

# Economic Consequences of Housing Speculation

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December 2018

## ABSTRACT

By exploiting variation in state capital gains taxation as an instrument, we analyze the economic consequences of housing speculation during the U.S. housing boom in the 2000s. We find that housing speculation, anchored, in part, on extrapolation of past housing price changes, led not only to greater price appreciation, economic expansions, and housing construction during the boom in 2004-2006, but also to more severe economic downturns during the subsequent bust in 2007-2009. Our analysis supports supply overhang and local household demand as two key channels for transmitting these adverse effects.

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This paper supersedes an earlier draft circulated under the title “Housing Speculation and Supply Overhang.” We are grateful to Gene Amromin, Barney Hartman-Glaser, Andrew Haughwout, Zhiguo He, Tim Landvoigt, Alvin Murphy, Charlie Nathanson, and seminar participants at the Federal Reserve Bank of New York, the University of Texas at Austin, the Wharton School, the American Economic Association Meetings, the American Finance Association Meetings, the CICF meetings, and the FRB Atlanta, GSU Real Estate Finance, and Texas Finance Festival Conference for helpful comments and discussion.

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Economists have long been concerned with the economic consequences of speculation and asset bubbles. A growing strand of the literature, including Shiller (2009), Haughwout et al. (2011), Barlevy and Fisher (2011), Mayer (2011), Case, Shiller, and Thompson (2012, 2015), Bayer et al. (2015), Chinco and Mayer (2016), Albanesi, De Giorgi, and Nosal (2017), DeFusco, Nathanson, and Zwick (2017), Nathanson and Zwick (2017), and Soo (2018) has highlighted the importance of housing speculation in driving the recent housing cycle.<sup>1</sup> Housing speculation became a national phenomenon in the low interest rate environment of the mid-2000s, with purchases of non-owner-occupied homes (second and investment homes) contributing up to 30% of all home purchases during the boom in cities such as Las Vegas. Housing speculation was also a source of housing demand largely orthogonal to the credit expansion to subprime households that occurred during the housing boom, which is widely regarded, for instance by Mian and Sufi (2009), Keys et al. (2009), and Justiano et al. (2017), as a key driver of the boom. Interestingly, areas in which speculation became more prevalent during the boom period experienced local economic expansions, while subprime credit expansion occurred more in areas that experienced local economic contractions. In addition, while supply inelasticity and non-recourse mortgage laws have a positive and statistically significant correlation with the fraction of subprime mortgages in a zip code, they have an opposite, smaller, and less significant correlation with housing speculation.<sup>2</sup> As such, speculation represents an important complementary channel in explaining the cross-sectional variation in the housing and economic cycles experienced across the U.S. during the 2000s.

An intuitive hypothesis posits that speculation in the housing market can have important economic consequences. Housing speculation, anchoring on extrapolative expectations of past housing price growth, can amplify local economic conditions by contributing a non-fundamental source of demand to housing markets. When these speculators purchase more non-owner-occupied homes in an area during a housing boom, this speculation can magnify the boom and contribute not only to a greater price drop, but also to a more severe economic contraction during the subsequent housing bust. Despite its intuitive appeal, this hypothesis remains elusive to test

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<sup>1</sup> Glaeser (2013) provides an eloquent analysis of nine episodes of real estate speculation in American history and highlights housing speculation as one of several recurring themes in these episodes.

<sup>2</sup> This opposite and less significant correlation suggests that studies that instrument the housing price boom with supply elasticity or variation in non-recourse mortgage laws are capturing the impact of subprime rather than speculation.

because of the well-appreciated endogeneity issue with identification. Since housing speculation may reflect local housing demand or other unobservable economic conditions, rather than be a cause of housing and economic cycles, it is difficult to measure its causal impact on these outcomes.

In this paper, we undertake this challenge to study how housing speculation contributed to higher housing prices and local economic expansions during the boom period of 2004-2006, and adversely affected economic activity during the bust period of 2007-2009. We measure housing speculation during the boom by the fraction of non-owner-occupied home purchases in a zip code. For identification, we construct a novel instrument for housing speculation that takes advantage of the variation across U.S. states in their taxation of capital gains. While homeowners can exclude capital gains from the sale of their primary residence from their income taxes, this exclusion does not cover capital gains from selling non-owner-occupied homes. As U.S. states have significant variation in how they tax capital gains, housing speculation is more intensive in states with either no or low capital gains taxes. We therefore construct our instrument as the marginal tax rate for the median income household in each state. Although this tax instrument is at the state level, it nevertheless provides substantial cross-sectional variation for us to identify the role of speculation during the recent U.S. housing cycle.

We first make use of our tax variable to investigate extrapolation of past housing price appreciation as a potential explanation for the cross-sectional variation in housing speculation. The existing literature, including Case and Shiller (2003), Glaeser, Gyourko, and Saiz (2008), Piazzesi and Schneider (2009), Bailey et al (2017), and Glaeser and Nathanson (2017), has emphasized the importance of accounting for home buyers' expectations and, in particular, extrapolative expectations in understanding housing cycles. Our analysis shows that, among states with lower capital gains taxes, the share of non-owner-occupied home purchases responds more strongly to past housing price increases, even after controlling for past changes in local housing fundamentals. This finding supports extrapolative expectations as a key driver of housing speculation.

Having identified extrapolative expectations as a potential driver of housing speculation, we next explore its consequences. By instrumenting non-owner-occupied home purchases with the capital gains tax variable, we find that zip codes with a greater share of non-owner-occupied home

purchases during the boom had not only a more pronounced housing cycle during the boom and bust, but also experienced greater swings in employment, payroll, per capita income, and the number of business establishments. The economic magnitude of these effects is substantial: an increase of 9.87% (one standard deviation across zip codes) in the share of non-owner-occupied home purchases in 2004-2006 led to a housing price increase of 26.5% during the boom, and a drop of 37.4% during the bust. Similarly, housing speculation led to an increase of 13.7% in real payroll, 8.4% in employment, 12.9% in per capita income, and 6.8% in the number of establishments from 2004-2006. During 2007-2009, in contrast, it contributed to declines of 15.4% in real payroll, 14.6% in employment, 7.8% in income per capita, and 8.7% in the number of establishments. These results establish a causal link between housing speculation and different aspects of local housing and economic cycles, and are robust to excluding the so-called “sand states” of Arizona, California, Florida, and Nevada that saw particularly phenomenal housing cycles. The geographical variation of housing speculation can account for approximately half of the change in house prices during the recent cycle.

We also examine two transmission mechanisms to understand how housing speculation during the boom propagated to the real economy during the bust. We first examine the supply overhang channel, explored, for instance, in Rognlie, Shleifer, and Simsek (2015). By again using the instrumental variable approach, we find that areas with more intensive housing speculation during the boom also had a greater increase in housing construction in the same period, which, in turn, contributed to the subsequent contraction of the construction sector. An increase of one standard deviation in instrumented housing speculation in 2004-2006 led to an increase of 4.2% in building permits in 2004-2006 relative to the number of housing units in 2000, as well as decreases of 33.8% in construction-sector employment and 12.4% in non-construction sector employment in 2007-2009. These findings confirm the importance of the supply overhang channel, which, however, cannot fully explain the substantial downturn experienced by the non-construction sectors.

We further examine a second transmission channel, local household demand, as suggested by Mian, Rao, and Sufi (2013) and Mian and Sufi (2014), by analyzing the impact of housing speculation on non-tradable sectors—and the retail and restaurant sectors more narrowly— which primarily rely on local consumption demand. We find significant real effects through this channel.

An increase of one standard deviation in instrumented housing speculation in 2004-2006 led to a decrease of 15.1% in non-tradable sectors' employment in 2007-2009, and a decline of 15.6% in the retail and restaurant sectors, specifically.<sup>3</sup> In contrast, housing speculation had a more modest effect on employment in tradable sectors and in industries other than retail and the restaurant business.

Our study contributes to the rapidly growing literature on housing speculation. By using credit-report data, Haughwout et al. (2011) document two important facts about housing speculation in the recent U.S. housing boom: 1) there were large increases in the share of housing purchases by real estate investors, especially in states that experienced the largest housing price booms and busts, and 2) by taking on more leverage, real estate investors had higher rates of default during the bust. Using micro-level data, Chinco and Mayer (2016) show that speculation by investment-home buyers played an important role in the dramatic house price boom and bust cycles in 21 cities, including Las Vegas, Miami, and Phoenix. Nathanson and Zwick (2017) turn to speculation in the land market and investigate how land investment by homebuilders shapes the house price boom in areas with elastic housing supply. DeFusco, Nathanson, and Zwick (2017) investigate the importance of short-term real estate investors in explaining housing price and volume dynamics in the recent housing cycle. While most of these studies have focused on the impact of speculation on housing market outcomes, such as house prices and default, we also explore its consequences for local economic activity, including establishments, payroll, employment, and per capita income growth, during the housing bust. In this respect, our work is similar to that of Chen et al. (2016), which shows that firms responded to rising real estate prices in China by diverting resources from their core businesses to real estate investment. It is also related to that of Charles, Hurst, and Notowidigdo (2016a, 2016b), which explore how the housing boom led to distortions in the employment and educational attainment decisions predominantly among low-skilled, prime-aged laborers by temporarily expanding the construction and services sectors. Consistent with their results, we find that construction and local retail and service sectors contracted during the housing bust.

