis that corporate income tax rates dominate the determination of the interest rate ratios. Second, an experiment that included the maximum corporate income tax rate did not support the New View: the corporate income tax rate had the wrong sign and was not statistically significant.

In order to capture the influence of *anticipated*

future tax rates, several measures of the implicit future tax rate were constructed: T_{2-5} is the implicit tax rate for two to five years in the future, T_{5-10} is the implicit tax rate five to ten years out, and T_{5-20} is the implicit tax rate five to 20 years hence. Each is constructed from the yield curve data that were used to construct Figure 2, using the method described in Section I above. These constructed variables are available for every month in the sample. Rather than include all three in the regression for each rate ratio, only the ones that seemed most relevant were included: t_{5-20} in the 20-year regression, t_{5-10} in the 10-year regression, and t_{2-5} in the five-year regression. Anticipated future tax rates were excluded from the one-year regression because the relevant tax rate is known at the time of purchase.

It was argued earlier that the *anticipated variability of bond prices* should affect the interest rate ratio because market discounts on municipal bonds are subject to capital gains taxes, placing them at a disadvantage relative to taxable bonds if bond prices fall, but giving them no advantage if bond prices rise. In order to reflect this, the Ibbotson Associates (1990) data on the monthly rate of change in prices of long-term Treasury bonds were used to construct a volatility index for each month. The result is a variable, called VOLATILE, available for each month.[22]

Three dummy variables were used to capture fixed effects. One, labeled NY, is for the New York City financial crisis, which is assumed to have occurred in the period June 1975 to December 1976. During this period, the yields on lower-rated municipal bonds rose relative to yields on prime grade bonds, but the New York City crisis could have affected prime grade bonds as well, although the direction of effect is not clear: NY could have a positive coefficient if the quality of high-grade bonds was called into question, or it could have a negative coefficient if a flight to quality drove high-grade bond yields down.

A second dummy variable, named TRA86, applies to the period January 1987 through the end of the sample. The 1986 Tax Reform Act had a variety of effects on the municipal bond market other that those that operate through tax rates (which are already captured in TMAX and PROGRSV). The limits on private-activity bonds and the severe limits on other tax shelters should induce a negative coefficient on TRA86, but the elimination of commercial bank deductibility of municipal carrying costs should have a positive effect. While the sign of the coefficient on TRA86 cannot be specified *a priori*, the common view is that the elimination of carrying-cost deductibility dominated the effect.

The third dummy variable, labeled Y86, refers to the 12 months of 1986 and this is introduced to capture any effects of the active and often-changing debate about tax policy during that year.

Estimation of the model was done with Three-Stage Least Squares, using a correction for first-order autocorrelation. Three-Stage Least Squares (3SLS) is a method of joint estimation of a system of equations combining Seemingly Unrelated Regression Equations (SURE) and Two-Stage Least Squares (2SLS). The four interest rate ratios are viewed as a four-equation system because of the potential for omitted variables common to interest rates at all four maturities. The SURE method employs this information on correlations between residuals to derive efficient estimates of the parameters.

The 2SLS aspect of 3SLS was necessary because the variables for anticipated future tax rates are endogenous: they are derived from the term structure of interest rates and, therefore, use the same interest rates that are used in defining the interest rate ratios. In order to eliminate this problem of feedback from the dependent variables to the variables T_{2-5}, T_{5-10} and T_{5-20}, a rather long list of instruments was used.[23]

As noted above, the estimation was done with a correction for first-order autocorrelation. The specific method of estimation involved two steps. First, each of the four equations was estimated separately, using 2SLS with an autocorrelation correction. This gives four autocorrelation coefficients, one for each equation; those autocorrelation coefficients are reported as the variable RHO in Table 1. Second, the variables in each equation were transformed to partial differences using the autocorrelation coefficient estimated for that equation in the first stage, after which the transformed variables were employed in a 3SLS estimation of the four-equation system.

[22] The rate of change in bond prices is Ibbotson's total return on long-term government bonds in each month less the income return due to coupons. The monthly volatility index is the square of the deviation of the bond price change from its sample mean, divided by the sample variance. The variable VOLATILE is the simple average of the volatility measure in the past three months.

[23] The instruments were all of the exogenous variables in the system, including a constant term, as well as the following additional instruments, all available monthly: a time trend, the level of the CPI, the rate of inflation, the civilian unemployment rate, real personal income, the earnings-price ratio for the S&P500, and the three-month Treasury bill rate.

