The Mortgage Interest Deduction: Revenue and Distributional Effects

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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, and thus overstate the increase in revenues and the progressivity associated with eliminating the MID. Were the MID to be eliminated, households would sell financial assets 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. We build on previous work that estimates the consequences of removing the MID using a framework that allows for portfolio rebalancing. Our estimates of the revenue loss of the MID are robust to various assumptions about household rebalancing behavior and the ratio of the conventional estimate to the rebalancing estimate is relatively stable over time. Based on these findings, we provide a rule of thumb for policymakers for estimating behavioral responses to changes in the MID.

Introduction

The mortgage interest deduction (MID) has been part of the US income tax system since its inception in 1913. Before the 2017 tax reform (Tax Cuts and Jobs Act, TCJA), this provision allowed an itemized deduction for any interest paid on mortgage debt of up to $1 million 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). Among other provisions, the TCJA lowered this cap to $750,000 for all newly originated mortgages and home equity debt.[i]

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 owner-occupied housing.

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 remarked,

> 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.[ii]

However, evidence that the current tax treatment substantially increases the incidence of homeownership is scant (Gruber, Jensen, and Kleven, 2017; Council of Economic Advisers, 2017). 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; Council of Economic Advisers, 2017). Indeed, the favorable treatment of 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,[iii] there have been proposals to limit the MID; and as mentioned above, the TCJA lowered the cap on eligible mortgages from $1 million to $750,000.[iv] 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 move toward reducing the distortion from the exemption of imputed rent.

Much discussion of the MID has focused on its effect on tax revenues and the distribution of the tax burden. According to the Joint Committee on Taxation (2018), the MID resulted in a loss of federal tax revenues of over $66 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 hold for higher-income households. According to the Joint Committee on Taxation (2017), households whose incomes are less than $100,000 received only 16 percent of the total tax benefit associated with the MID in 2017.[v]

Conventional estimates of the size and distribution of the MID, such as those done by the Office of Management and Budget, fail to account for potentially important responses in household behavior.[vi] One such response occurs because eliminating the MID would prompt households to sell financial assets such as stocks and bonds to pay down their mortgage debt (Dunsky and Follain, 2000). The returns on such assets—dividends, interest, and realized capital gains—are generally taxable. The smaller holdings of these assets would lower taxable income, and hence offset some of the revenue gains from taxing mortgage interest.[vii] Conventional estimates therefore overstate the increase in revenues associated with eliminating the MID. Similarly, conventional estimates overstate the progressivity of eliminating the MID, since households with greater holdings of taxable assets would have greater scope for selling them off.

To express this algebraically, begin by noting that the cost of mortgage debt to the borrower is the after-tax mortgage interest rate, $(1 - \tau_m)r_m$, where τ_m is the tax rate on mortgage interest, and r_m is the mortgage interest rate. The tax price of mortgage debt is defined as $1 - \tau_m$. Similarly, the cost to the taxpayer of using other taxable assets to finance the purchase of a home is $(1 - \tau)r$, where τ is the tax rate on the return to assets, and r is the expected return on the asset. Holding constant the before-tax mortgage interest rate and the return on taxable assets, the elimination of the MID increases the cost of mortgage debt relative to taxable investments, which encourages households

to shift money away from mortgage debt and into taxable assets, a phenomenon referred to as portfolio rebalancing (Dunsky and Folain, 2000).

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. This paper contributes to the literature on rebalancing in several ways. Our rebalancing estimates are based on an explicit model of excess mortgage debt, in the spirit of Ranney (1981) and Jones (1993). Unlike previous studies, instead of doing the calculations for a single year, we analyze data for several years—every third year from 1988 to 2015. This allows us to investigate how the differences between estimates with and without a portfolio response have evolved over time. We find that the ratio between the conventional and rebalancing estimates has been relatively stable over time between 0.75 and 0.90 and robust to various modeling assumptions. This finding provides policymakers with a convenient rule of thumb to convert revenue estimates that ignore portfolio rebalancing into those that do.

We then turn to a discussion of the distributional implications of the MID under the portfolio-rebalancing framework. A noteworthy feature of our distributional analyses is that we use both wealth and income as classifying variables. As noted above, a household's income has a substantial impact on the extent to which it benefits from the MID. At the same time, however, households with low incomes can have substantial wealth (think of retirees), and to the extent such wealth is held in owner-occupied housing, using income as the classifier could produce misleading assessments of the effects of the MID on progressivity. We find that, in fact, using wealth as a classifier suggests the MID is less regressive than using income as a classifier.

Finally, we briefly consider the impact of the TCJA's mortgage-related provisions, specifically, the reduction in the eligible mortgage cap from $1 million to $750,000. While a full analysis of

the TCJA is beyond the scope of this paper, we find that the revenue impact of the mortgage cap reduction, *ceteris paribus*, is likely to be inconsequential. There are simply not enough households with mortgages above $750,000 to have a substantial impact. We estimate the cost of the MID under various lower caps to get a sense of where the cap would need to be set to achieve a meaningful change in revenues.

The Policy Environment and Previous Literature

Most major tax reform proposals have called for limiting the MID.[viii] Such proposals include combinations of eliminating the eligibility of second homes and home equity lines of credit, lowering the cap on eligible mortgages from $1 million, and converting the MID to a tax credit.

There is a substantial literature on the elasticity of household borrowing with respect to the after-tax mortgage interest rate.[ix] These studies suggest that households' demand for mortgage debt is elastic with respect to the cost of borrowing; that is, they adjust their mortgage borrowing in response to changes in mortgage interest rates. Short-term elasticities estimated in the literature range between –1.0 and –1.5 (Follain and Dunsky, 1997; Ling and McGill, 1998; Dunsky and Follain, 2000). These elasticity estimates suggest that households with substantial financial assets would rebalance their portfolios if the MID were eliminated. From the standpoint of revenue estimation, the two key questions about portfolio adjustment are which balance sheet components households will adjust and what returns households would have earned on those assets had they continued to hold them.

Gale, Gruber, and Stephens-Davidowitz (2007) address these issues by making two strong assumptions. 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 those whose returns face the highest marginal tax rates to the lowest. A strong implicit assumption, which is necessary given their use of administrative tax return data, which has no direct information on asset holdings, is that all taxable financial assets have the same rate of return and that it is equal to the mortgage interest rate. This approach implies that households care exclusively about the tax treatment of their assets when deciding to how to rebalance their portfolios. Using the Tax Policy Center's microsimulation model, they calculate that the revenue gain from repealing the MID is roughly 84 percent of the conventional revenue estimate for 2006.[x]

Gervais and Pandey (2008) take an alternative approach using microdata with information on non-residential asset portfolios, tax rates, and mortgage holdings to simulate how different assumptions about the extent of portfolio rebalancing would influence the revenue effects of eliminating the MID. In contrast to Gale, Gruber, and Stephens-Davidowitz's (2007) approach, which assumes households base their rebalancing decisions solely on the basis of tax considerations, Gervais and Pandey (2008) assume households take a more holistic approach to managing the composition of their portfolios. This is possible because their household financial data are drawn from the Federal Reserve Board's Survey of Consumer Finances (SCF) for 1997, which contains detailed information on households' incomes and balance sheets (Moore, 2003). 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. They speculate about which assets households might sell should mortgage interest no longer be deductible and provide estimates of the revenue loss of the MID under various

assumptions on household behavior using the National Bureau of Economic Research's TAXSIM model (Feenberg and Coutts, 1993). Advantages of this approach are that 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 difficult to estimate in a compelling manner. Additionally, the SCF data allow them to distinguish among assets that are arguably similar but do not necessarily have the same tax treatment. 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 (2008), Poterba and Sinai (2011) employ the TAXSIM model and SCF data, but for 2003. They use a less restrictive setup, allowing each asset class 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, embodying the assumption that taxpayers exercise at least modest financial sophistication.[xi] Households are also assumed to use all their available assets to pay down their mortgages.[xii] According to their preferred specification, the cost of the MID is roughly 81 percent of the conventional estimate for 2003. This figure is similar to that of Gale, Gruber, and Stephens-Davidowitz (2007), but substantially higher than that of Gervais and Pandey (2008). The difference is presumably because the Gervais and Pandey (2008) assume an unusually high common rate of return of 7.29 percent, which generates larger revenue consequences when households rebalance.

Poterba and Sinai (2011) 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 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 available 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. If mortgage interest were no longer deductible but portfolio income were still taxed, then households with mortgages as well as financial assets would be borrowing at the before-tax interest rate but investing at the after-tax rate of return. This implies a strong incentive for these households to draw down financial assets to prepay mortgage debt, at least for households with substantial financial assets.

Are households sufficiently financially sophisticated to respond to these incentives? The 2016 SCF introduced several new questions related to financial literacy (Bricker et al., 2017). Table 1 shows that respondents tend to rate themselves highly in regard to financial literacy, with mortgage-holders rating themselves higher than non-mortgage-holders, and the wealthy rating themselves higher than the non-wealthy. The same holds for the likelihood of searching "for the very best terms" when making major decisions about borrowing money, obtaining credit, saving, and investing.

But individuals might overestimate their ability to manage their finances rationally, and indeed, consumer behavior in some contexts appears inconsistent with the assumption that households would be financially sophisticated enough to 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.[xiii] Consistent with the notion that households sensibly adjust their debt holdings in response to changing interest rates, Gross and Souleles (2002) find that higher interest rates on credit cards lead consumers to borrow substantially less.

More direct evidence is provided by Maki (1996), who analyzes the response of households to a provision in the Tax Reform Act of 1986 that phased out the deductibility of interest paid on all consumer debt.[xiv] 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 Tax Reform Act of 1986 resulted in significant 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.

Perhaps the most convincing evidence of rebalancing comes from Dunsky and Follain (2000), who study the elasticity of demand for mortgage debt with respect to its tax price using the 1983–89

panel sample of the SCF. This panel sample conveniently brackets the Tax Reform Act of 1986, which eliminated the deductibility of interest on consumer credit, increased the standard deduction, and reduced the number of expenses that could be itemized. Their results are supportive of an elastic (–1.13) demand for mortgage debt with respect to its tax price, as well as the tax prices of substitutes for mortgage debt, providing strong support for the phenomenon of portfolio rebalancing. Interestingly, Dunsky and Follain (2000) also find that the level of financial assets does not appear to significantly influence households' rebalancing decisions, as households with relatively few financial assets also exhibited rebalancing behavior. Alan and Leth-Petersen (2006) provide convincing evidence of portfolio rebalancing following a significant Danish tax reform in 1987 that altered after-tax returns and the cost of debt for a large number of households.

