9-1-2012

Size of Home, Home Ownership, and the Mortgage Interest Deduction

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Accepted version. *Journal of Housing Economics*, Vol. 21, No. 3 (September, 2012): 195–210. DOI.

Size of Home, Homeownership, and the Mortgage Interest Deduction

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Abstract: This paper offers an empirical test of the effect of the mortgage interest deduction (MID) on both the extensive (own vs. rent) and intensive (size of home) housing purchase margins. Using state level differences in MID availability to identify, I examine this relationship using standard ordinary least squares, instrumental variables, regression discontinuity, and sample selection estimation techniques. I find the MID to be responsible for a 10.9–18.4% increase in the size of home purchased, but that no relationship exists between the MID and home ownership. These results imply an elasticity of home size with respect to changes in user cost between −1 and −1.4.

1. Introduction

The mortgage interest deduction (MID,) will reduce income tax revenues by more than $98 billion in fiscal year 2012 (Executive Office of The President, 2011). A major criticism of this tax expenditure, and of the MID as a policy in general, is that it encourages excessive purchase of housing.[1] Using parameterized theoretical models, Mills, 1987 and Poterba, 1992 suggest the tax favored[2] status of housing

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causes a 12–24% increase in housing consumption (or over-investment relative to other assets in the context of the user cost model).[3] Although these theoretical models are parameterized using real values for important determinants of the housing purchase choice, they do not offer direct evidence that the MID effects housing purchase decisions. Existing empirical work offers little precise evidence that directly links the MID to the amount of housing purchase.[4]

This paper offers an empirical test of how the MID effects housing purchase on both the extensive (own vs. rent) and intensive (size of home) margins. I use state-level differences in the availability of the MID to identify how the MID effects housing purchase decisions.[5] Using state level policy as a basis, I compare housing purchase decisions for residents of states with an MID to several control groups where the MID is not available at the state level. I also employ several estimation techniques to identify the effect of the MID on housing purchase decisions – ordinary least squares, instrumental variables, and regression discontinuity.

Using dwelling level data from the American Housing Survey (AHS) on owner occupied homes, estimates show that the MID is responsible for a 10.9–18.4% increase in the size of home purchased (statistically significant in nearly all cases), depending on the econometric specification and comparison group. This result is robust to instrumental variables estimation, using states that take the federal definition of itemized deductions as an instrument for a state level MID. Estimates show a smaller, but still meaningful relationship between home size and the MID using regression discontinuity estimation with census tract level data. Estimates show no statistically significant relationship between the MID and the probability a home is owner occupied in most cases, although in some cases I find a negative relationship.

The remainder of the paper is organized as follows. Section 2 discusses the theoretical relationship between the MID, homeownership, and size of home purchase. Section 3 describes how this work fits into the previous literature. Section 4 outlines the identification strategy for estimating the relationship between the MID and housing purchase. Section 5 discusses the data for estimation.

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Section 6 reports results using my primary identification strategy and alternative identification strategies. Section 7 concludes.

2. Theoretical considerations for the relationship between the MID and housing

The standard model used to study the tax treatment of owner occupied housing is the user cost model. See Rosen, 1979a, Rosen, 1979b, Rosen, 1985, Poterba, 1984, Poterba, 1992, Green and Vandell, 1999, Glaeser and Shapiro, 2003 and Himmelberg et al., 2005 and Anderson et al. (2007) for variations of this model. The user cost model is useful for understanding how the presence of a MID and changing marginal tax rates effect both the purchase price and annual cost of home ownership. The user cost model, however, offers limited insight on the margin where the MID begins to subsidize housing purchase, and the joint effects of reduced income and changing relative price caused by income tax rate changes.

To examine how the MID effects housing purchase decisions, consider its impact on a consumer budget constraint, depicted in Fig. 1. Fig. 1 shows a budget constraint for a consumer considering the trade-off between owner occupied housing and all other goods. The dotted line shows the budget constraint without the MID, and the solid line shows how the MID changes the budget constraint. A budget constraint with the MID differs from the standard budget constraint in two important ways – it creates a "kink" point, and it makes consuming additional housing cheaper beyond this point.

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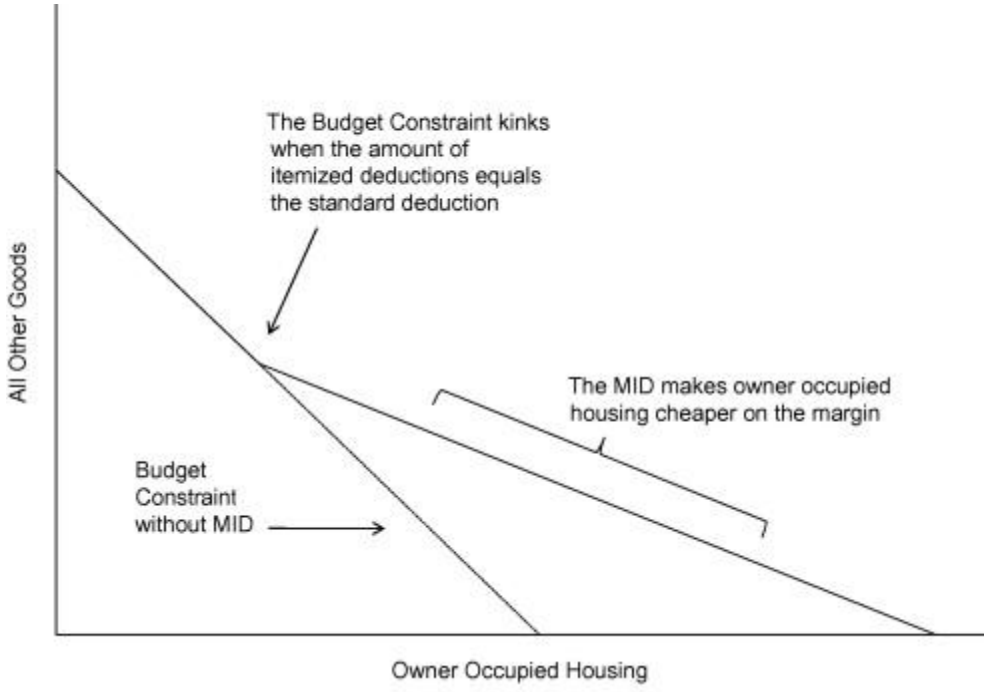

Fig. 1. Consumer budget constraint with mortgage interest deduction.

The kink point exists because the MID is not available until a home owner itemizes deductions on their tax return. A home owner will not itemize deductions until the sum of those deductions is greater than the standard deduction. Therefore, the MID does not begin to change the relative price of owner occupied housing until the amount of mortgage interest exceeds the difference between the standard deduction and all other itemized deductions. In equation form, the MID begins to subsidize the purchase of owner occupied housing when:

$$i\theta P_H = S_{Dedict} - \sum I_{Other\ Deduct} \tag{1}$$

where i is the interest rate on a mortgage, θ is the share of the home purchase financed with debt, and P_{H} is the full purchase price of the home. S_{Deduct} represents the amount of standard deduction allowed without itemizing, and $I_{\mathrm{OtherDeduct}}$ are amounts of all other deductions allowed for itemizers.

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After the point where a consumer purchases enough owner occupied housing so that the mortgage interest covers the difference between all other itemized deductions and the standard deduction, the MID lowers the relative price of additional housing, flattening the budget constraint. For this segment of the budget constraint, the income and substitution effects work together – encouraging consumers to purchase more owner occupied housing. Fig. 1 shows why the MID does not necessarily subsidize owner occupied housing on the extensive margin (moving from renting to owning), but subsidizes owner occupied housing on the intensive margin (purchasing a larger home). This is one explanation why previous evidence suggests no relationship between federal itemization rates and home ownership rates (Glaeser and Shapiro, 2003).

While Fig. 1 shows how implementing a MID effects the consumer's budget constraint, it does not consider the effect of an income tax directly (a necessary condition for the presence of the MID). Fig. 2 shows how increasing the marginal income tax rate and allowing an MID affect the consumer's budget constraint. The presence of an income tax with an MID changes the budget constraint in two ways – shifting it in closer to the origin at all points and flattening it out for all points where the amount of mortgage interest exceeds the difference between the standard deduction and all other itemized deductions.

