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Costly reversals of bad policies: The case of the mortgage interest deduction

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ABSTRACT

This paper measures the welfare effects of removing the mortgage interest deduction under a variety of implementation scenarios. To this end, we build a life-cycle model with heterogeneous households calibrated to the U.S. economy, which features long-term mortgages and costly refinancing. In line with previous research, we find that most households would prefer to be born into an economy without the deductibility. However, when we incorporate transitional dynamics, less than forty percent of households are in favor of a reform and the average welfare effect is negative. This result holds under a number of removal designs.

1. Introduction

When the mortgage interest deductibility (MID) was passed into law through the Revenue Act of 1913, it was largely insignificant. Hardly any households paid federal income taxes, and those who did predominantly faced a marginal tax rate of only one percent (Ventry, 2010). Today, the MID has become a symbol of the "American dream" of homeownership and reduces the cost of housing for millions of Americans.

The desirability of the MID has recently been called into question. In public discussions, opponents of the MID argue that it is a costly subsidy that does little to help households into the housing market as a disproportionate share of total deductions are claimed by high earners, who would be homeowners regardless (Desmond, 2017).[1] Moreover, the results in the academic literature generally show that most American households would be better off without the MID in the long run.[2]

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[1] Total tax expenditures due to the MID are estimated to 63.6 billion dollars in 2017 (JCT, 2017), which is close to the entire annual spending of the Departments of Commerce, Energy, and Justice.

[2] See, e.g., Chambers et al. (2009), Floetotto et al. (2016), Gervais (2002), and Sommer and Sullivan (2018).

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In this paper, we study how a removal of the MID affects households both in the short and the long run. While our analysis of long-run effects addresses the question whether households would prefer to be born into an economy with or without the MID, the short-run analysis specifically considers the welfare implications of those alive at the time of the removal. The welfare effects may be substantially different in the short run, as current households have already made long-term housing and financing decisions based on the presumption that they can deduct mortgage interest payments.

We find that although the vast majority of households would prefer to be born into a world without the MID, the implementation costs of a removal exceed the benefits. Less than forty percent of current households are in favor of removing the subsidy and the average welfare effect is significantly negative. Interestingly, more gradual removal policies that enable homeowners to adjust their asset holdings before the MID is removed do not increase the support for a removal. These results are robust to including the tax code changes made in the 2017 Tax Cuts and Jobs Act. Further, we cannot find a one-time transfer scheme that taxes winners and compensates losers, within the current generation, that leads to a Pareto improvement under any of the policies we consider. Our results thus show that the costs of reverting a bad policy can be substantial — even to the extent that it might not be worthwhile.

To arrive at this conclusion, we study the welfare effects of a removal of the MID through the lens of a life-cycle model with overlapping generations and incomplete markets in which house and rental prices adjust endogenously to clear the housing market. Households can borrow against their house in the form of long-term mortgages. These loans are subject to equity and payment-to-income requirements, and refinancing is costly. The tenure decision is endogenous and there are transaction costs associated with both buying and selling a house. We include the salient features of the U.S. tax code with respect to housing, namely that imputed rents are not taxed and that property taxes and mortgage interest payments are tax deductible. Furthermore, households can choose between itemized deductions and a standard deduction, where the former includes mortgage interest payments. Both deductions are subtracted from earnings that are subject to a progressive tax schedule.

We perform a series of decompositional exercises to better understand: i) why the results in the long run differ so markedly from those in the short run; and ii) why more gradual policies are ineffective in bridging this gap. A natural starting point is to understand why it is beneficial to remove the MID in the long run. We find that the positive welfare results in the long run are due to changes in several equilibrium objects. Households benefit from lower rental and house prices, a lower labor income tax rate, and higher bequests. The direct effect of removing the MID is an increase in the user cost of owning a house for households that itemize deductions. To accommodate the lower housing demand of these households, house and rental prices fall. Reduced prices make rental services more affordable and owned housing more accessible. To ensure tax neutrality, we let the labor income tax be reduced as the government no longer subsidizes mortgage financing. In addition, more bequests are distributed to households as the average net worth goes up. For most households, these positive effects outweigh the direct negative effect of removing the MID.

In our analysis of the transitional dynamics, we begin by studying the effects of an immediate removal and show that the fall in house prices, which increases welfare in the long run, decreases welfare in the short run. Lower house prices reduce housing equity, and thus the wealth of homeowners and the values of bequests. This effect hurts older homeowners in particular. Furthermore, the direct negative effect of increasing the user cost of owner-occupied housing is more prominent, especially for relatively young households that have just entered the housing market and are highly leveraged.

Given that it is beneficial for the lion's share of households to remove the MID in the long run, we explore two alternative policies that are less abrupt and give households time to adjust their asset holdings before the MID is repealed. First, we analyze the effects of linearly reducing the deductible share of mortgage interest payments over fifteen years. Second, we consider an announcement policy in which households can fully deduct their interest payments on mortgages for another fifteen years, after which no payments can be deducted. We find that the immediate policy actually results in the smallest average welfare loss among the policies and has the highest share of households who benefit from a removal. More gradual policies do successfully mitigate the welfare losses of older homeowners and households with large mortgages and high earnings. Importantly, though, these policies also significantly reduce the benefits associated with the immediate policy. Renters prefer reforms in which prices and taxes fall rapidly as they are not directly affected by an MID removal. Higher income and property taxes under more gradual policies also push a considerable share of homeowners that realize welfare gains under an immediate reform into negative welfare territory.

There is a relatively new literature that uses dynamic models with heterogeneous agents to evaluate the consequences of repealing the MID. We build on this strand of the literature, in particular on the work by Floetotto et al. (2016) and Sommer and Sullivan (2018) who both show the importance of studying heterogeneous effects in the implementation phase of housing tax reforms. We contribute to the literature in three ways.

First, contrary to the findings in Floetotto et al. (2016) and Sommer and Sullivan (2018), we find a large and negative average welfare effect of an immediate removal policy and that a majority of households are against such a reform. Although our model shares many similarities with the models in these papers, there are some key differences leading to the discrepancy in the results.[3] Of particular importance is that housing equity is less liquid in our model, due to the refinancing

[3] In terms of the long-run analysis, we corroborate the important result in Sommer and Sullivan (2018) that homeownership increases when the MID is removed.

costs of existing mortgages. These costs are considerable, both in the data and in our model, and make it more difficult for households to cushion negative shocks.

Our analysis also differs from that of Sommer and Sullivan (2018) along other important dimensions. We use a model that realistically captures the full life cycle of households and show that the inclusion of retirees is of quantitative importance for the welfare analysis. Specifically, we find that homeowners in retirement are worse off relative to the average working-age household when the MID is removed. For retirees, housing wealth constitutes a greater proportion of total resources, and they have fewer periods left to smooth the negative wealth shock caused by the house price decline. Moreover, in our analysis, households incur negative welfare effects from receiving smaller bequests along the transition due to the sudden house price drop.

Floetotto et al. (2016) study the short-run impact of an MID repeal using a life-cycle model that includes a bequest motive. However, in their analysis, mortgage interest deductions are claimed against earnings that are subject to a proportional labor income tax rate, and all homeowners are implicitly assumed to itemize deductions. In contrast, homeowners in the U.S. and in our model face a progressive labor income tax schedule, and a significant share of households with a mortgage do not itemize deductions. These features allow our model to replicate the pronounced skewness of mortgage interest deduction claims towards high-earning households as seen in the data.

The second contribution of this paper is that we consider and compare the welfare effects of alternative policies for removing the MID. We believe that our analysis of alternative policies enhances the understanding of why the MID has been challenging to repeal, and what type of trade-offs a policymaker faces. Importantly, our results suggest that natural candidates for removal policies – more gradual policies – are not necessarily preferred by households. Overall, our findings are closely related to those in Conesa and Krueger (1999), who find negative welfare effects of a transition from a pay-as-you-go social security system to a fully funded system, with the highest fraction of households in favor of an immediate reform.

Finally, we contribute by assessing how the 2017 Tax Cuts and Jobs Act affects the welfare consequences of removing the MID. The tax reform substantially reduces the number of households who itemize deductions, as the standard deduction is almost doubled and a cap on deductions for state and local income tax payments and property tax payments is introduced. Although fewer households claim mortgage interest deductions, we find that a majority of households are against a removal and the average welfare effect is still negative in the short run. The MID removal has a more moderate effect on taxes and prices, which reduces the welfare losses for homeowners, but also the welfare gains for renters.

The remainder of the paper is organized as follows. In Section 2 we present the model. We explore a simplified version of the model in Section 3 and use it to discuss the net benefit of owner-occupied housing and how it is affected by the MID. The calibration of the baseline economy is presented in Section 4, along with a comparison to both targeted and non-targeted data moments. Section 5 shows and discusses the results of the different policy experiments, while section 6 concludes the paper.

2. Model

To analyze the effects of removing the mortgage interest deductibility, we construct a life-cycle model with overlapping generations and incomplete markets. The model is in discrete time, where one model period corresponds to three years. It features three types of agents: households, rental firms, and a government. Households start their lives with different levels of net worth. Further heterogeneity arises from aging and idiosyncratic earnings shocks. Rental firms operate in a competitive market with free entry and exit, and provide rental services to households. The government taxes households and rental firms in a manner that mimics the U.S. tax system. Importantly, we include the main features of the U.S. tax code with respect to housing, namely that imputed rents are not taxed, and that property taxes and mortgage interest payments are tax deductible. Furthermore, itemized and standard tax deductions are available to households, and are deducted from earnings that are subject to a progressive tax schedule.

There are three assets in the economy: houses, mortgages, and risk-free bonds. Houses are available in discrete sizes, and there are transaction costs associated with both buying and selling a house. The stock of housing is fixed in aggregate, but flexible in its composition.[4] In equilibrium, house prices and rental prices adjust to clear the housing market. The interest rates on mortgages and bonds are exogenous and the supply of both assets is perfectly elastic.

2.1. Households

Households are born with initial assets as in Kaplan and Violante (2014). Over the course of the life cycle, households are hit by idiosyncratic permanent and transitory earnings shocks. A household retires with certainty after period J_{ret} and cannot live past period J. The probability of surviving between any two ages j and $j+1$ is $\phi_j \in [0,1]$, and the agents discount exponentially with a factor β. In each period, a household derives utility from a consumption good c and housing services s through a CRRA utility function with a Cobb-Douglas aggregator

[4] The main focus of this paper is the short-run effects of a housing subsidy removal. Therefore, we find the assumption of a fixed aggregate supply of housing reasonable.

$$U_j(c,s) = e_j \frac{\left(c^{\alpha} s^{1-\alpha}\right)^{1-\sigma}}{1-\sigma}, \tag{1}$$

where e_j is an age-dependent utility shifter that captures changes in household size over the life cycle (see, e.g., Kaplan et al. (2020)). There is also a warm-glow bequest motive similar to De Nardi (2004), given by the bequest function

$$U^B(q') = \upsilon \frac{\left(q' + \bar{q}\right)^{1-\sigma}}{1-\sigma}, \tag{2}$$

where υ is the weight assigned to the utility from bequests, q' is the net worth of the household, and $\bar{q}$ captures the extent to which bequests are luxury goods. The objective of the household is to maximize the expected sum of discounted lifetime utility.