A second important question is which balance sheet components households would adjust if the MID were repealed. Jones (1994) provides theoretical support for positive linkages between demand for excess mortgage debt and household choices of investments in vacation homes, real estate, and closely held businesses, suggesting households do not borrow in mortgage form to finance liquid asset positions or consumer durables. However, because the MID has not been substantially changed since it was first introduced in the United States, we have no direct evidence on which classes of assets would be sold to pay down mortgage debt if it were eliminated. Alan and Leth-Petersen (2006) do find that heavily taxed interest-bearing assets were used to pay off mortgage debt following the 1987 Danish reform.

Some evidence suggests that retirement 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. The reasonable implication is that for certain types of assets, considerations other than after-tax returns play a dominant role in their portfolio decisions.

Theoretical Framework

In this section, we begin by presenting a model of demand for mortgage debt, based on utility maximization principles. This model provides a framework for quantifying the amount of mortgage debt that is used to finance housing services and the amount used to finance consumption and the acquisition of other assets. Next, we employ a user cost of capital framework to demonstrate how changes in the tax treatment of mortgage interest will induce a household to rebalance its portfolio and estimate the difference between revenue estimates that do and do not account for such behavior. Finally, we outline the model used to estimate tax liabilities with and without mortgage interest deductibility.

Demand for Excess Mortgage Debt

To determine whether and the extent to which households use mortgage debt to finance non-housing assets and consumption, we employ Ranney's (1981) model of housing demand as extended by Jones (1993). In Jones's (1993) model, households are life-cycle utility maximizers, operating between times $t = 0$ and $t = T$, which are determined exogenously. A household purchases a house of fixed size H, which is endogenous, from which it derives utility from housing services, h, generated at a constant flow rate ϕ, so that $h = \phi H$. The unit price of the house at time t is denoted P_t. After-tax wealth at time t is denoted W_t. In addition to housing services, the household derives

utility from terminal wealth, W_T, and from consumption of non-housing goods c_t with price p_t. All prices are after tax and exogenously given.

Mortgage principal at time t is denoted M_t, and the loan-to-value ratio is λ_t, so that $M_t = \lambda_t P_t H$. The before-tax mortgage interest rate, which is fixed and exogenously given, is denoted r_m, and τ_m is the marginal tax rate that applies to the MID, so $(1 - \tau_m)r_m$ is the after-tax mortgage interest rate. (If mortgage interest is not deductible, then $\tau_m = 0$.) The household makes after-tax mortgage interest payments $(1 - \tau_m)r_m M_t$. Households can continuously choose the optimal M_t^* via costless mortgage recontracting.

Let the functions U denote the instantaneous utility derived from consumption of housing and non-housing services, F the utility derived from the value of terminal wealth, and V the lifetime utility derived from the demand for housing and non-housing. The household solves the following optimization problem:

$$
\begin{aligned}
V(H,Q) = \max_{c_t, W_T} \quad & \int_0^T U(h, c_t)\, dt + F(W_T) \\
\text{s.t.} \quad & Q = \int_0^T p_t c_t\, e^{-(1-\tau)rt}\, dt + W_T e^{-(1-\tau)rT} \\
& W_0 + \int_0^T Y_t e^{-(1-\tau)rt}\, dt + (P_T H - M_T) e^{-(1-\tau)rT} \\
& \quad = \int_0^T (1-\tau_m) r_m M_t e^{-(1-\tau)rt}\, dt + (P_0 H - M_0) + Q
\end{aligned}
$$

Q is terminal wealth plus the present value of expenditures on non-housing goods over the lifetime. After-tax labor income is denoted by Y_t, r is the before-tax return on non-housing assets, τ is marginal tax rate on investment income, and $e^{-(1-\tau)r}$ is the discount rate. The second constraint is the budget constraint, where the left-hand side is total lifetime wealth and the right-hand side is total lifetime expenditures.

Solving the optimization problem yields the optimal values H^* and G^*, and the first-order conditions give the optimal allocations c_t^* and W_T^*. We can also use first-order conditions to determine the optimal mortgage amount M_t^* that is consistent with utility maximization, and its relationship to the optimal size of the house, H^*. The budget constraint shows that feasible quantities of H and Q are functions of λ_t, and whether a larger λ_t allows more or less consumption of H and Q depends on the relationships between P_0 and P_T and between after-tax r_m and r.

Jones (1993) shows how the optimal loan-to-value ratio, λ_t^*, is simply a function of the relationship between after-tax r_m and r. If $r_m < r$, then utility maximization implies debt maximization, so $\lambda_t^* = 1$. If $r_m > r$, then utility maximization implies debt minimization. For households whose wealth exceeds the total cost of their house, $W_t > P_tH$, debt minimization implies the optimal mortgage is $M_t^* = 0$. For households with insufficient wealth to cover the total cost of the house, $W_t \leq P_tH$, debt minimization implies $M_t^* = P_tH - W_t$.

Following Jones (1993), we decompose a household's desired mortgage debt position at time t into two components: $M_t^* = M_t^*(h) + XM_t^*$, where $M_t^*(h)$ is the component of mortgage debt that is singularly derived from the demand for housing services, h; and XM_t^* is the household's desired mortgage debt in excess of $M_t^*(h)$. Since only debt collateralized by the home is used to acquire h, and $M_t^*(h)$ is the minimum debt position that allows the household to consume h given W_t, then XM_t^* is attributable to objectives unrelated to housing demand. Hence, $XM_t^* > 0$ can be interpreted as debt used to finance non-housing assets, and $XM_t^* < 0$ can be interpreted as the amount of non-mortgage debt used to finance the house.

Additionally, a portion of household demand for liquid assets is arguably directly dependent on housing demand (Plaut, 1987), so liquid assets may generate utility if Y_t and P_T are uncertain. In

this case, housing and liquid assets can be viewed as joint products. Let $L_t^*(H)$ denote the optimal liquidity position attributable to P_tH. Then the key equation for measuring excess mortgage demand is:

$$XM_t^* = \begin{cases} M_t^* - (P_tH + L_t^*(H) - W_t) & \text{if } W_t < P_tH + L_t^*(H) \\ M_t^* & \text{if } W_t \geq P_tH + L_t^*(H) \end{cases}$$

To allow for frictions in the adjustment of mortgage principal, we classify households as having no excess mortgage debt if M_t^* is within 2 percent of $M_t^*(h)$. Following Jones (1993), we estimate $L_t^*(H)$ for each household via the regression model

$$\ln(\text{LiquidAssets}) = \alpha + \beta \ln(\text{HomeValue}) + \boldsymbol{\gamma}\mathbf{X} + u$$

$$\hat{L}^*(H) = e^{\hat{\beta} \ln(\text{HomeValue})} = (\text{HomeValue})^{\hat{\beta}}$$

where LiquidAssets is the household's stock of liquid assets (bonds, checking accounts, savings accounts, and money market accounts), HomeValue is the market value of the household's principal residence, and **X** is a vector of socioeconomic controls (see Jones's (1993) appendix).

User Cost of Housing

The user cost of housing measures the marginal cost of consuming an additional unit of housing services and provides a conceptual framework for examining the incentive effects of tax policy on housing decisions (Poterba and Sinai, 2011). Algebraically, it is given by

$$c = \{1 - [\lambda\tau_m + (1-\lambda)\tau]\}r_R + (1-\tau)\beta - (r_m - r_R)\lambda\tau_m + (1 - \tau_m - \kappa)\tau_P + (\delta - \alpha)$$

where τ_m is the marginal tax rate that applies to the MID and property tax deduction (τ_m = 0 if not deductible), τ is the marginal tax rate that applies to investment income, τ_P is the property tax rate, λ is the loan-to-value ratio for the home, β is the housing risk premium, κ is the share of benefits received from paying property taxes, r_m is the mortgage interest rate, r_R is the risk-free interest

rate, δ is the cost of depreciation and maintenance, and α is the expected rate of nominal house price appreciation.

The first term, $\{1 - [\lambda\tau_m + (1-\lambda)\tau]\}r_R$, represents the opportunity cost of investing in risk-free assets. The second term, $(1-\tau)\beta$, represents the post-tax housing risk premium. We follow Poterba (1992) in including a risk premium in the user cost expression as a shorthand for a more complete analysis of owner-occupied housing as a portfolio asset. As noted by Poterba and Sinai (2011), this approach recognizes that because the total return to an investment in owner-occupied housing is risky, households would apply an effective discount rate that is higher than the riskless rate to any stream of future housing services.[xv]

The third term, $-(r_m - r_R)\lambda\tau_m$, reflects the fact that the tax code subsidizes the homeowner's options to prepay and default, which reduce the risk of owning a home. The interest rate spread $(r_m - r_R)$ reflects the risk to the lender that the borrower prepays or defaults. The fourth term, $(1 - \tau_m - \kappa)\tau_P$, represents the net cost of property tax payments. The final term, $(\delta - \alpha)$, is net depreciation.

In the current tax regime, mortgage interest is deductible, so $\tau_m > 0$ if the household itemizes:

$$c_1' = \{1 - [\lambda\tau_m + (1-\lambda)\tau]\}r_R + (1-\tau)\beta - (r_m - r_R)\lambda\tau_m + (1 - \tau_m - \kappa)\tau_P + (\delta - \alpha)$$

If the MID were eliminated, so $\tau_m = 0$ for all households, and if the loan-to-value-ratio did not respond to this change, then the household's user cost would become

$$c_1'' = \lambda\tau r_R + (1-\tau)\beta + (1 - \tau_m - \kappa)\tau_P + (\delta - \alpha)$$

Subtracting c_1' from c_1'' gives the change in the household's user cost of housing resulting from eliminating the MID.

$$\Delta c_1 = c_1'' - c_1' = \tau_m r_m \lambda$$

Conventional measures of the impact of the MID assume that the loan-to-value ratio remains unchanged between c_1' and c_1''. But if the tax treatment affecting the MID changed then taxpayers would respond by making portfolio adjustments to decrease the loan-to-value ratios on their homes (Follain and Dunsky, 1997; Ling and McGill, 1998, Dunsky and Follain, 2000).

