The Mortgage Interest Deduction: Revenue and Distributional Effects

by

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Abstract

Conventional estimates of the size and distribution of the mortgage interest deduction (MID) in the personal income tax fail to account for potentially important responses in household behavior. As noted by Gervais and Pandey (2008) and Poterba and Sinai (2011), among others, were the MID to be eliminated, households would sell financial assets such as stocks and bonds to pay down their mortgage debt, and the smaller holdings of these taxable assets would offset some of the revenue gains from taxing mortgage interest. Conventional estimates therefore overstate the increase in revenues associated with eliminating the MID. Conventional estimates also overstate the progressivity of eliminating the MID, because households with higher levels of non-residential assets would respond by selling their taxable, non-residential assets.

This paper builds on previous work that estimates the consequences of removing the MID using a framework that allows for the possibility of portfolio rebalancing. Unlike previous studies, we analyze data for several years—every third year from 1988 to 2012, inclusive. This reduces the likelihood that our estimates are due to the idiosyncrasies of some particular year, and allows us to investigate how and why the differences between estimates with and without a portfolio response have evolved over time. We then turn to the distributional implications of eliminating the MID, again looking at multiple years. A noteworthy feature of our distributional analyses is that we focus on both wealth and income as classifying variables.

Our main findings are: (i) The revenue loss associated with the MID is smaller if one allows for rebalancing, with the ratio of the rebalancing-adjusted revenue loss to the conventionally estimated revenue loss varying from 76 percent in 1997 to 90 percent in 2009. While not dramatic, these are non-trivial effects. (ii) During our sample period, changes in the ratio of the two revenue loss estimates were due primarily to changes in the relative stocks of assets to mortgage debt as opposed to changes in rates of return and the tax system. (iii) Portfolio rebalancing attenuates the increase in progressivity associated with elimination of the MID.

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1. Introduction

The mortgage interest deduction (MID) has been part of the U.S. tax system since the creation of the income tax in 1913. In its current incarnation, this provision allows an itemized deduction for any interest paid on mortgage debt of up to $1,000,000 for a main or second home, plus interest on up to $100,000 in home equity debt (that is, non-acquisition debt secured by the value of the home).

The MID has been the object of considerable criticism. The most fundamental critique stems from the observation that if the policy goal is to tax a comprehensive measure of income, then the tax base should include the net income generated by an owner-occupied home (Poterba and Sinai, 2008; Viard, 2013). Net income, in turn, is calculated as the imputed rental value of the house and the annual appreciation of its value minus the expenses of owning the home, which include mortgage interest payments. Under the status quo, imputed rent is not subject to taxation, but homeowners are nevertheless allowed to deduct mortgage interest. Hence, the current system in effect provides a subsidy to all imputed rent on owner-occupied homes, including the imputed rent on the mortgage-financed portion of the home.

A frequent justification for allowing mortgage interest to be deducted while exempting imputed rent is that it promotes the societal goal of homeownership. Thus, for example, Gary Thomas (2013), a former president of the National Association of Realtors observed,

> Americans remain committed to the principles of homeownership. … They continue to believe that ownership of real property is part of the American Dream that was envisioned from the very beginning by our Founders. … Congress should continue to support these same ideals as it seeks to reform the tax code.[1]

However, evidence that the current tax treatment substantially increases the incidence of homeownership is scant.[2] Moreover, some have argued that it is unclear whether the promotion of homeownership is a worthy public policy goal in the first place (Glaeser and Shapiro, 2003; Gale, Gruber, and Stephens-Davidowitz, 2007; Davis, 2012). Indeed, the favorable treatment of

[1] See also the Joint Committee on Taxation (1987, pp. 263–64) and Dietz (2013).
[2] See the papers surveyed in Gruber, Jensen, and Kleven (2017).

owner-occupied housing leads to lower tax rates on investments in housing than other assets, inducing overinvestment in housing (Brueckner, 2014).

While there has been little policy interest in taxing imputed rent, there have been proposals to limit the MID. Eliminating the MID while continuing to exempt imputed rent would withdraw the federal tax subsidy from the mortgage-financed portion of the house while retaining the subsidy for the homeowner's equity. Curbing or eliminating the MID can be viewed as a second-best way to address the distortion from the exemption of imputed rent.

There has been much discussion of the MID's effect on tax revenues and the distribution of the tax burden. According to the Joint Committee on Taxation (JCT, 2017), the MID will result in a loss of federal tax revenues of over $60 billion in 2017. It is widely believed that these tax benefits accrue disproportionately to high-income households because they have larger mortgages, because the value of the deduction increases with the household's marginal tax rate, and because the tax benefit only accrues to households that itemize their deductions (conditions that are more likely to occur for higher-income households). According to the JCT (2017), households whose incomes are less than $100,000 receive only 16 percent of the total tax benefit associated with the MID.

Conventional estimates of the size and distribution of the MID, such as those done by the Office of Management and Budget (OMB), fail to account for potentially important responses in household behavior. Because eliminating the MID while continuing to exempt imputed rent would eliminate the tax benefit for mortgage-financed owner-occupied housing but leave it intact for equity-financed owner-occupied housing, eliminating the MID would prompt households to sell financial assets such as stocks and bonds to pay down their mortgage debt, and the smaller holdings of these taxable assets would offset some of the revenue gains from taxing mortgage interest. (See Follain and Melamed (1998), Gervais and Pandey (2008), and Poterba and Sinai (2011).)[3] Conventional estimates therefore are likely to overestimate the increase in revenues associated with eliminating the MID. Similarly, conventional estimates overstate the progressivity of eliminating the MID, since households with higher levels of non-residential assets would respond by selling their taxable non-residential assets.

[3] These studies, as well as our own, largely ignore the endogeneity of the housing and mortgage holding decisions, and instead estimate the countervailing loss of tax revenue from households reducing their non-residential assets.

This paper builds on previous work that estimates the consequences of removing the MID within a framework that allows for the possibility of portfolio rebalancing. Unlike previous studies, instead of doing the calculations for a single year, we analyze data for several years—every third year from 1988 to 2012, inclusive. This allows us to investigate how and why the differences between estimates with and without a portfolio response have evolved over time. We then turn to the distributional implications of eliminating the MID, again looking at multiple years. A noteworthy feature of our distributional analyses is that we use both wealth and income as classifying variables. Examining the distributional implications by wealth class makes sense because people with low incomes can have substantial wealth (think of retirees). To the extent such wealth is held in owner-occupied housing, using income as the classifier could misleadingly suggest that the MID is progressive.

Section 2 discusses the public policy context and briefly reviews the previous literature. Section 3 describes the model and data used for our calculations. Sections 4 and 5 present the revenue estimates and distributional analyses, respectively. Our main findings are: (i) The reduction in revenues associated with the MID is smaller if one allows for rebalancing, and the ratio of the rebalancing-corrected revenue estimate to the conventional revenue estimate varies from year to year, ranging from 76 percent in 1997 to 90 percent in 2009. While not dramatic, these are non-trivial effects. (ii) During our sample period, changes in the ratio of the rebalancing to the conventional estimate were due primarily to changes in the relative stocks of assets and mortgage debt as opposed to changes in rates of return and the tax system. (iii) The benefits of the MID for high-income households depend on their wealth, but in general, portfolio rebalancing reduces the increase in progressivity associated with elimination of the MID. Section 6 provides a summary and some suggestions for future research.

2. The Policy Environment and Previous Literature

Most major tax reform proposals call for limiting the MID (see, for example, the President's Advisory Panel on Tax Reform, 2005; the National Commission on Fiscal Responsibility and Reform, 2010; and the Dominici-Rivlin Debt Reduction Task Force, 2010). Such proposals include mixtures of eliminating the eligibility of second homes and home equity lines of credit, lowering the cap on eligible mortgages from $1,000,000, and converting the MID to a refundable or non-refundable tax credit.

As noted above, the revenue and distributional impacts of eliminating the MID depend on how households respond, in particular, in the way they rebalance their overall portfolio holdings. In their analyses of the MID, Follain and Dunsky (1997) estimate reduced-form models of the demand for mortgage debt as a function of the tax price of mortgage debt, and Follain and Melamed (1998) embed their estimated elasticities into a simulation model to assess the impact of removing the MID.

Gale, Gruber, and Stephens-Davidowitz (2007) use the Tax Policy Center's microsimulation model with administrative tax return data to make static and dynamic revenue loss estimates for the MID. Due to limitations in the data, their dynamic estimate makes two strong assumptions, both of which imply taxpayers do a tremendous amount of tax avoidance in response to MID repeal. First, they assume taxpayers would use their taxable financial income to pay off enough mortgage debt to reduce mortgage interest payments to as close to zero as possible. Second, they assume taxpayers would sell assets in order from highest tax burden to lowest tax burden. Implicit in these assumptions is that all taxable financial assets have the same rate of return and that it is equal to the mortgage interest rate. Their dynamic estimate for the revenue gain from repealing the MID is roughly 84 percent of the conventional revenue estimate for 2006.[4]

Gervais and Pandey (2008) take an alternative approach, using microdata on non-residential asset portfolios, tax rates, and mortgage holdings to simulate how different assumptions about the extent of portfolio rebalancing would impact the revenue effects of eliminating the MID for 1997. They use the National Bureau of Economic Research's TAXSIM model to compute federal revenue estimates, employing data from the Federal Reserve Board's Survey of Consumer Finances (SCF), which contains detailed information on households' incomes and balance sheets (Moore, 2003).[5] They then make assumptions about which assets households might sell should mortgage interest no longer be deductible. The advantages of this approach are that it is transparent, it obviates the need to impute assets and liabilities, and it does not require estimates of the elasticity of demand for mortgage debt, a parameter that would be

[4] Toder et al. (2010) also use the Tax Policy Center's microsimulation model with administrative tax return data. Their dynamic revenue estimate is roughly 87 percent of the conventional revenue estimate for 2010.