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<sup>3</sup> Kaplan, Mitman, and Violante (2017), through the lens of a quantitative framework, also find that a shift in household expectations of future capital gains on housing investments deepened the Great Recession through the household balance sheet channel.

While our study focuses on the role of housing speculation in explaining the recent U.S. housing cycle, the housing literature has explored several other mechanisms. Himmelberg, Mayer, and Sinai (2005) and Mayer and Sinai (2009), for instance, focus on the role of interest rates, while Favilukis, Ludvigson, and Van Nieuwerburgh (2015) emphasize the relaxation of borrowing constraints. Mian and Sufi (2009, 2011) and Favara and Imbs (2015) link the surge in household debt and house prices during the recent housing cycle to an expansion in the supply of credit that resulted from securitization and subprime lending, and Mian and Sufi (2010) examine the relationship between this buildup and the cross-section of house price booms and busts in the recent cycle. Furthermore, Keys et al. (2009, 2010), Purnanandam (2011), and Griffin and Maturana (2016), among others, highlight that agency issues associated with securitization may have helped fuel this credit expansion. Along this dimension, Griffin and Maturana (2015) document the importance of mortgage origination misreporting by the worst originators in explaining housing price booms and busts. Similarly, Mian and Sufi (2015) show mortgage fraud to be associated with low income zip codes that exhibited the strongest mortgage credit growth in 2002 to 2005. The speculation channel that we quantify is distinct from that of fraud from misreporting, as our results remain robust when we control for the misreporting measure of Piskorski, Seru, and Witkin (2015). To the extent that agency issues in mortgage origination and an expansion of credit facilitated participation by optimistic speculators in housing markets during the boom, we view these channels as being complementary.

## **I. Empirical Hypothesis and Methodology**

Motivated by the literature on housing speculation, we aim to examine the economic impact of housing speculation during the boom and bust cycle of the U.S. housing markets in the 2000s. The extant literature has established that this national housing cycle was partially driven by a credit expansion to households across the country, which was ultimately precipitated by the rapid growth of securitization and shadow banking in early 2000s, e.g., Mian and Sufi (2009) and Keys et al (2010). While this was a national housing cycle, there were substantial variations across regions in the magnitude of the housing price boom and bust, and in the severity of the economic downturn that accompanied the bust. We are interested in testing whether housing speculation contributed

to such cross-region variation and, more important, whether housing speculation affected local economies by driving housing prices.<sup>4</sup>

To facilitate our cross-region analysis during this national cycle, we divide the housing cycle into three phases: 2001-2003 as the pre-boom period, 2004-2006 as the boom period, and 2007-2009 as the bust period. This definition is consistent with the convention in the literature. In particular, 2006 is widely recognized as the turning point of the cycle, as noted by Glaeser (2013). Haughwout et al. (2013) defines the boom period as 2000-2006, and the bust period as 2007-2010. As noted by Ferreira and Gyourko (2011), the start of the house price boom was not well synchronized across the U.S. We define 2004-2006 as the boom period because housing speculation, as we will show, was most intensive in this period. Anchoring on this three-year boom period, we analyze how housing price growth in the previous three years (the pre-boom period) stimulated housing speculation during the boom through home buyers' extrapolative expectations, and how housing speculation during the boom affected local economic performance during the subsequent three years (the bust period).<sup>5</sup>

We measure housing speculation in an area in a given year by the fraction of non-owner-occupied homes in all home purchases financed by mortgages. Since non-owner-occupied homes provide less housing services to their owners than primary homes, the decision to purchase a non-owner-occupied home is driven to a greater extent by buyers' speculative motives than is their decisions to purchase a primary home.<sup>6</sup> Thus, the fraction of non-owner-occupied home purchases provides a convenient measure of the intensity of housing speculation.

We take the following steps in organizing our empirical analysis. First, we test extrapolation as a cause of housing speculation. An extensive literature emphasizes extrapolative expectations as a key driver of housing cycles, e.g., Case and Shiller (2003), Glaeser, Gyourko, and Saiz (2008),

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<sup>4</sup> We focus on the recent U.S. housing cycle of the 2000s because the data are more complete for this period than for earlier years, and also because the national housing cycle allows us to directly compare the cross-sectional variation in housing markets and local economic conditions. Such a cross-sectional analysis is not feasible for the earlier housing cycles of the 1980s and 1990s, as they were asynchronous and experienced by only a few cities.

<sup>5</sup> Our results are robust to using an alternative definition of the boom period from 2000 to 2006 and the bust period from 2007 to 2010.

<sup>6</sup> This measure has its limitations. For instance, investors may purchase their houses for vacation purposes. Non-owner-occupied house purchases could also be affected by demand from renters and new migrants. To address this issue, we include various local characteristics such as the fraction of employment in the sectors of art, entertainment, and recreation, the ratio of renters, as well as the fraction of migrants, as controls in our analysis.

Piazzesi and Schneider (2009), DeFusco, Nathanson, and Zwick (2017), and Glaeser and Nathanson (2017). A central empirical prediction of extrapolative expectations is that home buyers react more strongly to recent past price changes than rational buyers when forecasting future housing price changes. As such, we examine whether housing speculation during the boom period of 2004-2006 was positively correlated with the housing price change during the pre-boom period of 2001-2003, controlling for fundamental sources of housing demand.

Second, as housing speculation contributes to local housing demand, we examine whether housing speculation during the boom was accompanied by greater housing price appreciation during the boom, and by greater housing price declines during the bust. While a positive correlation between housing speculation and housing price appreciation during the boom may simply reflect housing speculators being informed about local housing markets, a negative correlation between housing speculation during the boom and housing price change during the subsequent bust contradicts this information argument, and instead supports the view that housing speculation had exacerbated the housing price boom, which subsequently reversed during the bust.

Third, a key part of our analysis is to examine the potential impact of housing speculation on the real economy. There is a growing literature examining the economic impacts of the U.S. housing cycle. Mian and Sufi (2011, 2014) provide evidence that the housing price boom led to a significant increase in household leverage from 2002-2006, and that this leverage increase was further related to households' auto expenditures. There is also evidence linking the U.S. housing cycle to the Great Recession, for instance in Mian and Sufi (2011, 2014), Stumpner (2016), and Hurst et al. (2016). By exacerbating the housing cycle, we expect housing speculation during the boom to be positively correlated with local economic outcomes during the boom, and to negatively predict local economic outcomes during the bust. As before, evidence of the latter is a less obvious outcome, and would indicate an adverse role played by housing speculation.

Fourth, to further examine the channel by which housing speculation transmitted to the real economy, we analyze how housing speculation during the boom affected housing supply. By driving up housing demand during the boom, housing speculation may have boosted housing construction, which is a channel for housing speculation to affect the real economy. Since housing construction is irreversible, this impact of housing speculation on supply is asymmetric. While



exuberant housing speculation during the boom may have driven up new construction, the houses built during the boom could not be torn down during the bust after speculation dissipated. The increased housing supply would then overhang on the housing market and the local economy during the bust, as argued by Rognlie, Shleifer, and Simsek (2015). This effect implies that housing speculation during the boom has a stronger negative predictive power for economic outcomes in the construction sector than for the non-construction sector. The asymmetry of the overhang effect also motivates us to anchor our overall analysis on housing speculation during the boom to study its effect on the housing boom and bust, and the economic downturn subsequent to the housing boom, rather than examining housing speculation across the housing cycle.

Finally, we also examine an alternative channel for housing speculation to affect the real economy through local demand, as suggested by Mian, Rao, and Sufi (2013) and Mian and Sufi (2014).<sup>7</sup> As reduced housing wealth during the housing bust would suppress household consumption, housing speculation during the boom may also lead to an economic downturn through suppressed local demand during the bust. As such, we expect housing speculation during the boom to have stronger negative predictive power for economic outcomes in industries that are driven by local demand.

We summarize these steps in the following hypothesis:

### **Housing Speculation Hypothesis:**

1. *Extrapolation*: Housing speculation during the boom period of 2004-2006 responds positively to housing price appreciation during the pre-boom period of 2001-2003.
2. *Housing cycle*: Housing speculation during the boom period of 2004-2006 is positively correlated with housing price appreciation during the boom period of 2004-2006, and negatively predicts housing price change during the bust period of 2007-2009.

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<sup>7</sup> While we focus on these two channels as candidates for how speculation spilled over to the real economy during the bust, we would also acknowledge another possible channel. Charles, Hurst, and Notowidigdo (2016a, 2016b) show that the housing boom masked a secular decline in manufacturing employment, and distorted the choice to attend college for prime-aged workers, by expanding employment in residential construction and related FIRE (Finance, Insurance, and Real Estate) industries. This labor misallocation can have pernicious long-term consequences beyond exacerbating the economic contraction during the bust by distorting the composition of the workforce. While data limitation prevents us from explicitly analyzing this channel in this paper, our results from analyzing employment changes in construction and non-construction sectors, in tradable and non-tradable industries, and in service and non-service industries during the housing bust nevertheless reinforce their findings.

