Evidence on the effect of the Dutch tax-treatment of homeownership on the demand for housing:
Time for the mortgage interest deduction to move out?

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Abstract

I utilize two reforms to the Dutch mortgage interest deduction to study the effect of the mortgage interest deduction on real housing demand. I conduct difference-in-difference and instrumental variable analyses on a comprehensive micro-level dataset of Dutch households. From the results of this paper the following three conclusions can be drawn: First, the mortgage interest deduction has a statistically negligible effect on homeownership. Second, the mortgage interest deduction distorts intensive margin housing consumption and mortgage indebtedness, which do not provide positive externalities. Finally, consumption increases are largely concentrated among middle- and higher-income groups.

Introduction

In many countries, homeownership is seen as a merit good. It is therefore no surprise that a common feature of many tax systems is a subsidy of owner-occupied housing. The principal measure through which governments across developed economies subsidize homeownership is the mortgage interest deduction (MID). In the Netherlands, the MID in 2020 amounted to foregone taxation equal to roughly 1% of GDP, or about 3% of all spending for that year (Rijksoverheid, 2020). This is a substantial subsidy, but the situation on the housing market does not seem to be favorable for those looking to find a home. With rising house prices, the average age of homeowners has been steadily increasing since the Great Recession, going from 34 to 40 in the first seven years after the crisis (CBS, 2017). The Dutch Central Bank has argued that the mortgage interest deduction has increased inequalities in the cost of housing between renters and owner-occupants (NOS, 2021). Alongside this development, the social renting sector has been struggling to meet demand, while private rental costs have been increasing (NOS, 2020). Calls for reform on the housing market have thus become commonplace, with the MID a prime target for reform in both academia and the public debate.

Government subsidies to owner-occupied housing are usually motivated by a multitude of other positive externalities from homeownership (Glaeser & Shapiro, 2003; Bourassa & Grigsby, 2000). A large literature on the effects of the mortgage interest deduction exists, with early papers finding that the MID has a strong positive effect on both homeownership and the amount of housing consumed. More recent work in general equilibrium modelling, however, finds that the MID does not affect or even decreases homeownership (Binner and Day, 2015; Sommer and Sullivan, 2018). In addition to this, there are a number of papers that find adverse effects in tax systems with a mortgage interest deduction: the presence of the MID decreases the progressivity of the tax code (Wagstaff et al., 1999), inflates house prices (Sommer & Sullivan, 2018), and increases inequality in housing expenses between high- and lower income groups (Heylen & Haffner, 2012). The question is therefore if the benefits of the mortgage interest deduction in the form of the externalities of increased homeownership outweigh the adverse effects on house prices and equity.

In comparison to the amount of research in the field, there exists relatively little empirical evidence on the effect of the deduction on real housing consumption. Because both the mortgage interest deduction and measures of housing consumption on the extensive and intensive margin, such as homeownership or home size, are equilibrium outcomes, our estimate is dependent on the elasticity of supply for housing. If the elasticity of supply is not perfectly elastic, at least some of the increase in demand from the MID will be capitalized into prices. If this mechanism is not accounted for, estimates of the policy effect will be biased. Only a handful of papers use modern econometric research designs to solve this issue, most notable of which being Hanson (2012) and Kleven et al. (2021). These papers use exogenous variation in the MID to estimate the policy effect on a micro-level dataset. With this paper I contribute to the literature by providing new estimates of the effect of the MID on homeownership and housing consumption.

The Dutch government introduced a limitation to which mortgage types could receive MID and reductions to maximum LTV ratios in 2013 and a gradual reduction in the maximum deductible rate in 2014, which grants observable exogenous variation in the mortgage interest deduction with which the casual effect of the MID can be identified. I exploit these reforms to estimate the policy's effect through difference-in-difference (DiD) and instrumental variable (IV) methods. On the extensive margin I perform a DiD-analysis to compare the development of homeownership among high-income groups, who were affected by the 2014 reduction in the maximum rate of deductibility, to middle- and lower-income groups, who were untreated. On the intensive margin, I use the policy changes introduced in 2013 to construct two instruments, which are used to test the effect of the MID on home size, home value and mortgage indebtedness. I conduct these analyses on a comprehensive micro-level sample of Dutch households called the WoON-onderzoek, created in 2018. This dataset is comprised of detailed survey data on housing characteristics combined with administrative data provided by Statistics Netherlands. The features of this dataset grant this study a large sample size and level of detail to work with, covering a recent timeframe. In so doing, I hope to provide the academic debate and policymakers with a better understanding of the real demand effects of subsidies for owner-occupied housing.

From the results of this paper, I draw the following three conclusions: First, I find that the reduction of the maximum rate of deductibility of interest did not reduce homeownership, over multiple specifications and control groups. This signifies that the policy is likely to have a negligible effect on extensive margin housing demand. Secondly, I conclude that receiving more MID through differences in mortgage type does increase housing consumption. Homeowners substantially increase their home size and value in response to the MID. I also find that households significantly increase their mortgage indebtedness. These effects are especially strong when only observing a sub-sample of movers. Third, I find that the MID has differing incentives across income groups, caused by credit constraints. Higher and middle-income households increase their housing consumption in response to the deduction, while lower income brackets only increase their indebtedness to a statistically significant degree.

These findings provide useful insights for the debate on tax subsidies of housing. The mortgage interest deduction seems to be ineffective at encouraging the externalities that are associated with homeownership if they are present. Instead, the deduction induces distortions in consumption of both housing and mortgage debt, which have not been shown to provide positive externalities. This overconsumption of housing is disproportionally enjoyed by middle- and higher-income groups. The MID therefore falls short on grounds of efficiency and equity. Reforms should look to reduce or even abolish the deduction and stimulate individuals' access to housing in other ways. These implications are subject to a number of limitations. If the policy reforms of 2013 and 2014 did not introduce useful exogenous variation in the deductibility of interest, the results of this paper are still biased. In addition to this, I do not observe the long-run effect of the policy changes, which might differ from the estimates obtained in this paper.

The study proceeds as follows. In Section II I review the literature on the externalties of homeownership to develop a criterion by which the efficacy of the mortgage interest deduction can be evaluated. I then provide an overview of the results of previous studies on the effects of the

MID. In Section III I explain the institutional setting of the Dutch tax treatment of owner-occupied housing and the 2013 and 2014 reforms that are used for identification. In section IV I outline the construction of the micro-level sample of Dutch households, called the WoON Onderzoek, I then explain a simple model of housing consumption with which to understand the results of our estimation and provide the econometric specifications that will be used. In Section V I present the key results of the analysis on both extensive and intensive margins. In Section VI I perform some additional tests on the effects of the MID on housing consumption among movers only and for various income groups to account for credit constrains. In Section VII I conclude by discussing the results, their implications for policy and possibilities for future research.

II. Literature Review

In this section I provide an overview on the literature discussing the externalities of homeownership, previous research on the effects of MID on housing demand and the methodological difficulties in estimating this relationship. Before I do this, I separate the definition of housing consumption into two different dimensions: *extensive* margin housing and *intensive* margin housing. In the literature, extensive margin housing consumption is often defined as the choice between renting and owner-occupying. Intensive margin housing consumption on the other hand is the level of housing consumption: the living space, aesthetic qualities or location of the household's home. This distinction is helpful when discussing housing consumption because the two dimensions of housing could respond to incentives in differing ways and might provide different benefits.

Why Subsidize Homeownership?

When discussing the effectiveness of the Mortgage Interest Deduction (MID) it is useful to discuss why it is popular for governments to incentivize owner-occupied housing. Aside from the fact that many governments and societies consider owner-occupied housing a merit good, evidence suggests that there are potential positive externalities to housing consumption. Dietz and Haurin (2003) explain that homeownership might encourage mutually beneficial behavior such as social participation and neighborhood investment. This incentive arises due to the substantially larger transaction costs for owner-occupiers compared to renters and the long-term financing agreements that homeowners often make to purchase their homes. These factors promote responsible and sociable behavior with the household's surroundings and the upholding of the property's value: The household will be living in their neighborhood for the foreseeable future and has committed to a mortgage that rests on the value of their home. Important to note is that these incentives only arise from the extensive margin of housing consumption. There is no literature presenting evidence on the positive externalities of increased intensive margin housing consumption. In this subsection I will discuss the literature on the ways in which this incentive presents itself in children's development, labor market outcomes, social capital and residential investment.

The effect of homeownership on children's development and educational achievement has been a popular field of study following Green and White's (1997) paper on the topic, which found a strong correlation between homeownership and the likelihood of dropping out of school or teen

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pregnancy by estimating probit models on various panel datasets of American sophomore students in 1980. The authors estimated the effect to be as large as a public benefit of 31000 dollars per household of parents being homeowners rather than renters. A study by Haurin et al. (2000) uses an OLS estimation on a linked panel of US educational and administrative statistics to find that homeownership increases test scores by roughly 7% because of better home environments, even when correcting for potential treatment biases. Boehm and Schlottman (1999) use similar data and methods to find a significant increase in the levels of education completed and income earned for children of parents that were homeowners, amounting to an increase in average annual income of 7497 dollars when comparing children of homeowners and renters. The estimates of these papers therefore indicated that encouraging homeownership might provide significant benefits to human capital and productivity

An important criticism of the aforementioned papers is that these studies often use simple OLS estimation methods, potentially inviting issues of endogeneity and omitted variable biases. Aaronson (2000) uses an instrumental variable regression and finds that Green and White's (1997) findings are largely driven by homeownership's effect on residential mobility: a stable living situation stimulates educational development because children will be able to develop a social circle and get used to the school environment. When controlling for mobility factors the effect of homeownership on development diminishes significantly. This notion is further reinforced by Barker and Miller (2009), who utilize the same dataset Green and White (1997) used in their seminal paper. They find that controlling for factors such as residential mobility, wealth, dwelling type and vehicle ownership substantially reduces the positive correlation between educational attainment and parental homeownership. This attribution of educational attainment to residential stability is also echoed by Leventhal and Newman (2010), based on a critical review of the literature on the effect of housing situations on children's outcomes. They did not find any studies on the topic of homeownership and education that convincingly disentangled the effect of homeownership on education from other factors that are correlated to both homeownership and education, such as residential mobility. More recent work on the topic of homeownership and children's development therefore questions the direct causal link of homeownership and human capital. It is more likely that homeowners are better able to provide an environment suitable to development because of factors such as income, wealth, or job stability. It is therefore questionable whether stimulating homeownership is the most direct way to encourage human capital development in children.

Another dimension in which homeownership has potential externalities is the labor market. The fact that homeowners have a strong incentive to commit to their home for a long period of time means they are less able to move to new jobs after becoming unemployed or find better jobs elsewhere, following a simple interpretation of the search theory of labor. In contrast to this hypothesis, Coulson and Fisher (2002) find that homeowners have better labor market outcomes than renters. They earn higher incomes and are less likely to be unemployed. In a later analysis with a model including firm behavior Coulson and Fisher (2009) find that this effect is more nuanced. While homeowners are more likely to be unemployed or earn lower incomes on an individual level, the firm-level responses to a higher rate of homeownership in the area increase job creation and production. Broulikova et al. (2020) utilize exogenous variation in

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homeownership arising from differing degrees of housing privatization to find similar results through a fixed effects analysis: while on an individual level, homeownership reduces mobility and therefore labor market opportunities, the positive neighborhood-level effects on economic activity cancels out or surpasses the negative effect of reduced mobility. The effect of homeownership on labor market opportunities is therefore mixed. Promoting employment through subsidizing homeownership might therefore not be the most cost-effective policy, similar to when we consider human capital development.

Because homeowners are committed to their neighborhoods, they benefit from fostering relationships with the community around them. Homeownership could then have positive externalities on the degree of social participation of households. DiPascale and Glaeser (1998) estimate an instrumental variable regression and find that homeowners are about 3 to 4 percent more likely to be involved in volunteering or local politics. Glaeser and Sacerdote (2000) find that rental apartments experience more within-building social cohesion due to resident's closer proximity to each other but also experience higher levels of crime, which the authors attribute to a disconnect between residents and the neighborhood. A more recent randomized field experiment by Engelhardt et al. (2010) finds no impact of homeownership on social participation, however, calling into question whether the correlations identified in previous studies can be considered a causal link. It is possible that, like in the relationships analyzed earlier in this section, homeownership is a proxy for residential stability, which is the main driver of this externality.