[5] Ideally, one would like to know the exact amount of revenues generated by each component of households' balance sheets. Because the SCF does not provide such information directly, Gervais and Pandey (2008) specify a set of assets that are assumed to generate income at a common interest rate, while others generate tax-free revenues.

difficult to estimate in a compelling manner. According to their preferred estimate, which assumes households completely pay off their mortgages to the extent possible, the cost of the MID is only 58 percent of the conventional estimate for 1997. Relatedly, their estimates suggest that high-income households do not benefit as much from the MID as suggested by conventional estimates.

Like Gervais and Pandey, Poterba and Sinai (2011) employ the TAXSIM model and SCF data (for 2003). They use a less restrictive setup, allowing each class of assets to have its own rate of return rather than constraining all the rates of return to be the same. In their simulations, households respond to the elimination of the MID by paying down their assets in a specific order, from lowest to highest return. Like Gervais and Pandey, Poterba and Sinai assume that households would use all their available assets to pay down their mortgages.[6] According to their preferred specification, the cost of the MID is roughly 81 percent of the conventional estimate for 2003.

Poterba and Sinai note that some households appear to hold assets with expected after-tax returns below their after-tax mortgage interest cost, implying they might be unwilling to liquidate them if the MID were eliminated. They therefore do an alternative calculation that assumes households would only sell financial assets with after-tax returns that are between the before-tax and after-tax mortgage interest rate. Under this assumption, they find the cost of the MID to be roughly 88 percent of the conventional estimate for 2003, somewhat higher than the calculation that assumes all assets are used for paying down the mortgage.

The papers discussed thus far all posit that households would sell assets in response to the elimination of the MID, which raises the larger question of whether it is reasonable to assume any such portfolio rebalancing would actually occur. Some suggestive empirical evidence is provided by Maki (1996), who analyzes the response of households to the provision in the Tax Reform Act of 1986 that phased out the deductibility of interest paid on all consumer debt. He finds that the policy goals of the provision were frustrated because households shuffled their portfolios, substituting mortgage debt for consumer debt. Maki's (2001) calculations indicate that the phase-out of the deductibility of consumer debt after the 1986 act resulted in significant

[6] That is, households do not take into account after-tax returns on the various assets and how they compare to the mortgage interest rate.

portfolio rebalancing. High-income homeowners reduced the amount of interest they paid on consumer debt and increased their interest payments on mortgage debt relative to other homeowners. In contrast, high-income renters, who lacked access to home equity borrowing, did not reduce their consumer interest paid relative to other renters.

Consumer behavior in other contexts appears inconsistent with the assumption that households would rebalance their portfolios should the MID be eliminated. For example, many households hold sizeable amounts of low-return liquid assets while also carrying high-interest credit card debt, failing to liquidate the former to pay down the latter. Telyukova (2013) suggests an explanation for this so-called "credit card debt puzzle," arguing that households accumulate credit card debt rather than using bank account balances to pay it off because they anticipate needing that money in situations where credit cards cannot be used. That is, the unpredictable nature of cash needs may warrant holding large liquid balances for precautionary reasons.

Nevertheless, given that there is at least some evidence that the kind of portfolio rebalancing envisioned in the recent academic literature is plausible, we adopt this approach in our simulations below. Our data set provides the relevant information for every third year from 1988 to 2012, and for each of these years we calculate the difference between the revenue gains from eliminating the MID with and without portfolio rebalancing. Examining the MID across multiple years allows us to assess the extent to which there are differential changes over time, and if there are, whether these changes are driven by changes in the tax regime, holdings of assets and mortgage debt, or the interest rate environment. The latter is of particular relevance, given that ours is the first study to examine the MID in the low-rate environment that has existed since the Great Recession.

3. Data and Methods

Following Gervais and Pandey (2008) and Poterba and Sinai (2011), we use the TAXSIM model in our calculations of tax liability. The underlying data are from the Survey of Consumer Finances, a triennial, cross-sectional survey of roughly 4,500 U.S. families, sponsored by the Federal Reserve Board. The data set is constructed by the Federal Reserve Board, for every third

year from 1988 to 2012.[7] The SCF includes detailed balance sheet information, including assets such as bank accounts, retirement accounts, mutual funds, stocks, and bonds; and liabilities such as mortgages and various personal loans. In addition to balance sheet information, the SCF reports data on household demographic characteristics and income. The data set also includes sample weights for aggregating results to the national level (Kennickell and Woodburn, 1999).

SCF data are self-reported. Some households in the SCF report they itemize even though their tax liabilities would be lower if they took the standard deduction; conversely, other households report they do not itemize when the data suggest they would be better off doing so. Our simulations assume that households choose the optimal strategy. Additionally, married fillers are assumed to file jointly.[8] Table 1 provides summary statistics for several of the variables in our data set.

Our simulations require assumptions about which specific assets households would sell to pay down mortgage debt if the MID were eliminated. Following Gervais and Pandey (2008) and Poterba and Sinai (2011), we assume that if households could not deduct mortgage interest, they would sell their taxable assets to the extent that the after-tax return was lower than the (non–tax deductible) mortgage interest rate. More precisely, if r_i is the rate of return on taxable asset i and s_i is the amount of the asset sold, then the decrease in tax revenue is $r_i \times s_i \times t$, where t is a household's (combined state and federal) marginal tax rate.[9] Following Poterba and Sinai (2011) (and unlike Gervais and Pandey), we allow returns to vary across asset classes by linking the different asset classes in the SCF to historical data on rates of return. Appendix C provides details about how interest rates were assigned to the various asset classes. Of course, other

[7] See Moore (2003). Note that the SCF asks about the prior year's finances, thus, for example, the 2013 SCF corresponds to calendar year 2012. TAXSIM and the SCF data are available on the National Bureau of Economic Research's website (see Appendix C for a description of the model and data). Our TAXSIM estimates are quite close to those of the JCT and the OMB. For example, our conventional estimate for 2003 (in 2003 dollars) shows a revenue loss of $58.6 billion associated with the MID, while the JCT's (2002) estimate is $69.9 billion, and the OMB's (2004) estimate is $61.2 billion (both for fiscal year 2003). Poterba and Sinai's (2011) estimate is $63.0 billion (for calendar year 2003).

[8] Unlike Poterba and Sinai (2011), we do not exclude any observations. They exclude observations corresponding to households that live on a farm or a ranch or in a mobile home, households headed by someone under age 25, observations that report having mortgages but pay no mortgage interest, observations with loan-to-value ratios above 1.5, and observations with inexplicably high estimated marginal tax rates. Excluding observations using these criteria does not significantly change our results.

[9] When households sell their holdings of stock, then presumably the new owners of the stock will pay taxes on the returns generated by the stock. We do not know the marginal tax rates of the new owners, or indeed whether they are even taxable units. Hence, like Poterba and Sinai (2011) and Gervais and Pandey (2008), we ignore these effects.

variables such as risk, liquidity, and maturity also influence portfolio decisions. Indeed, a recent article in the *Wall Street Journal* specifically recommended that households take risk and liquidity considerations into account when deciding whether to pay down their mortgages (McGinty, 2017). For simplicity, our model focuses only on after-tax rates of return.

When households sell equities, tax revenues fall not only because dividends decrease, but also because realized capital gains fall. In the absence of data on realizations by household, we follow Poterba and Sinai (2011), and assume that a given proportion of stocks and mutual funds are sold each year, so that when these assets are used to pay down a mortgage, the government loses the associated capital gains tax revenue. This calculation requires an assumption about the appreciation rate for stocks and the frequency with which capital gains are realized. We assume stocks appreciate at a rate of 10 percent per year, which is roughly equivalent to the mean growth rate of the S&P 500 from 1988 to 2012. Following Poterba and Ramírez Verdugo (2011), for directly held stock we assume a quarter of gains are realized, and for stock mutual funds we assume half of gains are realized. Also following Poterba and Ramírez Verdugo (2011), we assume a 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, described by Poterba (1987).[10]

Also like Gervais and Pandey (2008) and Poterba and Sinai (2011), we assume that before-tax rates of return would remain unchanged if the MID were eliminated. In long-run equilibrium, this would not be the case. To see why, recall that eliminating the MID would induce households to shift away from taxable assets. This would lead to an increase in the rate of return on such assets and a decrease in mortgage rates until their after-tax returns (again, adjusting for risk, liquidity, term length, and other characteristics) were equal. Indeed, because eliminating the MID would change the user cost of housing,[11] it would eventually induce changes in housing decisions and the broader real estate market. In effect, then, our analysis does not take into account long-run general equilibrium effects in the financial and housing markets. This assumption is entirely reasonable in the context of annual revenue estimation.

