

PORTFOLIO SUBSTITUTION AND THE REVENUE COST OF THE FEDERAL INCOME TAX EXEMPTION FOR STATE AND LOCAL GOVERNMENT BONDS

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This paper illustrates how different assumptions about household portfolio behavior influence estimates of the amount of individual income tax revenue that would be collected if the interest tax exemption for state and local government bonds were repealed or curtailed. Using data from the 2004 Survey of Consumer Finances, we estimate that federal income tax revenues would rise by \$14.0 billion if current bondholders purchased taxable bonds, \$8.9 billion if corporate stock replaced tax-exempt bonds in household portfolios, and \$8.2 billion if they distributed their tax-exempt bond holdings across their other portfolio assets in proportion to their current portfolio shares.

Keywords: tax-exempt bonds, portfolio choice, tax expenditures

JEL Codes: H24, H74

I. INTRODUCTION

Proposals for broadening the income tax base often call for eliminating or restricting the federal personal income tax exemption for interest on bonds issued by state and local governments. The National Commission on Fiscal Responsibility and Reform (2010) recommended that all such interest payments on newly issued bonds be included in the personal income tax base. The reforms proposed by the Joint Committee on Taxation (2005) and the U.S. Department of the Treasury (1984) included limitations on the set of bonds that would be eligible for tax exemption. The U.S. Office of Management and Budget (2010) estimates that for fiscal year 2009, the tax expenditure for the exclusion of interest on state and local government bonds was \$18.1 billion. The corresponding corporate income tax expenditure was roughly one-quarter this size, or \$4.9 billion. The tax expenditures for exclusion of interest paid on “private-purpose”

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tax-exempt bonds were \$6.4 billion and \$1.7 billion, respectively. The exemption for interest on state and local government bonds, hereafter the “interest tax exemption,” attracts perennial attention from tax reformers because it is one of the largest individual income tax expenditures.

The estimated tax expenditure associated with an income tax provision is not the same as the estimate of the revenue that would be collected if that provision were repealed. In the case of the interest tax exemption, the former estimate assumes that the taxpayers who currently hold tax-exempt bonds would continue to hold them, as taxable bonds yielding higher interest rates, if the tax exemption were repealed. The latter calculation, the revenue estimate, depends on assumptions about how removing the tax exemption would affect the portfolios of taxable investors who currently hold tax-exempt bonds.

This paper illustrates how different assumptions about household portfolio behavior influence estimates of the amount of individual income tax revenue that would be collected if the interest tax exemption were repealed or curtailed. While we focus on the individual income tax, a similar analysis, with a different menu of potential portfolio responses, could in principle be applied to describe the consequences for corporate income tax revenues as well. We show that the tax expenditure estimate is likely to overstate the revenue gain from repealing the interest tax exemption, since at least some current holders of tax-exempt bonds would probably reposition their portfolios to hold other lightly-taxed assets, rather than heavily-taxed state and local government bonds, after interest payments on such bonds became fully taxable. Our analysis follows previous studies, notably Galper and Toder (1981), Slemrod (1983), Toder and Neubig (1985), and Gordon and Metcalf (1991), which recognize that household portfolios would be adjusted if the current tax exemption were repealed. These studies also recognize that state and local governments would likely respond to such a policy change by adjusting their investment in capital and by shifting their financing mix between debt and taxes.

While the prospect of household portfolio adjustments in response to a change in tax exemption has been widely recognized, it has proven difficult to calibrate such adjustments on the basis of econometric models of household portfolio behavior. This reflects in part the absence of a broadly-accepted theoretical framework for modeling household decisions about which assets to hold, and how much of them to hold, and in part the difficulty of finding credible identification strategies for estimating how taxes affect portfolio choices. To illustrate the importance of alternative assumptions for revenue estimation, we consider several different potential household portfolio adjustment strategies and demonstrate that the revenue cost of the current tax exemption can vary substantially under these different assumptions.

This paper is divided into seven sections. Section II summarizes data on the yield spread between taxable and tax-exempt bonds over the last two decades, which is an important input in estimating the potential revenue effect of eliminating the interest tax exemption. It also reports the aggregate holdings of taxable and tax-exempt bonds by different classes of investors. Section III explains the set of hypothetical household portfolio adjustment strategies that we consider, and Section IV describes the data sources that underlie our analysis. It also presents the current distribution of tax-exempt bond holdings across individual investors. The fifth section presents revenue estimates

for the elimination of tax exemption under each of the portfolio adjustment strategies we describe, and Section VI presents estimates for policies that would restrict but not eliminate the interest income tax exemption. A brief conclusion suggests directions for further research.

II. THE YIELD SPREAD AND THE OWNERSHIP OF TAX-EXEMPT BONDS

Table 1 shows annual average yields on AAA municipal, U.S. Treasury, and AAA corporate bonds with 10-year maturities. It also reports the “implicit tax rates” between tax-exempt bonds and both U.S. Treasury and top-grade corporate bonds. The implicit tax rate with respect to Treasury bonds is defined by θ_T in the equation $(1 - \theta_T)R_T = R_M$, where R_T and R_M respectively denote the yields to maturity on comparable maturity, newly-issued, U.S. Treasury and tax-exempt bonds. We define θ_C for corporate bonds in a similar fashion.

