

# Real Estate Taxes and Home Value: Evidence from TCJA

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## Abstract

We examine the impact of changes in the federal tax treatment of owner-occupied housing stemming from the implementation of the Tax Cuts and Jobs Act (TCJA) in January 2018 on local housing markets. Using county-level house price information and IRS tax data, we find that, holding everything else the same, capping the federal tax deduction of state and local taxes at \$10,000 has caused the growth rate of home value to decline by an annualized 0.9 percentage point, or 18 percent, in areas where real estate taxes as shares of taxable income exceeded the national median. The results are robust when controlling for other changes in the tax reform. The areas with a high real estate tax burden also suffered from reductions in market liquidity after the reform. Fewer houses were transacted either in absolute numbers or as shares of total listings and houses stayed on the market longer before being sold. Importantly, we find that the housing market slowdown was accompanied by declines in local construction employment growth as well as multi-family building permits. Furthermore, on net more people moved out of these areas after the reform. Finally, we show that the act has already had political consequences. In the 2018 midterm Senate elections, more voters voted for Democratic candidates in areas with high real estate tax burden than they did for Republican candidates.

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# 1. Introduction

The Tax Cuts and Jobs Act (TCJA), which went into effect on January 1, 2018, made the most significant changes in the federal tax treatment of owner-occupied housing since the Tax Reform Act of 1986. Among the many changes in the act, itemized deductions of state and local taxes (SALT) from federal income tax, previously uncapped, are now limited to \$10,000 for individuals and married couples filing jointly. This change undoubtedly affected different geographical areas differently as households' SALT obligation varies significantly with their residence. For instance, for the tax year of 2016, Internal Revenue Service tax data indicate that the average ratio of real estate taxes to adjusted gross income ranged from zero in Houston County, Georgia, King County, Texas, and Hayes County, Nevada to over 5 percent in Putnam County and Rockland County in New York.<sup>1</sup> Although TCJA also contained other provisions that offset some of the impact from capping SALT tax deductions such as reductions in marginal tax rates for many households and increases in standard deductions,<sup>2</sup> it is widely believed that for homeowners living in areas with high state and local taxes,<sup>3</sup> capping SALT deductions lowered the value of tax-exempt imputed income from owning their houses.

In this paper, we provide the first nationwide analysis on the heterogeneous impact TCJA had on U.S. residential housing value as well as other economic consequences over the period between January 2018 and October 2019. The main part of our study tests how changes in the tax treatment of homeownership in TCJA affected house prices across different geographical locations. It is important to understand this impact because housing wealth constitutes almost half of American household wealth and about 80 percent of the housing wealth is in owner-occupied units. Using county-level house price data from Zillow, an online real estate data company, and a difference-in-difference estimation method across time and space, we find that counties with high real estate taxes relative to income had slower house price growth during the first 22 months after the implementation of TCJA.

In our analysis, we utilize several measures of local home value including median home value

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<sup>1</sup>Note that in the IRS data, zero real estate taxes imply that no residents filed using itemized deductions or they had zero property tax in the itemized deductions.

<sup>2</sup>In section 3, we provide detailed discussion of all the provisions in TCJA that impacted the housing market.

<sup>3</sup>Local taxes are typically collected as property or real estate taxes.

per square foot, sale price, listing price per square foot and Zillow Home Value Index to fully take advantage of the different strength of these measures in terms of their coverage and construction methodology. We also calculate growth rates at both the (annualized) month-to-month frequency and the year-to-year frequency to capture different price growth volatility over different horizons, as year-over-year growth rates typically exhibit less volatility than month-over-month growth rates. Under our benchmark measure, annualized monthly growth rates of median home value per square foot, we find that counties with real estate taxes relative to income in the top half of the nation experienced a drop in home value growth rate of 0.9 percentage point per year or 18 percent during the first 22 months after the implementation of TCJA. This is equivalent to nearly \$2,900 for the median house in the high tax counties. The other measures generate a decline in house value growth rates ranging from a low of 0.04 percentage point to a high of 3.5 percentage points.

We tested confounding factors and the parallel trend assumption for identification. There are other changes in the tax reform that might have affected the house price growth differentially across counties. In addition, a number of events took place in and around 2018 besides the implementation of TCJA. For instance, the Federal Reserve raised interest rates three times in 2017 and then another three times in 2018 before lowering them three times in the second half of 2019. Mortgage rates rose in response during most of our sample period, hurting areas with high house prices where households likely need to borrow large amount of mortgages. Additionally, TCJA was first introduced in the House in November 2017, two months before it was signed into law. As a result, households may have preemptively responded to the proposal. We address these concerns by including additional controls for these other events and by conducting placebo tests where we assume intervention occurred in the other months of our sample period than January 2018. We also randomly assign counties to states. We find that our estimates are robust to the introduction of additional controls as well as the random assignment of counties to states and there exist no statistically significant price effects associated with these other dates in the placebo tests.

Our main argument for constructing real estate tax burden, i.e., normalizing real estate taxes paid by taxable income, to proxy for different location's exposure to TCJA is to account for the fact that households living in expensive areas also have higher income on average.<sup>4</sup> It is true, however,

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<sup>4</sup>In addition to the differences in statutory tax rates, our measurement of real estate tax burden captures differences in property tax exemptions states offer to older homeowners and the disabled as well as property tax breaks for home improvements and the installation of renewable energy.

that TCJA imposes constraints on tax levels. We thus repeat our analysis using average real estate taxes paid while controlling for taxable income as well as the other factors included in the previous analyses. We find that counties with average real estate taxes paid in the top half of the nation experienced a decline of 1.6 percentage points or about 30 percent in house price growth during that period.

To investigate the heterogeneous response within the local housing market, we further divide the local market by its purchase prices relative to the area median and repeat our analysis using the corresponding house price index from CoreLogic Solutions. We find that the negative impact on house price growth rates was most felt within the medium range of the market. While the most expensive segment of the local housing market also suffered after the tax reform, the positive income effect it received from the reduction in income tax rates for high income brackets negated the magnitude.

Given that residential rental prices are typically closely tied to residential house prices, it is likely that the slower house price growth transmits to the rental market and leads to slower rental price growth. TCJA, however, adversely affects only homeowners while landlords can continue to claim all SALT taxes as business expenses. In addition, TCJA added a generous new business deduction for pass-through businesses which benefited small business owners such as landlords. Indeed, our analysis reveals that the tax reform did not have a negative impact on local rent price growth for three of the four rental price measures we use.

Housing market liquidity affects households' ability to buy and sell housing units. Asset prices tend to decline when liquidity is poor. Using several proxies for local housing market liquidity and the same difference-in-difference estimation technique, we find that, after TCJA, in areas with high real estate taxes relative to income, fewer houses were sold both in absolute numbers and relative to those listed and houses stayed on the market longer before being sold. In other words, TCJA reduced housing market liquidity in areas with high real estate tax burden. This deterioration in housing liquidity likely contributed to the severity of the decline in local house price appreciation rates.

Taken together, our analysis indicates that there were sizable slowdowns in local house price growth in high tax areas after TCJA took effect. We next investigate whether these declines had real economic consequences and how households have responded to its differential impact

across geographical regions. For real economic consequences, we focus on employment in the local construction sector and building permits granted.<sup>5</sup> Our study suggests that, after the reform, growth rates in local construction sector employment slowed and building permits granted for multi-family units also declined in areas with high real estate taxes relative to income. Given the sizable negative effects on house prices and real economic variables associated with TCJA, it is, therefore, not surprising that less than two years after the implementation of TCJA, more people have moved out of areas with high real estate tax burden after the reform relative to areas with low real estate tax burden. This effect is more pronounced for individuals with a mortgage, a proxy of their homeownership status. Furthermore, it is also not surprising that the act appeared to have had political consequences. During the 2018 midterm Senate elections, the share of voters who voted for Democratic candidates increased in areas with real estate tax burdens above the national median. This result holds irrespective of the party affiliation of the incumbent candidate or the Senate election results in 2016.

The paper proceeds as follows. In the next section, we conduct literature review. In Section 3, we summarize the changes in SALT deduction as a result of the TCJA and present a simple user cost model. Section 4 describes the data. Section 5 investigates the differential impacts of the tax reform on house price growth across different geographical areas. Section 6 studies the effects of the tax reform on rental prices and house market liquidity. Section 8 explores other real economic effects. Section 9 concludes.

## 2. Literature Review

Our paper is related to an extensive literature that investigates the effect of taxation on residential housing. Some of the studies especially the earlier ones such as Laidler (1969), Aaron (1972), Rosen (1979), Rosen and Rosen (1980), Poterba (1984), Poterba (1991), and Capozza et al. (1996) focus on the response of the quantity of housing demanded and the consensus estimates there were -1.0 for price elasticity and 0.75 for income elasticity. Other studies focus on house price changes as we do in this paper. For example, using an asset-market approach, Poterba (1984) estimates that the coincidence of high inflation rates and the tax destructibility of nominal mortgage payments in

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<sup>5</sup>A building permit is the approval given by a local jurisdiction to proceed on a construction project.

the late 1970s and early 1980s accounted for as much as a 30 percent increase in real house prices. Poterba (1991) and Poterba (1992) study the long-run effect of the changes in tax policy toward housing in the 1980s (e.g., reductions in marginal income tax rates and increases in standard deductions) and find the tax changes reduced attraction of homeownership at high income levels and lowered after-tax rent benefits for landlords but had muted effects on house prices.<sup>6</sup> Capozza et al. (1998) assess the impact of income and property taxes on house prices using a panel data for 63 metropolitan areas from 1970 to 1990. They find that a three-percentage cut in marginal federal income tax rates and the removal of the property tax deduction lower house prices by as much as 5 percent with limited impact on homeownership rate or housing investment.

More recently, using data from 1984 to 2007, Hilber and Turner (2014) find that state and federal mortgage interest deduction only boosts homeownership of higher income households in less tightly regulated housing markets. Davis (2019) studies the distributional impact of mortgage interest subsidies and finds that average buyers at most incomes do not benefit from the mortgage interest subsidies. As in our paper, Peach and McQuillan (2019) and Gilbukh et al. (2019) study the impact of TCJA on housing. Peach and McQuillan (2019) focus on home sales between 2017Q4 and 2018Q3. They find evidence that changes in federal tax laws enacted in December 2017 have contributed to the slowdown in housing sales, a finding that we confirm in the paper. Using matched CoreLogic Solutions MLS data from January 2010 to October 2018, Gilbukh et al. (2019) document a narrowing in price/rent ratios between high- and low-tax states since the tax changes that started taking effect at the beginning of 2018. In level terms, the ratios in high-tax, high-itemization areas have stopped moving higher while the ratios in the rest of the country have continued to rise. Our paper differs from theirs in that we use a national sample and difference-in-difference approach that controls for other observables. In other words, we seek to isolate the effect associated with the implementation of TCJA on the housing market from other factors such as interest rates and local demand. Our results also suggest a narrowing in price-rent ratios between high-tax, high-itemization areas and low-tax, low-itemization areas, but the narrowing came from the decline in house price growth rates in the high-tax areas.

In addition to the works cited above, in recent years researchers have used theoretical dynamic

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<sup>6</sup>Poterba (1991) suggests changes in income, construction costs and baby boomers coming of age may explain the lack of the price declines in response to the 1980s reform that increased the user cost of homeownership.

models in the quantitative macroeconomic tradition to study the implication of real estate taxes on homeownership and house value. Berkovec and Fullerton (1992) find that the benefits to homeowners from the mortgage interest rate and property tax deduction are small in a static general equilibrium model. In a dynamic model but focusing on long-run steady state, Gervais (2002) and Chambers et al. (2009) also find that the elimination of taxation of the imputed rental income from owner occupied housing and mortgage interest deductions have small aggregate as well as distributional effects. Chatterjee and Eyigungor (2015), however, find that the 2008 foreclosure crisis might have been smaller if mortgage interest payments had not been tax deductible. Additionally, Sommer and Sullivan (2018) find much larger effects of changing housing tax policies than the earlier research once house prices and rents are endogenized. For example, eliminating the mortgage interest deduction causes house prices to decline and, hence, increases homeownership and improves welfare. Rappoport (2018) builds an economic model that features user cost and simulates the potential effect of TCJA on house prices. He finds that simulated house prices decline an average of 2 percent across a sample of 269 metropolitan areas with large dispersion ranging from as much as 7 percent to as low as 0 percent. Our empirical estimates are surprisingly in line with the simulated findings in Sommer and Sullivan (2018) and Rappoport (2018)

### **3. Homeowners and the Tax Treatment Before and After TCJA**

TCJA made significant changes to the federal income tax code for individuals and businesses. As summarized in Peach et al. (2018), several provisions of the new tax law have altered the tax treatment of individual homeownership in a number of ways. Among them, the new SALT deduction cap is the most significant change. Itemized deductions of SALT, previously uncapped, are now limited to \$10,000 for singles and married couples filing jointly. The SALT deduction provides a significant amount of savings for homeowners who itemize and pay a lot of real estate taxes. For example, the average amount of real estate tax reported for tax filers who itemized in 2016 is about \$3,800, which amounts to a \$950 saving per year assuming a 25 percent marginal federal income tax rate. The savings are even larger for households in areas with higher real estate taxes.