[10] We do not include in our estimate the increase in capital gains revenue that would result when households sell assets to pay down their mortgage, since this is a one-time transitional effect. Using the 2013 SCF, we calculate that this one-time increase in tax revenue would be roughly $30 billion. This is calculated using respondents' answers to the SCF question, "Overall, has there been a gain or loss in the value of all of your family's stock since you obtained it?" to which the respondent gives the dollar amount. (The SCF asks the same question for mutual funds.)

[11] Poterba and Sinai (2011) provide estimates of the impact of eliminating the MID on the user cost of housing.

Following the nomenclature of Poterba and Sinai, we group the items on a household's balance sheet into four classes, described in Table 2. *Financial assets* include (i) certificates of deposit (CDs), (ii) stocks, (iii) bonds, (iv) mutual funds, (v) checking accounts, (vi) savings accounts, (vii) money market accounts, and (viii) brokerage call accounts. The subset of items (i) through (iv) are the *non-transaction financial assets*. Items (v) through (viii) are relatively more liquid than items (i) through (iv), so it is therefore plausible that households would retain these liquid assets to use for other purposes, such as smoothing income shocks or paying household bills. As noted above, some households maintain substantial amounts of low-yielding liquid assets while simultaneously holding substantial credit card debt (Agarwal et al., 2015; Telyukova, 2013; Gross and Souleles, 2002). A likely reason is that the unpredictable nature of cash needs may warrant holding large liquid balances for precautionary reasons, in addition to holding money for predictable cash expenses. We therefore exclude the most liquid assets from our preferred specification, and include only the relatively liquid non-transaction financial assets, although the estimates are similar when we include all the financial assets.[12]

In addition to the two classes of assets described above, Poterba and Sinai (2011) consider even broader sets of assets as potential sources for paying down mortgage debt. *Non-housing, non-retirement assets* include items (i) through (viii), plus (ix) vehicles, (x) real estate, (xi) business interests, and (xii) other financial or non-financial assets. *All non-housing assets* include items (i) through (xii), plus (xiii) retirement accounts, (xiv) the cash value of life insurance, and (xv) other managed assets, such as trusts and annuities. There is no direct evidence on which classes of assets would be sold to pay down mortgage debt absent the MID. The answer would depend in part on the time frame of the analysis. Some evidence suggests that these broader categories of assets would probably not be used to pay down mortgages in response to the elimination of the MID. For example, Poterba, Venti, and Wise (1996) find no evidence that households with more rapid growth of retirement assets also incur more mortgage debt. Amromin, Huang, and Sialm (2007) find that roughly one-third of households that prepay their mortgages could have increased their after-tax net worth by instead contributing to a tax-qualified retirement plan. In addition, evidence from Agarwal et al. (2015) and Telyukova (2013) suggests that many households do not sell even *liquid* assets to pay off credit card debt, so it

[12] The results using the full set of financial assets differ by no more than $1.9 billion, except in 2006, where the difference is $3.9 billion.

seems a stretch to assume they would use *illiquid* asset to pay off a mortgage balance. All of these findings suggest that households would be reluctant to use such assets as vehicles, retirement accounts, or life insurance to pay down the balance of a mortgage. Thus, we do not consider these assets in our calculations.[13]

The calculations in Table 3 provide a sense of the scope of portfolio rebalancing. The table shows, for each quintile of the income distribution in 2012, the average value of non-transactional financial assets, the average value of financial assets, average mortgage debt, and the proportion of households that have enough non-transaction financial assets to fully pay down their mortgages. The calculations show that, unsurprisingly, wealth tends to increase with income, as does the value of one's mortgage. The top income quintile has, on average, roughly an order of magnitude more wealth than the fourth quintile, despite having only about twice the amount of mortgage debt. Consequently, roughly three times as many households in the top income quintile than in the fourth quintile would be able to fully pay down their mortgages.

Another data issue relates to the computation of marginal tax rates. Most states levy income taxes, and the rates vary across states. Given that state income taxes are deductible (for itemizers) on federal income tax returns, these state taxes affect federal tax revenues. In order to maintain confidentiality, the SCF data do not provide taxpayers' state of residence. Given this limitation, we follow Poterba and Sinai (2011) and randomly assign states to the households in our data based on their populations. (See Appendix B for details.)

4. Revenue Effects of the Mortgage Interest Deduction

Figure 1 plots our revenue estimates for repealing the MID for every third year from 1988 to 2012, both under the conventional method, which assumes no portfolio response, and under the assumption that households would sell all available non-transaction financial assets to

[13] Estimates that do include such assets would provide an upper bound for the potential revenue effects of portfolio rebalancing. Poterba and Sinai's (2011) revenue estimate using non-transaction financial assets is 80 percent of the conventional estimate; for all financial assets, 81 percent; for non-retirement, non-housing assets, 46 percent; and for all non-housing assets, 44 percent. Gervais and Pandey's (2008) conservative measure using non-liquid taxable financial assets is 66 percent of the conventional estimate; their preferred measure using non-liquid taxable financial assets, non-residential real estate assets, and other non-financial assets is 58 percent of the conventional estimate; and their inclusive measure using all non-housing assets other than vehicles and retirement assets is 36 percent of the conventional estimate.

pay down their mortgages.[14] Clearly, the revenue estimates assuming portfolio rebalancing are lower than the conventional estimates, and the differences are substantial, ranging from $8.0 billion in 2009 (conventional revenue loss of $77.4 billion versus rebalancing revenue loss of $69.4 billion) to $18.4 billion in 2000 (conventional revenue loss of $86.7 billion versus rebalancing revenue loss of $68.3 billion).[15]

Figure 2 reconfigures the data from Figure 1 to show the ratio of the rebalancing estimate to the conventional estimate. This ratio varies from year to year, ranging from 76 percent in 1997 to 90 percent in 2009, suggesting that it can be misleading to make inferences about the potential importance of portfolio rebalancing based on calculations from a single year.

The differences over time depicted in Figure 2 could reflect either a change in households' ability to rebalance their assets (say, due to changes in their holdings) or a change in the benefit from rebalancing (say, due to a change in the tax regime or in rates of returns on assets and mortgage interest rates). Both possibilities seem potentially important. In particular, tax rates and other provisions of the federal income tax changed considerably during the years covered in our analysis,[16] as did the interest rate environment. In 1988, there were two statutory income tax brackets, with marginal tax rates of 15 and 28 percent; by 2012, there were seven tax brackets, with a top marginal tax rate of 39.6 percent. During our sample period, interest rates experienced a great deal of change as well. From 1988 to 2012, the nominal federal funds rate declined from about 9 percent to near zero. In 1988, the average interest rate on a 30-year, fixed-rate mortgage was about 10 percent; in 2012, it was about 4 percent. Household balance sheets also changed significantly. Using the SCF, we calculate that average outstanding residential mortgage debt (in 2015 dollars) rose from roughly $92,000 per household in 1988 to roughly $163,000 per household in 2012, a 78 percent increase; average financial asset wealth rose from roughly $64,000 per household in 1988 to roughly $116,000 per household in 2012, an 81 percent increase.

[14] Our rebalancing estimates assume households do not take into account after-tax returns on the various assets and how they compare to the mortgage interest rate.
[15] All dollar values are expressed in 2015 dollars, using the CPI to adjust for inflation.
[16] Tax regimes in place over our sample include the Tax Reform Act of 1986, the Omnibus Budget Reconciliation Acts of 1990 and 1993, the Economic Growth and Tax Relief Reconciliation Act of 2001, the Jobs and Growth Tax Relief Reconciliation Act of 2003, and the American Taxpayer Relief Act of 2012.

To get a sense of the relative importance of these factors, Figure 3 decomposes the changes in Figure 2 by estimating how the proportion would have changed holding various factors fixed at their 1988 levels. The line marked (1) (yellow with short dashes) shows what the ratio of the rebalancing revenue estimate to the conventional revenue estimate would have been if the main features of the 1988 environment had persisted throughout the sample period. Specifically, for each year we compute the revenue estimates, holding taxes, assets and liabilities (including mortgage debt), and mortgage and asset interest rates fixed at their 1988 levels.[17] The line is not horizontal because we do not hold all variables fixed.[18] Tax deductions and liabilities other than mortgages, for example, changed during our sample period, both of which would change the rebalancing and conventional estimates.

Line (2) (green with longer dashes) holds taxes, asset stocks, and mortgage stocks fixed at their 1988 levels, but lets the interest rates on assets and mortgages vary at their actual levels. Line (3) (blue with long dashes) holds just taxes fixed; that is, stocks of assets and liabilities now take their actual values, as do interest rates on assets and mortgages. Finally, line (4) (solid red line) is the actual regime (that is, a reproduction of Figure 2).