A household enters each period j with bonds b, mortgage m, and house h, according to the choices made in the previous period. In the current period, earnings y are realized, the household receives bequests, and pays taxes Γ. It then chooses consumption c, housing service s, bonds b', mortgage m', and house h'. Housing services are either obtained via the agent's owned house or from a rental company. Each unit of housing costs p_h to buy and p_r to rent. An owned house of size h' produces housing services through a linear technology $s = h'$. These services have to be consumed by the owner of the house, which implies that households cannot be landlords. We model landlords implicitly through a rental market, as landlords are treated as business entities in the U.S. tax code. In addition, since landlords are treated as businesses, they are not directly affected by a removal of the mortgage interest deductibility. Households can use mortgages m', with the interest rate r^m, to finance their homeownership. Bonds b' can be purchased in any non-negative amount, earning interest $r < r^m$.

Mortgages are long-term and non-defaultable. In each period, a homeowner with a mortgage needs to adhere to an amortization schedule that specifies a minimum payment $\chi_j m$, where χ_j is defined as

$$\chi_j = \left(\sum_{k=1}^{M_j} \left[\frac{1}{(1+r_m)^k} \right] \right)^{-1}. \tag{3}$$

The maturity of the mortgage is given by $M_j = \min\{10, J - j\}$, which implies that the minimum payment is similar to that of an annuity mortgage with either 30 years remaining (10 model periods) or the number of years until the household dies with certainty.[5] A household that stays in a given house has the option to not follow the repayment plan by taking up a new mortgage, but then it incurs a fixed refinancing cost ς^r.

A household that takes up a new mortgage, either when it purchases a new house or refinances an existing mortgage, has to comply with two constraints. First, a loan-to-value (LTV) requirement states that a household can only use a mortgage to finance up to an exogenous share $1-\theta$ of the house value

$$m' \le (1-\theta) p_h h'. \tag{4}$$

Second, a payment-to-income (PTI) constraint ensures that a household can only choose a mortgage such that the cost of housing-related payments does not exceed a fraction ψ of current permanent income z. Formally,

$$\chi_{j+1} m' + (\tau^h + \varsigma^I) p_h h' \le \psi z, \tag{5}$$

where τ^h and ς^I capture property tax and home insurance payments, respectively.[6] The PTI and LTV requirements together with the refinancing cost limit the possibility to extract housing equity. Thus, instead of paying off a mortgage to increase the housing equity, liquid bonds constitute a more suitable instrument for precautionary savings purposes. In equilibrium, some households will therefore choose to hold bonds and mortgages at the same time.

The household problem has five state variables: age j, permanent earnings z, mortgage m, house size h, and cash-on-hand x. The first two are exogenous, while the latter three are affected by a household's choices. State x is defined as

$$x \equiv y + (1+r)b - (1+r^m)m + (1-\varsigma^s) p_h h - \delta^h h + a - \Gamma, \tag{6}$$

where $(1-\varsigma^s)p_h h$ is the value of the house net of transaction costs.[7] The transaction cost of selling a house is modeled as a share ς^s of the house value. The maintenance cost $\delta^h h$ is paid by all homeowners, and is proportional to the size of the

[5] The 30-year mortgage contract is the most common plan in the U.S. For other ways of modeling long-term mortgages, see, e.g., Kaplan et al. (2020) or Boar et al. (2020).

[6] Mortgage payments, property taxes, and home insurance costs are three main components used by banks to assess the payment capability of mortgage applicants. The home insurance payment does not enter the household budget constraint in the model, but is included in the PTI requirement for calibration purposes, see Section 4.1.

[7] For computational reasons, and without loss of generality, we define cash-on-hand as including the net revenue of selling the house. Households who do not sell their house between any two periods do not incur any transaction costs.

house. Initial assets and inheritance are captured by the term a. For a detailed description of how inheritance is modeled, see Section 2.3. Total tax payments are represented by Γ, and consist of five different taxes

$$\Gamma \equiv \tau^l y + I^W \tau^{ss} y + \tau^c rb + \tau^h p_h h + T(\tilde{y}). \tag{7}$$

Similar to the U.S. tax system, a household pays a local labor income tax τ^l, a payroll tax τ^{ss} (only paid by working-age households, represented by the dummy variable I^W), a capital income tax τ^c, a property tax on owned housing τ^h, and a federal labor income tax $T(\tilde{y})$.[8] The federal labor income tax is given by a non-linear tax and transfer system, which is a function of earnings net of deductions $\tilde{y}$. In turn, deductions depend on a household's mortgage, house value, and gross earnings. For a detailed description of the non-linear tax and transfer system see section 2.3, in particular equations (10) and (11).

The household problem includes the discrete choice of whether to rent a home, buy a house, stay in an existing house but refinance the mortgage, or stay in an existing house and follow the repayment plan. Therefore, we split the household problem into these four respective cases, and solve it recursively. Let us define the expected continuation value in the next period as

$$\mathbb{E}\left[W_j(z', x', h', m', q')\right] \equiv \phi_j \mathbb{E}\left[V_{j+1}(z', x', h', m')\right] + (1-\phi_j)U^B(q').$$

If the household chooses to rent, the optimization problem is given by

$$V_j^R(z, x) = \max_{c,s,b'} U_j(c, s) + \beta \mathbb{E}\left[W_j(z', x', h', m', q')\right]$$

subject to

$$\begin{aligned}
&x' = y' + (1+r)b' + a' - \Gamma' \\
&q' = b' \\
&x = c + p_r s + b' \\
&s \in S \\
&c > 0, h' = 0, b' \geq 0, m' = 0.
\end{aligned}$$

The problem is characterized by the Bellman equation, the law of motion for cash-on-hand, the equation for bequests, the budget constraint where the current period cash-on-hand is given, and a number of additional constraints. In this first case, the household rents a house and can therefore not take up a mortgage, implying $h' = m' = 0$. The choice of housing service is restricted to the ordered set of discrete sizes $S = \{\underline{s}, s_2, s_3, ..., \bar{s}\}$.

If the household chooses to buy a house of a different size than what it entered the period with, such that $h' \neq h$, the problem becomes

$$V_j^B(z, x) = \max_{c,h',m',b'} U_j(c, s) + \beta \mathbb{E}\left[W_j(z', x', h', m', q')\right]$$

subject to

$$\begin{aligned}
&x' = y' + (1+r)b' + a' - \Gamma' - (1+r^m)m' + (1-\varsigma^s)p_h' h' - \delta^h h' \\
&q' = b' + p_h h' - m' \\
&x = c + (1+\varsigma^b)p_h h' + b' - m' \\
&h' \in H \\
&c > 0, s = h', b' \geq 0, m' \geq 0,
\end{aligned}$$

along with the LTV constraint (4), and the PTI constraint (5). Since the household in this case buys a house, the budget constraint allows for the use of a mortgage to finance expenditures. The parameter ς^b captures the transaction cost of buying a house, which is modeled as proportional to the house value. Moreover, the household's choice of housing is limited to a set H, which is a proper subset of S. Specifically, the smallest house size $\underline{h}$ in H is larger than the smallest available size in S.[9] Above and including that lower bound, both sets are identical.

If the household decides to stay in the same house as when entering the period, such that $h' = h$, but chooses to refinance its mortgage, the problem is given by

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8 The local labor income tax is mainly included to ensure that high-earning households are more prone to itemize deductions.

9 A minimum size of owner-occupied housing $\underline{h}$ is also assumed in, e.g., Cho and Francis (2011), Floetotto et al. (2016), Gervais (2002), and Sommer and Sullivan (2018).

$$V_j^{RF}(z,x,h) = \max_{c,m',b'} U_j(c,s) + \beta \mathbb{E}\left[W_j(z',x',h',m',q')\right]$$

subject to

$$x' = y' + (1+r)b' + a' - \Gamma' - (1+r^m)m' + (1-\varsigma^s)p_h'h' - \delta^h h'$$
$$q' = b' + p_h h' - m'$$
$$x = c + b' + (1-\varsigma^s)p_h h - m' + \varsigma^r$$
$$c > 0, s = h' = h, b' \geq 0, m' \geq 0,$$

along with the LTV constraint (4), and the PTI constraint (5). In this case, the house size h enters as a state variable in the Bellman equation, since it directly determines the housing choice h'. Moreover, since x is defined such that it includes the value of the house when sold, the budget constraint is corrected for the agent not selling the house. This is done by adding $(1-\varsigma^s)p_h h$ to the expenditures in the budget constraint. The refinancing cost is captured by ς^r.

Finally, if the household decides to stay in its house and follow the repayment plan, the problem is

$$V_j^S(z,x,h,m) = \max_{c,m',b'} U_j(c,s) + \beta \mathbb{E}\left[W_j(z',x',h',m',q')\right]$$

subject to

$$x' = y' + (1+r)b' + a' - \Gamma' - (1+r^m)m' + (1-\varsigma^s)p_h'h' - \delta^h h'$$
$$q' = b' + p_h h' - m'$$
$$x = c + b' + (1-\varsigma^s)p_h h - m'$$
$$m' \leq (1+r_m)m - \chi_j m$$
$$c > 0, s = h' = h, b' \geq 0, m' \geq 0.$$

The mortgage level m now enters as an additional state variable as it determines the choice set for m'. Importantly, by following the repayment plan, the household is not subject to the LTV and PTI requirements.

The solution to the household problem is provided by

$$V_j(z,x,h,m) = \max\left\{V_j^R(z,x), V_j^B(z,x), V_j^{RF}(z,x,h), V_j^S(z,x,h,m)\right\}, \tag{8}$$

with the corresponding set of policy functions

$$\left\{c_j(z,x,h,m), s_j(z,x,h,m), h_j'(z,x,h,m), m_j'(z,x,h,m), b_j'(z,x,h,m)\right\}.$$

2.2. Rental market

The rental price p_r is determined in a competitive rental market. This market consists of a unit mass of homogeneous rental firms. Each firm f chooses either to buy a stock of housing h_f at price p_h per unit and rent it out to households, or to invest the value $p_h h_f$ in risk-free bonds. The present value of after-tax profits in the former case is

$$\pi_f^{Rent} = (1-\tau^c)\left(p_r h_f - \frac{1}{1+\tilde{r}}\left[\delta^r + \tau^h p_h' + \Delta p_h'\right]h_f\right).$$

Firm f's revenue is given by its rental income $p_r h_f$. The firm can deduct its operating expenses from these revenues before paying taxes at the rate τ^c. The operating expenses comprise a maintenance cost $\delta^r > \delta^h$ per unit of housing, a property tax on the value of the rental stock in the next period $\tau^h p_h' h_f$, and any negative price return on the rental stock $\Delta p_h' h_f$, where $\Delta p_h' \equiv p_h - p_h'$.[10] All operating expenses are discounted, as these costs are realized in the next period, at a rate given by the after-tax return on bonds $\tilde{r} \equiv (1-\tau^c)r$.

In case firm f instead invests in bonds, the present value of after-tax profits is given by

$$\pi_f^{Bonds} = \frac{(1-\tau^c)}{1+\tilde{r}} r p_h h_f.$$

[10] The assumption that $\delta^r > \delta^h$ is one common way in the literature to incorporate an advantage of owning (see, e.g., Piazzesi and Schneider (2016)). It was first introduced in Henderson and Ioannides (1983), and can be thought of as representing a moral hazard problem between owners of rental units and their tenants. An alternative approach would be to assume that owned housing units provide more housing services than rental units.