To take advantage of the SALT deduction, a tax filer has to itemize deductions. Since the tax

reform also increased the standard deduction substantially, the incentive to itemize decreased after 2018. For married couples filing jointly, the standard deduction increased to \$24,000, almost double the \$12,700 figure in 2017. For individuals and heads of households, the deduction increased to \$12,000 and \$18,000, respectively. Hence, capping the SALT deduction reduces the tax benefits of owning a house.

We use a simple model to describe effects of these changes on the tax benefits of homeownership. To understand the implications of capping SALT deductions embodied in TCJA, we first review the user cost of capital approach outlined in Poterba (1984) and subsequently adopted by many other studies such as Himmelberg et al. (2005), Poterba and Sinai (2011), and Albouy and Hanson (2014). Let  $\omega$  denote the one-period cost of housing services from a house with real price of  $Q$ . Before the implementation of the TCJA, the cost can be written as

$$\omega = [\tau_p + i_b(Q - m)/Q + i_m m/Q + \delta - \pi_H] - \tau_y[\tau_p + i_m m/Q] \times I[\text{itemized}], \quad (1)$$

where  $\tau_y$  is the federal income tax rate;  $\tau_p$  is the property tax rate;  $i_b$  is the opportunity cost of the fund;  $i_m$  is the mortgage interest rate;  $m$  is the amount of mortgage borrowed;  $\delta$  is house maintenance cost as a proportion of house value;  $\pi_H$  is the expected house appreciation rate; and  $I[\text{itemized}]$  is an indicator that takes value one if the household itemizes tax deductions. The terms inside the first brackets of equation (1) represent the usual user costs of owning a house and the remaining items in the equation represent the tax benefits of homeownership.

It is important to bear in mind that the user cost of homeownership matters only if the homeowner decides to itemize. Hence the tax benefit is equal to zero for tax filers not itemizing deductions. But homeownership also makes a tax filer more likely to itemize deductions due to the property taxes paid. For example, before the tax reform in 2017, the standard deduction for married couples filing jointly is \$12,700. So the indicator function takes the form

$$I[\text{itemized}] = I[\tau_p Q + T_s + i_m m + X > 12700], \quad (2)$$

where  $T_s$  indicates other state or local taxes, and  $X$  is all the other tax deductions. The larger the size of property tax  $\tau_p Q$ , the more likely a household itemizes and the higher the tax benefits as



illustrated in equation (1).

The tax reform affects both equations above. First, for households who continue to find benefits from using itemized deductions, the deductions become less generous due to the SALT deduction cap. In equation (3), the property tax deduction is no longer unlimited, but capped by the difference of \$10,000 and  $T_s$ , other SALT excluding the real estate taxes that the tax filer is already paying:

$$\omega = [\tau_p + i_b(Q - m)/Q + i_m m/Q + \delta - \pi_H] - \tau_y[\max(\tau_p Q, 10000 - T_s, 0) + i_m m]/Q \times I[\text{itemized}]. \quad (3)$$

Second, increasing the standard deduction limit to \$24,000 and capping the SALT deduction in 2018 reduce a tax filer's incentive to itemize. The indicator function in equation (4) is much less likely to take the value one, holding SALT and other deductions fixed:

$$I[\text{itemized}] = I[\max(\tau_p Q + T_s, 10000) + i_m m + X > 24000]. \quad (4)$$

Hence, the tax reform reduces tax savings of user costs for homeowners in areas with higher real estate taxes due to the new SALT cap, holding other things equal. If we assume that the housing utility  $Q\omega$  is kept fixed before and after the tax reform, house prices  $Q$  fall as user cost  $\omega$  increases, particularly in places with higher real estate taxes.<sup>7</sup>

It is important to note that other changes in the tax reform may directly and indirectly affect the user costs that are not captured in the equations (1) – (4) for ease of exposition. For example, the limit on the mortgage interest deduction for a married couple filing jointly has been reduced to the interest on a maximum of \$750,000 of acquisition indebtedness, down from \$1,000,000 under the old law. For individuals, the limit has also been lowered to \$750,000. Spouses filing separately each face a \$375,000 limit. Compared with the SALT provision, this provision affects only new home buyers after 2018. We control the effect of the new mortgage interest deduction cap in our empirical analysis explicitly in section 5.1.<sup>8</sup> TCJA also lowers the federal income tax rates for many households and this change lowers the tax savings of homeownership due to fewer federal taxes paid

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<sup>7</sup>One justification for this assumption is that rental markets are competitive. We also show that the rental prices in high tax places are not disproportionately more affected by the tax reform in Section 6.

<sup>8</sup>TCJA also suspends the deduction for interest paid on home equity loans and lines of credit when they are used for something other than substantial improvement of their home. This provision is applicable regardless of when the home equity debt had occurred.

in the first place. In our empirical section 5.1, we explicitly address the potential impact of the tax reform on households with different income levels.

## 4. Data and Summary Statistics

### 4.1. *Housing*

Our housing related data mainly come from Zillow Group, Inc., an online real estate database company. These include median home value per square foot (calculated by taking the estimated home value for each home in a given region and dividing it by the home’s square footage), median list price per square foot (median of list prices divided by the square footage of a home), median sale price, Zillow home value index,<sup>9</sup> home sales (the number of homes sold for the given time), listings with price cut (the percentage of current for-sale listings on Zillow with a price cut), and days on the market (the median days on market of homes sold including foreclosure resales). We further construct sales to listings ratios by dividing total number of home sales by total number of listings for the given time.

Home sales are arms-length transactions of single-family, condominium and cooperative properties. They include real-estate-owned sales as well as auctions, but exclude bank takeovers of foreclosed properties, title transfers after a death or divorce and non arms-length transactions. A transaction date is defined as the closing date recorded on the county deed. The data are publicly available at Zillow Research.

House price indices for different housing market segments come from CoreLogic Solutions. CoreLogic Solutions House Price Indices are repeat sales indices that match house price changes on the same properties in the public record files. CoreLogic Solutions computes separate indices by geographical areas and by purchase prices. In particular, CoreLogic Solutions constructs four purchase price tiers depending on whether the home sold for less than 75 percent of the area median price, for

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<sup>9</sup>Zillow home value index draws on Zestimates calculated on more than 100 million U.S. homes, including new construction homes and/or homes that have not traded on the open market in many years. To calculate a Zestimate, Zillow uses an algorithm that incorporates data from county and tax assessor records and direct feeds from hundreds of multiple listing services and brokerages. The Zestimate accounts for variables like: home characteristics including square footage, location or the number of bathrooms; unique features like hardwood floors, granite counter tops or a landscaped backyard; on-market data such as listing price, description, comparable homes in the area and days on the market; and off-market data — tax assessments, prior sales and other publicly available records. See <https://www.zillow.com/zestimate/> for more details.

between 75 percent and 100 percent of the area median, for between 100 percent and 125 percent of the area median and for more than 125 percent of the area median.

For mortgage information at the time of application, we make use of the Home Mortgage Disclosure Act (HMDA). HMDA records the vast majority of home mortgage applications and approved loans in the U.S. for both purchases and mortgage refinances. The data provide, among other things, mortgage applicants' application status, income, purpose of borrowing, occupancy type, and, importantly for the purpose of this paper, loan amount. We calculate the share of applications whose mortgages are above \$750,000. These are the people who would have been affected by the change in the cap in mortgage interest deductions in TCJA had TCJA been implemented that year.

#### *4.2. Tax*

The individual income tax data come from the IRS for the year 2016, which is tabulated using individual income tax returns (Forms 1040) filed with the IRS during a calendar year. The data include adjusted gross income, total number of returns, number of returns with itemized deductions, total itemized deductions amount, state and local income tax amount, and real state tax amount. With these data, we can calculate the indexes that capture the exposures of an area to TCJA: the average real estate tax to income ratio per tax return and the average adjusted gross income per tax return.<sup>10</sup>

#### *4.3. Other*

We obtain additional county-level information from various sources: unemployment from the Bureau of Labor Statistics, and total employment from the quarterly Census of Employment and Wages (QCEW). We also calculate the county-to-county migration flow using the FRB New York Consumer Credit Panel/Equifax. The credit panel is a nationally representative 5 percent random anonymous sample of all individuals with a Social Security number and a credit report (usually aged 19 and over) drawn from Equifax credit report data. For household creditworthiness, we use

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<sup>10</sup>Note that the tax data do not represent the full population of a given region because many individuals are not required to file an individual income tax return. Additionally, tax returns filed using Army Post Office (APO) and Fleet Post Office addresses, foreign addresses, and addresses in Puerto Rico, Guam, Virgin Islands, American Samoa, Marshall Islands, Northern Marianas, and Palau are excluded.

the credit score of all mortgage borrowers and fixed mortgage interest rates faced by new borrowers recorded by Black Knight McDash. Finally, we obtain the 2016 and 2018 county-level Senate general election information from Princeton University.<sup>11</sup>

#### *4.4. Summary Statistics*

Our real estate data span January 2015 to October 2019. We merge the real estate data with the 2016 tax data by county. For our baseline sample, we have an unbalanced panel with 3,079 unique counties. Table 1 presents the summary statistics of the main variables and the number of observations available for the associated variables.

According to Table 1, between January 2015 and October 2019, the annualized monthly median growth rate for house value per square foot averaged 5.2 percent. However, the variance of the growth rate was large. The top 5 percent of the counties had a growth rate of 23 percent while the bottom 5 percent of the counties had a price decline of 13 percent. In terms of levels, the median house value per square foot averaged \$109 and the median was \$82. The number of house sales also differed significantly across counties with an average of 240 and a median of 57. About 13 percent of the listings had a price cut. On average, a sale occurred after staying on the market for 3 months. Over 95 percent of the houses were sold after the listing during our sample period.

The size of the county as measured by the number of tax returns filed varied over time and across the counties with a mean of roughly 76,000 and a median of about 20,460. Real estate taxes as fractions of total gross income ranged from under 0.76 percent to almost 5 percent. Different counties had different income distribution. In the poorest counties, over 3 percent of the filers had adjusted gross income less than \$1,000. By comparison, in the richest counties, more than 7 percent of the filers had gross adjusted income above \$200,000. In 2016, very few counties had new home buyers who took out mortgages over \$750,000.

Finally, we present summary statistics for alternative house price growth rate measurement. Though these measurement had similar annualized mean growth rates, the variances were much larger when measured month over month than year over year. This is particularly true for median sale price and median list price per square foot. Not surprisingly, given its methodology, the Zillow house price index is the smoothest of all the measurement.

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<sup>11</sup>Data source: <https://libguides.princeton.edu/elections/us#s-lg-box-1612393>.

#### 4.5. *The Distribution of Real Estate Tax Burden in 2016*

We do not directly observe real estate taxes each household faces. However, we do observe at the county level the average share of real estate taxes to taxable income for those who itemize their tax deductions, which we proxy as a county's exposure to changes in the tax treatment of real estate taxes in TCJA. We discussed in the last subsection that the real estate tax burden thus constructed varies between 0.4 percent to almost 5 percent. In Figure 1, we graph the geographical distribution of the tax burden. Areas with darker shades of blue are areas that have higher real estate tax burden. As expected, these areas are concentrated in the East Coast such as Boston, New York City, and the states of Connecticut and New Jersey; the West including major cities in California and Portland in Oregon; and a few areas in central Texas and in Chicago near Lake Michigan.

In Figure 2, we present the map which charts the distribution of the fraction of tax filings with itemized deductions. Not surprisingly, areas with high real estate tax burdens are also areas that have large fraction of tax returns with itemized deductions. Given their relatively moderate house value, however, areas in the Midwest and Southeast, despite having large fractions of tax filings with itemized deductions, do not have large tax burdens.

### 5. Real Estate Taxes and House Prices

In this section, we use a difference-in-difference approach to examine how the implementation of TCJA affected local residential house prices through its changes in the deductibility of local real estate taxes. As discussed earlier, because the limit TCJA imposed on SALT deduction in federal taxes is uniform across the country, we expect the impact to be most felt in counties where the real estate tax burden is already high.

In Figure 3 panel (a), we chart the year-over-year growth rates of house value per square foot for high real estate tax versus low real estate tax areas. We use the per square foot measure because it controls for the house size in a county. High real estate tax areas include counties with average real estate tax relative to taxable income, i.e., real estate tax burden, above the median of the country in 2016. Low real estate tax areas include counties with average real estate tax burden

below the median of the country in 2016. We see that the two groups exhibit similar trends in home value growth rates prior to the implementation of TCJA. After the reform, however, the two groups demonstrate markedly different growth patterns, with the high tax burden areas experiencing much slower house value growth relative to the low tax burden areas. This phenomenon is more evident in Figure 3 panel (b) where we chart the growth rates of high tax group minus those of the low tax group. The difference exhibits a prominent downward trend after January 2018, the date TCJA became effective, indicating that home values grew slower in higher tax counties relative to lower tax counties. Before January 2018, there was no obvious trend of the difference.

As the next exercise, we divide the counties into five groups according to their real estate tax burden. In Figure 3 panel (c), we chart the difference in year-over-year home value growth rates of the top quintile and the bottom quintile. Prior to TCJA, there did not appear to be a trend in home value growth rates between the two groups. After TCJA, however, home value per square foot grew much faster for the bottom quintile than it did for the top quintile, leading to a drastic decline in the difference of the growth rates.