Perhaps the most salient feature of Figure 3 is the gap between line (1) and line (4) that opens up in 1997, and the biggest component of this gap is between line (2) and line (3). To interpret this finding,[19] recall that the only difference between lines (1) and (2) is that in the latter, asset rates of return and mortgage rates are at their actual levels, not fixed at 1988 levels. Thus, lines (1) and (2) remaining relatively close to each other indicates that changes in the rates of return on assets relative to mortgage interest rates are *not* the main reason for the 1997 decrease in the ratio of the rebalancing revenue estimate to the conventional revenue estimate. Rather, the principle factor is the difference between line (2) and line (3). Recall that the only

[17] Taxes are held fixed by assuming that the 1988 tax regime and 1988 level of income are held constant. A complication arises when it comes to holding mortgage rates fixed over time, because each household has its own rate, and the composition of the sample changes over time. To deal with this problem, we compute for every year the average mortgage rate across households and the ratio of this rate to the average in the base year (1988). We then scale each household's mortgage rate by this ratio so that the average rate is the same as in 1988. For example, suppose that in year *t* the average rate is twice the average rate in 1988. The mortgage rate of each household in year *t* would be divided by 2, so that, on average, the mortgage rates in years *t* and 1988 would be the same. This same scaling procedure is applied to household income, stocks of assets, and mortgage debt. Because historical data are used for the returns on assets, no scaling procedure is needed to hold the returns on assets fixed.

[18] Indeed, because the SCF is not a panel data set that follows the same households over time, it would not be possible to hold all variables fixed.

[19] See Appendix A for an algebraic interpretation of the gaps among the various lines in Figure 3.

difference between these lines is that the former holds the ratio of assets to mortgage holdings constant at the 1988 level. Line (3) being below line (2) in 1997 therefore suggests that the ratio of assets (which determine the revenue loss associated with portfolio rebalancing) to mortgage holdings (which determine the revenue gain from eliminating mortgage deductibility) was higher in 1997 than in 1988. In short, while year-to-year changes in taxes (represented by the difference between lines (3) and (4)) as well as relative rates of return (represented by the difference between lines (1) and (2)) play some role, the main reason for the increase in the importance of rebalancing during the late 1990s and early 2000s was an increase in the stock of taxable assets relative to mortgage debt.[20] Figure 3 also shows that the ratio of rebalancing and conventional estimates rose from 1997 to 2009, before dropping sharply from 2009 to 2012. Apparently, then, the Great Recession did not have a discernible immediate impact on the effect of portfolio rebalancing on revenue estimates of eliminating the MID.

5. Distributional Implications of the Mortgage Interest Deduction

We now turn to the impact of the MID on the distribution of the tax burden. As noted above, the conventional belief is that mortgage interest deductibility is regressive because the probability of being a homeowner and the size of the mortgage conditional on owning a home both tend to increase with income. Furthermore, the tax benefit of the MID only accrues to households that itemize their deductions, and higher-income households are more likely to itemize. For example, Gale, Gruber, and Stephens-Davidowitz's (2007) calculations suggest that the households in the lowest 80 percent of the distribution obtain less than 20 percent of the benefits of the MID.

However, just as was the case for the revenue estimates, portfolio rebalancing could affect the distributional impact of the MID. Because high-income individuals tend to have more overall wealth than do their lower-income counterparts, they would have the greatest capacity to respond to a repeal of the MID by reducing their holdings of taxable assets to pay down their mortgages. To the extent this happened, the goal of enhancing progressivity would be undermined. Put another way, both income and wealth come into play when assessing the distributional consequences of the MID. Income matters because of its impact on marginal tax

[20] For example, in 1997 the mean wealth-to-mortgage ratio for each household (excluding the top and bottom deciles) was 0.271, while in 1988 the ratio was lower, at 0.199.

rates, inter alia. However, imagine two households that have identical high taxable incomes and identical mortgages, but one household has a lot of wealth and the other has little. Under a conventional approach, the change in liabilities associated with eliminating the MID would be the same. But in the presence of rebalancing, the burden on the low-wealth household will be greater, because it has less ability to pay down its mortgage.

Table 4 provides a numerical example using the 2013 SCF to illustrate this point. The first row shows the mean conventional estimate and the mean rebalancing estimate for households that are in both the 9th income decile and the 9th wealth decile. The mean conventional estimate exceeds the mean rebalancing estimate by $201, or about 16 percent of the mean conventional estimate. The second row shows the mean conventional estimate and the mean rebalancing estimate for households that are in both the 9th income decile but only the 2nd wealth decile. The mean value of assets for such households is $520, an amount so low that portfolio rebalancing does not produce a meaningful change in tax liability. Hence, there is no difference between the mean conventional and the mean rebalancing estimates—low wealth households are harmed more by the elimination of the MID.

Given that older households tend to have more accumulated wealth than do younger households, this suggests that the removal of the MID might disproportionally affect younger households more than older households. While it would take us too far afield to discuss systematically the impact by age groups, it is interesting to note that, as conventional life-cycle considerations would suggest, the ratio of wealth to income tends to be much higher for older households than younger households.[21] Using the 2013 SCF, for example, we calculate that the average ratio of wealth to income for households age 30–35 is 0.23, while for those age 55–60 it is 0.95, nearly four times larger. Hence, for any given income, older households generally have a greater ability to pay down their mortgages than do younger households, so the burden associated with the removal of the MID would be greater for younger households, ceteris paribus.

Given the importance of wealth in understanding the distributional implications of eliminating the MID subject to rebalancing, we present results using both income and wealth to

[21] For econometric documentation of this point, see King and Dicks-Mireaux (1982) and Jianakoplos, Menchik, and Irvine (1989).

classify households. Figure 4 shows the distribution of the MID (in 2015 dollars) over time by quintiles of federal taxable income, for both the conventional estimate (left panel) and for the rebalancing estimate (right panel). Note that in each panel, in order to include all the information in a single legible diagram, the heights of the bars for the lower four quintiles are measured on the left axis, while the height of the line for the top quintile is measured on the right axis. The panels show that high-income households benefit vastly more from the MID than lower-income households, in dollar terms. It also suggests that the MID's regressivity is mildly attenuated when accounting for portfolio rebalancing.

Figure 5 shows the distribution of the MID over time by quintiles of wealth, again for both the conventional and the rebalancing estimates. (Figures 4 and 5 are shown on the same scale.) In contrast to Figure 4, accounting for rebalancing substantially reduces the regressivity of the MID, with households in the highest quintile of wealth accruing only a slightly higher dollar value from the MID compared to households in the next highest quintile. Indeed, while not reported here for brevity, households in the highest wealth quintile consistently receive a smaller benefit of the MID as a proportion of their tax liability than households in most of the lower quintiles. It is the middle wealth quintiles that generally receive the highest benefit from the MID as a proportion of their tax liabilities.

6. Conclusions

Using data from multiple years, we show that the effects of portfolio rebalancing on the revenue and distributional implications of eliminating the MID are not constant over time. The ratio of the rebalancing-adjusted estimate to the conventional estimate ranges from 76 percent to 90 percent between 1988 and 2012. Our analysis indicates that changes over time in the ratio of the rebalancing-adjusted estimate to the conventional estimate were due primarily to changes in the relative stocks of assets to mortgage debt, as opposed to changes in rates of return and the tax system, and that in general, portfolio rebalancing attenuates the increase in progressivity associated with elimination of the MID.

Eliminating the MID would reduce distortions arising from the failure to tax imputed rent, effectively withdrawing the tax exemption for mortgage-financed owner-occupied housing while leaving it intact for equity-financed owner-occupied housing. In the public policy arena,

though, most of the concern about the MID is its effect on tax revenues and the distribution of the tax burden. Proponents of eliminating the MID view it as an opportunity to raise a good deal of tax revenue and to enhance the progressivity of the personal income tax. However, failure to take into account the portfolio rebalancing activity that would be induced by the elimination of the MID leads to overestimates of the magnitude of these benefits.

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Table 1. Descriptive Statistics, 1988–2012

Year	Taxpayers (millions)	Mortgage holders (millions)	Mean income	Mean wealth	Mean mortgage	Median home price	Mean mortgage interest rate	Percent for which $1M cap is binding
1988	93.0	34.7	$116,131	$64,252	$91,764	$231,584	9.667%	0.01%
1991	95.9	36.9	$118,151	$64,346	$98,874	$205,615	9.077%	0.03%
1994	99.0	39.1	$108,509	$63,571	$104,767	$208,206	8.234%	0.03%
1997	102.5	42.3	$113,992	$108,293	$116,505	$220,547	7.944%	0.07%
2000	106.5	45.1	$134,802	$136,653	$128,634	$233,840	7.590%	0.04%
2003	112.1	50.4	$118,365	$113,639	$159,328	$278,884	6.187%	0.17%
2006	116.1	52.7	$125,423	$122,838	$178,499	$286,222	6.320%	0.52%
2009	117.6	52.5	$111,446	$109,752	$169,342	$239,222	5.711%	0.72%
2012	122.5	50.2	$116,526	$115,707	$163,134	$272,902	4.762%	0.55%

Sources: SCF; authors' calculations; U.S. Census Bureau (https://www.census.gov/construction/nrs/pdf/uspriceann.pdf).

Notes: Dollar values are expressed in 2015 dollars. All columns except the number of taxpayers and the median home price are calculated over the sample of households in the SCF who report having a positive mortgage balance. Median home price is from the U.S. Census Bureau. Income includes wages, dividends, interest, taxable pension income, gross Social Security benefits, non-taxable transfer income, unemployment insurance, and realized capital gains. Wealth includes CDs, mutual funds, bonds, stocks, checking accounts, savings accounts, money market mutual funds, and brokerage call accounts. Mortgages include first and second mortgages. The mean mortgage interest rate is for first mortgages only. The final column shows the percent of homeowners whose first and second mortgages together exceed than $1 million.