Table 1
Three-Stage Least Squares Regression: Interest Rate Ratios, 1–5–10–20 Year Maturities, June 1970 to December 1989
Dependent Variable (R_M/R_T)

Independent Variable	Maturity			
	20-Year	10-Year	Five-Year	One-Year
CONSTANT	0.3841	0.4636	0.3545	0.3275
	(42.53)	(28.81)	(44.35)	(8.57)
T_{5-20}	−.7004	n.a.	n.a.	n.a.
	(79.85)			
T_{5-10}	n.a.	−.4832	n.a.	n.a.
		(28.51)		
T_{2-5}	n.a.	n.a.	−.7705	n.a.
			(153.49)	
VOLATILE	.0011	.0019	.0014	.0070
	(1.46)	(1.54)	(1.96)	(2.17)
TMAX	−.0024	−.0043	−.0019	−.0083
	(3.27)	(4.01)	(2.69)	(2.73)
PROGRSV	.0017	.0031	.0015	.0071
	(2.42)	(3.10)	(2.38)	(2.47)
NY	−.0010	−.0031	−.0018	−.0089
	(.22)	(.49)	(.43)	(.48)
Y86	.0258	.0475	.0183	.0780
	(4.60)	(5.74)	(3.44)	(3.30)
TRA86	.0115	.0226	.0221	.1019
	(1.86)	(2.50)	(3.75)	(3.92)
RHO	.6088	.5170	.6310	.6023
	(2.83)	(1.80)	(5.47)	(5.41)
$\bar{R}^2$	.9514	.8818	.9526	.3071
DW	2.1845	1.9849	2.1597	2.1134

The method of estimation is 3SLS with correction for first-order autocorrelation; RHO is the autocorrelation coefficient. The $\bar{R}^2$ and DW are for the transformed equations. The instruments are used for the future tax rate variables; see footnote 23 for instrument list. Numbers in parentheses are absolute value of t-statistics, corrected for instrumental variables estimation.
n.a. = not applicable.

The results, reported in Table 1, provide strong support for the insights gained from our discussion of tax legislation. With respect to the fixed effects, we find that the New York City financial crisis played no role: the coefficient is negative in each equation, suggesting that this period was one of lower municipal bond yields, but it is not statistically significant.

The dummy variable Y86 is positive and statistically significant. The very active debate about tax policy in 1986 increased the interest rate ratios because of the uncertainty about future tax rates. The implied increase in the rate ratios in 1986 was about 0.03 for 20-year bonds, 0.05 for 10-year bonds, 0.02 for five-year bonds and 0.08 for one-year bonds. At the 1988–90 averages of Treasury bond yields, these rate ratio increases imply increases in municipal bond yields of 23 basis points (bp), 41 bp, 15 bp, and 62 bp, respectively.[24]

The variable TRA86 shows that the period of effectiveness of the 1986 Tax Reform Act (1987 and after) was also a period of higher interest rate ratios. Like Y86, TRA86 appears to have the greatest impact on one-year bonds (which had an interest rate ratio 0.10 higher after 1986), but it was both statistically and economically significant (roughly 0.01 to 0.02) for other maturities. This is predicted from the elimination of the deduction for commercial bank carrying costs. The municipal bond yield effects of TRA86, evaluated at 1988–90 Treasury bond yields, were 10 bp for 20-year bonds, 20 bp for 10-year bonds, 19 bp for five-year bonds, and 82 bp for one-year bonds.

The tax rate variables are all statistically significant with the signs predicted by theory. According to the estimated coefficients, the reduction in the maximum tax rate (TMAX) from 50 percent to 28 percent after the 1986 Tax Reform Act reduced the interest rate ratios by about 0.05 for 20-year bonds, 0.10 for 10-year bonds, 0.04 for five-year bonds and 0.18 for one-year bonds. The corresponding declines in municipal bond yields, evaluated at 1988–90 Treasury bond yield levels, were 46 bp, 82 bp, 35 bp, and 146 bp, respectively.

The tax progressivity variable (PROGRSV) also is statistically and economically significant in each equation. The 1986 Tax Reform Act reduced the progressivity variable by 22 percentage points, from 22 percent in 1985 to zero in 1988. This reduced the rate ratios by 0.04 for 20-year bonds, 0.07 for 10-year bonds, 0.03 for five-year bonds and 0.15 for one-year bonds. The corresponding decreases in municipal bond yields are 32 bp, 57 bp, 27 bp, and 120 bp.

