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NEW EVIDENCE ON THE EFFECT OF THE TCJA ON THE HOUSING MARKET

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Data provided by Zillow through the Zillow Transaction and Assessment Dataset (ZTRAX). More information on accessing the data can be found at http://www.zillow.com/ztrax. The results and opinions are those of the author(s) and do not reflect the position of Zillow Group.

ABSTRACT

The Tax Cuts and Jobs Act of 2017 (TCJA) dramatically changed tax law. It narrowed the subsidy on mortgage interest in several ways, which should lower mortgages and home prices; it also increased most taxpayers' after-tax incomes, which should have the opposite effect. Thus, the TCJA's overall effect on mortgages and home prices is ambiguous. Existing estimates of how the TCJA affected the housing market use synthetic data, calibrate models to aggregate data, or extrapolate from prior data. Our research is the first empirical estimate of how the TCJA affected mortgages and house prices that uses data on mortgages, house sales, income, and demographics aggregated by Public Use Microdata Area. We use a two-stage approach: first we estimate the effect of the TCJA on mortgages, then we estimate how the demand for mortgages affects house prices. We use the TCJA tax variables as excluded instruments. We find that the reduction in subsidies had a negative, statistically significant effect on mortgages and that the general reduction in taxes had a positive, statistically significant effect on mortgages. We also found that increased mortgages had a positive, statistically significant effect on home prices. However, combining these results, we find that the overall effect of the TCJA on home prices was close to zero, although some variation exists across by location: some areas experienced a positive effect while others experienced a negative effect.

INTRODUCTION

The Tax Cuts and Jobs Act of 2017 (TCJA) dramatically changed tax law. One of the biggest changes enacted in the law was to reduce the tax subsidy for homeownership. Before the law was passed, the Federal Open Market Committee of the Federal Reserve Board warned it could lead to "the possibility of a significant weakening in the housing sector," while the National Association of Realtors told members of Congress that the TCJA would "eviscerate the current-law tax incentives for purchasing and owning a home," leading to "a plunge in home values across America in excess of 10 percent." [1] This is consistent with the existing literature on how subsidies affect the demand for mortgages and housing. Further, three research papers predicted that in equilibrium house prices would fall between 0 and 23 percent (Martin 2018; Rappaport 2019; Sommers and Sullivan 2019).

The TCJA reduced the subsidy for homeownership in several ways. First, it raised the standard deduction from $6,350 to $12,000 for single taxpayers and from $12,700 to $24,000 for married couples filing jointly. Second, it capped the deduction for state and local taxes at $10,000. Because many homeowners pay more than $10,000 in deductible taxes, this reduced the size of itemizeable deductions for most homeowners and further reduced the likelihood of itemizing deductions. As a result, many taxpayers no longer itemize their deductions, effectively forgoing the subsidy for mortgage interest in favor of lower taxes. This should lead to two effects: dropping the subsidy should lower demand for mortgages, while reducing taxes should raise it. Other effects of the TCJA include a lowering of tax rates and a reduction in the maximum mortgage size for which interest can be deducted.

Our research represents the first empirical estimation of how the TCJA affected mortgages and house prices. The law was passed in December 2017 and was fully effective starting in January 2018, so nearly all home purchasers in 2017 were subject to prior law while all purchasers in 2018 and 2019 were subject to the new law.[2] Borrowers in those years should therefore adjust the size of their mortgage to reflect the new tax law, and this should be reflected in the purchase price of homes. We combine data from several sources, including the American Community Survey (ACS), data collected under the Home Mortgage Disclosure Act (HMDA), and Zillow (ZTRAX), which collectively provide data on population characteristics and mortgage and property values before and after the TCJA came into effect in 2018. Because we cannot match individuals across data sources, households are aggregated up to the Public Use Microdata Area (PUMA) level. Previous research on the mortgage interest deduction suggests that it does not encourage homeownership. Consequently, in this study we focus on the intensive margin—the size of mortgages among those purchasing a house—rather than the extensive margin—those deciding whether or not to purchase a house.

Our methodology involves a two-stage approach. In the first stage, we estimate a two-way fixed effect model of the effect of the subsidy rate and federal and state taxes. The subsidy rate for each taxpayer is calculated using a mortgage typical for new mortgages in that PUMA in 2017, and federal and state taxes are calculated with the National Bureau of Economic Research's TAXSIM program assuming that the taxpayer has no mortgage. Subsidy rates and taxes are calculated using tax law for the appropriate year but using 2017 data.

Thus, changes in the subsidy rates and taxes for 2018 and 2019 are caused only by changes in tax law and not by behavioral responses to tax law, interest rates, or the price of housing. In the second stage, we estimate how the change in mortgage size affected house prices, but because home prices and the size of mortgages are likely to be jointly determined, we estimate the effects using two-stage least squares, in which the excluded instruments are the subsidy rates and federal taxes. These instruments are likely to be exogenous because changes in house prices have no effect on federal tax law. Finally, we estimate the effect of the TCJA on the overall growth rate of home prices and the growth rate by census region, looking at regions with high and low prices, high and low incomes, and high and low shares of houseolds that are Asian, Black, or white.

We found a small, yet statistically significant decrease in the size of mortgages from the reduction in use of the subsidy of mortgage interest and a small, statistically significant increase from reducing taxes. We also found that the two effects, one negative and the other positive, roughly offset each other. However, the effects across regions vary somewhat.

The next section briefly describes the TCJA and reviews recent work on its predicted effects on house prices. We then discuss how the TCJA affected house purchase decisions using a simple one-period model. We follow with a section describing our data and the construction of our variables. Next, we describe the results of our analysis, and we finish with a brief conclusion.

THE TAX CUTS AND JOBS ACT AND LITERATURE REVIEW

The TCJA, which was enacted in late 2017 and came into effect in 2018, was the largest overhaul to the federal tax code in decades, and it affected the subsidy to home mortgages in several ways. First and most obviously, the TCJA nearly doubled the standard deduction for each filing status. Because the mortgage interest deduction (MID) is available only to taxpayers who itemize their deductions on their federal tax returns, the tax code only subsidizes home ownership for itemizers. The TCJA therefore also affected home mortgages by altering taxpayers' incentives to itemize. Second, the TCJA introduced a $10,000 cap on itemized deductions for state and local taxes, reducing after-tax income for those living in high-tax states. For those taxpayers who itemized because they deducted more than $10,000 in state and local taxes, it also eliminated the advantage of itemizing, which had the additional effect of removing the subsidy they received for home ownership. Thus, both the higher standard deduction and the state and local tax cap made it more likely that taxpayers take the standard deduction and entirely forgo the mortgage interest deduction's subsidy on homeownership. The TCJA also limited the amount of mortgage interest that can be deducted from taxable income. Interest on the first $1 million of mortgage debt was deductible before the TCJA; under the TCJA, interest on only the first $750,000 is deductible. Finally, the TCJA lowered tax rates for most taxpayers, dampening incentives contained in the tax code (including those on homeownership) but also increasing the after-tax incomes of potential homebuyers.