Table 1 shows that both implicit tax rate measures over the 1991–2010 period are well below the top statutory marginal tax rate in the federal income tax code. The entry for each year is the average of monthly values. The implicit tax rate with regard to Treasury bonds was only 8.2 percent in 2009. Even in less extraordinary years for financial markets, however, the implicit tax rate was well below the top tax rate. In 2000, for example, the implicit tax rate was 20.4 percent. At the beginning of the 1990s, the implicit tax rate was around 25 percent. The implicit tax rate computed with respect to corporate bonds is systematically greater than that computed with respect to Treasury bonds. In 2007, for example, the implicit tax rate based on corporate yields averaged 29 percent, when that computed using Treasuries was 18.5 percent. The corporate implicit tax rate rose by 86 basis points between 2007 and 2008, while that computed using Treasuries fell by more than 1,400 basis points. This suggests that much of the narrowing of the Treasury-municipal bond yield spread reflected a flight to quality and demand for Treasury bonds, rather than developments in the tax-exempt bond market.

While implicit tax rates are widely used to summarize yield spreads between tax-exempt and taxable bonds, they are difficult to map into tax parameters for market participants. Green (1993) emphasizes that when bonds may not be held to maturity, the interpretation of the implicit tax rate is more complicated than the simple expression defined above suggests. Poterba (1986) notes that implicit tax rates reflect both current and expected future tax policy parameters. Variations in the perceived risks of Treasury bonds, corporate bonds, and state and local government bonds can also affect measured implicit tax rates. Chalmers (2006) points out, however, that risk considerations do not seem able to explain the divergence between the level of implicit tax rates and the top statutory individual marginal tax rate.

The implicit tax rate may provide some guidance on the identity of the “marginal investor” who is choosing between taxable and tax-exempt bonds. The foregoing difficulties of interpretation, however, suggest that it is also valuable to examine actual ownership statistics on tax-exempt bonds. In 2008, for example, Federal Reserve Board of Governors (2008) data from the *Flow of Funds* (Tables L.209, L.211, and L.212) show that households owned 37 percent of state and local government debt directly.

Table 1
Implicit Tax Rates on Prime, 10-Year Municipal (Muni) Bonds Relative to Treasury and Corporate Bonds, 1991–2010

Year	Yields (%)			Spread (%)			Implicit tax rates (%)	
	Muni	Treasury	Corporate	Treasury-Muni	Corporate-Muni	Treasury	Corporate	
1991	6.02	8.17	8.39	2.15	2.37	26.32	28.25	
1992	5.58	7.25	7.43	1.67	1.85	23.03	24.90	
1993	4.74	6.19	6.32	1.45	1.58	23.42	25.00	
1994	5.28	7.21	7.49	1.93	2.21	26.77	29.51	
1995	5.04	6.71	6.97	1.67	1.93	24.89	27.69	
1996	4.92	6.55	6.82	1.63	1.90	24.89	27.86	
1997	4.75	6.48	6.73	1.73	1.98	26.70	29.42	
1998	4.31	5.49	5.83	1.18	1.52	21.49	26.07	
1999	4.62	6.00	6.46	1.38	1.84	23.00	28.48	
2000	4.97	6.25	7.14	1.28	2.17	20.48	30.39	
2001	4.28	5.23	6.00	0.95	1.72	18.16	28.67	
2002	4.05	4.91	5.57	0.86	1.52	17.52	27.29	
2003	3.69	4.24	4.75	0.55	1.06	12.97	22.32	
2004	3.67	4.44	4.90	0.77	1.23	17.43	25.14	
2005	3.71	4.37	4.87	0.66	1.16	15.14	23.86	
2006	3.93	4.86	5.48	0.92	1.54	18.99	28.20	
2007	3.88	4.76	5.47	0.88	1.59	18.48	29.00	
2008	3.93	4.09	5.60	0.16	1.67	3.98	29.86	
2009	3.32	3.62	5.03	0.30	1.71	8.24	33.97	
2010	2.97	3.39	n.a.	0.42	n.a.	12.43	n.a.	
Average	4.38	5.51	6.17	1.13	1.71	19.22	27.68	

Source: Authors' calculations using data from Bloomberg. Annual entries are simple averages of monthly data. The AAA corporate data series was not available for 2010. Averages for the columns including corporate data are for the 1991–2009 period.

Another 29 percent was held by mutual funds; a substantial share of these funds is in turn owned by households. The “rest of the world” owned only 1 percent of state and local government debt. In contrast, the “rest of the world” owned 32 percent of Treasury debt. Pension funds owned 6 percent of Treasury debt, mutual funds 9 percent, and the U.S. household sector held 11 percent. Tax-exempt institutions, such as universities, are included in the “household” sector and given their tax status they are natural holders of Treasury bonds. Our portfolio adjustment strategies below assume that the investors who currently hold Treasury debt would be prepared to increase their holdings of taxable bonds, and in particular would be prepared to purchase bonds issued by state and local governments if such bonds lost their tax exemption and households chose to reduce their holdings of these bonds.

III. PORTFOLIO RESPONSES TO REPEALING TAX EXEMPTION

The revenue effects of a change in the tax treatment of interest on currently tax-exempt bonds depends on several variables, most importantly the impact of the change on the financial behavior of households who currently demand these bonds, and the impact on the real and financial behavior of state and local governments that currently supply these bonds. We focus only on the first response. We recognize that it is not just households whose behavior could be affected by changes in the tax rules. Since any change in the portfolio holdings of households must be offset either by a change in the supply of the relevant securities or in the demand for these securities by other market participants, implicit in our analysis is an assumption about the willingness of other market investors to accommodate the changing portfolio choices of taxable households.

Unfortunately, relatively little empirical work informs the set of portfolio adjustments that may result from a change in the tax treatment of state and local government bonds. Existing work in the computational general equilibrium tradition, such as Galper and Toder (1981), Slemrod (1983), and Toder and Neubig (1985), considers a relatively small set of asset classes and does not include the full set of investors, notably foreigners, who are currently important participants in bond markets. Slemrod’s (1983) model, for example, includes six asset classes — corporate capital, rental housing, owner-occupied housing, taxable bonds, corporate stock, and tax-exempt bonds — and in equilibrium investors form clienteles with regard to asset ownership.