In each equation the coefficient on anticipated future tax rates is negative and statistically significant: when the market expects tax rates to be high, the interest rate ratio is reduced as tax-exempt bonds are substituted for taxable bonds. The very high t-statistics attest to the statistical importance of tax

[24] The 1988–90 averages for Treasury bond yields were 8.7 percent for 20 years, 8.6 percent for 10 years, 8.5 percent for five years, and 8.0 percent for one year.

rate anticipations, and the size of the coefficients attests to their economic significance.

In order to assess the economic significance of the 1986 Tax Reform Act, the change in the interest rate ratio between 1982–85 and 1988–90 attributable to changes in statutory tax rates (TMAX and PROGRSV) was calculated, as well as the fixed effect captured in the dummy variable TRA86. The changes in rate ratios were converted to changes in municipal bond yields, using the 1988–90 average values of the four Treasury bond yields.

The results are reported in the top portion of Table 2. These three tax policy variables account for a rise in the municipal bond yields by 25 to 44 bp for the longer maturities, and by a large 107 basis points for the one-year maturity. The primary source of the large increase at the one-year maturity is the TRA86 dummy variable. That this is most important at the short maturity is consistent with the withdrawal of a primary short-term lender—commercial banks—from the tax-exempt debt market.

Another avenue for tax policy is anticipated tax rates. The bottom portion of Table 2 assesses the effects of the anticipations variables after the Tax Reform Act of 1986. The results suggest only a minor effect of tax rate anticipations for 20-year and 10-year bonds: the implied yield changes are −11 bp and −7 bp, respectively. However, a 52 bp increase occurred in five-year yields in the 1987–89 period. This suggests that in this period tax rates were expected to decline further.

The combined effect of all four tax policy variables (Table 2) is to increase municipal bond yields after the 1986 Tax Reform Act, with the magnitude being greater for shorter maturities. The impacts are greater for shorter-term bonds, ranging from a mild 14-basis-point increase for 20-year bonds to a 107-basis-point increase for one-year bonds.

Bond price volatility (VOLATILE) increases the rate ratios, as the earlier discussion of capital gains taxation suggests. While the t-statistics suggest that this effect is not as reliable as the effect of tax variables, the evidence does support the hypothesis that the more volatile are bond prices (hence the higher the probability of a price decrease), the less desirable are municipal bonds. This is the effect of capital gains taxes on the relative desirability of tax-exempt and taxable bonds when market discounts exist.

Thus, the data provide very strong support for the role of personal income tax legislation, and the elimination of bank deductibility of carrying costs, in affecting interest rate ratios.

Table 2
Effects of Tax Policy on Interest Rate Ratios and Municipal Bond Yields, 1982–85/1988–90

Independent Variable	Maturity			
	20-Year	10-Year	Five-Year	One-Year
Tax Policy Variables				
TMAX	+.0528	+.0946	+.0418	+.1826
PROGRSV	−.0361	−.0659	−.0319	−.1509
TRA86	+.0115	+.0226	+.0221	+.1019
Subtotal ratio	+.0282	+.0513	+.0320	+.1336
R_M	+25 bp	+44 bp	+27 bp	+107 bp
Anticipated Tax Rate Variables				
T_{5-20}	−.0123	n.a.	n.a.	n.a.
T_{5-10}	n.a.	−.0076	n.a.	n.a.
T_{2-5}	n.a.	n.a.	+.0616	n.a.
Subtotal ratio	−.0123	−.0076	+.0616	n.a.
R_M	−11 bp	−7 bp	+52 bp	n.a.
Total ratio	+.0159	+.0437	+.0936	+.1336
R_M	+14 bp	+37 bp	+79 bp	+107 bp

Source: Coefficients in Table 1 times average values of variables in 1982–85 and 1988–90. The conversion from interest rate ratios to municipal bond yields is done at the 1988–90 average for Treasury bond yields: 8.75 percent, 8.63 percent, 8.45 percent, and 8.01 percent, respectively.
n.a. = not applicable.
bp = basis points.

VI. Summary

This article reviews the performance and changing structure of the municipal bond market in recent years. It shows that the ratio of yield to maturity on municipal bonds to yields on U.S. Treasury bonds (the interest rate ratio) has varied greatly in the last two decades, that the interest rate ratio is greater for longer maturities, that the yield curve for municipal bonds has sloped upward more rapidly than the yield curve for Treasury bonds, and that the yield curve shapes for municipals and Treasuries became much more similar after the mid 1980s.