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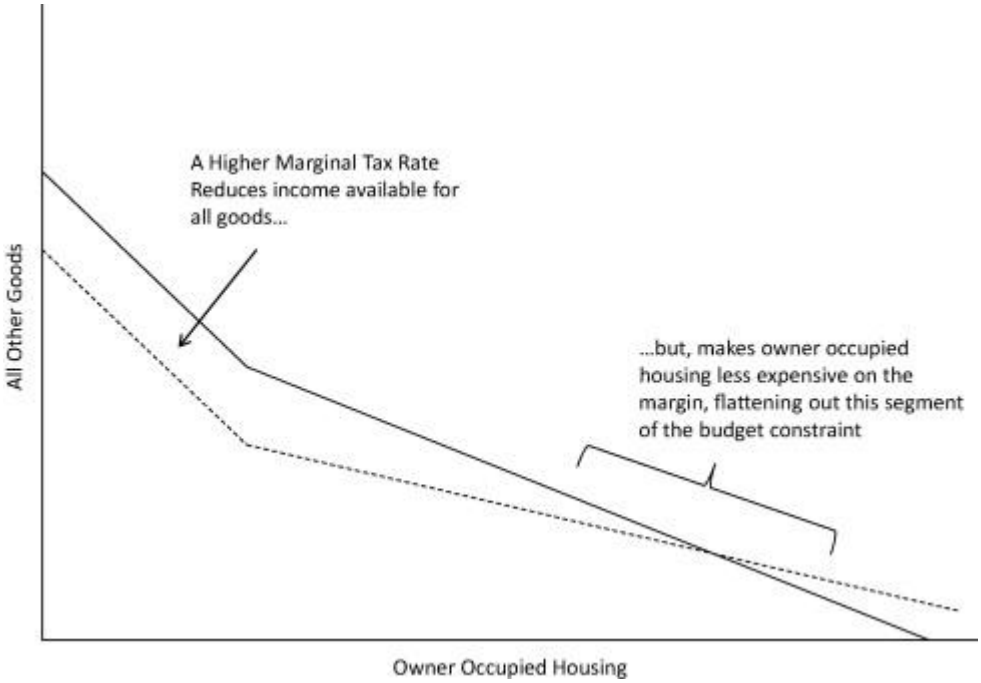

Fig. 2. Consumer budget constraint with higher marginal tax rate and mortgage interest deduction.

Fig. 2 shows why it is inappropriate to use only individual variation in the income tax rate to assess the effect of the MID on housing market outcomes, and why it is necessary to control for the marginal tax rate when assessing the effect of the MID. The first order effect of higher marginal tax rates is to shift the budget constraint toward the origin – causing a reduction in consumption of housing and all other goods. The second order effect of the higher marginal tax rate is to flatten the portion of the budget constraint for housing consumption greater than the kink point – where both the income and substitution effects say to consume more housing (relative to the case with no MID). Fig. 2 shows that comparing consumers with different marginal tax rates to identify the effect of the MID can be misleading because of the confounding effects of the income reduction, and suggests that estimates of the effect of the MID should control for the negative income effect of higher marginal tax rates when examining the effect of the MID.

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3. Previous studies of the relationship between the MID and housing

There have been a number of previous studies attempting to determine the link between home ownership and the MID. Rosen and Rosen (1980) estimate a model using time series variation to predict that the national home ownership rate would be 4% points lower without a MID. Hendershott and Schilling (1982) provide slightly higher estimates in the range of 5–6.5%, depending on the assumed average marginal income tax rate. Linneman (1985) uses proxies for marginal tax rates to show that tax treatment of housing is an important determinant of homeownership in a cross section of cities.[6] More recently, Glaeser and Shapiro (2003) estimate the relationship between the average subsidy created by the MID and home ownership rates using quarterly national time series data and a cross section of state level data. They find an extremely small positive relationship between the subsidy created by the MID and homeownership rates in some specifications, but on balance their results show no relationship between home ownership and the MID.

There is a smaller literature that links the MID to demand for mortgage debt. Using data from the Survey of Consumer Finances, Follain and Dunsky (1997) show that the demand for mortgage debt is highly responsive to changes in the income tax rate that applies to the MID. They find that the elasticity of mortgage debt with respect to an income tax rate change is between −1.5 and −3.5 depending on the year of data used in estimation. Using data from the American Housing Survey, Ling and McGill (1998) show the rate of tax savings on mortgage interest is a significant determinant of the amount of mortgage debt. They find that owners with a lower average rate of tax savings (measured by the amount of housing related deductions that potentially go unused) from the MID have significantly lower demand for mortgage debt.

In addition to studies that directly estimate the effect of the MID on home ownership decisions and the demand for mortgage debt, there is a literature that examines the interaction between both real and proposed policy and the value of the MID. Rosen (1979a) estimates a model to show without the MID, residents would live in

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homes that are less valuable. Follain and Ling (1991) show that the Tax Reform Act of 1986 made the MID essentially worthless for many households with low incomes. Poterba (1992) also analyzed the distribution of the MID before and after TRA86, finding a similar result. Green and Vandell (1999) examine a hypothetical revenue-neutral switch from the current MID and property tax deduction to a housing tax credit. Anderson and Roy (2001) examine the impact for taxpayers across the income distribution of removing both the mortgage interest and property tax deductions. Anderson et al. (2007) examine the differential effect of proposals to impose limits on federal mortgage interest deductibility across metropolitan areas. Bourassa and Yin (2007) also examine MID limits and show they would have an especially negative impact on ownership decisions for young residents of urban areas.

This paper makes four contributions to the previous literature. First, in addition to estimating the relationship between the MID and homeownership, I estimate the relationship between the MID and the amount of housing consumed (measured in square feet). Second, I improve upon the data used to estimate the effect of the MID on homeownership by using dwelling-level micro data. Third, I use cross section variation created by differences in state-level MID policy and control for the top marginal tax rate to eliminate the income effects of higher marginal tax rates. Lastly, I use both instrumental variables and regression discontinuity to estimate this relationship.

4. Identification strategy

The federal MID is available to all income taxpayers who itemize deductions, however, not all states have an income tax and not all states that have an income tax allow an MID. I use the cross section variation in MID availability for state income tax purposes to identify how it effects both the homeownership decision and the size of home purchased.[7] First, I use policy variation across all states to estimate the effect of the MID on home size and ownership. Estimates of this relationship compare homes in states with the MID against a variety of comparison groups; all other states, all other income tax states, and all states with a top marginal income tax above the median. Then, I estimate the effect of the MID on home size and ownership using the

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policy difference on either side of a state border where one state allows the MID and the other does not in a regression discontinuity framework.

The use of state-level policy variation as opposed to the actual choice to claim the MID is advantageous for two reasons. The first is that a data source containing both actual tax information and detailed home purchase decisions does not exist. The second is an econometric issue. An individual's decision to claim the MID is likely to be a function of several other factors: level of education, income, the presence of dependents (i.e. children), and availability of other deductions. Many of these factors are also likely to be directly linked to housing purchase decisions, immediately raising endogeneity concerns. State level availability of the MID is arguably exogenous at the individual level, or is at least not highly correlated with other individual characteristics that drive housing purchase decisions. [8]

4.1. Comparison of state-level policies

To identify the effect of the MID on home size and ownership I estimate the following regression:

$$\gamma_i = \alpha + \beta_1(\text{MID})_i + \beta_2(\text{Top MTR})_i + Z_i'\gamma + \varepsilon_i \tag{2}$$

where Y is either the size of the home measured in square feet, or an indicator variable equal to one if the home is owner occupied and equal to zero otherwise. MID is a variable equal to one if the home is in a state that allows the mortgage interest deduction and zero if it does not. Top MTR is the top marginal state income tax rate. The income tax burden is an important control because the MID is a feature of states that have an income tax, and the first order effect of an income tax is lower income, which lowers demand for housing.[9] Without controlling for the income tax rate, Eq. (2) would likely be biased toward underestimating the effect of the MID on housing market outcomes.[10] Z is a set of control variables that includes the age in years and age-squared of the housing unit, a dummy variable indicating if it is a single family residence, the annual maintenance costs per square foot, price per square foot, age (in years) of the

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household head, age of household head squared, a variable indicating if the household head is non-white, annual household income, an indicator if the house is located in the central city of a metropolitan area, the mortgage interest rate, and census region dummy variables. I also estimate Eq. (2) using controls for the year the current owner moved into the home in some specifications.

When the dependent variable in Eq. (2) is square footage of the home, the coefficient of interest (β_1) is interpreted as the marginal effect of an MID on the size of home purchased. When the dependent variable in Eq. (2) is an indicator of the home being owner occupied, the coefficient of interest (β_1) is interpreted as how the MID changes the probability of home ownership. Because of concerns with correlation between Z and the MID variable, I estimate Eq. (2) with and without control variables to eliminate concerns that bad control variable bias drives my results. The results section discusses concerns with comparison group viability and endogeneity in estimating (2).

4.2. Regression discontinuity

The abrupt change in mortgage interest deductibility that happens at a state border makes a regression discontinuity method attractive to identify the effect of the subsidy on outcomes of interest. If the mortgage interest deduction affects housing market outcomes, then we would expect to see a sharp change in outcomes on either side of a border between two states with differing MID policy. Using the border between Pennsylvania and Maryland, known as the Mason–Dixon Line (MDL), is ideal for regression discontinuity for several reasons.

First, this border is not the result of geological features like a river or mountains that could impede building a home.[11] Second, the border is between two states with similar income tax rates going back for several years. Similar income tax rates are necessary to avoid picking up income effects from the difference in tax rates. Lastly, Pennsylvania has never allowed a MID going back to when the income tax was implemented in 1971,[12] and Maryland has allowed a MID at going back as far as when the state income tax began being collected in 1939.[13]

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In practice, regression discontinuity requires regressions of the following form:

$$H_i = \alpha_{PA} + \beta_1(\text{Distance to MDL})_i + \varepsilon_i, \text{where: } 0 < \text{Distance to MDL} < h \tag{3}$$

And

$$H_i = \alpha_{MD} + \beta_1(\text{Distance to MDL})_i + \varepsilon_i, \text{where: } 0 < \text{Distance to MDL} < h \tag{4}$$

where H is a particular outcome of interest (tenure choice or home size) and h is the bandwidth in miles around the MDL used in the regression. Following Imbens and Lemieux (2008), I test the difference between estimated coefficients $(\alpha_{\text{MD}} - \alpha_{\text{PA}}) = 0$, as a measure of the effect of the MID policy change on housing market outcomes.