Homeowners might also be incentivized to take better care of their homes, due to their property values being affected by the state of their house and those of other residents in the neighborhood. Galster (1983) estimates a simple OLS model to find that owner-occupants are more likely to live in higher-condition homes than rental tenants but notes that this effect could be driven by self-selection based on differing preferences for housing conditions. Autor et al. (2014) utilize variation in homeownership from the removal of rent controls to conduct a quasi-experimental analysis on the effect of homeownership on residential investment and find a weak positive effect. Homeownership could therefore be a driver of higher quality homes and neighborhood environments, which increases quality of life.

While much research on the externalities of homeownership directly measures behavioral outcomes, research utilizing hedonic pricing techniques can provide a different perspective on the topic because it can put a price on non-monetary externalities of homeownership. If households derive value from living near other homeowners, they will be willing to pay more for their homes. This allows us to observe the monetary value of homeownership's externalities. Coulson and Li (2013) use a hedonic pricing model to find that a transition from renting towards owner-occupied housing creates roughly 1300 dollars in measurable benefits and expect this to be a lower bound, because their analysis was not able to capture all dimensions of externalities and the potentially slow-moving development of externalities caused by owner-occupied housing. Kortelainen and Saarimaa (2014) do not find this effect in a similar hedonic price estimation on a sample of multi-storied buildings, suggesting that the positive effects of homeownership might be heterogeneous depending on the type of residence the household occupies.

Summarizing, the literature on the externalities of homeownership has emphasized the possible presence of incentives for homeowners to behave in ways that create positive spillovers. Due to the difficulty of convincingly identifying these effects as separate from factors correlated with homeownership, the empirical support for this hypothesis is relatively mixed. More recent studies utilizing modern identification strategies do find that these positive effects are present in some of the dimensions studied, namely labor market opportunities and residential and neighborhood condition. Evidence on other possible externalities, such as human capital development or social participation, is still too mixed to convincingly support subsidies of homeownership. This evidence only pertains the extensive margin of housing consumption, however. Changes in the intensive margin of housing do not seem to generate positive externalities. This provides us a criterium against which to evaluate the MID: the policy can be considered efficient if it stimulates homeownership, while changes in the intensive margin of housing consumption can be considered distortions because intensive margin housing consumption does not provide externalities to society.

Previous research on the Mortgage Interest Deduction

The effects that the Mortgage Interest Deduction (MID) has on housing consumption has been a widely studied topic. In this section, I will discuss the findings of this body of literature.

The commonly used model to explain the effects of the tax treatment of owner-occupied housing is the user cost model[1]. In a simple representation of the model, the incentive to own as opposed to renting b_{own} can be defined as

$$b_{own} = (i + \pi + m)t + d_r - d_o$$

Where i is the real interest rate, π is inflation, m is the rate of deductibility of mortgage interest, t is the marginal tax rate of the household and d_r and d_o are the maintenance, depreciation and other costs related to renting and owning, respectively. Glaeser and Shapiro (2003) explain the intuition of the model as follows: introducing a MID to the tax system reduces the marginal tax rate for homeowners, which lowers the relative cost of owner-occupied housing compared to the costs of renting. This provides an incentive for households to own their housing (extensive margin consumption) and consume more housing (intensive margin consumption).

Another interesting feature of this model is that it highlights that higher-income groups, who face higher marginal tax rates, benefit more from this measure. As *t* increases, the effect the deduction *m* has on the incentive to own increases as well. A common criticism of the MID is therefore that the benefits of the policy are largely centered on people that need not be helped in their housing consumption, creating distributional issues.

The effect the MID has on the demand for housing has been studied extensively in the past on both the intensive and extensive margins. Rosen (1979) estimates the effect of the MID on the user cost of housing among an administrative dataset of the US population and use these predicted

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[1] See Rosen, 1979; Rosen, 1983; Hendershott, 1980; Glaeser and Shapiro, 2003 for early iterations of this model in action.

values of user cost to estimate the intensive margin demand for housing. Using these estimates, simulations indicate that the MID had sizeable effects on the amount of housing consume, with estimated intensive margin elasticities to the MID of about 1. Ling and McGill (1998) and Dunsky and Follain (2000) find a strong positive correlation between interest deductibility and the demand for mortgage debt (intensive margin demand). Dunsky and Follain find a lower implied elasticity to tax changes than Rosen: their elasticity to the tax price of mortgage debt is 0.5 for unconstrained and 1.3 for credit constrained households. On several facets, then, the deductibility of interest increases intensive margin housing consumption, with estimated elasticities to the MID being quite large. More important than the intensive margin elasticities, though, is the extensive margin elasticity of housing demand to the MID. As explained in section 2A, any externalities to housing have only been found on the extensive margin.

On the extensive margin, Hendershott (1980) uses Rosen's (1979) methodology to estimate the effect of the MID on the rate of homeownership in the United States from 1955 to 1979, finding that the deduction increased homeownership by roughly 5 percent compared to a situation without MID, implying an extensive margin elasticity of 0.6. Rosen and Rosen (1980) find similarly large effects on the extensive margin of housing demand on a larger US dataset, ranging from 1945 to 1975. Bourassa and Yin (2006) estimate the effect of the MID on extensive margin housing demand by simulating a tenure choice equation in which the relative cost of owner-occupied housing affects the rate of homeownership, where the relative cost of owner-occupied housing is calculated similarly to Rosen's (1979) two step estimation. They find an estimated extensive margin elasticity to the MID equaling roughly 0.3 in the US and Australia. This body of evidence therefore suggests that the mortgage interest deduction has a positive effect on homeownership. The evidence from these studies suggests that, in the presence of positive externalities to homeownership, the MID does provide welfare benefits.

It is important to investigate where these welfare benefits land, however. Research also finds that the distribution of MID and its effect on housing demand is heterogeneous among income groups: Follain and Ling (1991) and Poterba (1992) find that much of the United States' MID lands with higher income groups. While lower- and middle-income households seem to benefit less from the MID, they are incentivized to take on more mortgage debt with higher income groups being less responsive to changes in the MID compared to lower income groups. These heterogeneities in the effect and distribution of the MID can cause tax systems to be less progressive: In a study on the progressivity of OECD tax systems, Wagstaff et al. (1999) find that the redistributive effect of the tax system is reduced by the deductibility of mortgage interest. Heylen and Haffner (2012) find that the favorable tax treatment of housing in the Netherlands and Flanders increases inequalities in disposable income while not substantially moderating housing expenses for middle- and lower-income groups.

These early studies on the partial equilibrium effect of the MID on housing demand indicate that the favorable tax treatment of housing has considerable positive effects in stimulating both the rate of homeownership and the amount of housing consumed. This effect could be heterogeneous across income groups, however, as studies find that the deduction is distributed disproportionally towards the higher income groups. In a review of the contemporary literature on the topic,

however, Glaeser and Shapiro (2003) find that most of the research that had been done at that time did not use sound econometric methods to identify the causal effect of the MID on demand. Many studies use a simple OLS or two-step estimation method to analyze the mechanism and are therefore more susceptible to bias in their estimates. This bias is pointed out by Gale et al. (2007), who note that US homeownership barely changed over a period between 1965 and 2005, while the tax treatment housing changed substantially. In the following sub-section, I discuss the potential sources of bias when estimating the effect of MID on housing demand and review the findings of the literature that tackles these issues.

Identification issues and implications of price capitalization

It is difficult to estimate the causal link between the mortgage interest deduction and housing demand because both are equilibrium outcomes of housing market decisions. Running a simple OLS estimation, as has been done in the early literature on the topic, will be susceptible to issues of omitted variable bias or reverse causality. A crucial source of bias when omitted from our estimation model is the supply-side response to changes in the mortgage interest deduction. If supply is perfectly responsive to changes in demand, we could identify the effect of the MID on demand under the assumption that all other variables important in determining housing demand are included. It is likely, however, that the housing supply is inelastic to changes in demand. Land, especially in the Netherlands, is scarce and construction takes a long time to finance and complete. Capozza et al. (1998) develop an asset equilibrium model to investigate the effect of the user cost of housing on house prices and find that the positive effect of the favorable tax treatment of housing on demand is largely constrained by the supply elasticity of the housing market, which causes the MID to be capitalized into house prices instead. Studies have also investigated the price capitalization of the tax treatment of housing empirically and find that the effect of a housing tax reform had divergent effects on urban and rural housing markets, which have different supply elasticities related to the availability of land (Capozza et al, 1996; Voith & Gyourko, 2002). We therefore get a simultaneous effect when we increase the MID: housing demand will receive an upward incentive through a reduction of the relative cost of owner-occupied housing, while simultaneously receiving a downward incentive due to the capitalization of the deduction into prices. When we do not model this simultaneity or observe variation in the MID that is independent from this mechanism, our estimates of the responsiveness of demand will be biased upward.

One way to better approximate the effect of the deductibility of mortgage interest on housing demand is to account for geographic differences in supply elasticity using a fixed effects model. Vangeel et al. (2020) utilize a fixed-effects regression to estimate the MID's effects on prices in highly urban Belgium and find that the increase in demand is largely capitalized in house prices. This causes the extensive margin elasticity to the MID to not be significantly different from 0. This is not the case everywhere, however. Hilber and Turner (2014) estimate the effect of MID on homeownership and find that it does increase homeownership in loosely regulated housing markets with many high-income households. In other communities, it has an adverse effect on homeownership. This indicates that the transmission of the MID onto housing demand is dependent on income and supply elasticity.

The effect of the dynamic response of house prices to changes in the MID is also recognized by Bourassa and Yin (2008). They iterate on their previous study by adding house prices into their system of equations. The consideration of the dynamic response of house prices makes the effect of eliminating the MID on homeownership positive, showing that the supply side of the housing market affects our estimation of the demand response to interest deductibility substantially.

Another common method to address issues of simultaneity is to develop a general equilibrium model in which supply and demand are simultaneously determined. In an early general-equilibrium simulation of a housing market in which households both consume and invest in housing, Berkovec and Fullerton (1992) find that the mortgage interest deduction has a positive effect on the amount of housing consumed but a very weak or non-existent effect on homeownership. A more recent general equilibrium model developed by Binner and Day (2015) that incorporates public goods provision dependent on property taxes in the tenure choice process finds that reducing the MID has no strong effect on homeownership, while Sommer and Sullivan (2018) find that in a housing market with inelastic supply the elimination of the MID increases homeownership and decreases prices and mortgage debt. Findings from general-equilibrium models therefore indicate that the mortgage interest deduction has a negligible or negative effect on homeownership due to the capitalization of the deduction into house prices.

Only a few recent studies combine microdata and modern econometric methods to estimate the effect of MID on both the extensive and intensive margins of housing demand. Hanson (2012) conducts regression discontinuity and instrumental variable analyses on US tax data to find that the MID substantially increases the size of homes purchased, at an elasticity of roughly 1, but does not affect homeownership. In another study, Hanson (2020) uses the United States' 1-million-dollar MID limit to conduct a bunching analysis and finds that households do excessively bunch at the maximum interest deductibility, suggesting that the MID has a significant positive effect on indebtedness with an elasticity of 0.120. Kleven et al. (2021) use a reform in the maximum deductibility of interest for high-income groups in Denmark to perform a difference-in-difference analysis of both the intensive and extensive margin responses of housing demand. They find that the reduction in MID caused no significant reduction in homeownership while substantially reducing home sizes (elasticity of 0.10), values (0.175) and interest expenses (0.25) of movers. Using quasi-experimental research methods to observe variation in the MID that is exogenous to the supply elasticity of housing seems to suggest, then, that the MID is predominantly effective in stimulating the quantity of housing consumed, not homeownership.

To conclude the literature review, the mortgage interest deduction is desirable when the policy sufficiently increases extensive margin demand for housing so that the positive externalities associated with homeownership are encouraged. While early evidence has suggested that the mortgage interest deduction has a positive effect on both homeownership and the amount of housing consumed, more recent studies that address issues of simultaneity and omitted variable bias find that the effect of the MID on homeownership is negligible due to the capitalization of the demand increase into prices. In this study I intend to contribute to body of literature in two ways: First, I conduct a difference-in-difference and instrumental variables analysis to address issues of simultaneity and omitted variables and I join the small subsection of the literature that utilizes

micro-level data to analyze the household level effects of the deduction. Another addition to the literature I am making is the fact that I am analyzing data on the Netherlands, which sports a very densely populated and thus supply constrained housing market, while most studies on the MID have been conducted in the US.