Dramatic changes have occurred in the character of municipal bonds outstanding, with private-activity

bonds rapidly gaining market share in the 1970s and early 1980s, and losing market share just as rapidly after the mid 1980s. In addition, major changes in municipal bond ownership occurred, primarily the dramatic withdrawal of commercial banks from the market after the mid 1980s, with households taking the place of banks as the dominant investors.

The paper reviews the main aspects of the Internal Revenue Code that affect the demand for municipal bonds. It argues that municipal bond yields will rise relative to Treasury bond yields when personal income tax rates fall or become more progressive, and that the exposure of municipal bonds to capital gains taxes when market discounts emerge will place municipal bonds at a disadvantage in periods when bond prices are more volatile. Furthermore, it is argued that anticipated future income tax rates will have a strong impact on municipal bond yields.

Recent tax legislation was examined in some detail, particularly the 1986 Tax Reform Act. That Act not only radically revised the income tax rate schedule—moving toward a flat-rate system with few brackets—but it also contained non-tax-rate legislation that dramatically affected bond yields. Of particular importance is the elimination of commercial bank deductions for municipal bond carrying costs, which should raise the interest rate ratio. Offsetting this, perhaps only partially, were the Act's severe restrictions on tax-sheltered investments, which made municipal bonds more attractive.

The paper concludes with an econometric analysis of the interest rate ratio for four maturities: one-year, five-year, 10-year and 20-year bonds. The results of this statistical analysis provide strong support for the importance of tax legislation in general, and for the propositions outlined above about the role of personal income taxes and the 1986 Tax Reform Act. In particular, the analysis finds that both the decrease in the maximum personal income tax rate, and the decline in the progressivity of the tax rate schedule, had effects that were statistically and economically significant, that the 1986 Tax Reform Act had a positive fixed effect on municipal bond yields, and that tax rate anticipations were very important.

While each of these factors was statistically and economically significant, they tended to have offsetting effects. The combined effect of these tax policy variables after 1986 ranged from a small 14-basis-point increase for 20-year bonds to a large 107 bp increase for one-year bonds.

The results also show that the debate during 1986 about the 1986 Tax Reform Act—as opposed to its actual implementation—increased interest rate ratios. This suggests independent evidence for the importance of anticipated future tax rates.

Appendix: The "New View" of Municipal Bond Yields

The "New View" of municipal bond yield determination can be understood in two ways. Fama (1977) argued that corporations, primarily commercial banks, are the marginal investors in municipal bonds. Thus, the DD schedule follows the personal tax rate schedule for low quantities of municipal bonds outstanding; for these quantities, individuals with tax rates between t_{max} and t_c will provide the funds. However, the DD schedule becomes horizontal at a ratio of $(1 - t_c)$: any tendency for the ratio to go above that level will induce banks to enter the market in sufficient volume to restore the ratio to $(1 - t_c)$. Because the volume of municipal bonds outstanding is great enough to fully absorb the funds of high-bracket investors, commercial banks become the marginal investors and the equilibrium rate ratio will be $R_M/R_T = (1 - t_c)$.

Miller's (1977) explanation of the New View is slightly more exotic. According to the stripped-down Miller version, individual investors—and the personal tax rate schedule—determine the demand function, so DD remains the effective demand schedule. But Miller argues that the effective supply schedule for municipal bonds is horizontal at the interest rate ratio $(1 - t_c)$.

In Miller's view, common stocks and municipal bonds are perfect substitutes in investors' portfolios, and common stocks are virtually tax-exempt.[25] As a result, in equilibrium the equality $R_M = R_S$ will hold, where R_S is the yield on common stocks. Because a corporation will choose its debt-equity ratio so as to minimize its cost of capital, if the required return on stocks (R_S) exceeds the after-tax cost of debt (R_T), the corporation will sell bonds; this occurs when $R_S/R_T > (1 - t_c)$. On the other hand, if the cost of equity is less than the after-tax cost of debt, corporations will sell equity; this occurs when $R_S/R_T < (1 - t_c)$. Since all corporations face the same tax rate, all will finance themselves either with debt or with equity unless $R_S/R_T = (1 - t_c)$, in which case each firm will be indifferent; some firms will choose debt, others will choose equity, and still others will finance themselves with both debt and equity. This de-

[25] Because dividend-paying stocks can be held by low-tax sectors (such as pension funds) and capital gains taxes can be deferred, Miller's assumption that common stocks are tax-exempt has some merit.

scribes the equilibrium. Because equity and municipal bonds are (according to Miller) perfect substitutes in investors' portfolios, so $R_S = R_M$, the debt-equity decisions of corporations will ensure that $R_M/R_T = (1 - t_c)$: the interest rate ratio is determined by the corporate income tax rate. In effect, the supply schedule SS is horizontal at the interest rate ratio $(1 - t_c)$. At any higher ratio municipalities will not alter their debt decision, but corporations will sell less equity that, under the Miller assumptions, is equivalent to less tax-exempt debt.