The share of tax returns itemizing deductions fell from 31 percent in 2017 to 11 percent in 2018, but the declines varied by income group. That inevitably led to similar declines in the use of the MID, as well. Figure 1

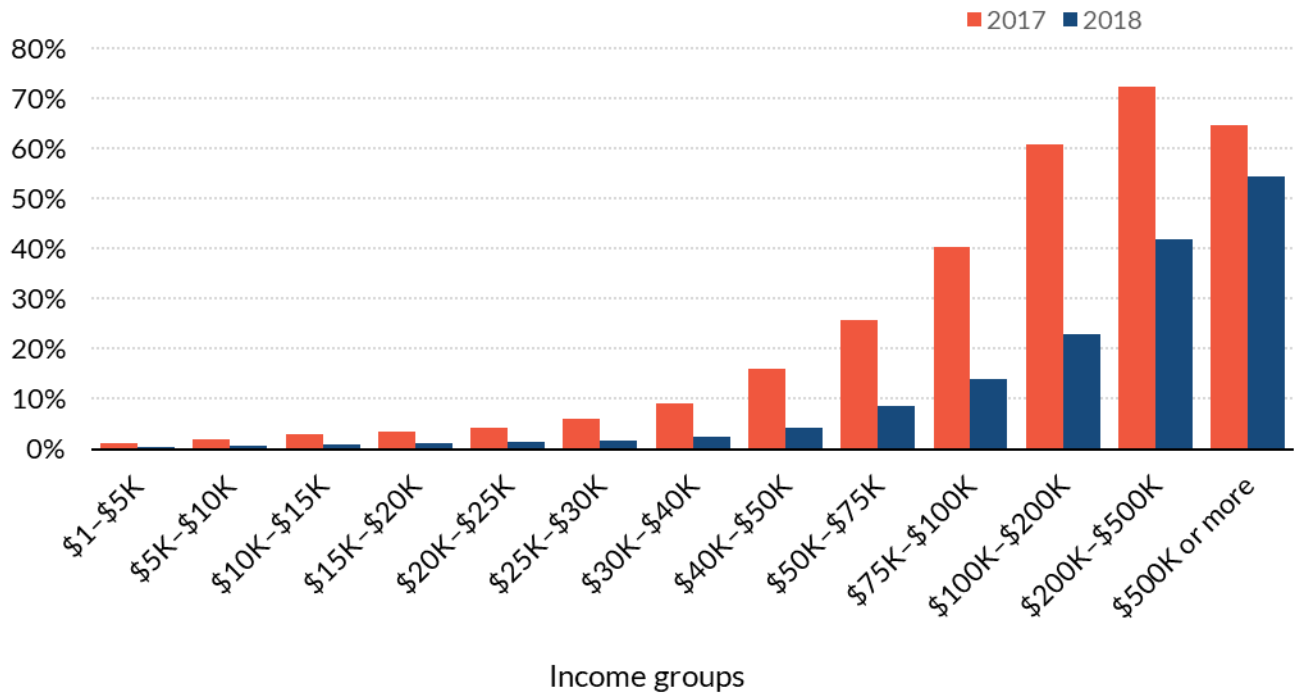
breaks down the change in use of the MID by income groups. Usage of the MID was higher in 2017 for those with higher incomes, up to about the top 99th percentile. In 2017 a small share of taxpayers with low incomes used the deduction; less than 10 percent of those with adjusted gross incomes under $40,000 used it. Tax units with incomes under $40,000 represent slightly less than 50 percent of all tax units (the median adjusted gross income in 2017 was $41,740). Higher incomes used the deduction much more frequently, both because they are more likely to own homes and because they are more likely to itemize their deductions. Usage peaks for those with incomes between $200,000 and $500,000, corresponding roughly to those between the 95th and 99th percentile of incomes ($208,053 and $515,731 respectively, in 2017).

The decline in the share of tax units using the mortgage interest deduction was generally greater for those with larger adjusted gross incomes, up through $200,000, and was much smaller for those with lower incomes. Usage of the deduction by tax units with incomes between $100,000 and $200,000 fell from 61 percent in 2017 down to 23 percent in 2018. The share of tax units with incomes between $30,000 and $40,000 using the mortgage interest deduction fell from 9 percent to 2 percent. Those in the highest income group saw a smaller decline.

Because a larger share of higher-income taxpayers switched the standard deduction, the average size of new mortgages should decline (or at least grow more slowly) in high-income areas than in moderate and low-income areas. Home prices in high-income areas may face more downward pressure (or grow more slowly), although higher-income tax units are more likely to be able to mitigate the loss of the subsidy by making larger down payments.

FIGURE 1

Share of Tax Filers Claiming Mortgage Interest Deduction



Source: SOI Tax Stats, Tables 1.4 and 2.1.

Although several articles estimate how the tax subsidy for mortgage interest influences the housing market, the literature on how the TCJA has affected the housing market is understandably much smaller. Several articles estimate the effect of repealing the MID on the demand and price of housing (Bruce and Holtz-Eakin 1997; Hilber and Turner 2013; Hanson and Martin 2016; Sommer and Sullivan 2018; Gruber, Jensen and Kleven 2021). Several others (e.g., Hilber and Turner 2013; Gale, Gruber, and Stephens-Davidowitz 2007) focus on how the MID affects homeownership decisions.

Using a simulation model, Bruce and Holtz-Eakin (1997) find that reforming the tax code by removing the MID would have only a small effect on home prices. Sommer and Sullivan (2018) use a dynamic simulation model and find that eliminating the MID would only lead to a small decrease in equilibrium housing prices. On the other hand, Hanson and Martin (2016) use a simulation model calibrated with zip code–level data from the SOI and find that removing the MID would in some areas cause price declines in excess of 13 percent. Most recently, Gruber, Jensen and Kleven (2021) use data from a 1987 Danish tax reform that sharply reduced the mortgage interest deduction, and they find that house prices fell about 12 percent.

Gruber and colleagues also found that the sharp drop in the mortgage interest deduction in 1987 had no effect on homeownership. Similarly, using data from the Pandel Study of Income Dynamics, Hilber and Turner (2013) found that the MID had little impact on homeownership outside of high-income areas with loosely

regulated housing markets. In a review of the literature, Gale, Gruber, and Stephens-Davidowitz (2007) conclude that time series evidence suggests that the MID does not affect homeownership.

Three additional papers predicted the effects of the TCJA on home values, with widely varying results. All three estimate the impact of the TCJA by estimating equilibrium home prices before the TCJA and with the TCJA, assuming the law is permanently extended (many provisions of the TCJA are currently set to expire in 2025).

Martin (2018) found that home prices would decline 5.7 percent on average but with wide geographic variation, ranging from a 0 percent to a 23 percent decline. The paper develops a user cost model applied to zip code–level data covering 2011 to 2015 from the ACS, HMDA, the SOI division of the the Internal Revenue Service, and proprietary data from McDash Analytics and Zillow. The model compares long-run equilibrium prices under both the TCJA and prior law, and the author conducts additional experiments in which only some parts of the TCJA are enacted.

Rappoport (2019) points out that some provisions of the TCJA should raise house prices while others should lower them but found that on average, home prices would decline 2 percent. Price declines varied across metropolitan regions and ranged from 0 percent to 7 percent. Using data from SOI, HMDA, and McDash Analytics and cost parameters for homeownership drawn from existing research, Rappoport simulated 2 million tax returns representing 2013 to 2015. To estimate the effect of the TCJA, Rappoport used TAXSIM to apply tax law from 2017 and 2018 to the simulated returns and compared prices in the two equilibriums.