Let λ' denote the loan-to-value ratio in the current tax regime, and λ'' denote the loan-to-value ratio in the new regime after elimination of the MID. Then

$$c_2' = \{1 - [\lambda'\tau_m + (1-\lambda')\tau]\}r_R + (1-\tau)\beta - (r_m - r_R)\lambda'\tau_m + (1 - \tau_m - \kappa)\tau_P + (\delta - \alpha)$$

$$c_2'' = [1 - (1-\lambda'')\tau]r_R + (1-\tau)\beta + (1 - \tau_m - \kappa)\tau_P + (\delta - \alpha)$$

$$\Delta c_2 = c_2'' - c_2' = \tau r_R(\lambda'' - \lambda') + \tau_m r_m \lambda' \leq \Delta c_1$$

The inequality $\Delta c_2 \leq \Delta c_1$ follows from the assumption that $\lambda'' \leq \lambda'$ after the elimination of mortgage interest deductibility.

Tax Liability

We use the National Bureau of Economic Research's TAXSIM model to do our calculations of tax liability. TAXSIM is a microsimulation function for calculating tax liabilities from individual data under US federal and state income tax laws (Feenberg and Coutts, 1993; see the Appendix). A household's tax liability Z_t in year t is a function of a vector of tax-relevant variables $\mathbf{D}_t$, including, among other things, tax year, state of residence, marital status, number of dependents, wages, and capital gains: $Z_t = f(\mathbf{D}_t)$. Aggregate tax revenues $\mathcal{Z}_t$ in year t is the sum over all households $\mathcal{H}$ in year t (appropriately weighted): $\mathcal{Z}_t = \sum_{\mathcal{H}} Z_t$.

Alternative scenarios can be modeled by changing the values of the tax variables $\mathbf{D}_t$. To calculate the change in tax liability from a change in policy, we take the difference between a baseline

revenue calculation and an alternative revenue calculation. Specifically, let $\mathbf{D}_t^B$ characterize a household's tax environment as observed from survey data. We say $Z_t^B = f(\mathbf{D}_t^B)$ is a household's baseline tax liability in year *t*—that is, its tax liability under "current law," which is captured by *t*—and $\mathcal{Z}_t^B = \sum_{\mathcal{H}} Z_t^B$ is baseline federal revenue in year *t*. Now suppose $\mathbf{D}_t^A$ characterizes a household's tax environment in an alternative regime, so the household's alternative tax liability in year *t* is $Z_t^A = f(\mathbf{D}_t^A)$, and $\mathcal{Z}_t^A = \sum_{\mathcal{H}} Z_t^A$ is aggregate federal revenue in year *t* under the alternative scenario. The change in revenue associated with a change in tax regime, R_t, is the difference between tax revenues under the alternative and the baseline: $R_t = \mathcal{Z}_t^A - \mathcal{Z}_t^B$.[xvi]

Data and Simulation Strategy

The underlying data are from the Survey of Consumer Finances, a triennial, cross-sectional survey of roughly 4,500 US families conducted by the Federal Reserve Board every third year from 1988 to 2015.[xvii] 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).

Historically, roughly 30 percent of taxpayers itemize deductions, while the other 70 percent take the standard deduction. SCF data are self-reported, and some households in the SCF report that they do not itemize when the data suggest they would be better off doing so. According to the Government Accountability Office (2002), only between 0.76 and 1.8 percent of taxpayers had qualifying deductions in excess of the standard deduction yet did not itemize. Our simulations

assume that households choose the optimal strategy, although allowing suboptimal (self-reported) itemization behavior barely changes the results. Additionally, married individuals are assumed to file jointly, since married filing separately is not usually desirable under US tax law. Table 2 provides summary statistics for several of the key variables in our data set.

Our simulations require assumptions about which assets households would sell to pay down mortgage debt if the MID were eliminated. The model of the demand for mortgage debt formulated above gives a sense of the magnitude of mortgage debt that is used to finance non-housing assets, but it provides no guidance about which non-housing assets are purchased.

One approach, used by Poterba and Sinai (2011) and Gervais and Pandey (2008), is to create groups of arguably similar assets and then explore the robustness of the results to different assumptions about the extent to which these different asset groups are used to pay down mortgages. More precisely, they assume that if households could not deduct mortgage interest, they would sell all available assets of a certain class to pay down mortgage debt to the greatest extent possible. Following Poterba and Sinai (2011), we allow before-tax returns to vary across asset classes by linking the different asset classes in the SCF to historical data on rates of return. The Appendix provides details about how we assigned rates of return to the various asset classes. Of course, other variables such as risk, liquidity, and maturity also influence portfolio decisions.[xviii] For simplicity, we assume households only care about relative rates of return across asset classes when deciding how to rebalance their portfolios.[xix]

Following Poterba and Sinai (2011), we group the items on a household's balance sheet into four classes, described in Table 3. *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. 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. Jones (1994) also argues that households do not use mortgage debt to finance liquid assets. 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.[xx]

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. Households would likely be reluctant to use assets such as vehicles, retirement accounts, or liquidated life insurance policies to pay down the balance of a mortgage.[xxi] Thus, we do not include these assets in our portfolio rebalancing calculations.[xxii]

As indicated in our theoretical model above, the tax consequences of rebalancing depend critically on the marginal tax rates associated with the returns on the various assets. In the case of equities, a complication arises. 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 households, 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.[xxiii] 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 2015.[xxiv] 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. In addition, 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, as described by Poterba (1987).[xxv]

Following Poterba and Sinai (2011), we assume that before-tax rates of return would remain unchanged if the MID were eliminated. That is, global capital markets determine both before-tax rates of return and risk premia, so they are unaffected by changes in the tax treatment of mortgage interest. As indicated in our model above, even with a given before-tax rate of return, eliminating the MID would change the user cost of housing and eventually induce changes in housing decisions and the broader real estate market.[xxvi] A complete model of the impact of the MID on household optimal portfolio choice with endogenous housing prices is beyond the scope of this paper. In effect, our analysis does not consider long-run general equilibrium responses in the financial and housing markets from a change in the MID.

Rather, our analysis assumes that homeownership rates and house prices are unchanged in the short run as a result of MID repeal. The former is a reasonable assumption given that most of the academic literature fails to find any effect of the MID on homeownership rates (Gruber, Jensen,

and Kleven, 2017; Hanson, 2012; Sommer and Sullivan, 2018). However, since eliminating the MID would raise the user cost of owning a home, the demand for housing would fall, leading to lower house prices in the short run (Poterba, 1984; Poterba and Sinai, 2011).[xxvii] While a full general equilibrium analysis of such a change is beyond the scope of this paper, Poterba and Sinai (2011) illustrate the nature of the potential change in housing demand associated with a rise in the user cost. Assuming a housing demand elasticity of –1.0 (Glaeser and Gyourko, 2006), a 1 percent increase in user cost implies a 1 percent decrease in housing demand. If households did not change their total wealth accumulation profiles, and if they had invested the funds that they would otherwise have invested in housing equity proportionally to other assets in their portfolios, then Poterba and Sinai (2011) estimate that average tax revenue would be about 7 percent higher than the estimate assuming portfolio rebalancing but fixed demand for housing.[xxviii] Our discussion of how eliminating the MID would affect housing demand and portfolio choices ignores the short-run adjustments in house prices that would be associated with any policy change.

To help illustrate the rebalancing process, consider the hypothetical balance sheet in Table 4. Assume that the household faces a marginal tax rate of 25 percent and makes no labor income. The table lists the value of various assets held by the household with hypothetical rates of return.[xxix] The tax revenue is calculated as the value of the asset times the before-tax rate of return times the marginal tax rate. The top panel represents the household's financial situation under the status quo.

As illustrated at the bottom of the table, with a change in the MID the household reevaluates its portfolio decision and sells non-transaction financial assets to pay down its mortgage balance. In our example, the only assets that fit this criterion are stocks and bonds.[xxx] Checking and savings accounts earn a low return, but since these assets have high liquidity value they are maintained. We assume households would not sell non-financial assets such as vehicles or business interests

nor liquidate retirement assets to pay down a mortgage. Since bonds have a lower rate of return than stocks, the household sells its entire $80,000 worth of bonds to prepay its mortgage, and $20,000 in stocks, leaving a remaining mortgage balance of $0. Because assets and liabilities are simply being shuffled around, the household's net worth is the same in both cases. The mortgage line of the tax revenue column is the implied revenue loss induced by the MID. If the MID were eliminated and the household did not rebalance, its new tax liability would be $9,250 + $750 = $10,000. If the household rebalanced its portfolio, its new tax liability would be lower: $9,200 + $0 = $9,200. Note that Table 4 represents the situation *before* the MID has been eliminated. Even though the household's tax liability would be lower after rebalancing, we assume that we observe households in equilibrium. Households have many competing financial objectives for their portfolios, and the portfolio that minimizes one's tax liability is not necessarily the equilibrium portfolio.

The calculations in Table 5 provide a sense of the scope for portfolio rebalancing. The table shows, for each quintile of the adjusted gross income distribution in 2015, 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 about an order of magnitude more wealth than the fourth quintile on average, despite having only about twice the amount of mortgage debt. Consequently, roughly four times as many households in the top income quintile than in the fourth quintile would be able to pay down their entire mortgages.

One final 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 were fully deductible (for itemizers)

on federal income tax returns before the TCJA (which limited the deduction to $10,000), these state taxes affect federal tax revenues. To maintain confidentiality, however, the SCF data do not provide taxpayers' state of residence. Given this limitation, we randomly assign states based on state income and age distributions.[xxxi]

To estimate excess mortgage positions, we must be satisfied that we observe households in the SCF data in equilibrium with respect to their mortgage debt positions (Jones, 1993). This assumption is reasonable given the widespread use of effectively open prepayment provisions and the increasing availability of flexible home equity financing.

Our simulation procedure can be summarized as follows: We use the model of the demand for mortgage debt set forth above to determine which households hold excess mortgage debt. To estimate the cost of the MID, we calculate aggregate tax revenue both under current law and assuming the MID is eliminated and take the difference. In a world with no MID, we assume that the change in the after-tax mortgage interest rate for households holding excess mortgage debt is such that there is no longer an incentive to hold excess mortgage debt, so households would sell non-transaction financial assets to pay down their excess mortgage balance. The associated sale of taxable assets results in a lower tax liability for these households. This difference in tax liabilities, summed over all households, is the aggregate overestimate of the conventional revenue calculation.[xxxii] We explore the size and implications of this overestimate in the next sections.

