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Transfer Efficiency and the Trickle-Up Phenomenon in the Market for Small-Issue Private Activity Bonds

Janet A. Meade and Stanley Y. Chang

ABSTRACT

Critics of the tax exemption on private activity bonds (PABs) contend, among other things, that the tax-favored status of these bonds distorts the overall tax-exempt bond market. In so doing, the exemption increases both the inefficiency of the federal revenue transfer to the issuing states or localities and the rate at which the tax advantage associated with the exemption "trickles-up" to bond purchasers in higher tax brackets. This study examines the effect of federal tax policies enacted during the 1980s on the transfer efficiencies and trickle-up yields of samples of small-issue PABs and general obligation bonds issued between 1980 and 1990. The results indicate that the Tax Equity and Fiscal Responsibility Act of 1982 (TEFRA), the Deficit Reduction Act of 1984 (DRA), and the Tax Reform Act of 1986 (TRA) significantly increased the transfer efficiencies of the bonds while simultaneously reducing the trickle-up yields. Additionally, the results show that these Acts differentially affected the transfer efficiencies and trickle-up yields of the two samples. One implication of these findings, therefore, is that TEFRA, DRA, and TRA restored much of the federal subsidy associated with tax-exempt bonds to the issuing state or local governments.

Tax exemption on bonds issued by state and local governments provides an indirect federal subsidy to these issuers by enabling them to borrow at interest rates lower than they otherwise would pay. Part of this subsidy, however, may be transferred by bond purchasers if the supply of tax-exempt bonds exceeds their demand among higher bracket taxpayers. When this situation arises, the difference between the marginal federal tax rate of the higher bracket bond purchasers and the rate implicitly paid to the state or locality in the form of a reduced return on the tax-exempt bonds is received by the higher bracket purchasers. An oversupply of tax-exempt bonds consequently causes part of the federal subsidy to "trickle-up" to these bond purchasers, resulting in a loss of the subsidy's transfer efficiency.

Transfer efficiency is one common criterion used to evaluate federal tax policies toward tax-exempt bonds (Zimmerman 1991). This criterion requires that the federal subsidy

Janet A. Meade is Associate Professor of Accountancy at the University of Houston and Stanley Y. Chang is Associate Professor of Accountancy at Arizona State University West.

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implicit in the tax exemption be structured in such a manner that the greatest possible share of the subsidy is received by the issuing state or local government. Beginning in the 1970s, however, the increasing issuance of tax-exempt bonds for private purposes diluted the market for tax-exempt bonds, causing an alleged loss of the subsidy's transfer efficiency (Kenyon 1991). Concern over this loss, as well as the concurrent loss of federal tax revenue, prompted Congress to place a number of restrictions on private activity bonds (PABs)[1] during this period. However, not until the Tax Equity and Fiscal Responsibility Act of 1982 (TEFRA) did Congress seriously modify the federal tax policies toward PABs. These policies were subsequently modified and clarified in the Deficit Reduction Act of 1984 (DRA) and the Tax Reform Act of 1986 (TRA).

This paper investigates the extent to which TEFRA, DRA, and TRA affected the transfer efficiency of the tax exemption associated with PABs. Specifically, it examines the portion of the yield on small-issue PABs that trickled-up to the highest bracket bond purchasers in the form of an inefficient transfer of the federal subsidy. Small-issue PABs are analyzed rather than other types of PABs because this group of PABs was more directly affected by the tax policy changes of the 1980s. As such, this group of PABs is more readily identifiable and suitable for analysis.[2]

The remainder of this paper is organized into six sections. In the first section, the relation between transfer efficiency and the trickle-up phenomenon is described. In the second section, the legislative history of small-issue PABs and the major tax provisions affecting the market for tax-exempt bonds are reviewed. The conceptual framework and hypotheses of the study are presented in the third section. In the fourth and fifth sections, the research design and empirical results are explained, respectively. The study's findings and limitations are discussed in the sixth section.

TRANSFER EFFICIENCY AND THE TRICKLE-UP PHENOMENON

Tax-exempt bonds, in general, and PABs, in particular, have long been criticized as providing an inefficient transfer of tax revenue from the federal government to state and local governments. This criticism is based on the contention that a portion of the federal subsidy "trickles-up" to higher bracket bond purchasers and is not received by the state and local governments (Bittker 1979). The extent of this trickle-up phenomenon, moreover, is believed to have increased during the 1970s as a greater number of localities issued PABs and, in so doing, diluted the market for other tax-exempt bonds (Joint Committee on Taxation 1983; Zimmerman 1989). The effect of federal tax policies enacted during the 1980s on the trickle-up phenomenon and transfer efficiency, however, has not yet been explored.

To illustrate the relation between the trickle-up phenomenon and the tax policy goal of transfer efficiency, assume a taxpayer with marginal tax rate t purchases a taxable corporate bond with an interest rate equal to r_c, thereby earning an after-tax return equal to $r_c (1 - t)$. This taxpayer is indifferent between purchasing such a taxable bond and a tax-exempt bond of equivalent risk if the yield on the tax-exempt bond is r_e, where $r_e = r_c (1 - t)$. When the taxpayer exchanges the higher yield on the taxable bond for the tax-free yield on the tax-exempt bond, however, he or she implicitly pays a tax (t_i) to the

[1] The Tax Reform Act of 1986 changed the terminology of bonds issued to finance private purposes from "industrial development bonds" (IDBs) to "private activity bonds" (PABs).

[2] Among the different groups of PABs listed in I.R.C. §141(d) are exempt facility bonds, qualified mortgage bonds, qualified veterans' mortgage bonds, qualified small-issue bonds, qualified student loan bonds, qualified redevelopment bonds, and qualified I.R.C. §501(c)(3) bonds.

locality issuing the tax-exempt bond at the rate of $t_i = (r_c - r_e)/r_c$ (Scholes and Wolfson 1992, 87). In effect, the taxable bond yield foregone by the taxpayer of $r_c - r_e$ is received by the issuing locality in the form of a reduced borrowing rate. Analogously, the total rate at which the federal government forgoes tax on the taxable bond, or tr_c, is transferred to the issuing locality. The transfer efficiency of such a tax exemption consequently is 100 percent because $tr_c = r_c - r_e$ and $t = t_i$.

Assume now that the bond purchaser's marginal tax rate, t, exceeds the marginal tax rate that clears the tax-exempt bond market and establishes the differential between taxable and tax-exempt bond yields, $(r_c - r_e)/r_c$ or t_i. Under this assumption, a portion of the federal subsidy intended for the issuing locality is received by the bond purchaser because he or she earns a higher yield on the tax-exempt bond than otherwise is necessary to induce the purchase of the bond. Specifically, the rate at which this federal subsidy trickles-up to the bond purchaser is $(t - t_i)r_c$. This trickle-up rate (hereafter referred to as the trickle-up yield) also corresponds to the difference between the rate of tax revenue foregone by the federal government, tr_c, and the reduction in the borrowing rate of the issuing locality, $r_c - r_e$. The transfer efficiency in this situation is less than 100 percent because $tr_c > r_c - r_e$ and $t > t_i$.