Empirical studies of taxes and portfolio behavior, including Scholz (1994), Bakija (2000), and Poterba and Samwick (2003), provide some evidence on how household portfolios respond to the vector of after-tax returns on various assets. For example, Scholz (1994) finds that the concentration of tax-exempt bond ownership among taxpayers in the highest income categories declined between 1983–1989, a period when the Tax Reform Act of 1986 reduced marginal tax rates for this group. Extrapolating his evidence to the prospective elimination of the tax exemption for state and local government interest payments is difficult, however, because many different tax parameters changed simultaneously in 1986. Empirical work on household portfolio structure is complicated by the need to model the high-dimensional portfolio choice set confronting households and to recognize the possibility of borrowing as well as investing in various assets.

Even if existing theoretical models and empirical findings fail to provide precise guidance for modeling changes in the demand for state and local government bonds around the elimination of tax exemption, they do provide two broad insights that are relevant for analyzing the portfolio effects of such a policy change. First, investors tend to invest in the asset classes for which they have a comparative tax advantage. Miller (1977) and Auerbach and King (1983) provide examples of models in which tax-induced clienteles emerge in equilibrium. Because individual investors in high tax brackets, and fully-taxable corporations, are the investor groups with the most to gain from holding bonds that generate tax-free interest, clientele considerations suggest that these investors should be important holders of these bonds; the evidence described above confirms this. If interest on bonds issued by state and local governments became taxable, there would be a substantial shift in the set of investors with a comparative tax advantage for holding these bonds, which would no longer be one of the most lightly taxed asset classes. If these bonds paid fully taxable interest, untaxed institutions such as pension funds and nonprofit institutions would have a comparative tax advantage for holding them. Tax clientele considerations alone would suggest the possibility of a marked shift in the ownership of state and local government bonds if interest on these bonds became taxable.

The second factor affecting the ownership of these bonds, however, is the risk aversion of all investor classes. Since it is difficult to construct a well-diversified portfolio using only assets in the set of asset classes for which a given investor has a tax comparative advantage, investors may hold assets in which they are tax-disfavored because of their diversification benefits. Thus, tax-exempt investors who have a comparative tax advantage in holding heavily-taxed bonds may also hold equities, and heavily-taxed top-bracket individual investors may hold some taxable bonds to diversify their exposure to lightly-taxed equities. Thus, the demand for diversification may partly counteract the tax clientele effect.

The introduction of risk and uncertain returns reminds us that the government's tax revenues from households' portfolio investments are a risky claim. In addition to changing the expected level of income tax revenues, which is the focus of our analysis, household portfolio changes in response to repeal of tax exemption may also alter the riskiness of the government's income tax revenue stream. Stock returns, for example, are more volatile than taxable bond returns. If repeal of tax-exemption increased the share of households' taxable portfolios in equities, this could raise the volatility of government revenues.

Since we cannot draw on previous empirical work to provide detailed guidance on how household portfolios would respond to elimination of tax exemption, we consider five alternative ways in which households might adjust their portfolios in response to the taxation of the interest on state and local government bonds. For each, we estimate expected federal income tax revenues after households adjust their portfolio holdings. We assume that non-taxable investors such as pension funds, foreign investors, and non-profit institutions will demand any assets that households are dropping from their portfolio, and that households can acquire from this group, without any effect on returns, any assets that they choose to hold in place of tax-exempt bonds. By assuming

that all portfolio adjustments take place with these tax-exempt investors, we can avoid considering the effects of individual income tax changes on the tax liability of taxable investors other than households.

The five household portfolio adjustment strategies that we consider are:

- (1) *Taxable bond substitution.* Households replace their currently tax-exempt bonds with taxable bonds. This is a “minimal response” case in which the interest rates on all bonds that are currently tax-exempt rise to current taxable interest rate levels, but the same investors that hold tax-exempt bonds hold the taxable bonds. This case involves no portfolio adjustment by taxable investors, and of the various adjustment strategies, it corresponds most closely to the thought experiment that underlies tax expenditure estimates.
- (2) *Proportional substitution.* Taxable individual investors who currently hold tax-exempt bonds sell their holdings when these bonds become taxable and invest the proceeds in other asset classes in proportion to those asset classes’ shares in their current portfolios. One unrealistic feature of this approach is that it increases total holdings in transaction accounts that offer low rates of return; households might not deploy assets to such accounts in rebalancing their portfolios.
- (3) *Equity substitution.* Investors who currently hold tax-exempt bonds seek other lightly-taxed assets. They sell their current holdings of state and local government bonds, and purchase common stocks, which are taxed less heavily than bonds. This adjustment scenario involves the largest shift in the riskiness of household portfolios, and it is probably extreme for that reason. Households might not respond to the decline in after-tax returns on fixed-income securities that would be associated with this tax change with a substantial shift in the risk composition of their portfolios.
- (4) *Tax-efficient debt or equity substitution.* In this scenario, households with marginal tax rates below 20 percent replace their tax-exempt debt with taxable debt, and households facing higher marginal tax rates replace tax-exempt debt with common stock. This case allows some degree of portfolio specialization based on comparative tax advantage.
- (5) *Debt repayment.* Households with outstanding mortgage debt or investment debt, who currently deduct interest payments on this debt when computing their taxable income, sell their currently tax-exempt bonds and repay part or all of their outstanding debt. If they have no debt to repay, they hold taxable bonds in place of their currently tax-exempt bonds. Investors who borrow in tax-deductible forms and hold tax-exempt bonds are engaged in a form of tax arbitrage. This behavior is related to the supply-side practices studied by Gentry (2002) in his analysis of hospitals that simultaneously borrow in the tax-exempt bond market while investing in taxable bonds. For households in top marginal tax brackets, the data in Table 1 suggest that tax-deductible borrowing at rates less than or equal to the AAA corporate rate, combined with an investment in prime grade tax-exempt bonds, would have a positive expected return.