While the difference-in-difference approach has the advantage of being simple and straightforward, we need to address concerns of our identification strategy. The first concern is related to confounding factors. The results in Figure 3 can be spurious due to confounding events that occurred at the same time as the tax reform that also have differential impacts on house value growth in high and low tax counties. For example, the tax reform made significant changes to the federal income tax brackets. Since levels of income are correlated with real estate taxes at the county level, the negative coefficients we see in the regression can be because counties with higher income had slower growth of home value due to the changes in the income tax brackets. Section 5.1 addresses these concerns by including various controls to ensure no spurious regression results.

Second, the difference-in-difference approach requires the parallel trend assumption. House price of high and low real estate tax counties need to have a similar trend absent of the tax reform. We test this assumption by using two separate placebo tests. The results in Section 5.2 show that the parallel trend assumption cannot be rejected.

Third, Figure 3 uses a particular measure of the tax burden and the house value. To corroborate our results and ensure our results are not simply due to measurement errors, Section 5.3 shows that our results hold for various alternative measures of tax burden and home value.

Finally, we investigate the heterogeneity of the impact associated with the act within the local housing market. In particular, we divide the local housing market into four segments according to their purchase prices. The results in Section 7 indicate that the medium segment of the local housing market experienced the most negative impact on house price growth rates after the reform.

### 5.1. *Confounding Factors*

Table 2 reports regression results when we control for potential confounding factors. We cluster standard errors at the county level in all regressions. Column (1) includes measures of income such as whether a county’s average taxable income is above the national median. In addition, measures of local economic condition such as local unemployment rates and employment growth rates are included. Column (2) adds county and time fixed effects to capture time-invariant heterogeneity among counties and economy-wide time trend. Column (3) includes county and state-by-time fixed effects, which absorbs time-varying factors that affect all counties in a state. The inclusion of the state-by-time fixed effects helps address concerns that the tax reform may affect state level economy differently over time. As a result of these fixed effects, some of the controls in the earlier specification such as whether county average taxable income is above the national median and whether there is tax reform or not drop out. The coefficient estimates remain negative and statistically significant when including these control variables. Under this benchmark specification in column (3), we estimate that the implementation of TCJA lowered the high real estate tax burden area house price growth rates by 0.9 percentage point or 18 percent per year.<sup>12</sup> This amounts to about \$2,900 of loss in home value appreciation for the high tax counties on average relative to counties with lower taxes. In terms of other variables, areas with average income over the national median or high income were also negatively impacted by the implementation of the act, as were areas with high unemployment rates.

The tax reform made significant changes to the tax brackets. To control for the differential effects of the tax reform on counties with more granular levels of household income, column (4) divides counties into more income categories. The IRS reports the number of filers in each income group by counties. We compute the fraction of filers in each income group in 2016 and interact these

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<sup>12</sup>The 18 percent is calculated by dividing 0.9 by 5.2, where 5.2 is the average annualized monthly growth rate of house prices in percent.

variables with the tax reform dummy. The omitted group in the regression is for households with taxable income between \$25,000 and \$50,000. We find that the impact of the tax reform on house prices in areas with high real estate tax burden remained negative and statistically significant with a slightly larger magnitude. Taxable income exhibited a nonlinear effect on house price growth rates. In general, lower income areas tended to benefit from the act while higher income areas tended to suffer in terms of house price growth.

In column (5), we examine the impact of lowering mortgage interest deduction allowance to \$750,000 from \$1 million for new home buyers. We compute by county the fraction of buyers who borrowed more than \$750,000 in 2016, the range of mortgage borrowers affected by the provision. Not surprisingly, we find that counties with more mortgages above \$750,000 had slower house price growth, but the economic magnitude was not large and the estimate was not statistically significant either.

Column (6) considers the size effect. We include the interaction of the median house sale price from the previous year and the tax reform dummy. Our hypothesis is that areas with higher house value would be more adversely affected by the act holding everything else the same since these areas have high property taxes. In addition, counties with more expensive houses can be negatively impacted by the rising interest rate during our sample period due to the larger mortgage size. As expected, areas with high median sale prices indeed experienced slower house price growth after the tax reform. The coefficient estimate of tax burden measure continues to be negative and significant, though the extent of the impact differed a bit from our benchmark estimate reported in column (3), mainly as a result of a smaller sample size due to the inclusion of the house sale price control.

We include all the additional factors in column (7). The effect of the new real estate tax deduction cap increased to 1.5 percentage points from the baseline estimate of 0.9 in column (3), with more expensive houses continuing to be hurt by the act. Areas with more exposure to the changes in the cap of mortgage interest deduction now are no longer negatively affected by the reform.<sup>13</sup>

In the Appendix, we report additional analyses with more controls. In Table A2, we include log county per capita income. Columns (1) to (3) correspond to columns (1) to (3) in Table 2. In

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<sup>13</sup>For estimates of the 12 lags of the dependent variable, see Table A1 in the Appendix. Column (2) is the same as column (1) in Table 2 and column (1) is column (2) without the 12 lags.



columns (4) to (6), we investigate how county level income alone affected local house price growth. In Table A3, we include two measures of creditworthiness, average county level credit scores and average mortgage interest rates faced by fixed-rate first-lien mortgage borrowers in the county, to our baseline specifications in columns (1) to (3). The data are from the Black Knight McDash database. In column (4), we include log county per capita income at the annual frequency as an additional control. Note that our sample sizes fluctuated due to the availability of the additional variables. For instance, county income is not available for 2019 at the time of writing this paper. Our benchmark price effect survived the inclusion of these additional controls and the size of the effect became even larger than the baseline estimate.

## 5.2. *Placebo Tests*

To test the parallel trend assumption, we conduct two different placebo tests in this section. In the first placebo test, we run a similar regression as in column (3) of Table 2, but with different definitions of the tax reform dummy. In Table 3, each column includes a time dummy with a different starting year and its interaction with the high tax burden indicator.<sup>14</sup> For example, in column (1) the time dummy is equal to 1 if the year is 2014 or after, instead of the cut-off of 2018 as in Table 2. This regression treats the tax reform as if it became effective in 2014 and tests whether there were divergent trends in house price growth between high and low tax counties after the year 2014. The parallel trend assumption would be violated if the coefficient of the interaction term is significant both statistically and economically for starting years other than 2018. But Table 3 shows that the only significant coefficient is for the cut-off year of 2018, indicating that the results we see in Table 2 are unlikely due to differential trends of the high and low tax burden counties.

In the second test, we assume that the reform occurred in 22-month rolling windows with the beginning month ranging from January 2016 to January 2019. For example, in the first regression, the time dummy variable is equal to one between January 2016 and October 2018, and zero otherwise. We run our benchmark regression for each of the artificially created 22-month reform period indicated by the time dummies described above. Figure 4 reports the coefficient estimates and the corresponding 95 percent confidence intervals for each of the regressions with the date on the

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<sup>14</sup>We use a longer panel than that in the benchmark, January 2013 to October 2019, in order to test the parallel trend assumption for a longer horizon.

horizontal axis indicating the starting month of the 22-month periods. The coefficient estimates are not statistically significant before the actual reform effective month of January 2018. The estimates become significant when the rolling windows overlap with the actual reform period and less significant when the starting month is after the actual effective month of January 2018.

In addition to the placebo tests, we conduct several analyses to address locational concerns. First, we randomly assign counties across states and then re-produce our baseline regression with counties reassigned. The goal of this exercise is to make sure that the price effect we estimated is indeed due to the tax reform, but not due to the location of the county, unit of observation in our model. In our analysis, location matters through the state by time fixed effects we imposed in the regressions. We report two different specifications in Table 4 columns (1) and (2). The negative effect on house price growth nearly doubled.

Then, using the benchmark model but instead of state by time fixed effects, we include commuting zone by time fixed effects in columns (3) and (4) to control for time-varying commuting zone level factors. The results do not change much. In specification (5), we aggregate counties to MSAs (metropolitan statistical area) so that the unit of observation is now at the MSA level. MSA is viewed as an integrated labor market. The negative price effect remained and became slightly larger in all specifications except the last one. This last result of no significant house price effect at the MSA level is not surprising because the large size of MSAs masked the heterogeneity in housing market that we try to uncover here.

### 5.3. *Alternative Measures*

We conduct two robustness analyses in this section concerning measurement. First, we experiment with different house price measurement. Second, we construct different measures of local exposure to the TCJA provision of capping SALT.

In Table 5, we experiment with different measures of the house price growth rates. Column (1) uses our benchmark measure in Table 2 for ease of comparison. Columns (2) to (4) use sale price, list price per square foot, and the Zillow House Price Index. As with the benchmark specification, we construct the corresponding house price growth rates as annualized month over month. Columns (5) to (8) use the same house price measures as in columns (1) to (4), but construct the house price growth rates using the year-over-year basis. Two observations stand out from our exercises. First,

the negative effects associated with the tax reform that restricted local property tax deduction on house price growth rates hold in all eight specifications and the estimates are all statistically significant. Second, the size of the effects does vary over the different measures used. Overall, the effects are smaller when the growth rates are measured as the year-over-year changes. Additionally, the effects associated with sale price and list price are much larger than those associated with the median value per square foot and the Zillow House Price Index. The smaller effect associated with median value per square foot suggests that house size matters in the estimation. The smaller effect associated with the Zillow House Price Index may have to do with the smoothness built in the construction of the index as the Zillow House Price Index exhibits much stronger auto-correlation than the other house price measures.

So far we have measured the exposure to TCJA as the real estate tax burden, i.e., the ratio of real estate tax to taxable income. Areas with high real estate tax payment relative to income are more likely to have high real estate taxes and, hence, more likely to be adversely affected by the TCJA cap on the SALT federal tax deduction. To corroborate our results, we experiment with several alternative measures. First, we add together state and local taxes, and construct a high state and local tax to income dummy that takes the value of 1 if the ratio exceeds the national median, and zero otherwise. Then, we focus on tax levels and define high real estate tax areas as areas where the average real estate taxes paid exceed the national median. Similarly, we define high income tax areas as areas where the average income taxes exceed the national median. The results are displayed in Table 6.

Interestingly, when we lump the state income taxes paid with the real estate taxes paid, though the house price appreciation rates still slowed after the reform, the effect became statistically insignificant as shown in column (2). This may be due to the fact that the state by time fixed effects in the regression absorb most of the state-level variation in state income tax rates. When we measure the exposure by levels, i.e., the amount of real estate taxes paid in column (3) or the total amount of the state and local taxes paid in column (4), we observe a much larger negative impact on house price growth rates after the implementation of the reform. Specifically, areas with high real estate taxes or high state and local taxes experienced a slower house price growth of 1.6 percentage points, a reduction in growth rates of over 30 percent ( $=1.6/5.2$ ). The new estimates, however, are on par with that in Table 2 columns (6) and (7) when we explicitly control for the

median sale price from the previous year. This is not surprising, as this alternative measure of TCJA exposure is highly correlated with our benchmark measure with a correlation coefficient over 0.6.

#### 5.4. *Dynamic Price Effects*

How does the response in local house prices to TCJA change over time? Following Jorda (2005), we obtain local projections based on sequential regressions of local house price growth rates shifted forward. Specifically, the dynamic effect is given by a vector of estimates  $\{\beta_1^{(i)}\}_{i=0,1,2,\dots,12}$  collected from the estimations

$$\log(HPI_{c,t+i}) - \log(HPI_{c,t+i-1}) = \beta_1^{(i)} Taxburden_{c,t-1} \times TaxReform_t + \beta_2 X_{c,t} + \alpha_c + \gamma_{s,t} + \varepsilon_{c,t}, \quad (5)$$

where each estimate of  $\beta_1^{(i)}$  captures the effect of TCJA at horizon  $i$ .<sup>15</sup> The case where  $i = 0$  corresponds to our baseline specification (column 3 table 2).

We use the full sample for our regressions. Figure 5 presents the dynamic house price effects implied by the estimations. The negative price effect was stable for the first eight months after the implementation of TCJA. Then it became insignificant and quickly disappeared, potentially because our data ends in October, 2019.<sup>16</sup>

## 6. Rental Prices and Housing Market Liquidity

We focused on the effects of the tax reform on house prices in the previous section. To corroborate the evidence, we investigate how the implementation of TCJA affected the rental prices and other local housing market indicators such as sales volume, number of sales with price cuts, days on the market before sale, and sales-to-list ratio.

The tax reform on the SALT deduction does not directly affect rental properties since real estate taxes are considered business expenses for landlords and can still be deducted from rental income the same way as before the reform. To test the impact of the tax reform on rental prices, we run

<sup>15</sup>Of the other control variables,  $Taxburden_{c,t-1}$  represents the real estate tax burden,  $X_{c,t}$  represents other county level controls,  $\alpha_c$  represents county fixed effects and  $\gamma_{s,t}$  represents state time fixed effects. The term  $\varepsilon_{c,t}$  represents the error term. We cluster the standard errors at the county level.

<sup>16</sup>For example, with the forecast horizon  $i = 12$ , the regression can be run only with data till October, 2018. This reduces the statistical power of detecting longer term effects of the tax reform.

our benchmark regressions on rental price growth. Table 7 reports the results. The coefficient for the interaction term between the tax reform dummy and the tax burden measure is not statistically significant in three of the four specifications and only marginally statistically significant at 10% for one measure. This indicates that the tax reform had no differential impact on rental price growth in counties with high or low real estate tax burden. These results are consistent with our assumption of a constant housing utility flow  $\omega Q$  in equations (1) and (3), as mentioned in section 3.