As the above examples illustrate, transfer efficiency can be expressed as the ratio of the reduction in the issuing locality's borrowing rate, $r_c - r_e$, to the rate of tax revenue foregone by the federal government, tr_c, or $(r_c - r_e)/tr_c$ (Zimmerman 1991). This ratio measures the rate at which the issuing locality receives the federal subsidy associated with the tax exemption. However, transfer efficiency also can be expressed as the implicit tax rate on the tax-exempt bond, t_i, divided by the weighted average marginal tax rate of tax-exempt bond purchasers, t_a, or t_i/t_a.[3] Under this later computation, it can be seen that when the trickle-up phenomenon exists (i.e., $t_a > t_i$), the transfer of the federal subsidy to the issuing locality is inefficient (i.e., $t_i/t_a < 1$). Moreover, the greater the magnitude of the trickle-up phenomenon, the greater the inefficiency of the transfer.

PABs AND FEDERAL TAX POLICIES

In a typical PAB financing arrangement, a locality sells bonds to finance the acquisition, construction, or rehabilitation of industrial facilities. The facilities are then leased to a private company, which in turn pays rent in an amount sufficient to cover interest and amortization of the bond principal. Generally, the bond purchasers look only to the company's credit rating in assessing the merits of the bonds as an investment since the obligations are secured by the facilities and the related revenues. However, because interest paid on the bonds usually is exempt from federal taxation, the locality is able to borrow at a rate approximately two to four percentage points below that paid on the company's taxable bonds (Fortune 1988; Poterba 1986).[4]

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[3] Given that $t_i = (r_c - r_e)/r_c$, then $t_i r_c = r_c - r_e$. Substituting this expression into the transfer efficiency ratio of $(r_c - r_e)/tr_c$ gives $t_i r_c/tr_c$, which can be reduced to t_i/t. When a tax-exempt bond offering is purchased by more than one taxpayer, t becomes the average marginal tax rate of the bond purchasers weighted by the amount of their bondholdings, or t_a, and the transfer efficiency ratio becomes t_i/t_a.

[4] The primary benefactors of a PAB financing arrangement are the locality and the private company. The locality benefits from the arrangement because it is able to enhance economic development, employment, and housing within the community at little direct cost to its taxpaying public. Similarly, the private company benefits because it is able, under a long-term lease with an option to purchase, to acquire newly constructed facilities at a discounted price. The private company also may benefit from relief of the expenses of state and local property taxes and registration under the Securities Act of 1933.

Although PABs were first issued in 1936,[5] the extensive use of such tax-exempt financing did not occur until the 1960s. The growing issuance of PABs during this period prompted Congress to enact the Revenue and Expenditure Control Act of 1968, which introduced a number of restrictions intended to regulate the supply of these tax-exempt bonds. In particular, this Act established a two-part eligibility test that effectively denied tax exemption to any bond for which (1) all or a major portion of the bond proceeds were used in a trade or business and (2) all or a major portion of the principal or interest was secured by or derived from property used in a trade or business.[6] Bonds meeting these two tests were classified as PABs and were not eligible for tax exemption.

The 1968 Act contained numerous exceptions to the general restrictions on PABs. Among the more controversial of these was the small-issue exception, whereby any PAB issue of $1 million or less was excepted if the proceeds were used for the acquisition, construction, or improvement of land or depreciable property. Additionally, this exception allowed the issuer to elect to increase the $1 million limit to $5 million if the aggregate amount of the related capital expenditures made over a six-year period was not expected to exceed $5 million.

Further liberalization of the eligibility requirements for PABs was enacted in the Tax Reform Act of 1976, the Revenue Act of 1978, the Crude Oil Windfall Profit Tax Act of 1980, and the Economic Recovery Tax Act of 1981. Together, these Acts extended tax exemption to a broad array of PABs serving quasi-governmental purposes.[7] The 1978 Act also raised the $5 million limit on six-year capital expenditures for small-issue PABs to $10 million, and to $20 million for projects in certain economically distressed areas.

Beginning in the early 1980s, Congress became concerned that by allowing tax exemption to so many quasi-governmental projects and, in particular, by allowing virtually any business project costing less than $10 million to qualify for PAB financing, it had undercut the integrity of the general PAB restrictions.[8] The enactment of TEFRA in 1982, therefore, signaled a reversal in the federal policy toward small-issue PABs. This Act terminated the small-issue exception for bonds issued after December 31, 1986 and eliminated the tax exemption of such bonds beginning in 1983 if any portion of the proceeds was used to finance certain recreational activities or more than 25 percent of the proceeds were used to fund certain retail facilities. In addition, TEFRA imposed other reporting and public approval restrictions on all new PAB issues.

The DRA of 1984 continued the trend begun with TEFRA. This Act imposed arbitrage rebate requirements, bond yield restrictions, and state volume limitations on certain PABs.[9]

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[5] Mississippi issued the first successful PABs in 1936 (1936 Miss. Laws, 1st Ext. Sess. ch. 1., upheld in *Albritton*, 181 Miss. 75, 178 So. 799, *appeal dismissed*, 303 U.S. 627 (1938)). Prior to *Albritton*, the Supreme Court on several occasions had invalidated the tax-exempt status of PABs because the proceeds were found to be used for private purposes.

[6] In 1972, Treas. Reg. §1.103-7(b)(3) defined the term "major portion" as more than 25 percent. This definition was later changed by TRA to more than 10 percent.

[7] Among the various types of PABs exempted by these Tax Acts were local electric energy and water facilities, solid waste disposal facilities, hydroelectric generating facilities, renewable energy facilities, mass commuter vehicle financing, and volunteer fire departments.

[8] In 1981, the volume of new issues qualifying under the small-issue exception reached $13.3 billion, or more than 40 percent of the total number of PABs issued and more than 20 percent of the entire tax-exempt bond market (Congressional Budget Office 1981).

[9] Specifically, these three provisions of DRA (1) required that all arbitrage profits on PABs be rebated to the Treasury, with the exception of those issues in which the entire proceeds were expended for the intended governmental purpose within six months, (2) restricted the amount of proceeds that could be invested at a yield higher than the tax-exempt bond yield to 150 percent of the debt service for the year, and (3) imposed state volume limitations on certain PABs equal to the greater of $150 per state resident or $200 million (see General Accounting Office [1991] and Zimmerman [1991] for more detailed explanations).

DRA also denied tax exemption to any non-excepted PAB for which more than five percent or $5 million of the bond proceeds were used to make or finance a loan to persons other than governmental units. Together, these provisions reduced the attractiveness of small-issue PABs by increasing the administrative costs per dollar of debt financing. Less restrictive was DRA's extension of the sunset date on small-issue PABs through December 31, 1988 if the proceeds were used to finance manufacturing facilities. The original sunset date of December 31, 1986 established by TEFRA, however, continued to apply to all other small-issue PABs.

Additional restrictions on the issuance of tax-exempt PABs were imposed by TRA. This Act tightened the definition of "major portion" for purposes of the dual eligibility test,[10] narrowed the list of facilities qualifying for tax exemption, extended the arbitrage rebate requirements and bond yield restrictions, imposed uniform state volume limitations, expanded the reporting and public approval requirements, and restricted the use of advance refunding. As with DRA, however, TRA again extended the sunset date on the issuance of small-issue PABs used to fund manufacturing facilities to December 31, 1989. In addition, TRA included under this sunset provision small-issue PABs used to finance certain farm property.