Sommer and Sullivan (2019) found that the TCJA did not substantially change house prices, but it did disproportionately accrue welfare gains to the wealthy. The authors use the heterogeneous agent equilibrium model from their previous work (Sommer and Sullivan 2018), calibrating their model with some parameters chosen from the literature and others calibrated from aggregate data. They conduct two experiments. In the first, only those provisions affecting deductions are set at their TCJA levels, and they find that demand for houses would fall for those who no longer itemize under the TCJA, reducing prices. In the second experiment, they applied all provisions of the TCJA and found that the cut in tax rates increased the demand for housing, especially for wealthier households, raising house prices almost up to their pre-TCJA level.

MODEL

The overall theoretical effect of the TCJA on mortgages and prices of newly purchased homes is ambiguous. On the one hand, raising the standard deduction and lowering tax rates raised the after-tax income of some taxpayers, allowing these homebuyers to take on larger mortgage payments. On the other hand, several provisions reduced the tax subsidy for mortgage interest. Here we graphically describe the changes induced by the TCJA using a simple one-period model of consumer demand. Because the existing empirical literature

suggests that the MID does not affect homeownership decisions, our description assumes that consumers are purchasing a home.

In this model of home purchasers, consumers choose the size of a mortgage M and consumption C to maximize

$$U(H, C)$$

subject to

$$H = M + S$$

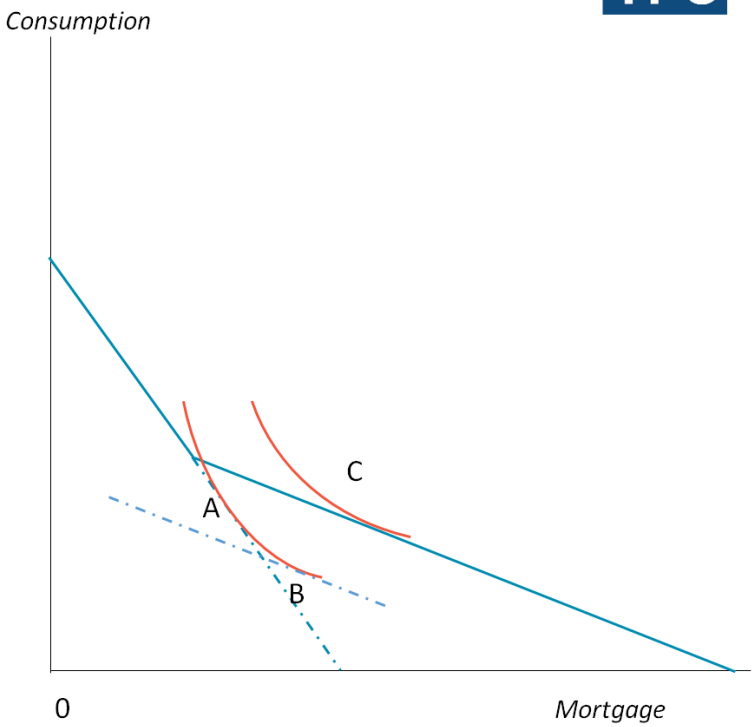
$$C + (1 + r)M = Y - T(Y, M)$$

where U is a standard utility function that depends on housing H and consumption C. Housing is purchased with a mortgage and savings S dedicated to that purpose. Borrowing money incurs interest r, so the total cost of the mortgage is $(1 + r)M$. Consumption plus the cost of the mortgage equals after-tax income, which is pretax income Y minus a tax function that depends on income and the mortgage. This tax function can contain all of the parameters changed by the TCJA, including itemized deductions and a standard deduction, tax rates, a cap on the deduction for state and local taxes, and a cap on the size of mortgages for which interest may be deducted. Throughout this analysis, we assume that housing services are a normal good, so a lump sum decrease in taxes will increase the size of the optimal mortgage.

If the tax function only has a standard deduction and taxes increase continuously with income, it is straightforward to show that changing the tax function to allow taxpayers to deduct mortgage interest

FIGURE 2

Tax Subsidy for Mortgage Interest



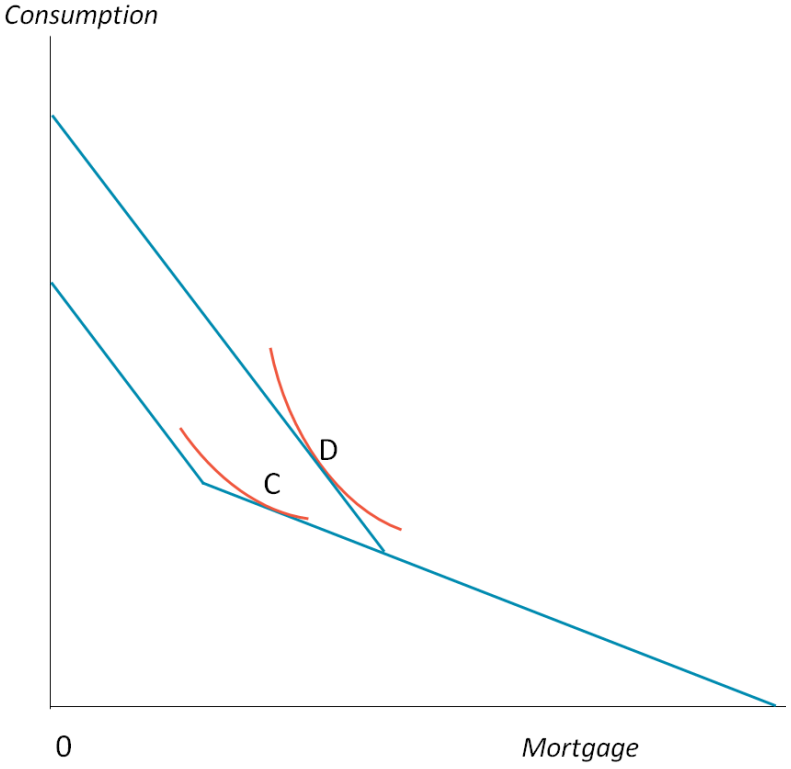
payments can increase the size of the optimal mortgage. Assume the tax function is $T(Y, M) = T(Z)$, where Z is taxable income equal to $Y - SD$ and SD is a standard deduction. An example of the optimal bundle of consumption and mortgage is defined as point A in figure 2. At the optimum mortgage $\boldsymbol{M}$, the marginal rate of substitution between consumption and mortgage is equal to the slope of the budget constraint, $-(1 + r)$.[3] If taxpayers can itemize their deductions, taxable income becomes $Y - \max(SD, rM)$. If $r\boldsymbol{M} > SD$, or equivalently $\boldsymbol{M} > SD/r$, itemizing mortgage interest decreases the price of obtaining a mortgage. Typically a price decrease would cause the budget constraint to rotate out around the point in which $M=0$, but here the budget constraint rotates around the point at which $M=SD/r$. Points B and C in figure 2 break down the change in optimal mortgage size in response to the price decrease; the change from A to B is the substitution effect, and the change from B to C is the income effect.

The move from point A to point B reduces the marginal rate of substitution to $-(1 + r(1 - dT/dZ))$, increasing the mortgage. If there is a single tax rate τ, as in figure 2, this becomes $-\big(1 + r(1 - \tau)\big)$. Because housing services are a normal good, an outward shift of the budget constraint also increases the optimal mortgage.