The logic behind the regression discontinuity is to estimate the intercept term at the MDL approaching it from both the north and the south. The difference in intercepts estimate, $(\alpha_{\text{MD}} - \alpha_{\text{PA}})$, allows me to see if there is a sharp change in housing market outcomes at the point where the MID policy change happens. I also estimate the regression discontinuity equations without controlling for distance to the MDL, these results essentially compare the unconditional mean home size within a specified bandwidth around the MDL.

5. Data on home size and homeownership

I estimate Eq. (2) using dwelling level data from the 2007 American Housing Survey (AHS). I use the 2007 AHS National survey, rather than the newer 2009 survey, because it includes dwellings sampled from the six largest metropolitan areas. For the size of home regressions, only homes that are owner occupied are used because renters will not benefit from the MID directly. The ownership regressions use all homes in the AHS survey.

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The unit of observation in the AHS is the dwelling. The AHS data consists of householder responses to survey questions on the actual dwelling and the composition of the occupants of the dwelling. The homes surveyed in the AHS include a core sample of homes that has not changed since 1985 and newly constructed dwellings added to the core annually by sampling addresses from building permits data. The data contain a wealth of information about the dwelling, including if it is owner-occupied, and its size measured in square feet- used as dependent variables in Eq. (2).

The constraint on using the AHS data to estimate Eq. (2) is knowledge of MID availability across states and time. To identify whether a state has an MID available in a given year I examine state tax forms.[14] I am able to match state MID policy information for all states from 2003 to 2007 (the final year of new homes in the AHS), Table 1 summarizes the state tax information. I use dwellings where the current resident moved in during the 2003–2007 period, and match data on MID availability according to the year of move and state location.

Table 1. State tax summary.

	Income tax	**MID available**	**Use federal itemized**
Alabama	Yes	Yes	Yes
Alaska	No	No	No
Arizona	Yes	Yes	Yes
Arkansas	Yes	Yes	No
California	Yes	Yes	Yes
Colorado	Yes	Yes	Yes
Connecticut	Yes	No	No
Delaware	Yes	Yes	Yes
District of Columbia	Yes	Yes	Yes
Florida	No	No	No
Georgia	Yes	Yes	Yes
Hawaii	Yes	Yes	No
Idaho	Yes	Yes	Yes
Illinois	Yes	No	No
Indiana	Yes	No	No
Iowa	Yes	Yes	No
Kansas	Yes	Yes	No
Kentucky	Yes	Yes	No
Louisiana	Yes	No	–[a]

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	Income tax	MID available	Use federal itemized
Maine	Yes	Yes	Yes
Maryland	Yes	Yes	Yes
Massachusetts	Yes	No	No
Michigan	Yes	No	No
Minnesota	Yes	Yes	Yes
Mississippi	Yes	Yes	Yes
Missouri	Yes	Yes	Yes
Montana	Yes	Yes	No
Nebraska	Yes	Yes	Yes
Nevada	No	No	No
New Hampshire[b]	No	No	No
New Jersey	Yes	No	No
New Mexico	Yes	Yes	Yes
New York	Yes	Yes	Yes
North Carolina	Yes	Yes	Yes
North Dakota	Yes	Yes	Yes
Ohio	Yes	No	No
Oklahoma	Yes	Yes	Yes
Oregon	Yes	Yes	Yes
Pennsylvania	Yes	No	No
Rhode island	Yes	Yes	Yes
South Carolina	Yes	Yes	Yes
South Dakota	No	No	No
Tennessee[b]	No	No	No
Texas	No	No	No
Utah	Yes	Yes	Yes
Vermont	Yes	Yes	Yes
Virginia	Yes	Yes	Yes
Washington	No	No	No
West Virginia	Yes	No	No
Wisconsin	Yes	Yes	–[c]
Wyoming	No	No	No

[a]Beginning in 2007, Louisiana allowed taxpayers to deduct 57.5% of federal itemized deductions in excess of the standard deduction.

[b]New Hampshire and Tennessee do not tax wages, only interest and dividends; they are considered to have 0 mtr for this reason.

[c]Wisconsin gives tax payers a credit based on the value of federal itemized deductions.

The National AHS sample identifies the location of a home at the Standard Metropolitan Statistical Area (SMSA) level. I match the SMSA to a state to identify MID availability and marginal tax rates; however, some SMSAs span multiple states. I exclude most multi-state MSAs,

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except New York and Chicago, which the AHS codes to allow identification of sub-MSA areas (for example New York is separated into Northern New Jersey and New York plus some of the Long Island counties). I exclude the following SMSAs from my analysis because I cannot directly allocate MID and tax rate information to them: Augusta, GA-SC, Chattanooga, TN-GA, Cincinnati, OH-KY-IN, Davenport-Rock Island-Moline, IA-IL, Duluth, MN-WI, Johnson City-Kingsport-Bristol, TN-VA, Kansas City, KS-MO, Lawrence-Haverhill, MA-NH, Memphis, TN-AR, MS, Norfolk-Virginia Beach, VA-NC, Omaha, NE-IA, Philadelphia, PA-NJ, Saint Louis, MO-IL, Washington, DC-MD-VA (included in the regression discontinuity estimates as state is identifiable in census data).[15]

The SMSA identifier in the AHS is also restricted to only identify homes in an SMSA with a population greater than 100,000, excluding all homes in smaller SMSAs and homes not in SMSAs. The Appendix Table shows the counts of homes in my data by SMSA for both the size and ownership regressions. Using a sample of relatively large SMSAs and excluding rural areas may be problematic for estimating the effect of the MID if the excluded homes in MID states are more (less) likely to be owner occupied or be larger (smaller). This is classic sample selection based on the exogenous explanatory variable, highlighted in Wooldridge (2002), and I perform robustness checks accounting for this problem accordingly. Data constraints leave a sample of 2,315 observations where the home is owner-occupied to estimate the size of home regressions, and 6,531 observations of owners and renters to estimate the probability of ownership regressions. Column 1 of Table 2 summarizes the control variables used in estimating (2) for the units in the sample.

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Table 2. Comparison of observable differences between states with MID and comparison areas.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
	All owner occupied homes	**States with MID**	**States without MID**	**States without MID, With Income Tax**	**States with MID, with income tax over median**	**States without mid, with income tax over median**	**(2)–(3)**	**(2)–(4)**	**(5)–(6)**
Top State MTR	5.49 (3.66)	7.94 (1.79)	3.18 (3.65)	5.82 (3.00)	9.28 (0.68)	10.16 (1.48)	4.76 [0.00]	2.12 [0.00]	−0.88 [0.00]
Age of housing unit (years)	40.77 (24.69)	41.07 (24.67)	40.49 (24.80)	45.03 (26.62)	40.24 (23.69)	53.44 (27.61)	0.58 [0.57]	−3.96 [0.00]	−13.2 [0.00]
Single family home	0.74 (.44)	0.73 (0.44)	0.75 (0.43)	0.74 (0.44)	0.71 (0.45)	0.68 (0.47)	−0.02 [0.30]	−0.01 [0.51]	0.03 [0.50]
Annual maintenance costs per sq. ft.	0.57 (1.13)	0.62 (1.35)	0.52 (0.87)	0.56 (0.90)	0.57 (1.02)	0.77 (1.08)	0.1 [0.07]	0.06 [0.42]	−0.2 [0.06]
Purchase price per sq. ft. (thousands)	0.18 (0.29)	0.23 (0.38)	0.13 (0.15)	0.15 (0.18)	0.28 (0.23)	0.26 (0.30)	0.1 [0.00]	0.08 [0.00]	0.02 [0.43]
Head of household age	42.26 (13.55)	42.12 (12.64)	42.41 (14.36)	41.52 (14.70)	42.28 (12.44)	39.31 (13.44)	−0.29 [0.61]	0.60 [0.36]	2.97 [0.01]
Non-White head of household	0.18 (0.39)	0.20 (0.40)	0.17 (0.38)	0.18 (0.38)	0.21 (0.41)	0.21 (0.41)	0.03 [0.09]	0.02 [0.32]	0.00 [0.91]
Annual household income (thousands)	97.77 (96.07)	103.90 (101)	92.03 (90.11)	93.11 (84.17)	113.36 (109)	112.38 (91.84)	11.87 [0.00]	10.79 [0.02]	0.98 [0.92]
Home in central city	0.49 (.50)	0.57 (0.49)	0.42 (0.49)	0.33 (0.47)	0.53 (0.50)	0.20 (0.40)	0.15 [0.00]	0.25 [0.00]	0.33 [0.00]
Mortgage interest rate	5.73 (1.87)	5.66 (1.90)	5.81 (1.84)	5.70 (1.85)	5.59 (2.08)	5.61 (2.10)	−0.15 [0.08]	−0.04 [0.75]	−0.02 [0.92]

Standard deviations shown in parenthesis (); *p*-values shown in brackets []. Summary statistics are for owner-occupied homes only.
Source: Author calculations using data from 2007 American Housing Survey, National Sample.