III. *Institutional Setting*

Dutch tax treatment of Owner-Occupied Housing pre-2013

The Dutch tax system taxes income from labor and capital through a constellation of 3 "boxes": Labor income and some capital such as pension savings and imputed rent from owner-occupied housing was taxed in Box 1 through progressive rates ranging from 33.10% to 52%; Dividends and capital gains were taxed in Box 2 at a rate of 25%; and financial assets over the exemption level of €21.139 were taxed in Box 3, through an effective net returns tax at 1.2%.

Effective taxation of homeowners is lower through two channels: A mortgage interest deduction and an exemption from imputed rent taxes for households with low or no mortgage debt. The mortgage interest deduction allows for the deduction of mortgage interest payments for a household's first house up to the rate the household pays their income tax. Imputed rent from owner-occupied housing is added to labor income for the calculation of the tax rate for box 1. This means that higher-income households deduct their mortgage interest at a higher rate than lower income brackets. Households with no or very little mortgage debt were also exempted from the imputed rent tax, a measure that was implemented to encourage homeowners to pay off their mortgage debt.

The 2013 Mortgage Interest Deduction Reform

This tax design created a very favorable fiscal position for mortgage-financed owner-occupied housing, through a substantial reduction in the effective tax on imputed rent. This raised several complaints: the design favored high-income households, who paid tax at higher rates in box 1 and thus benefitted from higher deductions; it encouraged taking on larger amounts of debt for longer periods of time through mortgage designs such as interest-only and savings-based mortgages; and it stimulated demand for owner-occupied housing, causing inflated house prices. These complaints have been part of the debate on the Dutch housing market for more than a decade, and with aftermath the Great Recession and the Eurocrisis, which caused falling house prices and households faced with residual debt on their mortgages, the Dutch cabinet (Rutte II) was expected to come up with reforms to improve the situation in the sector.

The policy that was enacted was not entirely expected, however. While much attention was directed towards moving owner-occupied housing from Box 1 to Box 3 and reducing the mortgage interest deduction, the government opted for limiting access to the Mortgage Interest Deduction to only two-types of mortgages: the annuity and linear-payment mortgages. This reform was aimed at combatting the attractiveness of the previously highly fiscally advantageous mortgage types that did not require repayment of debt. These mortgages kept debt and therefore interest payments high, thus increasing the amount of deducted income tax. After the 1st of January, only new annuity or

linear-payment mortgages would be able to deduct interest payments from income tax. This means that mortgages that do not require repayment signed before this date retained deductibility.

This reform affected the amount of mortgage interest deduction in two ways. First, households looking to finance their homes through interest-only or savings-based mortgages were now ineligible for the mortgage interest deduction. Second, deductibility of mortgage interest for eligible households was reduced through an increase in required repayments. As households opt for annuity and linear-payment loans and pay off their loans, interest payments go down, reducing the amount that can be deducted from Box 1.

This reform is of interest to the study at hand because proper identification of the causal effect of the mortgage interest deduction on the demand for housing requires variation in the mortgage interest deduction that is disconnected from fluctuations in price. If our analysis does not use exogenous variation in its estimation, the simultaneity between supply and demand effects on the housing market will bias our results. The 2013 reform to which mortgage types are eligible for MID introduces this type of exogenous variation: it was largely unexpected, as policy debate was mostly focused on other measures, and the reform only affected the mortgage interest deduction through the type of mortgage eligible for deduction and the development of debt it encouraged.

Other reforms relevant to the Mortgage Interest Deduction post-2013

The 2013 reform of which mortgage types receive MID was not the only policy passed onto the housing market after the Great Recession, however. The policy treatment of housing was changed in two other relevant ways; A yearly reduction of the maximum loan-to-value (LTV) ratio starting in 2013 to 100% in 2019, and a gradual reduction in the maximum rate of deductibility starting in 2014.

From 2013 to 2019, the maximum LTV ratio was reduced from 106% to 100% year-on-year. Households taking on a mortgage for their new homes during this period were therefore allowed a lower amount of debt than households buying a home before 2013. With less debt, households pay lower amounts of interest and can therefore receive less MID than households with a higher LTV ratio on their debt. This reform, like the one discussed previously, introduces some variation in households' MID exogenous from the elasticity of the housing supply. I therefore use the maximum LTV ratio in the year a households purchased their home as an instrument for the MID. In doing so, I better identify the causal effect of the MID on the intensive margin of housing consumption.

From 2014 onwards, the government reduced the maximum rate of deductibility for mortgage interest by 0.5% until 2019, where this reduction was accelerated to 3% per year until 2023, for a final maximum deductibility rate of 37.05%. This reduction was accelerated to 3% per year until 2023, for a final maximum deductibility rate of 37.05%. Up to the time of writing, this reform only affects high-income households. As such, this reform allows for the comparison of the development of homeownership between high-income and other groups. I will use this to conduct a difference-in-difference analysis on the extensive margin of housing demand later on in this paper. If the development of homeownership in the higher income group followed a parallel

pattern to the homeownership rates of middle- and lower-income groups, the difference-in-difference estimation can identify the causal effect of the MID on extensive margin housing consumption.

A. *Data and Descriptive Statistics*

I will estimate the specifications explained in the following section using rolling cross-sectional data from the 2018 edition of the WOON-onderzoek. This study is carried out in a collaboration between the Dutch government and Statistics Netherlands to provide policymakers with information on the characteristics of households in the Netherlands. It includes household-level administrative data combined with property and household characteristics and surveyed questions on housing preferences. Each household's main respondent has a personal identification number, with which administrative data of both the respondent and household members is linked to the entry in the dataset. It includes detailed information on incomes, homeownership, home and neighborhood characteristics, and a broad range of socioeconomic variables. Another important feature of this dataset is its inclusion of a detailed description of the household's housing and mortgage costs, allowing for the observation of a household's tax benefit of owner-occupied housing.

In this study I investigate the impact of the MID on both the extensive and intensive margins of demand for housing. For the extensive margin analysis, I utilize the 2018 edition of the WOON-onderzoek, because it covers a larger range of moving dates, which is the measure I use as a proxy for the year in which the household made the decision between homeownership or renting. This will be integrated into the difference-in-difference estimation strategy used for identification. The dependent variable for this analysis is a binary variable denoting whether the household owns or rents. I calculate the average yearly rate of homeownership for treatment and control groups, informed by the year in which the household took up residence in their home. The treatment group is defined as those households paying taxes in the highest income tax bracket, and control groups are divided between the middle and lowest tax brackets. A descriptive analysis of the properties of the extensive margin of housing demand over the studied timeframe can be found in section 4B.

When studying the impact of the mortgage interest deduction on the intensive margin demand for housing, I observe home living space, home value and interest expenses as outcomes. Home living size is defined as the house's usable living space in square meters. Home value is based on an appraisal by municipal authorities on a yearly basis and is used for the calculation of a household's imputed rent and wealth for that year. Interest expenses include all monthly mortgage interest payments. This means that all interest payments across all mortgages are combined into this measure.

As the main independent variable of interest I observe the fiscal benefit of homeownership, or the mortgage interest deduction. The MID is calculated based on the household's deductible mortgage interest expenses and is deductible at the rate of the top income tax bracket paid by the household. Important to note is that the maximum deductible rate for top tax brackets was reduced

by 0.5% year-on-year from 2014 onwards. This means that for one year the MID for top income brackets was 0.5% lower than the rest of the period covered in the data. Important control variables are the household's after-tax income and liquid wealth. Both are calculated from accurate tax records of Statistics Netherlands.

Variable	Mean	Std. Dev.	10th pct.	90th pct.
Homeownership	0.63	-	-	-
Non-Repaying Mortgage	0.76	-	-	-
MID Received (in Euros)	167.98	226.24	0	410.083
Pre-tax Income (in Euros)	51061	46033	15286	93973
After-tax Income (in Euros)	42453	32147	17288	71819
Liquid Wealth (x1000 Euros)	59.92	166.26	1.68	146.63
Home Value (x1000 Euros)	225	137	110	376
Living Space (in square meters)	124	74	67	187
Monthly Mortgage Payments (in Euros)	718	297.91	0	300
Mortgage Debt (in x1000 euros)	96.95	139.18	0	260
Respondent Age	51.52	12	32	79

Table 1: Descriptive Statistics relevant variables WoON Onderzoek 2018. Monetary values in euros.

The analyses on the intensive margin of housing demand are based on a sub-section of the data that owns a house and did not have any missing observations for the main variables of interest. These restrictions resulted in a sample of 26783 unique observations. Table 1 shows descriptive statistics of the sampled population. Tables 12 through 14 in appendix A show descriptive statistics divided by income group. As you can see, 76% of homeowners in the sample bought their home using a mortgage that did not require monthly repayments. This is not surprising: Before the 2013 reforms, this form of mortgage was highly popular due to the fiscal benefits described in the previous section. Households receive about 200 euros of deductions per month on average. Income is slightly higher than the national average: Average after-tax income in the Netherlands in 2015 was 38600 euros. This could be explained by the fact I am looking at homeowners, who generally have more stable and higher-paying occupations. The average liquid wealth of homeowners is also higher than the national average (40.000 euros). Note that the difference between the top and bottom percentiles of liquid wealth is quite large, as wealth inequality in the Netherlands is quite substantial. The average age of homeowners in the sample is also, expectedly, higher than the national average age of 42. Homeowners possessed houses worth 250 thousand euros on average

and had 139 square metres of living space. They paid 683.83 euros of interest per month on average and repaid their loans at an average amount of 89.50 euros per month. This skewed ratio of interest payments and repayments can be explained by the high degree of non-repaying mortgages in the sample.

B. *Descriptive Analysis of Extensive Margin Housing Demand*

The descriptive characteristics of the extensive margin of housing demand can provide some useful information on the life-cycle development of housing demand and the existence of time-trend or seasonal effects that we need to control for in our analysis. In figure 1A you can see graphical evidence on homeownership over time. Around 64 percent of the Dutch population are homeowners, a rate that has stayed relatively stable for the last 15 years. The 2013 reform, which resulted in a reduction of the tax favorability of owner-occupied housing, did not seem to affect the stability of the rate of homeownership. The gradual reduction of the mortgage interest deduction from 2014 onwards also seems to not move the rate of homeownership by a large amount. This gives a small indication towards the low responsiveness of housing demand towards the MID. This is of course not causal evidence but does provide our analysis with some context. If the policy reducing the tax favorability of housing seems to not have affected extensive margin housing demand, did it incentivize changes in the level of housing consumption among homeowners?