Following TRA, few new restrictions on small-issue PABs were enacted. The Revenue Reconciliation Act of 1987, for example, contained no new provisions affecting small-issue PABs. Similarly, the only impact of the Technical and Miscellaneous Revenue Act of 1988 on small-issue PABs was a clarification of the definition of qualified manufacturing facility. More recently, the Revenue Reconciliation Acts of 1989 and 1990, as well as the Tax Extension Act of 1991, each contained provisions extending the sunset date for small-issue PABs used to finance manufacturing facilities and certain farm property. The first of these Acts extended the date through September 30, 1990, the second extended the date through December 31, 1991, and the third extended the date through June 31, 1992. More recently, the Revenue Reconciliation Act of 1993 permanently removed the sunset provision for this class of small-issue PABs.

Taken together, TEFRA, DRA, and TRA eliminated many of the tax advantages previously derived from the issuance of PABs. The restrictions imposed on the issuers of these bonds, however, were not enacted in isolation but instead were part of much broader legislation that also affected the demand for tax-exempt bonds. Among these changes, TEFRA limited commercial banks and other financial institutions to deducting only 85 percent of their interest payments on borrowings used to hold tax-exempt bonds. DRA further reduced this deduction so that after January 1, 1985, only 80 percent of such interest was deductible. Finally, TRA completely eliminated the interest deduction for tax-exempt bonds acquired after August 7, 1986.[11]

In addition to the elimination of the interest deduction, TRA contained several other provisions directly affecting tax-exempt bond investors. Among the most noteworthy of these was a provision expanding the alternative minimum tax to include tax-exempt interest income on PABs as a preference item. Additionally, TRA curtailed the tax savings provided by many other forms of tax shelters through the imposition of passive activity restrictions. Investment in tax-exempt bonds by property and casualty insurance companies also was made less attractive in that TRA required these taxpayers to decrease their reserve deductions by 15 percent of their tax-exempt interest. Most important in terms of the trickle-up phenomenon and transfer efficiency, however, was TRA's reduction of the max-

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[10] *Supra*, note 6.

[11] See Scholes et al. (1990) for an analysis of the effect of the interest deduction rules on commercial banks.

imum statutory tax rates from 50 to 28 percent for individuals and from 46 to 34 percent for corporations.[12] These reductions substantially decreased the tax savings from investment in tax-exempt bonds.

CONCEPTUAL FRAMEWORK AND HYPOTHESES

Before considering the specific effects of TEFRA, DRA, and TRA on the trickle-up phenomenon and transfer efficiency, a general understanding of the relations between the supply, demand, price, yield, implicit tax rate, trickle-up yield, and transfer efficiency of a tax-exempt bond is necessary. First, when the supply of a tax-exempt or taxable bond decreases, standard economic theory shows that, *ceteris paribus*, the price of the bond will rise and the yield will decline. A decline in the yield of a tax-exempt bond, however, will cause the implicit tax rate, given by $t_i = (r_c - r_e)/r_c$, to increase since the difference between the yield on a comparable corporate bond, r_c, and the tax-exempt bond, r_e, is greater. Concurrently, the portion of the federal subsidy implicit in the tax-exempt bond that trickles up to a higher bracket taxpayer, given by $(t - t_i)r_c$, will decline as a result of a reduction in the difference between the taxpayer's marginal tax rate of t and the implicit tax rate of t_i. Finally, the efficiency of the federal transfer to the issuing locality will improve since the increase in the implicit tax rate, t_i, also causes the transfer efficiency ratio of t_i/t_a to rise. For similar reasons, when the demand for a bond drops, the reverse effects occur since once again standard economic theory shows that, *ceteris paribus*, the price of the bond will decline and the yield will rise relative to other bonds. A summary of the effects of changes in the supply or demand of a tax-exempt bond on the variables is presented in table 1.

Using this framework, TEFRA and DRA should have had no effect on the demand for small-issue PABs relative to other tax-exempt bonds because the limitation imposed by these Acts on the deductibility of tax-exempt interest by financial institutions applied

TABLE 1
CONCEPTUAL RELATIONS AMONG THE VARIABLES

		Direction of Change			
Variable	**Notation**	**Supply ↓**	**Supply ↑**	**Demand ↓**	**Demand ↑**
Price		↑	↓	↓	↑
Yield	r_c	↓	↑	↑	↓
Implicit tax rate	t_i, or $(r_c - r_e)/r_c$	↑	↓	↓	↑
Trickle-up yield	$(t - t_i)\, r_c$	↓	↑	↑	↓
Transfer efficiency	t_i/t_a	↑	↓	↓	↑

The directional effects assume everything else is held constant.
See the discussion of the conceptual framework for an explanation of the notation.

[12] TRA's maximum statutory tax rate of 28 percent for individuals effectively rose to a 33 percent marginal tax rate for certain high bracket taxpayers because of the imposition of a 5 percent surtax on taxable income in excess of specified levels. Similarly, TRA's maximum statutory tax rate of 34 percent for corporations effectively rose to a 39 percent marginal tax rate for firms having taxable incomes between $100,000 and $335,000.

to interest received on both PABs and other tax-exempt bonds. However, TEFRA and DRA should have reduced the supply of PABs relative to other tax-exempt bonds because both Acts imposed significant restrictions on the issuance of such bonds, with specific emphasis on the issuance of small-issue PABs.

Aggregate data on small-issue PABs for the years 1979 to 1986 support the proposition that TEFRA and DRA reduced the supply of these PABs relative to other tax-exempt bonds. These data show that in the years immediately following TEFRA and DRA, the percentage of small-issue PABs in the tax-exempt bond market declined from an average of 19.75 percent during the years 1980-82 to 15.79 percent during the years 1983-84, and 6.80 percent during the years 1985-86 (Clark 1987; Clark and Neubig 1984; Office of Management and Budget 1990). Accordingly, if this reduction in the supply of small-issue PABs took place with no offsetting reduction in demand, then, holding all other factors constant, the trickle-up yield and transfer efficiency of small-issue PABs relative to other tax-exempt bonds should have decreased and increased, respectively. These hypothesized effects are stated separately at this point so that later empirical analyses can investigate both the trickle-up yield received by individual bond purchasers and the transfer efficiency of the entire tax-exempt bond market.

H_1: TEFRA and DRA reduced the rate at which the federal subsidy associated with small-issue PABs trickled-up to the highest bracket bond purchasers, relative to the rate at which the subsidy trickled-up to the highest bracket purchasers of other tax-exempt bonds.

H_2: TEFRA and DRA increased the transfer efficiency of the federal subsidy to the issuers of small-issue PABs, relative to the efficiency of the subsidy to the issuers of other tax-exempt bonds.

The effects of TRA are more difficult to evaluate. Although TRA imposed additional restrictions on PABs, it also extended the sunset date on small-issue PABs used to fund manufacturing facilities and farm property. However, because this particular class of small-issue PABs constitutes only a fraction of the total supply of small-issue PABs, a more dominate effect coinciding with TRA should have been TEFRA's termination of the tax exemption for other small-issue PABs issued after December 31, 1986. Because TRA did not extend TEFRA's 1986 termination date for the majority of small-issue PABs, the total supply of small-issue PABs relative to other tax-exempt bonds should have declined after 1986.