By raising the standard deduction, the TCJA effectively eliminated the subsidy for mortgage interest payments for many taxpayers, yet it may have led to either increases or decreases in the size of new mortgages. Taxpayers taking the standard deduction under prior law minimize their taxes by continuing to do so under the

FIGURE 3

Effect of Increased Standard Deduction



TCJA, although the increased standard deduction will lead to larger optimal mortgages. But some taxpayers who purchase a mortgage and itemize prior to the TCJA (point C in figure 3) will choose to take the standard deduction under the higher standard deduction SD^*. The leftward kink in the budget constraint represents, as in figure 2, the point at which $M=SD/r$. The new, rightward kink represents the point at which $M=SD^*/r$. Taxpayers who itemize for values of $M<SD^*/r$ will take the standard deduction when it is raised to SD^*, as exemplified by point D in figure 3. In this case, there are two effects. As the slope of the budget constraint rises to $-(1+r)$, the incentive to obtain a large mortgage falls. However, after-tax income increases from $Y-rM$ to $Y-SD^*$, which increases the size of the optimal mortgage. In the example in figure 3, the income effect exceeds the substitution effect, in which case the optimal mortgage is larger than before the TCJA. However, it is also possible for the substitution effect to exceed the income effect, in which case the TCJA reduces the optimal mortgage. Although this holds for mortgages such that $M<SD^*/r$, it also holds for some homebuyers for whom $M\geq SD^*/r$. In figure 4, the homebuyer is indifferent between itemizing and taking the standard deduction SD^*, but otherwise-identical homebuyers who choose a slightly smaller mortgage will itemize under pre-TCJA law and take the standard deduction under the TCJA.

(Those homebuyers could be those with more savings and thus in need of smaller mortgages to purchase the same amount of housing).

FIGURE 4

Taxpayer Indifferent to Itemization Status

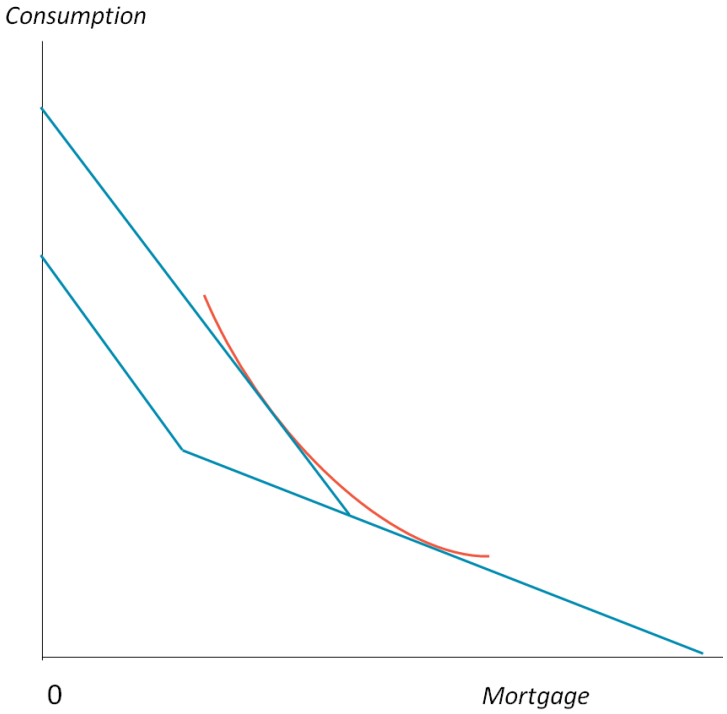
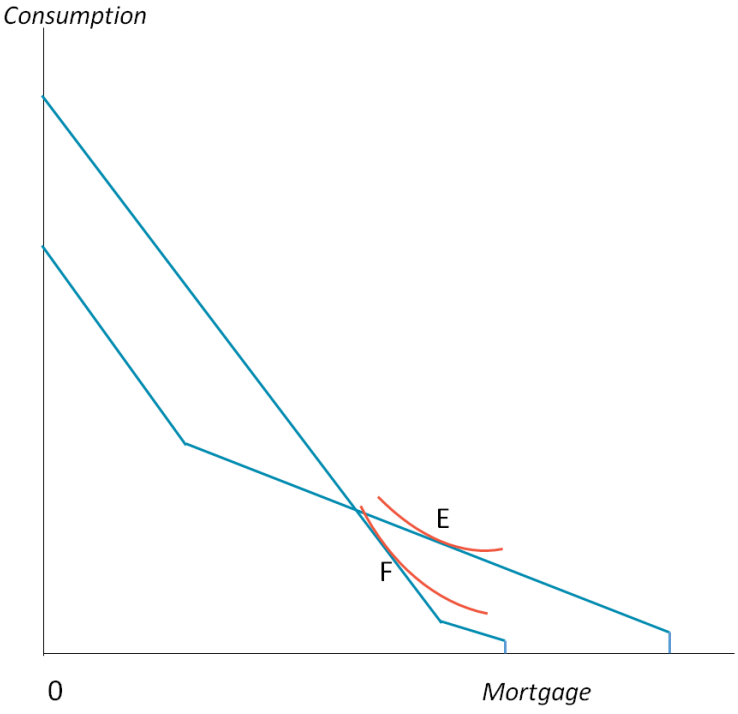


FIGURE 5

SALT Cap Reduces Income for Some Taxpayers



The TCJA also changed the size of the optimal mortgage in other ways. Figure 5 includes the effects of limiting the deduction on state and local taxes to $10,000, shown as a downward shift in the righthand segment of the budget constraint. This is a negative income effect that unambiguously lowers the size of the optimal mortgage. As shown in the movement from point E to point F, the state and local tax cap also induced some homebuyers to use the standard deduction, further reducing the size of the optimal mortgage. Figure 5 also shows the reduction from $1 million to $750 thousand on the size of mortgages for which interest may be deducted. Lastly, most taxpayers experienced a decrease in tax rates, which also reduced the subsidy for mortgage interest.

DATA

The analysis in this report uses data from several sources. To calculate the tax subsidy of mortgages and obtain characteristics of the general population, we use data from the American Community Survey (ACS). For information on mortgages taken out for the purchase of homes, we use data published by the Federal Financial Institutions Examinations Council under the Home Mortgage Disclosure Act, commonly known as HMDA data. For information on the sale price of new homes, we use data provided by Zillow through the ZTRAX. Summary statistics are in table 1.

TABLE 1

Summary Statistics

Variable	2017		Change from 2017 to 2018		Change from 2017 to 2019	
	Mean	Standard deviation	Mean	Standard deviation	Mean	Standard deviation
Home price	256,672	230,225	14,183	84,334	19,508	69,528
Mortgage	247,747	147,805	11,933	16,423	22,824	19,498
Subsidy rate	0.148	0.109	-0.107	0.064	-0.107	0.065
Federal taxes	11,757	10,083	-1,423	713	-910	517
Interest rate	4.09	0.12	0.61	0.06	0.14	0.06
Median income	64,302	25,708	2,361	6,734	5,913	7,418
Share of households that can afford						
25th percentile of mortgages	67%	15%	-3%	4%	-1%	4%
50th percentile of mortgages	57%	15%	-3%	4%	-1%	4%
75th percentile of mortgages	46%	15%	-3%	4%	-1%	4%
95th percentile of mortgages	29%	12%	-3%	4%	-1%	4%
Share of households headed by someone over 65 years of age	16%	5%	0%	1%	1%	1%
Share of households headed by someone under 30 years of age	40%	5%	0%	2%	-1%	2%
Share Asian	6%	8%	0%	1%	0%	2%
Share Black	12%	16%	0%	2%	0%	2%
Share white	73%	20%	0%	3%	0%	4%

Source: 2017 – 2019 data drawn from ACS, HMDA and Zillow, author calculations.