The New View received some empirical support in its early years, a prominent example being the work of Trczinka (1982). However, it fails to fit the 1980s data, as shown by Fortune (1988) who used Trczinka's method, and by Peek and Wilcox (1986), who used a different method. Furthermore, the event analyses by Poterba (1986, 1989) have demonstrated the importance of the personal income tax. A more recent study of the importance of personal income tax rates is Fortune (1991b).

In addition, recent changes in the structure of the market clearly have weakened any validity of the New View. For example, Fama's explanation is based on high commercial bank participation in the municipal bond market, but banks have been notoriously absent from the market for municipal bonds in the 1980s. Also, Miller's explanation is less convincing in the 1980s, when corporations clearly were not balancing debt and equity at the margin, but were apparently at a corner solution, issuing debt in large quantities and retiring equity.

References

Bushman, Charles and Philip S. Winterer. 1983. "Legal Arbitrage." In Fabozzi, Frank J. and others, *The Municipal Bond Handbook*, Volume I, Chapter 15, pp. 204–27. New York: Dow Jones-Irwin.

Fama, Eugene. "A Pricing Model for the Municipal Bond Market." Unpublished working paper, University of Chicago (May).

Fortune, Peter. 1973. "Tax Exemption of State and Local Interest Payments: an Economic Analysis of the Issues and an Alternative." Federal Reserve Bank of Boston, *New England Economic Review*, May/June, pp. 3–31.

———. 1988. "Municipal Bond Yields: Whose Tax Rates Matter?" *National Tax Journal*, vol. 41, no. 2, (June), pp. 219–33.

———. 1991a. "Stock Market Efficiency: An Autopsy." Federal Reserve Bank of Boston, *New England Economic Review*, March/April, pp. 17–39.

———. 1991b. "Do Bond Yields Forecast Tax Policy?" Tufts University Working Paper No. 9. Medford, MA: Tufts University.

Huefner, Robert. 1971. *Taxable Alternatives to Municipal Bonds: An Analysis of the Issues*. Research Report No. 53, Federal Reserve Bank of Boston, Boston, MA.

Ibbotson Associates. 1990. *Stocks, Bonds, Bills and Inflation Yearbook*. Chicago, IL: Ibbotson Associates.

Kenyon, Daphne. 1991. "Effects of Federal Volume Caps on State and Local Borrowing." *National Tax Journal* (forthcoming).

Kidwell, David S. , Timothy W. Koch and Duane R. Stock. 1984. "The Impact of State Income Taxes on Municipal Borrowing Costs." *National Tax Journal*, vol. 37, no. 4, (December), pp. 551–61.

Miller, Merton. 1977. "Debt and Taxes." *Journal of Finance*, vol. 32, no. 2, (May), pp. 261–75.

Pechman, Joseph A. 1987. *Federal Tax Policy*. Washington, D. C. : The Brookings Institution.

Peek, Joe and James Wilcox. 1986. "Tax Rates and Interest Rates on Tax-Exempt Securities." Federal Reserve Bank of Boston, *New England Economic Review*, January/February, pp. 29–41.

Petersen, John E. 1991. "Innovations in the Tax Exempt Market." *National Tax Journal* (forthcoming).

Poterba, James M. 1986. "Explaining the Yield Spread between Taxable and Tax-Exempt Bonds: The Role of Expected Tax Policy." In Rosen, Harvey S., ed., *Studies in State and Local Public Finance*, pp. 5–49. Chicago, IL: University of Chicago Press.

———. 1989. "Tax Reform and the Market for Tax-Exempt Debt." *Regional Science and Urban Economics*, August, pp. 537–62.

Trczinka, Charles. 1982. "The Pricing of Tax-Exempt Bonds and the Miller Hypothesis." *Journal of Finance*, vol. 37, no. 4, (September), pp. 907–23.

Zimmerman, Dennis. 1991. *The Private Use of Tax-Exempt Bonds: Controlling Public Subsidy of Private Activity*. Washington D. C.: The Urban Institute.