3. *Economic cycle*: Housing speculation during the boom period of 2004-2006 is positively correlated with local economic outcomes during the boom period of 2004-2006, and negatively predicts local economic outcomes during the bust period of 2007-2009.
4. *Supply overhang*: Housing speculation during the boom period of 2004-2006 is positively correlated with the increase in housing supply during the boom, and has stronger negative predictive power for economic outcomes in the construction sector.
5. *Local demand*: Housing speculation during the boom period of 2004-2006 has stronger negative predictive power for economic outcomes in industries that are driven by local demand.

With a number of economic variables recently becoming available at the zip code level, a rapidly growing strand of the housing literature employs micro-level analysis to take advantage of the within -Metropolitan Statistical Area (MSA) variation, and studies neighborhood effects at levels below MSAs. Such studies include Mian and Sufi (2009, 2011, 2015), Pool, Stoffman, and Yonker (2015), Griffin and Mantura (2015, 2016), and Adelino, Schoar, and Severino (2016). Following this literature, we test the housing speculation hypothesis across different zip codes.

As discussed in the introduction, we face the typical issue of endogeneity in testing the housing speculation hypothesis. A large fraction of non-owner-occupied home purchases in an area might reflect local economic conditions rather than be a cause of the housing and economic cycles. To resolve this challenging identification issue, we need an instrumental variable that exogenously affects housing speculation in the area.

To construct such an instrument, we take advantage of the heterogeneous capital gains taxes imposed by different states. The primary residence exclusion allows homeowners to exclude up to \$250,000 (\$500,000 per couple) of capital gains from the sale of their primary residence, at both the federal and state levels, defined as a home they have owned and lived in for at least two of the five years prior to the sale. As there is no capital gains exclusion for sales of non-owner-occupied homes, buyers of non-owner-occupied homes are subject to capital gains taxation.

Taxation of capital gains at the state level is similar to that at the federal level, but different states impose different capital gains tax rates, and nine states (i.e., Alaska, Florida, Nevada, New Hampshire, South Dakota, Tennessee, Texas, Washington, and Wyoming) impose no capital gains

taxes at all. Furthermore, the choice of capital gains tax rates are not driven by shocks to housing markets. In fact, during the boom period of 2004-2006, all of these nine states remained without capital gains taxes, and only the District of Columbia and Ohio slightly changed their capital gains tax rates.

There is ample evidence showing that agents across the U.S. were overly optimistic about the housing market.<sup>8</sup> As optimistic households might choose to buy investment homes, state capital gains taxes provide a source of exogenous variation in the fraction of non-owner-occupied home purchases across areas. In particular, optimistic buyers expect to realize a capital gain rather than a loss on the sale of an investment home. As such, capital gains taxes would have a negative impact on investment home purchases. The magnitude of this impact could be substantial: as reported by the Bureau of Census, the average sales price for houses sold in 2003 is \$244,550 dollars. For a back-of-the-envelope calculation, using the summary statistics in our sample in Panel A of Table 1, the capital gains would be, on average, \$68,000 dollars if one purchased a house in 2003 and sold it in 2006. This sale would incur a tax of \$3,400 dollars for a 5% average state capital gains tax.

That capital gains taxation represents an important margin for home buyers and sellers can be seen by revealed preference from the passage of the Taxpayer Relief Act of 1997. This act introduced the exclusion of capital gains from the sale of primary residences at the federal level. States followed suit in honoring this exclusion, providing an additional windfall to their residents. Shan (2011) studies housing market behavior after the passage of the act and finds that the semi-annual housing sales rate increased by 17 to 24% from baseline levels for homeowners with capital gains between \$0 and \$500,000, with an elasticity of -0.1 to -0.2% in home sales for a \$10,000 increase in capital gains taxes. That some states have extended the capital gains exclusion to secondary homes after the financial crisis suggests that taxes on capital gains are a relevant margin in home buyer decisions.

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<sup>8</sup> Even credit rating agencies, such as Moody's, calculated the credit risk of mortgage-backed securities during the boom period under the assumption that housing prices would not decline in the near future. In addition, Cheng, Raina, and Xiong (2014) find that a sample of securitization agents also increased their own exposures to housing in 2004-2006.

Motivated by this observation, we instrument the fraction of non-owner-occupied home purchases during the boom period of 2004-2006 with a tax variable that incorporates the marginal tax rate across states. This variable is equal to zero in states with no capital gains taxes and the marginal tax rate for a median income household in states with capital gains taxes.<sup>9</sup> In using this instrument, we implicitly assume that the marginal buyer of non-owner-occupied homes is an in-state resident. According to a survey by the National Association of Realtors (2015), the typical investment property is 24 miles from the buyer's primary residence. This finding suggests that the typical investment home buyer is likely to be in-state, supporting the relevance requirement of our instrument.<sup>10</sup> In Section II, we also conduct a border analysis for states without capital gains taxes to provide evidence of the relevance of state capital gains taxes as an instrument for housing speculation.

For our instrument to be valid, it needs to also satisfy the exclusion restriction for causality with respect to the housing boom and the subsequent housing bust and economic contraction. While economic activity in a state might be related to its treatment of state-level personal taxation, our analysis requires only that, absent omitted variables correlated with both taxes and changes in housing prices, the relative magnitudes of the housing boom and bust and real outcomes during the Great Recession were not directly driven by variation in state-level capital gains taxation during the boom period. We believe that this is the case for several reasons.

First, capital gains taxation is just part of state taxes. As summarized by Fajgelbaum et al (2018), there are several sources of state tax revenue, such as personal income taxes, corporate income taxes, general sales taxes, selective sales taxes (e.g., alcohol sales taxes), and license taxes, which accounted, respectively, for 35%, 7%, 32%, 15%, and 6.2% of total state tax revenue in 2017. Capital gains taxes are part of personal income taxes. There is substantial variation across

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<sup>9</sup> We have also verified that our results are robust to using instead the top marginal capital gains tax rate.

<sup>10</sup> Investment home buyers from out of state introduce a nuanced issue. A buyer expects to pay taxes on future capital gains in both states – the state of residence and the state where the home resides – but may receive tax credits from the state of residence to offset the double tax incidence. The buyer thus pays the higher tax rate between the two states. We expect this issue to mostly affect zip codes close to the state border. In Section B of the Internet Appendix, we repeat our empirical tests after splitting zip codes into two subsamples: 1) zip codes within 50 miles of state borders, and 2) zip codes further than 50 miles from state borders. Consistent with our relevance assumption, the impact of housing speculation on housing prices and real outcomes is quantitatively more pronounced in the second subsample, where there is likely less noise from incorrect assignment of the tax treatment to non-owner occupied home purchases. Our results are still quantitatively and statistically significant for the first subsample, despite this classification issue.

states in the total state tax revenue, as well as the rate for each of the tax components. While one might argue that total state tax revenues should impact local housing cycles and economic activity, there is not any particular argument directly associating these variables to capital gains taxes, a small component in total state tax revenue. Even then, several studies, including Walden (2014) and Gale, Krupkin, and Reuben (2015), find little relation between the relative size of the public sector (state and local taxes as a percentage of personal income) and state differences in economic growth during the recent recovery.

Second, to directly verify such potential links, we conduct several placebo tests of the reduced-form regressions of our IV analysis, available in Section A of the Internet Appendix, for the pre-sample period of 1999 to 2001.<sup>11</sup> We find an economically and statistically insignificant link between state capital gains taxation and housing market and economic outcomes during this period.

Third, we perform several reverse causality tests, available in Section E of the Internet Appendix, and find that neither contemporaneous, lagged, nor leading changes in housing prices or economic performance can predict state capital gains taxes from 1978 to 2010.<sup>12</sup> The lack of any evidence directly linking state capital gains taxes to housing market and economic outcomes ensures the validity of our instrument.

Finally, there is little evidence suggesting that state fiscal policies and capital gains taxation impact real activity. Da et al. (2016) document that state fiscal policies have a negligible effect on firm cash flows, and only impact discount rates if a firm has a concentrated investor base. Furthermore, the correlation of our state capital gains tax instrument with their fiscal policy betas is -0.079, suggesting an insignificant relation between our instrument and cyclical variation in fiscal risk to state economic activity.

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<sup>11</sup> We report the results for this pre-sample period because the data from the IRS start from 1998. The results are also insignificant for the variables available in the Zip Code Business Patterns database since 1994.

<sup>12</sup> Specifically, we run the state-level panel regressions of marginal state capital gains tax rate for \$50,000 in income (in 2005 USD) on contemporaneous, lagged (one or five years), or leading (one or five years) changes in housing prices, and economic performance including wages and salaries, number of establishments, employment, per capita income, and unemployment rate. We also control for the corporate tax rate, sales tax rate, and year fixed effects. We find similar results for the \$10,000, \$25,000, \$75,000, and \$100,000 income brackets. We also find similar results if, instead of one and five year leads lags, we use two, three, or four years. These state-level variables are from Serrato and Zidar (2018) and NBER TAXISM.

While the state-level instrument is not ideal for our analysis of housing speculation at the zip-code level, this weakness biases our results against finding support evidence for the housing speculation hypothesis. Nevertheless, this instrument provides sufficient cross-sectional variation to identify economic consequences of housing speculation.

## II. Data Description

Panel A of Table 1 provides summary statistics for a set of variables used in our analysis.