Regression discontinuity equations use census tract-level data for Maryland and Pennsylvania from the 2000 Census. The census does not have as detailed information on dwellings as the AHS, but does offer some measure of the size of homes and if they are owner

occupied. As a proxy for the size of home, I use the number of rooms in owner occupied dwellings, reported as the median for each census tract. To estimate the effect of the MID on home ownership I use the percentage of owner occupied homes in the census-tract.

I measure the distance to the MDL border for each census tract in Maryland and Pennsylvania as straight-line distance using ArcGIS software. To do this, I measure the distance to the border from the geographic center of the census tract. For the regression discontinuity equations, I have 7,513 total census tract observations, 3,147 in Pennsylvania and 1,219 in Maryland. 565 of the census tract observations are within 50 miles of the state border in Pennsylvania, and 619 are within 50 miles of the state border in Maryland. The number of census tracts shrinks considerably using bandwidths less than 50, there are only 325 tracts within 25 miles of the border, and only 113 within 10 miles of the border.

6. Results

6.1. State policy results

Table 3 presents the results for estimating Eq. (2) using the AHS dwelling level data. The first four columns of Table 3 show the results from a variety of specifications estimating the effect of a state MID on the size of home (measured in square feet), these regressions include only data on owner-occupied units as the MID is only available to home-owners. The last four columns of Table 3 show results from regressions estimating the effect of the MID on the probability the occupant is an owner and use both renter and owner occupied units.

Table 3. The effect of the MID on home size and home ownership: state policy estimates (standard errors clustered at the state level in parenthesis).

	Home size				**Home ownership**			
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
MID available	214.8**	207.3**	277.0*	288.0**	−0.0326	−0.0498	−0.00748	−0.0182
	(102.1)	(98.46)	(136.6)	(135.9)	(0.0340)	(0.0312)	(0.0213)	(0.0193)
Top MTR	−16.93	−15.10	−21.14	−21.98	−0.00360	−0.00100	−0.00133	−0.000121
	(16.60)	(16.09)	(19.91)	(20.18)	(0.00574)	(0.00472)	(0.00330)	(0.00283)
Age of housing unit (years)			−33.15***	−33.59***			−0.00664***	−0.00625***
			(7.826)	(7.665)			(0.00112)	(0.00106)

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	Home size				Home ownership			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Age of housing unit squared (years)			0.269***	0.274***			3.87e−05***	3.64e−05***
			(0.0767)	(0.0753)			(1.03e−05)	(9.84e−06)
Single family home			733.2***	736.1***			0.487***	0.463***
			(115.1)	(116.0)			(0.0207)	(0.0218)
Annual maintenance costs per sq. ft.			−118.4***	−121.3***				
			(41.83)	(41.11)				
Purchase price per sq. ft. (thousands)			−619.9**	−646.3**				
			(250.0)	(255.3)				
Head of household age			48.33*	53.00**			0.00875***	0.00529**
			(23.80)	(22.63)			(0.00242)	(0.00230)
Age squared			−0.404	−0.452*			−6.74e−05***	−4.17e−05*
			(0.280)	(0.264)			(2.37e−05)	(2.27e−05)
Non-white head of household			−153.2*	−146.6*			−0.0678***	−0.0648***
			(85.54)	(85.36)			(0.0150)	(0.0139)
Annual household income (thousands)			4.231***	4.221***			0.00128***	0.00122***
			(0.592)	(0.588)			(0.000105)	(9.64e−05)
Home in central city			−196.5***	−199.2***			−0.0353**	−0.0346**
			(64.31)	(63.45)			(0.0145)	(0.0142)
Mortgage interest rate			−2.901	−10.49				
			(20.71)	(22.10)				
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year of move dummies	No	Yes	No	Yes	No	Yes	No	Yes
Observations	2315	2315	1480	1480	6531	6531	6363	6363
R-squared	0.004	0.007	0.199	0.202	0.003	0.092	0.393	0.419

Notes: Results are from estimates using the 2007 American Housing Survey National Sample for households moving into homes from 2003 to 2007.
The omitted region in all regressions controlling for regions is Northeast, the omitted year in all regressions controlling for year of move is 2003.
Size of home is measured in square feet and these results include only owner occupied properties.
Ownership estimates cannot control for price, interest rate, or maintenance costs as these are only available for owners.
***$p < 0.01$.
**$p < 0.05$.
*$p < 0.1$.

The results presented in Table 3 show a strong positive relationship between the presence of a state MID and the square footage of owner occupied homes. The point estimates suggest the presence of a state MID increases the average size of owner-occupied homes by between 207 and 288 square feet, or between 10.9% and 15.2% at the sample mean. These results are statistically significant at either 5% or 10% level depending on the specification. All regressions in Table 3 control for the census region of the home and cluster standard errors at the state level.

Results in columns (3) and (4) of Table 3 control for a variety of household characteristics that also effect the size of home purchased. Comparing these results with columns (1) and (2), the point estimates are somewhat larger when using control variables, but still within one standard error. All control variables have the expected sign- older homes are smaller, single family homes are larger, homes with higher maintenance per square foot are smaller, homes with higher price per square foot are smaller, older heads of households with more income purchase larger homes, homes in central cities are smaller, and homes with a higher mortgage interest rate are smaller.

Table 3 shows the relationship between the presence of a state MID and the probability a unit is owner-occupied is quite weak. In fact, point estimates suggest the MID actually decreases the probability a unit is owner-occupied by as much as 4.9% points. None of the results estimating the effect of the MID on the probability of homeownership is statistically different than zero, evidence that the MID does not work on the extensive margin in the housing market.[16] Combined with the results in columns (1)–(4) these results suggest the MID does not encourage home ownership, but instead encourages the purchase of a larger home.

The MID may have a differential effect for houses that are purchased close to the construction date, as those homes most accurately capture the optimal housing choice given current market conditions.[17] While this is certainly true, the limited number of observations (between 140 and 215 homes depending on control variables) that I am able to match MID availability, year of construction, and a move in date after 2003 make this estimation less reliable. I run regressions for the sub-sample of homes that match my

other data requirements and find the MID coefficient is positive for homes purchased within 5 years of construction. The magnitude of this coefficient varies considerably across estimation techniques, however, and suggests the MID is responsible for an increase in home size between 84 and 407 square feet. The MID coefficient is not statistically different than zero for any specification using home purchased within 5 years of construction, likely due to the small sample size.

6.2. Regression discontinuity results

For the regression discontinuity design, estimating (3) and (4) I use census-tract level data for Maryland and Pennsylvania from the 2000 Census. The top panel of Table 4 shows regression discontinuity results using the median number of rooms in owner occupied homes as the dependent variable (a proxy for home size, as square footage is not available). The bottom panel of Table 4 shows results for a regression discontinuity using the percent of owner-occupied homes as the dependent variable. Both panels include estimation controlling for distance to the MDL, as well as estimates that do not control for distance.

Table 4. The effect of the MID on home size and ownership: regression discontinuity estimates (*p*-value in brackets).

	Bandwidth around limit (*h*)					
	Full sample	**150 miles**	**100 miles**	**50 miles**	**25 miles**	**10 miles**
Size of home						
N in PA, N in MD	3147, 1219	2753, 1200	2345, 1109	565, 619	178, 147	53, 60
$\alpha_{MD} - \alpha_{PA}$	0.24	0.11	0.01	0.32	−0.06	0.02
%Increase from MID	3.65	1.60	0.00	5.00	−0.01	0.01
Ho: $\alpha_{MD} - \alpha_{PA} = 0$	[0.00]	[0.14]	[0.94]	[0.01]	[0.72]	[0.91]
$\alpha_{MD} - \alpha_{PA}$ (excluding distance)	0.35	0.35	0.34	0.11	0.04	0.02
%Increase from MID	5.43	5.45	5.24	1.73	0.66	0.01
Ho: $\alpha_{MD} - \alpha_{PA} = 0$	[0.00]	[0.00]	[0.00]	[0.25]	[0.43]	[0.82]
Percent owner occupied						
N in PA, *N* in MD	3131, 1213	2737, 1195	2329, 1104	564, 615	178, 146	53, 60
$\alpha_{MD} - \alpha_{PA}$	−0.03	−0.02	−0.04	0.04	−0.13	0.06
%Increase from MID	−4.49	−3.88	−5.74	5.75	−15.63	8.08
Ho: $\alpha_{MD} - \alpha_{PA} = 0$	[0.02]	[0.07]	[0.02]	[0.07]	[0.00]	[0.30]
$\alpha_{MD} - \alpha_{PA}$ (excluding distance)	−0.02	−0.02	−0.02	0.01	−0.08	−0.07

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	Bandwidth around limit (*h*)					
	Full sample	**150 miles**	**100 miles**	**50 miles**	**25 miles**	**10 miles**
% Increase from MID	−3.55	−3.37	−3.26	1.58	−10.40	−8.98
Ho: $\alpha_{MD} - \alpha_{PA} = 0$	[0.00]	[0.00]	[0.00]	[0.56]	[0.00]	[0.02]

Notes: Results in the top panel are reported from regressions that use the median number of rooms per owner-occupied home in the census tract as the dependant variable.
Results in the bottom panel are reported from regressions that use the percent of owner occupied homes in the census tract as the dependant variable.
Source: Author's calculations using 2000 Census data.