Table 2. Assets Available for Rebalancing

	Asset	Asset class	Used for rebalancing
(i)	Certificates of deposit	Non-transaction financial assets	Yes
(ii)	Stocks	Non-transaction financial assets	Yes
(iii)	Bonds	Non-transaction financial assets	Yes
(iv)	Mutual funds	Non-transaction financial assets	Yes
(v)	Checking accounts	Financial assets	No
(vi)	Savings accounts	Financial assets	No
(vii)	Money market accounts	Financial assets	No
(viii)	Brokerage call accounts	Financial assets	No
(ix)	Vehicles	Non-housing, non-retirement assets	No
(x)	Real estate	Non-housing, non-retirement assets	No
(xi)	Business interests	Non-housing, non-retirement assets	No
(xii)	Other financial or non-financial assets	Non-housing, non-retirement assets	No
(xiii)	Retirement accounts	All non-housing assets	No
(xiv)	Life insurance policies	All non-housing assets	No
(xv)	Other managed assets	All non-housing assets	No

Source: SCF.

Table 3. Descriptive Statistics by Income Quintile, 2012

Income quintile	Income range	Mean value of non-transaction financial assets	Mean value of financial assets	Mean mortgage value	Percent that can fully pay down mortgage
Bottom	$0 to $19,999	$4,719	$10,151	$71,342	0.9%
Second	$20,000 to $34,999	$4,893	$11,392	$84,510	1.1%
Third	$35,000 to $59,999	$10,615	$19,857	$105,064	3.2%
Fourth	$60,000 to $99,999	$22,904	$39,372	$134,957	4.1%
Top	$100,000 to $135 mil.	$204,466	$286,346	$257,300	14.6%

Source: SCF; authors' calculations.

Notes: Dollar values are expressed in 2015 dollars. The sample is restricted to households in the 2013 SCF who report having a positive mortgage balance. Mortgage value includes first and second mortgages. The final column compares households' non-transaction financial assets to the lesser of their mortgage value or $1 million. See the notes to Table 1 for the definition of income. See Table 2 for the definitions of non-transaction financial assets and financial assets.

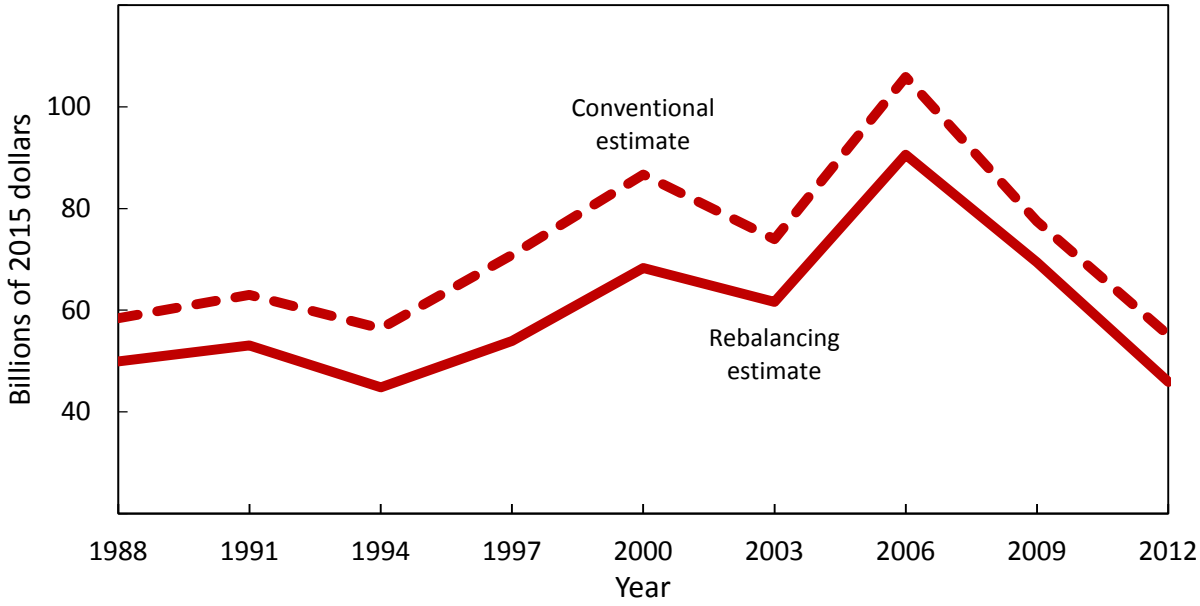
Table 4. The Mean Benefit of the MID for High-Income/High-Wealth Households and High-Income/Low-Wealth Households, 2012

	Conventional	Rebalancing	Difference	Mortgage	Assets
High income, high wealth	$1,247	$1,046	$201	$233,504	$88,508
High income, low wealth	$1,209	$1,209	$0	$180,175	$520

Sources: SCF; Bloomberg; FRED; authors' calculations.

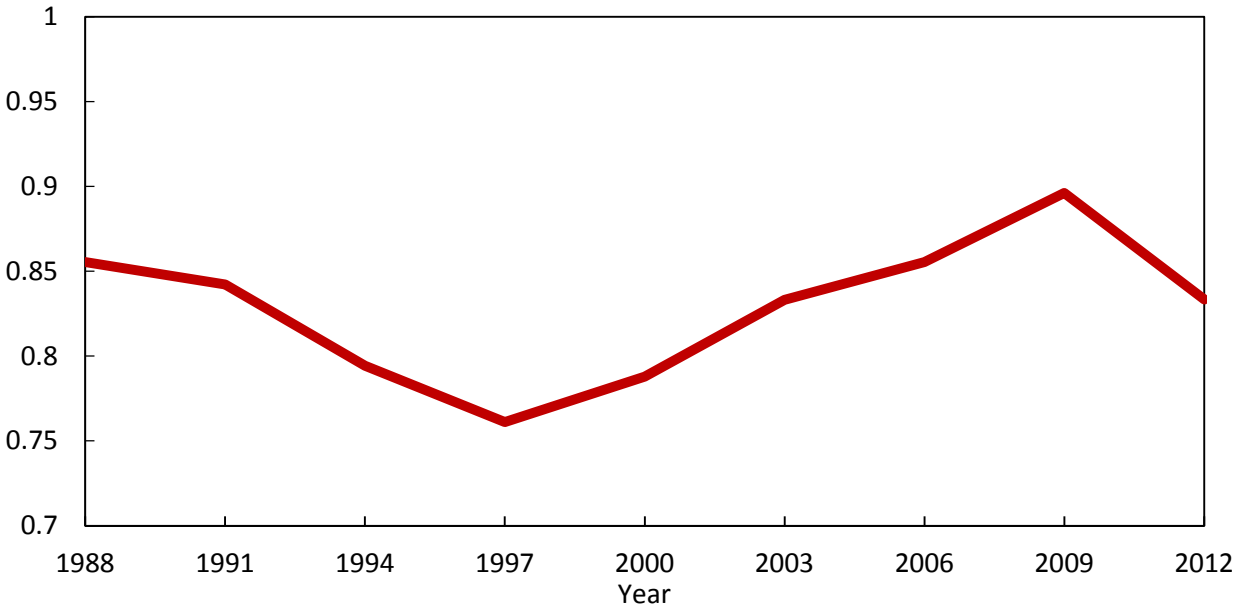
Notes: All values are expressed in 2015 dollars. The sample is restricted to households in the 2013 SCF who report having a positive mortgage balance. The first row shows mean values for households that are in both the 9th income decile and the 9th wealth decile. The second row shows mean values for households that are in both the 9th income decile and the 2nd wealth decile. See the notes to Table 1 for the definitions of income and wealth.