Imposing a free entry and exit condition, such that $\pi_f^{Rent} = \pi_f^{Bonds}\ \forall f$, the equilibrium rental price is

$$p_r = \frac{1}{1+\tilde{r}}\left[\delta^r + rp_h + \tau^h p_h' + \Delta p_h'\right]. \tag{9}$$

Admittedly, the rental market can be modeled in other ways. This formulation captures that the return of rental investments should be closely related to the return of other assets. An additional advantage of using this approach is that it yields a tractable closed-form solution for the rental price and the net benefit of owning (see equation (16)), which is key to understanding how the MID affects the demand for owner-occupied housing.

2.3. Government

The role of the government in the model is to provide retirement benefits to households, collect bequests and distribute these to surviving households, and tax the agents in a manner that replicates the U.S. tax system. Households pay five different taxes. The local level labor income tax, the payroll tax, the capital income tax, and the property tax are modeled linearly, as shown in equation (7). In contrast, the federal labor income tax is given by a function that mimics the U.S. federal tax and transfer system. The labor income tax function takes earnings net of deductions $\tilde{y}$ as its argument and is assumed to be continuous and convex, following Heathcote et al. (2017). Specifically,

$$T(\tilde{y}) = \tilde{y} - \lambda\tilde{y}^{1-\tau^p}, \tag{10}$$

where λ governs the tax level, and τ^p determines the degree of progressivity.

The type and amounts of deductions a household takes affect taxable earnings. Before retirement, households can itemize deductions, opt for the standard deduction, or not deduct at all. Itemized deductions, including mortgage interest payments, are only permissible as long as the sum of these exceeds the standard deduction. During retirement, households can only use the standard deduction or not deduct at all. To summarize, households' taxable earnings are such that $T(\tilde{y})$ is minimized, subject to

$$\tilde{y} \in \begin{cases} \{\max(y-ID,0), \max(y-SD,0), y\}, & \text{if } j \le J_{ret} \text{ and } ID > SD \\ \{\max(y-SD,0), y\}, & \text{otherwise} \end{cases} \tag{11}$$
$$\text{where } ID = \tau^m r^m m + \tau^h p_h h + \tau^l y.$$

The max operators reflect the fact that taxable earnings must be nonnegative. SD is the common exogenous amount that can be deducted if households opt for the standard deduction, while ID is the sum of itemized deductions that includes mortgage interest payments, property tax payments, and local tax payments. These are among the most important deductions in the U.S. tax code (Lowry, 2014). The parameter τ^m is the mortgage deductibility rate in the economy and it is the parameter of interest in this paper. In line with the U.S. tax code, τ^m is set to one in the benchmark model. In other words, all mortgage interest payments are deductible from earnings when calculating taxable earnings for an itemizing household. From equations (6), (7), (10), and (11), we see that the MID reduces taxable earnings, and hence increases cash-on-hand, provided that the agent itemizes tax deductions and has a mortgage.

Rental firms pay two taxes: the property tax on their rental stock and the capital income tax on their accounting profits. In total, the government's tax revenues from households and rental firms are given by

$$TR = \sum_{j=1}^{J} \Pi_j \int_0^1 \Gamma_{ij}\, di + \int_0^1 \left(\tau^c r h_f + \tau^h p_h h_f\right) df, \tag{12}$$

where i indexes households, f indexes rental firms, Π_j is the age distribution of households, and Γ are total taxes as defined in equation (7). We assume that both households and rental firms are of unit measure. The government uses part of the tax revenues to finance the retirement benefits. The remaining revenues are allocated to spending that does not affect the other agents.

The government collects bequests in the form of bonds, houses, and mortgages from households who die. After the government has received these bequests, it earns the interest on bond holdings, sells the houses and incurs the transaction costs of selling, and pays off any outstanding mortgages including interest. Thus, the net amount collected from households is given by

$$BQ = \sum_{j=1}^{J} \Pi_j (1-\phi_j) \int_0^1 \left((1+r)b_{ij}' + (1-\varsigma^s)p_h' h_{ij}' - (1+r_m)m_{ij}'\right) di. \tag{13}$$

In the initial economy with MID, the government distributes some of these bequests to cover the initial asset holdings of newborns, whereas the remainder is, for simplicity, assumed to cover wasteful government spending. Thus, in the initial steady state, inheritance a in equation (6) is zero for all households of age $j > 1$.

Altering the MID is likely to affect the amount of bequests left behind. To capture the welfare effects of changes in the bequests collected, we assume that any increase or decrease in bequests is distributed to surviving households (except newborns) in proportion to a household's permanent earnings in the previous period, i.e., $a_j = \gamma z_{j-1}$ for $j > 1$. Specifically, the parameter γ is adjusted such that the amount distributed equals the change in bequests collected.

2.4. Equilibrium

In the equilibrium of the model, house and rental prices are endogenously determined and they adjust to ensure that the demand for housing equals the supply of housing. The model setting can be interpreted as a small open economy, where houses can only be purchased by residents and the interest rates on risk-free bonds and mortgages are taken as given.

In the initial steady state with MID, i.e., $\tau_m = 1$, we set the house price p_h equal to one. House values (price times size) are comparable to the data as the supply of housing quantity (size) is perfectly elastic and households' preferences ensure that a realistic share of expenditures is spent on housing. With the house price at hand, the rental price p_r is easily computed from equation (9). The rental market clears automatically as we let the rental companies cater any demand for rental units. Taking house and rental prices as given, we solve for the value and policy functions of the households and proceed by simulating the economy. The aggregate housing supply is then given by the overall demand for housing services. In the remainder of the analysis, the housing supply is fixed at this initial level, but its composition is flexible.

When we solve for the steady-state equilibrium without MID, i.e., $\tau_m = 0$, the demand for housing is affected and the house and rental prices adjust to clear the housing market. Further, we solve for the average labor income tax rate λ, such that the government's tax revenues are the same as in the initial steady state, and the bequest rate γ, such that any changes in bequests left behind are distributed to the households. Additionally, a change in the house price affects the purchasing power of a household that receives bequests. To capture the change in purchasing power, the net worth q' that enters the utility function for bequests is deflated by a price index $\alpha + (1-\alpha)p_h$.

To compute a transitional equilibrium, we first choose a sequence of mortgage interest deductibility parameters $\{\tau_t^m\}_{t=1}^{t=T}$, where T is the last transition period. We then solve for the sequences of house and rental prices, $\{p_{ht}, p_{rt}\}_{t=1}^{t=T}$, and the sequences of the parameters governing the average labor income tax rate $\{\lambda_t\}_{t=1}^{t=T}$ and the bequest rate $\{\gamma_t\}_{t=1}^{t=T}$, such that for all $t \in \{1, ..., T\}$, total housing demand equals the initial housing stock, tax neutrality is achieved, and any changes in bequests are distributed to the households. In the transition, the removal policies are implemented unexpectedly and households have perfect foresight of the transition paths of the deductibility parameter, house and rental prices, as well as the tax and bequest parameters. Any unexpected change in the house price in the first period of the transition, affects the profits of the rental companies. We assume that any profit changes in the first period of the transition are distributed to the homeowners in proportion to their cash-on-hand x. For a detailed description of the equilibrium definitions, the computational methods, and the solution algorithms, see the online Appendices.

3. The MID and the benefit of owning

To better grasp the mechanisms behind the results in this paper, it is useful to understand why households want to own a house in the model and how this is affected by the MID. Our discussion builds upon previous work on the user cost of owning by, e.g., Díaz and Luengo-Prado (2008), but here we distinguish between those who itemize deductions and those who do not, as this is central to our analysis. We compare a household who owns a house of size h' to a similar household who instead obtains the equivalent housing service $s = h'$ on the rental market. The ex-post net benefit of owning NB^{Own}, in any period, is given by

$$NB^{Own} = UC^{Rent} - UC^{Own}, \tag{14}$$

where UC^{Rent} is the user cost of renting and UC^{Own} is the user cost of owning. Intuitively, the net benefit of owning is positive whenever owning is less costly as compared to renting.

The user cost of renting is given by $p_r s$, i.e., the rental price times the size of the rental unit. The user cost of owning is more complicated, as an owned house is an asset that comes with the possibility of debt financing. To keep the analysis in this section tractable, we make a few simplifying assumptions as compared to the full model. First, we abstract from any risk by assuming that prices are constant over time and that the earnings in the next period y' are known. Second, we assume that the interest rate on mortgages r^m is equal to the risk-free rate r. Third, we abstract from the possibility of selling and buying a house and hence, from the transaction costs that occur when doing so. Fourth, we assume that local labor income taxes are not tax deductible.

Given the modifications to the full model, the user cost of owning includes the sum of four costs. First, there is a maintenance cost of $\delta^h h'$. Second, there is an opportunity cost of equity. If the equity had not been invested in the house, it would have yielded an after tax return of $\tilde{r}(p_h h' - m')$, where $\tilde{r} \equiv (1-\tau^c)r$ is the net of tax risk-free rate. Third, a homeowner needs to pay a property tax on the house. This property tax cost is modeled as a fixed share of the house value, and is given by $\tau^h p_h' h'$. Last, a homeowner incurs a cost whenever it uses a mortgage to finance its dwelling. The borrowing cost is simply the interest payment on the mortgage rm'.

The costs of owner-occupied housing can be reduced whenever a homeowner chooses to itemize deductions rather than simply opt for a standard deduction. The sum of the itemized deductions amounts to $ID' = \tau^h p_h' h' + \tau^m rm'$, and is subtracted from earnings which, in turn, are subject to the progressive tax schedule $T(\tilde{y}')$. Importantly, any itemized deductions in excess of the standard deduction reduce the tax liabilities of the homeowner and therefore lower the effective cost of property taxes and mortgage financing. The total benefit from being able to itemize deductions is given by

$$I^d \int_{SD}^{ID'} T_{\tilde{y}'}(y' - \hat{D}) d\hat{D},$$

where I^d is an indicator variable for itemized tax deductions. The user cost of owning is the present value of the sum of all costs, adjusted for deductions

$$UC^{Own} = \frac{1}{1+\tilde{r}} \left(\delta^h h' + \tilde{r}(p_h h' - m') + \tau^h p_h' h' + rm' - I^d \int_{SD}^{ID'} T_{\tilde{y}'}(y' - \hat{D}) d\hat{D} \right). \tag{15}$$

Substituting equations (9) and (15) into (14), we get

$$NB^{Own} = \frac{1}{1+\tilde{r}} \left[(\delta^r - \delta^h) h' + \tau^c r(p_h h' - m') + I^d \int_{SD}^{ID'} T_{\tilde{y}'}(y' - \hat{D}) d\hat{D} \right]. \tag{16}$$

The first term is the benefit of owning due to a lower depreciation of owned housing as compared to rental housing. The second term is the benefit of investing equity in an asset (housing) where the return is not taxed, compared to investing in bonds where the return is taxed at a rate τ^c. This benefit to owner-occupied housing arises because the imputed rent is not taxed. The last term consists of the tax benefits of owner-occupied housing due to property tax and mortgage interest deductions. Thus, the above measure of the net benefit of owning encapsulates the main features of the U.S. tax treatment of housing.