The results in the top panel of Table 4 show a fairly robust relationship between the presence of the MID and the size of home purchased by owner–occupants. Using the full sample of census tracts in each state and controlling for distance to the MDL, the discontinuity in the median number of rooms is .24 at the state border – a difference of 3.65% of the sample mean. This says that the MID is responsible for a 3.65% increase in the median number of rooms in owner occupied homes. Fig. 3 demonstrates the estimated regression discontinuity results graphically as a jump in the median size of homes occurs at the border.

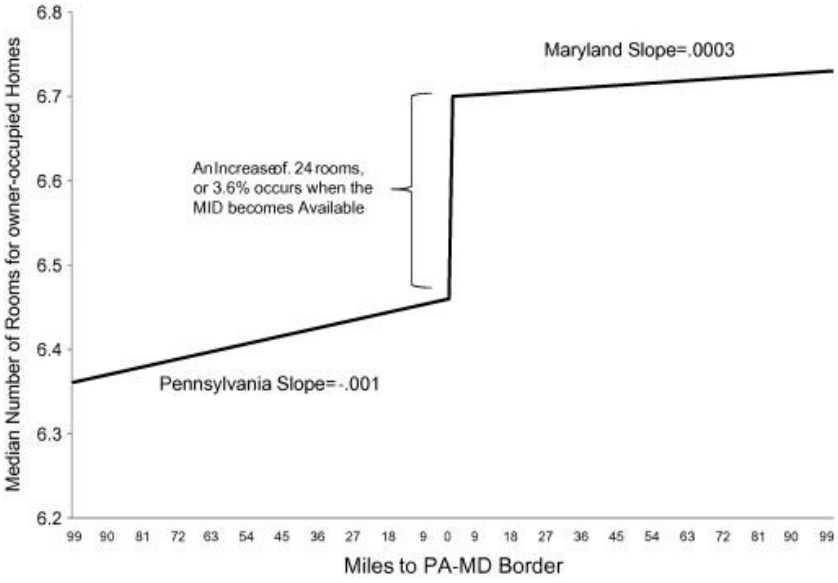

Fig. 3. Regression discontinuity results for effect of MID on median number of rooms.

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The size and significance of this relationship are strained when adjusting the bandwidth around border, the relationship becomes insignificant for samples within 150 and 100 miles of the border when controlling for distance. Using only census tracts within 50 miles of the border, the measured discontinuity is strong and shows a statistically significant increase in home size of .32 rooms when the MID is available. The .32 room increase from the MID equals a 5% increase in home size at the sample mean. Tightening the bandwidth to 25 or 10 miles yields statistically insignificant results with extremely small magnitudes.

The regression discontinuity results that exclude distance controls all show a positive relationship between the MID and home size. These results suggest a slightly larger magnitude, and remain stronger at smaller bandwidths than the results that control for distance. Using the full sample, the regression discontinuity results suggest about a 5.4% increase in the median number of rooms, a result than remains consistent when narrowing the bandwidth to 150 or 100 miles while retaining statistical significance. As with the results that control for distance, specifications with smaller and smaller bandwidths lose statistical significance.

The regression discontinuity results in the bottom panel of Table 4 show the MID actually reduces the percent of owner–occupants in four out of six specifications. These results are more evidence that the MID does not encourage home-ownership on the margin. The exceptions to the negative estimates are the results using census tracts within 50 and 10 miles of the state border, which show a substantial increase in the percent of owner–occupants, only the 50 mile results is marginally statistically significant, but suggests that the MID increases the probability of home-ownership by about 5.75% at the mean.

The regression discontinuity results for homeownership that exclude distance controls are similar to the results controlling for distance. These results suggest a negative relationship between the MID and homeownership that is similar in size to the results controlling for distance in most specifications, with the primary exception being the results within 10 miles of the MDL. Results that do not control for distance suggest a sizable negative relationship between the MID and

ownership rates that is statistically significant, whereas the results that control for distance suggest a statistically imprecise positive relationship.

6.3. Alternative comparison group results

The results using state level policy to identify the effect of the MID on size of home and home ownership decisions rely on three primary assumptions. First, homes in states without an MID make a valid counter-factual for what homes in states with an MID would look like in the absence of the policy. Second, there are no omitted variables influencing size and ownership decisions correlated with availability of the MID. Third, the policy is not endogenous- individuals with larger homes do not cause states to have an MID.

The summary statistics and corresponding *t*-tests in Table 2 address the first point to some degree. Column (7) of Table 2 shows how the group of states with and without the MID differ statistically along several observed dimensions. Homes in states with a MID are more likely to be located in a central city, have household heads with higher incomes, and have a higher price per square foot than homes in states without an MID. They are also marginally more likely to have household heads that are non-white, higher annual maintenance costs, and lower mortgage rates.

The regression results presented in Table 3 control for all observable factors, however, the observed differences shown in Table 2 suggest that there may be other important differences between these states that cannot be observed. This possibility suggests homes in states without an MID do not make an ideal group for creating a counter-factual. I use two alternative comparison groups to create a counter-factual for what home size and ownership would look like in the absence of a state MID. First, I compare states without an MID, but that have an income tax, to states with an MID (and income tax). Second, I use only states with a top marginal income tax rate more than the median in the sample (7.7%), and compare those with and without a state MID.

Column (8) of Table 2 shows how states with an MID compare to states without an MID, but with an income tax. Notice that the

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difference in maintenance costs, interest rates, and non-white head of household are no longer apparent, although differences in purchase price, income, and central city location remain. Column (9) of Table 2 shows how states with or without MID, but with a top marginal income tax rate more than the median in the data compare. Using this comparison group eliminates observed differences income, but differences in age of the home and householder become stronger.

Table 5 shows estimation results for Eq. (2) using the alternative comparison groups to estimate the effect of the MID on home size and homeownership. The results are quite similar to the primary results shown in Table 3 – the MID is responsible for increasing the size of home purchased, but not for increasing the probability a home is owner-occupied.

Table 5. The effect of the MID on home size and home ownership: alternative control group estimates (standard errors clustered at the state level in parenthesis).

	Home size				**Home ownership**			
	Income tax states		**States with MTR over median**		**Income tax states**		**States with MTR over median**	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
MID available	307.7**	322.9**	251.8**	320.9*	−0.0156	−0.0226	−0.0640	−0.0298*
	(143.0)	(140.6)	(98.65)	(145.1)	(0.0198)	(0.0195)	(0.0658)	(0.0151)
Top MTR	−13.77	−14.18	23.12	8.334	−0.00208	−0.000142	−0.0371	−0.00401
	(24.60)	(24.67)	(33.81)	(60.19)	(0.00518)	(0.00427)	(0.0418)	(0.00660)
Age of housing unit (years)	−37.14***	−37.43***	−31.34***	−30.53**	−0.00700***	−0.00661***	−0.00867***	−0.00831***
	(8.058)	(7.947)	(9.081)	(9.309)	(0.00135)	(0.00126)	(0.000542)	(0.000672)
Age of housing unit squared (years)	0.308***	0.312***	0.240**	0.234**	4.16e−05***	3.91e−05***	6.11e−05***	5.74e−05***
	(0.0758)	(0.0752)	(0.0865)	(0.0897)	(1.22e−05)	(1.14e−05)	(6.33e−06)	(7.02e−06)
Single family home	754.9***	755.6***	601.6***	606.8***	0.489***	0.468***	0.462***	0.444***
	(139.0)	(137.5)	(123.4)	(127.8)	(0.0231)	(0.0244)	(0.0479)	(0.0462)
Annual maintenance costs	−107.5**	−110.9**	−73.08***	−73.69***				
	(40.52)	(40.30)	(7.630)	(7.866)				
Purchase price per sq.	−582.5**	−604.9**	−1,098***	−1,131***				

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	Home size				Home ownership			
	Income tax states		States with MTR over median		Income tax states		States with MTR over median	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
ft. (thousands)								
	(234.9)	(241.1)	(169.4)	(172.8)				
Head of household age	36.82	41.61	26.77	35.09	0.00862***	0.00550*	0.0104**	0.00688
	(30.13)	(28.37)	(29.73)	(30.63)	(0.00310)	(0.00292)	(0.00443)	(0.00448)
Age squared	−0.273	−0.322	−0.0732	−0.154	−6.80e−05**	−4.58e−05	−8.80e−05*	−6.15e−05
	(0.354)	(0.332)	(0.351)	(0.357)	(2.97e−05)	(2.80e−05)	(4.05e−05)	(4.16e−05)
Non-white head of household	−140.3	−134.9	−59.00	−42.73	−0.0587***	−0.0548***	−0.0273	−0.0225
	(106.5)	(105.5)	(108.2)	(107.0)	(0.0162)	(0.0144)	(0.0177)	(0.0174)
Annual household income (thousands)	4.145***	4.124***	2.902***	2.879***	0.00130***	0.00124***	0.00137***	0.00128***
	(0.719)	(0.716)	(0.575)	(0.549)	(0.000110)	(9.93e−05)	(0.000106)	(7.76e−05)
Home in central city	−242.3***	−241.7***	−208.7***	−215.2***	−0.0226**	−0.0236**	−0.00161	−0.00660
	(75.78)	(74.25)	(57.15)	(55.22)	(0.0110)	(0.0115)	(0.0149)	(0.0165)
Mortgage interest rate	9.739	3.000	12.38	8.932				
	(18.64)	(21.31)	(23.87)	(27.31)				
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year of move dummies	No	Yes	No	Yes	No	Yes	No	Yes
Observations	1173	1173	497	497	4952	4952	2041	2041
R-squared	0.205	0.208	0.242	0.249	0.398	0.423	0.388	0.414

Notes: The income tax states control group includes all states that have a tax on wage income.
The states with MTR over median control group includes all states that have a top marginal income tax rate over 7.7, the median for states that tax wage.
Results are from estimates using the 2007 American Housing Survey National Sample for households moving into homes from 2003 to 2007.
The omitted region in all regressions controlling for regions is Northeast, the omitted year in all regressions controlling for year of move is 2003.
Size of home is measured in square feet and includes only owner occupied properties.
Ownership estimates cannot control for price, interest rate, or maintenance costs as these are only available for owners.
***$p < 0.01$. **$p < 0.05$. *$p < 0.1$.