Figure 1. Conventional and Rebalancing Estimates of the Revenue Cost of the MID



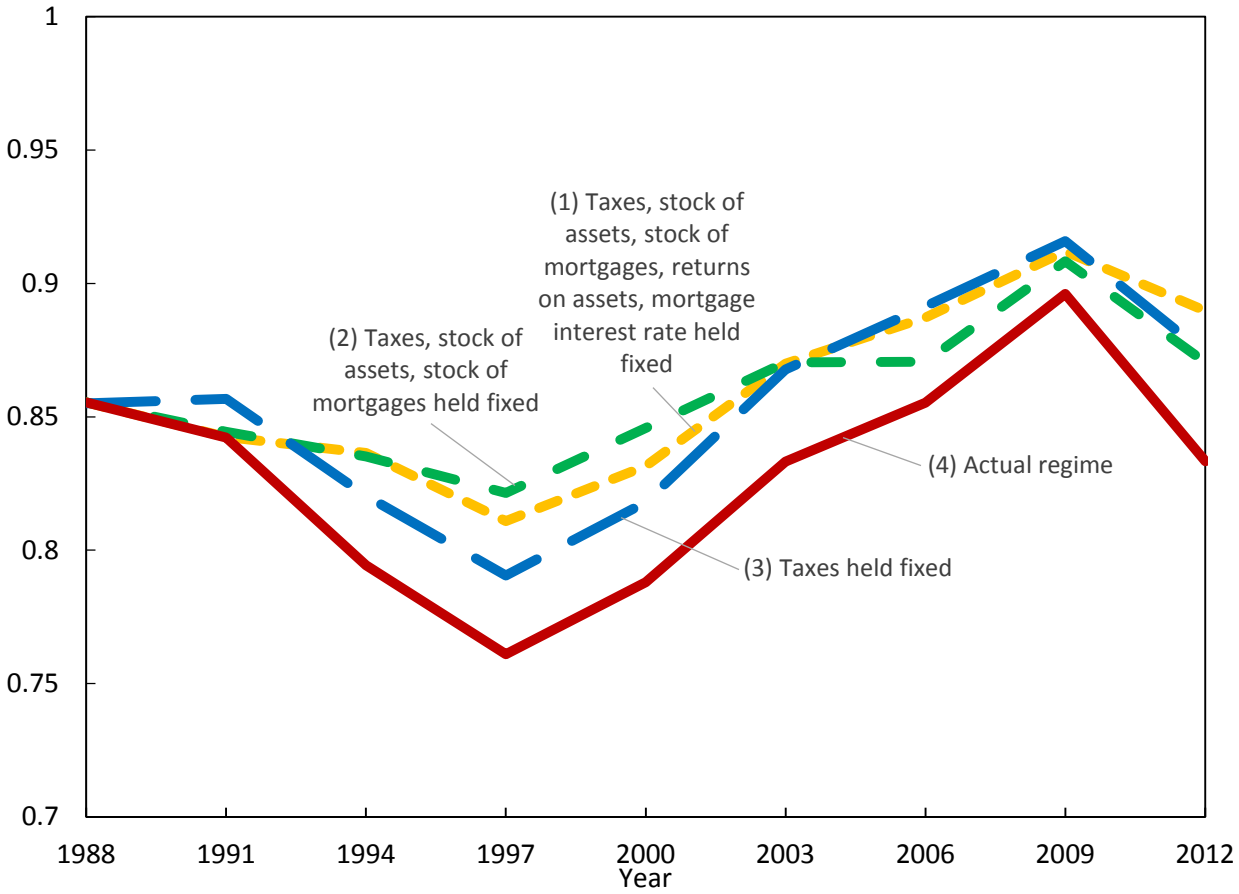
Sources: SCF; Bloomberg; FRED; authors' calculations.
Notes: The conventional estimate assumes there would be no portfolio rebalancing if the MID were eliminated. The rebalancing estimate assumes that households would sell all available non-transaction financial assets to pay down their outstanding mortgage.

Figure 2. Ratio of Rebalancing to Conventional Estimate of the Revenue Cost of the MID



Sources: SCF; Bloomberg; FRED; authors' calculations.
Notes: The conventional estimate assumes there would be no portfolio rebalancing if the MID were eliminated. The rebalancing estimate assumes that households would sell all available non-transaction financial assets to pay down their outstanding mortgage.

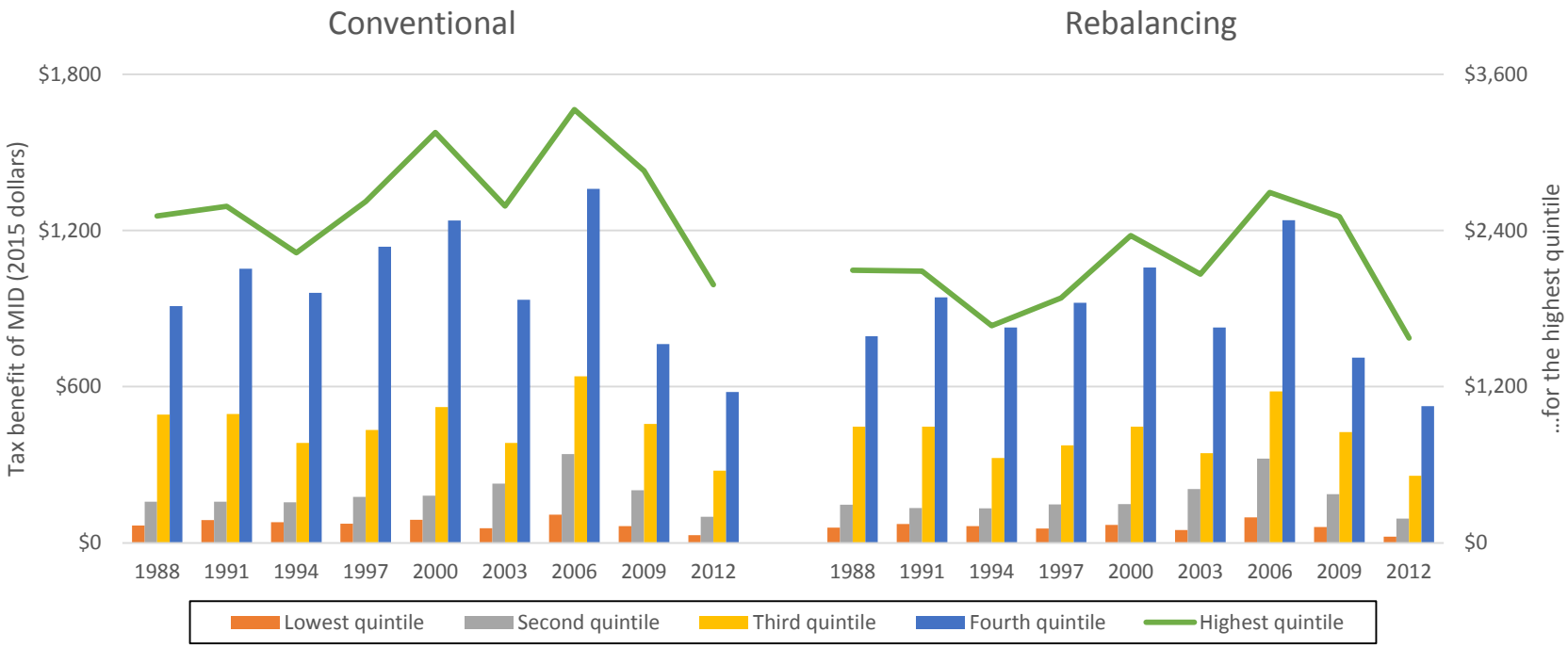
Figure 3. Decomposing the Ratio of Rebalancing to Conventional Estimate of the Revenue Cost of the MID



Sources: SCF; Bloomberg; FRED; authors' calculations.

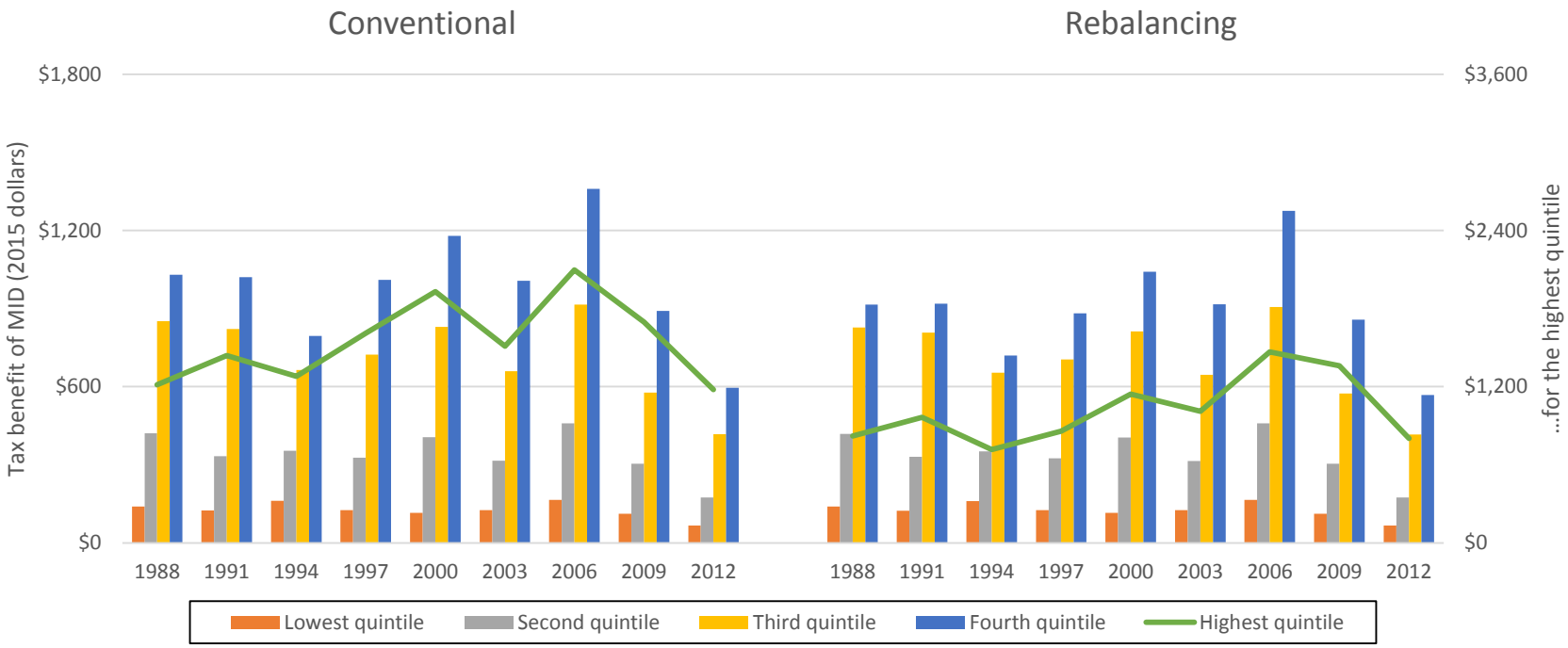
Notes: The conventional estimate assumes there would be no portfolio rebalancing if the MID were eliminated. The rebalancing estimate assumes that households would sell all available non-transaction financial assets to pay down their outstanding mortgage. The line marked (1) holds the 1988 tax regime fixed, and scales incomes, assets, mortgage debt, and mortgage interest rates so that the means across households are equal to their respective means in 1988. The returns on assets are fixed at their 1988 levels, based on historical data. The line marked (2) holds the 1988 tax regime fixed, and scales incomes, assets, and mortgage debt so that the means across households are equal to their respective means in 1988. The line marked (3) holds the 1988 tax regime fixed, and scales incomes so that the mean across households is equal to the 1988 mean. The line marked (4) is a reproduction of Figure 2, which shows each year's actual ratio of the rebalancing estimate to the conventional estimate.