Another important aspect of extensive margin housing demand is its strong dependency on age: as you can observe in figure 1B, homeownership rises sharply through early adulthood and then remains constant for most of the individual's life. Through retirement, homeownership declines. Controlling for this life-cycle effect is important when one wants to examine the effect of tax favorability on housing demand, both on the intensive and extensive margin.
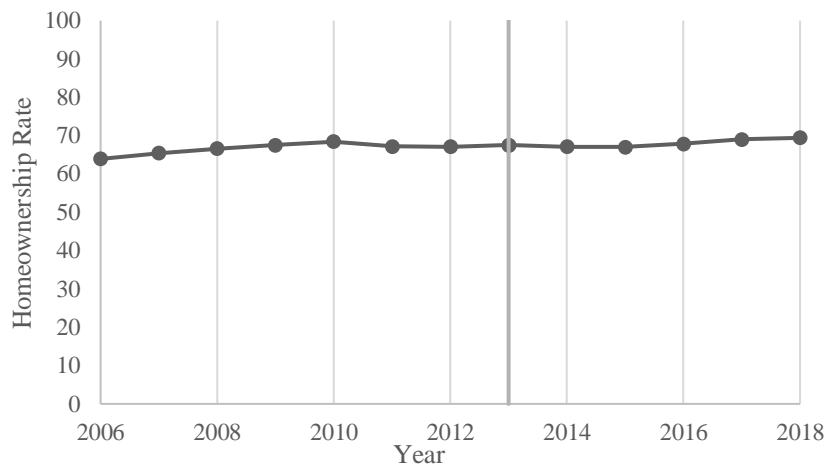

Figure 1A: Homeownership Rate in the Netherlands over time from 2006 to 2021. Source: Eurostat
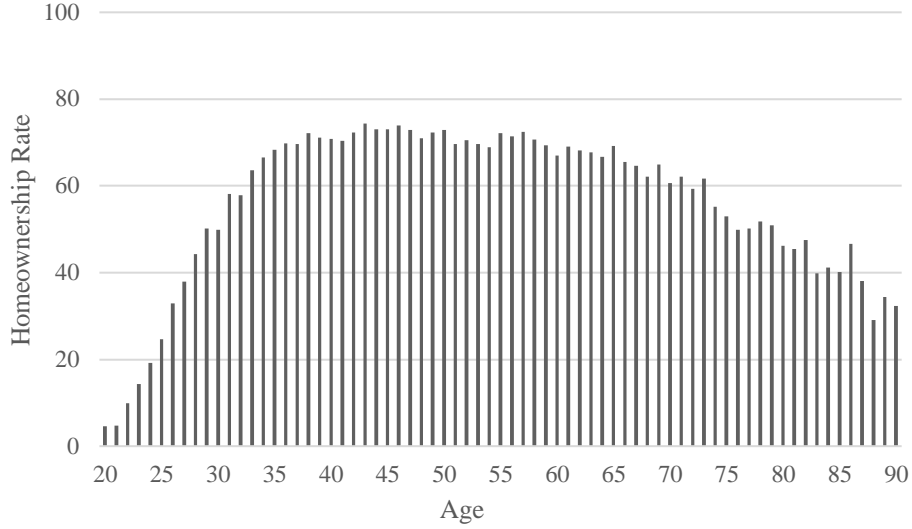
Figure 1B: Homeownership Rate by Age in 2018

C. *Model Housing Market*

To better understand why it is difficult to estimate the effect of the MID with a simple OLS model and thus why we need to use econometric techniques to introduce exogenous variation in the MID, I develop a model housing market following the example of Kleven et al. (2021). This model can then be used to interpret the implied elasticities of the studies' estimations defined in the next section. This model will allow for the separation of the effect of a change in the tax treatment of housing into the effect on housing decisions (extensive margin) and the determination of housing consumption (intensive margin).

Households derive utility from the consumption of a numeraire good c and housing h. They decide between owner-occupied housing or renting and determine the level of housing consumption. For simplicity, we assume that a household only occupies one house so that $h = h^O > 0$ and $h^r = 0$ in the case of owner-occupied housing or $h = h^r > 0$ and $h^O = 0$. We then develop the follow parameters for preferences:

$$(1) \qquad u = c + \frac{A}{1 + 1/\varepsilon}\left(\frac{h}{A}\right)^{1+1/\varepsilon} + q \cdot I\{h^O > 0\}$$

Where ε is the intensive-margin elasticity of housing demand, q is the preference for owning over housing (which can be negative for always-renters). This preference indicator can be heterogeneous in the population following a smooth pdf $f(q)$ and cdf $F(q)$. The distribution of preferences is therefore the key determinant of the extensive margin elasticity of housing demand.

The budget constraint is given by

$$(2) \qquad c + ((1-s)m + t\tilde{r}) \cdot ph^O \cdot I\{h^O > 0\} + rh^r \cdot I\{h^r > 0\} = (1-t)y$$

Where y is exogenous labor income, t is the income tax rate, s is the rate of deductibility of mortgage interest, m is the mortgage interest rate, r is the price of renting, $\tilde{r}$ is imputed rent of owner-occupied housing and p is the price per unit of housing. Note that we allow for the taxation

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of imputed rent from owner-occupied housing at the same rate as labor income, as per the Dutch system in box 1. This imputed rent is set at a very low level, however, as described in Section III of this paper. When owning their house, households maximize

$$(3) \qquad u = (1-t)y - ((1-s)m + t\tilde{r}) \cdot ph^O + \frac{A}{1+1/\varepsilon}(\frac{h^O}{A})^{1+1/\varepsilon} + q$$

Which gives the following first-order condition for the intensive margin of owner-occupied housing

$$(4) \qquad h^O = A[((1-s)m + t\tilde{r})p]^\varepsilon$$

Note that $\varepsilon < 0$ now functions as the elasticity of housing demand to the user cost $((1-s)m + t\tilde{r})p$ of owner-occupied housing. The income tax has an ambiguous effect on the demand for owner-occupied housing: As described in expression (4), the mortgage interest deduction *(1-s)* increases demand while the taxation of imputed rent reduces it. Kleven et al. (2021) note, however, that if the level of imputed rent is sufficiently low, higher income tax rates always increase demand for owner-occupied housing.

When renting, households maximize

$$(5) \qquad u = (1-t)y - rh^r + \frac{A}{1+1/\varepsilon}(\frac{h^r}{A})^{1+1/\varepsilon}$$

Which gives the first-order condition for the intensive margin of rental housing

$$(6) \qquad h^r = Ar^\varepsilon$$

To determine the extensive margin elasticity of housing demand we need to also define the preference parameter for ownership over renting q. Because households only step into owner-occupied housing if the utility of ownership is greater than renting, we can find a lower bound on q:

$$(7) \qquad q \geq ((1-s)m + t\tilde{r}) \cdot ph^O - rh^r + \frac{A}{1+1/\varepsilon}[(\frac{h^r}{A})^{1+1/\varepsilon} - (\frac{h^O}{A})^{1+1/\varepsilon}]$$

Which, using the first order conditions of intensive housing demand implies

$$(8) \qquad q \geq \frac{A}{1+\varepsilon} \cdot ([((1-s)m + t\tilde{r})p]^{1+\varepsilon} - r^{1+\varepsilon}) \equiv \bar{q}$$

Households with q higher than the minimum threshold for ownership $\bar{q}$ become homeowners so that the rate of ownership equals *1-F($\bar{q}$)*. As with the intensive margin, the deductibility of mortgage interest s increases homeownership, while the taxation of imputed rent reduces it. The extensive margin elasticity with respect to the net of tax interest expenses *1-s* is defined as

$$(9) \qquad \eta \equiv \frac{\partial(1-F(\bar{q}))}{\partial\bar{q}}\frac{d\bar{q}}{d(1-s)}\frac{1-s}{1-F(\bar{q})} = -f(\bar{q})\frac{d\bar{q}}{d(1-s)}\frac{1-s}{1-F(\bar{q})}$$

Kleven et al. (2021) highlight two aspects of this elasticity that should be noted. First, this elasticity is a partial equilibrium rather than a general equilibrium elasticity. The derivative $d\bar{q}/d(1-s)$ assumes that rental prices r and interest m are given, but in general equilibrium these may respond to changes in the MID (s). This general equilibrium effect might also have effects on the demand for housing through relative prices and might therefore cause problems with identification of the causal effect of the MID on housing demand. In the case of this study I argue that this is an acceptable approach to take, however, because we can assume that the variation in s is exogenous as well. The 2013 reforms to the MID unexpectedly reduced the deductibility s of some mortgages to 0 while leaving it positive for others. This allows us to identify the (micro) partial-equilibrium effect of the mortgage interest deduction on the demand for housing. A second characteristic of the extensive-margin elasticity is that this factor depends on the density of preferences for homeownership in the population. If there is heterogeneity in preferences across income levels, then elasticities might differ as well. If preferences for homeownership are strong enough that the density is near zero around the cutoff, then it follows that the extensive margin elasticity for this demographic is zero. Controlling for income is therefore important when attempting to estimate this elasticity.

Total demand for owner-occupied housing is given by

(10) $$D = \int_y \int_{\bar{q}} h^o f_y(q) g(y) dq dy = A[((1-t)m + t\tilde{r})p]^\varepsilon \bullet H$$

Where $g(y)$ is the density of the income distribution and $H \equiv \int_y (1 - F_y(\bar{q})) g(y) dy$ is the aggregate rate of homeownership in the population. Total demand for owner-occupied housing must be met by the supply of housing net of the housing that is rented. A model of the supply for housing on owner-occupied and rental sectors is beyond the scope of this paper. It is important to note the effects of the supply elasticity on the equilibrium effects of demand changes induced by tax treatment changes, however. If short-run elasticity of supply for housing is less than perfectly elastic, we should expect to see that part of the increase of demand will be capitalized in rising house prices.

D. *Empirical Estimation*

The ideal experiment to test the effect of mortgage interest deductions on housing demand would randomly assign different amounts of mortgage interest deduction to households and observe their elasticity of demand for housing to MID on both the intensive and extensive margins. If homeownership increases or households increase their home sizes or are more likely to be homeowners, the mortgage interest deduction must have a positive effect on the demand for housing. In this setting, a simple OLS estimation procedure would be able to capture this effect. However, the MID is not exogenously determined. It is a function of the interest paid on a mortgage, and therefore increases with loan size. Loan sizes are largely determined by house prices, which is an equilibrium outcome resulting from the interaction between supply and demand. This makes the price elasticity of supply an important factor in determining how changes in interest deductibility translate into house prices and market outcomes we use as measures for demand, such as the rate of homeownership and home size. If we do not isolate the changes in

MID that are exogenous to changes in price, our estimates of the elasticity of demand to MID will be subject to endogeneity bias. In addition to this, the price channel may also create issues of reverse causality; does an increase in demand result from the MID, or does the MID rise in response to the price rise caused by a demand increase? In this section I will explain how I employ the exogenous variation granted by the 2013 and 2014 policy reforms to identify a causal effect using difference in difference and instrumental variables approaches.

Extensive margin estimation (DiD)

Starting from 2014, the Dutch government reduced the top rate of deductibility for the top income brackets by 0.5% each year. This exogenous change therefore affected top income groups while leaving lower incomes' MID unchanged. If homeownership amongst these groups experienced comparable trends before the policy was introduced, I can use the 2014 reform to identify the effect of the MID on the *extensive* margin demand for housing. This approach mimics that of Kleven et al. (2021), who use a similar reduction of maximum rates of deductibility in Denmark to estimate the same effect. I use the following difference-in-difference (DiD) specification:

(11) $Own_{tg} = B_0 + B_1 * post_t + B_2 * treated_g + B_3 * post_t * treated_g + B_4 * age_t + B_5 * agetreated_{tg}$

Where Own_{tg} is the rate of homeownership for the year in which the household moved in t and group g, where t is a proxy for the year in which the household made the decision to take a mortgage or rent their home; $post_t$ is a dummy denoting whether a year t is before or after the 2014 reform; $treated_g$ is a dummy variable denoting whether a group g is in the treated high tax bracket; $post_t * treated_g$ captures the DiD estimator, the main coefficient of interest that measures the effect of the 2014 reduction of MID; As was shown in section 4B, age has a strong correlation with the likelihood of homeownership. age_t controls for the average age of sampled households in that year; and $agetreated_{tg}$ is an interaction term that controls for differences in the distribution of age between high income tax brackets and those below. Like Kleven et al. (2021), I control for age in this manner to ensure that the comparability of the trends of treatment and control groups is unaffected by the effects of population aging and differences in the distribution of age among tax brackets. Lower tax brackets are likely to be populated by younger people and older people.

As mentioned earlier in this section, identification in DiD estimation is based on the common trend assumption. If treatment and control groups exhibit similar trends in homeownership rates before the 2014 reduction in MID, we can use the possible divergence in trends after the policy to measure the effect the policy had on the rate of homeownership in the post-reform period. I provide a graphical representation of the development of homeownership rates in the results of this analysis in section 5A to verify the common trend assumption. The graph shows that the high- and middle-income groups show highly similar patterns of homeownership rates over the sample period, strengthening the case for successful indentifcation of the causal effect of the MID on extensive margin housing consumption.

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Intensive margin estimation (2SLS)

The 2013 and reforms introduced arguably exogenous variation in the MID available to households by making deductions conditional on mortgage repayments and reducing the maximum loan to value ratio gradually year-on-year until 2018. I can use this to estimate the causal effect of the MID on the *intensive* demand for housing using the following 2SLS strategy:

$$\ln(y)_h = B_0 + B_1 \ln(MID_h) + B_2 \ln(ATI_h) + B_3(LW_h) + B_4 D_h + B_5 G_h + \varepsilon_{ht}$$

$$(12) \qquad \ln(MID_h) = B_0 + B_1 mortgagetype_h + B_2 MaxLTV_h + \varepsilon_h$$

Where $livesize_h$ is the living space of the households' home; MID_h is the deducted mortgage interest of the household; ATI_h is the after tax income of the household; LW_h is the liquid wealth of the household; D_h is a vector of demographic variables such as marital status, education and age; and G_h is a vector of regional dummies to account for geographic variation in prices and home size. MID_h is instrumented for by a combination of $mortgagetype_h$, which is a binary variable that equals 1 for mortgage types that do not require monthly repayment over the contract period.; and $MaxLTV_h$, which measures the maximum loan-to-value ratio allowed in the year in which the household purchased their home.