Revenue Effects of the Mortgage Interest Deduction

Figure 1 plots our revenue estimates for repealing the MID for every third year from 1988 to 2015, both under the conventional method, which assumes no portfolio response, and under the portfolio rebalancing assumptions discussed above (households would sell non-transaction financial assets to pay down their excess mortgages).[xxxiii] As expected, the revenue estimates assuming portfolio rebalancing are lower than the conventional estimates. The differences are nontrivial, ranging from $5.0 billion in 1988 (8 percent difference) to $13.6 billion in 1997 (19 percent difference).[xxxiv]

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 81 percent in 1997 to 92 percent in 2009. The revenue estimates are robust to a range of assumptions, as shown in Table 6. Our preferred estimate is shown in bold. In the left panel, we impute state of residence simply by drawing from the state population distribution for 2004, following Poterba and Sinai (2011). In the right panel, we use a more elaborate state assignment method based on year-specific, state-specific, age and income distributions. Both methods yield about the same results.

The columns distinguish among the groups of assets that are available for rebalancing (see Table 3). The differences between the rebalancing estimates using non-transaction financial assets or all financial assets are relatively small (on average $1.8 billion, or about 3 percent of the conventional estimate) compared to the differences between the conventional and non-transaction financial assets rebalancing estimates (on average $7 billion, or about 13 percent of the conventional estimate). The decision to rebalance using all financial assets or only non-transaction financial assets appears to be inconsequential.[xxxv]

Our preferred estimate assumes households would only pay down their excess mortgage (Jones, 1993) as opposed to their entire mortgage. These results (shown in rows 1–3 of Table 6) are on

average $1.7 billion less than those that assume households would pay down their entire mortgage balance to the extent possible given their available assets (shown in rows 4–6 of Table 6). Viewed through the lens of Jones's (1993) framework, this implies that many mortgage balances may in fact be excess. The assumption that households only sell assets with after-tax returns lower than the mortgage interest rate is also inconsequential (compare rows 1 and 2 and rows 4 and 5 of Table 6). Rows 3 and 6 assume households sell assets in a random order, and these estimates too are very close to the estimates that assume households sell assets in a particular order, from lowest return to highest. Finally, we also compute estimates in which households rebalance their portfolios according to elasticities of demand for mortgage debt with respect to the mortgage interest rate that have been estimated in the literature (between –1.5 and –1.0; see rows 7–9 of Table 6). These results, too, are almost indistinguishable from the estimates using the other methods mentioned above.

The within-year robustness of our results to various assumptions about rebalancing behavior raises the question of what restrictions on rebalancing one could impose that would meaningfully change our estimates. The final three rows of Table 6 suppose that households choose to sell up to an arbitrary share of each of their assets, specifically, 25, 50, and 75 percent. Our preferred rebalancing estimate implicitly assumes households would sell 100 percent, while the conventional estimate implicitly assumes they would sell zero. As expected, the estimates increase as the percent of assets sold decreases, but even with the 25 percent restriction the estimates are not all that different from our preferred estimate (the difference is about $4 billion, or 7.5 percent of the conventional estimate). This suggests that the bulk of the difference between the conventional and rebalancing estimates is driven by households that have large excess mortgages but even larger

holdings of financial assets, so large that restricting rebalancing to only 25 percent of their overall portfolios does not significantly constrain their ability to pay down their mortgages.

Figure 3 provides more detail along these lines. It shows the non-transaction financial assets rebalancing estimate as the upper bound on the percentage of assets sold is decreased (in 5 percentage point increments) from 100 percent to 0 percent. The curve rises gradually between 100 percent and 50 percent and rises sharply starting around 25 percent. This is consistent with the calculations in Table 6—the largest contributors to the difference between the conventional and rebalancing estimates are households that have more than enough assets to pay down their excess mortgage. The sharp rise at around 25 percent suggests the point at which the diminishing amount of assets available for rebalancing becomes binding for these individuals. Calculations based on the 2016 SCF suggest the following: Households with enough financial assets to fully pay down their excess mortgage are responsible for 92 percent of the difference between the conventional and rebalancing estimates; households with financial assets greater than twice their excess mortgage contribute 54 percent to the difference; households with assets greater than four times their excess mortgage contribute 36 percent; and households with assets greater than ten times their excess mortgage contribute 15 percent. The average excess mortgage for households in these groups are $90,180, $102,439, $116,147, and $105,373, respectively.

A Rule of Thumb for Policymakers

As shown in Figure 2, the ratio of the rebalancing revenue estimate to the conventional estimate is fairly tight, ranging from about 80 percent to 95 percent. From Table 6, our ratio for tax year 2015 is 87 percent, about the midpoint of this range. Remarkably, Poterba and Sinai (2011), Gale, Gruber, and Stephens-Davidowitz (2007), and Toder et al. (2010) all find similar results, the latter

two using different methods, models, and data than ours. Taken together, these figures suggest 88 percent (plus or minus 8 percentage points) could be a reasonable rule of thumb for estimating behavioral responses to changes in the MID.

Now, there is no perfect substitute for careful revenue estimates that take into account as many behavioral effects as possible, particularly for policies as economically and politically important as the MID. When such estimates require the modeling of complicated behavior, however, they can take a long time to produce and be quite costly. The conventional estimates, on the other hand, are relatively easy to generate. For proposals that involve modifications of the MID, our results provide policymakers with a rule of thumb that could be used for a preliminary assessment of their revenue consequences. Such estimates can help policymakers decide in a timely fashion whether it is worthwhile to move forward with these proposals.

Figure 4 augments Figure 1 with our rule-of-thumb estimate. It differs from the more careful rebalancing estimate by $2.0 billion (in 2015 dollars) on average, or roughly 3 percent of the conventional estimate. The top of the shaded area is the conventional estimate multiplied by 95 percent, and the bottom of the shaded area is the conventional estimate multiplied by 80 percent. The 80 percent bound differs from the rebalancing estimate by $5.7 billion on average, and the 95 percent bound differs by $5.1 billion on average.

Eligible Mortgage Cap

We conclude this section with a brief, partial discussion of mortgage interest deductibility and the TCJA. The TCJA has several provisions that will affect the revenue implications of the MID, including the reduction in individual marginal income tax rates and the increase in the standard

deduction. A full analysis of the impact of these measures is beyond the scope of this paper, but we can get a sense of the potential importance of one provision that has received quite a lot of attention: the reduction in the eligible mortgage cap from $1 million to $750,000. Using the 2016 SCF, we simulate the revenue consequences of changing the cap both with and without portfolio rebalancing.

Figure 5 shows the cost of the MID under different caps using our preferred specification. These estimates implicitly assume households' choices of how large a mortgage to obtain are independent of the eligible mortgage cap, which is likely to be a reasonable assumption for eligible caps that do not go too far below the median home price. That the graph is relatively flat for high eligible mortgage caps indicates that these caps are not binding for many households, which is consistent with the data. Under a $1 million cap, the revenue loss of the MID is $45.6 billion. Lowering the cap to $750,000—the cap set by the TCJA—lowers this figure to $44.1 billion, a roughly 3 percent reduction. When the cap is lowered to $500,000—the cap proposed in the House version of the TCJA and many major reform proposals—the revenue loss is $40.8 billion, roughly 10 percent below the $1 million cap estimate. At a $300,000 cap—roughly the median home price—the revenue loss is $33.2 billion, significantly (27 percent) below the $1 million cap estimate.

Taken together, the calculations depicted in Figure 5 indicate that the revenue impact of the TCJA's change in the eligible mortgage cap is likely inconsequential, regardless of the rebalancing assumption. There are simply not enough households with mortgages above $750,000—only 1.5 percent of the total in 2015—to make a significant difference.[xxxvi] Thus, although the impact of the TCJA, *in toto*, could be quite large, we do not expect the change in the cap to have much of an impact on revenues, other things being the same.

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.

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.[xxxvii] 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 rates, *inter alia*. However, imagine two households that have identical high adjusted gross incomes and identical mortgages, but one household has substantial 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 7 illustrates this point with a numerical example based on the 2016 SCF. 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 $152, or about 20 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 and the 2nd wealth decile. The mean value of assets for such households is $478, 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. This implies that, holding incomes fixed, 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, the removal of the MID might disproportionally affect younger households more than older households.[xxxviii] 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 than younger households.[xxxix] In the 2016 SCF, for example, the average ratio of wealth to adjusted gross income for households age 30–34 is 0.35, while for those age 55–59 it is 3.43. Hence, for any given income, older households on average 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 potential importance of wealth in understanding the distributional implications of eliminating the MID, we present results using both income and wealth to classify households. Figure 6 shows the distribution of the MID (in 2015 dollars) over time by quintiles of federal adjusted gross 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 figure shows that high-income households benefit 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 7 shows the distribution of the MID over time by quintiles of wealth, again for both the conventional and the rebalancing estimates. (Figures 6 and 7 are shown on the same scale.) In contrast to Figure 6, 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. Our estimate of the Gini coefficient for the MID is 0.746, which compares to roughly 0.450 for the distribution of income in the United States as a whole. (Values of zero signify perfect equality and values of one signify perfect inequality.)

Although high-income households receive the largest dollar benefits they also pay substantially more in taxes than do low-income households. To put the dollar figures above in context, then, it is useful to consider the distribution of MID benefits as a proportion of taxes paid. This is done in Figure 8, which plots the distribution of MID benefits as a share of taxes paid using the 2016 SCF, both by income and wealth deciles. As can be seen, the MID provides large benefits as a share of taxes paid to the lowest wealth deciles, but starting with the third decile the MID benefits as a share of taxes paid generally increase with income and wealth until the highest two deciles, where there is a drop. The MID provides roughly the same benefit to the middle income deciles as a share of taxes paid, a large benefit to the 9th decile, and a low benefit to the top decile. Higher-income and higher-wealth households in general receive a larger MID benefit in terms of raw dollars but also in terms of the share of taxes paid. Although rebalancing attenuates the regressivity of the

MID, the analysis of this section shows that the MID is still quite regressive. This is consistent with the Gini coefficient calculations reported above.

Conclusions

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. Using data from multiple years, we show that the ratio between the conventional and rebalancing estimates is relatively stable over time—approximately 0.88—and robust to a variety of alternative modeling assumptions. This relatively stable ratio could prove useful for policymakers, as it provides a convenient rule of thumb for converting conventional estimates (which are relatively simple to calculate) to rebalancing estimates (which are more involved to calculate).