To see how the net benefit of owning is affected by the deductibility parameter τ^m, it is useful to take the derivative of equation (16) with respect to mortgages

$$NB^{Own}_{m'} = \frac{1}{1+\tilde{r}} \left[-\tau^c r + I^d T_{\tilde{y}'}(y' - ID') \tau^m r \right]. \tag{17}$$

An increase in the mortgage level, and consequently a reduction in equity, has two effects on the net benefit. On the one hand, the reduction in equity means a smaller benefit resulting from the lack of taxation of imputed rent, which is captured by the first term. On the other hand, since mortgage interest payments are tax deductible ($\tau^m = 1$ in the initial steady state), the increased mortgage results in larger deductions and hence a higher net benefit.

Overall, equations (16) and (17) are key to understanding how the MID affects the net benefit of owning and, subsequently, the demand for owner-occupied housing. First, the MID increases the net benefit of owning by decreasing the cost of mortgage financing only for those who itemize deductions. In the full model, itemizing households are those with relatively large mortgages, houses, or earnings, or a combination of the three. Second, the net benefit of owning due to mortgage interest deductions is increasing in the marginal tax rate. Fig. 1 illustrates that the marginal tax rate differs substantially between households, leading to significant differences in the user cost of owning between households. Third, the net benefit of owning is positive regardless of the MID, due to the difference in the depreciation rates, the lack of taxation of the imputed rent, and the property tax deduction. In the full model, transaction costs, borrowing constraints, the mortgage interest spread, and the minimum size of owner-occupied housing hinder some households from owning and make some households prefer renting.

4. Calibration

We calibrate the model to the U.S. economy. To avoid capturing business-cycle movements in the data, calibration figures are taken from pooled data over the period 1989-2013, subject to data availability. Most of our parameters are calibrated independently, based on data or previous studies, whereas the remaining parameters are calibrated using simulated method of moments.

4.1. Independently calibrated parameters

Yearly parameter values taken from other studies or calculated directly from the data are listed in Table 1.

Table 1
Independently calibrated parameters, based on data and other studies.

Parameter	Description	Value
σ	Coefficient of relative risk aversion	2
τ^l	Local labor income tax	0.05
τ^c	Capital income tax	0.15
τ^{ss}	Payroll tax	0.153
τ^h	Property tax	0.01
τ^m	Mortgage interest deductibility	1
r	Interest rate	0.03
κ	Yearly spread, mortgages	0.014
γ	Bequest rate	0
θ	Down-payment requirement	0.20
ψ	Payment-to-income requirement	0.28
δ^h	Depreciation, owner-occupied housing	0.03
ς^I	Home insurance	0.005
ς^b	Transaction cost if buying house	0.025
ς^s	Transaction cost if selling house	0.07
ς^r	Refinancing cost	3.0
R	Replacement rate for retirees	0.5
B^{max}	Maximum benefit during retirement	51.1

Note: The table presents calibrated parameter values. The values are annual for relevant parameters. When simulating the model, we adjust these values to their three-year (one model period) counterparts. The refinancing cost ς^r and the maximum benefit during retirement B^{max} are in 1000's of 2013 dollars.

4.1.1. Demographics and preferences

The households enter the economy at age 23. The probability of a household dying between two consecutive ages is taken from the Life Tables for the U.S. social security area 1900-2100 (see Bell and Miller (2005)). We use the observed and projected mortality rates for males born in 1950. In the model, the retirement age is set to 65, and we assume that all households are dead by the age of 83. Using data from the Panel Study of Income Dynamics (PSID), we specify the equivalence scale e_j as the square root of the predicted values from a regression of family size on a third-order polynomial of age. In the CRRA utility function, we set the coefficient of relative risk aversion σ to 2, which is widely used in the literature.

4.1.2. Assets and bequests

The initial asset holdings for households are calibrated as in Kaplan and Violante (2014). We divide households aged 23-25 in the Survey of Consumer Finances (SCF) into 21 groups based on their earnings. For each of these groups, we calculate the share with asset holdings above 1,000 in 2013 dollars and the median asset holdings conditional on having assets above this limit. The median asset value for each group is scaled by the median earnings among working-age households (23-64) in the SCF data. For model purposes, we rescale these asset values with the median earnings of working-age households in our model.

The parameter γ, which determines how much bequests each household receives, is set to zero in the initial steady state. When conducting the policy experiments, this parameter is adjusted to account for changes in bequests.

4.1.3. Tax system

The local labor income tax rate τ^l is set to 0.05, which is the average state and local labor income tax rate for itemizers in 2011 (Lowry, 2014). The capital income tax τ^c is set to 0.15, to match the maximum rate that applies to long-term capital income for most taxpayers. In the U.S., the payroll tax is levied equally on both the employer and the employee, and amounts to 15.3 percent of earnings (Harris, 2005). Since there is no explicit production sector in our model, we let the full tax burden fall on the worker by setting τ^{ss} to 0.153. The American Housing Survey (AHS) shows that the median amount of real estate taxes per $1,000 of housing value is approximately 10 dollars.[11] Following this estimate, we set the property tax parameter τ^h to 0.01.

The mortgage interest deductibility rate τ^m is our parameter of interest. In the analysis we alter this parameter from one to zero, where the benchmark economy is characterized by full deductibility ($\tau^m = 1$).

4.1.4. Market setting

The interest rate is estimated from market yields on the 30-year constant maturity nominal Treasury securities, deflated by the year-to-year headline Consumer Price Index (CPI). The average real rate over the period 1997 to 2013 is 3.4 percent (Federal Reserve Statistics Release, H15, and the Bureau of Labor Statistics, Databases & Tables, Inflation & Prices). We set

[11] See table C-10-OO in the 2011 and 2013 American Housing Survey, and table 3-13 in the 2009 wave.

the real interest rate r to 0.03. Using the Federal Reserve's series of the contract rate on 30-year fixed-rate conventional home mortgage commitments over the period 1997 to 2013, we find that the average yearly spread to the above Treasuries is 1.4 percentage points. Consequently, we choose a yearly spread for mortgages κ of 0.014, implying a mortgage interest rate r^m of 0.044.

Similar to Floetotto et al. (2016) and Sommer and Sullivan (2018), we set the minimum down-payment requirement θ to 0.20 in the model. The payment-to-income requirement ψ is taken from Greenwald (2018) and is set to 0.28.

The depreciation rate of owned housing is set to 3 percent. This follows from the estimate of the median depreciation rate of owned housing, gross of maintenance, in Harding et al. (2007). The transaction costs of buying and selling a house are taken from Gruber and Martin (2003). They use the median transaction costs from CES data and estimate the costs of buying and selling to be 2.5 and 7 percent of the house value, respectively. The home insurance is calibrated to match the median property insurance payment in the AHS. In the 2013 AHS, this is roughly half of the median property tax payments, thus we set ς^I to 0.005.

The fixed refinancing cost ς^r is set to 3,000 in 2013 dollars and is the sum of application, appraisal, inspection, and survey fees, along with attorney review, and title search and insurance costs. Data on the different costs are taken from the Federal Reserve. We use the average of the low and high estimates for these costs.[12]

4.1.5. Labor income

In this section, we outline the central elements of our estimation procedure, and relegate a more detailed description of the data and estimation method to online Appendix D. The labor income process is similar to that of Cocco et al. (2005). We estimate a deterministic life-cycle profile of earnings and include the idiosyncratic earnings risk via permanent and transitory shocks. At each age j, household i receives exogenous earnings y_{ij}. For any household, the log earnings before retirement are

$$\log(y_{ij}) = \alpha_i + g(j) + n_{ij} + \nu_{ij} \quad \text{for } j \le J_{ret}, \tag{18}$$

where α_i is a household fixed effect with distribution $N(0, \sigma_\alpha^2)$. The function $g(j)$ represents the hump-shaped life-cycle profile of earnings. The remaining two terms, ν_{ij} and n_{ij}, capture the idiosyncratic earnings risk. The former is an i.i.d. transitory shock with distribution $N(0, \sigma_\nu^2)$. The latter, n_{ij}, allows for households' earnings to permanently deviate from the deterministic trend, and is assumed to follow a random walk

$$n_{ij} = n_{i,j-1} + \eta_{ij} \quad \text{for } j \le J_{ret}, \tag{19}$$

where η_{ij} is an i.i.d. shock, distributed $N(0, \sigma_\eta^2)$. All shocks are assumed to be uncorrelated with each other. Note that log earnings are represented by the sum of a permanent component, $\log(z_{ij}) = \alpha_i + g(j) + n_{ij}$, and a transitory component ν_{ij}. The permanent earnings state variable in the model is given by z_{ij}.

During retirement there is no earnings risk. Households receive benefits given by

$$\log(y_{ij}) = \min\left(\log(R) + \log(z_{i,J_{ret}}),\ \log(B^{max})\right) \quad \text{for } j \in]J_{ret}, J], \tag{20}$$

where R is a common replacement rate for all households and B^{max} is the maximum amount of benefits a household can receive. For simplicity, retirement benefits are a function of permanent earnings in the last period before retirement only.

Equations (18) and (19) are estimated using PSID data for the survey years 1970 to 1992, following Cocco et al. (2005). The deterministic life-cycle profile $g(j)$ is estimated by regressing log household earnings on dummies for age, marital status, family composition, and education. We control for household fixed effects by running a linear fixed effect regression. A third-order polynomial is fitted to the mean predicted earnings by age.

The variances of the transitory σ_ν^2 and permanent σ_η^2 shocks are estimated in a similar fashion as in Carroll and Samwick (1997). The variance of the fixed effect shock σ_α^2 is identified as the variance of earnings, net of the deterministic trend value in the first period of working life, that is not explained by the estimated variances of the transitory and the permanent shocks. Table 2 presents the resulting variances.

The maximum allowable benefit during retirement, B^{max} in equation (20), is calculated using data from the Social Security Administration (SSA). The common replacement rate R is set to 50 percent, as in Díaz and Luengo-Prado (2008).

4.2. Estimated parameters

Table 3 shows the structural parameters calibrated by simulated method of moments, along with a comparison between data and model moments. Unless otherwise stated, we use data from the SCF, where we pool the 1989 to 2013 survey years.

[12] For the estimates of the different costs, see "A consumer's guide to mortgage refinancing", available at https://www.federalreserve.gov/pubs/refinancings/default.htm.

Table 2
Estimated variances of three-year shocks.

Parameter	Description	Value
σ_α^2	Fixed effect	0.095
σ_η^2	Permanent	0.030
σ_υ^2	Transitory	0.028

Note: During working age, households receive permanent and transitory earnings shocks. In addition, households obtain a fixed effect shock when they enter the economy. During retirement there is no earnings risk. Estimated using PSID data.

Table 3
Estimated parameters.