One portfolio adjustment strategy that we considered, but do not include in our analysis, would involve substitution of taxable bonds in tax-deferred accounts such as IRAs and 401(k)s for current tax-exempt bond holdings. We explored the extent of such substitution by summing the maximum of current wage income, or the contribution limit to 401(k) plans, which was \$12,000 per year in 2003, across all households with tax-exempt bond holdings. Contributions to a tax-deferred retirement plan cannot exceed a household's wage income. The sum across all households was \$29 billion, which suggests that only a modest fraction of tax-exempt bond holdings could be replaced by making new contributions to tax-deferred accounts. It is possible that households with existing tax-deferred accounts would alter their asset allocations in these accounts, but as we will show below, the skewed distribution of tax-exempt bond holdings limits the capacity of any transactions involving tax-deferred accounts to offset a change in tax status.

IV. THE 2004 SURVEY OF CONSUMER FINANCES AND TAXSIM

To evaluate how income tax revenues would be affected if interest on state and local government bonds were no longer tax exempt, and if the current holders of those bonds followed each of the adjustment strategies above, we rely on household-level data from the 2004 Survey of Consumer Finances (SCF). We impute marginal tax rates to SCF households using the code provided by Moore (2004) to construct the 22 variables needed to run the National Bureau of Economic Research's Internet TAXSIM program, and then append the marginal tax rates to each household record. Feenberg and Coutts (1993) describe the basic structure of the TAXSIM program, which can be used to produce last-dollar marginal tax rates on taxable interest income and other components of adjusted gross income (AGI).

A. Aggregate Consistency Checks for SCF Data

The SCF is the most detailed and reliable source of data on household finances. We nevertheless performed some external validation tests for the data on tax-exempt bond holdings. In 2004, the SCF interviewed 4,519 households. The public use SCF data file includes 22,595 observations, which corresponds to five "replicates" for each underlying SCF observation. Because the SCF file includes imputed values for some data items that are missing in the household's actual responses, the replicates associated with a given underlying observation may have different values of some variables. Different observations have different sample weights, and the weighted sum of SCF households corresponds to 112 million U.S. households.

Total financial assets of these households, defined following Poterba and Samwick (2002) as the sum of directly held equity, equity in mutual funds, tax-deferred equity, tax-deferred bonds, tax-exempt bonds, taxable bonds, interest bearing accounts, and other financial assets, is \$17.4 trillion. The tax-exempt bonds category includes tax-exempt bonds held through mutual funds that are identified as tax-exempt bond funds. Taxable

bonds include government bonds, corporate bonds, foreign bonds, and mortgage bonds, once again including both direct holdings and holdings through mutual funds. Interest bearing accounts include checking and savings accounts, plus certificates of deposits. Other financial assets include annuities, trust funds, hedge funds with equity interest, and life insurance premiums.

The 2004 SCF reports aggregate direct household ownership of tax-exempt bonds of \$756 billion. By comparison, the Federal Reserve Board of Governors (2008) *Flow of Funds Accounts* shows \$704 billion of direct household-owned tax-exempt bonds. While the “household sector” includes nonprofit institutions, these tax-exempt institutions are unlikely to hold substantial amounts of tax-favored state and local debt. In addition, the *Flow of Funds Accounts* shows holdings of tax-exempt bonds by mutual funds, money market mutual funds, and closed-end funds of \$290 billion, \$292 billion, and \$89 billion, respectively, at year-end 2003. The household sector owned 62.3 percent of mutual fund shares and 48 percent of money market mutual fund shares. The SCF reports tax-exempt bonds in mutual funds, but it does not distinguish between money market mutual funds and regular mutual funds. The SCF total for these holdings is \$300 billion, compared with \$376 based on the ownership shares and aggregate values of the various funds from the *Flow of Funds Accounts*. While these summary statistics suggest some differences between the *Flow of Funds Accounts* aggregates and the SCF, they also suggest that the SCF asset stocks are reasonably close to other information on these aggregates.

The amount of tax-exempt interest that SCF households reported for 2003 was \$57.5 billion. The U.S. Internal Revenue Service (2005) indicates that in 2003, households reported \$53.7 billion of tax-exempt interest on their tax returns — quite close agreement.

B. Consistency of Stocks and Flows in the SCF

One potential difficulty with the SCF data is the imperfect matching between asset income and asset holdings. Table 2 illustrates the problem. Nearly 3 percent of SCF observations, corresponding to slightly less than 2 percent of the population, report holdings of tax-exempt bonds but no tax-exempt interest. In addition, just over 3 percent of the observations, representing slightly more than 1 percent of the population, report tax-exempt interest but no holdings of tax-exempt bonds.

The mismatch problem can be further illustrated by calculating the distribution of the ratio of tax-exempt interest payments to tax-exempt bond holdings. Table 3 shows that the median of this “implied interest rate” for all households with tax-exempt bond holdings is 4.9 percent. The inter-quartile range, however, spans 3.2–12.7 percent. The inter-quartile range when weighted by the household’s ownership of tax-exempt bonds is 2.0–5.4 percent. There are some outliers in the data set: nearly 5 percent of households with tax-exempt bonds report tax-exempt interest rates of less than 1 percent, and more than 10 percent reported interest rates of more than 10 percent.