To help us understand the effects on market liquidity associated with the new SALT deduction cap, we apply our benchmark regressions to various housing market indicators. The baseline housing market liquidity results are reported in Table 8 columns (2) to (5). We include the benchmark house price results in column (1) for ease of comparison. Overall, we find some evidence that TCJA had a negative impact on housing market liquidity in areas with high real estate tax burden. In particular, after TCJA took effect, areas with high real estate tax burden had a decline in sales volume, an increase in listings that had a price cut (though this estimate is not statistically significant), longer days on the market before sales (though this estimate is not statistically significant), and lower sale-to-list ratio relative to areas with low real estate tax burden. Specifically, the implementation of TCJA reduced the sales volume by a little over 1 percent, and reduced the sale-to-list ratio by 12 basis points or about 0.13 percent. In addition to the negative impact from TCJA on high real estate tax burden areas, we find negative housing liquidity effects associated with TCJA for high income areas with magnitudes similar to those associated with high real estate tax burden areas. In other words, the negative housing market liquidity effects from TCJA are doubled for those areas with both high real estate tax burden and high income.

In Table A4 in the Appendix, we include more taxable income groups as controls, similar to column (4) of Table 2. All the results reported continue to hold. Moreover, we find additional negative housing liquidity effect on days on the market before sale. In particular, TCJA increased the number of days a property stayed on the market before sale by 1.3, or around 1.4 percent.

## 7. Different Housing Market Segments

In our earlier analysis as reported in Table 2 column (6), we demonstrated that the tax reform impacted areas with large median sale prices disproportionately more negatively. In this section, we

further investigate whether the effects of the tax reform on the housing markets vary by finer tax burden groups or by different price segments.

In Table 9, we allow for more real estate tax burden groups. This allows us to investigate the nonlinear relationship between the effect of the tax reform over different tax burden levels. The omitted group in the regressions is the third quintile of real estate tax burden. We see that areas in the bottom two quintiles of real estate tax burden were not affected by the implementation of the tax reform with the exception of the number of days on the market before sale, while areas in the top two quintiles were significantly and negatively affected both in home value and in market liquidity (with the exception of the percent of house sales with price cut). More importantly, the house price effect for the fifth quintile is much larger in magnitude, with the house price growth being 1.9 percentage points slower per year relative to the middle quintile.

In Table 10, we bring in house price indices for different local housing market segments as constructed by CoreLogic Solutions, an on-line property data provider. The CoreLogic Solutions Home Price Index is a repeat sales index created by CoreLogic Solutions. Specifically, CoreLogic Solutions matches house price changes on the same properties in the public record files from First American and then computes separate indexes by locality and price range. We use the four purchase price tiers constructed depending on whether the home sold for less than 75 percent of the area median price, for between 75 percent and 100 percent of the area median, for between 100 percent and 125 percent of the area median and for more than 125 percent of the area median.

Looking across columns of Table 10, the top two segments of the housing market suffered the most in terms of house price appreciation rates after the tax reform, and the magnitude of the negative effects was in line with our earlier findings reported in Table 2 column (6). The lower segments of the housing market were not affected statistically significantly. Of the top two segments, the highest segment of the market had a smaller negative impact due to the positive income tax we discussed earlier as more expensive houses are typically associated with higher homeowner income.

## 8. Real Effects and Household Response

We now turn to analyzing the differential real effects of the tax reform on the local economies and household response to the tax reform. We ask how the reform has affected the local labor market,

specifically the construction activities. We also examine household responses such as cross-county migration and voting outcomes of the 2018 midterm Senate elections.

### *8.1. Labor Market Performance and Construction Activities*

In the analysis, we follow the specification in our benchmark analysis (Table 2 specification (3)) and also allow for the nonlinear effects (Table 9). For labor market performance, we use annualized year-over-year employment growth rates in the construction sector as the dependent variables. For construction activities, we use the log of the number of building permits for multi-family units and single-family units. A building permit is an official approval issued by the local governmental agency that allows a homeowner or a contractor to proceed with a construction or remodeling project on the property. The estimation results are reported in Table 11. To control for other local demand factors, we include non-construction employment growth in a county in the regressions.

Areas with high real estate tax burden experienced slower employment growth in the construction sector after TCJA took effect (column (1)). While areas with high real estate tax burden also had a decline in multi-family building permits after the act, areas with high income had a rise in multi-family building permits though the estimate for the latter was not statistically significant (column (2)). In terms of single-family building permits, the effects were negative for both groups but were not statistically significant. When we allow for more categories of tax burden, column (4) shows that the effects of the tax reform on construction employment growth are more negative as the real estate tax burden increases. For building permits, interestingly, the negative impact is statistically significant for the 4th quintile for multi-family and the first quintile for single-family.

Our construction employment results are intuitive. Our finding that the single-family building permits were not affected significantly by TCJA while the multi-family building permits were significantly negatively affected seems counter intuitive since single-family houses tend to be more expensive than multi-family units. It is important to bear in mind that building permits include remodeling on the property, which is much less costly than constructing a new house.

### *8.2. Cross-County Migration*

Given the significant heterogeneity in real estate tax burden across counties within the country, everything else being equal, we expect to see relatively more out-migration in counties that are

more exposed to real estate tax burden than in counties that are less exposed after the tax reform. To construct our migration rates at the county level, we use the FRB New York Consumer Credit Panel/Equifax. The data record the county code of the individual each quarter. A person is considered a mover if the recorded county codes are different across two adjacent quarters. For each county in each quarter, we calculate the number of people who left the county as out-migration and the number of people who moved into the county as in-migration. Then we divide the numbers for the total number of people in that county to obtain the out-migration and in-migration rates. Net out-migration rates are the difference of the two and they are annualized before the regression analysis. We also separately measure the net migration rates for homeowners and non-homeowners. We indicate an individual as a homeowner if the person has a mortgage in the previous quarter. We hypothesize that homeowners are more negatively affected by the tax reform in high real estate tax areas.

We report our estimation results where we allow for nonlinear effects associated with the real estate tax burden and with taxable income in Table 12. For areas with the highest real estate tax burden, we see a statistically significant positive effect from TCJA on net out-migration rates (column (1)). In addition, this effect is more pronounced for individuals with a mortgage in the previous quarter. For example, counties in the fifth quintile of real estate tax burden experienced a 0.19 percentage point increase in the net out-migration rate relative to counties in the middle quintile. For individuals with a mortgage, the effect increased to 0.29 percentage point.

### *8.3. 2018 Midterm Senate Elections*

The 2018 midterm Senate elections were held on November 6, 2018. Of the 100 seats, 33 were contested in regular elections while two others were contested in special elections due to Senate vacancies in Minnesota and Mississippi. Senate Democrats had 26 seats up for election while Senate Republicans had nine seats up for election.

To test whether the tax reform act affected the voting behavior, we construct a cross-sectional sample that consists of 806 counties that voted in the 2018 midterm elections. We use the voting share for Democratic candidates as our dependent variable, which is the total number of voters who voted for Democratic candidates divided by the total number of voters for either Democratic or Republican candidates. The constructed voting share is very similar to total voting share,



since votes for third parties are negligible. We include our variable of interest, high real estate tax relative to income, as well as control variables such as whether the county belongs to the high income category, the unemployment rates and employment growth rates for year 2016 and 2018, the 2016 voting shares for Democratic candidates in the same county, party affiliation of the incumbent in both 2016 and 2018, and state fixed effects.

In Table 13, we report our regression results under four different specifications. For all the specifications, we find that counties with high real estate tax burden had a larger voting share for Democratic candidates relative to counties with low real estate tax burden, even holding constant their Democratic voting shares in 2016. Areas with high tax burden had an increase in their Democratic voting share ranging from 1.4 percentage points to 2.7 percentage points. Given that the mean voting share for Democratic candidate was 38.6 percent, the effect amounts to 3 to 7 percent of the votes for Democratic candidates.

## 9. Conclusion

In this paper, we provide evidence that capping the SALT deduction as part of the Tax Cuts and Jobs Act in January 2018 has had important distributional impacts on the nation’s residential housing market. Using county-level housing data as well as IRS tax data, we show that areas with high real estate taxes relative to income were more adversely affected by the act than areas with lower real estate taxes relative to income. After 2018, the high tax areas experienced slower growth in home value and a deterioration in housing liquidity as measured by the number of housing transactions and market listing performance.

The tax reform also had differential real impacts on the labor market across counties with high and low tax burden. We show that areas with high tax burden experienced slower employment growth in the construction sector as well as relatively less housing construction as measured by the number multi-unit building permits. On net, more people also moved out of these high tax exposure areas, especially homeowners. Taken together the areas with high real estate taxes had less economic benefit relative to the areas with low real estate taxes after TCJA. It is not surprising that we also find that relatively more voters in these areas voted for their Democratic candidates than the Republican candidates during the 2018 midterm Senate elections. It is important to keep

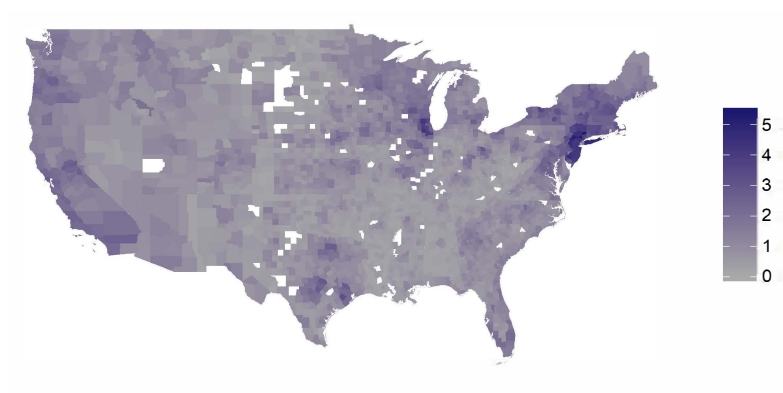
in mind that we do not attempt to assess the overall benefits of the tax reform. The methodology in the paper only allows us to measure the relative effects of the SALT cap on different local economic areas, while holding all other factors constant.

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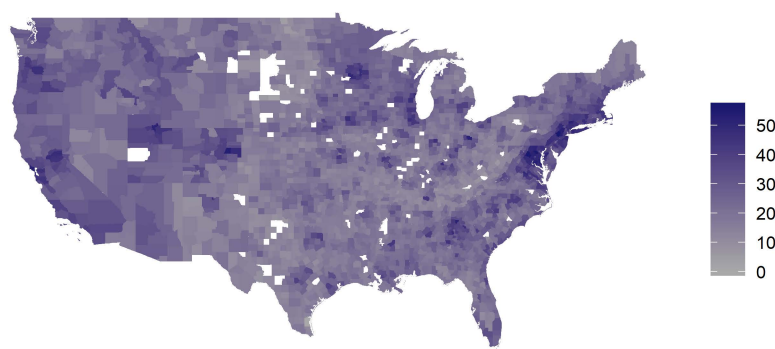
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Figure 1: Average Real Estate Tax over Taxable Income in Percents



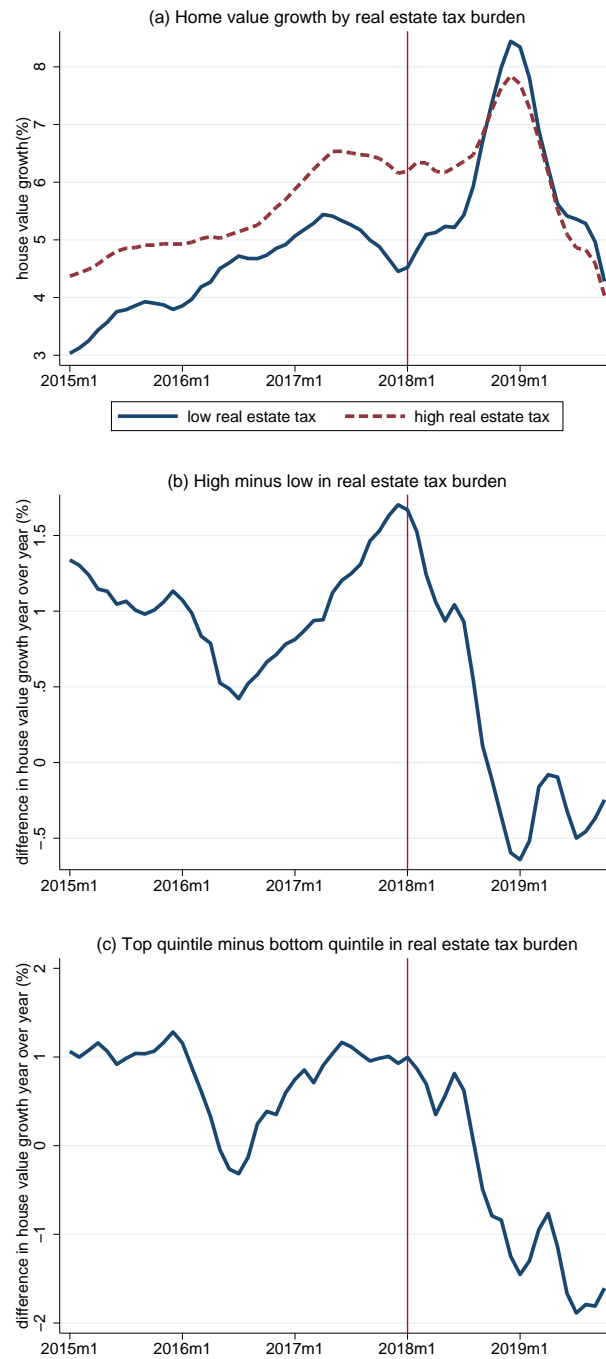
**Note:** The map is drawn at the county level. The data are based on the 2016 IRS report.