For instruments to be a valid source of exogenous variation for estimation, they should have a meaningful first stage (the instrument has a significant measurable effect on the variable of interest); should satisfy the assumption of independence; and exclusively affect the dependent variable through its effect on the variable of interest. If our instrument is weakly correlated with our variable of interest, our results will be biased. In table 2 the results from the first stage regression are displayed. All instruments have a significant effect on the MID, with a sizeable magnitude.

Dependent variable: Log Deducted Mortgage Interest	(1)	(2)	(3)
Mortgage Type	0.120***	-	0.189***
Maximum LTV	-	-0.196***	-0.24***
		(0.14)	(0.14)
F	58.38	190.01	163.39
R^2	0.02%	0.7%	1.21%

Table 2: First Stage Regression of Deducted Mortgage Interest on instruments. Standard errors in brackets. ***: Significant at the 1% level. **: Significant at the 5% level.

While it is difficult to test for the validity of the second and third assumptions, it is still important to discuss the potential dangers to identification and my case for the validity of these assumptions. If the independence assumption does not hold and mortgage types and repayments are correlated with any variables in the error term, our estimates of the effect of the MID on housing demand will be biased. I argue that the assumption of independence holds because the decision as

to which mortgage types would have MID available and the maximum loan-to-value ratio allowed were exogenously changed by the government. I argue that these variables are unlikely to affect housing demand directly, or in any other way except the fiscal benefits they provide to potential homeowners: households will choose the mortgage type and loan-to-value ratio that will grant them the most fiscal benefit and adjust their purchasing decision accordingly. Van Bekkum et al. (2019) find that the reductions in LTV in the Netherlands did not cause homeowners to reduce housing consumption, instead the policy induces them to opt for consuming more liquidity, supporting the case for the exclusion restriction. Conditional on the assumptions discussed above, the specification in equation (12) will estimate the effect of differences in received MID due to mortgage types and maximum loan-to-value ratios on the intensive margin demand for housing.

V. Results

A. *Extensive Margin*

The first set of results will examine the effect of the 2014 reduction of the maximum MID available for top income brackets. This reduction affects households in the upper tax bracket while leaving other income groups unaffected. If homeownership rates for high income groups developed similarly to other groups, we can use a difference-in-difference strategy to identify the effect of the MID on the extensive margin for homeownership: whether the household chooses to rent or own their housing. I follow Kleven et al. (2021) for the specifications of this analysis.

Figure 3 provides a graphical representation of the results of one of the difference-in-difference specifications. The graph shows the homeownership rate over time for the treated households in the top income tax bracket and the untreated middle tax bracket group, before and after the 2014 reform. The rate of homeownership for both groups exhibit a very similar pattern, which supports the common trend assumption necessary for identification of a causal effect.
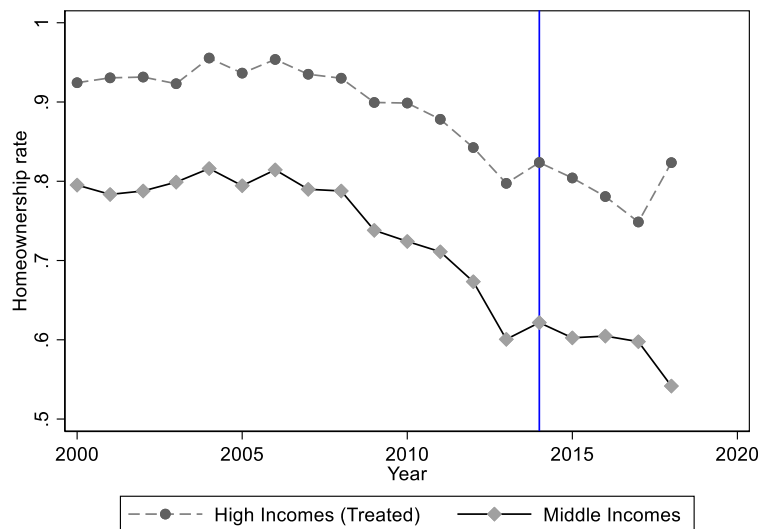

Figure 3: Graphical representation of specification 1 of panel A in table 3. The figure shows homeowner rates over time, comparing high to middle incomes before and after the 2014 top MID reduction.

Homeownership stays relatively stable for about 8 years, after which the financial crisis induces a reduction of homeownership rates that continues through the post-reform period. Important to note is that this result is different from our descriptive analysis of homeownership in section 4B, where homeownership did not decrease much after the Great Recession. This development can be explained by the fact that the rate of homeownership in this analysis is based on the year in which the household moved into their new homes. It is quite likely that, as a result of the financial crisis, acquisition of new homes fell, which is the effect captured in Figure 3. The post-policy trend for the treated high-income group does not differ much from the pre-policy trend, apart from a sudden increase in 2018. The reduction of the top rate of mortgage interest deductibility therefore seems to not have caused an increased reduction of homeownership amongst those treated. Table 3 shows more detailed results of this analysis, subject to numerous controls.

	(1)	(2)	(3)
Panel A: High-to-medium comparison			
Effect of MID reduction	0.051	0.034	0.034
	(0.036)	(0.023)	(0.035)
Implied Elasticity to	-0.056	-0.037	-0.037
s	(0.04)	(0.025)	(0.037)
Observations	35610	35610	35610
Panel B: High-to-low comparison			
Effect of MID reduction	0.043	-0.074*	-0.082
	(0.046)	(0.040)	(0.063)
Implied Elasticity to	-0.047	0.082*	0.091
s	(0.051)	(0.044)	(0.07)
Observations	41547	41547	41547
Controls Included			
Age		x	x
Age*Treated			x

Table 3: Results Difference-In-Difference specifications of the effect of the 2014 Top MID changes. Panel A and B show different control groups, based on tax brackets. Controls included in specifications can be found at the bottom of the table. Estimated effect is the average of the 4 post-reform periods. Standard errors in brackets. *: Significant at the 10% level.

The results of the various specifications of the difference-in-difference analysis are displayed in table 3. I perform the estimation on two control groups: households in the middle tax brackets and households in the bottom tax bracket. Specifications in panel A utilize the middle tax group. As you can see, the reduction of the MID is estimated to have had a weakly positive effect on homeownership rates. When plugging this into the model discussed in section 4C, I find implied elasticities to the MID s ranging from –0.56 to -0.037. This is an unexpected sign: a reduction in the fiscal favorability should cause a reduction in demand for owner-occupied housing. The results are not significantly different from 0, however, and decrease in magnitude as age is included as a control. Controlling for the distribution of age among treated and untreated groups seems to not change estimates. When comparing the treated high-income bracket to the untreated middle-income bracket, the reduction in the maximum available MID is estimated to have had no effect on the rate of homeownership among households, and the elasticity of extensive margin demand to the MID is not statistically different from 0.

In panel B the same analysis is performed using the low tax-bracket groups as a control group. From inspecting the development of homeownership between high- and low-income groups in figure 4, it is less clear that the common trend assumption holds. The lines exhibit similar trends, but the low-income group has much stronger fluctuations. It is therefore less likely that low tax-bracket households are comparable to high tax-bracket households, which compromises our ability to make claims about the causality of the treatment. This test is still useful, however, to investigate whether the effect size or sign changes when we compare them.

When no controls are concluded, the estimated effect of the 2014 reform is similar to that estimated in panel A. The reform is said to have had a weakly positive effect that is not significantly different from 0 and implies an elasticity to the MID of -0.047. When including age as a control, however, the effect of the reform becomes negative and is significant at the 10% level. From these results, extensive margin demand elasticity to the MID is around 0.085. This estimate ceases to be significantly different from 0 when controlling for differences in age
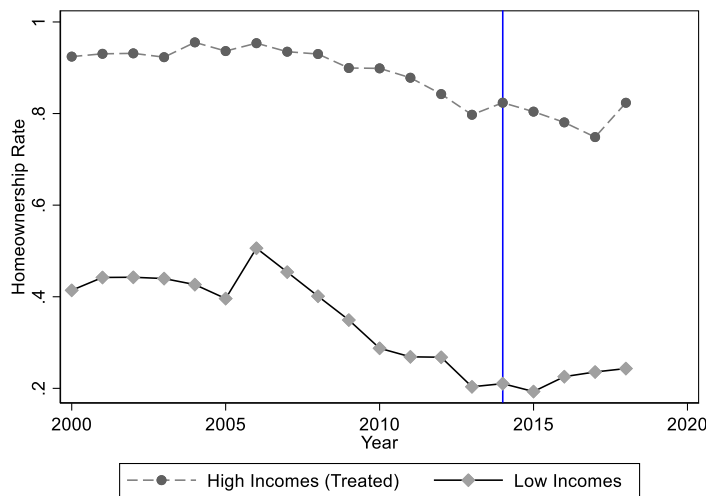

Figure 4: Graphical representation of specification 1 of panel B in table 3. The figure shows homeowner rates over time, comparing high to low incomes before and after the 2014 top MID reduction.

between treatment and control groups. Comparing high- and low-income groups therefore provides a slight indication to a reduction in homeownership as a result of the 2014 MID reduction but does not show strong evidence that this effect is strong enough to be different from 0.

To summarize, this section provides evidence that the reductions in MID started in 2014 have had no substantial effect on homeownership. This indicates that the MID is likely to have no economically substantial effect on the extensive margin demand for owner-occupied housing.

B. Intensive Margin: Living Space

The first set of results can be examined in table 4. It shows the results from the 2SLS regressions of living space on the mortgage interest deduction, instrumented for by mortgage type and maximum LTV ratios, and controlling for geographic effects. Because both the MID and the dependent variables are in log transformed, we can interpret the coefficient of MID as the intensive margin elasticity of demand to the deduction as defined in section 4C. In this regression, living space is a proxy for the intensive margin of housing demand. If the mortgage interest deduction stimulates households' demand for housing, a likely output through which this would be presented is the households' living space.

Dependent variable: Log Living Space (square meters)	(1)	(2)	(3)
Log MID	0.047***	0.09***	0.084***
	(0.018)	(0.017)	(0.023)
Log Liquid Wealth (x1000)	-	0.08***	0.08***
		(0.003)	(0.004)
Log Yearly After-Tax Income (x1000)	-	0.176***	0.08***
		(0.01)	(0.02)
Age	-	0.046***	0.051***
		(0.004)	(0.005)
Demographic Dummies Included?	-	-	X
Intercept	4.60***	1.38***	2.56***
	(0.092)	(0.07)	(0.167)
F-Statistic	6.67	1224.65	83.17
Observations	26783	26783	26783

Table 4: Results 2SLS regression of Living Space on MID, instrumented with Mortgage Type and Maximum LTV. Standard errors in brackets. ***: Significant at 1% level. **: Significant at 5% level. Monetary values in euros. Every specification controls for geographic differences.

In specification (1), I perform the regression without any controls. The coefficient on MID is positive and highly significant. The estimated elasticity of intensive margin demand to the MID is 0.047. This is quite a significant finding; on the extensive margin, the deduction was found to not shift demand. This regression specification is quite a simple reflection of the components determining housing demand, however. In this and the following analyses, I use specifications (2) and (3) to examine whether the result from specification (1) persists when considering important controls for determinants of housing demand using controls from the user-cost literature of housing consumption (source, source).

In specification (2) I add the main variables measuring the financial situation of households and a control for the life-cycle effect of housing consumption. Income and liquid wealth increase the purchasing power of the household and eases the borrowing constraint on their mortgage, which allows households to consume more housing. Including these controls should increase the precision of our estimation and reduces the risk of bias resulting from omitted variables. The exclusion of age from an estimation of housing demand is also hard to justify when housing demand has such a strong correlation with age, as shown in section 3B. Unsurprisingly, liquid wealth and after-tax income both have strong positive correlations with living space. Households' consumption is strongly responsive to their income, at an elasticity of 0.176, while also responding to a lesser degree to increased wealth at an elasticity of 0.08. The control for age is highly significant and positive. Adding these controls increases the elasticity of intensive margin demand to the MID to 0.09, meaning that the average household consumes 18 square meters more housing as a result of the deductibility of mortgage interest. In specification (3) I add the vector of demographic variables to the regression. Household characteristics such as marital status and parenthood likely affect the need for larger housing and should therefore influence intensive margin demand for housing. These new set of controls reduce the estimated elasticity to the MID to 0.084.