One potential explanation for these inconsistencies is that while households were interviewed in 2004, the questionnaire specifically asks about tax information for fiscal

Table 2
Stock-Flow Inconsistency in Tax-Exempt Bond Holdings and Interest Income

	Households		Observations		Financial Assets	
	Millions	Percentage	Thousands	Percentage	Trillions	Percentage
Neither bonds nor interest	106.7	95.2	19.1	84.6	10.0	57.6
Bonds and interest	2.1	1.8	2.1	9.3	4.8	27.3
No bonds but interest	1.2	1.1	0.7	3.3	1.5	8.6
Bonds but no interest	2.1	1.8	0.6	2.8	1.1	6.5
Total	112.1	100.0	22.6	100.0	17.4	100.0

Source: Authors' calculations using the 2004 Survey of Consumer of Finances. Inconsistencies may result from inconsistent data reported by survey participants or from imputation procedures that are used to "fill" missing data.

Table 3
Distribution of Implied Interest Rates on Tax-Exempt Bonds

	Weighting Variable			
	Households	Observations	Financial Assets	Tax-exempt Bond Holdings
Minimum	0.0	0.0	0.0	0.0
10 th percentile	1.8	1.6	1.7	1.5
25 th percentile	3.2	2.7	2.5	2.0
Median	4.9	4.7	4.5	3.7
75 th percentile	12.7	9.0	8.4	5.4
90 th percentile	45.5	23.4	20.0	8.4
Maximum	320,000	320,000	320,000	320,000

Source: Authors' calculations using the 2004 SCF. Entries are reported in percentage points, and are computed by dividing reported tax-exempt interest by reported holdings of tax-exempt bonds.

year 2003. The households with stock-flow inconsistencies might have bought or sold tax-exempt securities between 2003 and 2004. It is also possible that the differences are due to misreporting in either flows of income or stocks of assets — measurement error or failures of some households to understand their detailed financial affairs. Finally, some errors may arise because some of the entries on SCF records are imputed. Inter-

est income is imputed separately from tax-exempt bond holdings; this could generate outlying ratios of the two. The 22,595 observations represent 4,519 unique households. Among the 566 households reporting tax-exempt bond holdings, there are 32 (4) households for which the SCF algorithm imputes some zero and some non-zero tax-exempt bond holdings (tax-exempt interest). The imputed values vary substantially. Among households with imputed tax-exempt bond holdings, the mean holdings are \$8.2 million while the mean absolute deviation from each household's mean is \$1.3 million. Mean tax-exempt interest is \$160,000, and the mean absolute deviation from each household's mean is \$18,000. The median implied interest rate is about 4.7 percent, while the mean is about 7.8 percent. The source of such stock-flow inconsistencies is a subject of ongoing SCF research.

C. Portfolio Holdings of Households with and without Tax-Exempt Bonds

To illustrate what the proportional substitution strategy described in the last section would involve, Table 4 describes the aggregate portfolio structure of households with and without positive holdings of tax-exempt bonds. The table describes holdings excluding tax-deferred retirement accounts such as 401(k) plans and IRAs. Table 4 shows that for households without tax-exempt bonds, taxable bonds account for 4 percent of their portfolio while interest-bearing accounts represent 24 percent. For those with tax-exempt bonds, taxable bonds represent 6 percent, and interest bearing accounts 9 percent, of the total. Tax-exempt bonds, in contrast, represent 18 percent of the portfolio for these households. Taxable interest-bearing assets are a smaller share of the portfolios

	Households Without Tax-exempt Bonds (%)	Households with Tax-exempt Bonds (%)
Directly held equity	25	29
Equity in mutual funds	10	15
Tax deferred equity	8	5
Tax deferred bonds	15	8
Tax-exempt bonds	0	18
Taxable bonds	4	6
Interest bearing accounts	24	9
Other financial assets	14	10

Source: Authors' calculations using the 2004 SCF. Entries describe the total value of portfolio assets held in each portfolio category.

of households with tax-exempt bonds than of households without such bonds. Equity, held directly or through mutual funds, accounts for 44 percent of the portfolio of those who hold tax-exempt bonds and 35 percent of those who do not. If the households who currently hold tax-exempt bonds were to sell these bonds and allocate the proceeds in proportion to their holdings of all of the other assets in their portfolios, only 7.3 percent ($= 6/(1 - 0.18)$) of the current holdings of tax-exempt bonds would be replaced by taxable bonds. If we consider interest bearing accounts as similar to taxable bonds, this fraction rises to 18.3 percent ($= 15/(1 - 0.18)$). If we also include taxable bonds held in tax-deferred accounts, the fraction becomes 28 percent ($= 23/(1 - 0.18)$). Other more lightly taxed assets, such as equities, and assets that generate low rates of return, such as holdings in transaction accounts, would account for the remainder of the portfolio.

Table 5 presents more specific information about the holders of tax-exempt bonds, as it shows the distribution of such holdings by households in various marginal tax rate categories for 2003. Households with marginal tax rates in excess of 30 percent hold 53 percent of tax-exempt bonds and report 49 percent of tax-exempt interest. As in Feenberg and Poterba (1991), households with very low marginal tax rates hold close to 10 percent of tax-exempt debt. For these households, holding tax-exempt debt would seem tax-inefficient, although it is possible that data errors or specialized financial circumstances explain these outcomes. It is also possible that we have assigned these households incorrectly low marginal tax rates by understating some components of income or by over-stating deductions, or that the tax rates for these households are below their long-run average.

Table 5
Distribution of Tax-exempt Bond Ownership and Interest Income
by Federal Marginal Tax Rate, 2004 SCF

Federal Marginal Tax Rate (%)	Tax-Exempt Bond Holdings		Tax-Exempt Interest Income	
	\$Billions	Percentage	\$Billions	Percentage
<0	1.0	0.1	0.0	0.0
0	95.3	9.0	5.0	8.8
0-10	21.2	2.0	0.9	1.6
10-15	89.7	8.5	6.0	10.5
15-25	153.0	14.4	8.0	13.9
25-30	133.0	12.5	9.4	16.3
30+	562.0	53.0	28.1	48.9
Total	1,060.0	100.0	57.5	100.0

Source: Authors' calculations using the 2004 SCF. Marginal tax rate applies to income for 2003.