Figure 2: Percents of Returns with Itemized Deductions



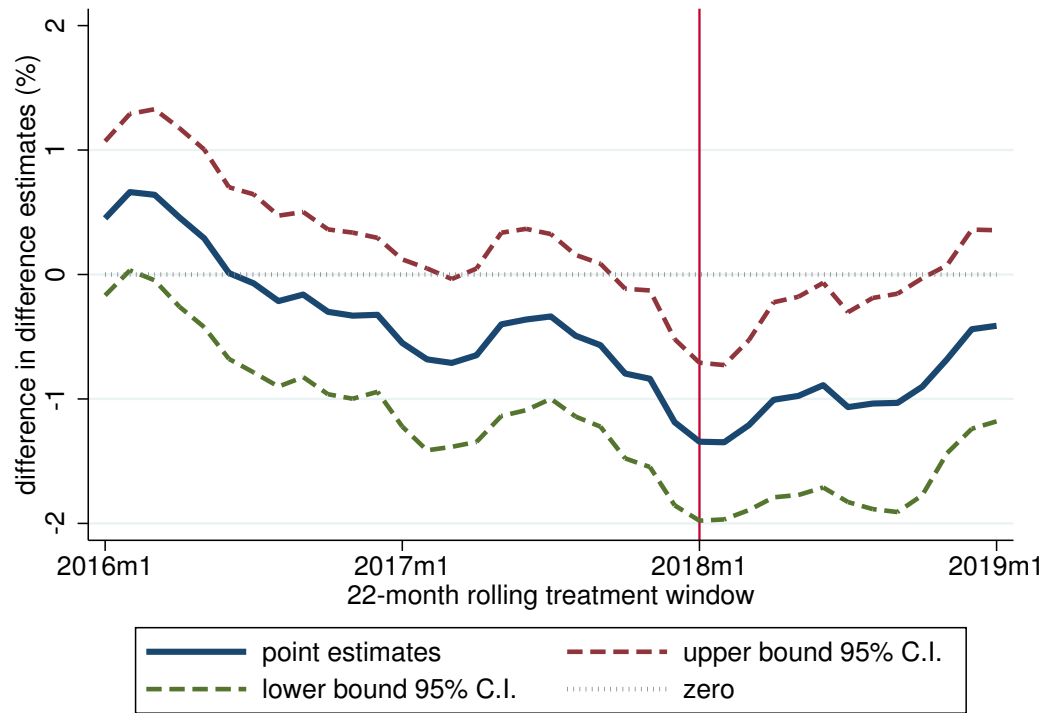
**Note:** The map is drawn at the county level. The data are based on the 2016 IRS report.

Figure 3: House Value Growth Rates and Real Estate Tax Burden



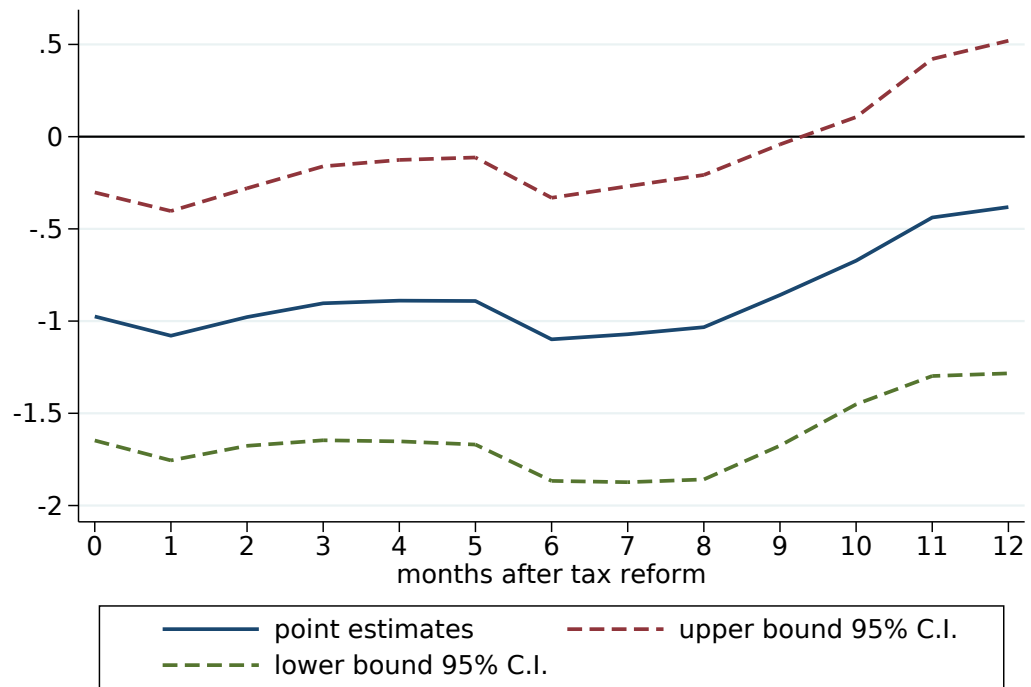
**Note:** Real estate tax burden is calculated as real estate taxes relative to taxable income. The data for the real estate tax burden come from 2016 IRS report. The house value growth rates use the median house value per square foot from Zillow.

Figure 4: Rolling-Window Placebo Tests



**Note:** This figure depicts 22-month rolling window placebo test results. The x-axis corresponds to the starting month of the assumed time dummy and the y-axis corresponds to the associated point estimates. The vertical line is the actual reform starting month. The dotted lines represent the 95 percent confidence intervals.

Figure 5: The Dynamic House Price Effects



**Note:** This figure depicts dynamic house price effects from TCJA. The x-axis corresponds to the month since the implementation of TCJA and the y-axis corresponds to the associated point estimates on house prices. The dotted lines represent the 95 percent confidence intervals.



Table 1: Summary Statistics

	count	mean	sd	p5	p25	p50	p75	p95
House price growth (annualized monthly growth, %)	102952	5.19	11.2	-12.7	0	0	12.2	22.9
Median price per square foot (\$)	102964	108.6	81.6	44	66	89	126	218
Number of sales	83406	239.5	600.6	1	19	57	206	1037
Percent with price cut (%)	73695	12.5	4.04	6.21	9.63	12.3	15.1	19.6
Days on markets	38488	92.2	30.3	54.5	70	86	109	150
Sale-to-list ratio (%)	54799	96.1	3.03	91.1	94.5	96.3	97.8	100
Number of filers	102964	76153	199226	2790	9470	20460	61300	336450
Ratio of real estate tax to income (county average) (%)	102964	1.19	0.76	0.36	0.64	1.02	1.51	2.57
Average county income (\$'000)	102964	56.8	16.9	39.8	46.3	52.8	62.5	88.7
Percent of filers with income less than \$1	102964	1.70	0.85	0.89	1.15	1.43	1.95	3.45
Percent of filers with income between \$1 and \$10k	102964	14.8	1.81	11.9	13.6	14.7	15.9	17.7
Percent of filers with income between \$10k and \$25k	102964	22.5	4.42	15.7	19.5	22.2	25.2	30.1
Percent of filers with income between \$25k and \$50k	102964	24.6	2.74	19.8	23.2	24.8	26.2	28.7
Percent of filers with income between \$50k and \$75k	102964	13.9	1.45	11.4	13.0	14.0	14.9	16.1
Percent of filers with income between \$75k and \$100k	102964	8.92	1.59	6.26	7.88	8.94	10	11.5
Percent of filers with income between \$100k and \$200k	102964	10.8	3.91	5.60	7.97	10.2	12.8	18.6
Percent of filers with income above \$200k	102964	2.81	2.32	0.85	1.42	2.09	3.35	7.42
Percent of mortgages between \$750k and \$1m in 2016	102964	0.89	3.49	0	0	0.19	0.52	3.05
Other House Price Measures								
	count	mean	sd	p5	p25	p50	p75	p95
Median price per square foot (annualized monthly growth, %)	102952	5.19	11.2	-12.7	0	0	12.2	22.9
Median sale price (annualized monthly growth, %)	56177	5.68	49.9	-73.7	-15.0	6.03	26.7	84.9
Median listed price per square foot (annualized monthly growth, %)	88790	4.61	31.3	-42.5	-8.13	3.20	17.0	55.0
Zillow Home Price Index (annualized monthly growth, %)	98315	5.25	8.19	-6.53	1.27	5.14	9.23	17.3
Median price per square foot (year-over-year growth, %)	102808	5.19	4.48	-1.63	2.70	5.13	7.70	12.2
Median sale price (year-over-year growth, %)	87219	4.23	6.08	-5.51	0.99	4.14	7.42	14.2
Median listed price per square foot (year-over-year growth, %)	53378	5.70	8.13	-7.55	1.50	5.82	10.00	18.5
Zillow Home Price Index (year-over-year growth, %)	98192	5.27	4.42	-1.27	2.75	5.18	7.74	12.3

**Note:** This table reports summary statistics for the variables used in the paper. Count refers to the number of observations. The house value per square foot is calculated by taking the estimated home value for each home in a county and dividing it by the home's square footage. Median list price is the median price of homes listed for sale at Zillow. Median list price per square foot is the median of listed prices divided by the square footage of the listed home. Zillow home value index is a smoothed, seasonally adjusted measure of the typical home value in a county. See <https://www.zillow.com/research/data/> for more information on housing data. Data source: IRS and Zillow.

Table 2: House Price Growth and Tax Reform

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	House price growth (%)	House price growth (%)	House price growth (%)	House price growth (%)	House price growth (%)	House price growth (%)	House price growth (%)
High real estate tax to income * Tax reform	-1.351*** (0.175)	-1.873*** (0.237)	-0.912*** (0.288)	-1.006*** (0.334)	-0.886*** (0.290)	-1.750*** (0.353)	-1.476*** (0.328)
High income * Tax reform	-1.271*** (0.181)	-1.888*** (0.254)	-1.765*** (0.246)		-1.740*** (0.259)	-1.239*** (0.369)	
High real estate tax to income	0.623*** (0.112)						
High income	0.324** (0.129)						
Tax reform	1.677*** (0.167)						
Percent of filers with income less than \$1 * Tax reform				0.602** (0.242)			1.224*** (0.352)
Percent of filers with income between \$1 and \$10k * Tax reform				-0.147 (0.142)			-0.0186 (0.139)
Percent of filers with income between \$10k and \$25k * Tax reform				0.0825 (0.123)			0.298* (0.157)
Percent of filers with income between \$50k and \$75k * Tax reform				-1.196*** (0.284)			-0.879*** (0.338)
Percent of filers with income between \$75k and \$100k * Tax reform				1.552*** (0.263)			1.865*** (0.278)
Percent of filers with income between \$100k and \$200k * Tax reform				-0.261** (0.116)			-0.291** (0.130)
Percent of filers with income above \$200k * Tax reform				-0.333*** (0.103)			0.167 (0.159)
Percent of mortgages above \$750k * Tax reform					-0.136 (0.237)		-0.515 (0.373)
Median sale price one year ago * Tax reform						-0.00852*** (0.00144)	-0.00780*** (0.00266)
Unemployment rate (%)	0.0934*** (0.0284)	0.0266 (0.0879)	-0.321*** (0.103)	-0.227** (0.0951)	-0.321*** (0.103)	-0.236** (0.113)	-0.239** (0.113)
Employment growth (%)	0.136*** (0.0206)	0.0539* (0.0317)	0.0199 (0.0430)	0.0125 (0.0413)	0.0196 (0.0430)	0.0276 (0.0522)	0.0129 (0.0542)
N	101014	101014	100957	100957	100957	52724	52724
R-sq	0.133	0.198	0.280	0.284	0.280	0.338	0.340
Fixed effects		county, time	county, state by time	county, state by time	county, state by time	county, state by time	county, state by time
Lagged dependent variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes

**Note:** This table explores the effect of TCJA on house prices with alternative controls. House price growth rate is computed as the log growth rate of the median house value per square foot reported by Zillow Inc. The growth rate is annualized and in percentage terms. We include 12 lags of house price growth rates for all regressions. High real estate tax to income is a dummy variable that takes a value of 1 if the ratio is above the national median and zero otherwise. High income is also a dummy variable that takes a value of 1 if the county's average AGI is above the national median and zero otherwise. Tax reform is another dummy variable that takes the value of 1 after January 2018 and zero otherwise. Standard errors are clustered at the county level and reported in parentheses, \*, \*\*, and \*\*\* indicate the estimated coefficients are statistically significant at the 10 percent, 5 percent, and 1 percent level, respectively. Data source: HMDA, IRS, BLS and Zillow.