Figure 4. The Dollar-Value Benefit of the MID with and without Rebalancing, by Income



Sources: SCF; Bloomberg; FRED; authors' calculations.
Notes: Income is defined as federal taxable income. The conventional estimate assumes there would be no portfolio rebalancing if the MID were eliminated. The rebalancing estimate assumes that households would sell all available non-transaction financial assets to pay down their outstanding mortgage.

Figure 5. The Dollar-Value Benefit of the MID with and without Rebalancing, by Wealth



Sources: SCF; Bloomberg; FRED; authors' calculations.
Notes: See the notes to Table 1 for the definition of wealth. The conventional estimate assumes there would be no portfolio rebalancing if the MID were eliminated. The rebalancing estimate assumes that households would sell all available non-transaction financial assets to pay down their outstanding mortgage.

APPENDIX A

This Appendix provides some algebra to augment the interpretation of Figure 3, the decomposition of the changes in the ratio of the rebalancing revenue estimate to the conventional revenue estimate.

To begin, note that the red line (4) in Figure 3 represents the ratio of revenues with portfolio rebalancing to the conventional way without portfolio rebalancing:

$$\text{Red line (4)} = \frac{\text{conventional estimate} - \text{rebalancing effect}}{\text{conventional estimate}}$$

$$= \frac{\left[t_m^y \times r_m^y \times m^y\right] - \left[t_a^y \times r_a^y \times a^y\right]}{\left[\, t_m^y \times r_m^y \times m^y\right]}$$

$$= 1 - \frac{t_a^y \times r_a^y \times a^y}{t_m^y \times r_m^y \times m^y}$$

where
$t_a^y =$ tax rate on asset a in year y
$r_a^y =$ return on asset a in year y
$a^y =$ stock of asset a in year y
$t_m^y =$ tax rate on mortgage m in year y
$r_m^y =$ interest rate on mortgage m in year y
$m^y =$ stock of mortgage m in year y

Taking advantage of this equation, the other 3 lines are defined as follows:

$$\text{Blue line (3)} = 1 - \frac{t_a^{1988} \times r_a^y \times a^y}{t_m^{1988} \times r_m^y \times m^y}$$

$$\text{Green line (2)} = 1 - \frac{t_a^{1988} \times r_a^y \times a^{1988}}{t_m^{1988} \times r_m^y \times m^{1988}}$$

$$\text{Yellow line (1)} = 1 - \frac{t_a^{1988} \times r_a^{1988} \times a^{1988}}{t_m^{1988} \times r_m^{1988} \times m^{1988}}$$

As noted in the text, there is a large gap between the blue line and the green line in 1997, with the blue line below the green line:

$$\text{Blue line}^{1997} < \text{Green line}^{1997}$$

Applying the identities above gives us:

$$1 - \frac{t_a^{1988} \times r_a^{1997} \times a^{1997}}{t_m^{1988} \times r_m^{1997} \times m^{1997}} < 1 - \frac{t_a^{1988} \times r_a^{1997} \times a^{1988}}{t_m^{1988} \times r_m^{1997} \times m^{1988}}$$

$$- \frac{t_a^{1988} \times r_a^{1997} \times a^{1997}}{t_m^{1988} \times r_m^{1997} \times m^{1997}} < - \frac{t_a^{1988} \times r_a^{1997} \times a^{1988}}{t_m^{1988} \times r_m^{1997} \times m^{1988}}$$

$$\frac{t_a^{1988} \times r_a^{1997} \times a^{1997}}{t_m^{1988} \times r_m^{1997} \times m^{1997}} > \frac{t_a^{1988} \times r_a^{1997} \times a^{1988}}{t_m^{1988} \times r_m^{1997} \times m^{1988}}$$

$$\frac{a^{1997}}{m^{1997}} > \frac{a^{1988}}{m^{1988}}$$

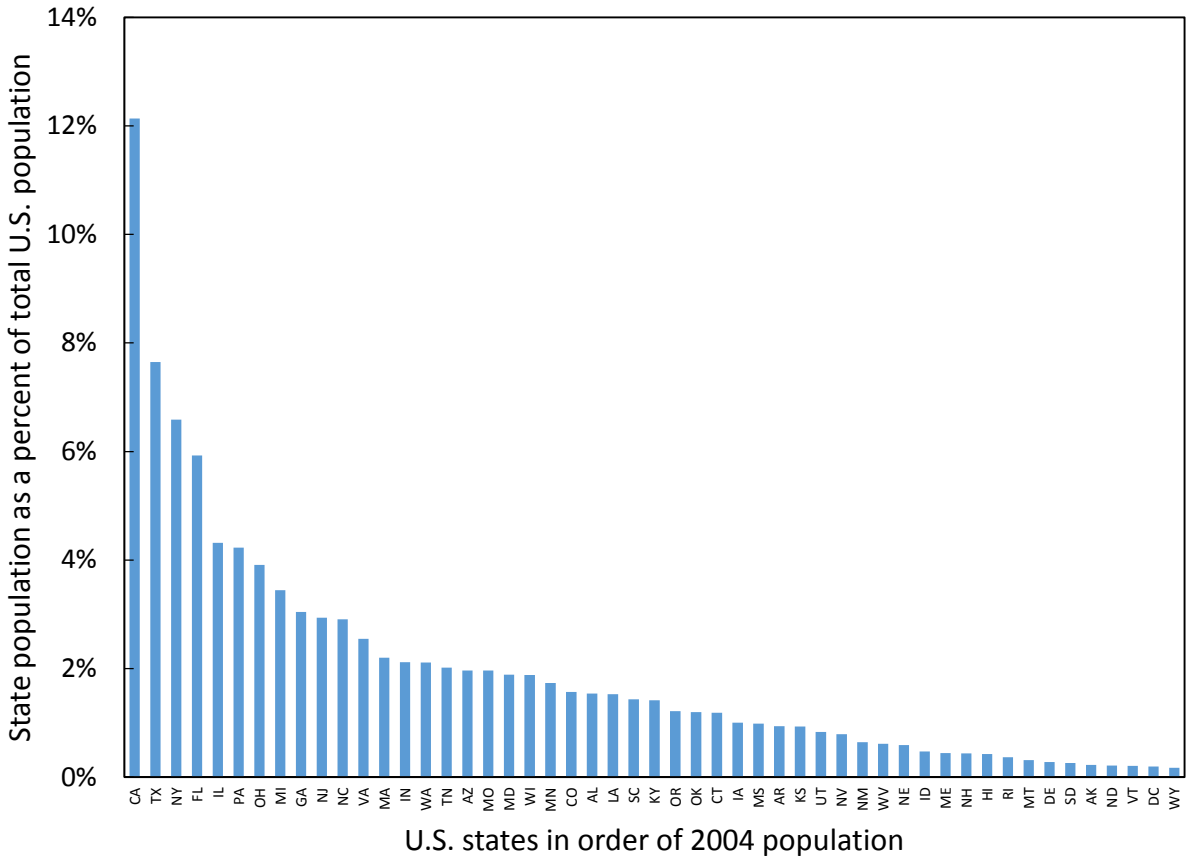
This expression tells us that the blue line falls below the green line in 1997 because the asset-to-mortgage ratio in 1997 is greater than the asset-to-mortgage ratio in 1988. This makes sense intuitively: When the blue (and red) line dip down below the green (and yellow) line, the government is losing more money relative to the conventional approach; that is, there is more rebalancing. Therefore, there are more assets relative to mortgage debt, ceteris paribus. Consistent with this notion, in 1997 the mean wealth-to-mortgage ratio in our data was 0.271 while in 1988 it was 0.199.[22]

[22] To reduce the impact of outliers, this calculation drops the top and bottom deciles of the ratio of wealth to mortgage debt.

APPENDIX B

This Appendix provides information on the procedure used to assign state of residence to observations in the SCF. As noted in the text, this is necessary because state income tax rates enter calculations of households' tax liabilities, but the SCF does not indicate state of residence.

We follow Poterba and Sinai (2011) by randomly assigning households to states based on relative state populations. State population data are from the Population Division of the U.S. Census Bureau, and population shares are based on each state's 2004 population. The distribution is shown in the figure below. We use Stata's `rdiscrete()` command to draw from the distribution and assign states to households.



APPENDIX C

This Appendix provides information on the model and data used in the analysis.