Because we cannot match data on individual households across surveys, we aggregate data on individual households within geographic areas and combine the surveys at that level. In our analysis, we aggregate all data to the PUMA level, which are geographic areas defined by states using the decennial census and guidelines issued by the US Census Bureau; for example, each area must contain at least 100,000 people. There are 2,351

total PUMAs in the United States. We removed PUMAs from three states in which itemization status on federal and state returns could be selected independently but in which TAXSIM required an identical choice. Prices were missing for 12 PUMAs in 2017, 33 PUMAs in 2018, and 345 in 2019, reducing the number of PUMAs in the associated regressions. We also removed 41 PUMAs in 2019 that appeared to have price changes from 40 percent up to 413 percent, likely because of incomplete reporting.[3]

Using HMDA data, we calculate the median size (measured in logs) and number of new mortgages, income, and several measures of affordability. Under HMDA, banks and other lending institutions are required to submit data on each loan application they process. HMDA records used in our analysis include originated, first-lien home purchase loans on owner-occupied, one- to four-family primary residences (not including manufactured housing). Areas with a small number of affordable homes may experience greater increases in mortgage sizes and home values than other areas. To account for this, we calculate the 25th, 50th, 75th, and 95th percentile of mortgages for each PUMA in each year and then calculate the share of households that can afford these mortgages, as defined below.

HMDA records provide information on the size of loans that homebuyers procure to finance their purchases, but they do not indicate the value of these purchases. We obtain sale price data using ZTRAX. The dataset contains property assessment records sourced from county offices matched with any legal transaction records (i.e., Deeds, mortgages, and foreclosures) associated with the property. For our analysis, we include only records for the arms-length sale of first-lien, first-home residential properties in the years 2017, 2018, and 2019.

Interest rates are an important determinant of mortgage size, but because complete information on interest rates is unavailable for 2017 HMDA records, we impute interest rates for all three years at the PUMA level. We do this by using a linear regression to estimate the effect of various explanatory variables on the deviation of PUMA interest rates in 2018 and 2019 from the national average in those years. Explanatory variables are the share of loans purchased by various organizations, (such as Fannie Mae or Freddie Mac) the share for which preapproval was requested, median applicant income, and a measure of high rate spread. Rate spread is the amount by which the interest rate on a loan exceeds the prime rate, and in 2017 it is available in the HMDA data only if it equals at least 1.5 percentage points. This allows us to calculate (1) the share of loans with atypical interest rates relative to the prime rate and (2) the median difference between the interest rate and prime rate for such atypical loans. The R^2 from this regression is 0.81, indicating that most of the variation in interest rates is explained by our approach. The predicted value from this regression is the predicted deviation for each PUMA and each year from the national average in that year. To test its ability to predict out of sample, we split the set of PUMAs in 2018 and 2019 in two, reestimated the model on half, and predicted interest rates on the remaining half. The correlation between the actual median interest rates and the predicted rates was 0.86. We then used the predicted values from the full regression to predict the deviations from the national level interest rates in 2017.

We primarily use data from the ACS to calculate the federal subsidy rate for mortgage interest and federal taxes by applying the TAXSIM calculator to ACS households. To prevent subsidy rates and taxes from being endogenously determined by changes in mortgages, we calculate both the 2017 and 2018 subsidy rates and taxes using 2017 ACS and HMDA data, so that only the tax law differs between the two years. To use ACS data, we must resolve the discrepancy between ACS households and taxpaying units. We first remove individuals living in group quarters. We calculate taxes only for the primary family in each household, whose income is likely the main determinant in obtaining a mortgage. We thus drop all individuals who are not heads of households, spouses, unmarried partners, or children. Unmarried partners are considered separate taxpaying units from heads of households. We finally determine marital status, taxpayer ages, income, and dependents for each taxpaying unit.

To calculate the mortgage subsidy, we generated two TAXSIM calculations for each tax unit under each tax regime, $T_t(0)$ and $T_t(0.7 \cdot rM)$, where $T_t(\cdot)$ is federal taxes in year t as a function of deductible mortgage interest in the first year of a 30-year fixed interest mortgage. For each tax unit, annual mortgage interest on the first year of a loan is calculated as 70 percent of imputed interest r multiplied by mortgage M.[4] M is imputed in two ways. First, we impute PUMA-level mortgages using the median ratio of mortgage to income for the tax unit's PUMA calculated from HMDA data multiplied by the tax unit's income as recorded in the ACS. In other words, the median ratio of mortgage to income for new homebuyers is applied to the income for each ACS household. This could lead to an endogeneity problem because the dependent variable in our regressions is the median natural log of mortgages for each PUMA in each year. We therefore instrument the subsidy rate with a rate calculated using a mortgage imputed using a national average.

All variables used to calculate taxes, including both the interest rate and mortgage amount, were calculated at 2017 levels, adjusted by the consumer price index. In this approach, the tax code changes from year to year, but we avoided potential endogeneity problems by applying the tax code to the first year of data. Sources of income used to calculate taxes are earned income, pensions, interest income, Social Security payments, transfer payments, and other property income of both the head of household and spouse, if present. The number of dependents was included to determine eligibility for the earned income tax credit and child tax credit. Potential itemized deductions include property taxes, state taxes, charitable contributions, and mortgage interest. Property taxes are available in ACS data, and state taxes are calculated by TAXSIM. To impute deductible giving, charitable contributions as a share of income and probability of contributing are estimated from 2019 Survey of Consumer Finances data based on marital status and income brackets.

Because the population of the ACS differs from the population of mortgage seekers, tax subsidies calculated on ACS data are reweighted to reflect the population of households taking out mortgages. We reweighted each ACS household in a PUMA to reflect the share of similar households in 2017 HMDA data using a raking process. Target variables for raking included cohabitation status, race, ethnicity, and income brackets. Through the raking procedure, we adjusted the weighted sums of each category to equal the corresponding

totals in the HMDA data; for example, the weighted sum of Black households in a given PUMA equals the number of new loans in that PUMA obtained by Black applicants. In a small number of PUMAs, there were no ACS households with incomes in a bracket observed in the PUMA data. In those cases, we created a single faux household with an income equal to an income in the middle of the bracket and then reweighted it accordingly.

We used additional variables from the ACS to represent characteristics of the PUMA. Because these are meant to represent the population in the PUMA rather than just those purchasing a mortgage, they were not raked. These variables included median income in the ACS; although the income of mortgage holders is available in HMDA data, this measure only represents the income of homebuyers and therefore varies with mortgage size. Income describes the amount of money that may be borrowed by the typical household, but mortgages may be determined by more than a single measure. Mortgage sizes are also linked to the price of homes, purchased by consumers with various incomes, competing against one another. To account for changes in competitive conditions, we calculate the share of households for whom 28 percent of their income exceeds the annual loan payments required of the 25th, 50th, 75th, and 95th percentiles of mortgages originated in 2017. As controls for exogenous shifts in the demand for housing, we calculate the share of individuals who are employed and the share of individuals who recently migrated to the PUMA. For the same reason, we calculate the share of individuals at least 65 years old (who may be selling homes to move into retirement communities) and the share under 30 years old (who may be purchasing their first homes). To analyze the effect of the TCJA on PUMAs with different racial compositions, we calculated the share of households headed by a person identifying as Asian, Black, or white.[5]

ANALYSIS

In this section, we describe the results of our analysis, concluding that the TCJA slightly raised mortgage sizes. We begin by analyzing how the TCJA affected new mortgages using PUMA-level data for 2017 through 2019. We then estimate a model of newly purchased home prices using a two-way fixed effects model, or equivalently, a difference model with a constant term. We find small but statistically significant effects from reductions in the subsidy for mortgage interest and reductions in taxes.