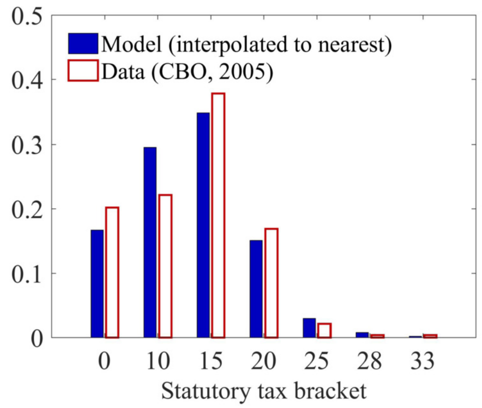
Parameter	Description	Value	Target moment	Data	Model
β	Discount factor	0.93	Median LTV	0.35	0.35
δ^r	Depreciation rate, rentals	0.047	Homeownership rate, age $<$ 35	0.44	0.44
$\underline{h}$	Minimum owned house size	137.0	Homeownership rate	0.70	0.70
α	Consumption weight in utility	0.76	Median house value-to-earnings	2.30	2.30
$\bar{q}$	Luxury parameter of bequest	135.6	Net worth p75/p25, age 68-76	5.30	5.61
υ	Utility shifter of bequest	6.5	Median net worth, age 75/50	1.43	1.43
λ	Level parameter, tax system	1.66	Average marginal tax rates	0.13	0.13
SD	Standard deductions	8.02	Itemization rate	0.53	0.53
τ^p	Progressivity parameter	0.14	Distr. of marginal tax rates	See text	

Note: Parameters calibrated by simulated method of moments. The third column shows the resulting parameter values from this estimation procedure. The values are annual when applicable. When simulating the model, we adjust these parameter values to their three-year (one model period) counterparts. The minimum owned house size $\underline{h}$ and the standard deduction SD are in 1000's of 2013 dollars. The fifth column presents the values of data moments that are targeted. The last column shows the model moments that are achieved by using the parameter values in column three.

Although all the parameters are jointly determined in the simulated method of moments, some parameters are especially important for some moments. The discount factor β impacts households' savings and borrowing decisions. Hence, this parameter is used to match the median LTV. The depreciation rate of rental housing δ^r affects how favorable owner-occupied housing is relative to rental housing, which in turn impacts how early in life households become homeowners. Therefore, this parameter is used to target the homeownership rate for those under the age of 35. The minimum owner-occupied house size $\underline{h}$ is calibrated to match the overall homeownership rate. The parameter α determines the weights on consumption and housing services in the utility function. We use this parameter to calibrate the median house value relative to earnings, conditional on owning. The bequest function has two parameters; $\bar{q}$ determines the extent to which bequests are luxury goods, and υ determines the strength of the bequest motive. The former is calibrated to capture the dispersion in net worth among old households, measured as the ratio of net worth in the 75th percentile to the 25th, for ages 68 to 76. The latter is calibrated to fit the difference in net worth between working-age and retired households. As a target, we use the ratio of median net worth for ages 75 and 50. We use the parameter λ, which governs the level of the convex tax and transfer function $T(\tilde{y})$, to target the average marginal tax rate. The target is taken from Harris (2005). We calibrate the standard deduction to match the fraction of the working-age population that itemize tax deductions. Using self-reported rates for working-age households, the itemization rate is 0.53.[13] Our calibrated standard deduction is about $8,000$ in 2013 dollars, which is within the range of standard deductions available to single filers ($6,100) and married households filing jointly ($12,200) in 2013.

The parameter determining the progressivity of the federal labor income tax τ^p, is set to match the distribution of households exposed to the different statutory marginal tax rates. We minimize the sum of the absolute values of the differences between the shares of households exposed to the statutory tax brackets in data compared to in the model. For this estimation procedure, we allocate households to their nearest tax bracket in the model, and we use data on shares from the Congressional Budget Office in 2005 (Harris, 2005). The statutory tax brackets we use are consistent with the tax code from 2003 to 2012 (The Tax Foundation, 2013). The resulting progressivity parameter value is 0.14, which is close to that in Heathcote et al. (2017). Fig. 1 displays the fractions of the working-age population exposed to the different statutory marginal tax rates in the data (Harris, 2005) versus in the model.

[13] In this case, we do not include households aged 23-25 when we compute the model moment. These ages correspond to the first model period, where households by construction cannot deduct property taxes or mortgage interest payments. Hence, the itemization rate is artificially low in the model for this age group.



Note: The model refers to the results from the initial steady state with MID. For comparison purposes, we interpolate households' marginal tax rates to the nearest tax brackets, as the labor income tax schedule is continuous in the model. The data is from Harris (2005).

Fig. 1. Fractions of taxpayers facing different marginal tax rates.

4.3. Model fit

As is evident in Table 3, the calibration enables the model to successfully hit the target moments. However, the reliability of our results does not only depend on how well the model performs with respect to aggregate measures. It also depends on the distributions and life-cycle profiles of relevant variables.

The life-cycle profiles of homeownership, LTV, and mortgage-to-earnings are key indicators of the heterogeneity in exposure to the mortgage interest deductibility. Comparisons to SCF are displayed in Fig. 2. The model performs well with respect to these variables, both in terms of magnitudes and life-cycle patterns, although there are some discrepancies. The model also produces a decent fit of the median house-to-earnings, which is a measure of exposure to price changes in the housing market. The jump in the median house-to-earnings at age 65 in the model is a result of households retiring with certainty at that age.

Data on U.S. tax returns and the SCF show that the fraction of households that itemize deductions is increasing in earnings and that there is a strong skewness in MID claims.[14] In the 2013 tax filings, only about four percent of those earning less than $15,000 (24 percent of all returns) itemized deductions, and they merely claimed two percent of all mortgage interest deductions. This stands in sharp contrast to comparable numbers for those earning more than $100,000 (top 15 percent). They claimed 55 percent of the total mortgage interest deductions, and more than 82 percent used itemized deductions. A similar skewness is apparent in the SCF, although somewhat less pronounced. As seen in Fig. 3a and Fig. 3b, our model is able to replicate these important patterns: high earners itemize the most and claim a disproportionately large share of the mortgage interest deductions.

5. Results

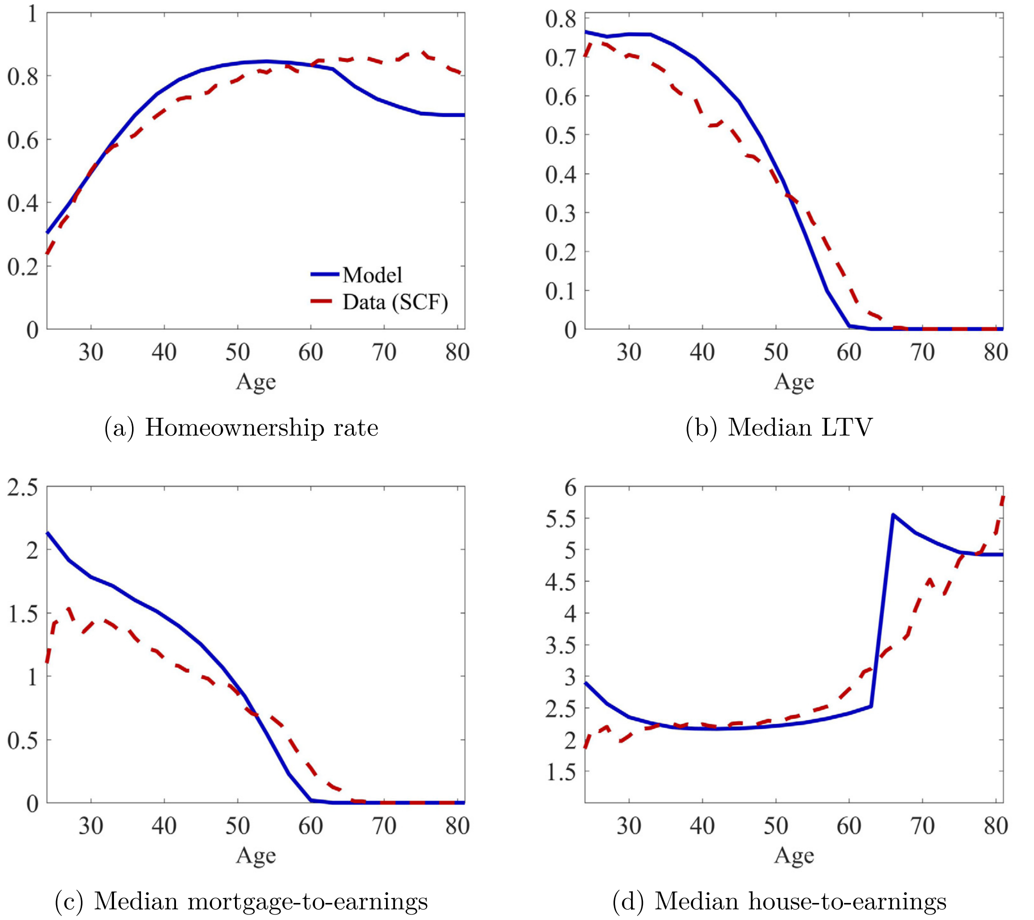
5.1. What are the long-run effects of removing the MID?

What would the level of house prices in the U.S. be if households were not able to deduct mortgage interest payments? Does the MID promote homeownership? What fraction of American households would prefer to be born into a world without the MID, and how much would they gain or lose?

These questions regarding the long-run implications of removing the MID are all addressed in this section. Although the focus of this paper is on the transitional dynamics of repealing the MID, the answers to these questions are also relevant for our purpose. Indeed, it is difficult to motivate a study of the short-run dynamics if the long-run welfare effects are negative. Moreover, the key mechanisms in the long run are also at work in a transition.

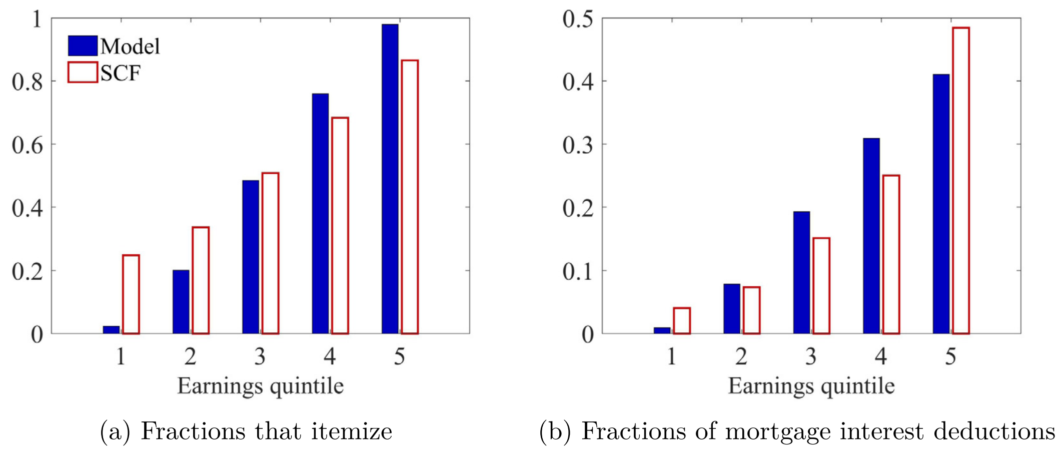
In order to study the long-run effects of removing the MID, we compare the initial steady state with MID to a new steady state in which the possibility to deduct mortgage interest payments is repealed. Specifically, we study the effects of changing the deductibility parameter τ^m from the initial value of one to zero, while imposing tax neutrality and accounting for changes in bequests. The labor income tax level parameter λ is adjusted so that the net tax revenue for the government is unchanged between the steady states. We alter the bequest parameter γ to distribute any changes in bequests.

[14] The tax return data is publicly available at the IRS webpage. We use data from "SOI tax stats - individual statistical tables by size of adjusted gross income", tables 1.4 and 2.1.



Note: The model refers to the results from the initial steady state with MID. The data is taken from Survey of Consumer Finances (SCF), survey years 1989-2013.