The results from this section show that the Local Average Treatment Effect of an increase in received mortgage interest deduction because of differences in interest deductibility between mortgage types is positive and significant. The effect is substantial: while estimates are not conclusive on the exact magnitude of the effect, the estimated elasticity of intensive margin demand to the MID is roughly 0.085, which means that the average household increases their consumption of living space by 12 square meters because of the deduction.

C. Intensive Margin: House Value

I now move on to the results on a different dimension of intensive margin housing demand. While home value is a crude measure of the quantity of housing a household owns because it is likely to be subject to measuring error, it can still provide us useful insights onto how the MID affects the demand for housing on a broad level. Whereas home size only measures changes in consumption of housing in the form of living space, home value captures all dimensions through which households can increase their consumption of housing. In table 5 I show the results from the 2SLS regressions of Home Value on the mortgage interest deduction, instrumented with mortgage type and maximum LTV ratios. I also control for geographic effects.

In specification (1), I only include the MID in the regression. The effect of the MID on home value is positive and significant. The estimated elasticity at 0.105 is larger than the same specification measuring living space as the dependent variable, suggesting that households might consume more housing through dimensions other than living space.

When moving on to specification (2), the main controls for household finances and age are added. Age, income, and wealth are once again important predictors of housing demand: these coefficients are positive and highly significant. After-tax income has a substantial effect, with an estimated elasticity of demand of 0.257. As in the regression of living space on MID, the effect of liquid wealth is smaller than that of income. The elasticity of demand to wealth is estimated to be 0.14, meaning that for the average household every 1000 euros of liquid wealth is associated with an increase in housing consumption of 130 euros. Like in section 5B, adding the aforementioned controls increases the elasticity of demand to the MID, in this case to 0.126.

Dependent variable: Log Home Value (x1000)	(1)	(2)	(3)
Log MID	0.105***	0.126***	0.133***
	(0.02)	(0.02)	(0.023)
Log Liquid Wealth (x1000)	-	0.14***	0.135***
		(0.003)	(0.004)
Log Yearly After-Tax Income (x1000)	-	0.257***	0.173***
		(0.017)	(0.02)
Age	-	0.037***	0.048***
		(0.004)	(0.005)
Demographic Dummies Included?	-	-	X
Intercept	11.81***	7.18***	8.51
	(0.10)	(0.07)	(0.16)
F-Statistic	24.86	2722.99	231.37
Observations	26783	26783	26783

Table 5: Results 2SLS regression of Living Space on MID, instrumented with Mortgage Type and Maximum LTV. Standard errors in brackets. ***: Significant at 1% level. **: Significant at 5% level. Monetary values in euros. Every specification controls for geographic differences.

Specification (3) adds demographic controls into the regression. Parenthood, marital status, and education are all significant predictors of home value. In this specification, the effect of MID on house value becomes slightly larger, with an estimated elasticity of 0.133. The results of these specifications point towards the mortgage interest deduction having a significant and strong effect on the value of housing that households consume. According to this estimation, the average household acquires homes worth roughly 32000 euros more. When using house value as a dependent variable, estimated elasticities of demand are likely to be higher than the same analysis

using living space as a dependent variable, because house value captures increases of housing consumption through other channels, such as location, aesthetics or nearby services.

D. Intensive Margin: Mortgage Debt

My final measure of intensive margin housing demand is household's mortgage debt. Most households finance the purchase of their home via mortgage debt. If households increase their demand for housing because of the mortgage interest deduction, this should be reflected in increased levels of household mortgage debt. This is because mortgage debt, and by extension interest expenses, are the main channel through which the mortgage interest deduction stimulates demand for housing. The results of previous sections would therefore be less convincing if I do not find an effect of MID on the demand for mortgage debt.

Dependent variable: Log Mortgage Debt (x1000)	(1)	(2)	(3)
Log MID	0.507***	0.427***	0.429***
	(0.03)	(0.02)	(0.03)
Log Liquid Wealth (x1000)	-	0.014***	0.011**
		(0.004)	(0.006)
Log Yearly After-Tax Income (x1000)	-	0.186***	0.133***
		(0.025)	(0.03)
Age	-	0.005	0.0005
		(0.007)	(0.007)
Demographic Dummies Included?	-	-	X
Intercept	9.48	7.67***	8.47
	(0.13)	(0.113)	(0.28)
F-Statistic	363.30	1887.58	192.30
Observations	26783	26783	26783

Table 6: Results 2SLS regression of Mortgage Debt on MID, instrumented with Mortgage Type and Maximum LTV. Standard errors in brackets. ***: Significant at 1% level. **: Significant at 5% level. *: Significant at 10% level. Monetary values in euros. Every specification controls for geographic differences.

Table 6 shows the results of the 2SLS regression of mortgage debt on the mortgage interest deduction, instrumented for by mortgage type and controlling for geographic differences. In specification (1), I perform the estimation without any controls. The MID has a significant and positive effect on mortgage debt, with an estimated demand elasticity of 0.507. According to this estimate, the average household increases their mortgage debt by roughly 150000 euros due to the mortgage interest deduction.

I add controls for the financial situation of the household and age in specification (2). We expect wealth and income to significantly increase the borrowing capacity of the household, and

therefore mortgage debt. Liquid wealth has a significant and positive effect, but the estimated elasticity is quite small at 0.014. Yearly income is correlated with households increasing their mortgage debt as well: the estimated elasticity of mortgage debt demand to yearly income is 0.186. This makes sense. Households that earn more have fewer constraints on their borrowing and are thus able to take on more debt. Age has no strong effect on the demand for mortgage debt. Adding these controls reduces the effect of MID on mortgage indebtedness. Now, the estimated elasticity of mortgage debt demand is 0.427.

The demographic controls added in specification (3) are all significant predictors of household debt. Controlling for these factors does not change the estimate substantially from the one in specification (2), only increasing the elasticity of mortgage debt demand to the MID to 0.429.

The results of this section point towards MID having a strong positive effect on household indebtedness. This finding confirms the hypothesis mentioned earlier: mortgage debt is the main mechanism through which mortgage interest deductions influence housing decisions and should therefore follow the effect the policy has on other measures of housing demand.

VI. Robustness Checks

A. *Effects among movers only*

In the previous analyses I performed my regressions on the full sample of homeowners in the dataset. Some measures of housing consumption, like home size or value, might adjust slowly to policy shocks, which might cause our main analysis to underestimate the elasticity of intensive margin demand to the MID. To assess this hypothesis, I perform the analyses from sections 5A to 5C on the sample of movers from the dataset. In doing so, we better observe the short-term effect of the changes to the MID, which might be different from the overall estimate we obtained in previous sections.

Dependent variable: Log Living Space (square meters)	(1)	(2)
MID	0.224***	0.174***
	(0.03)	(0.03)
Controls?	No	Yes
Intercept	3.62***	4.36***
	(0.16)	(0.44)
F-Statistic	51.45	16.95
Observations	3501	3501

Table 7: Results 2SLS regression of Living Space on MID, instrumented with Mortgage Type and Maximum LTV. Sample limited to movers. Standard errors in brackets. ***: Significant at 1% level. **: Significant at 5% level. Monetary values in euros. Every specification controls for geographic differences.

In table 7 we can observe the results of the IV-regression of living space on the mortgage interest deduction. In specification (1), I perform the regression without any controls. The coefficient of MID is positive and significant: the elasticity of demand to the MID is estimated to be 0.224. This is a substantially larger effect than our results from section 5A: there, the no-control specification estimated an elasticity of 0.047. I add the full set of controls in specification (2). The coefficient of MID is still positive and significant, but of a lesser magnitude than the previous specification. The estimated elasticity is 0.174. In our main analysis, the specification with all controls finds an elasticity of 0.08.

Both coefficients of the effect of MID on living space from the analysis on the sample of movers are substantially larger in magnitude than the coefficients from the full-sample analysis. This indicates that our main analysis could be a lower bound of the effect of MID on living space.

Dependent variable: Home Value (x1000)	(1)	(2)
MID	0.210***	0.180***
	(0.03)	(0.03)
Controls?	No	Yes
Intercept	11.23***	11.09***
	(0.03)	(0.39)
F-Statistic	37.73	32.06
Observations	3501	3501

Table 8: Results 2SLS regression of Living Space on MID, instrumented with Mortgage Type and Mortgage Repayments. Sample limited to movers. Standard errors in brackets. ***: Significant at 1% level. **: Significant at 5% level. Monetary values in euros. Every specification controls for geographic differences.

In table 8 we can see the movers-only IV regression of Home Value on the MID. In specification (1) I perform the test without controls. The coefficient of MID is positive and significant at an estimated elasticity of 0.210. This is about double the estimated elasticity in the main analysis, which was 0.105. When I add the controls in specification (2), the effect of MID on home value remains positive and significant. The effect does diminish in magnitude, though, with a coefficient of 0.180. This is higher than the estimated elasticity in this specification's counterpart in the main analysis, which was 0.111.

Similar to what happened in the movers-only analysis using living space as a dependent variable, limiting the sample used for the regressions to movers increases the magnitude of the effects of the MID on home value. Another interesting development is that the estimated elasticities of both measures of the intensive margin demand for housing seem to converge to around 0.175 when including all controls. While the results from the movers-only specifications

are less reliable due to a decrease in sample size, they do indicate that the short-run effect of the MID on consumption of house value is likely to be positive.

B. Heterogeneity across income groups

Another characteristic of the relationship between MID and the demand for housing is a high degree of heterogeneity in effects between income groups. Borrowing constraints on the household dictate how much mortgage debt is available to the household, and therefore affect how much MID is received. If the household is unable to receive a large amount of MID due to borrowing constraints, they might not be incentivized to increase their demand for housing. High-income households might have lower demand for debt as they are able to finance their housing demand themselves, reducing the incentive to increase housing consumption resulting from MID. The strength of the mechanism through which the interest deduction stimulates demand for owner-occupied housing could therefore be different depending on the income-group the household is in. Our estimated intensive margin demand elasticities might therefore be higher or lower depending on the income levels of the group studied. Insight into this mechanism can provide us with a stronger understanding of the income-related effectiveness of the MID.

In this section, I investigate this potential effect by performing the regression analyses from sections 5A through 5C on the income subsets of our dataset. For this analysis I use the same controls as those specified in specifications (3) from sections 5A through 5C. The Low-income group is defined as those households earning a cumulative household income below 40000 euros, the Middle-income group lies between household incomes of 40000 and 85000 euros and the High-income group consists of household incomes of 85000 euros and above.

Table 9 shows the results from the IV Regressions of living space on MID for each income group, utilizing the full set of controls. For low-income groups, MID received is weakly correlated with increased demand for living space: the coefficient is small at -0.002 and not statistically different from 0. The middle-income group enjoys a much stronger effect of the mortgage interest deduction. They exhibit an elasticity of 0.10 towards the MID.

Dependent Variable: Log Living Space (Square Meters)	(1)	(2)	(3)
Group	Low	Middle	High
Log MID	-0.002	0.10***	0.25***
	(0.04)	(0.03)	(0.029)
Intercept	5.92***	4.30***	3.20***
	(0.53)	(0.23)	(0.53)
F-Statistic	5.53	23.52	13.52
Observations	3180	11957	5634

Table 9: Results 2SLS regression of Living Space on MID, instrumented with Mortgage Type and Maximum LTV. Results separated by income group. Full set of controls used. Standard errors in brackets. ***: Significant at 1% level. **: Significant at 5% level. Monetary values in euros.

The effect of MID on the demand for living space of high-income households is weaker but still significant at the 5% level, with an elasticity of 0.25. There is a clear curve of coefficients for MID on living space across income groups: Low-income groups do not respond to the MID, while the elasticity of the demand for living space increases with income.