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Columns (1) and (2) of Table 5 show results using only homes in states with an income tax as the comparison group for homes in states with an income tax and MID. The point estimates suggest the MID is responsible for between a 307 and 322 square foot increase in the size of home purchased, larger than the estimates using all homes as the comparison group. These estimates are equal to between a 16.3% and 17.1% change in the size of home at the mean. The standard errors on the estimates using only income tax states as a comparison group are larger than the full sample estimates, but still small enough to be able to make the estimates statistically significant at the 5% level.

Columns (3) and (4) of Table 5 show results using only homes in states with a top marginal income tax rate above the sample median (7.7%) to estimate the effect of the MID. The point estimates suggest the MID is responsible for increasing the size of homes purchased by between 251 and 320 square feet, or between 13.3% and 17% at the mean. The standard errors on these estimates are quite small, making the estimates statistically significant at either 5% or 10% level. The larger point estimates than the primary results using only state policy variation, suggest that these regressions remove the direct effects of higher income taxes on consuming more housing, so they may be a more pure measure of the MID-only effect.

Columns (5–8) of Table 5 show that despite changing the comparison group the MID continues to have almost no statistically discernable effect on the probability a home is owner-occupied. The estimated effect of the MID on homeownership is only marginally statistically significant (at the 10% level) in one specification, and in all cases suggests a negative effect on the probability that a home is owner occupied. The sign and lack of statistical significance for the effect of the MID on home ownership using the alternative comparison groups matches the estimates using the full sample of homes.

6.4. Instrumental variables results

The strong link between the MID and size of home and non-existent link between the MID and home ownership is robust to using different comparison groups to create a counterfactual for what housing would look like in the absence of the policy. Two remaining

concerns – omitted variables bias, and policy endogeneity – can both be addressed using instrumental variables estimation.[18] One could make the argument that residents who have a strong preference for consuming housing are more likely to lobby state governments to allow a state level MID. If this is the case, then it is large homes causing the state MID – a classic policy endogeneity.

An instrument in this case requires a variable correlated with a state allowing a deduction for mortgage interest, but only correlated with home size through its correlation with state MID policy. An instrument that plausibly meets these criteria is whether the state uses the federal definition of itemized deductions, thus passively allowing the MID.[19] Using the federal definition of itemized deductions is arguably uncorrelated with many of the potential sources of omitted variable bias and reverse causality between the MID and home size because it implies that the residents of the state did not actively lobby to get a MID. States that take the federal definition of itemized deductions allow all federal deductions, not just the MID, so it is unlikely that having this policy is strongly correlated with resident preferences for housing consumption. States still actively choose to allow the federal definition of itemized deductions but this would most likely be the result of influence from a number of beneficiaries of such a decision as there are a variety of itemized deductions including for medical and dental expenses, state and local taxes, gifts to charity, and business expenses incurred.

The second criterion for an instrument, being correlated with having a state MID, is an empirical question to be answered by the first stage regression results. As shown in Table 6, using the federal definition of itemized deductions is strongly correlated with having a state MID. This correlation exists when controlling for other variables, regional dummy variables, year-of-move dummy variables, and clustering standard errors at the state level. For all specifications, the instrument F-statistic is above 150, far greater than the typical accepted value of 10, and in all cases the *p*-value for this statistic shows it is significant at less than the 1% level.[20]

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Table 6. First Stage IV results: instrument for MID with states that use federal definition of itemized deductions.

	(1)	(2)	(3)	(4)
Federal definition of itemized deductions	0.8922***	0.8916***	0.8718***	0.8711***
	(0.0674)	(0.0675)	(0 .0110)	(0.0714)
Instrument *F*-test	175.37	174.45	150.47	148.9
	[0.0000]	[0.0000]	[0.0000]	[0.0000]
Includes other control variables	No	No	Yes	Yes
Census region dummies	Yes	Yes	Yes	Yes
Year of move-in dummies	No	Yes	No	Yes
Observations	2251	2251	1434	1434

Standard errors clustered at the state level in parentheses.
***$p < 0.01$.

Table 7 presents the 2nd stage instrumental variables results estimating the effect of the MID on home size and ownership using states that take the federal definition of itemized deductions as an instrument for the MID. Columns (1) through (4) show the results using instrumental variables are quite similar to the primary results and the results using alternative comparison groups. The instrumental variables results suggest the MID is responsible for home size increasing by between 221 and 348 square feet, or between 11.7% and 18.4% at the sample mean. The IV results using all control variables are significant at the 5% level; however, the results using no control variables are only significant at the 10% level. The results estimating the effect of the MID on homeownership again show no statistically significant relationship, with negative point estimates as in the primary results.

Table 7. The effect of the MID on home size and home ownership: instrumental variables estimates (standard errors clustered at the state level in parenthesis).

	Home size				**Home ownership**			
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
MID available	232.3*	221.9*	335.8**	348.6**	−0.0394	−0.0584	−0.0170	−0.0277
	(119.4)	(118.0)	(152.9)	(151.2)	(0.0381)	(0.0346)	(0.0248)	(0.0224)
Top MTR	−21.64	−19.66	−26.96	−27.58	−0.00323	−0.000506	−0.000774	0.000374

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	Home size				Home ownership			
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
	(19.00)	(18.69)	(22.50)	(22.67)	(0.00608)	(0.00503)	(0.00339)	(0.00286)
Age of housing unit (years)			−34.31***	−34.74***			−0.00703***	−0.00661***
			(7.971)	(7.817)			(0.00114)	(0.00109)
Age of housing unit squared (years)			0.283***	0.288***			4.21e−05***	3.95e−05***
			(0.0781)	(0.0767)			(1.07e−05)	(1.02e−05)
Single family home			726.3***	729.3***			0.482***	0.458***
			(118.1)	(119.4)			(0.0207)	(0.0218)
Annual maintenance costs			−120.2***	−123.3***				
			(42.83)	(42.04)				
Purchase price per sq. ft. (thousands)			−614.5**	−644.0**				
			(244.9)	(250.7)				
Head of household age			46.26*	50.97**			0.00902***	0.00555**
			(24.85)	(23.60)			(0.00246)	(0.00235)
Age squared			−0.382	−0.432			−7.02e−05***	−4.41e−05***
			(0.292)	(0.276)			(2.42e−05)	(2.33e−05)
Non-white head of household			−143.7	−135.4			−0.0651***	−0.0625***
			(87.83)	(87.27)			(0.0148)	(0.0139)
Annual household income (thousands)			4.272***	4.258***			0.00127***	0.00121***
			(0.608)	(0.605)			(0.000105)	(9.62e−05)
Home in central city			−213.9***	−215.9***			−0.0389**	−0.0381**
			(66.47)	(65.21)			(0.0145)	(0.0142)
Mortgage interest rate			−0.743	−10.16				
			(21.82)	(23.58)				
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year of move dummies	No	Yes	No	Yes	No	Yes	No	Yes
Observations	2251	2251	1434	1434	6353	6353	6190	6190
R-squared	0.003	0.006	0.199	0.202	0.003	0.093	0.392	0.418

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***Notes**:* Results are from estimates using the 2007 American Housing Survey National Sample for households moving into homes from 2003 to 2007.
The omitted region in all regressions controlling for regions is Northeast, the omitted year in all regressions controlling for year of move is 2003.
Size of home is measured in square feet and includes only owner occupied properties.
Ownership estimates cannot control for price, interest rate, or maintenance costs as these are only available for owners.
$***p < 0.01$. $**p < 0.05$. $*p < 0.1$.

6.5. Accounting for sample selection

One remaining concern with the primary estimates using the AHS sample is that I can only identify MID status for homes that are located in an SMSA with a population greater than 100,000, thus any homes in more rural areas and small SMSAs are excluded from the estimation. I start with the sample of 16,785 homes where the occupant moved in during the 2003–2007 period to match the MID availability data. From this sample, 7,398 include SMSA information. Of the 7,398 potential usable homes in the sample about another 800–1000 are missing data on at least one explanatory variable, size, or ownership status and do not appear in all regressions. A potential problem highlighted by the select sample is that it is made up of only about 35% home owners.[21] This section explores using sample selection techniques to deal with any bias that using a smaller sample of homeowners that reside in relatively larger SMSAs may cause in the primary estimates.