Although published data on the supply of small-issue PABs after 1986 are incomplete (Auten and Chung 1988; Office of Management and Budget 1990), unpublished data suggest that a decline in the supply of small-issue PABs relative to other tax-exempt bonds did occur (Internal Revenue Service 1992). This decline, however, may have been offset by TRA's effect on demand. TRA effectively removed bond purchasers subject to the alternative minimum tax from the market for PABs. Other tax-exempt bonds, therefore, should have become relatively more attractive to certain taxpayers. This attractiveness should have been further enhanced by TRA's restrictions on passive activities, which encouraged many taxpayers to replace former investments in tax shelters with investments in tax-exempt bonds (Nelson and Petska 1990). The trickle-up yield and transfer efficiency of small-issue PABs relative to other tax-exempt bonds consequently should have increased and decreased, respectively. This analysis motivates the following two research hypotheses:

H_3: TRA increased the rate at which the federal subsidy associated with small-issue PABs trickled-up to the highest bracket bond purchasers, relative to the

rate at which the subsidy trickled-up to the highest bracket purchasers of other tax-exempt bonds.

H_4: TRA reduced the transfer efficiency of the federal subsidy to the issuers of small-issue PABs, relative to the efficiency of the subsidy to the issuers of other tax-exempt bonds.

In addition to the preceding hypothesized effects, TRA should have unilaterally affected the demand for both PABs and other tax exempt bonds with its compression of the individual and corporate tax rate structure, elimination of the deductibility of tax-exempt interest for financial institutions, and restriction on the reserve deductions associated with tax-exempt interest for property and casualty insurance companies. The combined effect of these tax law changes should have reduced the differential between the implicit tax rate, t_i, and the average tax rate of tax-exempt bondholders, t_a, after 1986 (see Feenberg and Poterba [1991] for an analysis of the implicit tax rate after TRA). The overall transfer efficiency of the federal subsidy on tax-exempt bonds consequently should have increased following TRA as compared to that before TRA. This analysis leads to the final research hypothesis:

H_5: TRA increased the transfer efficiency of the federal subsidy to the issuers of small-issue PABs and other tax-exempt bonds, relative to the efficiency of the subsidy to these issuers prior to TRA.

RESEARCH DESIGN

TEFRA, DRA, and TRA altered the taxation of both small-issue PABs and other tax-exempt bonds. This study examines the effect of these tax law changes on the portion of the yields on samples of small-issue PABs and general obligation bonds that trickled-up to the highest bracket bond purchasers during the ten-year period from January 1, 1980 to December 31, 1990. In addition, the study explores the effect of these law changes on the transfer efficiencies of the bonds. The effects of tax laws enacted prior to TEFRA, DRA, and TRA are not examined because pre-1980 data are unreliable.

To test for significant differences in the magnitude of the change in the trickle-up yields and transfer efficiencies of the bond samples following TEFRA, DRA, and TRA, regression models using accumulation indicator variables are constructed. These models allow the cumulative effects of the laws to be examined in combined tests, without inflating the alpha level of the tests. In addition, these models allow the incremental effects of each of the tax acts to be calculated.

Bond Samples

Two samples of tax-exempt bonds were purchased from Security Data Corporation, a New York firm specializing in bond information. The first sample consisted of 390 bonds and included all small-issue PABs issued from January 1, 1980 to December 31, 1990 for which net interest cost data were available.[13] The second sample consisted of a random selection of 660 general obligation bonds issued during this same time period and distributed in such a manner that each month in the period included five bonds. By specifying a uniform distribution among this second sample, arbitrary clustering was avoided and a more representative picture of the general obligation bond market over the entire ten-year period was achieved.

[13] At the time the sample of small-issue PABs was purchased, only 390 out of 2,904 small-issue PABs had net interest cost data available.

Legislative Periods

Four legislative periods were examined. The first period extended from January 1, 1980 to December 31, 1982 and included those bonds issued prior to TEFRA's effective date. The second period extended from January 1, 1983 to December 31, 1984 and included those bonds issued after TEFRA's effective date but before DRA's effective date. The third period extended from January 1, 1985 to December 31, 1986 and included those bonds issued after DRA's effective date but before TRA's effective date. The fourth period extended from January 1, 1987 to December 31, 1990 and included those bonds issued after TRA's effective date.

Trickle-Up Yields

The effects of TEFRA, DRA, and TRA on the trickle-up phenomenon were analyzed by examining the yields received by the highest bracket individual purchasers of tax-exempt bonds.[14] Corporations, estates, trusts, and other tax-exempt bond purchasers were not included in the analysis because to do so would have masked the effects for any single type of bond purchaser, thereby clouding interpretation of the results. As discussed later, however, the analysis of the Acts' effects on the transfer efficiencies of the federal tax exemption for small-issue PABs and general obligation bonds considered the entire tax-exempt bond market.

To measure the yield on small-issue PABs and general obligation bonds that trickled up to the highest bracket individual bond purchasers in the form of a federal subsidy, a variable identified as TRICKLE was calculated. This variable subtracted the implicit tax rate on each bond in the samples from the maximum individual tax rate in effect at the time of the bond's issuance. The resulting tax rate differential was then multiplied by the yield of a comparable corporate bond.[15] In terms of the notation used earlier, the TRICKLE variable was calculated as $(t - t_i)r_c$, which corresponds to the previous conceptual definition.

The implicit tax rate of the TRICKLE variable was computed by subtracting the tax-exempt yield on each bond in the samples from the taxable yield on a comparable corporate bond and then dividing the resulting yield differential by the taxable yield on the corporate bond. Using the earlier notation, this variable was calculated as $(r_c - r_e)/r_c$. The maximum tax rate of the TRICKLE variable was computed as the highest federal tax rate assessed on individual taxpayers, reduced by any federal tax deduction permitted by the state in which the issuer was located, or $t_f - (t_f t_{as})$, where t_f denotes the maximum federal rate and t_s denotes the maximum state tax rate. The reduction for a federal tax deduction was based on research by Kidwell et al. (1984) which found that a state's residents generally are the marginal investors in that state's tax-exempt bonds.[16] Data on federal and state

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[14] Prior research indicates that individual tax rates are one of the primary determinants of the yield spread between taxable and tax-exempt interest rates (Fortune 1988; Peek and Wilcox 1986; Poterba 1989).

[15] Corporate bonds were identified as comparable to the sampled bond on the basis of the following criteria: (1) issue date, (2) issue amount, (3) credit rating, (4) maturity date, (5) callable date and, if relevant, (6) location of issuer. Data regarding corporate bonds were obtained from *Moody's Bond Survey*.

[16] The TRICKLE variable included the effect of state taxes only to the extent that they interacted with the trickle-up phenomenon resulting from federal tax policy. The state subsidy associated with the state tax-exemption of interest on the bonds was not considered since it had no effect on the trickle-up phenomenon. Tests of the sensitivity of the results to the assumption regarding the effect of state taxes indicated that the inclusion of the state tax adjustment increased the explanatory ability of the empirical analysis.

statutory tax rates were obtained from the *CCH Standard Federal Tax Reports* and *Research Institute of America All States Tax Guide*, while data on corporate bond yields and other issue characteristics were gathered from the weekly news reports of *Moody's Bond Survey*.

Transfer Efficiencies

To estimate the transfer efficiencies of the federal tax exemption for the small-issue PABs and general obligation bonds included in the samples, a variable identified as EFFICIENCY was calculated. This variable considered the entire tax-exempt bond market and was computed as the ratio of the implicit tax rate on each bond in the two samples to an estimated average tax rate of the bond purchasers, or t_i/t_a, when expressed in terms of the earlier notation.