Standard theoretical considerations suggest that the MID would reduce distortions in households' homeownership decisions. 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. Financial Literacy, 2015

	Overall	Mortgage	No mortgage	Difference
Knowledge about personal finances	7.26	7.56	7.07	0.49
	(2.19)	(1.88)	(2.35)	[14.37]
Search for best terms when borrowing	6.54	7.24	6.09	1.15
	(3.21)	(2.68)	(3.44)	[23.47]
Search for best terms when saving and investing	6.01	6.29	5.82	0.47
	(3.21)	(3.01)	(3.32)	[9.22]
No. of observations	31,240	12,148	19,092	

	Overall	High wealth	Low wealth	Difference
Knowledge about personal finances	7.26	7.65	6.80	0.85
	(2.19)	(1.86)	(2.46)	[34.37]
Search for best terms when borrowing	6.54	7.02	5.95	1.07
	(3.21)	(2.95)	(3.42)	[29.14]
Search for best terms when saving and investing	6.01	6.46	5.45	1.01
	(3.21)	(2.90)	(3.48)	[27.55]
No. of observations	31,240	19,715	11,525	

Sources: SCF; authors' calculations.

Notes: Respondents were asked to rate from 0 to 10 their knowledge about personal finance, and their effort in searching for the "very best terms" when it comes to borrowing and credit decisions, and saving and investment decisions. The first column shows the mean rating for the sample. The second column of the top panel shows the mean rating for respondents with a positive mortgage balance, and the corresponding figures in the third column show the mean rating for respondents with no mortgage balance. The second column of the bottom panel shows the mean rating for respondents in the top three wealth quintiles, and the third column shows the mean rating for respondents below the top three wealth quintiles. Standard deviations are in parentheses. The last column shows the difference between the second and third columns, with *t* values in brackets.

Table 2. Descriptive Statistics, 1988–2015

Year	Taxpayers (millions)	Mortgage holders (millions)	Mean income	Mean wealth	Mean mortgage	Median home price	Mean mortgage interest rate (percent)	Percent for which $1 million cap is binding
1988	93.0	34.7	$113,727	$64,252	$88,121	$217,097	9.667	0.01
1991	95.9	36.9	$115,943	$64,346	$94,634	$203,080	9.077	0.03
1994	99.0	39.1	$106,590	$63,571	$102,253	$202,146	8.234	0.03
1997	102.5	42.3	$112,500	$108,293	$113,010	$211,135	7.944	0.07
2000	106.5	45.1	$133,377	$136,653	$124,771	$225,574	7.590	0.04
2003	112.1	50.4	$116,522	$113,639	$156,565	$246,088	6.187	0.17
2006	116.1	52.7	$123,589	$122,838	$173,238	$284,609	6.320	0.52
2009	117.6	52.5	$109,294	$109,752	$166,229	$233,714	5.711	0.72
2012	122.5	50.2	$114,711	$115,707	$160,818	$248,858	4.762	0.55
2015	126.0	49.6	$130,444	$166,246	$159,228	$294,200	4.360	0.83

Sources: SCF; authors' calculations; US 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 US Census Bureau. Income is adjusted gross income. Wealth includes CDs, mutual funds, bonds, stocks, checking accounts, savings accounts, money market mutual funds, and brokerage call accounts. Mean mortgage is the remaining balance on first mortgages. Mean mortgage interest rate is for first mortgages. The final column shows the percent of homeowners whose first and second mortgages together exceed $1 million.

Table 3. Assets Available for Rebalancing in the Simulations

	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.
Notes: Asset classes are not mutually exclusive. Non-transaction financial assets are a subset of financial assets, which are a subset of non-housing, non-retirement assets, which are a subset of all non-housing assets.

Table 4. Hypothetical Household Balance Sheet and Rebalancing Behavior

Asset or liability	Value	Pretax rate of return	Posttax rate of return	Tax revenue	Used for rebalancing
Before rebalancing					
Mortgage	–100,000	3	2.25	–750	
Stocks	150,000	6	4.5	2,250	Yes
Bonds	80,000	2.5	1.875	500	Yes
Checking accounts	250,000	0	0	0	No
Savings accounts	50,000	2	1.5	250	No
Business vehicle	20,000	–10	–7.5	–500	No
Retirement assets	750,000	4	3	7,500	No
Total	1,200,000			9,250	
After rebalancing					
Mortgage	0	3	2.25	0	
Stocks	130,000	6	4.5	1,950	
Bonds	0	2.5	1.875	0	
Checking accounts	250,000	0	0	0	
Savings accounts	50,000	2	1.5	250	
Business vehicle	20,000	–10	–7.5	–500	
Retirement assets	750,000	4	3	7,500	
Total	1,200,000			9,200	

Source: Authors' calculations.
Notes: The household faces a marginal tax rate of 25 percent and earns no labor income.

Table 5. Descriptive Statistics by Income Quintile, 2015

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 $17,599	$11,328	$21,185	$74,620	4.2
Second	$17,600 to $38,999	$4,425	$13,149	$85,851	1.9
Third	$39,000 to $67,999	$15,685	$29,889	$106,768	2.7
Fourth	$68,000 to $113,599	$30,764	$50,511	$135,288	4.9
Top	$113,600 and above	$347,568	$442,821	$262,062	18.0

Source: SCF; authors' calculations.

Notes: Dollar values are expressed in 2015 dollars. The sample is restricted to households in the 2016 SCF who report having a positive mortgage balance. Mortgage value is the remaining balance on first mortgages. The final column compares households' non-transaction financial assets to the lesser of their mortgage value or $1 million. Income is adjusted gross income. See Table 3 for the definitions of non-transaction financial assets and financial assets.

Table 6. Robustness of Revenue Estimates, 2015

	Population state assign			Age and income state assign		
	Conv	NTFA	FA	Conv	NTFA	FA
Excess mortgage	52.6	45.4	48.0	52.6	**45.4**	48.0
Excess mortgage if less	52.6	45.7	48.1	52.6	45.7	48.1
Excess mortgage random	52.6	45.3	46.4	52.6	45.3	46.5
Entire mortgage	52.6	43.9	45.9	52.6	43.7	44.6
Entire mortgage if less	52.6	43.9	45.9	52.6	43.9	44.7
Entire mortgage random	52.6	43.7	44.6	52.6	43.7	44.6
Elasticity –1.5	52.6	45.6	48.1	52.6	45.6	48.1
Elasticity –1.3	52.6	45.4	48.0	52.6	45.4	48.0
Elasticity –1.0	52.6	45.4	48.0	52.6	45.6	48.1
Sell up to 75%	52.6	46.4	48.3	52.6	46.6	48.4
Sell up to 50%	52.6	47.4	48.6	52.6	47.4	48.6
Sell up to 25%	52.6	49.0	49.7	52.6	49.1	49.8

Source: SCF; Bloomberg; FRED; American Community Survey; authors' calculations.

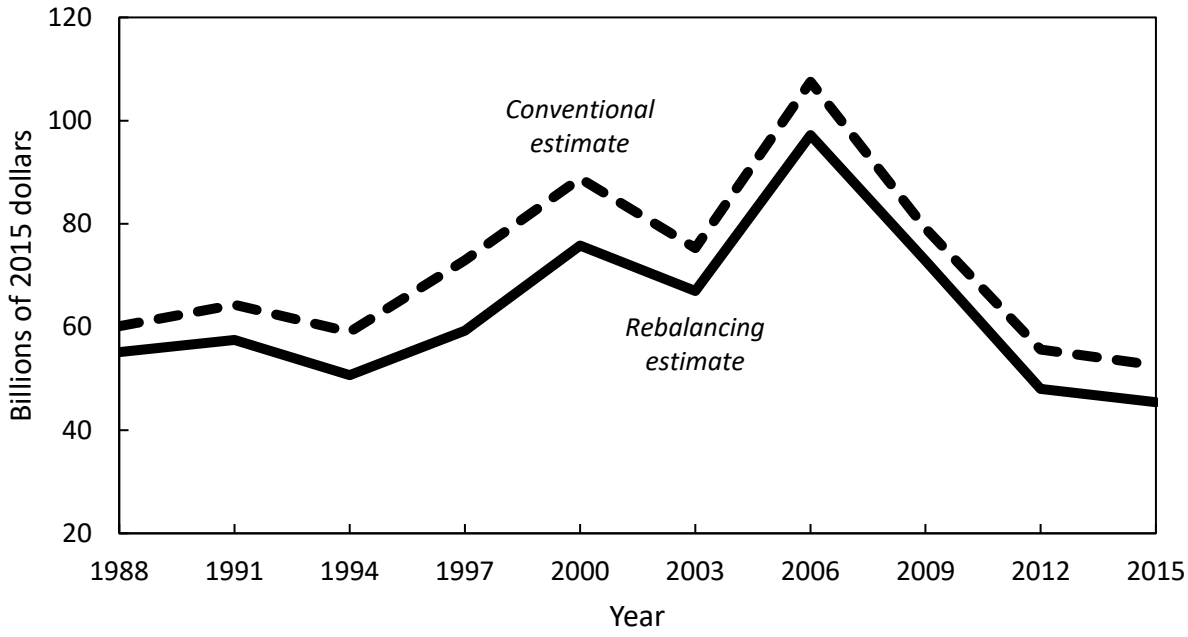
Notes: All values are expressed in billions of 2015 dollars. The left panel randomly assigns states of residence based on 2004 state population densities. The right panel randomly assigns states of residence based on year-specific, state-level, income and age distributions. The columns labeled "Conv" (conventional) do not allow for portfolio rebalancing. The columns labeled "NTFA" and "FA" assume households would sell non-transaction financial assets or all financial assets, respectively, to pay down their mortgages; see Table 3 for the definitions. Unless otherwise noted, households do not take into account the relative after-tax return between assets and the mortgage interest rate when deciding whether to rebalance; the qualifier "if less" indicates households only sell assets with a lower after-tax return than the mortgage interest rate. The rows labeled "random" assume households pay down assets in a random order. The rows labeled "excess mortgage" assume households only pay down their excess mortgages, as described in the text. The rows labeled "entire mortgage" assume households pay down their mortgages to the extent possible given their available assets. The rows labeled "elasticity" assume households rebalance according to the given elasticity of demand for mortgage debt with respect to the mortgage interest rate. The rows labeled "sell up to" assume households sell up to the given percentage of each of their assets. Our preferred estimate is bolded.