V. REVENUE ESTIMATES UNDER ALTERNATIVE PORTFOLIO ADJUSTMENT SCENARIOS

We now describe the effects of eliminating the interest tax exemption on individual income tax revenues under each of the portfolio adjustment scenarios described above. We begin by summarizing our revenue estimation procedure for the case of taxable bond substitution, and then apply similar calculations for the other four portfolio adjustment scenarios. We first compute the interest income that the household would receive if it replaced all of its tax-exempt bonds with taxable bonds. We do this assuming that the “replacement” taxable bonds would have a yield equal to an equal-weighted average of the Treasury interest rate in 2003 (4.24) and the AAA corporate rate (4.75), or 4.495 percent. We then modify any other variables that enter the calculation of tax liability, such as deductions under the Alternative Minimum Tax (AMT). We then compute the difference between the TAXSIM estimate of the household’s tax liability under the status quo, and its tax liability with the modified income pattern associated with the alternative portfolio holdings. The sample-weight-weighted sum of the changes in tax liabilities across households is our estimate of the impact on federal income tax revenues.

An approximation to this estimate of the revenue change can be computed as

$$(1) \quad \Delta Revenue_{2004} = \sum_j w_j (\tau_{j,2003} \times B_{j,2004} \times i_{2003}).$$

In this expression, the tax-exempt bond holdings of each household are denoted by $B_{j,2004}$, the household’s last-dollar marginal tax rate is $\tau_{j,2003}$, and i_{2003} denotes the assumed rate of return on taxable bonds in 2003. The calculation in (1) does not capture the nonlinearities of the income tax schedule, the role of the AMT, and other subtleties that are reflected in the difference between the TAXSIM estimates of tax liability under the two portfolio structures. It nevertheless illustrates our basic approach.

To find the change in tax liability in the five distinct scenarios considered, we must make assumptions about the income generated by a number of different asset classes. For taxable bonds we assume an interest rate of 4.495 percent. We assume an average return on interest bearing accounts equal to one-quarter of the interest rate on taxable bonds: 1.124 percent. Equities are assumed to generate realized capital gains equal to 2.75 percent of their market value. This value is roughly equal to the nominal long-term return on corporate stocks for the period beginning in 1926 (Morningstar, 2007), less an assumed dividend yield of 2.0 percent. We assume, based on studies of the degree of capital gains deferral described in Poterba (1987), that only one-quarter of unrealized capital gains are taxed in a given year as a result of the deferral of accrued gains and the opportunity to step-up basis at death. For equity held through mutual funds we assume that half of accruing gains are realized, which implies a higher capital gains tax burden. We assume equal dividend yields on stocks held directly and through mutual funds.

For each alternative portfolio adjustment scenario, we construct a counterfactual portfolio for each SCF household that currently holds tax-exempt bonds, and we impute capital income flows under the rate of return assumptions described above.

Table 6 shows how the aggregate portfolios of all households with current tax-exempt bond holdings would change if tax-exemption were eliminated and these households followed each of the five portfolio adjustment strategies we described above. The table shows that the portfolio share for directly-held equity would rise sharply, from 29 to 47 percent, in the equity substitution case, and that it would also increase substantially, to 42.4 percent, in the “tax efficient substitution” case. In the taxable bond substitution case, the portfolio share for this asset category rises from 6 to 24 percent. These are large changes in portfolio shares, in part because for those households who invest in tax-exempt bonds, these assets represent nearly one fifth of their portfolio. Even with proportional adjustment across all asset categories, the share of directly-held equity would rise from 29 to 37 percent of the household portfolio.

Table 7 presents revenue estimates under different portfolio adjustment scenarios. The taxable bond substitution case yields the largest revenue gain, \$14.0 billion. When we assume that households replace tax-exempt debt with equity, or that they choose between equity and other assets in a tax-efficient way, we find smaller estimates of the revenue cost of the tax expenditure: \$8.9 billion and \$9.9 billion, respectively. The proportional substitution case produces the lowest revenue gain (\$8.2 billion) because some of the assets that are assumed to replace tax-exempt bonds have low yields, such as transaction accounts. We do not regard this substitution pattern as particularly likely; tax-exempt bond investors are unlikely to use them for liquidity purposes, so it seems unlikely that they would substitute toward highly liquid assets if tax-exempt bonds ceased to exist. The debt repayment case generates an increase in tax revenue of \$12.3 billion. This is close to the value in the taxable bond substitution case, because the average interest rate on the debt that the households pay down in this scenario is close to the average taxable interest rate that households earn on taxable bonds.

Table 7 illustrates the sensitivity of the revenue estimate for eliminating the interest tax exemption to alternative portfolio adjustment assumptions. The estimated revenue gain in the proportional substitution case is slightly less than 60 percent of that in the taxable bond substitution case. The other portfolio adjustment cases yield revenue estimates between these extremes.

The last six columns of Table 7 report the share of the increase in income tax liability associated with taxpayers in various categories based on AGI. Because the ownership of tax-exempt bonds is highly skewed, the highest income group — AGI over \$500,000 per year — is responsible for nearly half of the increase in tax liability when the tax exemption is repealed. The households with AGI between \$250,000 and \$500,000 account for another quarter of the increase in tax liability.

Table 8 reports the weighted mean change in federal tax liabilities due to the repeal of the tax exemption. For households with incomes below \$40,000 but some holdings of tax-exempt bonds, the mean and median changes are close to zero. For those with incomes above \$500,000, the average tax increase exceeds \$12,000, and the median tax increase is greater than \$1,500.