The implicit tax rate of the EFFICIENCY variable was the same rate as that calculated for the TRICKLE variable. The average tax rate of the bond purchasers, however, was estimated from the results of a number of preliminary calculations. First, data regarding the percentage of tax-exempt bond ownership for the years 1980 through 1990 were determined from the Board of Governors of the Federal Reserve Board, *Flow of Funds Accounts*. These data decomposed the tax-exempt bond market into four ownership categories: (1) individuals (either directly or indirectly through mutual funds), (2) commercial banks, (3) property and casualty insurance companies, and (4) other institutions. Maximum federal tax rates for each of these ownership groups were then obtained from the *CCH Standard Federal Tax Reports*.[17] Adjustments to these rates subsequently were made so that the resulting tax rates represented the differential between the highest federal rate at which the ownership group would have paid tax on a taxable versus a tax-exempt bond.[18] Lastly, the adjusted maximum federal tax rates of the ownership groups were weighted by the percentages of tax-exempt bonds held by each group, with the result being a composite maximum federal tax rate for each of the years 1980 through 1990.

In calculating the composite maximum federal tax rates, it was assumed that both small-issue PABs and general obligation bonds were purchased equally by the four ownership groups. This assumption was necessary because more specific data were not available regarding the separate ownership profiles of small-issue PAB and general obligation bond purchasers.[19] A second assumption that was necessary was that the average tax rate

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[17] State tax rates were not considered in the calculation of the EFFICIENCY variable since the conceptual definition of transfer efficiency is the ratio of the reduction in the borrowing rate of the issuing locality to the rate of tax revenue foregone by the federal government, or $(r_c - r_e)/tr_c$. Since this definition ignores the effect of the state tax rates of the bond purchasers, the calculation was based solely on the federal tax rates.

[18] The adjustment for commercial banks reduced the maximum tax rates by 15 percent in the years 1983 and 1984, by 20 percent in the years 1985 and 1986, and by 100 percent in the years 1987 through 1990. This adjustment reflected the phased-in limitations on the deductibility of tax-exempt interest to financial institutions provided for by TEFRA, DRA, and TRA. The adjustment for property and casualty insurance companies reduced the maximum tax rates by 15 percent in the years 1987 through 1990, reflecting the effect of the reserve deduction requirement provided for by TRA.

[19] Ownership data were used in the computation because data are not available regarding bond purchasers. The computation assumes, therefore, that the four categories of tax-exempt bond purchasers and owners hold similar percentages of bonds and that later sales of the bonds do not significantly distort these percentages. Additionally, the computation assumes that the tax-exempt bondholdings of the various groups are similar for both small-issue PABs and general obligation bonds. While these assumptions may not fully reflect the tax-exempt bond market, they conservatively favor the null hypothesis of no difference between the two bond samples.

of the purchasers of each bond in the samples was the rate that corresponded to the midpoint between the composite maximum federal tax rate and the implicit tax rate. Again, this assumption was necessitated by the unavailability of specific data regarding the percentage of bond ownership at various tax rates within each ownership group. Descriptive data of the mean yields, implicit tax rates, trickle-up yields, and transfer efficiencies of the two bond samples are reported in table 2.

EMPIRICAL MODELS AND RESULTS

Tests of the hypothesized effects of TEFRA, DRA, and TRA employed regression models with accumulation indicator variables. Before constructing the final regression models,

TABLE 2
DESCRIPTIVE STATISTICS OF THE VARIABLES

	Small-Issue Private Activity Bonds		General Obligation Bonds	
Variable Legislative Period	Mean	Standard Deviation	Mean	Standard Deviation
Yield				
1-1-80 to 12-31-82	11.311	1.559	11.257	2.028
1-1-83 to 12-31-84	9.672	1.058	10.201	.600
1-1-85 to 12-31-86	7.803	1.414	8.453	1.220
1-1-87 to 12-31-90	7.580	.894	7.385	.630
1-1-80 to 12-31-90	10.001	2.129	9.147	2.057
Implicit Tax Rate				
1-1-80 to 12-31-82	20.780	7.859	20.829	9.761
1-1-83 to 12-31-84	23.703	8.167	20.171	5.151
1-1-85 to 12-31-86	23.547	10.706	20.665	6.025
1-1-87 to 12-31-90	21.174	8.800	23.555	5.598
1-1-80 to 12-31-90	21.322	8.521	21.180	7.221
Trickle-Up Yield (TRICKLE)				
1-1-80 to 12-31-82	5.706	1.849	5.590	1.723
1-1-83 to 12-31-84	2.883	1.038	3.350	.707
1-1-85 to 12-31-86	2.412	1.173	2.962	.735
1-1-87 to 12-31-90	1.101	.884	.855	.606
1-1-80 to 12-31-90	4.090	2.472	2.947	2.160
Transfer Efficiency (EFFICIENCY)				
1-1-80 to 12-31-82	57.150	15.616	57.627	17.281
1-1-83 to 12-31-84	68.430	15.804	61.181	10.607
1-1-85 to 12-31-86	69.790	17.775	62.427	12.281
1-1-87 to 12-31-90	86.103	22.367	91.651	13.313
1-1-80 to 12-31-90	65.074	19.148	71.612	18.438
Sample Size				
1-1-80 to 12-31-82	222		180	
1-1-83 to 12-31-84	51		120	
1-1-85 to 12-31-86	40		120	
1-1-87 to 12-31-90	77		240	
1-1-80 to 12-31-90	390		660	

several initial models were analyzed to determine which subset of 22 different variables most parsimoniously explained variations in the issue characteristics of the bonds and changing market conditions. The variables considered in this analysis were selected from the tax-exempt bond pricing literature and included such bond specific attributes as the sample grouping of the bond, the issue amount, the number of years to maturity, the number of years to the first callable date, the credit rating, the negotiated or competitive bid status, the issuer, and the regional location of the issuer. Also considered in the analysis were general market condition control variables such as the composite weekly average yields on long-term municipal bonds, 20-year corporate bonds, and 90-day Treasury bills, as well as the quarterly consumer price index (CPI) and quarterly change in the gross national product (GNP). In addition, measures of specific market conditions, such as risk within the tax-exempt bond market and long-term corporate bond market, were considered, as were several measures intended to control for changes in federal tax rates.

Several of the control variables exhibited greater explanatory power when transformed using natural logarithms.[20] Others displayed high degrees of correlation. None of the transformed or multicollinear control variables, however, was highly correlated with the hypothesized variables. Thus, their inclusion did not affect the interpretation of the coefficients of the hypothesized variables. Control variables were excluded from the final regression models only when they improved neither the fit nor the explanatory power of the models. The final models are stated below:

$$\begin{aligned}\text{TRICKLE} = {} & b_0 + b_1\text{TEFRA} + b_2\text{DRA} + b_3\text{TRA} + b_4\text{SAMPLE} + b_5(\text{SAMPLE} \times \text{TEFRA}) \\ & + b_6(\text{SAMPLE} \times \text{DRA}) + b_7(\text{SAMPLE} \times \text{TRA}) + b_8\text{LOG(AMOUNT)} \\ & + b_9\text{LOG(MATURITY)} + b_{10}\text{RATING} + b_{11}\text{CALLDATE} + b_{12}\text{ISSUER} \\ & + b_{13}\text{BIDSTATUS} + b_{14}\text{MARKETRISK} + b_{15}\text{AVGTAXRATE} + b_{16}\text{CPI} \\ & + b_{17}\text{MUNIYIELD} + e\end{aligned}$$

and

$$\begin{aligned}\text{EFFICIENCY} = {} & b_0 + b_1\text{TEFRA} + b_2\text{DRA} + b_3\text{TRA} + b_4\text{SAMPLE} + b_5(\text{SAMPLE} \\ & \times \text{TEFRA}) + b_6(\text{SAMPLE} \times \text{DRA}) + b_7(\text{SAMPLE} \times \text{TRA}) \\ & + b_8\text{LOG(AMOUNT)} + b_9\text{LOG(MATURITY)} + b_{10}\text{RATING} \\ & + b_{11}\text{CALLDATE} + b_{12}\text{BIDSTATUS} + b_{13}\text{MARKETRISK} \\ & + b_{14}\text{AVGTAXRATE} + b_{15}\text{MUNIYIELD} + e\end{aligned}$$

where

TEFRA = indicator variable representing the cumulative legislative periods following TEFRA. TEFRA = 1 if the bond was issued after December 31, 1982, and TEFRA = 0 if otherwise.