*Housing speculation:* The Home Mortgage Disclosure Act (HMDA) data set includes comprehensive individual mortgage application and origination data for the U.S. It discloses owner occupancy for each individual mortgage and indicates whether the mortgage is for a primary residence or a non-owner-occupied home. We aggregate the HMDA data to the zip code level and calculate the fraction of mortgage originations for non-owner-occupied homes in the total mortgage origination as our measure of the share of non-owner-occupied home purchases.<sup>13</sup> The fraction of non-owner-occupied home purchases in 2004-2006 has a mean of 13.6% and a standard deviation of 9.9% across zip codes.

Figure 1 depicts the fraction of non-owner-occupied home purchases for the U.S. and three cities, New York, Las Vegas, and Charlotte, from 2000 to 2010. Non-owner-occupied home purchases represent a sizable fraction of mortgage originations, comprising 15.31% of all new originations in the U.S. at its peak in 2005. While this measure of non-owner-occupied home purchases contains both second home and investment home purchases, both types of home purchases are at least partially influenced by the motive to speculate on housing price appreciation, which became a national phenomenon in the low interest rate environment of the mid-2000s. Among the three cities, Las Vegas had the highest fraction of non-owner-occupied home purchases, which rose from a level 17.77% in 2000 to 29.41% in 2005, and then dropped back

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<sup>13</sup> Haughwout et al. (2011) use the FRBNY Consumer Credit Panel to determine housing investors based on the number of first-lien mortgage accounts that appear on their credit reports. Their proprietary data are more reliable than the HMDA data. Chinco and Mayer (2016) identify out-of-town second home buyers by distinguishing between the property and tax bill mailing addresses in transaction deeds. These data, however, are not as comprehensive as the HMDA data with which we are able to conduct a nationwide analysis of housing markets.

down to 17.77% in 2008. New York had the lowest fraction, which, while having a synchronous rise and fall as the other two cities, remained below 7% during this period.

One may be concerned that our measure of speculation has substantial measurement error because it does not include investment home purchases made in cash, and there is evidence of systematic misreporting of owner occupancy by banks to MBS investors, for instance in Piskorski, Seru, and Witkin (2015). Consistent with the intuition that our measure of speculation underestimates the true level of speculation in a zip code, Table C2 in Section C of the Internet Appendix confirms that the OLS estimates of all our coefficients of interest are biased downward compared to their IV counterparts. To address the potential issue that our results may be driven by fraud from misreporting, rather than speculation itself, we add the misreporting measure from Piskorski, Seru, and Witkin (2015), which measures the mean fraction of loans in a zip code with undeclared second-liens or non-owner occupancy status, as a control in all our main regressions in Section D of the Internet Appendix.<sup>14</sup>

***Capital gains instrument:*** We use the historical state capital gains tax rate as a key instrument for our analysis of housing speculation. Specifically, we collect state capital gains tax data from the Tax Foundation and state median income data from the American Community Survey conducted by the Census Bureau. We construct the measure of the capital gains tax burden on housing speculation at the state level based on the historical tax schedule in these states. We exploit variation in the state capital gains taxation by measuring the marginal capital gains tax burden for the median-income residents within a state in 2005.<sup>15</sup> Figure 2 displays a map of the distribution of capital gains taxes at the state level. As shown in this figure, there are nine states without capital gains tax: Alaska, Florida, Nevada, New Hampshire, South Dakota, Tennessee, Texas, Washington, and Wyoming. For states with capital gains taxes, the marginal capital gains tax rates range from 2.1% in states such as North Dakota to 9% in states such as Oregon. The mean of the tax burden on the intensive margin is 4.77% and the standard deviation is 1.27%.<sup>16</sup>

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<sup>14</sup> We do not control for it in our main tables because of the loss of zip code observations in matching the data.

<sup>15</sup> In a previous version of this paper, we constructed the tax instrument as a dummy indicator variable of whether a state has a capital gains tax. Both specifications deliver quantitatively similar results.

<sup>16</sup> Table C1 in Section C of the Internet Appendix reports reduced-form regressions of house price changes and all our economic outcomes during the cycle on the tax instrument. While the coefficients are not economically interpretable

To demonstrate that state capital gains taxes influenced speculation during the boom period, we perform a border analysis by examining zip codes within 50 miles of the border of states with zero capital gains taxes, excluding Alaska.<sup>17</sup> Panel A of Table 2 tests for a jump across borders in the fraction of non-owner occupied home purchases from 2004 to 2006 and in the fraction of subprime mortgages in 2005, and reveals that the dummy for whether the state has capital gains taxes significantly negatively predicts our measure of speculation, but has no impact on subprime credit expansion. The fraction of non-owner occupied home purchases jumps by 4.9%, and this economic magnitude is substantial relative to its mean of 13.6% and standard deviation of 9.9%. Panel A of Figure 3 confirms graphically that there is a discontinuous jump in the fraction of non-owner occupied home purchases at the state borders when plotting the coefficients from the distance regression, while Panel B demonstrates that there is no discernable analogous jump in the fraction of subprime mortgages. To further confirm that our instrument captures only variation in housing speculation, Panel B of Table 2 reports results from border regressions of the tax dummy on all our control variables, and reveals that all coefficients are statistically insignificant. Our border analysis consequently provides evidence that our instrument satisfies the relevance condition, and that it instruments for housing speculation and not for subprime credit expansion.

**House prices:** We use zip code level house price data from the Case-Shiller Home Price indices, which are constructed from repeated home sales. We further deflate the Case-Shiller Home Price Indices with the Consumer Price Index (CPI) from the Bureau of Labor Statistics. The real house price change has a mean of 27.8% in 2004-2006 across the zip codes in our sample, and a mean of -41.3% in 2007-2009.<sup>18</sup>

Figure 4 displays the Case-Shiller real house price indices for the U.S. and three cities, New York, Las Vegas, and Charlotte, from 2000-2010. The national housing market experienced a significant boom and bust cycle in the 2000s with the national home price index increasing over 60 percent from 2000-2006 and then falling back to the 2000 level in 2007-2009. New York had

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in the context of housing speculation, their statistical significance provides evidence of an economic link between our tax instrument and economic outcomes, which is central for our IV regressions.

<sup>17</sup> Mian, Sufi, and Trebbi (2015) used a similar zip code-level analysis around state borders with different foreclosure laws to justify state judicial requirements as an instrument for foreclosures. They find a jump in the foreclosure rate at the border between a judicial and a non-judicial state.

<sup>18</sup> All of our results are quantitatively similar, and remain significant, if we instead use Zillow housing price indices as our measure of local housing prices. These results are reported in Section F of the Internet Appendix.



a real housing price appreciation of more than 80 percent during the boom and then declined by over 25 percent during the bust. Charlotte had an almost flat real housing price level throughout this decade. Interestingly, Las Vegas, which had the most dramatic rise and fall in non-owner-occupied home purchases, also experienced the most pronounced price expansion—over 120 percent—during the boom, and the most dramatic price drop—over 50 percent—during the bust.

***Local economic performance:*** We collect data on economic performance at the zip code level from various sources. Annual population and annual per capita income at the zip code level are available from the Internal Revenue Service (IRS). The IRS does not, however, provide data for 2000 and 2003. We thus use the data for 2002 and 2006 to calculate the changes during the boom period and the changes from 2001 to 2002 for the pre-boom period. Annual total employment, annual payroll, and the number of establishments at the zip code level are from the Zip Code Business Patterns database. We include both resident income and annual payroll from employers because, as argued by Mian and Sufi (2009), residents in a certain area do not necessarily work in the same place that they live. The change in per capita income has a mean of -11.3% in 2007-2009, which is consistent with the severe economic recession during the bust period. Similarly, the employment change has a mean of -8.3%, the change in the number of establishments has a mean of -3.8%, and the real payroll change has a mean of -10.0% in 2007-2009.

Zip Code Business Patterns database also provides employment data by establishment size and by industry. For our analysis, we are interested in the construction industry as it is directly related to the supply side of housing markets. We also follow Mian and Sufi (2014) to identify non-tradable industries because they produce non-tradable goods and services, which reflect the strength of local demand. Alternatively, we examine the retail and restaurant industries, which rely on local consumption.

***New housing supply:*** To measure supply-side activities in local housing markets, we use building permits from the U.S. Census Bureau, which conducts a survey of permit issuing all over the U.S. Compared with other construction-related measures, such as housing starts and housing completions, building permits are more detailed and available at the county level. In addition, building permits are issued before housing starts and can therefore predict price trends in a timely

manner.<sup>19</sup> Nevertheless, a potential weakness of this measure is that the Census Bureau does not provide building permit data at the zip code level. Specifically, using 2000 U.S. census data, we measure new housing supply during the boom period by the building permits issued from 2004 to 2006 relative to the existing housing units in 2000.<sup>20</sup> This measure has a mean of 5.6% across counties in our sample and a substantial standard deviation of 5.6%.

Figure 5 depicts the annual building permits granted in 2000-2010 relative to the number of housing units in 2000 for the U.S. and three cities, New York, Las Vegas, and Charlotte. At the national level, annual building permits had a modest increase from 1.05% in 2000 to 1.45% in 2005 and then a substantial drop to 0.38% in 2009. New York saw very little increase in its housing supply, with annual building permits staying at a flat level of less than 0.4% throughout this decade. Charlotte had a larger new supply than New York in the 2000s. Interestingly, Las Vegas had the most dramatic rise and fall in annual building permits, rising from 2.03% in 2000 to a level above 5% in 2005 and 2006, and then dropping to 0.50% in 2009, roughly in sync with the rise and fall of non-owner-occupied home purchases as well as the housing price cycle.