Table 7. The Mean Benefit of the MID for High-Income, High-Wealth Households and High-Income, Low-Wealth Households, 2015

	Conventional	Rebalancing	Difference	Mortgage	Assets
High income, high wealth	$735	$583	$152	$160,050	$107,719
High income, low wealth	$1,752	$1,752	$0	$198,205	$478

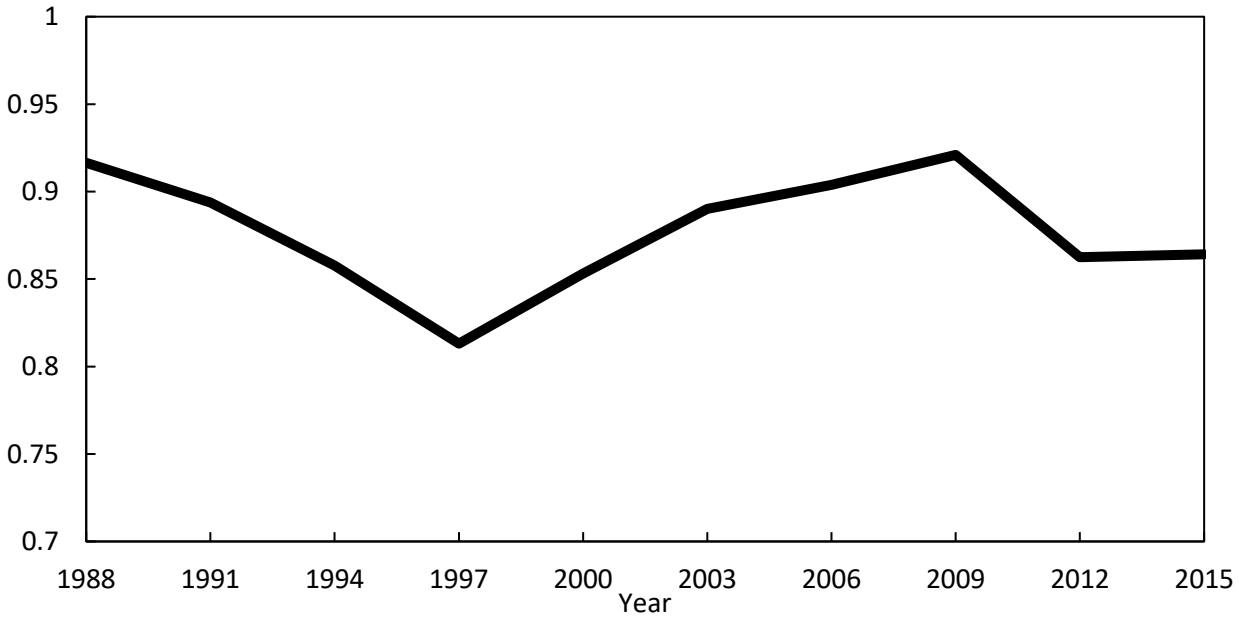
Sources: SCF; Bloomberg; FRED; American Community Survey; authors' calculations.
Notes: All values are expressed in 2015 dollars. The sample is restricted to households in the 2016 SCF who report having a positive mortgage balance. The first row shows mean values for households that are in both the 9th 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. Income is adjusted gross income. See the notes to Table 2 for the components of wealth.

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



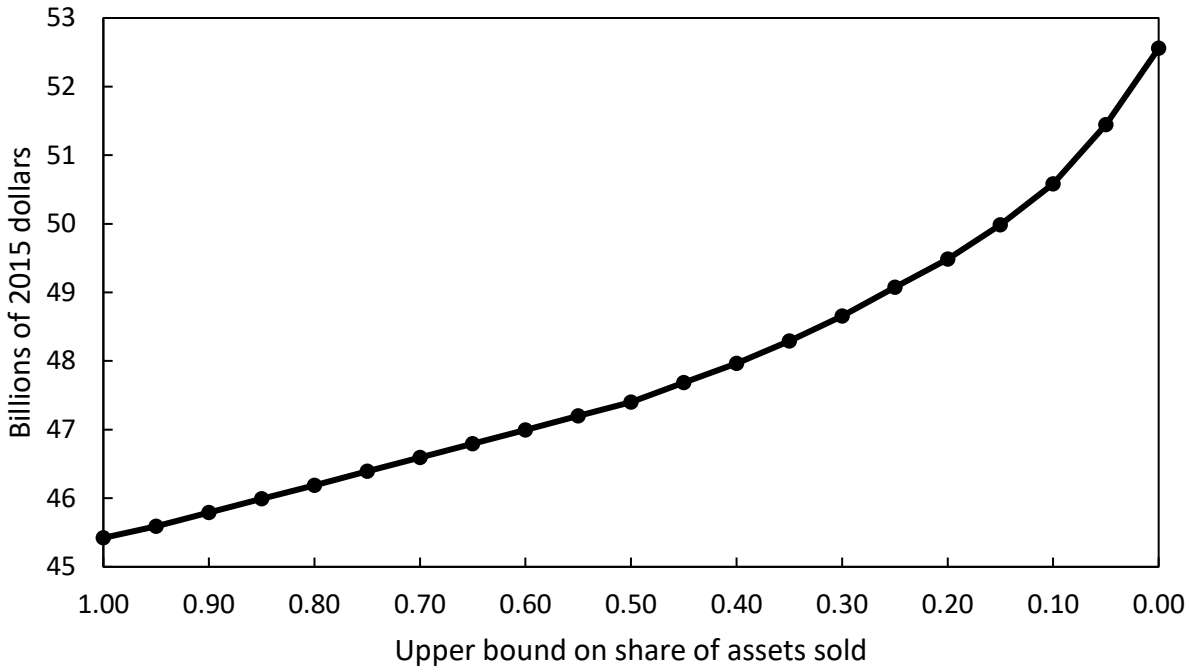
Sources: SCF; Bloomberg; FRED; American Community Survey; authors' calculations.
Notes: The conventional estimate assumes there would be no portfolio rebalancing if the MID were eliminated. The rebalancing estimate assumes that households would sell all available non-transaction financial assets to pay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

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



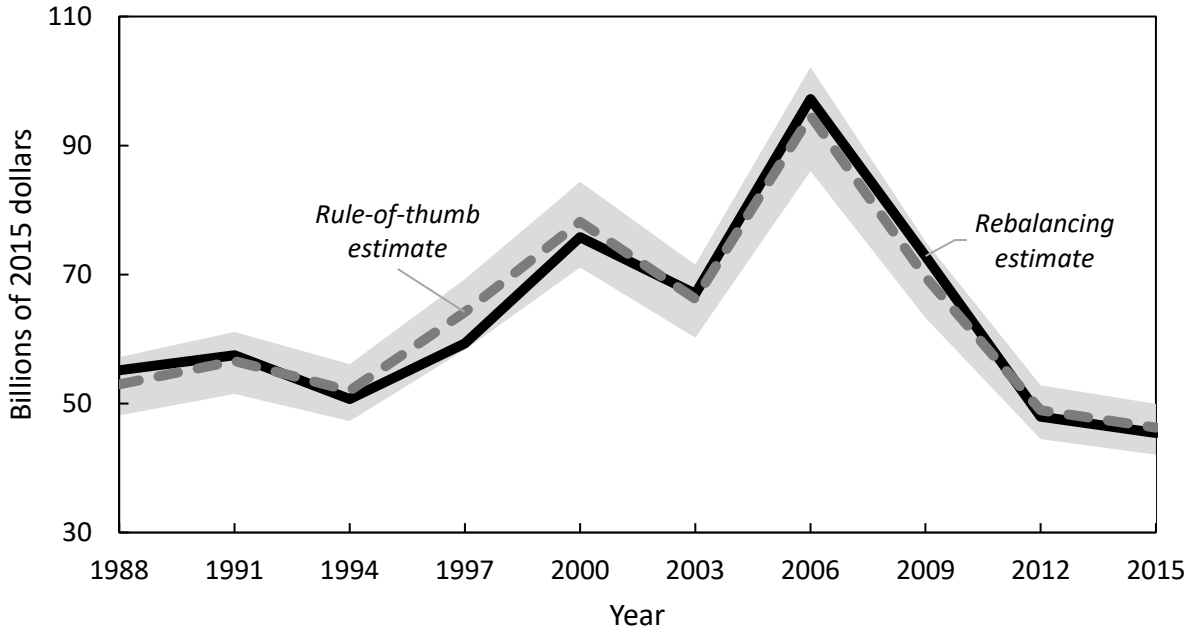
Sources: SCF; Bloomberg; FRED; American Community Survey; authors' calculations.
Notes: This diagram reconfigures the information from Figure 1 by showing each year's ratio of the rebalancing to the conventional estimate of the cost of the MID.

Figure 3. Rebalancing Estimate of the Revenue Cost of the MID when the Share of Assets Used for Rebalancing is Arbitrarily Bounded Above, 2015



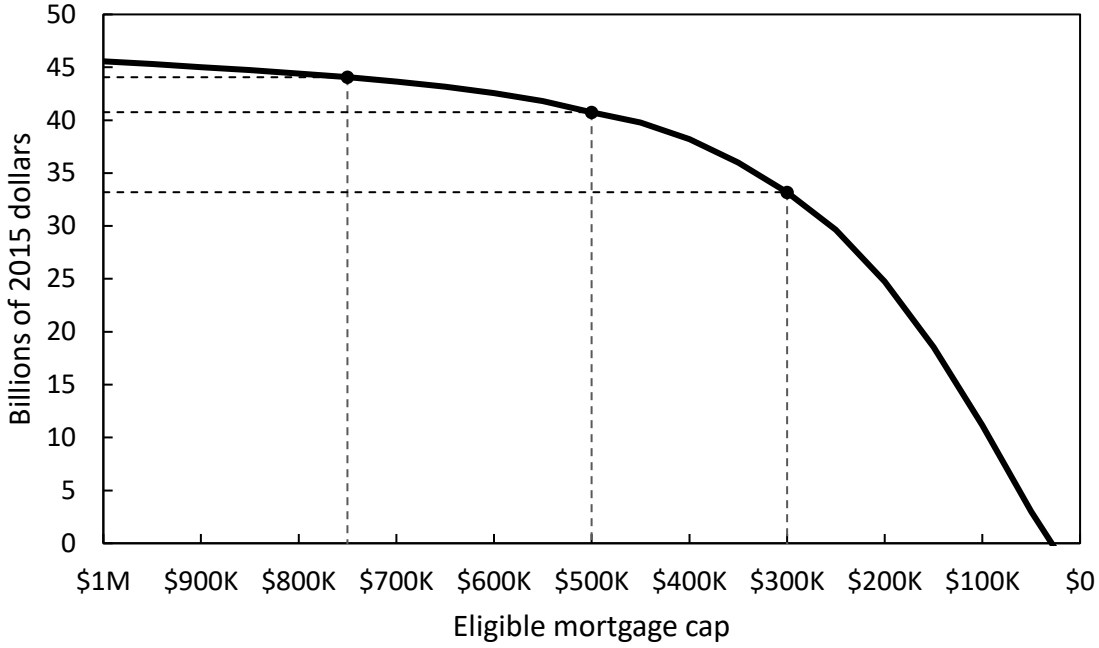
Sources: SCF; Bloomberg; FRED; American Community Survey; authors' calculations.
Notes: The rebalancing estimate assumes that households would sell non-transaction financial assets to pay down their excess mortgage. The horizontal axis indicates the maximal proportion of the households' assets that would be used to pay down their excess mortgage.