DRA = indicator variable representing the cumulative legislative periods following DRA. DRA = 1 if the bond was issued after December 31, 1984, and DRA = 0 if otherwise.

TRA = indicator variable representing the cumulative legislative periods following TRA. TRA = 1 if the bond was issued after December 31, 1986, and TRA = 0 if otherwise.

SAMPLE = indicator variable representing the sample grouping of the bond issue. SAMPLE = 1 if the bond was a small-issue PAB and SAMPLE = 0 if otherwise (general obligation bond).

[20] Logarithmic transformations are common in studies examining the tax-exempt bond market (e.g., Hsueh and Kidwell 1988; Kidwell et al. 1987; Lamy and Thompson 1988).

LOG(AMOUNT) = dollar amount of the bond in millions, transformed using the natural logarithm.

LOG(MATURITY) = years to maturity of the bond, transformed using the natural logarithm.

RATING = municipal bond credit rating of the bond as generally determined from *Moody's Bond Survey*. RATING = 1 if the bond was not rated,[21] RATING = 2 if the bond was rated AAA, RATING = 3 if the bond was rated AA, RATING = 4 if the bond was rated A, and RATING = 5 if the bond was rated BBB.

CALLDATE = years to the first call date of the bond, divided by the years to maturity.

ISSUER = indicator variable representing the type of bond issuer. ISSUER = 1 if the bond was issued by a state authority or agency, and ISSUER = 0 if otherwise (local authority or agency).

BIDSTATUS = indicator variable representing the bid status of the bond issue. BIDSTATUS = 1 if the bond was competitive, and BIDSTATUS = 0 if otherwise (negotiated).

MARKETRISK = composite weekly average yield on long-term municipal bonds during the week of the bond issue less the tax equivalent weekly average yield on 20-year corporate bonds during the same week.[22]

AVGTAXRATE = average federal tax rate of tax-exempt bond purchasers, computed as the midpoint between the maximum federal tax rate and the implicit tax rate on long-term municipal bonds during the week of the bond issue.[23]

CPI = consumer price index during the quarter of the bond issue, with 1982 as the base year.

MUNIYIELD = composite weekly average on long-term municipal bonds during the week of the bond issue.

e = error term.

Because the two dependent variables were both conceptually and quantitatively related, the only difference between the two models was the inclusion and/or exclusion of

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[21] Based upon the results of a sensitivity analysis, it was determined that the RATING variable exhibited the most explanatory power when nonrated bonds were coded as the highest category. This coding assignment seemed most appropriate since the nonrated bonds in the samples generally had lower yields, larger issue amounts, longer maturities, longer call dates, and more state issuers. As an alternative to coding the nonrated bonds, they could have been excluded from the samples. This alternative was not considered viable for the sample of small-issue PABs, however, because the reduction in the sample size would have limited the statistical power of the regression tests, as well as the generalizability of the results.

[22] The tax equivalent yield on 20-year corporate bonds was calculated as $r_c(1 - t_a)$, where r_c denotes the composite weekly average yield on the corporate bonds and t_a denotes the average federal tax rate on the bonds. The average federal tax rate was computed as the midpoint between the maximum federal tax rate and the implicit tax rate on long-term municipal bonds during the week of the tax-exempt bond issue (see *infra* note 23).

[23] The implicit tax rate on long-term municipal bonds was computed as $(r_c - r_e)/r_c$, where r_c denotes the composite weekly average yield on 20-year corporate bonds and r_e denotes the composite weekly average yield on long-term municipal bonds during the week of the bond issue.

the ISSUER and CPI variables. These variables were not included in the EFFICIENCY model because they were insignificant.

The results of the TRICKLE model are reported in table 3. As shown, this model explains 89 percent of the variation in the trickle-up yields. The signs and coefficients of the hypothesized variables, although insignificant in some cases, are as expected. Considering first the SAMPLE variable, the regression results indicate that during the period from January 1, 1980 to December 31, 1982 the mean trickle-up yield of the sample of small-issue PABs was .093 percentage points higher than that of the sample of general obligation bonds. The insignificance of this difference ($p = .461$), suggests that prior to the tax law restrictions on small-issue PABs and tax-exempt bond purchasers enacted by TEFRA, DRA, and TRA, the portion of the yields that trickled-up to the highest bracket purchasers of small-issue PABs and general obligation bonds was similar.

The regression results also indicate that during the two year period following TEFRA, significant changes occurred in both the absolute and relative trickle-up yields of the two bond samples. With respect to the effect of TEFRA on the absolute trickle-up yields, the sign and coefficient of the TEFRA variable indicate that during the period from January 1, 1982 to December 31, 1984 a significant decline of 1.577 percentage points ($p = .000$) occurred in the mean trickle-up yield of the sample of general obligation bonds. In comparison, the sign and coefficient of the SAMPLE × TEFRA interaction term indicate that the decline in the mean trickle-up yield of the sample of small-issue PABs was .899 percentage points more than that of the sample of general obligation bonds. The absolute decline exhibited in the mean trickle-up yield of the sample of small-issue PABs, therefore, was 2.476 percentage points during the post-TEFRA period, computed as the sum of the coefficients of the TEFRA variable and the SAMPLE × TEFRA interaction term. The relative difference between the declines in the mean trickle-up yields of the two bond samples is significant ($p = .000$) and in the direction posited by hypothesis H1. Support consequently is provided for hypothesis H1 regarding the differential effect of TEFRA on the trickle-up yields of small-issue PABs and general obligation bonds.

Support also is provided for hypothesis H1 regarding the differential effect of DRA on the trickle-up yields of small-issue PABs and general obligation bonds. As indicated by the sign and coefficient of the SAMPLE × DRA interaction term, the decline in the mean trickle-up yield of the sample of small-issue PABs was .854 percentage points more than that of the sample of general obligation bonds during the period from January 1, 1984 to December 31, 1986. This relative difference is both significant ($p = .000$) and in the hypothesized direction. Additionally, the regression results for the DRA variable indicate that the Act caused an absolute decline of 1.051 percentage points ($p = .014$) in the mean trickle-up yield of the sample of general obligation bonds and an absolute decline of 1.905 percentage points for the sample of small-issue PABs (computed as the sum of the coefficients of the DRA variable and the SAMPLE × DRA interaction term). The restrictions imposed on small-issue PABs by DRA, therefore, appear to have significantly augmented TEFRA's earlier effect.