***Credit conditions:*** We include several variables on credit conditions at the zip code level to control for the credit expansion during the recent housing boom. We use mortgages originated for home purchases and link the lender institutions on the HUD subprime home lender list to the HMDA data to identify the mortgages issued to the subprime households. As the HUD subprime home lender list ended in 2005, we use the fraction of subprime mortgage originations in 2005 as the share of low-quality loans in the zip code during the housing cycle. This fraction has a mean of 21.1% and a standard deviation of 13.8%. The HMDA data set also indicates whether a mortgage application is denied by the lender, and whether the originated mortgage is sold to government sponsored entities (GSEs). Consequently, we can also control for the mortgage denial rate and the share of mortgages sold to GSEs in 2005 at the zip code level.<sup>21</sup> The mortgage denial

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<sup>19</sup> Authorization to start is a largely irreversible process, with housing starts being only 2.5% lower than building permits at the aggregate level according to <https://www.census.gov/construction/nrc/nrcdatarelationships.html>, the website of the Census Bureau. Moreover, the delay between authorization and housing start is relatively short, on average less than one month, according to <https://www.census.gov/construction/nrc/lengthoftime.html>. These facts suggest that building permits are an appropriate measure of new housing supply.

<sup>20</sup> Our results for new housing supply are robust to allocating new building permits at the county level to zip codes according to the fraction of employment in residential construction in 2000.

<sup>21</sup> We control these variables only in 2005 as we use the subprime mortgage fraction in 2005. The results also hold if we choose these controls in 2004-2006.

rate has a mean of 13.9% and the fraction of GSE mortgages has a mean of 19.3%.<sup>22</sup> We also include the denial rate and the fraction of mortgages sold to GSEs for non-owner-occupied mortgages to control for the possible heterogeneous credit conditions to housing investors.

*Other controls:* For housing supply elasticity, we employ the widely used elasticity measure constructed by Saiz (2010). This measure reflects geographic constraints in home building by defining undevelopable land for construction as terrain with a slope of 15 degrees or more as areas lost to bodies of water including seas, lakes, and wetlands. This measure has a lower value if an area is more geographically restricted.<sup>23</sup>

We also control for various economic fundamentals at the zip code level. We use information from the Census Bureau in 2000 including population, fraction of college-educated population, fraction of workforce, median household income, poverty rate, urban rate, and fraction of white people. In addition, we control for whether a state is one of the so-called “sand states” (Arizona, California, Florida, and Nevada), and whether the state has non-recourse mortgage laws. As highlighted, for instance, by Nathanson and Zwick (2017) and Choi et al. (2016), the sand states experienced phenomenal housing cycles in comparison to the rest of the U.S. in such outcomes as mortgage origination, defaults, and housing price fluctuations.<sup>24</sup> The nature of the mortgage laws in a given state has been found to be an important predictor of real outcomes in the housing market (Dobbie and Goldsmith-Pinkham (2014)) and of speculative activity in the housing market (Nam and Oh (2016)).

Also, we also control for other potential sources of secondary housing demand beyond speculation. We collect the fraction of renters in a zip code, as well as the fraction of immigrants in the past five years to control for long-term trends in local demographics. We also collect the fraction of employment in recreational and entertainment to proxy for the appeal of zip code as a

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<sup>22</sup> We acknowledge that misreporting is common in mortgage data, such as in Griffin and Maturana (2015 and 2016). For example, recent studies such as Avery et al. (2012), Blackburn and Vermilyea (2012), and Mian and Sufi (2015), cast doubt on the accuracy of HMDA data, and in particular, find that the income variable could be overstated by home buyers. For this reason, we use income data from the IRS and control for the misreporting measure from Piskorski, Seru, and Witkin (2015) for robustness.

<sup>23</sup> The Saiz (2010) measure is not, however, without its issues. Davidoff (2015), for instance, argues that the Saiz measure is a poor instrument for housing prices because it is correlated with many variables related to housing demand.

<sup>24</sup> In the Internet Appendix, we rerun all of our regressions excluding the four sand states for robustness. It is reassuring that our results are not affected by their exclusion.

vacation destination. We construct these variables from the 2000 Census data. Finally, we collect the denial rate for second home mortgage applications and the fraction of GSE mortgages that are second home purchases from HMDA to control for cross-sectional heterogeneity in second home credit supply.

*Speculation vs subprime:* Figure 6 shows little correlation between the distribution of housing speculation and that of subprime mortgages across zip codes. Statistically, the correlation coefficient between the fraction of non-owner-occupied home purchases in 2004-2006 and the fraction of subprime mortgages in 2005 is only 0.004 and is insignificant. This suggests that housing speculation is a phenomenon largely independent of the credit expansion to subprime households. Instead, our measure of housing speculation captures the purchases of second homes by relatively wealthier households in booming areas.

Panel B of Table 1 provides evidence of where non-owner occupied versus subprime housing purchases were prevalent during the boom period by examining their correlations with our controls. Although both occurred in areas with similar initial fundamentals in 2000, along demographic dimensions such as the poverty rate, median household income, and employment, and were pronounced in the four sand states and areas that had higher housing price appreciation from 2003 to 2006 and mortgage denial rates in 2005, they differed along several substantive dimensions during the boom. Speculation occurred in areas that experienced economic expansions, with regard to income, payroll, and employment. Subprime credit expansion, in contrast, flourished in areas that experienced economic contractions, and that had inelastic housing supplies, non-recourse mortgage laws, and a lower fraction of GSE loans.

*Regression analysis:* To account for the relative importance of different zip codes in the recent U.S. housing cycle, we conduct all of our regression analyses by weighting observations by the number of households within the zip code in 2000. All of our results are robust to employing an equal-weighting scheme instead. In addition, because our instrument varies across states, we cluster the standard errors at the state level in all regressions.

### **III. Empirical Results**

This section reports our empirical results from examining different aspects of the Housing Speculation Hypothesis.

### **A. Extrapolation**

We first examine extrapolative expectations as a driver of housing speculation, as posited by part 1 of the Housing Speculation Hypothesis. We expect that non-owner-occupied home purchases in areas with less capital gains taxation would anchor more strongly on lagged housing price changes, given that speculators can benefit more from capital gains from investing in housing. Table 3 displays the regression results of regressing the fraction of non-owner-occupied home purchases during the boom period of 2004-2006 on the housing price change during the pre-boom period of 2001-2003 and its interaction with capital gains tax rates, controlling for a host of local fundamental variables that predict future price changes. Column 2 of Table 3 shows that past housing price increases significantly predict a higher fraction of non-owner-occupied home purchases. More important, the coefficient of their interaction terms is both strongly negative and statistically significant at the 1% level, suggesting that housing speculation at the zip code level in states with less capital gains taxes reacted more strongly to past housing price changes.<sup>25</sup> This finding thus provides evidence that speculation, anchored on past house price changes, contributed a non-fundamental source of housing demand during the boom, especially in areas more prone to speculative behavior.<sup>26</sup>

### **B. Housing Cycle**

We now examine part 2 of the Housing Speculation Hypothesis on the link between housing speculation and the housing cycle. Figure 7 provides a scatter plot of the real housing price change during the boom period of 2004-2006 (Panel A) and the bust period of 2007-2009 (Panel B) against

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<sup>25</sup> The Frisch Waugh Theorem gives an alternative interpretation of our results. The coefficient on past housing prices and its interaction with the tax instrument is equivalent to regressing the residual from regressing the fraction of non-owner occupied home purchases on fundamentals on the residuals from regressing past housing prices and its interaction on fundamentals. The OLS coefficients therefore capture the responsiveness of non-fundamental housing demand to past housing price growth that is orthogonal to fundamentals, and its interaction with the tax instrument.

<sup>26</sup> Consistent with our results, Wheaton and Nechayev (2008) show that a regression forecasting housing price appreciation systematically underestimates the realized housing price growth between 1998 and 2005, and that these forecast errors are positively correlated with the percentage of home sales attributed to investors and second home buyers within a MSA.

the fraction of non-owner-occupied home purchases during the boom period of 2004-2006 at the zip code level. The plot displays a clear association between more intensive housing speculation and both greater housing price increases during the boom, and greater subsequent housing price drops during the bust.

Table 4 reports the two-stage instrumental variable approach to formally analyze this relationship by using the variable of the marginal capital gains tax rate for the median income household within the state as the instrument. Column (1) of Table 4 shows the first-stage result from regressing the fraction of non-owner-occupied home purchases during the boom period of 2004-2006 on the tax instrument. Column (1) shows that the tax instrument has a significant explanatory power for the fraction of non-owner-occupied home purchases. The F-statistic of 69.93 provides reassurance that the tax rate variable is a valid instrument, with regard to relevance, for the fraction of non-owner-occupied home purchases.

We next analyze the causal effect of housing speculation on price expansion during the boom period, and the price contraction during the bust period. Column (2) of Table 4 reports the IV results of regressing the housing price change in 2004-2006 on the fraction of non-owner-occupied home purchases during the boom period of 2004-2006, instrumented by the tax rate variable, following the first-stage regressions in column (1). Similarly, column (3) reports the IV results of regressing the housing price change in 2007-2009 on the instrumented fraction of non-owner-occupied home purchases during the boom period of 2004-2006. We also add the same control variables as used in column (1). We again weight observations by the total number of households in the zip code, and cluster standard errors at the state level.