Figure 4. Rule-of-Thumb Estimate of the Revenue Cost of the MID



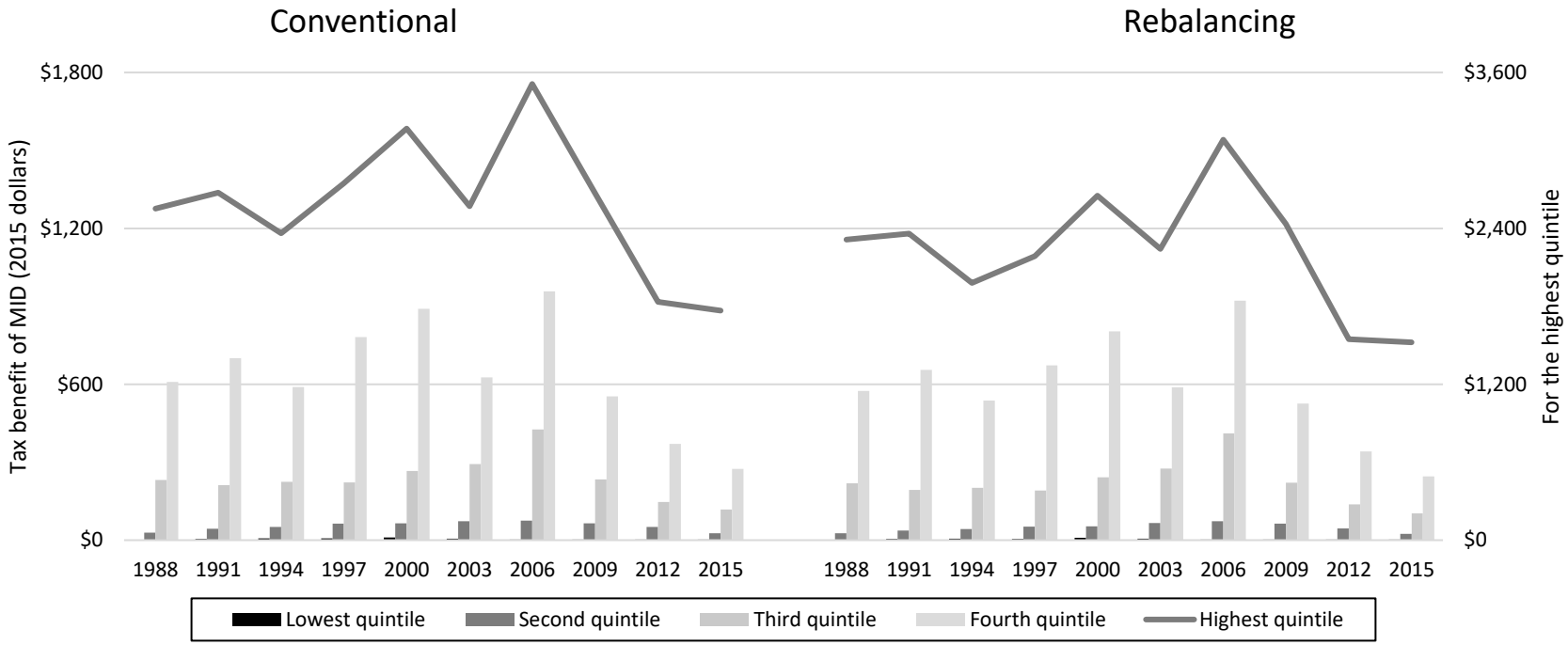
Sources: SCF; Bloomberg; FRED; American Community Survey; authors' calculations.
Notes: The conventional estimate assumes there would be no portfolio rebalancing if the MID were eliminated. The rebalancing estimate assumes that households would sell all available non-transaction financial assets to pay down their excess mortgage. The rule-of-thumb estimate is the conventional estimate multiplied by 0.88. The shaded area is the conventional estimate multiplied by 0.95 (top) and 0.80 (bottom).

Figure 5. Estimate of the Revenue Cost of the MID under Different Eligible Mortgage Caps



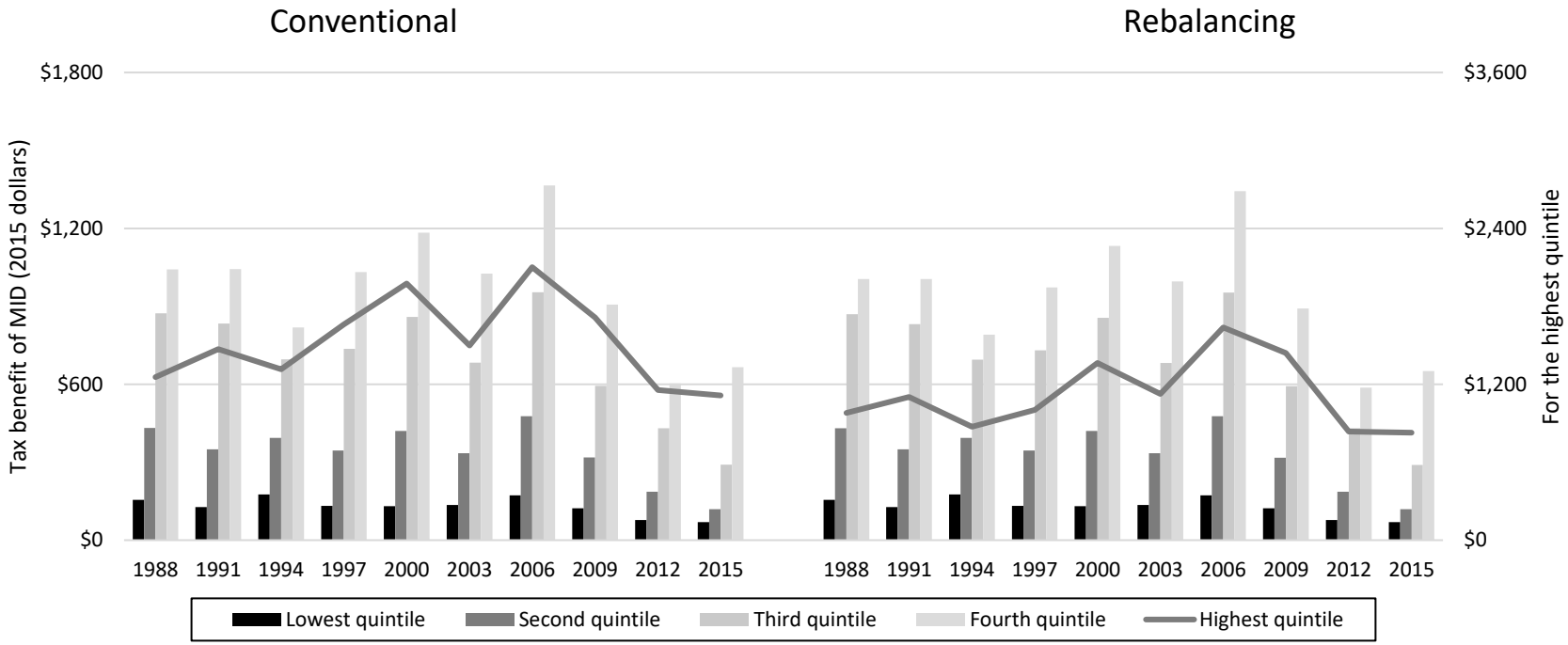
Sources: SCF; Bloomberg; FRED; American Community Survey; authors' calculations.
Notes: The rebalancing estimate assumes that households would sell all available non-transaction financial assets to pay down their excess mortgage. Households are assumed not to change their borrowing behavior in response to a change in the eligible mortgage cap.

Figure 6. The Dollar-Value Benefit of the MID With and Without Rebalancing, by Income



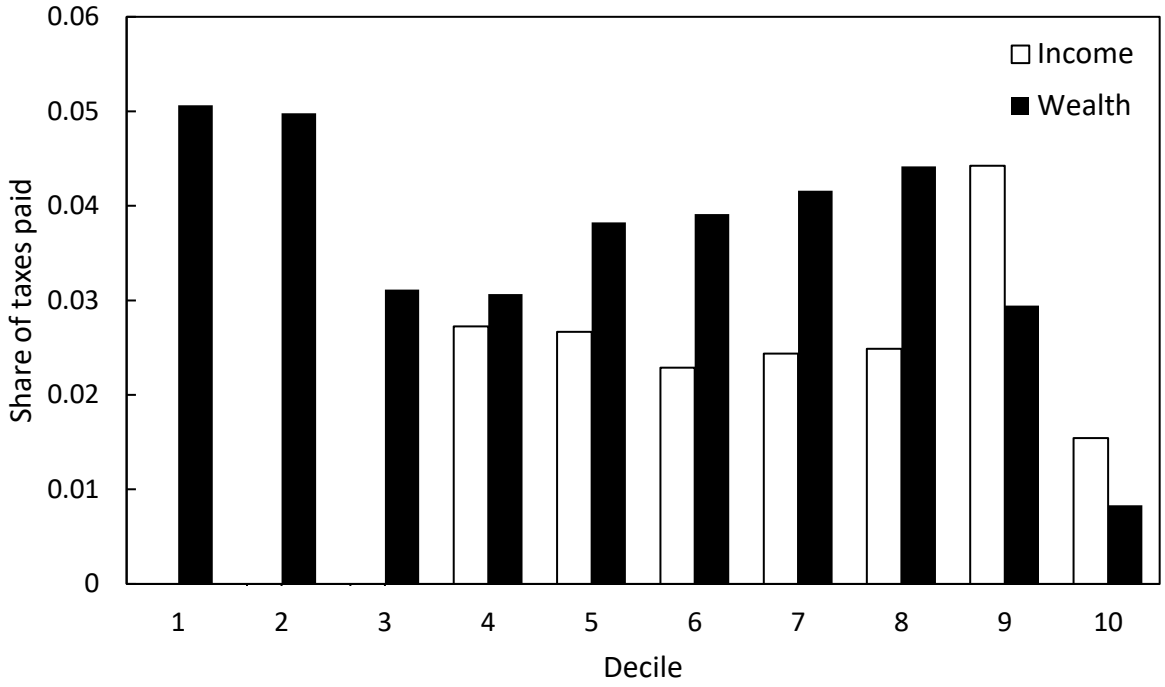
Sources: SCF; Bloomberg; FRED; American Community Survey; authors' calculations.
Notes: Income is adjusted gross income. The conventional estimate assumes there would be no portfolio rebalancing if the MID were eliminated. The rebalancing estimate assumes that households would sell all available non-transaction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

Figure 7. The Dollar-Value Benefit of the MID With and Without Rebalancing, by Wealth



Sources: SCF; Bloomberg; FRED; American Community Survey; authors' calculations.
Notes: See the notes to Table 2 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 excess mortgage.