Fig. 2. Comparison of model versus data: non-targeted profiles.



Note: Working-age households only. The data is taken from the SCF, survey years 1995-2013 (the data on itemization is missing in the 1989 and 1992 waves). Mortgage interest deductions are computed from reported mortgages and interest rates for those who itemize.

Fig. 3. Itemizers and MID claims in the initial steady state, across earnings quintiles.

Table 4
Long-run effects on prices and aggregates of removing the MID.

	MID	No MID	Relative difference (%)
House price	1	0.965	−3.47
Rental price	0.238	0.234	−1.66
Homeownership rate	0.70	0.71	1.88
Fraction ever-owner	0.88	0.89	1.59
Mean owned house size	215	211	−2.15
Mean LTV	0.36	0.31	−12.09
Mean mortgage	74	60	−19.29
Mean bond holdings	20.6	21	1.81
Mean marginal tax rate	0.150	0.146	−2.59
Mean bequest collected	152	158	3.57

Note: The first column shows prices and aggregate measures in the initial steady state with MID, whereas the second column shows the corresponding values in the steady state without MID. The rental price corresponds to a three-year (one model period) cost of renting. "Fraction ever-owner" is the fraction of households that own a house at some point during their life. The mean house size, LTV, and the mortgage level are conditional on owning. The mean owned house size, mortgage, bond holdings, and bequest collected are in 1000's of 2013 dollars. The mean marginal tax rate is gross of deductions.

5.1.1. Prices and aggregates

Table 4 presents a comparison of the two steady states for a number of key variables. Overall, the new steady state without MID is characterized by lower house and rental prices, higher homeownership, reduced indebtedness, lower taxes, and more bequests. The price decrease is driven by a downward shift in the demand for housing among homeowners who often itemize. These households experience an increase in the user cost of owning, as discussed in Section 3. If the house price is held constant, households in this group would wait longer until they buy their first house, and buy smaller houses. When the house price is allowed to decline, households who often itemize do no longer postpone their house purchases, but they still demand smaller houses. Overall, in the new steady-state equilibrium, the homeownership rate is virtually unchanged for this group of households, whereas they demand smaller houses.

For those who seldom itemize, the lower house price has a positive effect on homeownership. Some households who would never own a house in the initial steady state are homeowners in the new steady state. Indeed, the fraction of households that own a house at some point in life increases by about one percentage point (see *fraction ever-owner* in Table 4). Moreover, those who own a house but seldom itemize in the initial steady state choose to buy their first house earlier in the new steady state. Overall, the homeownership rate increases by approximately one percentage point to around 71 percent. This result confirms the findings and the underlying mechanism in Sommer and Sullivan (2018). They document that removing the MID is associated with an increase in the homeownership rate due to the fall in the house price.

In Table 4, we see that the mean mortgage level decreases significantly. This is primarily driven by households that often itemize. The fall in the mortgage level is not only caused by the higher cost of mortgage financing, but also by the change in house sizes and the fall in the house price. Since it is the itemizing households that demand smaller houses and are directly affected by the MID, they are also those that decrease their mortgage levels the most.

5.1.2. Why are U.S. households better off without the MID in the long run?

We use the ex-post consumption equivalent variation (CEV) as our welfare measure. This is defined as the per-period percentage change in realized consumption that is required in the steady state with MID to make a household indifferent to an economy without MID. Formally, let $\tilde{V}$ be the discounted welfare and $(\tilde{c}_{i,j}, \tilde{s}_{i,j}, \tilde{q}'_{i,j})$ be the realized consumption, housing services, and net worth in the steady state without MID,

$$\tilde{V} \equiv \sum_{j=1}^{J} \left(\beta^{j-1} \prod_{k=1}^{j-1} \phi_k \right) \left[U_j(\tilde{c}_{i,j}, \tilde{s}_{i,j}) + \beta(1-\phi_j) U^B(\tilde{q}'_{i,j}) \right].$$

Then, for each household we solve for Δ that makes the discounted welfare under the two tax regimes equal

$$\sum_{j=1}^{J} \left(\beta^{j-1} \prod_{k=1}^{j-1} \phi_k \right) \left[U_j\left((1+\Delta)c_{i,j}, s_{i,j}\right) + \beta(1-\phi_j) U^B(q'_{i,j}) \right] = \tilde{V},$$

where $(c_{i,j}, s_{i,j}, q'_{i,j})$ are the realizations of each variable in the steady state with MID. If we set Δ to zero, the left-hand side of this equation is simply the discounted welfare in the initial steady state. In the remainder of the paper we will refer to Δ as CEV. We are also interested in what fraction of households that benefit from a removal, which we define as the share of households with a CEV greater than or equal to zero.

An overwhelmingly large fraction, 88 percent of households, are better off being born into the steady state without MID, see the last column in Table 5. On average, the welfare gain of being born into the steady state without MID is equivalent to that of increasing consumption by 0.91 percent in all periods in the initial steady state.

Table 5
Long-run welfare effects of removing the MID, for newborns.

Mean CEV (%)	−0.54	0.32	0.78	0.91
Fraction in favor	0.15	0.74	0.85	0.88
Rental and house prices adjust	–	✓	✓	✓
Tax neutrality	–	–	✓	✓
Bequests adjust	–	–	–	✓

Note: Mean CEV (%) refers to the average consumption equivalent variation in percent, for newborns. For example, the average welfare effect of removing the MID when house prices, taxes, and bequests adjust is equivalent to a 0.91 percent increase in consumption in all periods, in the initial steady state. The fraction in favor is the fraction of newborns with a CEV greater than or equal to zero.

The direct effect of no longer having the mortgage subsidy is negative as seen in the first column of Table 5. Yet a large fraction of households experience a small or no loss. Even with MID in place, many households do not itemize deductions. In addition, as seen in Fig. 3b, the amounts of mortgage interest deductions are highly skewed. Households with higher earnings claim a disproportionately large share of the total mortgage interest deductions. Most itemizing households deduct relatively modest amounts of mortgage interest payments.

There are three equilibrium effects that improve households' welfare: the lower house and rental prices, the lower labor income taxes, and the increased bequests. The lower house price in the steady state without MID makes both rental and owner-occupied housing more affordable, which increases welfare. Importantly, the lower house price reduces the equity requirement and makes the PTI requirement less stringent. This enables more households to become homeowners and allows some households to purchase a house earlier. In the second column in Table 5, we see that the price adjustment is sufficient to create significant positive welfare effects, and 74 percent would prefer to live in a world without MID. The lower labor income tax and the increased bequests in the new steady state further increase the welfare for all households. Households at the top of the earnings distribution constitute the only group for which the direct negative effect of removing the MID outweighs the benefits of lower equilibrium prices and taxes and higher bequests.

5.2. *What are the effects of an immediate removal of the MID?*

Our results in the previous section suggest that U.S. households would be considerably better off in a world in which they cannot deduct mortgage interest payments. However, the long-run analysis does not touch upon another important question: is a repeal of the MID also beneficial for current households? To shed some light on this question, we need to consider the short-run effects. In this section, we present the results of an immediate removal of the MID, i.e., $\tau_t^m = 0$ for all $t \geq 1$.

5.2.1. *Who are the winners and losers from a reform?*

In order to evaluate the welfare effects of the immediate removal, we consider the lifetime gains and losses incurred by households alive when the policy is implemented. These welfare effects can differ markedly from the long-run analysis, as households have made long-term decisions based on the presumption that they can deduct mortgage interest payments. As is shown in the analysis below, the welfare effects therefore tend to be significantly lower and much more dispersed.

Similar to the steady-state analysis, there are four main factors influencing how a household is affected by the removal policy. First, households that itemize deductions and have a mortgage are directly negatively affected by a reduction of the MID. Second, the sudden fall in the house price, as seen in Fig. 4, reduces the home equity for existing homeowners, while renters benefit from less stringent constraints in the housing market and lower rental prices. Third, all households are positively affected by an instant fall in the labor income tax level since the government no longer subsidizes mortgage financing. Finally, the unexpected fall in the house price lowers the values of bequests, which affects all households negatively. A detailed overview of the transitional dynamics is presented in Section 5.3, where we compare the immediate policy to alternative removal policies.

On average, the immediate removal policy results in significant welfare losses for current U.S. households. The average welfare effect of an immediate removal is equivalent to a 0.4 percent decrease in consumption in all remaining periods in the initial steady state and only 39 percent would gain from such a reform. This stands in sharp contrast to the long-run analysis, where 88 percent would benefit from a world without MID.

Furthermore, we could not find a one-time cash transfer scheme that, in combination with the removal, would lead to a Pareto improvement. Taxing all winners and compensating all losers such that every household is indifferent between a reform and no reform would produce a transfer-scheme deficit of 1.2 percent of average cash-on-hand.

The aggregate results mask important heterogeneous welfare effects. Fig. 5 displays the distribution of welfare changes in the first period of the transition. Based on this distribution, we allocate households into four groups as indicated by the vertical lines in the figure. The first group contains the households who experience the largest welfare losses in the transition. The second group contains the households with less extreme, but still sizable negative CEVs. The third group is made up by a mass of households that have CEVs around zero. The households in the right bell of the distribution are allocated to the fourth group. Table 6 presents key characteristics for the different groups.

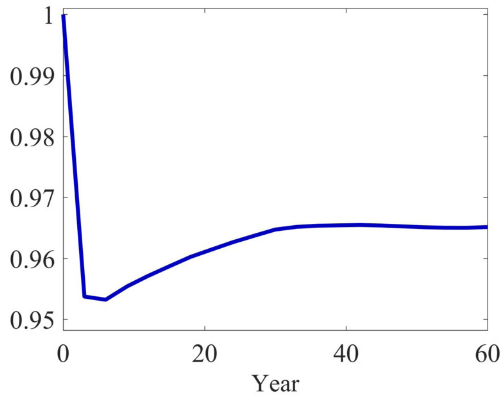
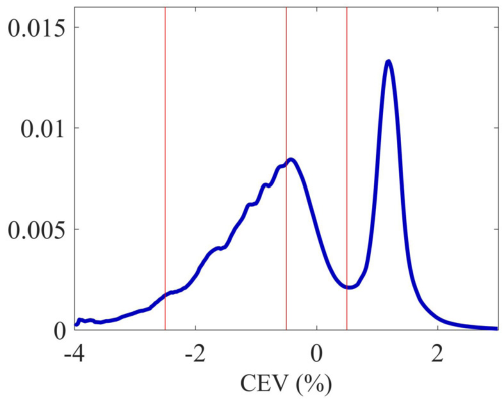


Fig. 4. House price dynamics from an immediate removal of the MID.



Note: CEV (%) refers to the ex-post consumption equivalent variation in percent, for all households that are alive in the first period of the transition. The vertical lines allocate households into different groups based on their welfare effects. See Table 6 for key characteristics of these groups.

Fig. 5. The distribution of welfare effects under the immediate removal policy.

The bimodal shape of the CEV distribution stems from differences in welfare effects between homeowners and renters. The mass around the right-hand peak consists of renters, while the mass around the left-hand peak, groups one to three, consists of homeowners. Renters are not directly affected by the removal of the MID, but benefit from the lower rental price, relaxed LTV and PTI constraints in the housing market, and lower taxes.