Column (2) shows that the IV coefficient estimate of the impact of housing speculation on housing prices during the boom is significantly positive, both statistically and in its economic magnitude: a 1% increase in the fraction of non-owner-occupied home purchases is associated with a 2.7% price expansion in 2004-2006. This coefficient, when multiplied by 0.0987—the standard deviation of the fraction of non-owner-occupied home purchases across zip codes, as reported in Table 1—gives a substantial price increase of 26.5%.

Column (3) shows the IV coefficient estimate of the impact of housing speculation on the housing price contraction during the bust is significantly negative, both statistically and in its

economic magnitude: a 1% increase in the fraction of non-owner-occupied home purchases is associated with a 3.8% price contraction in 2007-2009. When multiplied by the standard deviation of the fraction of non-owner-occupied home purchases across zip codes, this translates to a substantial price decline of 37.4%. Taken together, we are able to establish a causal link between housing speculation during the boom period of 2004-2006 and the house price cycle during 2004-2009.

### **C. Economic Cycle**

By affecting housing prices, housing speculation may also impact local economic activity, as posited by Part 3 of the Housing Speculation Hypothesis. We first examine to what extent housing market speculation contributed to local economic expansions during the boom period. Table 5 Panel A reports the results of regressing the aforementioned measures of economic activity in 2004-2006 on the fraction of non-owner-occupied home purchases in 2004-2006, instrumented by our tax rate variable. Housing speculation is positively associated with all of the measures of economic consequences at the 1% significance level during the boom period. Among our measures of economic activity, real payroll, which is shown in column (3), is most heavily affected by local housing speculation during the boom: an increase of 138.3 basis points is associated with a 1% increase in the fraction of non-owner-occupied home purchases. This coefficient, when multiplied by 0.0987—the standard deviation of the fraction of non-owner-occupied home purchases across zip codes—gives a substantial increase of 13.7% in real payroll.

Employment and income per capita also increase to a large extent, with the coefficient estimates of 0.850 and 1.305 in columns (4) and (1), respectively. These coefficients, when multiplied by the standard deviation of the fraction of non-owner-occupied home purchases across zip codes, give a substantial increase of 8.4% and 12.9% in employment and income per capita, respectively. Finally, the change in the number of establishments, shown in column (2), is the most modest, although the effect is still economically meaningful: a 1% increase in housing speculation implies an increase of 68.7 basis points in the number of establishments. When multiplied by the standard deviation of the fraction of non-owner-occupied home purchases across zip codes, this effect translates to an increase of 6.8% in the number of establishments. The variation across zip codes in their economic responses reflects not only differences in firm adjustment costs of

employment, wages, and establishments, but also differences in exposure to housing speculation during the boom.

Next, we examine to what extent housing market speculation contributed to the slowdown in local economic activity during the bust. Table 5 Panel B reports the results of regressing our measures of economic activity in 2007-2009 on the fraction of non-owner-occupied home purchases in 2004-2006, instrumented by our tax rate variable. Housing speculation is negatively associated with all of the measures of economic consequences at the 1% significance level during the bust. Among our measures of economic activity, real payroll, which is shown in column (3), is most heavily affected by local housing speculation during the boom: a decrease of 156.3 basis points during the bust, is associated with a 1% increase in the fraction of non-owner-occupied home purchases. This coefficient, when multiplied by 0.0987—the standard deviation of the fraction of non-owner-occupied home purchases across zip codes—corresponds to a substantial drop of 15.4% in real payroll.

Employment and income per capita also decrease to a large extent, with the coefficient estimates of -1.475 and -0.794 in columns (4) and (1), respectively. These coefficients, when multiplied by the standard deviation of the fraction of non-owner-occupied home purchases across zip codes, give a substantial drop of 14.6% and 7.8% in employment and income per capita, respectively. Finally, the change in the number of establishments, shown in column (2), is the most modest, although the effect is still economically meaningful: a 1% increase in housing speculation implies a decrease of 87.7 basis points in the number of establishments. When multiplied by the standard deviation of the fraction of non-owner-occupied home purchases across zip codes, this effect translates to a substantial decline of 8.7% in the number of establishments. The variation across zip codes in their economic responses reflects not only differences in firm adjustment costs of employment, wages, and establishments, but also differences in exposure to housing speculation during the boom.

To simplify the exposition, we omit reporting coefficients and standard errors for all control variables in Tables 4 and 5. Instead, we report them in Section H of the Internet Appendix. Some of these control variables are highly significant. In particular, the fraction of subprime mortgages in 2005 is significantly correlated with the magnitudes of the housing price boom and bust, as well



as our four measures of the local economic downturn during the bust period, consistent with the findings of Mian and Sufi (2009, 2014).

In addition to the results presented here, we also report robustness analyses in the Internet Appendix. As two of the four sand states, Florida and Nevada, have no capital gains taxes, this raises a potential concern that the effect of housing speculation on the price increase during the boom, and decline during the bust, might be driven by these two states. Section G of the Internet Appendix invalidates this concern by repeating Tables 4 and 5 excluding the four sand states. Section F illustrates that our results are quantitatively similar, and remain significant, if we instead use Zillow housing price data. Section I shows that our results are robust after excluding control variables related to local economic performance during the boom period that are potentially correlated with speculation and endogenous to the housing cycle. Finally, Table C2 in Section C reports the OLS estimates of Tables 4 and 5. Our IV analysis reveal a consistent downward bias in the OLS estimates, with magnitudes increasing, on average, by a factor of 2 to 4, though the changes are relatively small in levels. This is consistent with investment home buyers reducing their demand as house prices increase, and consequently having a smaller impact on economic outcomes, as well as with a downward bias in our measure of speculation because of cash deals and bank misreporting.

#### **D. Supply Overhang**

By driving up housing demand, housing speculation may have impacted the supply side of the housing market during the boom, as posited in Part 4 of the Housing Speculation Hypothesis. The inflated housing supply, in turn, could have led to a supply overhang problem during the bust, which resulted in a stronger contraction in the construction sector than in non-construction sectors. To examine this supply overhang effect, we first examine the impact of housing speculation on housing supply. Given that the Census Bureau provides building permit data only at the county level, we carry out the analysis by aggregating non-owner-occupied home purchases and all other controls into the county level. Figure 8 provides a scatter plot of the building permits in 2004-2006 relative to the number of housing units in 2000—a measure of the new housing supply—against the fraction of non-owner-occupied home purchases in the same period. The plot vividly illustrates a positive relation between housing speculation and new housing supply.

Table 6 then demonstrates a causal link by regressing the new housing supply measure on the fraction of non-owner-occupied home purchases in 2004-2006, instrumented by the state tax rate variable. We report the two stage results in columns (1) and (2), respectively. We weight observations by the total number of households at the county level, and cluster standard errors at the state level. As shown in column (1), the tax instrument also has significant explanatory power for the fraction of non-owner-occupied home purchases at the county level. The F-statistic of 19.75 of the first stage suggests that the instrument is statistically strong for this county-level test. Column (2) reports the second stage result. The IV coefficient estimate of the impact of housing speculation on the new supply during the boom is significantly positive, establishing a causal link between them. Specifically, a 1% increase in the fraction of non-owner-occupied home purchases during the boom period is associated with an expansion of 42.8 basis points in new housing supply, or equivalently, a one standard deviation increase in the fraction of non-owner-occupied home purchases across counties implies a substantial increase of 4.2% in new housing supply between 2004 and 2006.

Supply overhang can both exacerbate the subsequent housing price bust and reduce demand for new housing, leading to a large decline in construction activity during the recession. We examine this effect by returning to a zip code-level analysis. Column (1) of Table 7 reports the results of zip code-level regressions on how housing speculation leads to a severe reduction in employment in the construction sector. Consistent with the supply overhang channel, the IV coefficient estimate shows that the impact of housing speculation on the construction sector is more than twice as great as that on total employment (reported in Table 5)—a one standard deviation increase in the fraction of non-owner-occupied home purchases across zip codes is associated with a decrease of 33.8% in construction-sector employment.

The drag on the construction sector, however, cannot explain all of the economic impact of housing speculation. In column (2), we also examine the change in employment in all industries except the construction sector. The result is still both statistically and economically significant. A 1% increase in housing speculation during the housing boom decreases non-construction employment by 125.3 basis points during the housing bust, or equivalently, a one standard deviation increase in the fraction of non-owner-occupied home purchases across zip codes is

associated with a decrease of 12.4% in non-construction sector employment. This result suggests that the economic effects of housing speculation are not restricted to the construction sector.

## **E. Local Demand**

To further examine the effects of housing speculation on the non-construction sectors, we now focus on non-tradable industries as our measure of local demand. We use the classification of non-tradable and tradable industries from Mian and Sufi (2014),<sup>27</sup> who define these sectors based on an industry's geographical concentration. Since non-tradable sectors service local demand within a region, their locations tend to be dispersed geographically. In contrast, tradable sectors supply goods to meet national demand and are less exposed to local economic conditions, and therefore they should be more concentrated spatially to take advantage of economic scale and specific resources. Alternatively, we examine the restaurant and retail sectors, which mainly rely on local demand. By analyzing these sectors, we can test whether housing speculation affected local economic conditions during the bust through the local demand channel, as posited in Part 5 of the Housing Speculation Hypothesis.