TAX CALCULATION MODEL

Calculations of tax liabilities were done using the National Bureau of Economic Research's TAXSIM microsimulation model, version 9: http://users.nber.org/~taxsim/taxsim-calc9/

The model is run using the taxsim9.ado file interface for Stata:
http://users.nber.org/~taxsim/stata.html

Consult the taxsim9.ado documentation for instructions on use:
http://www.nber.org/stata/taxsim9.html

DATA RELATING TO HOUSEHOLDS' FINANCES

The data on households' finances are from the Federal Reserve Board's Survey of Consumer Finances: http://users.nber.org/~taxsim/to-taxsim/scf/

SAS programs by Kevin Moore of the Federal Reserve Board were used to construct variables for use with TAXSIM: http://users.nber.org/~taxsim/to-taxsim/scf/src/

The following income-related variables are used in TAXSIM's calculations:

`mortgage`: Mortgage interest and charitable contribution deductions

`pwages`: Wage income of primary taxpayer
`swages`: Wage income of secondary taxpayer
`dividends`: Dividend income
`otherprop`: Interest and other property income
`pensions`: Taxable pension income
`gssi`: Gross Social Security benefits
`transfers`: Non-taxable transfer income
`ui`: Unemployment compensation benefits
`stcg`: Short term capital gain or loss (+/-)
`ltcg`: Long term capital gain or loss (+/-)

SCF variables used in the analysis

Variable description	SCF variable name	SCF codebook description (2013)
Total mortgage amount		What was the amount of the land contract when you took it out?
First mortgage	X804	
Second mortgage	X904	
Remaining mortgage balance		What is the amount still owed on the land contract?
First mortgage	X805	
Second mortgage	X905	
Mortgage interest rate		What is the current annual rate of interest being charged on the (loan/land contract)?
First mortgage	X816	
Second mortgage	X916	
Charitable contributions	X5823	Roughly, how much did you (and your family living here) contribute?
Certificates of deposit (CDs)	X3721	What is the total dollar value of (this CD/these CDs)?
Mutual funds		
Stock mutual funds	X3822	What is the total market value of all of the stock mutual funds that you (and your family living here) have?
Tax-free bond mutual funds	X3824	What is the total market value of all of the tax-free bond mutual funds that you (and your family living here) have?
Government bond mutual funds	X3826	What is the total market value of all of the U.S. government or government-backed bond mutual funds that you (and your family living here) have?
Other bond mutual funds	X3828	What is the total market value of all of the other bond mutual funds that you (and your family living here) have?
Combination funds	X3830	What is the total market value of all of the combination funds that you (and your family living here) have?
Other mutual funds	n.a. (pre-1995) X6704 (1995-2001) X7787 (post-2001)	What is the total market value of all of these other funds that you (and your family living here) have?
Bonds		
Savings bonds	X3902	What is the total face value of all the savings bonds that you (and your family living here) have?

Mortgage-backed bonds	X3906		What is the face value of all of the mortgage-backed bonds that you (and your family living here) have?
Government bonds and T-bills	X3908		What is the face value of all of the U.S. government bonds or Treasury bills that you (and your family living here) have?
Tax-exempt bonds	X3910		What is the face value of all of the state or municipal bonds, or other tax free bonds that you (and your family living here) have?
Foreign bonds	X3912 (1989) X7633 (post-1989)		What is the face value of all of the foreign bonds that you (and your family living here) have?
Corporate or other bonds	X3912 (1989) X7634 (post-1989)		What is the face value of all of the corporate or any other type of bonds that you (and your family living here) have?
Stocks	X3915		What is the total market value of this stock?
Checking accounts			How much is in this account?
#1	X3506		
#2	X3510		
#3	X3514		
#4	X3518		
#5	X3522		
#6	X3526		
#7	X3529		
Savings and money market accounts	pre-2004	2004-2013	How much is in this account?
#1	X3804	X3730	
#2	X3807	X3736	
#3	X3810	X3742	
#4	X3813	X3748	
#5	X3816	X3754	
#6	X3818	X3760	
#7		X3765	
Brokerage call accounts	X3930		What is the total dollar value of all the cash or call money accounts that you (and your family living here) have?

Asset rates of return

Asset description	Rate of return used	Source	Mnemonic
Certificates of deposit (CDs)	1988-1997: Rate of return on 1-year T-bill	FRED	TB1YR
	1998-2013: Bankrate.com US 1 Year CD National Avg	Bloomberg	ILSYNAVG
Mutual funds			
Stock mutual funds	Dividend yield on the S&P 1500 Composite	Robert Shiller	n.a.
Tax-free bond mutual funds	Rate of return on Moody's Aa 20-year municipal bonds	Bloomberg	MMBAAA2
Government bond mutual funds	Rate of return on 10-year Treasury bond	FRED	DGS10
Other bond mutual funds	Average of:		
	Rate of return on Moody's Aaa corporate bonds	Bloomberg	MOODCAAA
	Rate of return on Moody's Aa 20 year municipal bonds	Bloomberg	MMBAAA2
	Rate of return on 10-year Treasury bond	FRED	DGS10
Combination funds	Average of:		
	Dividend yield on the S&P 1500 Composite (60%)	Robert Shiller	n.a.
	Rate of return on other bond mutual funds (40%)	(see above)	(see above)
Other mutual funds	Rate of return on other bond mutual funds	(see above)	(see above)
Bonds			
Savings bonds	Rate of return on 10-year Treasury bond	FRED	DGS10
Mortgage-backed bonds	Rate of return on 10-year Treasury bond	FRED	DGS10
Government bonds	Average of:		
	Rate of return on 6-month T-bill	FRED	DTB6
	Rate of return on 10-year Treasury bond	FRED	DGS10
Tax-exempt bonds	Rate of return on Moody's Aa 20-year municipal bonds	Bloomberg	MMBAAA2
Foreign bonds	Rate of return on Moody's Aaa corporate bonds	Bloomberg	MOODCAAA
Corporate or other bonds	Rate of return on Moody's Aaa corporate bonds	Bloomberg	MOODCAAA
Stocks	Dividend yield on the S&P 1500 Composite	Robert Shiller	n.a.
Checking accounts	0% return	n.a	n.a.
Savings and money market accounts	1988-2008: Rate of return on 3-month T-bill	FRED	TB3MS
	2009-2013: National Rate on Non-Jumbo Deposits: Savings (FDIC)	FRED	SAVNRNJ
Brokerage call accounts	Bloomberg Broker Call Money Loan Rate	Bloomberg	BLR

TAX RATES

The rebalancing algorithm assumes that the income normally generated from assets is no longer taxed once sold to pay off a mortgage. But under U.S. tax law, the returns to various assets are generally taxed at different rates:

Wages, salaries, tips, etc. (line 7 of IRS Form 1040) are taxed at the **ordinary income tax rate**.

Taxable interest (line 8a) is taxed at the **ordinary income tax rate**. Examples include the returns to savings accounts, money market accounts, certificates of deposit, and corporate bonds.

Tax-exempt interest (line 8b) is **not taxed** at the federal level. This includes the return on state and municipal bonds.

Ordinary dividends (line 9a) are taxed at the **ordinary income tax rate**. Prior to the passage of the Jobs and Growth Tax Relief Reconciliation Act of 2003, all dividend income was taxed at the ordinary income tax rate; after 2003, qualified dividend income was taxed at the long-term capital gains rate.

Qualified dividends (line 9b) are taxed at a **lower rate than ordinary income**.

Short-term capital gains (line 13, Schedule D) are taxed at the **ordinary income tax rate**.

Long-term capital gains (line 13, Schedule D) are taxed at a **lower rate than ordinary income**.

Brokerage call accounts hold stock investments. It is a taxable event any time one sells an investment in a brokerage call account. We treat income on brokerage call accounts as long-term capital gains for tax purposes.

The tax treatment of the income from mutual funds depends on the types of securities held by the fund. The fund company will account for how total gains or losses are generated, and will report to the investor which portions are attributable to long-term capital gains, short-term capital gains, and interest income—all of which affect the amount of tax owed. We assume distributions from stock mutual funds are taxed as long-term capital gains. Distributions from tax-free bond mutual funds are not taxed. We assume distributions from government and other bond mutual funds are taxed as ordinary income. We assume combination funds and other mutual funds are composed of 60% stocks and 40% bonds, and are taxed accordingly.

All this is summarized in the following table:

Tax treatment of asset income

Asset description	Tax treatment of income
Certificates of deposit (CDs)	Ordinary income
Mutual funds	
Stock mutual funds	Long-term capital gains
Tax-free bond mutual funds	Not taxed
Government bond mutual funds	Ordinary income
Other bond mutual funds	Ordinary income
Combination funds	60% as long-term capital gains; 40% as ordinary income
Other mutual funds	60% as long-term capital gains; 40% as ordinary income
Bonds	
Savings bonds	Ordinary income
Mortgage-backed bonds	Ordinary income
Government bonds	Ordinary income
Tax-exempt bonds	Not taxed
Foreign bonds	Ordinary income
Corporate or other bonds	Ordinary income
Stock dividends	Ordinary income (pre-2003) Long-term capital gains (post-2003)
Checking accounts	Ordinary income
Savings and money market accounts	Ordinary income
Brokerage call accounts	Long-term capital gains