Tables 7 and 8 present increases in tax liabilities, but these cannot be interpreted as measures of the economic incidence of repealing tax exemption without many other

Table 6
Household Portfolio Structure (Portfolio Shares) After Repeal
of Interest Tax Exemption: Various Portfolio Adjustment Strategies

	Before Repeal	Taxable Bond Substitution	Proportional Substitution	Equity Substitution	Tax Efficient Substitution	Deductible Debt Pay-Down
Directly held equity	0.290	0.290	0.373	0.469	0.424	0.302
Equity in mutual funds	0.149	0.149	0.176	0.150	0.149	0.155
Tax deferred equity	0.045	0.045	0.045	0.045	0.045	0.047
Tax deferred bonds	0.085	0.085	0.085	0.085	0.085	0.088
Tax-exempt bonds	0.180	0	0	0	0	0
Taxable bonds	0.060	0.239	0.079	0.060	0.105	0.208
Interest bearing accounts	0.088	0.088	0.115	0.088	0.088	0.091
Other financial assets	0.104	0.104	0.128	0.104	0.104	0.108

Source: Author's calculation using 2004 SCF, Internet TAXSIM, and Kevin B. Moore's Code. Portfolio adjustment strategies are described in further detail in the text.

Table 7
Revenue Cost and Distributional Effects of Repealing Tax Exemption

Assumption about Household Portfolio Adjustment	Estimated Revenue Effect (\$Billions)	Percentage of Tax Increase Allocated to Households in Different AGI Categories (\$Thousands)					
		0-40	40-75	75-125	125-250	250-500	> 500
Taxable bond substitution	14.00	0.7	4.7	8.7	11.2	25.4	49.6
Proportional substitution	8.20	0.3	5.3	7.1	13.2	26.5	47.7
Equity substitution	8.87	0.5	4.7	9.6	12.3	26.2	46.7
Tax efficient substitution	9.85	0.9	5.0	10.9	11.5	24.0	47.7
Deductible debt pay-down	12.30	1.0	4.4	7.8	13.3	23.4	50.0

Source: Authors' calculations using 2004 SCF, Internet TAXSIM, and Kevin B. Moore's Code. See text for further details regarding portfolio adjustment strategies. Households with AGI between \$125K-\$250K paid 20.3 percent of federal income taxes in 2003, those with AGI between \$250K-\$500K paid 12.0 percent, and those with AGI of greater than \$500K paid 29.4 percent.

Table 8
Average Dollar Increase in Federal Income Tax Liabilities From Repeal of Tax Exemption

Portfolio Substitution Assumption	Income Level (\$Thousands)					All
	0-40	40-75	75-125	125-250	250-500	
	Mean for All Households					
Taxable bonds substitution	2	24	79	227	2,320	7,922
Proportional substitution	0	15	38	156	1,419	4,457
Equity substitution	1	15	55	158	1,512	4,721
Tax efficient substitution	1	18	70	164	1,544	5,363
Deductible debt pay-down	2	19	62	237	1879	7,014
	Mean for All Households with Tax-Exempt Bond Holdings					
Taxable bonds substitution	146	609	1,477	2,010	9,118	21,383
Proportional substitution	51	400	706	1,385	5,578	12,029
Equity substitution	83	386	1,032	1,401	5,942	12,743
Tax efficient substitution	134	455	1,297	1,452	6,069	14,476
Deductible debt pay-down	178	496	1,155	2,102	7,385	18,932
	Median for All Households with Tax-Exempt Bond Holdings					
Taxable bonds substitution	27	142	229	324	2,358	3,241
Proportional substitution	10	62	110	183	1,609	1,586
Equity substitution	14	69	177	223	1,851	1,984
Tax efficient substitution	15	136	177	223	1,851	1,984
Deductible debt pay-down	27	136	229	337	2910	3,933

Source: Authors' calculations using 2004 SCF, Internet TAXSIM, and Kevin B. Moore's Code. See text for further details regarding portfolio adjustment strategies. The last column presents results for all households.

assumptions. Households who currently hold tax-exempt bonds pay an “implicit tax” that is never recorded as a tax liability. The ultimate incidence of eliminating the interest tax exemption depends on the difference between the after-tax return households earned from tax-exempt bonds, and the after-tax return that they earn from their substitute investments. Some of the incidence of repealing the tax exemption would also fall on households in their role as taxpayers to state and local governments, as the higher interest costs associated with borrowing in the taxable rather than the tax-exempt market would be passed through to taxpayers in the form of higher taxes.

VI. LIMITATIONS ON TAX-EXEMPTION

In addition to proposals to eliminate tax-exempt interest, there are also proposals to limit the amount of such interest that any taxpayer could receive. One such plan would limit the amount of tax-exempt interest to a fixed fraction of AGI; another would cap the amount of tax-exempt interest per tax return. Table 9 reports the distribution across

	Holdings of Tax Exempt Bonds		Number of Taxpayers	
	\$Billion	Share of Total (%)	Thousands	Share of Total (%)
Ratio of Tax-Exempt Interest to AGI %:				
0	107	10.2	108,800	97.1
0–10	313	29.7	2,418	2.2
10–30	241	22.8	566	0.5
30–50	127	12.0	132	0.1
50–100	124	11.7	97	0.1
100 +	144	13.6	72	0.1
Total	1,056	100.0	112,100	100.0
Amount of Tax-Exempt Interest (\$K):				
0	100	9.5	108,800	97.1
0–10	130	12.3	2,499	2.2
10–50	160	15.1	528	0.5
50–100	251	23.7	195	0.2
100–250	135	12.8	53	0.0
250–500	121	11.5	18.24	0.0
500K–1,000	101	9.6	6.54	0.0
1,000 +	58	5.5	2.69	0.0
Total	1,056	100.0	112,100.00	100.0

Source: Authors' calculations using the 2004 SCF.

taxpayers of the ratio of tax-exempt interest to AGI and the amount of tax-exempt interest received. It shows that absent any taxpayer response, limiting exempt interest to 10 percent of AGI would affect approximately 867,000 households, who hold approximately 60 percent of tax-exempt bonds. Limiting such interest to 30 percent of AGI would affect households owning 37 percent of tax-exempt bonds. Limiting the amount of tax-exempt interest to \$10,000 per tax return would affect about 800,000 households that own 78 percent of tax-exempt bonds, while increasing this limit to \$100,000 would reduce the number of affected households by a factor of 10 and limit the fraction of tax-exempt bonds affected to 39 percent.