Table 8 reports the coefficient estimates of the fraction of non-owner-occupied home purchases during the boom period on the change in employment in the non-tradable sectors in column (1), and the retail and restaurant sectors in column (3), during the bust period using our IV method. The instrumented housing speculation is negatively associated with these employment changes at the 1% significance level: an increase of one standard deviation in the share of non-owner occupied home purchases in 2004-2006 led to a decrease of 15.1% in the employment of non-tradable sectors in 2007-2009, and of 15.6% in the employment of retail and restaurant sectors. These economic magnitudes are similar to that for overall employment change reported in column (4) of Table 5 and for non-construction employment change in column (2) of Table 7. This strong effect on the non-tradable sectors, whether broadly or narrowly defined, indicates that housing speculation during the housing boom has a substantially adverse effect on local demand during the housing bust.

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<sup>27</sup> For the detailed classification, refer to Appendix Table 1 of Mian and Sufi (2014).

For comparison, we also include the estimates for the employment change in tradable industries in column (2) and the employment change in industries other than retail and restaurant in column (4). Housing speculation has an insignificant effect on the employment of tradable industries and a moderate negative impact (11.2% from a one-standard-deviation increase in housing speculation) on industries other than retail and the restaurant business. As employment in these sectors relies more on national demand, the adverse effects of local housing speculation are weaker for these industries.

Taken together, our analysis provides evidence that housing speculation affected real economic outcomes during the Great Recession through the supply overhang channel and the local demand channel. Since employment in residential construction contributes to local demand, these two channels are likely complementary, and it is reassuring that we find that both are significant in contributing to the severity of local recessions.

#### **IV. Conclusion**

In this paper, we provide evidence that housing speculation, as measured by the fraction of non-owner-occupied home purchases, arose from extrapolation by speculators of past housing price changes. We document how this speculation during the boom period of 2004-2006 had positive economic consequences during the boom period, and adverse consequences during the bust period of 2007-2009. We demonstrate this causal relationship by taking advantage of an instrument based on variation in state capital gains taxation. Our results suggest that housing speculation had real economic consequences during the boom, by increasing housing prices and fueling local economic expansions, and during the recession, by depressing residential construction employment, as a result of supply overhang, and by reducing local household demand. Taken together, our analysis reveals that speculation in housing markets, partly driven by behavioral biases, impacted the real economy both during and in the aftermath of the recent U.S. housing cycle.

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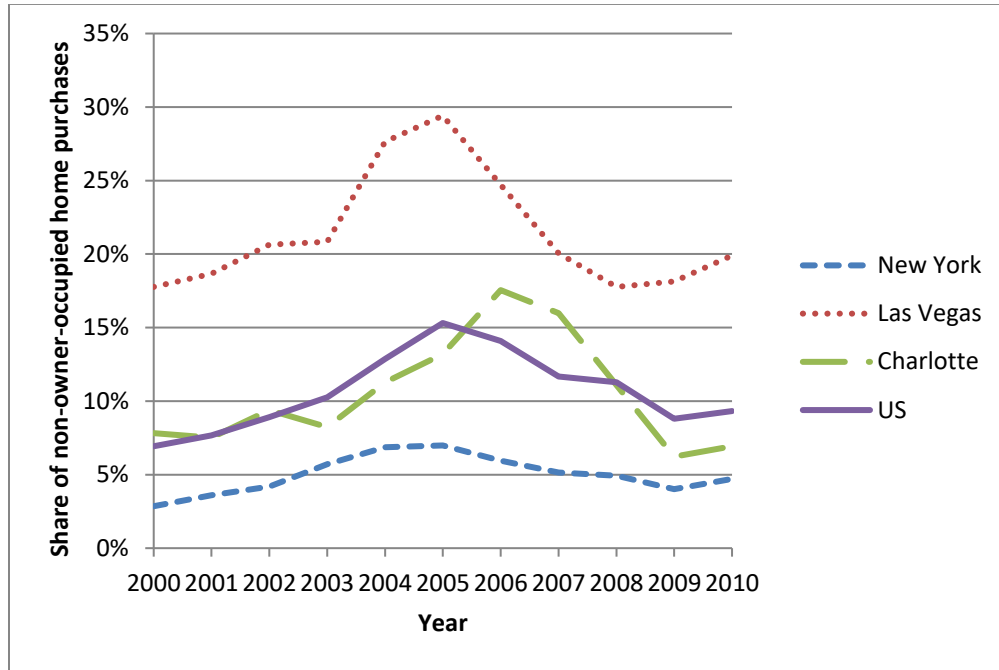
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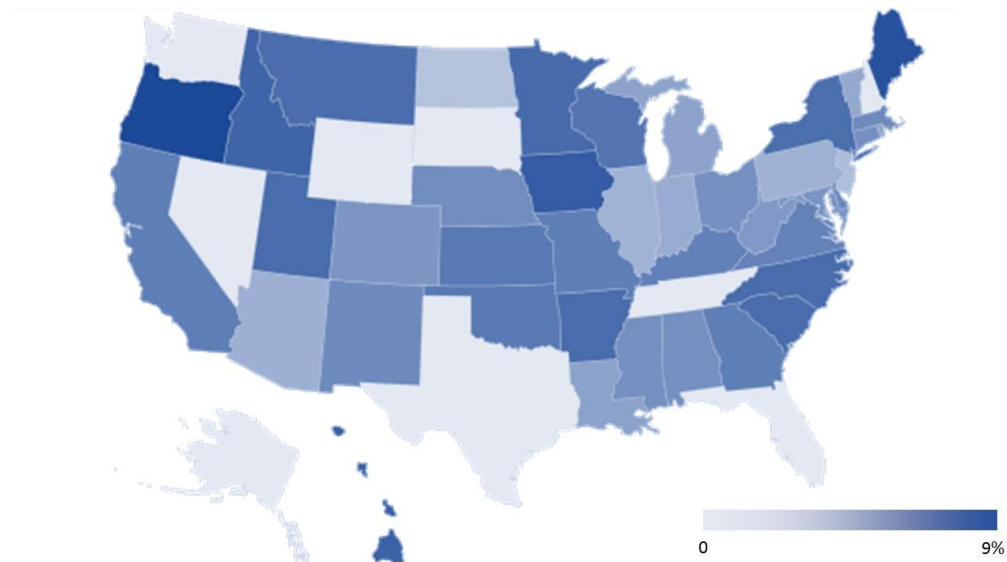
**Figure 1: Fraction of Non-Owner-Occupied Home Purchases**

This figure plots the share of non-owner-occupied home purchases for the U.S. and three cities, New York, Las Vegas, and Charlotte. The fraction of non-owner-occupied home purchases in each city is computed from the “Home Mortgage Disclosure Act” data set.



**Figure 2: Distribution of Capital Gains Tax across U.S. States**

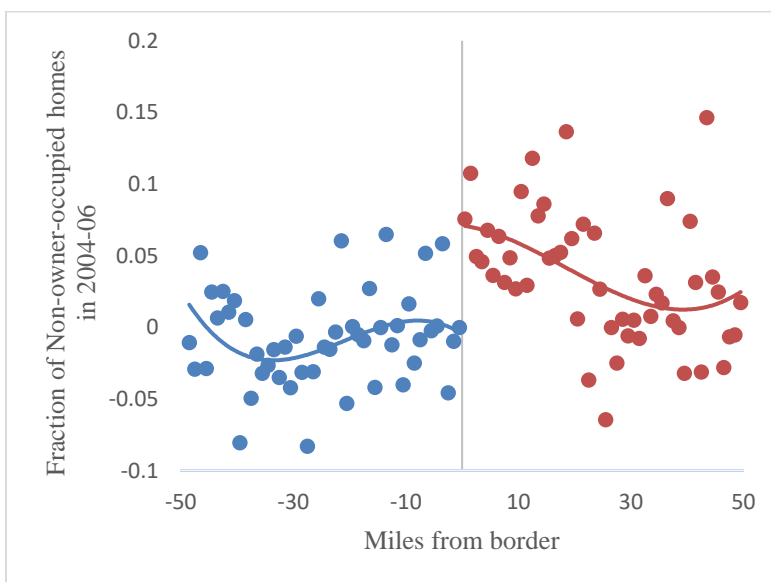
This figure plots the map of the marginal state tax rates on capital gains for state median income in 2005 across U.S. states.