The vast majority of sample selection comes from excluding information on the SMSA, which can be considered as a classic problem of sample selection based on an exogenous explanatory variable, detailed in Wooldridge (2002) and first explained by Heckman (1979). To account of this type of selection, I first estimate the selection equation to explain SMSA status. The selection equation is a probit of the following form:

$$\gamma = e^{\alpha} + \beta_1(\text{Floors}) + X\beta + Z \tag{5}$$

where Y is equal to one when SMSA information is known, and zero otherwise, X represents all control variables from the home size

equations including: unit age (squared), single family status, household head age (squared), non-white household head, household income, and central city status. In addition, the exogenous variable "Floors" is the height of the building the housing unit resides in measured by the number of floors. Floors is used as an exogenous variable to explain SMSA status, and is excluded from primary estimation. Although using building height is not randomly assigned, it meets the condition of being correlated with SMSA status, and is arguably orthogonal to anything unobservable in the ownership or size regressions. I use the coefficients from Eq. (5) to create predicted probabilities that a home is in the sample, also known as the inverse Mills ratio. These predicted probabilities, λ, are then used in the primary estimating equation to control for sample selection. The estimating equation with the selection correction becomes:

$$\gamma_i = \alpha + \beta_1(\text{MID})_i + \beta_2(\text{Top MTR})_i + \beta_3(\lambda) + \mathrm{Z}_i'\gamma + \varepsilon_i \tag{6}$$

Table 8 shows the results of estimating Eq. (6), both with OLS and also treating MID as endogenous and using IV. These results again confirm what the previous estimation techniques showed – the MID is associated with larger homes in a statistically meaningful way, but is not related to homeownership rates. The magnitude of the selection corrected estimates is in the middle of the OLS and IV estimates, and suggests the MID is responsible for increasing home size by between 273 and 314 square feet, or between 14.5% and 16.6% at the sample mean.

Table 8. The effect of the MID on home size and home ownership: sample selection corrected estimates (standard errors clustered at the state level in parenthesis).

	Home size				**Home ownership**			
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
MID Available	273.1**	299.8**	280.5**	314.7*	−0.00621	−0.0176	−0.0197	−0.0278
	(110.9)	(139.6)	(124.5)	(156.0)	(0.0227)	(0.0193)	(0.0239)	(0.0221)
Top MTR	−19.65	−24.29	−23.80	−22.97	−0.00462	−0.000164	−0.00358	0.000386
	(17.44)	(20.82)	(19.84)	(23.16)	(0.00410)	(0.00281)	(0.00429)	(0.00284)
Sample selection parameter	−804.4**	8,610***	−792.9**	4,970***	−0.496***	0.377	−0.505***	0.0144

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	Home size				Home ownership			
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
	(303.0)	(2,545)	(313.3)	(1,550)	(0.0510)	(0.363)	(0.0476)	(0.0826)
Age of housing unit (years)		−182.5***		−120.6***		−0.0127**		−0.00685***
		(45.64)		(23.94)		(0.00579)		(0.00197)
Age of housing unit squared (years)		1.627***		1.069***		9.50e−05*		4.17e−05**
		(0.409)		(0.210)		(5.18e−05)		(1.85e−05)
Single family home		1,895***		1,441***		0.512***		0.460***
		(345.6)		(158.9)		(0.0541)		(0.0236)
Annual maintenance costs per sq. ft.		−119.0***		−117.6**				
		(42.19)		(43.91)				
Purchase price per sq. ft. (thousands)		−654.4**		−709.1**				
		(252.7)		(259.1)				
Head of household age		19.20		30.74		0.00407**		0.00550**
		(20.66)		(25.07)		(0.00198)		(0.00240)
Age squared		−0.0440		−0.184		−2.64e−05		−4.36e−05*
		(0.249)		(0.303)		(1.89e−05)		(2.38e−05)
Non-white head of household		−593.9***		−387.5***		−0.0844***		−0.0632***
		(174.8)		(126.6)		(0.0191)		(0.0140)
Annual household income (thousands)		−1.988		0.780		0.000953***		0.00120***
		(1.737)		(1.252)		(0.000323)		(9.93e−05)
Home in central city		−3.554***		−2.130***		−0.182		−0.0437
		(998.8)		(593.0)		(0.140)		(0.0371)
Mortgage interest rate		−10.66		−3.977				
		(21.69)		(21.71)				
Region dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year of move dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	2284	1480	2223	1434	6363	6363	6190	6190
R-squared	0.017	0.213	0.016	0.214	0.143	0.419	0.146	0.418

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Results are from estimates using the 2007 American Housing Survey National Sample for households moving into homes from 2003 to 2007.
The omitted region in all regressions controlling for regions is Northeast, the omitted year in all regressions controlling for year of move is 2003.
Size of home is measured in square feet and these results include only owner occupied properties.
Ownership estimates cannot control for price, interest rate, or maintenance costs as these are only available for owners.
The sample selection variable is the predicted probability that a home is in an SMSA using the age, single family status, head of household, race of household head, income, and central city status as explanatory variables, estimated using the full AHS sample. This equation uses building height of the residence measured in floors as the exogenous variation in selection. Columns (3), (4), (7), and (8) treat MID as endogenous and estimate with instrumental variables, while (1), (2), (5), and (6) estimate with OLS.
$^{***}p < 0.01$.
$^{**}p < 0.05$.
$^{*}p < 0.1$.

7. Conclusion

This paper uses differences in state level policy to estimate the effect of mortgage interest deductibility on homeownership and size of home purchased. Empirical estimates suggest the MID is responsible for a 10.9–18.4% increase in the size of home purchased, but that it is not correlated with home ownership. The size of these point estimates depend on the comparison group and estimation technique.

The size of the estimates suggests that a state level MID induces about an additional 300 square feet of housing purchase, or about an average size room for owner occupied homes in the American Housing Survey. Applying the user cost model of housing to a state with the median top marginal income tax rate, the MID reduces annual user cost of homeownership by about 11%.[22] The user cost figure implies an elasticity of housing purchase on the intensive margin of between −1 and −1.4 using the OLS point estimates, so that an increase in user cost by 1% reduces housing purchase on the intensive margin by between 1% and 1.4%.

Although the results presented here generally suggest no meaningful relationship between the MID and homeownership, the OLS and IV point estimates are negative, and the RD point estimates are negative and in many cases statistically meaningful. One possible

explanation for a negative relationship between the MID and homeownership rates is that the MID drives up home prices for everyone, while a much smaller number actually claim the deduction and receive the subsidy (only about one third of tax filers claim the MID). Susin (2002) proposes a similar story for the Section 8 housing voucher subsidy, finding that subsidized renters driving up prices hurt renters who do not receive the subsidy.

These findings offer empirical evidence that the tax treatment of owner-occupied housing increases the amount of housing consumption along a similar magnitude as the parameterized theoretical models of Mills, 1987 and Poterba, 1992. The empirical evidence presented here suggests the MID causes increased consumption of housing on the intensive (larger home) rather than extensive (more home owners) margin.

Acknowledgments

I would like to thank Geoffrey Turnbull and Zach Richards for helpful discussion and comments. Also like to thank Mike Walsh at the Maryland Comptroller's Office and Sandra Mueller at the Maryland Department of Legislative Services for assistance with Maryland's Historical Tax Code and administrators at the Pennsylvania department of revenue for assistance with historical tax laws in that state.

Appendix A. Sample size by SMSA used in regressions

SMSA	Ownership regressions	Home size regressions
Akron, OH**u**	23	7
Albany, NY	25	8
Albuquerque, NM	35	11
Allentown, PA	28	6
Alton, IL	3	0
Anaheim, CA	130	42
Appleton, WI	9	2
Atlanta, GA	143	39
Atlantic City, NJ	3	3
Aurora, IL	17	9
Austin, TX	64	19
Bakersfield, CA	30	18
Baltimore, MD	105	44
Baton Rouge, LA	22	8

SMSA	Ownership regressions	Home size regressions
Beaumont, TX	6	4
Beaver, PA	5	3
Bergen, NJ	48	19
Birmingham, AL	36	14
Boston, MA	133	55
Boulder, CO	16	4
Bridgeport, CT	18	9
Canton, OH	17	7
Charleston, SC	12	3
Chicago, IL	305	101
Cleveland, OH	69	21
Colorado Springs, CO	24	9
Columbia, SC	19	6
Columbus, OH	85	28
Corpus Christi, TX	19	5
Dallas, TX	172	46
Daytona Beach, FL	4	1
Denver, CO	51	17
Des Moines, IA	15	7
Detroit, MI	175	80
East Saint Louis, IL	5	0
El Paso, TX	33	17
Erie, PA	3	0
Eugene, OR	11	1
Flint, MI	14	5
Fort Lauderdale, FL	92	37
Fort Myers, FL	4	1
Fort Wayne, IN	12	5
Fort Worth, TX	89	36
Fresno, CA	29	8
Gary, IN	21	7
Grand Rapids, MI	28	11
Greensboro, NC	33	10
Greenville, SC	12	6
Hartford, CT	11	1
Honolulu, HI	27	11
Houston, TX	170	50
Indianapolis, IN	69	22
Jackson, MS	11	4
Jacksonville, FL	55	21
Jersey City, NJ	36	4
Knoxville, TN	25	7