Table 10 displays the results from the income-group regressions of home value on MID. When dividing the analysis into income groups, there is a similar curve to the coefficients as observed in the analysis using living space as dependent variable. Low-income households do not respond to the MID by buying higher value homes, while the elasticity of demand for home value increases as households enter the middle- and high-income groups, with elasticities of 0.13 and 0.26 respectively.

Dependent Variable: Log Home Value (x1000)	(1)	(2)	(3)
Group	Low	Middle	High
Log MID	0.039	0.137***	0.265***
	(0.03)	(0.03)	(0.07)
Intercept	13.21***	11.76***	10.16***
	(0.53)	(0.25)	(0.57)
F-Statistic	12.72	43.34	24.10
Observations	3180	11957	5634

Table 10: Results 2SLS regression of Mortgage Debt on MID, instrumented with Mortgage Type and Maximum LTV. Results separated by income group. Full set of controls used. Standard errors in brackets. ***: Significant at 1% level. **: Significant at 5% level. Monetary values in euros.

Dependent Variable: Log Mortgage Debt (x1000)	(1)	(2)	(3)
Group	Low	Middle	High
Log MID	0.38***	0.41***	0.61***
	(0.04)	(0.03)	(0.08)
Intercept	11.23***	10.25***	8.60***
	(0.86)	(0.36)	(0.64)
F-Statistic	35.09	89.56	40.45
Observations	3180	11957	5634

Table 11: Results 2SLS regression of Living Space on MID, instrumented with Mortgage Type and Maximum LTV. Results separated by income group. Full set of controls used. Standard errors in brackets. ***: Significant at 1% level. **: Significant at 5% level. Monetary values in euros.

In table 11 we can observe the results from analyzing the relationship between the mortgage interest deduction and mortgage debt, divided between the income groups. Whereas before, the MID did not seem to affect demand for housing on the intensive margin for low-income groups, the elasticity of the demand for mortgage debt is now 0.38 and strongly significant. Reminiscent of the previous tests in this section, this elasticity increases as households enter higher income groups: Middle-income groups exhibit an elasticity of mortgage demand of 0.41, and higher-income groups respond to the MID at an elasticity of 0.61.

The results of this section show that there is a strong heterogeneity of the effect MID has on various dimensions of intensive margin housing demand. Borrowing constraints are likely to be the driver of the MID's heterogenous effect on demand, as the MID mostly provides its incentive through borrowing behavior. Whereas lower income households are unable to increase their consumption of housing in response to the fiscal benefits of the MID due to their borrowing constraint they are incentivized to increase their mortgage borrowing, albeit to a lesser degree than higher- and middle-income groups. Considering the income-related effectiveness of the MID to stimulate various aspects of housing demand is important for understanding the distributional impacts of the policy. If middle- and high-income households benefit more from the MID, it might have a regressive impact on the distribution of housing wealth and consumption.

Conclusion

In many economies, governments spend a large amount of resources subsidizing owner-occupied housing. The most prevalent method to do so is through favorable tax treatment for homeowners. In the Netherlands, like many other countries, the mortgage interest deduction is the main subsidy for owner-occupied housing. This policy has been criticized extensively in both the public sphere and the academic debate for being an inequitable policy that inflates prices and mortgage debt, leading to large inflation of house prices. According to the literature on the topic, subsidies of this kind are motivated by the existence of possible externalities to homeownership.

Although the mortgage interest deduction has been widely discussed for a long time, the literature still lacks conclusive empirical evidence on the effect the policy has on the demand for housing on both the extensive and intensive margins. This lack of conclusive evidence has arisen because much of the early literature on the topic, which suggested the MID positively affects homeownership and housing consumption, utilizes methods that are not up to par with modern econometric standards. More recent papers that address issues of identification find negligible or sometimes even negative effects of the MID on homeownership, while the distortions on the intensive margin of housing demand remains. This paper seeks to add to this growing body of literature by using modern identification strategies on Dutch household-level data. Using policy reforms to the mortgage interest deduction in 2013 and 2014, I investigate the effect of the MID on homeownership through a difference-in-difference analysis, while I utilize instrumental variables for the estimation of the intensive-margin effects. In doing so, I better approximate the effect of the MID on real demand.

The results from this paper indicate that the reduction of the top deduction rate in 2014 had no significantly negative effect on homeownership. This fits the results from recent studies like Kleven et al. (2021) and Hanson (2012), that find similarly negligible effects on homeownership. Table 14 in Appendix B provides an overview of estimated elasticities of housing demand on the intensive and extensive margins from the literature and the elasticities found in this paper. The results from the analyses in this paper are quite close to the elasticities estimated by Kleven et al. (2021) and Hanson (2012), who use similar research methods. This is damning evidence against the efficacy of the mortgage interest deduction: the efficiency motivation of the MID rests on the positive externalities generated by homeownership, which is not stimulated by the policy. On the other hand, I find that the mortgage interest deduction does incentivize intensive margin demand on multiple facets. Households significantly increase the size of their homes and take on more mortgage debt in response to the deduction. This effect is stronger when only observing movers and is heterogeneous across income groups, where low-income groups take on more debt while not increasing housing consumed, while middle- and higher income groups increase housing consumption on all measures. This finding is consistent with the literature, which also finds that the mortgage interest deduction distorts consumption of housing and is distributed disproportionately towards middle- and higher-income groups because of its regressive nature. The results of this paper provide empirical evidence that the Dutch mortgage interest deduction does not cause increases in homeownership while distorting intensive margin demand for housing and mortgage debt. The increase in intensive margin consumption seems to be largely centered around middle- and high-income groups. The policy can therefore be criticized on the grounds of both efficiency and equity.

If the mortgage interest deduction is not pro-homeownership and does not aid in distributing disposable income as desired by society, policymakers should look to change the way they look to stimulate housing or homeownership. Abolishing or reducing the mortgage interest deduction would create welfare gains on three dimensions. First, the mortgage interest deduction could be reduced or abolished to avoid further stimulation of house prices through capitalization. This would allow households easier access to homeownership (Sommer & Sullivan, 2018). Furthermore, the empirical evidence on the presence of externalities to homeownership is still mixed. It is possible that there is no noticeable difference in welfare to renting or homeownership. In this case, abolishing the mortgage interest deduction would allow for a neutral stimulus to both forms of housing by having a tax credit applicable to expenses for both owner-occupied and rental housing. Second, the current tax-treatment of mortgage debt encourages households to take on more debt, an incentive that is stronger for low-income households. Reducing this incentive would decrease indebtedness of households, reducing the exposure of households to financial risk. This could make consumption responses to credit crunches less intense (Guerreri & Lorenzoni, 2017). Finally, eliminating the favorable tax treatment of housing would produce substantial revenue gains that can be used to reduce distortions in the tax system (Alpanda & Zubairy, 2016). In a critical assessment of the Dutch tax system, Cnossen and Jacobs (2020) suggest that eliminating the tax favorability of housing would grant roughly 7 billion euros worth of tax revenue, which can be used to lower tax rates across all income levels by about 2 percent.

The findings of this paper are subject to a number of limitations which provide avenues for further research. For the extensive margin analysis, the time horizon of 15 years can be considered relatively short when observing a slow-moving variable like housing consumption. Changes in the mortgage interest deduction might take longer to materialize into real demand responses. If I could observe a longer time horizon, the effect of the MID on homeownership might be larger. For the intensive margin analysis, investigating the current consumption behavior of all homeowners in a cross-section might introduce a downward bias as movers, which is the group that is more likely to present a response to the MID, are outnumbered by those that have been living in their home for a substantial amount of time. I address this problem by performing the analyses on a sample of movers-only, but this reduces the sample size and might inadvertently causes issues of sample selection. In addition to this, the validity of the assumptions necessary for the mortgage type and repayment instruments can be called into question. While I believe the institutional setting allowed for variation in MID that is exogenous from other outcomes that determine housing consumption, it might be possible that households sort themselves into mortgage types by a variable that I did not consider. This would compromise identification. The literature using modern econometric estimation strategies to analyze the mortgage interest deduction is still quite small. Further research can therefore improve our understanding of the effects of the mortgage interest deduction by using micro-level data to perform more quasi-experimental tests, use different instruments in 2SLS estimation or widening the time horizon at which we observe the demand response.

References

Aaronson, D. (2000). A note on the benefits of homeownership. *Journal of Urban Economics*, *47*(3), 356–369. https://doi.org/10.1006/juec.1999.2144

Alpanda, S., & Zubairy, S. (2016). Housing and Tax Policy. *Journal of Money Credit and Banking*, *48*(2–3), 485–512. https://doi.org/10.1111/jmcb.12307

Autor, D. H., Palmer, C. J., & Pathak, P. A. (2014). Housing Market Spillovers: Evidence from the End of Rent Control in Cambridge, Massachusetts. *Journal of Political Economy*, *122*(3), 661–717. https://doi.org/10.1086/675536

Barker, D., & Miller, E. (2009). Homeownership and Child Welfare. *Real Estate Economics*, *37*(2), 279–303. https://doi.org/10.1111/j.1540-6229.2009.00243.x

Bekkum et al. - Take It to the Limit The Effects of Household Leve.pdf. (n.d.). Retrieved 26 July 2021, from https://rirani.web.illinois.edu/vanBekkumGabarroIraniPeydro_TakeItToTheLimit.pdf

Bekkum, S. V., Gabarro, M., Irani, R. M., & Peydro, J.-L. (2019). *Take It to the Limit? The Effects of Household Leverage Caps*. 48.

Berkovec, J., & Fullerton, D. (1992). A General Equilibrium-Model of Housing, Taxes, and Portfolio Choice. *Journal of Political Economy*, *100*(2), 390–429. https://doi.org/10.1086/261822

Binner, A., & Day, B. (2015). Exploring mortgage interest deduction reforms: An equilibrium sorting model with endogenous tenure choice. *Journal of Public Economics*, *122*, 40–54. https://doi.org/10.1016/j.jpubeco.2014.12.005

Boehm, T. P., & Schlottmann, A. M. (1999). Does home ownership by parents have an economic impact on their children? *Journal of Housing Economics*, *8*(3), 217–232. https://doi.org/10.1006/jhec.1999.0248

Bourassa, S. C., & Yin, M. (2006). Housing Tenure Choice in Australia and the United States: Impacts of Alternative Subsidy Policies. *Real Estate Economics*, *34*(2), 303–328. https://doi.org/10.1111/j.1540-6229.2006.00168.x

Bourassa, S. C., & Yin, M. (2008). Tax Deductions, Tax Credits and the Homeownership Rate of Young Urban Adults in the United States. *Urban Studies*, *45*(5/6), 1141–1161.

Broulikova, H. M., Huber, P., Montag, J., & Sunega, P. (2020). Homeownership, mobility, and unemployment: Evidence from housing privatization. *Journal of Housing Economics*, *50*, 101728. https://doi.org/10.1016/j.jhe.2020.101728

Capozza, D. R., Green, R. K., & Hendershott, P. H. (1996). Taxes, mortgage borrowing, and residential land prices. In H. Aaron & W. G. Gale (Eds.), *Economic Effects of Fundamental Tax Reform* (pp. 171–210). Brookings Inst.

Capozza, D. R., Green, R. K., & Hendershott, P. H. (1998). TAX REFORM AND HOUSE PRICES: LARGE OR SMALL EFFECT? *Proceedings. Annual Conference on Taxation and Minutes of the Annual Meeting of the National Tax Association*, *91*, 19–24.