Figure 8. MID Benefits as a Share of Taxes Paid, by Income and Wealth Deciles, 2015



Sources: SCF; Bloomberg; FRED; American Community Survey; authors' calculations.
Notes: Taxpayers with non-positive income are excluded. The rebalancing estimate assumes that households would sell all available non-transaction financial assets to pay down their excess mortgage. Income is adjusted gross income. See the notes to Table 2 for the definition of wealth.

APPENDIX

This Appendix provides information on the TAXSIM model and the 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 HOUSEHOLD FINANCES

The data on household 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, which are constructed from SCF data, are used in the TAXSIM 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 (2016)
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	
Current home value	X716	What is the current value of this (home and land/apartment/property)?
Home purchase price	X717	How much did it cost when you originally acquired it?
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	2004-2016	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	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 US tax law, the returns to various assets are generally taxed at different rates:

Wages, salaries, tips, etc. are taxed at the **ordinary income tax rate**.

Taxable interest 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 is **not taxed** at the federal level. This includes the return on state and municipal bonds.

Ordinary dividends are taxed at the **ordinary income tax rate**. Before 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 are taxed at a **lower rate than ordinary income**.

Short-term capital gains are taxed at the **ordinary income tax rate**.

Long-term capital gains 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 accounts for how total gains or losses are generated, and reports 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 make the following assumptions: (i) Distributions from stock mutual funds are taxed as long-term capital gains; (ii) Distributions from tax-free bond mutual funds are not taxed. (iii) Distributions from government and other bond mutual funds are taxed as ordinary income. (iv) Combination funds and other mutual funds are composed of 60% stocks and 40% bonds, and are taxed accordingly.

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

Endnotes

[i] The limits apply to "the combined amount of loans used to buy, build, or substantially improve the taxpayer's main home and second home." Mortgages issued before the 2017 tax law are still subject to the $1 million cap, but so is home equity debt used to buy, build, or substantially improve the home; all are considered "acquisition debt," rather than "home equity indebtedness." Home equity debt used for other purposes—such as for personal living expenses or paying off credit card debt—is no longer deductible. Non-grandfathered debt is subject to the lower $750,000 cap. See Internal Revenue Service (2018), Sahadi (2018), Bischoff (2018), and Carrns (2018).

[ii] See also the Joint Committee on Taxation (1987, pp. 263–64) and Dietz (2013).

[iii] Several countries tax imputed rent, including Iceland, Luxembourg, the Netherlands, Slovenia, and Switzerland.

[iv] The House version of the Tax Cuts and Jobs Act proposed to lower the cap to $500,000, while the Senate version proposed no change to the cap. The conference committee split the difference and settled on $750,000.

[v] The Joint Committee on Taxation (2018, p. 52) reports the distribution of the MID by income class *after* the TCJA while the Joint Committee on Taxation (2017, p. 44) reports the distribution *before* the TCJA. The Joint Committee on Taxation's estimates show that households whose incomes are less than $100,000 will receive only 12 percent of the total tax benefit associated with the MID in 2018. While households in all income classes see a reduction in the MID benefit after the TCJA, households whose incomes are greater than $200,000 see a smaller proportional decline, 38 percent, compared to 60 percent for households making between $100,000 and $200,000, and 64 percent for households making less than $100,000 (Joint Committee on Taxation 2017, p. 44). This is consistent

with the notion that higher-income homeowners are hurt less (in proportional terms) by a reduction in the MID, presumably because of their greater ability to rebalance their portfolios.

[vi] Note that, in contrast, the Joint Committee on Taxation's estimates do allow for the possibility of portfolio rebalancing, although documentation about the exact methodology is not publicly available (Barthold, 2011; Joint Committee on Taxation, 1995, 2005, 2011). We thank Thomas Barthold for clarifying this for us.

[vii] See Follain and Melamed (1998), Gervais and Pandey (2008), and Poterba and Sinai (2011). 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.

[viii] See, for example, the President's Advisory Panel on Federal Tax Reform (2005), the National Commission on Fiscal Responsibility and Reform (2010), the Dominici–Rivlin Debt Reduction Task Force (2010), and the TCJA.

[ix] Notable contributions include Follain and Dunsky (1997), Ling and McGill (1998), and Dunsky and Follain (2000).

[x] 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.

[xi] Further, our estimates are largely unchanged if we assume that the order in which assets are used to pay down the mortgage is chosen randomly.

[xii] That is, households do not take into account after-tax returns on the various assets and how they compare to the mortgage interest rate. Our results are substantively the same if we assume that households would only sell assets with after-tax returns below the mortgage interest rate.

[xiii] There is also a possibility that homeowners may be deterred from paying down their mortgages ahead of schedule due to prepayment penalties. Mortgages with a prepayment penalty are less common today than they were in the early 2000s, and even lenders who charge such fees generally allow borrowers to pay off up to 20 percent of the loan balance each year without penalty. In fact, the Dodd–Frank Act prohibits prepayment penalties for most residential mortgages, except under a few specific circumstances. In particular, a prepayment penalty, not to exceed 2 percent of the outstanding loan balance, is only allowed during the first three years after the loan is consummated. See 12 C.F.R. § 1026.42(g) and 78 Fed. Reg. 6407 (January 10, 2014).

[xiv] See also Skinner and Feenberg (1990).

[xv] Note, however, that the inclusion of β does not imply that when households make portfolio adjustments in response to tax changes they only draw down assets with a risk premium equal to β when they pay down their mortgages.

[xvi] The model of mortgage demand has implicitly assumed that households holding an excess mortgage $XM_t > 0$ face after-tax $r_m < r$. That is, these households implicitly use low-interest-rate mortgage debt to finance assets yielding a higher after-tax return than the mortgage interest rate. If mortgage interest were no longer deductible, then the after-tax mortgage interest rate would increase from $(1 - \tau_m)r_m$ to r_m. In order to calculate the change in tax liability resulting from elimination of the MID we assume that the mortgage interest rate increases to the point at which after-tax $r_m > r$. If after-tax $r_m > r$ then households have no incentive to finance non-housing assets with excess mortgage debt and will consequently sell assets to pay down their excess mortgage debt.

[xvii] See Moore (2003). Note that the SCF asks about the prior year's finances; thus, for example, the 2016 SCF corresponds to calendar (tax) year 2015. TAXSIM and the SCF data are available on the

National Bureau of Economic Research's website (see the Appendix for a description of the model and data).

[xviii] McGinty (2017) specifically recommends that households take risk and liquidity considerations into account when deciding whether to pay down their mortgages. For instance, individuals may want to hold long-term mortgage debt while simultaneously holding short-term debt instruments to hedge against the possibility that interest rates will rise.

[xix] This assumption implies risk neutrality when it comes to the portfolio rebalancing decision. We do not assume, however, that households are risk neutral in equilibrium. Risk neutrality in this specific circumstance is reasonable and makes the model more tractable. The results are robust to relaxing this assumption, as shown in Table 6. We make a rough attempt to incorporate liquidity considerations by excluding relatively liquid "transaction" financial assets from the rebalancing decisions of households. See Table 3 for definitions.

[xx] The results using the full set of financial assets differ by no more than $2.5 billion, and on average $1.4 billion over all the years.

[xxi] Note that because the returns to some retirement assets are untaxed, using them to pay down one's mortgage would not affect the revenue consequences of the MID.

[xxii] 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.

[xxiii] 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. Hence, we ignore these effects.

[xxiv] The 10 percent figure comes from Investopedia, which reports that, "The average annual return for the S&P 500 since its inception in 1928 through 2017 is approximately 10 percent." This is consistent with our own calculations based on Robert Shiller's stock price data for our sample period, 1988–2015.

[xxv] 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 2016 SCF, we calculate that this one-time increase in tax revenue would be roughly $34.1 billion. This value 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.

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

[xxvii] Hilber and Turner (2014) note that if the supply of owner-occupied housing is inelastic then the MID will be capitalized into the purchase price.

[xxviii] This calculation assumes a constant loan-to-value ratio but a reduced demand for housing.

[xxix] The rate shown for business vehicles is negative because it represents a depreciation rate, which can be deducted from business income.

[xxx] One could instead assume households only sell assets with an after-tax rate of return below the mortgage interest rate—in this example, stocks would not be sold. We investigate the robustness of the results to this assumption in Table 6.

[xxxi] We are grateful to one of our referees for this suggestion. The distributions are calculated from the American Community Survey.

[xxxii] In short: First, a baseline (current law) gross revenue estimate is calculated. Second, a conventional (no rebalancing) gross revenue estimate is calculated. The "conventional estimate" is the difference between the conventional and baseline gross revenue estimates. (This is the figure that plays a major role in policy debates.) Next, a rebalancing gross revenue estimate is calculated. The "rebalancing estimate" is the difference between the rebalancing and baseline gross revenue estimates. Finally, the "ratio of the conventional and rebalancing estimates" is calculated as the ratio of these two estimates. We are taking the ratio of two differences.

[xxxiii] Our conventional estimates are quite close to those of the Joint Committee on Taxation and Office of Management and Budget. For example, our conventional estimate for 2003 (in 2003 dollars) shows a revenue loss of $59.6 billion associated with the MID, while the Joint Committee on Taxation's (2002) estimate is $69.9 billion, and Office of Management and Budget'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).

[xxxiv] All dollar values are expressed in 2015 dollars, using the CPI to adjust for inflation.

[xxxv] This finding is consistent with Poterba and Sinai (2011), who find an average change in tax liability from MID elimination of $858 per household under the scenario using non-transaction financial assets and $864 under the scenario using all financial assets.

[xxxvi] Only 4.3 percent of households have mortgages above $500,000, the cap initially proposed in the House version of the TCJA.

[xxxvii] However, this effect might be attenuated because there is an implicit tax on rebalancing, to the extent that non-housing assets earn a higher after-tax return than the mortgage interest rate.

[xxxviii] Gross and Souleles (2002) note that younger households tend to be more liquidity-constrained.

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