The regression results of the TRICKLE model also support hypothesis H3. As posited by hypothesis H3, the restrictions imposed on small-issue PABs and tax-exempt bond purchasers by TRA should have reduced the absolute trickle-up yields of both bond samples. The relative change in the trickle-up yields of the two bond samples, however, should have been less pronounced for small-issue PABs than general obligation bonds. Both of these posited effects are observed in the TRICKLE model. With respect to the effect of TRA on the direction of the absolute change in the samples' trickle-up yields, the sign and coefficient of the TRA variable indicate that a significant decline of 2.283 percentage

TABLE 3
ESTIMATES OF INTERCEPT AND SLOPE COEFFICIENTS OF THE TRICKLE-UP PHENOMENON ON TAX-EXEMPT BONDS FROM JANUARY 1, 1980 TO DECEMBER 31, 1990

Variable	Coefficient	t-statistic (p-value)	Difference from 1980–82		Difference from 1983–84		Difference from 1985–86	
			Coefficient	t-statistic (p-value)	Coefficient	t-statistic (p-value)	Coefficient	t-statistic (p-value)
INTERCEPT	−5.726	−5.421 (.000)						
TEFRA	−1.557	−3.834 (.000)						
DRA	−1.051	−2.462 (.014)						
TRA	−2.283	−3.330 (.001)						
SAMPLE	.093	.749 (.461)						
× TEFRA			−.899	−5.291 (.000)				
× DRA					−.854	−3.942 (.000)		
× TRA							1.135	5.896 (.000)
LOG(AMOUNT)	−.139	−5.074 (.000)						
LOG(MATURITY)	.761	13.069 (.000)						
RATING	.189	8.581 (.000)						
CALLDATE	.348	5.392 (.000)						

(Continued)

TABLE 3 (Continued)
ESTIMATES OF INTERCEPT AND SLOPE COEFFICIENTS OF THE TRICKLE-UP PHENOMENON ON TAX-EXEMPT BONDS FROM JANUARY 1, 1980 TO DECEMBER 31, 1990

Variable	Coefficient	t-statistic (p-value)	Difference from 1980–82 Coefficient	Difference from 1980–82 t-statistic (p-value)	Difference from 1983–84 Coefficient	Difference from 1983–84 t-statistic (p-value)	Difference from 1985–86 Coefficient	Difference from 1985–86 t-statistic (p-value)
ISSUER	−.155	−2.647 (.009)						
BIDSTATUS	−.578	−7.924 (.000)						
MARKETRISK	1.112	21.699 (.000)						
AVGTAXRATE	.035	3.105 (.002)						
CPI	.030	5.293 (.000)						
MUNIYIELD	−.145	−2.888 (.004)						
Dependent variable		TRICKLE						
Sample size		1,050						
F-statistic		517.06						
p-value		.00						
Adjusted R^2		.89						

See the discussion of the model for a description of the variables.
Reported t-statistics and p-values are two-tailed tests.

points occurred in the mean trickle-up yield of the sample of general obligation bonds during the period from January 1, 1987 to December 31, 1990 ($p = .001$). Likewise, a decline of 1.148 percentage points occurred in the mean trickle-up yield of the sample of small-issue PABs (computed as the sum of the coefficients on the TRA variable and the SAMPLE × TRA interaction term). The relative change in the declines of the mean trickle-up yields of the two bond samples of 1.135 percentage points shown by the sign and coefficient of the SAMPLE × TRA interaction term is significant ($p = .000$) and positive. These results support hypothesis H3 and provide evidence indicating that the effect of TRA was less dramatic on the trickle-up yields of small-issue PABs than on general obligation bonds.

Table 4 reports the results of the EFFICIENCY model. As expected, the results for this model are similar to those for the TRICKLE model. However, possibly because the computation of the EFFICIENCY variable is based on several simplifying assumptions regarding the bond purchasers, the explanatory power of the model is lower, with only 67 percent of the variation in the transfer efficiencies explained by the model.

With respect to the difference in the transfer efficiencies of the two bond samples during the period from January 1, 1980 to December 31, 1982, the sign and coefficient of the SAMPLE variable indicate that the mean transfer efficiency of the sample of small-issue PABs was 1.246 percentage points less than that of the sample of general obligation bonds. Similar to the results of the SAMPLE variable in the TRICKLE model, the difference detected between the transfer efficiencies of the two bond samples is not significant ($p = .129$). The insignificance of this regression result consequently suggests that prior to the restrictions of TEFRA, DRA, and TRA, comparable transfer efficiencies existed for both small-issue PABs and general obligation bonds.

For the two year period following TEFRA, the regression results indicate that the transfer efficiencies of the two bond samples changed significantly, both in absolute and relative terms. In absolute terms, the sign and coefficient of the TEFRA variable indicate that a significant increase of 3.743 percentage points ($p = .033$) occurred in the mean transfer efficiency of the sample of general obligation bonds during the period from January 1, 1982 to December 31, 1984. Similarly, the sum of the coefficients of the TEFRA variable and the SAMPLE × TEFRA interaction term indicate that an absolute increase of 12.583 percentage points occurred in the mean transfer efficiency of the sample of small-issue PABs. The relative difference between the increases in the mean transfer efficiencies of the two bond samples of 8.840 percentage points, as indicated by the coefficient of the SAMPLE × TEFRA interaction term, is both in the direction posited by hypothesis H2 and significant ($p = .001$). The differential effect of TEFRA on the transfer efficiencies of small-issue PABs and general obligation bonds posited by hypothesis H2, therefore, is supported.

Similarly, the differential effect of DRA posited by hypothesis H2 is supported by the regression results. These results show that both the absolute and relative changes in the mean transfer efficiencies of the two bond samples were significant during the period from January 1, 1984 to December 31, 1986. Specifically, the sign and coefficient of the DRA variable indicate that an absolute increase of 2.174 percentage points occurred in the mean transfer efficiency of the sample of general obligation bonds during the two year period following DRA ($p = .048$). Additionally, the sum of the coefficients of the DRA variable and the SAMPLE × DRA interaction term indicate that an absolute increase of 9.078 percentage points occurred in the mean transfer efficiency of the sample of small-issue PABs. This larger increase of 6.904 percentage points in the mean transfer efficiency of the sample of small-issue PABs shown by the sign and coefficient of the SAMPLE ×

TABLE 4
ESTIMATES OF INTERCEPT AND SLOPE COEFFICIENTS OF THE TRANSFER EFFICIENCY OF TAX-EXEMPT BONDS FROM JANUARY 1, 1980 TO DECEMBER 31, 1990

			Difference from 1980–82		Difference from 1983–84		Difference from 1985–86	
Variable	Coefficient	t-statistic (p-value)	Coefficient	t-statistic (p-value)	Coefficient	t-statistic (p-value)	Coefficient	t-statistic (p-value)
INTERCEPT	34.549	2.651 (.008)						
TEFRA	3.743	2.145 (.033)						
DRA	2.174	1.982 (.048)						
TRA	21.812	12.295 (.000)						
SAMPLE	−1.246	−1.524 (.129)						
× TEFRA			8.840	3.281 (.001)				
× DRA					6.904	2.913 (.003)		
× TRA							−13.602	−6.714 (.000)

LOG(AMOUNT)	2.113	4.924
		(.000)
LOG(MATURITY)	−11.753	−12.751
		(.000)
RATING	−3.292	−9.385
		(.000)
CALLDATE	−6.684	−6.512
		(.000)
BIDSTATUS	8.642	7.491
		(.000)
MARKETRISK	−12.219	−15.014
		(.000)
AVGTAXRATE	1.525	8.767
		(.000)
MUNIYIELD	6.197	7.759
		(.000)
Dependent variable		EFFICIENCY
Sample size		1,050
F-statistic		137.25
p-value		.00
Adjusted R^2		.67

See the discussion of the model for a description of the variables.
Reported t-statistics and p-values are two-tailed tests.