Table 3: House Price Growth and Tax Reform: Alternative Reform Date

	(1)	(2)	(3)	(4)	(5)	(6)
	Time dummy = 1 if year >= 2014	Time dummy = 1 if year >= 2015	Time dummy = 1 if year >= 2016	Time dummy = 1 if year >= 2017	Time dummy = 1 if year >= 2018	Time dummy = 1 if year >= 2019
High real estate tax to income *	0.361	-0.389	-0.418	-0.514*	-0.899***	-0.380
Time dummy	(0.391)	(0.294)	(0.320)	(0.284)	(0.274)	(0.388)
High income * Time dummy	-1.944***	-1.253***	-1.316***	-1.660***	-1.883***	-1.257***
	(0.348)	(0.261)	(0.244)	(0.222)	(0.234)	(0.324)
Unemployment rate (%)	-0.355***	-0.342***	-0.326***	-0.306***	-0.323***	-0.394***
	(0.101)	(0.101)	(0.100)	(0.0993)	(0.0983)	(0.100)
Employment growth (%)	0.0532**	0.0534**	0.0575***	0.0546***	0.0531**	0.0539***
	(0.0213)	(0.0214)	(0.0194)	(0.0201)	(0.0209)	(0.0206)
N	141294	141294	141294	141294	141294	141294
R-sq	0.315	0.315	0.316	0.316	0.316	0.315
Fixed effects	county, state by time	county, state by time	county, state by time	county, state by time	county, state by time	county, state by time
Lagged dependent variables	Yes	Yes	Yes	Yes	Yes	Yes

**Note:** We repeat our benchmark regression analysis in Table 2 column (3) using a longer panel January 2013-October 2019. We include 12 lags of house price growth rates. In each analysis, we assume a different time dummy. Column (5) in this table sets the time dummy to 2018 which corresponds to the true reform time. High real estate tax to income is a dummy variable that takes a value of 1 if the ratio is above the national median and zero otherwise. High income is also a dummy variable that takes a value of 1 if the county's average AGI is above the national median. Tax reform is another dummy variable that takes the value of 1 after January 2018 and zero otherwise. Standard errors are clustered at the county level and reported in parentheses, \*, \*\*, and \*\*\* indicate the estimated coefficients are statistically significant at the 10 percent, 5 percent, and 1 percent level, respectively. Data source: IRS, BLS and Zillow.

Table 4: House Price Growth and Tax Reform: Random State Assignment and Other Robustness Analyses

	(1)	(2)	(3)	(4)	(5)
	House price growth (%)	House price growth (%)	House price growth (%)	House price growth (%)	House price growth (%)
High real estate tax to income * Tax reform	-1.800*** (0.235)	-1.668*** (0.337)	-1.100** (0.462)	-1.004** (0.509)	-0.309 (0.352)
High income * Tax reform	-1.790*** (0.255)		-1.406*** (0.344)		-0.872*** (0.294)
Percent of filers with income less than \$1 * Tax reform		-0.298 (0.321)		1.066** (0.444)	
Percent of filers with income between \$1 and \$10k * Tax reform		0.347*** (0.119)		-0.0175 (0.206)	
Percent of filers with income between \$10k and \$25k * Tax reform		0.266** (0.132)		0.0849 (0.240)	
Percent of filers with income between \$50k and \$75k * Tax reform		-0.0845 (0.266)		-1.091** (0.449)	
Percent of filers with income between \$75k and \$100k * Tax reform		1.232*** (0.244)		1.767*** (0.436)	
Percent of filers with income between \$100k and \$200k * Tax reform		-0.113 (0.116)		-0.332 (0.207)	
Percent of filers with income above \$200k * Tax reform		0.296*** (0.111)		-0.0685 (0.202)	
Percent of mortgages above \$750k * Tax reform		-0.756** (0.321)		-0.198 (0.480)	
Median sale price one year ago * Tax reform		-0.00758*** (0.00132)		-0.00602* (0.00323)	
Unemployment rate (%)	0.0275 (0.0708)	0.00808 (0.0752)	-0.258* (0.150)	-0.166 (0.134)	-0.794*** (0.215)
Employment growth (%)	0.0525* (0.0296)	0.0533 (0.0397)	-0.0504 (0.0573)	-0.0159 (0.0571)	0.0789 (0.0832)
N	100560	52556	91918	44486	35244
R-sq	0.265	0.329	0.530	0.585	0.524
Fixed effects	county, state by time	county, state by time	county, commuting zone by time	county, commuting zone by time	county, state by time
Lagged dependent variables	Yes	Yes	Yes	Yes	Yes
Specification	county random assignment	county random assignment	commuting zone by time fix effects	commuting zone by time fix effects	metro level aggregation

**Note:** This table presents the analysis of TCJA on house price while we randomly assign counties to states in columns (1) and (2). Columns (3) and (4) apply different location by time fixed effects. Column (5) uses MSA as our unit of our observation. The taxable income brackets are as those reported in the IRS data. Standard errors are clustered at the county level and reported in parentheses, \*, \*\*, and \*\*\* indicate the estimated coefficients are statistically significant at the 10 percent, 5 percent, and 1 percent level, respectively. We include 12 lags of the dependent variables in each regression. High real estate tax to income is a dummy variable that takes a value of 1 if the ratio is above the national median and zero otherwise. High income is also a dummy variable that takes a value of 1 if the county's average AGI is above the national median. Tax reform is another dummy variable that takes the value of 1 after January 2018 and zero otherwise. Data source: IRS, BLS and Zillow.

Table 5: House Price Growth and Tax Reform: Alternative House Price Measurement

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Median value per sq ft growth (%)	Sale price growth (%)	List price per sq ft growth (%)	Zillow HPI growth (%)	Median value per sq ft year over year growth (%)	Sale price year over year growth (%)	List price per sq ft year over year growth (%)	Zillow HPI year over year growth (%)
High real estate tax to income * Tax reform	-0.912*** (0.288)	-3.476*** (1.167)	-2.306*** (0.857)	-0.392*** (0.127)	-0.0909** (0.0402)	-0.302*** (0.116)	-0.502*** (0.160)	-0.0391** (0.0152)
High income * Tax reform	-1.765*** (0.246)	-1.125 (1.119)	-3.759*** (0.501)	-0.763*** (0.0956)	-0.209*** (0.0317)	-0.459*** (0.0666)	-0.141 (0.189)	-0.0678*** (0.0120)
Unemployment rate (%)	-0.321*** (0.103)	-0.483 (0.403)	-0.902*** (0.344)	-0.136*** (0.0409)	-0.0578*** (0.0107)	-0.0314 (0.0396)	-0.0169 (0.0455)	-0.0235*** (0.00434)
Employment growth (%)	0.0199 (0.0430)	-0.0225 (0.170)	0.169 (0.166)	0.00454 (0.0184)	-0.0000177 (0.00562)	0.00794 (0.0202)	-0.00190 (0.0239)	0.00100 (0.00206)
N	100957	60828	111550	111689	100746	107967	56129	111417
R-sq	0.280	0.417	0.312	0.820	0.958	0.851	0.813	0.994
Fixed effects	county, state by time	county, state by time	county, state by time	county, state by time	county, state by time	county, state by time	county, state by time	county, state by time
Lagged dependent variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

**Note:** This table explores the effect of TCJA on house prices with alternative house price measurement. The monthly growth rates used in specifications (1) to (4) are annualized. We include 12 lags of house price growth rates. High real estate tax to income is a dummy variable that takes a value of 1 if the ratio is above the national median and zero otherwise. High income is also a dummy variable that takes a value of 1 if the county's average AGI is above the national median and zero otherwise. Tax reform is another dummy variable that takes the value of 1 after January 2018 and zero otherwise. Standard errors are clustered at the county level and reported in parentheses, \*, \*\*, and \*\*\* indicate the estimated coefficients are statistically significant at the 10 percent, 5 percent, and 1 percent level, respectively. Data source: IRS, BLS and Zillow.

Table 6: House Price Growth and Tax Reform: Alternative Measures of Tax Exposure

	(1) House price growth (%)	(2) House price growth (%)	(3) House price growth (%)	(4) House price growth (%)
High real estate tax to income * Tax reform	-0.912*** (0.288)			
High state and local tax to income * Tax reform		-0.142 (0.333)		
High real estate tax * Tax reform			-1.640*** (0.272)	
High state and local tax * Tax reform				-1.390*** (0.442)
High income * Tax reform	-1.765*** (0.246)	-2.034*** (0.243)	-1.527*** (0.246)	-1.594*** (0.280)
Unemployment rate (%)	-0.321*** (0.103)	-0.327*** (0.103)	-0.325*** (0.104)	-0.327*** (0.104)
Employment growth (%)	0.0199 (0.0430)	0.0193 (0.0431)	0.0175 (0.0435)	0.0163 (0.0434)
N	100957	100957	100957	100957
R-sq	0.280	0.280	0.281	0.281
Fixed effects	county, state by time	county, state by time	county, state by time	county, state by time
Lagged dependent variables	Yes	Yes	Yes	Yes

**Note:** We repeat our benchmark regression analysis in column (3) of Table 2 using alternative measures of county exposure to TCJA SALT tax changes. We include 12 lags of house price growth rates. Column (1) reproduces the benchmark result for ease of comparison. In column (2), we define high state and local tax to income as a dummy variable that take the value of 1 if the ratio exceeds the national median and zero otherwise. In column (3), we define high real estate tax as a dummy variable that takes the value of 1 if the county's average real estate taxes paid exceed the national median and zero otherwise. We define high state and local tax and high income variables accordingly. Standard errors are clustered at the county level and reported in parentheses, \*, \*\*, and \*\*\* indicate the estimated coefficients are statistically significant at the 10 percent, 5 percent, and 1 percent level, respectively. Data source: IRS, BLS and Zillow.

Table 7: Rental Price Growth and Tax Reform

	(1)	(2)	(3)	(4)
	Zillow Rental Price Index growth (%)	Rental price per sq ft growth (%)	Zillow Rental Price Index year over year growth (%)	Rental price per sq ft year over year growth (%)
High real estate tax to income * Tax reform	-0.0856 (0.370)	0.310* (0.167)	0.0119 (0.0247)	0.121 (0.103)
High income * Tax reform	-0.459* (0.251)	-0.448*** (0.120)	-0.0357** (0.0157)	-0.114 (0.0881)
Unemployment rate (%)	-0.410*** (0.103)	-0.0848 (0.0607)	-0.0148*** (0.00566)	-0.0881** (0.0373)
Employment growth (%)	0.0821*** (0.0268)	0.0353** (0.0147)	0.00538*** (0.00166)	0.0125 (0.0108)
N	108477	83980	92746	19815
R-sq	0.391	0.784	0.989	0.961
Fixed effects	county, state by time	county, state by time	county, state by time	county, state by time
Lagged dependent variables	Yes	Yes	Yes	Yes

**Note:** This table reports the effects of tax reform on county rental price indices. We use the benchmark regression specification in Table 2 column (3). The monthly growth rates used in columns (1) and (2) are annualized. We include 12 lags of rent price growth rates. High real estate tax to income is a dummy variable that takes a value of 1 if the ratio is above the national median and zero otherwise. High income is also a dummy variable that takes a value of 1 if the county's average AGI is above the national median and zero otherwise. Tax reform is another dummy variable that takes the value of 1 after January 2018 and zero otherwise. Standard errors are clustered at the county level and reported in parentheses, \*, \*\*, and \*\*\* indicate the estimated coefficients are statistically significant at the 10 percent, 5 percent, and 1 percent level, respectively. Data source: IRS, BLS and Zillow.

Table 8: Housing Market Liquidity and Tax Reform

	(1) House price growth (%)	(2) Number of sales (log)	(3) Percent with price cut	(4) Days on market	(5) Sale-to-list ratio (%)
High real estate tax to income *	-0.912*** (0.288)	-0.0117** (0.00542)	0.0538 (0.0583)	0.567 (0.530)	-0.115* (0.0644)
Tax reform					
High income * Tax reform	-1.765*** (0.246)	-0.0119** (0.00575)	0.230*** (0.0514)	3.034*** (0.561)	-0.144*** (0.0407)
Unemployment rate (%)	-0.321*** (0.103)	-0.00537*** (0.00185)	0.0292 (0.0290)	0.802*** (0.232)	-0.0928*** (0.0290)
Employment growth (%)	0.0199 (0.0430)	0.000781** (0.000338)	-0.0189*** (0.00666)	-0.239** (0.113)	0.00947 (0.0116)
N	100957	141123	92967	35458	56758
R-sq	0.280	0.993	0.901	0.945	0.925
Fixed effects	county, state by time	county, state by time	county, state by time	county, state by time	county, state by time
Lagged dependent variables	Yes	Yes	Yes	Yes	Yes

**Note:** This table explores the effect of TCJA on housing market liquidity. Column (1) repeats our benchmark analysis on house prices for ease of comparison. We include 12 lags of the dependent variables in each regression. High real estate tax to income is a dummy variable that takes a value of 1 if the ratio is above the national median and zero otherwise. High income is also a dummy variable that takes a value of 1 if the county's average AGI is above the national median. Tax reform is another dummy variable that takes the value of 1 after January 2018 and zero otherwise. Standard errors are clustered at the county level and reported in parentheses, \*, \*\*, and \*\*\* indicate the estimated coefficients are statistically significant at the 10 percent, 5 percent, and 1 percent level, respectively. Data source: IRS, BLS and Zillow.