The Effect of the TCJA on New Mortgages

We used a two-way fixed effects model to estimate the demand for new mortgages, regressing the natural log of median mortgages on the subsidy rate, taxes, and additional covariates. The dependent variable is the median natural log of new mortgages in each PUMA in each year. Explanatory variables in each PUMA and each year are the subsidy rate, S_{Pt}, and the natural log of federal and state taxes assuming no mortgage. Because of the potential for endogeneity caused by our method for imputing mortgages described in the previous section, we perform a Hausman test by comparing the results from a two-way fixed effect regression using S_{Pt}, which are calculated using PUMA-level mortgages, and a two-way fixed effect regression instrumenting S_{Pt} with subsidies calculated using national-level mortgages $S^N_{P,t}$. The test strongly rejects the null that two-way fixed

effects are consistent, so our estimates are calculated using instrumental variables two-way fixed effects. We also include imputed interest rates, which strongly influence the size of mortgages.

Measurement error, which can substantially attenuate coefficient estimates in differenced and fixed-effects models, should not be a problem in this analysis, because we aggregate up to the PUMA level. Thus, errors in individual responses are averaged out, while PUMA-wide errors constant over all years are eliminated by the use of a fixed effect. Our use of medians eliminates idiosyncratic shifts caused by outliers, which should also reduce measurement error in ACS data. Further, HMDA and ZTRAX data represent censuses of administrative data and should therefore have very little error at any level of aggregation.

Our coefficient estimates could also be attenuated if home purchasers in 2017 changed the size of the optimal mortgage in anticipation of the change in taxes in the TCJA. But the details of the TCJA were announced on November 2, 2017. According to a study by Freddie Mac (Mortgage Closing Cycle Time, 2020), in the fourth quarter of 2017 the average time to close on a home sale was about 42 days, which left a small window in which to act. However, at that time it was far from certain that the bill would become law. The TCJA was signed into law on December 22, 2017, which leaves no window at all for those home buyers acting on established law rather than speculation. We therefore believe that potential anticipation had little or no effect on our results.

In a second set of regressions, we include controls for the affordability of mortgages, and controls shifting demand. We estimate our model on the two-year period 2017–18 so that the two-way fixed-effect model is identical to a simple regression of the change in loan size on the change in subsidy rates, federal taxes, and other variables. The coefficient on S_{Pt} is the estimated percent change in mortgages from a one-point change in the subsidy rate caused by the TCJA. We also estimate our model over the three-year period 2017–19 in which all of the variation in the subsidy rate and federal taxes fall because of the TCJA.

The results of our analysis (table 2) show that the change in subsidy rates had a statistically significant effect on median mortgage size, while the reduction in taxes had a positive effect on mortgage size. In the first column are the results from regressing the log of the median mortgage on the subsidy rate. The first column estimates the effect of the change in subsidy rate on loans, absent any controls. In column two, controls for affordability, supply, and demand are added, slightly increasing the coefficient from 0.057 to 0.059. The coefficient 0.059, taken from table 1, means that a 10.66 percentage-point decrease in the subsidy rate (the average decrease from 2017 to 2018) decreased the growth rate of mortgages on newly purchased homes about 0.6 percent. This is about 14 percent of the average growth in mortgage size of 4.6 percent.

Federal taxes, calculated in the absence of a mortgage, declined because of the increase in the standard deduction and for other reasons. From table 2, a 10 percent increase in federal taxes would lead to a 1.2 percent increase in mortgages. Using the calculated average decline in federal taxes of 14.7 percent led to a 1.8

percent increase mortgage size. Adding the effect of subsidy changes to the effect of changes in taxes, we conclude that the TCJA actually increased typical mortgages 1.2 percent.

Table 2 also shows that from 2017 to 2019 the effects are stronger than between 2017 and 2018. This is not surprising, because table 1 shows that although the increase in loan size was greater between 2017 and 2019 than between 2017 and 2018, the change in the subsidy rate was about the same, and the change in federal taxes was actually lower. The coefficient of 0.103 implies that an average decline in the subsidy rate of 10.7 percentage points reduced mortgage size about 1.1 percent. Similarly, the decline in federal taxes increased mortgage size about 1.1 percent. Adding the effects together, the TCJA had close to no effect on mortgages from 2017 through 2019.

TABLE 2

Change in Mortgages

	2017 – 2018		2017 – 2019	
	(1)	(2)	(3)	(4)
Subsidy rate	0.057*	0.059**	0.124***	0.103***
	(0.023)	(0.020)	(0.021)	(0.019)
Interest rates	-0.114*	-0.065	-0.161***	-0.114***
	(0.047)	(0.041)	(0.043)	(0.038)
Federal tax	-0.123***	-0.122***	-0.114***	-0.117***
	(0.018)	(0.016)	(0.015)	(0.013)
Controls	No	Yes	No	Yes
R^2 within	*0.59*	*0.67*	*0.71*	*0.78*
PUMAs across years	*4,524*	*4,524*	*6,786*	*6,786*

Source: 2017-2019 data drawn from ACS, HMDA and Zillow, author calculations.
Note: For the first three variables, the first line holds the coefficient and the second holds the robust standard error. For all regressions a dummy variable for the year 2018 was included. * p<0.05, ** p<0.01, *** p<0.001

The Effect of New Mortgages on the Sale Price of Houses

We estimated the demand for homes as a function of mortgage size using a constant elasticity specification in a two-way fixed-effect model. However, when families choose a home to purchase, the home price and the mortgage are inevitably determined together. This simultaneity likely holds at the aggregate PUMA level as well, so the effect of mortgage size on prices will be overestimated. A second bias in the opposite direction (i.e., price increases can lead existing homeowners who are "trading up" to need smaller mortgages) implies that the sign of the overall bias is ambiguous. This second bias will be stronger if the prices of lower-priced homes increase more than the prices of higher-priced homes. As we show in the next section, this pattern holds across PUMAs.[6]

We addressed this simultaneity by using a two-stage-least squares model in which the explanatory variables used in the last section were used in the first stage. The main explanatory variables in the first stage, the change in the subsidy rate and federal taxes calculated using data from 2017, are clearly exogenous. We assume that interest rates are driven by national economic factors and not by changes in home prices, but we checked this assumption by regressing interest rates on the log of home prices and the log of mortgages and found a statistically insignificant relationship between interest rates and home prices, conditional on mortgage size. We also included several variables in the second stage: income as a proxy for wealth, which may be used as a down payment, migration into the PUMA, the share of households headed by someone under age 30, the share of households headed by someone over age 65, and the share of the population that was employed.

Estimating our model on 2017 and 2018 data, we found an elasticity of 0.58 (table 3).[7] As with the analysis of mortgages, the fixed-effect model can be interpreted as a simple regression of differenced variables. In this case, the elasticity of 0.58 indicates the percent change in prices from a 1 percent change in mortgages between 2017 and 2018.