Homeowners realize several negative effects in the short run, but the extent to which they are affected varies with the household characteristics. By comparing the three groups of homeowners in Table 6, we see that the CEV is decreasing in mortgages, permanent earnings, and the itemization rate for working-age households. Homeowners with larger mortgages and higher earnings benefit more from itemizing deductions. Consequently, they are relatively worse off when they can no longer deduct mortgage interest payments, as represented by the long, thick tail of negative values in Fig. 5. Table 6 also shows that households with lower CEVs on average own larger houses, which primarily reflects that these households are high earners. In addition, younger homeowners tend to be worse off. This mainly follows from younger homeowners having higher LTVs. For retired households, the very old with large houses are the biggest losers. These households rely heavily on housing equity as they have low earnings relative to wealth, and thus suffer significantly from the house price fall.

The transition also entails positive effects for homeowners, although these are generally outweighed by the negative effects. All homeowners benefit from the lower labor income taxes when the MID is removed, as well as the decreased property tax payments following the fall in the house price.

The results in Table 6 also help explain why a one-time cash transfer between households cannot achieve a Pareto improvement. Not only is a majority of households against the reform, but those who are hurt by the removal tend to have higher life-time earnings. This negative correlation between income and welfare implies that relatively large transfers in absolute terms are required to compensate the losers.

Table 6
Characteristics of winners and losers in the short run.

Group:	1	2	3	4
CEV range:	< -2.5	$[-2.5, -0.5[$	$[-0.5, 0.5[$	≥ 0.5
Working age:				
Mean CEV	−3.09	−1.18	−0.13	1.23
Homeownership rate	1	0.98	0.87	0.03
Itemization rate	0.99	0.84	0.56	0.01
Age	38	45	47	37
Earnings	133	106	85	44
House size	310	231	180	165
Mortgage	219	119	67	71
LTV	0.71	0.54	0.41	0.42
Retirement age:				
Mean CEV	−4.57	−1.39	−0.19	1.19
Homeownership rate	1	1	1	0.03
Age	79	70	68	74
Earnings	42	40	28	15
House size	235	218	161	146
LTV	0.02	0.03	0.05	0.07

Note: Groups 1 to 4 correspond to the four groups indicated by the vertical lines in Fig. 5. Thus, the welfare effects are those experienced under the immediate removal policy. Other measures correspond to mean values of households in the event that the MID is not repealed. House size, mortgage, and LTV are conditional on owning a house. Earnings, house size, and mortgage are in 1000's of 2013 dollars.

5.2.2. Why do we find negative welfare effects?

Other papers that have studied the short-run welfare effects of removing the MID find that a majority of households would benefit from an immediate policy; see Floetotto et al. (2016) and Sommer and Sullivan (2018). Our model differs from those in earlier papers along a variety of dimensions. Although our model does not nest theirs, three major modeling features account for most of the differences in the welfare effects relative to Sommer and Sullivan (2018), which is arguably the paper closest to ours in terms of modeling. These features include having a refinancing cost of mortgages, an explicit modeling of households in retirement, and accounting for changes in bequests caused by a lower house price in the transition.

A refinancing cost of mortgages makes housing equity less liquid and it is more difficult for homeowners to cushion negative shocks. The refinancing cost makes it costly to increase a mortgage, and it is only worthwhile to increase a mortgage by a relatively large amount. In the transition, the house price decline limits the amount by which households can increase their mortgage, through the LTV constraint. Thus, households who receive negative shocks during the transition are less inclined to use housing equity to smooth their consumption, resulting in lower welfare. Furthermore, refinancing costs lead to a larger house price decline early in the transition, through a similar mechanism. In an economy where mortgage refinancing is costly, households are more inclined to get access to their housing equity by selling their home, which has a negative impact on the aggregate price level.

As we explicitly model the full life-cycle of households, we are able to study the welfare effects of retirees. We find that homeowners in retirement are relatively worse off when the MID is removed. Older households hold more housing wealth, and their housing wealth relative to earnings is substantially higher as depicted in Fig. 2d. Furthermore, older households have fewer periods left to smooth the negative wealth shock resulting from the house price drop. Finally, because retirees have a higher probability of dying, they care more about the bequests they leave behind. Thus, for many retirees, the unexpected fall in net worth in the transition lowers their welfare.

In our analysis, households are also negatively affected by a reduction in the values of bequests received. This is crucial at the beginning of the transition when the house price fall sharply reduces wealth. When households receive less bequests, there is a reduction in welfare. In contrast, Sommer and Sullivan (2018) use a standard assumption that any accidental bequests are fully taxed and that the government spends this revenue on activities that do not affect any agents in the economy.

In a calibration where we remove the cost of refinancing, consider the welfare effects of the working-age population only, and do not distribute changes in bequests, we find a positive average welfare effect that is more in line with previous studies. In the first column of Table 7, we can see that under these assumptions, the average CEV is 0.03 percent and a majority (52 percent) of households are in favor of an immediate removal of the MID. Moreover, the results in this table suggest that all three model features are central for understanding why our welfare results are lower than those in Sommer and Sullivan (2018).

Table 7
Model features that can explain our negative welfare result.

Mean CEV (%)	0.03	−0.14	−0.22	−0.40
Fraction in favor	0.52	0.46	0.41	0.39
Include welfare retirees	–	✓	✓	✓
Bequests adjust	–	–	✓	✓
Refinancing cost	–	–	–	✓

Note: Welfare results of an immediate removal policy. The first column shows the results from a model specification where we do not: i) include the welfare effects of retirees; ii) adjust bequests received by households; and iii) include refinancing costs of mortgages. The last column shows our benchmark result. The fraction in favor is the fraction of households with a CEV greater than or equal to zero. For a description of CEV (%) see *Note* below Fig. 5.

5.3. Do households prefer more gradual removal policies?

In the previous section, we show that an immediate removal of the MID results in considerable negative welfare effects on average. The negative effects are primarily driven by homeowners who can no longer deduct mortgage interest payments and who suffer from losses in their housing equity. Given the large positive long-run welfare effects of an MID removal, an investigation of alternative removal policies that could potentially improve the welfare effects for homeowners is warranted.

To enable homeowners to adjust their asset allocations before the MID is repealed, we consider two policies in which the MID is removed less rapidly.[15] Under a *gradual* policy, households can deduct mortgage interest payments for another 15 years (5 model periods), but the deductible share is reduced stepwise over that period such that $\{\tau_t^m\}_{t=1}^{t=\infty} = \{1, 0.8, 0.6, 0.4, 0.2, 0, 0, ...\}$. We also study an *announcement* policy in which households are informed that all interest payments can be deducted for another 15 years before the MID is removed permanently, i.e., $\{\tau_t^m\}_{t=1}^{t=\infty} = \{1, 1, 1, 1, 1, 0, 0, ...\}$. These policies together with the immediate reform are depicted in Fig. 6a.

5.3.1. How do short-run dynamics depend on the timing of policies?

Fig. 6 shows the short-run dynamics for the house price, the rental price, the average marginal labor income tax rate before deductions, and the bequest rate, for all three policies. The house price falls most rapidly under the immediate policy. The price fall under a given removal policy is mainly driven by changes in the housing demand of young itemizing households. As seen in the second row of Fig. 2, young households have high LTVs and mortgage-to-earnings when they enter the housing market. As these households also tend to itemize deductions, they respond strongly to changes in the deductibility rate. Under the gradual and announcement policies, the response in housing demand is smaller due to the extended possibilities to deduct mortgage interest payments.

Although the instantaneous drop in the house price is the largest under the immediate policy, more than fifty percent of the total price fall occurs in the first transition period for the gradual and announcement policies. The higher present value of the future user cost of owning instantly results in a lower demand for owned housing, under all policies. The demand effect is reinforced by the transaction costs associated with buying and selling a house. The transaction costs restrain households from frequently re-optimizing their house size, which makes a house purchase a long-term investment.

The short-run dynamics of the rental price is fully explained by the path of house prices, as shown in equation 9. Under the immediate policy, the rental price closely follows the house price, whereas the rental price remains elevated for some periods under the more gradual policies.

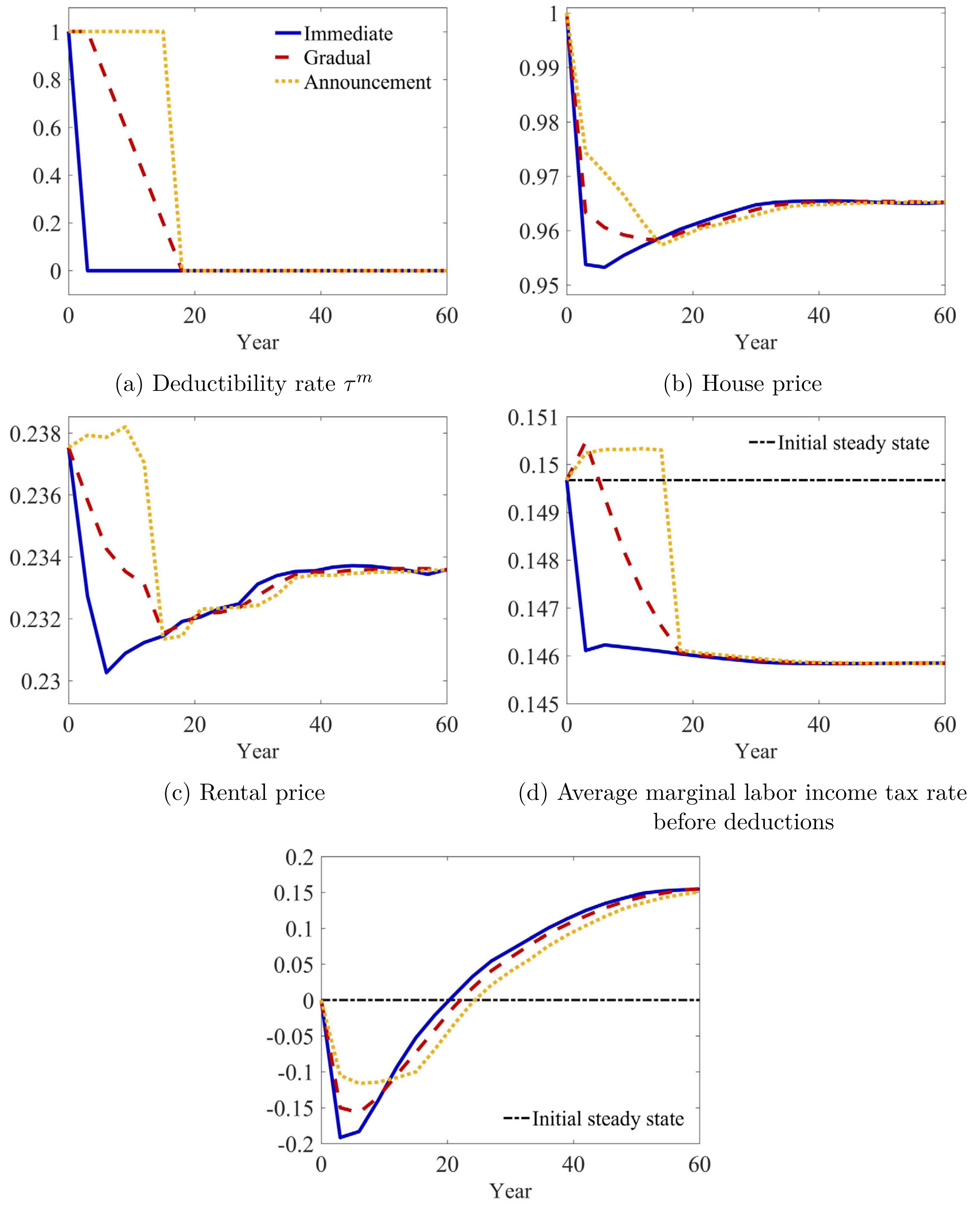
The differences in the labor income tax levels between policies are driven by the paths of the deductibility rate and the house price. A lower mortgage deductibility rate decreases the government's tax expenditures, and allows the government to reduce the labor income tax level. On the other hand, a fall in the house price decreases the property tax payments, which worsens the government's budget. Under the immediate policy, the labor income tax level can be reduced at once. Under the gradual and announcement policies, the labor income tax rates initially increase, as the revenue from property taxes falls and the government still spends large amounts on interest deductions.