Table 9: House Price Growth, Housing Liquidity and Tax Reform: Nonlinear Effects

	(1) House price growth (%)	(2) Number of sales (log)	(3) Percent with price cut	(4) Days on market	(5) Sale-to-list ratio (%)
Real estate tax to income 1st quintile *	-0.406	0.0122	0.0987	2.903***	-0.0210
Tax reform	(0.509)	(0.00892)	(0.0993)	(0.832)	(0.0777)
Real estate tax to income 2nd quintile *	-0.325	0.00620	0.0587	0.536	-0.0679
Tax reform	(0.359)	(0.00640)	(0.0730)	(0.936)	(0.0510)
Real estate tax to income 4th quintile *	-1.633***	-0.00688	0.0296	1.586***	-0.155***
Tax reform	(0.324)	(0.00510)	(0.0712)	(0.501)	(0.0509)
Real estate tax to income 5th quintile *	-1.890***	-0.0166**	-0.00168	1.997***	-0.155**
Tax reform	(0.344)	(0.00671)	(0.0894)	(0.620)	(0.0625)
Percent of filers with income less than \$1	0.602**	0.00443	-0.0723	0.163	0.0500
* Tax reform	(0.243)	(0.00308)	(0.0840)	(0.543)	(0.0613)
Percent of filers with income between \$1	-0.158	0.00279	0.0121	0.236	-0.0399
and \$10k * Tax reform	(0.132)	(0.00186)	(0.0423)	(0.260)	(0.0343)
Percent of filers with income between	0.102	0.00566**	-0.0656*	-0.103	-0.0342
\$10k and \$25k * Tax reform	(0.123)	(0.00261)	(0.0366)	(0.237)	(0.0235)
Percent of filers with income between	-1.148***	0.00450	0.154*	1.431***	-0.174***
\$50k and \$75k * Tax reform	(0.275)	(0.00387)	(0.0844)	(0.491)	(0.0607)
Percent of filers with income between	1.465***	0.00510	-0.303***	-1.414***	0.0365
\$75k and \$100k * Tax reform	(0.260)	(0.00370)	(0.0696)	(0.542)	(0.0533)
Percent of filers with income between	-0.196	0.00292	0.0445	0.204	-0.00462
\$100k and \$200k * Tax reform	(0.122)	(0.00208)	(0.0351)	(0.208)	(0.0224)
Percent of filers with income above	-0.332***	0.00347*	-0.0153	0.279	-0.0930***
\$200k * Tax reform	(0.102)	(0.00179)	(0.0385)	(0.198)	(0.0240)
Unemployment rate (%)	-0.219**	-0.00504***	0.0124	0.737***	-0.0836***
	(0.0946)	(0.00185)	(0.0267)	(0.223)	(0.0284)
Employment growth (%)	0.0106	0.000672**	-0.0175***	-0.231**	0.00951
	(0.0412)	(0.000338)	(0.00666)	(0.110)	(0.0111)
N	100957	141123	92967	35458	56758
R-sq	0.285	0.993	0.902	0.946	0.926
Fixed effects	county, state by time	county, state by time	county, state by time	county, state by time	county, state by time
Lagged dependent variables	Yes	Yes	Yes	Yes	Yes

**Note:** This table reports analysis where we allow for real estate tax burden to affect local housing conditions nonlinearly in addition to the nonlinear effects coming from taxable income. We include 12 lags of the dependent variables in each regression. High real estate tax to income is a dummy variable that takes a value of 1 if the ratio is above the national median and zero otherwise. High income is also a dummy variable that takes a value of 1 if the county's average AGI is above the national median. Tax reform is another dummy variable that takes the value of 1 after January 2018 and zero otherwise. Standard errors are clustered at the county level and reported in parentheses, \*, \*\*, and \*\*\* indicate the estimated coefficients are statistically significant at the 10 percent, 5 percent, and 1 percent level, respectively. Data source: IRS, BLS and Zillow.

Table 10: House Price Growth and Tax Reform: Different Housing Market Tiers

	(1)	(2)	(3)	(4)	(5)
CoreLogic Solutions House Price Growth (%)	Overall	Less than 75% of median house price	Between 75% and median house price	Between median and 125% of median house price	Above 125% of median house price
Real estate tax to income 1st quintile *	-0.125	6.990**	-3.285*	0.701	-2.363
Tax reform	(0.758)	(3.198)	(1.789)	(1.587)	(1.664)
Real estate tax to income 2nd quintile *	-0.393	2.038*	0.757	-0.603	-0.0624
Tax reform	(0.429)	(1.197)	(0.900)	(0.796)	(0.588)
Real estate tax to income 4th quintile *	-1.445***	-0.333	-1.037	-2.367***	-1.348***
Tax reform	(0.414)	(0.849)	(0.872)	(0.806)	(0.467)
Real estate tax to income 5th quintile *	-1.632***	-1.169	-1.162	-1.407*	-1.492***
Tax reform	(0.475)	(0.924)	(1.003)	(0.736)	(0.571)
Percent of filers with income less than \$1 * Tax reform	-0.297	-0.651	0.356	-0.547	-0.381
	(0.425)	(0.749)	(0.895)	(0.950)	(0.508)
Percent of filers with income between \$1 and \$10k * Tax reform	-0.230	-0.829**	-0.567**	-0.426	-0.462*
	(0.203)	(0.375)	(0.276)	(0.261)	(0.247)
Percent of filers with income between \$10k and \$25k * Tax reform	-0.128	-0.106	-0.312	-0.451	-0.0828
	(0.167)	(0.274)	(0.280)	(0.373)	(0.206)
Percent of filers with income between \$50k and \$75k * Tax reform	-1.429***	-1.995***	-1.883***	-2.557***	-1.670***
	(0.415)	(0.699)	(0.664)	(0.783)	(0.508)
Percent of filers with income between \$75k and \$100k * Tax reform	1.013***	1.090*	0.960	2.070***	1.750***
	(0.369)	(0.640)	(0.686)	(0.639)	(0.443)
Percent of filers with income between \$100k and \$200k * Tax reform	-0.173	-0.166	-0.239	-0.686**	-0.446**
	(0.166)	(0.285)	(0.302)	(0.342)	(0.207)
Percent of filers with income above \$200k * Tax reform	-0.483***	-0.576***	-0.894***	-0.586**	-0.291
	(0.155)	(0.208)	(0.284)	(0.297)	(0.178)
Unemployment rate (%)	-0.553***	-0.518**	-0.417*	-0.606***	-0.583***
	(0.135)	(0.240)	(0.213)	(0.227)	(0.174)
Employment growth (%)	0.0780	0.121**	0.204***	0.201***	0.221***
	(0.0774)	(0.0586)	(0.0526)	(0.0577)	(0.0751)
N	76551	39501	44745	41610	52497
R-sq	0.356	0.347	0.379	0.362	0.353
Fixed effects	county, state by time	county, state by time	county, state by time	county, state by time	county, state by time
Lagged dependent variables	Yes	Yes	Yes	Yes	Yes

**Note:** This table reports analysis where we study the impact of tax reform on different housing market segments. There are four purchase price tiers constructed by CoreLogic Solutions depending on whether the home sold for less than 75% of the area median price (column 2), for between 75% and 100% of the area median (column 3), for between 100% and 125% of the area median (column 4) and for more than 125% of the area median (column 5). We allow for real estate tax burden to affect local housing conditions nonlinearly in addition to the nonlinear effects coming from taxable income. We include 12 lags of the dependent variables in each regression. High real estate tax to income is a dummy variable that takes a value of 1 if the ratio is above the national median and zero otherwise. High income is also a dummy variable that takes a value of 1 if the county's average AGI is above the national median. Tax reform is another dummy variable that takes the value of 1 after January 2018 and zero otherwise. Standard errors are clustered at the county level and reported in parentheses, \*, \*\*, and \*\*\* indicate the estimated coefficients are statistically significant at the 10 percent, 5 percent, and 1 percent level, respectively. Data source: CoreLogic Solutions, IRS, BLS and Zillow.

Table 11: Housing Construction Activities and Tax Reform

	(1)	(2)	(3)	(4)	(5)	(6)
	Construction sector employment growth (%)	Log number of building permits (multi- family units)	Log number of building permits (single- family units)	Construction sector employment growth (%)	Log number of building permits (multi- family units)	Log number of building permits (single- family units)
High real estate tax to income * Tax reform	-0.302** (0.143)	-0.0509*** (0.0177)	-0.00840 (0.0124)			
High income * Tax reform	-0.207** (0.105)	0.0237 (0.0153)	-0.00613 (0.00806)			
Real estate tax to income 1st quintile * Tax reform				0.263 (0.466)	0.0865 (0.0732)	-0.0142* (0.00860)
Real estate tax to income 2nd quintile * Tax reform				-0.0759 (0.340)	0.0507 (0.0497)	-0.00320 (0.00575)
Real estate tax to income 4th quintile * Tax reform				-0.194 (0.228)	-0.0270** (0.0136)	-0.00920 (0.0107)
Real estate tax to income 5th quintile * Tax reform				-0.518* (0.276)	-0.0141 (0.0152)	-0.00758 (0.0144)
Percent of filers with income less than \$1 * Tax reform				-0.140 (0.231)	-0.0148 (0.0137)	0.000453 (0.00533)
Percent of filers with income between \$1 and \$10k * Tax reform				0.000582 (0.0996)	-0.00142 (0.00471)	-0.00145 (0.00297)
Percent of filers with income between \$10k and \$25k * Tax reform				0.142 (0.102)	-0.00812* (0.00482)	-0.00253 (0.00262)
Percent of filers with income between \$50k and \$75k * Tax reform				0.222 (0.210)	-0.0136 (0.0104)	-0.00661 (0.00763)
Percent of filers with income between \$75k and \$100k * Tax reform				0.249 (0.200)	0.0113 (0.00950)	0.00402 (0.00605)
Percent of filers with income between \$100k and \$200k * Tax reform				-0.0439 (0.0992)	-0.0104** (0.00522)	-0.00249 (0.00315)
Percent of filers with income above \$200k * Tax reform				0.133 (0.103)	-0.00246 (0.00299)	-0.00211 (0.00191)
Unemployment rate (%)	-0.414*** (0.0700)	-0.00141 (0.00411)	-0.00411** (0.00187)	-0.386*** (0.0836)	-0.00134 (0.00421)	-0.00449** (0.00216)
Non-construction employment growth (%)	-0.0458 (0.0400)	-0.000168 (0.000959)	0.000325 (0.000350)	-0.0494 (0.0476)	-0.000114 (0.000961)	0.000349 (0.000341)
N	141057	18187	33301	141057	18187	33301
R-sq	0.717	0.991	0.999	0.717	0.991	0.999
Fixed effects	county, state by time	county, state by time	county, state by time	county, state by time	county, state by time	county, state by time
Lagged dependent variables	Yes	Yes	Yes	Yes	Yes	Yes

**Note:** This table reports analysis where we analyze how TCJA affected local construction activities. We include 12 lags of the dependent variables in each regression. High real estate tax to income is a dummy variable that takes a value of 1 if the ratio is above the national median and zero otherwise. High income is also a dummy variable that takes a value of 1 if the county's average AGI is above the national median and zero otherwise. Tax reform is another dummy variable that takes the value of 1 after January 2018 and zero otherwise. Standard errors are clustered at the county level and reported in parentheses, \*, \*\*, and \*\*\* indicate the estimated coefficients are statistically significant at the 10 percent, 5 percent, and 1 percent level, respectively. Data source: Data source: IRS, BLS and Zillow.

Table 12: Migration and Tax Reform

	(1)	(2)	(3)
	Net move out rate (%)	Net move out rate (conditional on having a mortgage) (%)	Net move out rate (no mortgage) (%)
Real estate tax to income 1st quintile * Tax reform	0.0660 (0.0756)	0.426* (0.241)	0.0235 (0.0774)
Real estate tax to income 2nd quintile * Tax reform	0.0416 (0.0580)	0.231 (0.171)	0.0232 (0.0623)
Real estate tax to income 4th quintile * Tax reform	0.0601 (0.0598)	0.273** (0.118)	0.0346 (0.0647)
Real estate tax to income 5th quintile * Tax reform	0.194*** (0.0685)	0.390*** (0.130)	0.188*** (0.0726)
Percent of filers with income less than \$1 * Tax reform	-0.0408 (0.0445)	-0.291*** (0.105)	-0.0120 (0.0444)
Percent of filers with income between \$1 and \$10k * Tax reform	0.0239 (0.0198)	0.0589 (0.0463)	0.0172 (0.0210)
Percent of filers with income between \$10k and \$25k * Tax reform	0.00145 (0.0190)	-0.0305 (0.0426)	0.00505 (0.0207)
Percent of filers with income between \$50k and \$75k * Tax reform	0.122*** (0.0383)	-0.0241 (0.0878)	0.150*** (0.0424)
Percent of filers with income between \$75k and \$100k * Tax reform	-0.161*** (0.0385)	-0.0188 (0.0859)	-0.193*** (0.0428)
Percent of filers with income between \$100k and \$200k * Tax reform	0.0302* (0.0179)	-0.00595 (0.0376)	0.0341* (0.0199)
Percent of filers with income above \$200k * Tax reform	0.0237 (0.0171)	0.0393 (0.0322)	0.0211 (0.0191)
Unemployment rate (%)	0.108*** (0.0163)	0.121*** (0.0355)	0.103*** (0.0168)
Employment growth (%)	-0.0162*** (0.00458)	-0.0118 (0.0115)	-0.0155*** (0.00463)
N	58158	58093	58158
R-sq	0.338	0.189	0.311
Fixed effects	county, state by time	county, state by time	county, state by time
Lagged dependent variables	Yes	Yes	Yes

**Note:** This table reports analysis where we analyze how TCJA affected migration between counties. The migration rates are four-quarter moving average constructed from the FRB New York Consumer Credit Panel/Equifax. We include 12 lags of the dependent variables in each regression. High real estate tax to income is a dummy variable that takes a value of 1 if the ratio is above the national median and zero otherwise. High income is also a dummy variable that takes a value of 1 if the county's average AGI is above the national median. Tax reform is another dummy variable that takes the value of 1 after January 2018 and zero otherwise. Standard errors are clustered at the county level and reported in parentheses, \*, \*\*, and \*\*\* indicate the estimated coefficients are statistically significant at the 10 percent, 5 percent, and 1 percent level, respectively. Data source: FRB New York Consumer Credit Panel/Equifax, IRS and BLS.