CBS. (2017). *Huizenkopers worden steeds ouder* [Webpagina]. Centraal Bureau voor de Statistiek. https://doi.org/10/huizenkopers-worden-steeds-ouder

Coulson, N. E., & Fisher, L. M. (2002). Tenure choice and labour market outcomes. *Housing Studies*, *17*(1), 35–49. https://doi.org/10.1080/02673030120105875

Coulson, N. E., & Fisher, L. M. (2009). Housing tenure and labor market impacts: The search goes on. *Journal of Urban Economics*, *65*(3), 252–264. https://doi.org/10.1016/j.jue.2008.12.003

Coulson, N. E., & Li, H. (2013). Measuring the external benefits of homeownership. *Journal of Urban Economics*, *77*, 57–67. https://doi.org/10.1016/j.jue.2013.03.005

Dietz, R., & Haurin, D. (2003). The social and private micro-level consequences of homeownership. *Journal of Urban Economics*, *54*(3), 401–450. https://doi.org/10.1016/S0094-1190(03)00080-9

DiPasquale, D., & Glaeser, E. L. (1998). *Incentives and Social Capital: Are Homeowners Better Citizens?* (No. w6363). National Bureau of Economic Research. https://doi.org/10.3386/w6363

Dunsky, R. M., & Follain, J. R. (2000). Tax-induced portfolio reshuffling: The case of the mortgage interest deduction. *Real Estate Economics*, *28*(4), 683–718. https://doi.org/10.1111/1540-6229.00816

Engelhardt, G. V., Eriksen, M. D., Gale, W. G., & Mills, G. B. (2010). What are the social benefits of homeownership? Experimental evidence for low-income households. *Journal of Urban Economics*, *67*(3), 249–258. https://doi.org/10.1016/j.jue.2009.09.010

Floetotto, M., Kirker, M., & Stroebel, J. (2016). Government intervention in the housing market: Who wins, who loses? *Journal of Monetary Economics*, *80*, 106–123. https://doi.org/10.1016/j.jmoneco.2016.04.005

Follain, J. R., & Dunsky, R. M. (1997). The Demand for Mortgage Debt and the Income Tax. *Journal of Housing Research*, *8*(2), 155–199.

Follain, J. R., & Ling, D. (1991). The Federal Tax Subsidy to Housing and the Reduced Value of the Mortgage Interest Deduction. *National Tax Journal*, *44*(2), 147–168.

FOLLAIN, J. R., & LING, D. C. (1991). THE FEDERAL TAX SUBSIDY TO HOUSING AND THE REDUCED VALUE OF THE MORTGAGE INTEREST DEDUCTION. *National Tax Journal*, *44*(2), 147–168.

Gale, W., Gruber, J., & Stephens-Davidowitz, S. (2007). Encouraging Homeownership Through the Tax Code. *Tax Notes*, *115*.

Galster, G. C. (1983). Empirical Evidence on Cross-Tenure Differences in Home Maintenance and Conditions. *Land Economics*, *59*(1), 107–113. https://doi.org/10.2307/3145880

Glaeser, E. L., & Sacerdote, B. (2000). *The Social Consequences of Housing* (SSRN Scholarly Paper ID 263369). Social Science Research Network. https://doi.org/10.2139/ssrn.263369

Glaeser, E. L., & Shapiro, J. M. (2003). The benefits of the home mortgage interest deduction. In J. M. Poterba (Ed.), *Tax Policy and the Economy, Vol 17* (Vol. 17, pp. 37–82). M I T Press. https://doi.org/10.1086/tpe.17.20140504

Green, R. K., & White, M. J. (1997). Measuring the benefits of homeowning: Effects on children. *Journal of Urban Economics*, *41*(3), 441–461. https://doi.org/10.1006/juec.1996.2010

Guerrieri, V., & Lorenzoni, G. (2017). Credit Crises, Precautionary Savings, and the Liquidity Trap*. *The Quarterly Journal of Economics*, *132*(3), 1427–1467. https://doi.org/10.1093/qje/qjx005

Hanson, A. (2012). Size of home, homeownership, and the mortgage interest deduction. *Journal of Housing Economics*, *21*(3), 195–210. https://doi.org/10.1016/j.jhe.2012.06.001

Hanson, A. (2020). Taxes and Borrower Behavior: Evidence from the Mortgage Interest Deductibility Limit. *Journal of Urban Economics*, *118*, 103256. https://doi.org/10.1016/j.jue.2020.103256

Haurin, D. R., Parcel, T. L., & Haurin, R. J. (2000). *The Impact of Home Ownership on Child Outcomes* (SSRN Scholarly Paper ID 218969). Social Science Research Network. https://doi.org/10.2139/ssrn.218969

Hendershott, P. H., & Shilling, J. D. (1980). *The Economics of Tenure Choice: 1955-79* (No. w0543). National Bureau of Economic Research. https://doi.org/10.3386/w0543

Heylen, K., & Haffner, M. (2012). The Effect of Housing Expenses and Subsidies on the Income Distribution in Flanders and the Netherlands. *Housing Studies*, *27*(8), 1142–1161. https://doi.org/10.1080/02673037.2012.728572

Hilber, C. A. L., & Turner, T. M. (2014). The Mortgage Interest Deduction and Its Impact on Homeownership Decisions. *Review of Economics and Statistics*, *96*(4), 618–637. https://doi.org/10.1162/REST_a_00427

Jacobs, B., & Cnossen, S. (2020). *Tax by Design for the Netherlands*. Oxford University Press.

Klemm, A., Hebous, S., & Waerzeggers, C. (2021). *Capital Income Taxation in the Netherlands* (IMF Working Paper 9781513573441/1018-5941; p. 41). IMF. https://www.imf.org/en/Publications/WP/Issues/2021/05/20/Capital-Income-Taxation-in-the-Netherlands-50226

Kleven, H., Jensen, A., & Gruber, J. (2021). Do People Respond to the Mortgage Interest Deduction? Quasi-Experimental Evidence from Denmark. *American Economic Journal: Economic Policy*, *13*(2), 273–303. https://doi.org/10.1257/pol.20170366

Kortelainen, M., & Saarimaa, T. (2015). Do Urban Neighborhoods Benefit from Homeowners? Evidence from Housing Prices. *Scandinavian Journal of Economics*, *117*(1), 28–56. https://doi.org/10.1111/sjoe.12090

Leventhal, T., & Newman, S. (2010). Housing and child development. *Children and Youth Services Review*, *32*(9), 1165–1174. https://doi.org/10.1016/j.childyouth.2010.03.008

Ling, D. C., & McGill, G. A. (1998). Evidence on the demand for mortgage debt by owner-occupants. *Journal of Urban Economics*, *44*(3), 391–414. https://doi.org/10.1006/juec.1997.2079

Newman, S. J. (2008). Does housing matter for poor families? A critical summary of research and issues still to be resolved. *Journal of Policy Analysis and Management*, *27*(4), 895–925. https://doi.org/10.1002/pam.20381

NOS. (2020). *Starters op woningmarkt: 'Tegenwoordig hebben ze het echt moeilijk'*. https://nos.nl/l/2350140

NOS. (2021). *DNB: belast eigen woning zwaarder. Huurders te veel in het nadeel*. NOS Nieuws.

> https://nos.nl/l/2363424

Poterba, J. (1992). Taxation and Housing: Old Questions, New Answers. *American Economic Review*,

> *82*(2), 237–242.

Rijksoverheid. (2020). *Miljoennennota*.

Rosen, H. (1979). Housing decisions and the U.S. income tax: An econometric analysis. *Journal of*

> *Public Economics*, *11*(1), 1–23. https://doi.org/10.1016/0047-2727(79)90042-2

Rosen, H. S. (1983). *Housing Subsidies: Effects on Housing Decisions, Efficiency, and Equity* (No.

> w1161). National Bureau of Economic Research. https://doi.org/10.3386/w1161

Rosen, H. S., & Rosen, K. T. (1980). Federal Taxes and Homeownership: Evidence from Time Series.

> *Journal of Political Economy*, *88*(1), 59–75.

Sommer, K., & Sullivan, P. (2018). Implications of US Tax Policy for House Prices, Rents, and

> Homeownership. *American Economic Review*, *108*(2), 241–274.
> https://doi.org/10.1257/aer.20141751

Vangeel, W., Defau, L., & Moor, L. D. (2021). The influence of a mortgage interest deduction on

> house prices: Evidence across tax systems in Europe. *The European Journal of Finance*, *0*(0), 1–
> 16. https://doi.org/10.1080/1351847X.2021.1941173

Voith, R., & Gyourko, J. (2002). Capitalization of federal taxes, the relative price of housing, and

> urban form: Density and sorting effects. *Regional Science and Urban Economics*, *32*(6), 673–
> 690. https://doi.org/10.1016/S0166-0462(02)00011-X

Wagstaff, A., van Doorslaer, E., van der Burg, H., Calonge, S., Christiansen, T., Citoni, G.,

> Gerdtham, U. G., Gerfin, M., Gross, L., Hakinnen, U., John, J., Johnson, P., Klavus, J., Lachaud,
> C., Lauridsen, J., Leu, R. E., Nolan, B., Peran, E., Propper, C., … Winkelhake, O. (1999).

Redistributive effect, progressivity and differential tax treatment: Personal income taxes in twelve OECD countries. *Journal of Public Economics*, *72*(1), 73–98. https://doi.org/10.1016/S0047-2727(98)00085-1

Xhignesse, G., & Verbist, G. (2019). An assessment of the spatial efficiency of tax benefits for home mortgages in Belgium. *Housing Studies*, *0*(0), 1–27. https://doi.org/10.1080/02673037.2018.1562057

Variable	Mean	Std. Dev.	10th pct.	90th pct.
Homeownership	0.42	-	-	-
Non-Repaying Mortgage	0.25	-	-	-
MID Received (in Euros)	81.63	139	0	243.58
Pre-tax Income (in Euros)	23572	13426	12815	36542
After-tax Income (in Euros)	24163	16356	13929	35019
Liquid Wealth (x1000 Euros)	30	83	0.44	72
Home Value (x1000 Euros)	182	110	95	365
Living Space (in square meters)	106	72	58	155
Monthly Mortgage Payments (in Euros)	427	484	0	946
Mortgage Debt (in x1000 euros)	398	83	0	152
Respondent Age	44	9	24	75
Parent	0.16	-	-	-

Table 12: Descriptive Statistics relevant variables WoON Onderzoek 2018 for low-income groups. Monetary values in euros.

Variable	Mean	Std. Dev.	10th pct.	90th pct.
Homeownership	0.91	-	-	-
Non-Repaying Mortgage	0.64	-	-	-
MID Received (in Euros)	295.63	345.41	0	654.79
Pre-tax Income (in Euros)	128026	77404	88260	177857
After-tax Income (in Euros)	90107	52323	63724	120362
Liquid Wealth (x1000 Euros)	91	353	7	192
Home Value (x1000 Euros)	344	186	181	545
Living Space (in square meters)	165	83	98	244
Monthly Mortgage Payments (in Euros)	993.32	652.92	300	1800
Mortgage Debt (in x1000 euros)	222	213	0	452
Respondent Age	55	12	34	59
Parent	0.57	-	-	-

Table 13: Descriptive Statistics relevant variables WoON Onderzoek 2018 for middle income groups. Monetary values in euros.

Variable	Mean	Std. Dev.	10th pct.	90th pct.
Homeownership	0.63	-	-	-
Non-Repaying Mortgage	0.76	-	-	-
MID Received (in Euros)	167.98	226.24	0	410.083
Pre-tax Income (in Euros)	51061	46033	15286	93973
After-tax Income (in Euros)	42453	32147	17288	71819
Liquid Wealth (x1000 Euros)	59.92	166.26	1.68	146.63
Home Value (x1000 Euros)	225	137	110	376
Living Space (in square meters)	124	74	67	187
Monthly Mortgage Payments (in Euros)	718	297.91	0	300
Mortgage Debt (in x1000 euros)	96.95	139.18	0	260
Respondent Age	51.52	12	32	79
Parent	0.40	-	-	-

Table 14: Descriptive Statistics relevant variables WoON Onderzoek 2018 for high income groups. Monetary values in euros.

Appendix B: Comparison of Elasticities of Demand to MID

Paper	Data Country and Year	Methodology	Extensive Margin Elasticity	Intensive Margin Elasticity
Rosen, 1979	US, 1970-1980	OLS	-	~1 (Home Value)
Dunsky and Follain, 2000	US, 1983-1989	OLS&IV	-	0.5-1.3 (Debt)
Hendershot, 1980	US, 1955-1979	OLS	0.6	-
Bourassa and Yin, 2006	Australia & US, 1989-1990	Repeated OLS	0.3	-
Hanson, 2012	US, 2007	IV & RDD	0	0.24 (Home Size)
Kleven et al., 2021	Denmark, 1980-2010	DiD	0	0.06 (Home Size) 0.12 (Home Value) 0.253 (Interest Expenses)
Wittebrood, 2021	Netherlands, 2000-2018	IV & DiD	0	0.08 (Home size) 0.13 (Home Value) 0.43 (Debt)

Table 15: Estimated or implied elasticities from a selection of the literature on the demand effects of the mortgage interest deduction that provide them. For the intensive margin, the measure of intensive margin housing demand is stated in brackets.