SMSA	Ownership regressions	Home size regressions
Lake County, IL	25	15
Lakeland, FL	7	4
Lancaster, PA	7	4
Lansing, MI	7	2
Las Vegas, NV	75	31
Lexington, KY	28	7
Little Rock, AK	20	10
Los Angeles, CA	415	108
Madison, WI	19	6
McAllen, TX	21	6
Melbourne, FL	12	4
Miami, FL	113	39
Middlesex, NJ	35	17
Milwaukee, WI	72	27
Minneapolis, MN	122	47
Mobile, AL	11	2
Modesto, CA	13	4
Monmouth, NJ	24	12
Montgomery, AL	8	3
Nashville, TN	53	16
Nassau-Suffolk, NY	74	46
New Haven, CT	19	9
New Orleans, LA	46	14
New York, NY	450	100
Newark, NJ	83	24
Oakland, CA	119	49
Oklahoma City, OK	72	23
Orlando, FL	61	26
Oxnard, CA	29	11
Pensacola, FL	8	2
Peoria, IL	14	3
Phoenix, AZ	182	94
Pittsburgh, PA	77	26
Providence, RI	26	9
Raleigh, NC	50	16
Riverside, CA	88	34
Rochester, NY	38	14
Rockford, IL	5	3
Sacramento, CA	89	28
Salem, MA	8	4
Salinas, CA	12	3
Salt Lake City, UT	70	30

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SMSA	Ownership regressions	Home size regressions
San Antonio, TX	64	14
San Diego, CA	157	54
San Francisco, CA	91	26
San Jose, CA	86	30
Santa Barbara, CA	14	3
Santa Rosa, CA	15	5
Sarasota, FL	6	5
Scranton, PA	16	5
Seattle, WA	108	42
Shreveport, LA	10	7
Spokane, WA	17	9
Springfield, MA	29	6
Stamford, CT	10	4
Stockton, CA	26	8
Syracuse, NY	18	2
Tacoma, WA	34	10
Tampa, FL	94	39
Toledo, OH	26	9
Trenton, NJ	7	4
Tucson, AZ	44	15
Tulsa, OK	29	5
Utica, NY	3	1
Vallejo, CA	15	9
Waterbury, CT	6	3
West Palm Beach, FL	45	22
Wichita, KS	23	7
Worcester, MA	8	6
Youngstown, OH	15	7
Chicago Areas (Joliet, Lake)	49	38
New York Areas (Nassau, Suffolk, New York)	23	16
Northern New Jersey	80	53

***Notes**:* Sample counts are from 2007 American Housing Survey for households moving into homes from 2003 to 2007. Counts for units in ownership regressions include all units in the sample where MID is identified by matching the SMSA to a state. Counts for units in size regressions include all units in the sample where MID is identified by matching the SMSA to a state and the unit is owner occupied. The sample excludes the following multi-state SMSAs: Augusta, GA-SC, Chattanooga, TN-GA, Cincinnati, OH-KY-IN, Davenport-Rock Island-Moline, IA-IL, Duluth, MN-WI, Johnson City-Kingsport-Bristol, TN-VA, Kansas City, KS-MO, Lawrence-Haverhill, MA-NH, Memphis, TN-AR, MS, Norfolk-Virginia Beach, VA-NC, Omaha, NE-IA, Philadelphia, PA-NJ, Saint Louis, MO-IL, Washington, DC-MD-VA.

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[1]Critics also point out that because the value of the MID increases with a taxpayers marginal tax rate (and thus income), the MID creates a larger subsidy to those who are less likely to be on the margin between owning and renting a home. Another criticism of the MID is that it contributes to urban sprawl, Voith and Gyourko (2002) present a theoretical model showing that under reasonable conditions the MID causes relatively wealthy households to locate further from the city center while keeping the poor closer to the urban core.

[2]These models include both the MID and deduction for property taxes paid. The primary reason the MID is considered a subsidy is because the imputed rental value of housing is not considered income (and taxed).

[3]Poterba (1992) offers a range of estimates between 12% and 23% that vary based on the income (tax bracket) of taxpayers for the federal tax system after the Tax Reform Act of 1986. Mills (1987) offers a point estimate of 24% based on the entire US capital stock of housing.

[4]Empirical evidence on whether the MID causes additional housing purchase focuses on the decision to own or rent, and the demand for mortgage debt.

[5]The focus of this analysis is on the mortgage interest deduction, for a study (and references to previous studies) that focuses on a broader range of economic and demographic determinants of home ownership see Coulson (2002).

[6]See Rosen (1985) and Smith et al. (1986) for a review of the early literature on the link between homeownership and the MID.

[7]Only one state, Louisiana, changes MID policy in the years of my sample. The small number of observations (68) available in the AHS for this state makes using a difference-in-difference estimation technique unattractive.

[8]A similar issue arises when choosing the control variables to use in estimating the relationship between the MID and home purchase decisions. Many attractive control variables are correlated with choosing to claim the MID. Of particular concern is an individual's marginal tax rate. I adopt the strategy of using a proxy (the top marginal tax rate in the state), outlined in Angrist and Pischke (2009), to avoid undue bias on the coefficient of interest.

[9]As an alternative to Eq. (2), I tried a specification that interacts the MID indicator and the Top MTR variable. This interaction term represents the combined negative income effect of a higher tax burden and the positive price effect of making housing relatively cheaper. In these regressions, the negative income effect dominates and the coefficient on the interaction term is negative. This says that on the margin, the tax rate that applies to the deduction is not as important as the presence of the deduction.

[10]Negative bias would result if housing is a normal good, as lower after tax income would reduce demand for housing and having an MID is positively correlated with an income tax.

[11]Although the Mason-Dixon Line is famous for marking the division between northern and southern states in the American Civil War, it was originally surveyed between 1763 and 1784 to settle a property rights dispute between two prominent land owners, the Calverts of Maryland and the Penns of Pennsylvania (Danson, 2001).

[12]According to personal conversations with administrators at the Pennsylvania Department of Revenue, taxpayers may have believed a deduction for mortgage interest existed for a brief time in 1971, although it never actually did. This is because the original Pennsylvania income tax intended to use federal taxable income as a base (and thus allow all federal deductions). The Pennsylvania Supreme Court over-turned this idea in the *Amidon v. Kane* decision for being in violation of the uniformity clause in the state constitution by creating different effective

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rates for taxpayers with equal gross incomes. After the tax was passed in March, 1971 but before the *Amidon v. Kane* decision was final in August, 1971 taxpayers may have erroneously believed an MID would be available.

[13]Under the original income tax law, Maryland explicitly allowed the deduction of any interest paid during the tax year (Article 81, § 244 of the Annotated Code of Maryland of 1939–1980), Maryland State Tax Form 502: 1980–2007). In 1967, Maryland changed their tax code to allow taxpayers to take all federal deductions at the state level, excluding those for state and local taxes (Article 81, § 281 of the Annotated Code of Maryland of 1967).

[14]State's prior year tax forms are typically available through the state treasury or department of revenue websites. Some states post state tax forms going back decades, while others only post the previous few years.

[15]As a robustness check, I do a separate analysis that includes the multi-state SMSA's where the presence of the MID is consistent across states in the SMSA. For example, both Iowa and Nebraska have a state MID, so Omaha would be included in the robustness check and coded to have a MID, but Georgia has an MID and Tennessee does not so Chattanooga would be left out of the robustness check. For this robustness check, I code the state marginal tax rate according to the top rate in the state where the majority of SMSA residents live, even though state tax rates vary widely. The magnitude of the point estimates shown here is somewhat sensitive to including these additional SMSAs in the analysis, with the coefficient on the MID variable suggesting home size increases by about 15% less than the primary results; however in no case can I reject the null hypothesis that the point estimates in this sample are equal to the primary results.

[16]To see if the large standard errors in these estimates are driven by a heterogeneous impact of the MID on home ownership across groups that are more or less likely to be on the margin between owning and renting I estimated (2) separately by age and race groups. These estimates show the same negative and statistically insignificant relationship as the full sample.

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[17]I would like to thank a particularly helpful referee for pointing out that because the MID has been in place for a long time without changes in most states, it is likely that the size of all homes has been optimized with respect to this large tax incentive, so finding an effect on all homes is meaningful.

[18]Results of a Hausman (1978) test do not indicate a concern for endogeneity in any of the primary regressions. This test shows that the predicted error term from a regression explaining MID availability is not statistically different than zero in a regression explaining either the square footage of a housing unit or owner occupancy. This is true when regressions use either no controls or the full set of controls described as matrix *Z*. Given that the Hausman test is typically seen as a weak test because the null hypothesis is that the predicted error term is zero (no endogeneity exists), it seems reasonable to proceed with IV estimation as a precaution.

[19]Specifically, I use whether the state starts with the federal definition of itemized deductions to calculate state itemized deductions. Most states that start with the federal definition of itemized deductions allow taxpayers to use all federal itemized deductions except state and local taxes paid. Some states add on other itemized deductions that are not allowed at the federal level.

[20]The instrument also performs well against more rigorous testing using the ivreg2 command in Stata. These tests suggest that the correlation between the instrument and MID availability is strong enough to be relevant (the under-identification test) and strong enough not to cause severe bias (the weak-identification test).

[21]In the fourth quarter of 2011, the US homeownership rate was 66% according to the US Census Current Population Survey/Housing Vacancy Survey.

[22]This figure is for a 6.5% mortgage, for a taxpayer with a 25% marginal federal tax rate, with 1% annual maintenance costs, 1% annual property taxes, and 2.5% net appreciation.

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