TABLE 3

Change in Prices

	2017 – 2018		2017 – 2019	
	(1) OLS	(2) 2SLS	(3) OLS	(4) 2SLS
Loan	0.581***	0.625*	0.544***	0.565**
	(0.143)	(0.269)	(0.111)	(0.197)
Income	-0.004	-0.004	0.018	0.018
	(0.047)	(0.047)	(0.039)	(0.040)
R^2 within	*0.04*	*0.04*	*0.04*	*0.04*
PUMAs across years	*4,495*	*4,458*	*6,379*	*6,341*

Source: 2017-2019 data drawn from ACS, HMDA and Zillow, author calculations.
Note: For the first two variables, the first line holds the coefficient and the second holds the robust standard error. For all regressions a dummy variable for the year 2018 was included. * p<0.05, ** p<0.01, *** p<0.001

Using two-stage least squares, we found an elasticity of 0.62. The excluded instruments were the subsidy rates, federal and state taxes, interest rates, and the share of households that could afford the 25th, 50th, 75th, and 95th percentile mortgage. We tested for overidentifying restrictions using a Sargan-Hansen J test (which also tests for endogeneity of the excluded instruments) and found no evidence of overidentification. We also estimated our model on data from 2017 to 2019 and found a small decrease in both models. The elasticities are approximately the same as in the 2017–18 sample: 0.54 in a linear regression and 0.56 using two-stage-least squares.

HOW THE CHANGE IN TAXES AFFECTED VARIOUS GROUPS

Combining the results of the previous two sections allows us to estimate the effect of the TCJA on the prices paid by those purchasing homes. Although the overall change is small because the average change in subsidy and the change in taxes balance each other, effects vary by Census region, average home price, average income, and race. We find that price changes varied widely across the different groups, with some areas seeing a negative effect and others seeing a positive effect.

Overall, prices prices rose about 6.6 percent from 2017 through 2019 (table 4). Comparing the change in log prices of homes purchased from 2017 to 2019, the average percent increase across PUMAs was about 6.7 percent. In contrast, the percent change in the average price was 9.9 percent over those two years. The

TABLE 4

Average Change in PUMAs by Census Regions

	Median income	Percent change in prices	Change in subsidy	Percent change in federal tax	TCJA percent change in prices
National	64,302	6.55%	-0.11	-10%	0.10%
Northeast	74,151	9.98%	-0.15	-9%	-0.24%
Midwest	63,195	6.26%	-0.09	-11%	0.28%
South	58,371	3.04%	-0.09	-10%	0.24%
West	65,761	9.06%	-0.11	-9%	0%

Source: 2017-2019 data drawn from ACS, HMDA and Zillow, author calculations.

difference between the two mostly occurs because a small number of PUMAs saw a sharp decline in prices, pulling down the average of the percent changes. The median percent change, which is unaffected by negative outliers, was 9.1 percent. The Federal Housing Finance Agency national repeat-sales index from quarter 3 of 2017 to quarter 3 of 2019 increased about 11.3 percent.

We find that the effect of the TCJA was to slightly increase prices over that period, with the effect of an 11 percentage-point decrease in subsidy rates nearly offsetting the effect of a 10 percent decrease in federal taxes. We found that prices in northeast PUMAs rose nearly 10 percent, but those PUMAs also had the largest reduction in the subsidy for mortgage interest, about a 15 percentage-point decline. This, and a slightly smaller decrease in taxes, led to an estimated decline in prices of -0.24 percentage points. We estimated that prices in PUMAs in the Midwest and South were increased by about a quarter of a percentage point, although overall prices rose more than twice as fast in the Midwest.

Prices in the lowest 10 percent of prices in 2017 had an average change in log prices of about 9 percent, while those in the top 10 percent increased just under 4 percent (table 5). We estimated that the TCJA increased prices in PUMAs with low prices in 2017 had a small decline in subsidy rates and a larger decline in federal taxes, leading to about a 0.6 percent increase. High-priced areas saw a much sharper decline in subsidy rates and a smaller decline in federal taxes; we estimated that the TCJA led to about a 1 percent price decline in these areas.

The prices of homes sold in PUMAs with low or high median incomes showed a similar pattern, but among high-income PUMAs, the very small price increase, combined with the relatively large decline in prices induced by the TCJA, means that the TCJA had a substantial effect on prices. Prices in low-income areas increased more than 12 percent, while those in the top 10 percent had an average price increase of about 1 percent. The effect of the TCJA also varied because different groups of PUMAs experienced different declines in the subsidy rate and federal taxes. The pattern for low- and high-income areas was similar for similar reasons. We estimated that for low-income areas, the TCJA slightly increased prices about 0.4 percent, but the TCJA reduced prices in high-income areas about 0.5 percent. Thus, absent the TCJA, prices in high-income areas would have increased an extra third.

Structural racism in the United States, both historically and currently, has left many people of color both with lower average incomes to pay mortgages and fewer assets to make downpayments in lieu of payments. Thus, a putatively race-blind tax policy, such as the MID, can have adverse effects on people of color. We should then expect that changes to the MID, such as the TCJA, may also have incidental effects that vary by race. To measure how the TCJA affected prices in PUMAs in which people of color are more or less represented, we rank PUMAs by the share of households that are Asian, Black, or white and recalculate prices and the effect of the TCJA on the 1st and 10th decile of shares.

The average growth rate of prices for PUMAs with the lowest share of Black households was greater than average, while PUMAs with the highest share of Black households saw even greater growth in prices. Because of lower-than-average declines in subsidy rates but an average change in federal taxes, we estimated that the TCJA had a positive effect on prices for PUMAs with both low and high shares of Black households. Regions with a small share and large share of Asian households both saw price increases through 2019, although these were below the overall increase of 6.55 percent. We estimated that the TCJA reduced the growth rate of prices about 0.3 percent in areas with a larger share of Asian households but increased the growth rate of prices about 0.60 percent in areas with a small share of Asian households. Finally, PUMAs with a low share of white households experienced home price increases of more than 12 percent, while PUMAs with a high share of white households experienced home price increases of just over 6 percent. We estimated that the TCJA lowered prices in PUMAs with a small share of white households by about the same amount as the overall average. We also estimated that the TCJA raised prices by about 0.5 percent for PUMAs with a high share of White households.

TABLE 5

Average Change in PUMAs by Home Price, Income, and Race

	Share	Median income	Percent change in prices	Change in subsidy	Percent change in federal tax	TCJA change in prices
Overall		64,302	6.55%	-0.11	-10%	0.10
Price						
Low		43,205	9.33%	-0.03	-11%	0.63
High		89,238	3.87%	-0.14	-5%	-0.41
Income						
Low		32,127	12.28%	-0.06	-10%	0.42
High		120,902	1.10%	-0.17	-7%	-0.53
Share Asian						
Low	0.30%	48,710	2.96%	-0.04	-11%	0.60
High	25.90%	83,892	3.37%	-0.14	-7%	-0.32
Share Black						
Low	0.40%	60,504	9.29%	-0.08	-10%	0.32
High	52.10%	43,412	11.55%	-0.09	-10%	0.21
Share white						
Low	28.70%	47,711	12.55%	-0.10	-9%	0.07
High	95.60%	58,899	6.57%	-0.06	-11%	0.46

Source: 2017-2019 data drawn from ACS, HMDA and Zillow, author calculations.