The initial drop in the bequest rate is driven by the unexpected fall in the house price, which decreases the value of collected bequests. As the fall in the house price is the largest under the immediate policy, so is the negative effect on bequests. Along the transition, the bequest rate increases as households' asset holdings become increasingly similar to those in the new steady state, where the average net worth is higher.

5.3.2. How do welfare effects depend on the timing of policies?

Although the less abrupt policies give households more time to adjust their allocations, we find that the immediate policy is actually preferred to those policies. As seen in Table 8, the immediate policy has both the highest mean CEV and is the policy with the highest share of households experiencing welfare improvements. Thus, we find that none of the policies are able to achieve a majority support or positive welfare effects on average. Even in an analysis where we consider the discounted welfare of all households that enter the economy along the transition, the average welfare effect remains

[15] For an analysis of a grandfather policy, see online Appendix E.



(a) Deductibility rate τ^m

(b) House price

(c) Rental price

(d) Average marginal labor income tax rate before deductions

(e) Bequest rate γ (%)

Note: Panel (a) shows how the deductibility rate is decreased under the three policy reforms. All policies are implemented unexpectedly and households have perfect foresight of the transition paths of prices, taxes, and bequests. Panels (b)-(e) show how the house price, the rental price, the average marginal tax rate before deductions, and the bequest rate behave in the short run, in response to the paths of the deductibility rate. The rental price corresponds to a three-year (one model period) cost of renting.

Fig. 6. Short-run dynamics from removing the MID, across policies.

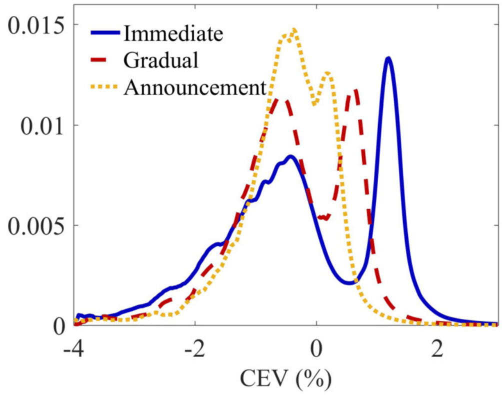
negative for all policies.[16] Moreover, we cannot find a one-time cash transfer scheme that results in a Pareto improvement under any of the policies considered.

[16] Specifically, the mean discounted CEV (%) would be −0.08, −0.14, and −0.16 under the immediate, gradual, and announcement policy, respectively. We discount the welfare of newborns by β^{t-1}, noting that $t = 1$ is the first period of the transition.

Table 8
Welfare effects of households alive in the first period of the transition.

	Immediate	Gradual	Announcement
Mean CEV (%)	−0.40	−0.52	−0.52
Fraction in favor	0.39	0.35	0.27

Note: The fraction in favor is the fraction of households with a CEV greater than or equal to zero. For a description of CEV (%) see *Note* below Fig. 5.



Note: Distributions of welfare effects of the three policies, for households alive in the first period of the transition. For a description of CEV (%) see *Note* below Fig. 5.

Fig. 7. Distributions of short-run welfare effects, across policies.

There are substantial differences in the CEV distributions across policies, as seen in Fig. 7. Naturally, the direct effect of removing the MID is negative under all policies. The average welfare loss from this channel is dampened under the gradual and announcement reforms, which reduces the left-hand tail of the CEV distribution.

The slower fall in rental prices and house prices under the gradual and announcement policies affects both renters and homeowners. Renters prefer the immediate policy, since they benefit from a faster decline in prices. As a result, the right-hand peak of the distribution in Fig. 7 is shifted to the left under the gradual and announcement policies. For homeowners, the accelerated fall in the house price under the immediate policy reduces the housing equity more rapidly, and the losses distributed from the rental companies are higher. The overall effect of changes in rental prices and house prices is a decrease in average welfare. Quantitatively, this negative effect is similar in magnitude under all policies.[17]

The fall in house prices also leads to a reduction in bequests during the first periods of the transition and has a negative impact on all households. This negative effect is somewhat less pronounced under the more gradual policies when the house price fall is smaller.

A lower labor income tax level benefits all households and shifts the whole CEV distribution to the right. Households benefit the most from labor income tax changes under the immediate policy, which has the lowest tax rate in the first five periods of the transition. The short-term differences in tax rates between policies have important implications for welfare and constitute a key reason why the immediate policy achieves the smallest welfare loss.

5.4. An MID removal after the Tax Cuts and Jobs Act

At the end of 2017, the Tax Cuts and Jobs Act (TCJA) was enacted (see, e.g., Gale et al. (2019) for a summary). In this section, we take a closer look at the welfare effects of an MID removal after incorporating some of the main changes of the tax reform. Specifically, we focus on two changes to the tax system: the near doubling of the standard deduction and the new cap on deductions for state and local income taxes and property taxes. These changes are likely to be particularly important for an MID removal. They reduce the fraction of households that choose to itemize deductions and thus the number of households that benefit from the MID. There are other features of the fiscal reform that we have not incorporated in the model because we believe that they are unlikely to have large effects on our results.[18]

[17] For a detailed account of the welfare effects under different equilibrium assumptions, see online Appendix F.

[18] There are primarily three parts of the tax reform that are related to our modeling framework that we have chosen to not incorporate. First, under the TCJA it is no longer possible to deduct interest payments for home equity lines of credit. We have no explicit role for home equity lines of credit in the model and only 5 percent of total mortgages are home equity loans in the SCF 2013 wave. Second, the cap on total mortgage interest payments that can be deducted was reduced from 1M to 750k. In our model, this change affects very few households, especially since the new cap on property tax deductions reduces the house sizes of high-income households. Finally, the TCJA reduced the tax rates and altered the thresholds for most federal income

Table 9
Short-run welfare effects: Tax Cuts and Jobs Act.

	Immediate	Gradual	Announcement
Mean CEV (%)	−0.28	−0.30	−0.26
Fraction in favor	0.39	0.38	0.35

Note: The fraction in favor is the fraction of households with a CEV greater than or equal to zero. For a description of CEV (%) see *Note* below Fig. 5.

We operationalize the TCJA by increasing the baseline standard deduction by a factor of 1.9 and by setting the maximum deduction for the sum of state and local income taxes and property taxes to 10,000 in 2018 dollars.[19] For simplicity, we assume that the new legislation is permanent, although these individual tax code provisions are all scheduled to expire at the end of 2025. Note that we do not require the TCJA to be tax neutral, i.e., the labor income tax level is not changed. However, we do adjust the bequest parameter γ, taking into account that the bequests left behind may change. We proceed by repeating the policy experiments in the previous section, but take as a starting point the steady state with taxes set according to the TCJA.

Table 9 summarizes the results of the short-run policy experiments, whereas the long-run results are provided in online Appendix G. For all removal policies, a majority of households are against a removal and the average CEV is negative. Quantitatively, the average welfare effects are less negative compared to our benchmark results, as the direct effect of removing the MID is reduced under the new tax code. Under the TCJA tax code, only households with considerable mortgages find it worthwhile to itemize tax deductions, resulting in an itemization rate of just 9 percent. Since removing the MID affects fewer households directly, the removal also has a more muted effect on taxes and prices. For example, the house price fall is only about half as large as under the baseline calibration. As a result, the welfare losses for homeowners are smaller, but so are the welfare gains for renters.

6. Concluding remarks

A growing academic literature consistently shows that, in the long run, most American households would be better off without the MID. Much less is known about how a repeal of the MID would affect current households and, in particular, how these effects depend on the design of the removal policy. In this paper, we attempt to fill this gap by taking into account transitional dynamics and studying the welfare effects of several MID removal policies.

Our results show i) that the welfare effects of an unexpected and immediate removal policy are negative on average and less than forty percent of households benefit from the reform, and ii) that more gradual policies do not improve these outcomes. The results materialize despite our finding that 88 percent of households would prefer to be born into a world without the MID. We argue that the inclusion of mortgage-refinancing costs, which reduce the liquidity of housing wealth, and an explicit modeling of retirees, are the main reasons why we find considerably lower welfare effects as compared to the existing literature. In our analysis, we find that both aggregate and distributional welfare measures depend significantly on how the MID is removed and that households differ in their preferred policy design. More gradual policies, which give households more time to prepare for an MID removal, are successful in mitigating the losses for those who suffer the most under an immediate policy. However, a majority of households actually prefer an immediate removal with large and instantaneous equilibrium effects of lower prices and taxes.

Our analysis highlights the importance of including realistic life-cycle dynamics and key frictions to understand the welfare effects of tax policies in the housing market. To further increase our comprehension of how government policies affect households differentially, this class of heterogeneous agent models provide a promising platform. There are a number of extensions that are worthwhile considering in future work on housing tax reforms, in particular when studying a removal of the MID. First, potential demand effects on output from, e.g., lower house prices could be explored. To the extent that such changes in output can have important feedback effects into house prices, these effects are omitted from our analysis. Second, it would be interesting to explore whether a Pareto improvement can be achieved by combining the removal with more elaborate transfer schemes. In this paper, we do not find a one-time transfer scheme between winners and losers of the current generation that would make everyone better off. However, since future generations benefit from the removal, it might be possible to obtain a Pareto improvement by allowing the government to take up debt and redistribute gains from coming generations. Last, expanding the analysis by allowing house prices to be non-linear in house size may have implications for homeownership and welfare. Our analysis shows that a removal of the MID reduces the demand for larger

tax brackets. In the model, we calibrate the two parameters of our labor income tax function to match the average marginal tax rate in data, and the distribution of households exposed to the different statutory marginal tax rates. We do not have data for this after the new tax rates and thresholds were implemented, and it is therefore not obvious how the changes should be translated into changes of the parameters. However, with lower marginal tax rates for high-income households, the benefits of the MID are likely further reduced with the new tax schedule. As a result, the negative effects of a removal may be smaller.

[19] Under prior law, the 2018 standard deduction would have been 6,500 dollars for single filers, 13,000 dollars for joint filers, and 9,550 dollars for head of household. Under the TCJA, the standard deduction is 12,000 dollars for single filers, 24,000 dollars for joint filers, and 18,000 dollars for head of household; see Gale et al. (2019).

houses, whereas more households buy smaller homes. Although we find these considerations interesting, we leave them as suggested avenues for future research.

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Appendix A. Supplementary material

Supplementary material related to this article can be found online at https://doi.org/10.1016/j.red.2020.08.003.

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