To compute the revenue effects of various limits on tax-exempt interest, we follow a procedure similar to that used to analyze total repeal of tax exemption. For a given limit on tax-exempt interest, if a household's 2004 portfolio would place it above the limit, we assume that this investor would adjust the share of her tax-exempt bond holdings that generate interest above the limit in accordance with one of our portfolio adjustment strategies.

Table 10 reports our estimates of the revenue effects of various limits on tax-exempt interest. Limiting tax-exempt interest to \$100,000 per tax return would raise \$4.8 bil-

Table 10
Revenue Effects (\$Billion) of Limiting Tax Exemption

	Limit to 10% of AGI	Limit to \$10K Per Taxpayer
Taxable bonds substitution	5.8	10.4
Proportional substitution	3.2	5.9
Equity substitution	3.7	6.5
Tax efficient substitution	4.5	7.4
Deductible debt pay-down	4.8	8.5
	Limit to 30% of AGI	Limit to \$50K Per Taxpayer
Taxable bonds substitution	2.7	6.7
Proportional substitution	1.4	3.7
Equity substitution	1.7	4.1
Tax efficient substitution	2.2	4.8
Deductible debt pay-down	2.3	5.3
	Limit to 50% of AGI	Limit to \$100K Per Taxpayer
Taxable bonds substitution	1.4	4.8
Proportional substitution	0.7	2.7
Equity substitution	0.9	2.9
Tax efficient substitution	1.2	3.5
Deductible debt pay-down	1.3	4.0

Source: Authors' calculations using 2004 SCF, Internet TAXSIM, and Kevin B. Moore's Code. See Table 6 for further details and explanation of substitution assumptions.

lion if households substitute taxable bonds for tax-exempt bonds, \$2.9 billion if they substitute with equity, and \$4.0 billion if households repay tax-deductible debt. For a \$50,000 limit, the corresponding values are \$6.7, \$4.1, and \$5.3 billion, respectively. Limiting tax-exempt interest to 30 percent of AGI would raise \$2.7 billion in the taxable bond substitution case, \$1.7 billion in the equity substitution case, and \$2.3 billion in the debt repayment case.

VII. CONCLUSION

Our results demonstrate that estimates of the revenue gain from eliminating the income tax exemption for interest paid by state and local governments are sensitive to assumptions about how taxable investors would adjust their portfolios in response to this change. If high-tax-bracket individual taxpayers shun bonds issued by state and local governments when the interest on those bonds is taxable, and if they invest instead in lightly-taxed assets such as low-yield corporate equities, the revenue gain from curtailing the exemption is likely to be substantially smaller than if these investors continue to hold state and local government bonds even after the interest becomes taxable.

The extent of household portfolio adjustment depends on the degree to which households pursue tax-efficient investment strategies and on their desire to preserve the diversification that they currently receive from investing in state and local government debt. Shifting from such debt to lightly-taxed equity, one of the portfolio strategies we consider, would add volatility to the returns on household portfolios, since equities have historically displayed more variable returns than tax-exempt bonds. Changes in the mix of assets in household portfolios, offset in our analysis by shifts in the portfolios of non-taxable investors such as pension funds or investors from other nations, would affect the risk properties of the federal government's income tax revenue stream.

Our analysis has focused on the demand for tax-exempt bonds. We have not discussed how the supply of these bonds might be affected if their interest payments were no longer tax exempt. Gordon and Slemrod (1983, 1986) and Gordon and Metcalf (1991) emphasize that states and localities face a choice between debt and tax finance, and that this choice is sensitive to the tax treatment of interest on state and local government bonds and to the income tax deductibility, or lack therefore, for state and local taxes. If interest payments on state and local government bonds were taxable, it is likely that these governments would shift toward tax finance. The extent of such a shift, and the impact of such a shift on the pre-tax return on the bonds issued by these governments, would affect the amount of additional federal income taxes collected if the interest exemption were repealed. Gordon and Slemrod (1983) suggest that there could be a dramatic response to taxing interest on state and local government bonds; in their model, governments would not issue bonds if the interest was taxable. Joulfaian and Matheson (2009) estimate how fluctuations in borrowing costs affect the level of bond issuance; they find a substantial elasticity of supply.

The supply side of the market for tax-exempt bonds, and the interplay between tax and debt finance, is an important direction for future empirical study. The recent experience with the Build America Bonds program, a 2009 initiative that provided a federal subsidy to bonds issued by state and local governments, may provide an opportunity to evaluate supply side responses.

Our reliance on illustrative examples of portfolio adjustment strategies for households who currently hold tax-exempt bonds, rather than our use of an explicit model of household portfolio choice, underscores the need for further investigation of how taxation affects household investment decisions. There are open questions about what objective function households seek to maximize in their portfolio choices, and about the elasticity of demand for individual asset classes with regard to expected after-tax return and the variability of that return. Future research on this issue will not only assist in developing revenue estimates for changes in the tax treatment of particular asset classes, but may also lead to a framework for evaluating the welfare costs of taxes and other policies.

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