CONCLUSION

As the TCJA was being formulated, some expressed concern that because fewer taxpayers would itemize, its passage would reduce home prices. However, these commentators underestimated the income effects of the law, which render its total effect on housing demand ambiguous. Raising the standard deduction did eliminate the subsidy for mortgage interest for those no longer itemizing, but this was only because taxpayers increased their after-tax income (which could be spent on housing if they wished) by taking the standard deduction. Many taxpayers who took the standard deduction before the TCJA came into effect also saw an increase in their after-tax income, some of which could be used for purchasing a house. Some taxpayers itemizing before and after the law change also saw an increase in after-tax income, while some who were subject to the $10,000 cap on the deduction of state and local taxes saw a decrease in their income.

Three previous studies have also predicted that the TCJA, if it were permanent, would lead to lower house prices in equilibrium. Each developed a theoretical model, applied it to pre-TCJA data, and extrapolated house prices under the TCJA. Martin (2018) found that some areas would experience no decline, while others could see a decline as high as 23 percent. Rappoport (2019) also found that some areas might experience no decline, while house prices in other areas might decline as much as 7 percent. Sommer and Sullivan (2019) found that house prices would be more or less unchanged, although the changes would mostly benefit the wealthy.

Our paper presents the first empirical research on the question. We focused on those purchasing homes under the old and new tax law, and we find a small, statistically significant positive effect of the TCJA on mortgages. This positive relationship was the sum of both a small negative effect from the decreased number of house buyers receiving a subsidy on mortgage interest and a small positive effect from increased after-tax income. By estimating how the increase in mortgages affected home values, we also found that the increase in

mortgages led to a small increase in the price of houses. Finally, we estimated how the TCJA affected Census regions, areas with high and low prices, areas with high and low incomes, and areas with high and low shares of households headed by Asian people, Black people, and white people. We found that although there is variation across these areas, the overall effect of the TCJA on the growth of home prices was modest.

APPENDIX

In this appendix, we briefly summarize dataset construction and our analysis. Because we cannot match data on individual households across surveys, all data on households were aggregated up to the Public Use Microdata Area (PUMA) level. A small number of PUMAs were removed because of missing information or because the absolute value of median price changes between 2017 and 2019 were extremely large. All dollar variables are calculated as medians rather than means.

We use HMDA data, which holds a near census on new mortgages, to calculate the median log mortgage and several measures of affordability. Because interest rates were unavailable in 2017 data, for 2017 through 2019 imputations were used based on 2018 and 2019 data.

We obtain sale price data from ZTRAX. The dataset contains property assessment records sourced from county offices matched with any legal transaction records (e.g., deeds, mortgages, foreclosures) associated with the property. For our analysis, we include only records for the arms-length sale of first-lien, first-home residential properties in the years 2017, 2018, and 2019.

We transform household data from the ACS into tax units and use TAXSIM to calculate the federal subsidy rate for mortgage interest and federal taxes by applying the National Bureau of Economic Research's TAXSIM calculator to ACS households. To prevent subsidy rates and taxes from being endogenously determined by changes in mortgages, we calculate both the 2017 and 2018 subsidy rates and taxes using 2017 ACS and HMDA data, so that only the tax law differs between the two years. Mortgages were imputed in two ways. First, we imputed PUMA-level mortgages using the median ratio of mortgage to income for the tax unit's PUMA calculated from HMDA data multiplied by the tax unit's income as recorded in the ACS. This could lead to an endogeneity problem because the dependent variable in our regressions is the median natural log of mortgages for each PUMA in each year. Subsidies were calculated as the difference in taxes calculated with and without a mortgage, and the subsidy rate is the subsidy divided by the annual mortgage payment.

Because the population of the ACS differs from the population of mortgage seekers, tax subsidies calculated on ACS data are reweighted to reflect the population of households taking out mortgages. Each ACS household in a PUMA was reweighted to reflect the share of similar households in 2017 HMDA data using a raking process. Target variables for raking included cohabitation status, race, ethnicity, and income bracket.

We used additional variables from the ACS to represent characteristics of the PUMA. Because these are meant to represent the population in the PUMA rather than those purchasing a mortgage, they were not raked. These variables included median income in the ACS and the share of households for whom 28 percent of their income exceeds the annual loan payments required of the 25th, 50th, 75th, and 95th percentiles of mortgages originated in 2017. As controls for exogenous shifts in the demand for housing, we calculated the share of individuals who are employed and the share of individuals who recently migrated to the PUMA. For the same reason, we calculated the share of individuals at least 65 years old, who may be selling homes to move into

retirement communities, and the share under 30 years old, who may be purchasing their first homes. To analyze the effect of the TCJA on PUMAs with different racial compositions, we calculated the share of households headed by a person identifying as Asian, Black, or white.

We used a two-way fixed effects model to estimate the demand for new mortgages, regressing the natural log of median mortgages on the subsidy rate, taxes, and interest rates. Explanatory variables in each PUMA and each year are the subsidy rate and the natural log of federal and state taxes assuming no mortgage. Because a Hausman test strongly rejects the null hypothesis that our imputed interest rates are exogenous, we used an instrumental two-way fixed effects model using national-level mortgages as an instrument. In a second set of regressions, we included controls for the affordability of mortgages, and controls shifting demand. We estimated our model on the two-year periods 2017–18 and 2017–19.

We then estimated the demand for homes as a function of mortgage size using a constant elasticity specification in a two-way fixed effect model. The simultaneity between home prices and mortgage size was addressed using a two-stage-least squares model in which the explanatory variables used in the previous regression were used in the first stage. We also included several variables in the second stage: income as a proxy for wealth (which may be used as a down payment), migration into the PUMA, the share of households headed by someone under age 30, the share of households headed by someone over age 65, and the share of the population that was employed.

The change in home prices from 2017 to 2019 caused by the TCJA was calculated in two steps. In the first step, the predicted change in mortgages was calculated by multiplying coefficients on subsidies and federal taxes by the respective average changes from 2017 to 2019. In the second step, the coefficient from the constant elasticity regression of prices on mortgages was multiplied the predicted change in mortgages. The effect of the TCJA on home prices in Census regions was calculated using average changes in subsidies and federal taxes in each region. To calculate the effects on PUMAs with the highest and lowest prices; the highest and lowest incomes; and the highest and lowest shares of Asian, Black, and white households, we first sorted PUMAs by each category. We then used the average change in subsidies and federal taxes for the highest and lowest decile in each category and calculated the change in prices and the change caused by the TCJA as before.

NOTES

[1] Jim Tankersley, "The Trump Tax Cuts Were Supposed to Depress Housing Prices. They Haven't," *New York Times*, August 27, 2018; National Association of Realtors, letter to the United States Senate, November 20, 2017, https://narfocus.com/billdatabase/clientfiles/172/2/3045.pdf.

[2] It is possible that a few purchases near the end of 2017 were delayed or accelerated, but sales at that time represent a small fraction of sales throughout the year.

[3] We are currently waiting for Zillow to renew the contract that allows us to analyze individual records, so we currently cannot determine if these extraordinary price changes are caused by small sample sizes.

[4] 70 percent is the share of first-year mortgage payments that are devoted to interest for a 30-year fixed loan of $247,747 at an interest rate of 4.09 percent, which are the average mortgage amount and interest rate in our sample for 2017.

[5] We recognize that these do not represent all of the ways people may identify their race. We use the categories included in both the ACS and HMDA and do not include the "other" category.

[6] We are currently waiting for Zillow to renew the contract that allows us to analyze individual records, so we currently cannot determine if this same pattern holds within PUMAs.

[7] Recall that because some PUMAs are missing prices, there are fewer observations in the regressions using prices.

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