Table 13: 2018 Senate Election and Tax Reform

	(1)	(2)	(3)	(4)
	2018 voting share for Democratic candidates (%)	2018 voting share for Democratic candidates (%)	2018 voting share for Democratic candidates (%)	2018 voting share for Democratic candidates (%)
2016 voting share for Democratic candidates (%)	0.828*** (0.0127)	0.839*** (0.0116)	0.867*** (0.0115)	1.040*** (0.0129)
High real estate tax to income	1.421* (0.735)	2.696*** (0.709)	1.761** (0.712)	1.183*** (0.343)
High income	4.413*** (0.708)	4.308*** (0.657)	3.934*** (0.637)	1.172*** (0.256)
i(Incumbent is Democrat 2016)		-9.682*** (0.591)	-12.18*** (0.704)	
i(Incumbent is Democrat 2018)		4.466*** (0.680)	4.950*** (0.751)	
Unemployment rate 2016 (%)			-0.0399*** (0.00559)	-0.00412** (0.00206)
Unemployment rate 2018 (%)			0.0486*** (0.00682)	0.00339 (0.00269)
Employment growth rate 2016 (%)			-0.0247* (0.0149)	0.00354 (0.00299)
Employment growth rate 2018 (%)			0.00943 (0.00853)	-0.00682 (0.00583)
N	806	806	806	806
R-sq	0.859	0.877	0.893	0.979
Fixed effects				State

**Note:** This table presents regression analysis of 2018 Senate election results on real estate taxes using cross section county-level information. We include 12 lags of the dependent variables in each regression. High real estate tax to income is a dummy variable that takes a value of 1 if the ratio is above the national median and zero otherwise. High income is also a dummy variable that takes a value of 1 if the county's average AGI is above the national median. Tax reform is another dummy variable that takes the value of 1 after January 2018 and zero otherwise. Incumbent is Democrat 2016 (2018) is a dummy variable that takes the value of 1 if the incumbent in 2016 (2018) is a democrat. Standard errors are clustered at the county level and reported in parentheses, \*, \*\*, and \*\*\* indicate the estimated coefficients are statistically significant at the 10 percent, 5 percent, and 1 percent level, respectively. Data source: IRS and Princeton University Election Data.

## Appendix

This appendix reports four additional tables. The first table is the same as specification (1) in Table 2 in the main text, but shows coefficient estimates of all the lagged dependent variables in column (2). The second table adds annual county level average income as additional controls to our benchmark specifications in columns (1) to (3) and then explores the role of these income controls exclusively in columns (4) to (6). The third table allows for additional effects from credit quality in the local market as captured by the two dummies indicating whether the county has average credit scores higher than the national median and whether the interest rate faced by fixed-rate first-lien mortgage borrowers was higher than the national median. The fourth and final table corresponds to Table 8, but includes more control variables of the different income categories.

Table A1: House Price Growth and Tax Reform: Full Benchmark Analysis

	(1) House price growth (%)	(2) House price growth (%)
High real estate tax to income * Tax reform	-2.342*** (0.326)	-1.351*** (0.175)
High income * Tax reform	-2.413*** (0.350)	-1.271*** (0.181)
High real estate tax to income	1.479*** (0.250)	0.623*** (0.112)
High income	0.639** (0.319)	0.324** (0.129)
Tax reform	3.471*** (0.292)	1.677*** (0.167)
Unemployment rate (%)	0.0867 (0.0675)	0.0934*** (0.0284)
Employment growth (%)	0.324*** (0.0450)	0.136*** (0.0206)
Lagged house price growth (L1)		0.198*** (0.0159)
Lagged house price growth (L2)		0.143*** (0.00812)
Lagged house price growth (L3)		-0.00643 (0.0107)
Lagged house price growth (L4)		0.0602*** (0.00772)
Lagged house price growth (L5)		0.0214*** (0.00640)
Lagged house price growth (L6)		0.0238*** (0.00774)
Lagged house price growth (L7)		0.0380*** (0.00921)
Lagged house price growth (L8)		0.0296*** (0.00670)
Lagged house price growth (L9)		0.0508*** (0.00665)
Lagged house price growth (L10)		0.0386*** (0.00872)
Lagged house price growth (L11)		-0.00108 (0.00759)
Lagged house price growth (L12)		-0.00774 (0.00702)
N	101175	101014
R-sq	0.018	0.133

**Note:** In this table, we report results with and without 12 lags of the dependent variables in a regression specification the same as in Table 2 column 1. High real estate tax to income is a dummy variable that takes a value of 1 if the ratio is above the national median and zero otherwise. High income is also a dummy variable that takes a value of 1 if the county's average AGI is above the national median. Tax reform is another dummy variable that takes the value of 1 after January 2018 and zero otherwise. Standard errors are clustered at the county level and reported in parentheses, \*, \*\*, and \*\*\* indicate the estimated coefficients are statistically significant at the 10 percent, 5 percent, and 1 percent level, respectively. Data source: IRS, BLS and Zillow.

Table A2: House Price Growth and Tax Reform: Additional Income Controls

	(1)	(2)	(3)	(4)	(5)	(6)
	House price growth (%)	House price growth (%)	House price growth (%)	House price growth (%)	House price growth (%)	House price growth (%)
High real estate tax to income * Tax reform	-1.794*** (0.254)	-2.089*** (0.311)	-1.111*** (0.395)			
High income * Tax reform	-1.751*** (0.260)	-2.091*** (0.336)	-1.901*** (0.314)			
High real estate tax to income	0.856*** (0.121)					
High income	0.611*** (0.156)					
Tax reform	3.710*** (0.255)					
Income (log)	-1.350*** (0.320)	-12.22** (5.741)	-10.34 (6.366)	-0.952*** (0.283)	-15.96*** (5.884)	-12.72* (6.613)
Unemployment rate (%)	-0.0556* (0.0319)	-0.0296 (0.107)	-0.319*** (0.114)			
Employment growth (%)	0.126*** (0.0243)	0.0342 (0.0346)	0.00898 (0.0435)			
N	83389	83389	83341	83389	83389	83341
R-sq	0.117	0.170	0.253	0.112	0.167	0.251
Fixed effects		county, time	county, state by time		county, time	county, state by time
Lagged dependent variables	Yes	Yes	Yes	Yes	Yes	Yes

**Note:** This table presents the analysis of TCJA on house price growth allowing for additional effect from county income. Standard errors are clustered at the county level and reported in parentheses, \*, \*\*, and \*\*\* indicate the estimated coefficients are statistically significant at the 10 percent, 5 percent, and 1 percent level, respectively. We include 12 lags of the dependent variables in each regression. High real estate tax to income is a dummy variable that takes a value of 1 if the ratio is above the national median and zero otherwise. High income is also a dummy variable that takes a value of 1 if the county's average 2016 AGI is above the national median. Tax reform is another dummy variable that takes the value of 1 after January 2018 and zero otherwise. Income is annual log county per capita income. Data source: IRS, BLS and Zillow.



Table A3: House Price Growth and Tax Reform: Credit Worthiness Controls

	(1)	(2)	(3)	(4)
	House price growth (%)	House price growth (%)	House price growth (%)	House price growth (%)
High real estate tax to income * Tax reform	-1.419*** (0.228)		-1.393*** (0.341)	-1.564*** (0.449)
High income * Tax reform	-1.002*** (0.225)		-1.682*** (0.325)	-1.791*** (0.389)
High risk scores * Tax reform	-0.902*** (0.158)	-1.427*** (0.193)	-1.297*** (0.192)	-1.312*** (0.234)
High interest rates * Tax reform	-0.536*** (0.171)	-0.335 (0.276)	-0.293 (0.272)	-0.0638 (0.299)
High real estate tax to income	0.512*** (0.149)			
High income	0.251 (0.167)			
High credit scores	0.0509 (0.124)			
High interest rates	0.554*** (0.116)			
Tax reform	2.278*** (0.275)			
Unemployment rate (%)	0.0747** (0.0302)	-0.391*** (0.129)	-0.312** (0.126)	-0.390*** (0.140)
Employment growth (%)	0.148*** (0.0256)	0.0344 (0.0607)	0.0333 (0.0601)	0.00701 (0.0595)
Income (log)				-12.95* (6.832)
N	50818	50761	50761	42262
R-sq	0.157	0.330	0.331	0.299
Fixed effects		county, state by time	county, state by time	county, state by time
Lagged dependent variables	Yes	Yes	Yes	Yes

**Note:** This table presents the analysis of TCJA on house prices allowing for effects from credit worthiness as proxied by county level average credit scores and average mortgage interest rates faced by fixed-rate first-lien mortgage borrowers. High credit scores or high interest rates indicates that the county has an average credit score/mortgage interest rate above the national median. We include 12 lags of the dependent variables in each regression. High real estate tax to income is a dummy variable that takes a value of 1 if the ratio is above the national median and zero otherwise. High income is also a dummy variable that takes a value of 1 if the county's average AGI is above the national median. Tax reform is another dummy variable that takes the value of 1 after January 2018 and zero otherwise. Income is the county level average household income. Standard errors are clustered at the county level and reported in parentheses, \*, \*\*, and \*\*\* indicate the estimated coefficients are statistically significant at the 10 percent, 5 percent, and 1 percent level, respectively. The credit score measure and interest rate information are based on the Black Knight McDash data. Data source: Black Knight McDash, IRS, BLS and Zillow.

Table A4: House Price Growth, Housing Liquidity and Tax Reform: Nonlinear Controls

	(1)	(2)	(3)	(4)	(5)
	House price growth (%)	Number of sales (log)	Percent with price cut	Days on market	Sale-to-list ratio (%)
High real estate tax to income * Tax reform	-1.006*** (0.334)	-0.0148*** (0.00500)	0.0540 (0.0655)	1.272** (0.606)	-0.152** (0.0648)
Percent of filers with income less than \$1 * Tax reform	0.602** (0.242)	0.00492 (0.00310)	-0.0691 (0.0844)	0.253 (0.547)	0.0468 (0.0607)
Percent of filers with income between \$1 and \$10k * Tax reform	-0.147 (0.142)	0.00284 (0.00188)	0.0161 (0.0423)	0.249 (0.275)	-0.0422 (0.0347)
Percent of filers with income between \$10k and \$25k * Tax reform	0.0825 (0.123)	0.00554** (0.00253)	-0.0653* (0.0368)	-0.0945 (0.232)	-0.0369 (0.0234)
Percent of filers with income between \$50k and \$75k * Tax reform	-1.196*** (0.284)	0.00423 (0.00387)	0.157* (0.0843)	1.464*** (0.506)	-0.180*** (0.0614)
Percent of filers with income between \$75k and \$100k * Tax reform	1.552*** (0.263)	0.00623* (0.00358)	-0.299*** (0.0706)	-1.470*** (0.543)	0.0401 (0.0536)
Percent of filers with income between \$100k and \$200k * Tax reform	-0.261** (0.116)	0.00211 (0.00194)	0.0414 (0.0348)	0.254 (0.210)	-0.00865 (0.0225)
Percent of filers with income above \$200k * Tax reform	-0.333*** (0.103)	0.00349* (0.00178)	-0.0137 (0.0387)	0.274 (0.198)	-0.0945*** (0.0238)
Unemployment rate (%)	-0.227** (0.0951)	-0.00507*** (0.00186)	0.0116 (0.0269)	0.743*** (0.222)	-0.0834*** (0.0284)
Employment growth (%)	0.0125 (0.0413)	0.000703** (0.000339)	-0.0177*** (0.00667)	-0.235** (0.110)	0.00976 (0.0111)
N	100957	141123	92967	35458	56758
R-sq	0.284	0.993	0.902	0.946	0.926
Fixed effects	county, state by time	county, state by time	county, state by time	county, state by time	county, state by time
Lagged dependent variables	Yes	Yes	Yes	Yes	Yes

**Note:** This table presents the analysis of TCJA on house price and housing market liquidity allowing for nonlinear effects from taxable income. The taxable income brackets are as those reported in the IRS data. Standard errors are clustered at the county level and reported in parentheses, \*, \*\*, and \*\*\* indicate the estimated coefficients are statistically significant at the 10 percent, 5 percent, and 1 percent level, respectively. We include 12 lags of the dependent variables in each regression. High real estate tax to income is a dummy variable that takes a value of 1 if the ratio is above the national median and zero otherwise. High income is also a dummy variable that takes a value of 1 if the county's average AGI is above the national median. Tax reform is another dummy variable that takes the value of 1 after January 2018 and zero otherwise. Data source: IRS, BLS and Zillow.