DRA interaction term is in the direction posited by hypothesis H2 and is significant ($p = .003$). These findings suggest, therefore, that DRA altered the relation between the transfer efficiencies of small-issue PABs and general obligation bonds in a manner similar to TEFRA.

In comparison to TEFRA and DRA, TRA appears to have had the greatest effect on the relation between the two bond samples. As shown by the sign and coefficient of the TRA variable, a significant absolute increase of 21.812 percentage points occurred in the mean transfer efficiency of the sample of general obligation bonds during the period from January 1, 1987 to December 31, 1990 ($p = .000$). TRA's effect on the mean transfer efficiency of the sample of small-issue PABs, however, was not as dramatic, with an absolute increase of only 8.210 percentage points observed (computed as the sum of the coefficients on the TRA variable and the SAMPLE × TRA interaction term). The direction of these absolute changes in the mean transfer efficiencies of the two bond samples, as well as the significantly smaller relative change of 13.602 percentage points for the sample of small-issue PABs shown by the sign and coefficient of the SAMPLE × TRA interaction term ($p = .000$), are as posited by hypothesis H4. TRA consequently appears to have improved the overall efficiencies of the federal subsidy associated with the two bond samples, but to have differentially affected the efficiencies of the samples in a manner opposite that of TEFRA and DRA.

Hypothesis H5 posits that TRA increased the transfer efficiencies of both small-issue PABs and general obligation bonds over the efficiencies of the bonds prior to the Act. As discussed, the sign and coefficient of the TRA variable in the EFFICIENCY model is positive and significant ($p = .000$), thereby indicating that TRA increased the mean transfer efficiency of the sample of general obligation bonds. Likewise, the significance and positive sum of the coefficients of the TRA variable and the SAMPLE × TRA interaction term indicate that TRA increased the mean transfer efficiency of the sample of small-issue PABs. The results consequently support hypothesis H5 by showing that TRA increased the mean transfer efficiencies of the samples and directed much of the federal subsidy associated with tax-exempt bonds back to the issuing state or local government.

In addition to the primary tests, the TRICKLE and EFFICIENCY models were tested for the sensitivity of their results. The first sensitivity test added period interaction terms for each of the control variables. Under this specification, the TRICKLE and EFFICIENCY models included 30 and 24 additional interaction terms, respectively. The advantage of this specification was that by computing incremental slopes for each of the control variables, the resulting models were capable of controlling for any fundamental changes in the bond market pricing models taking place concurrently with TEFRA, DRA, and TRA. The disadvantage was that by including so many control variables, the models were overfitted and biased toward the null hypotheses. The significance levels of several of the variables consequently were expected to decline. Generally, the results of these models were consistent with the findings of the primary models. Three reportable differences, however, were that the DRA and DRA × SAMPLE variables became insignificant in the TRICKLE and EFFICIENCY models and the significance of the TRA variable in the TRICKLE model declined from the .01 to the .05 level.

The second sensitivity test addressed a concern that the inclusion of the MARKETRISK and AVGTAXRATE variables in the primary models might be reducing the power of the tests because their calculations were functionally related to the dependent variables. To test this concern, additional regression models were constructed in which both the MARKETRISK and AVGTAXRATE variables were excluded from the original specification of the TRICKLE and EFFICIENCY models. For the TRICKLE model, no reportable differences from the primary results were detected for any of the variables of interest.

For the EFFICIENCY model, the only reportable difference was an increase in the significance of the DRA variable from the .05 to the .01 level. The significance levels of the other variables remained comparable.

CONCLUSIONS

This study examined the effects of TEFRA, DRA, and TRA on the trickle-up yields and transfer efficiencies of samples of small-issue PABs and general obligation bonds issued between 1980 and 1990. The results indicate that prior to TEFRA, no significant differences existed in either the portion of the yields that trickled-up to the highest bracket purchasers of small-issue PABs and general obligation bonds or the transfer efficiencies of the federal subsidy associated with the bonds. After TEFRA, however, significant differences occurred in both the trickle-up yields and transfer efficiencies of the bonds. Specifically, the mean trickle-up yield of small-issue PABS decreased relative to that of general obligation bonds, while the mean transfer efficiency of small-issue PABS increased relative to that of general obligation bonds. Together with the earlier findings of no significant pre-TEFRA differences between the two bond samples, these relative changes consequently suggest that in the two year period following TEFRA a smaller portion of the yield was received by the highest bracket purchasers of small-issue PABs than by similar purchasers of general obligation bonds. Concurrently, the findings also suggest that a larger share of the federal subsidy associated with the bonds was received by the issuers of small-issue PABs than by the issuers of general obligation bonds.

In the two year period following DRA, similar changes in the relative trickle-up yields and transfer efficiencies of the bonds also were detected. DRA consequently appears to have continued the trend begun by TEFRA of lessening the portion of the yield received by the highest bracket purchasers of small-issue PABs relative to comparable purchasers of general obligation bonds. Simultaneously, DRA also appears to have increased the relative share of the federal subsidy received by the issuers of small-issue PABs.

In contrast to the relative changes detected for TEFRA and DRA, the findings of this study indicate that over the four year period following TRA the decline in the mean trickle-up yield and the increase in the mean transfer efficiency of small-issue PABs were smaller than those of general obligation bonds. The directions of the absolute changes in the mean trickle-up yields and transfer efficiencies of small-issue PABs and general obligation bonds, nevertheless, were the same for TEFRA, DRA, and TRA. These Tax Acts consequently appear to have reduced the portion of the yield on small-issue PABs and general obligation bonds received by the highest bracket purchasers, while increasing the efficiency of the federal subsidy received by the issuers of the bonds.

One implication of the results is that the tax law restrictions on small-issue PABs and tax-exempt bond purchasers enacted by TEFRA, DRA, and TRA made substantial gains toward increasing the transfer efficiency of the subsidy associated with the tax exemption on small-issue PABs and general obligation bonds. Additionally, the findings suggest that these Acts altered the supply of and demand for PABs and other tax-exempt bonds and restored much of the federal subsidy to the issuing states and localities. Not explored in this study, but equally important for future research, is the extent the tax restrictions imposed by TEFRA, DRA, and TRA affected the economic and administrative efficiency of the tax exemption, as well as its equity. Future studies of these effects, therefore, could provide a more comprehensive understanding of the implications of federal tax policies.

The study's primary limitation is the restricted sample size of small-issue PABs. Because much of the data regarding these bonds are private or difficult to obtain, the sample

of small-issue PABs examined in this study may not be representative of the overall population. The results reported in this paper, therefore, may be sensitive to sample variations that could affect the relations between the bond issue characteristics and the dependent variables. In addition, the results may be sensitive to the assumptions employed to empirically specify the conceptual variables. More complete data or different assumptions could produce different results.

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