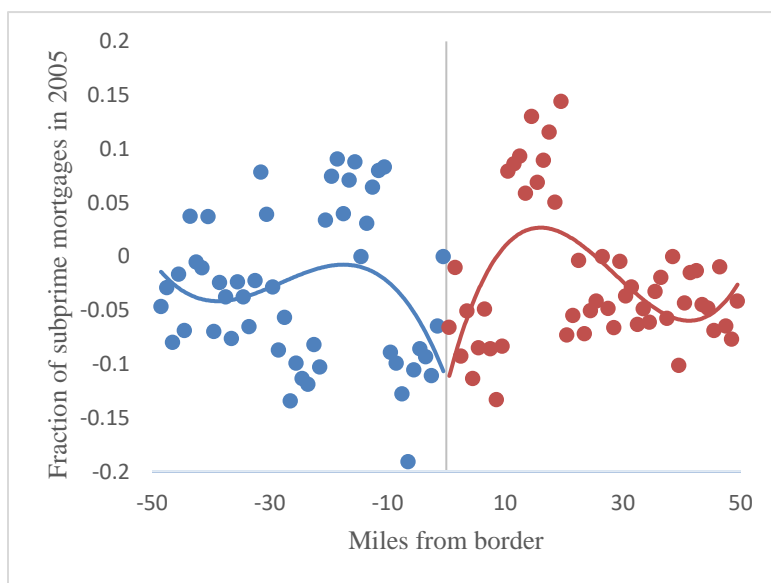
**Figure 3: Zip codes near borders of states without capital gains taxes**

This figure plots the fraction of non-owner-occupied home purchases in 2004-06 (Panel A) and the fraction of subprime mortgages in 2005 (Panel B) in zip codes near borders of states without capital gains taxes. The variables of interests are regressed on dummies indicating each one mile distance from the border (dummies are negative for neighboring states with capital gains taxes) and state-border\*10-mile strip fixed effects. The figure plots the coefficients on the distance dummies.

**Panel A: Non-owner-occupied home purchases**

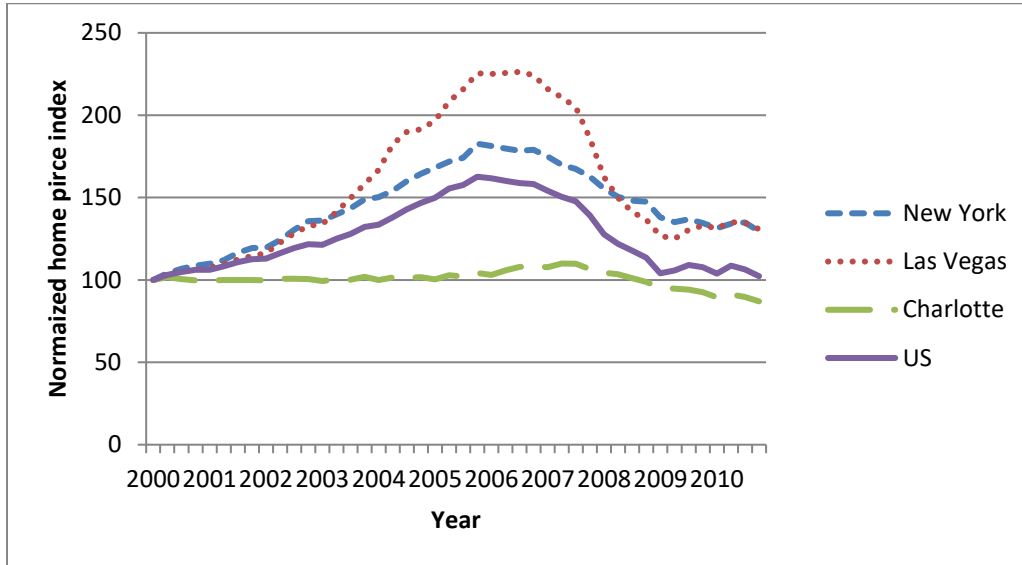


**Panel B: Subprime mortgages**



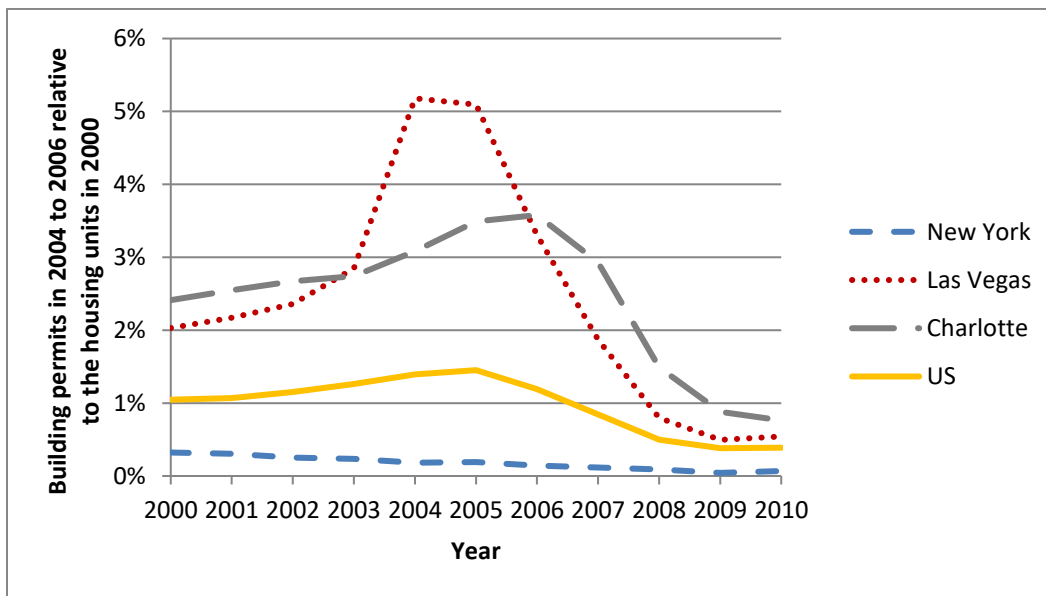
**Figure 4: Case-Shiller Home Price Indices**

This figure plots the Case-Shiller home price indices for the U.S. and three cities, New York, Las Vegas, and Charlotte. The price index is deflated by the CPI and normalized to 100 in 2000.



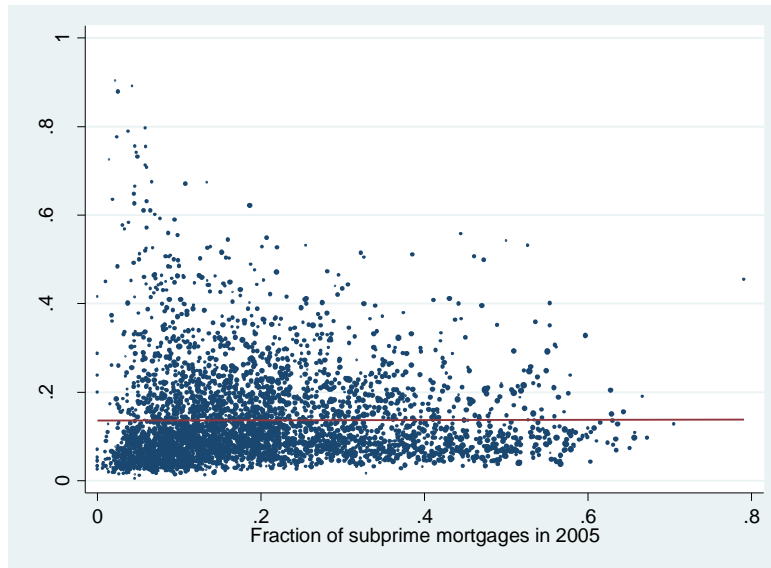
**Figure 5: New Housing Supply**

This figure depicts building permits in 2000 to 2010 relative to the housing units in 2000 for the U.S. and three cities, New York, Las Vegas, and Charlotte.



**Figure 6: Speculation and Subprime Households**

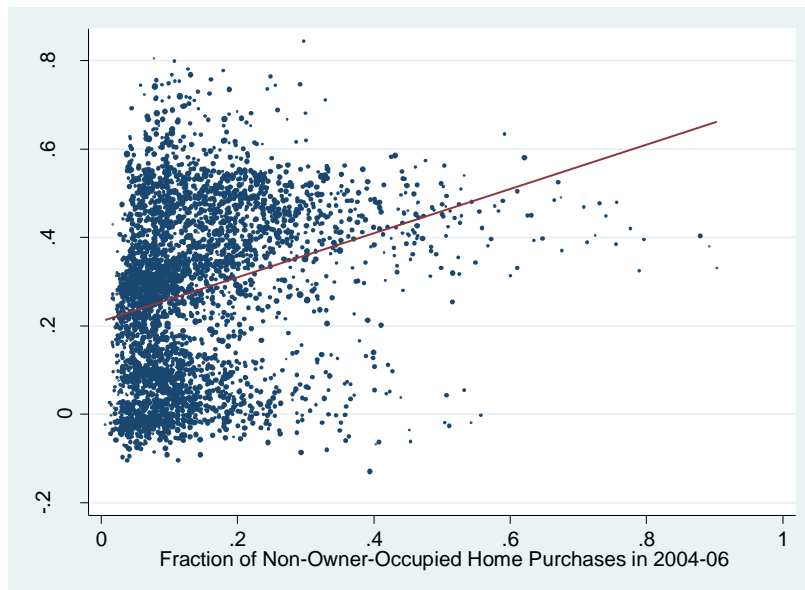
This figure plots the fraction of non-owner-occupied home purchases in 2004 to 2006 against the fraction of subprime mortgages in 2005 at the zip code level.



**Figure 7: Speculation and Housing Price Cycle**

These figures plot the real housing price change during the boom period of 2004 to 2006 (Panel A) and the bust period of 2007 to 2009 (Panel B) against the fraction of non-owner-occupied home purchases in 2004 to 2006 at the zip code level.

**Panel A:**

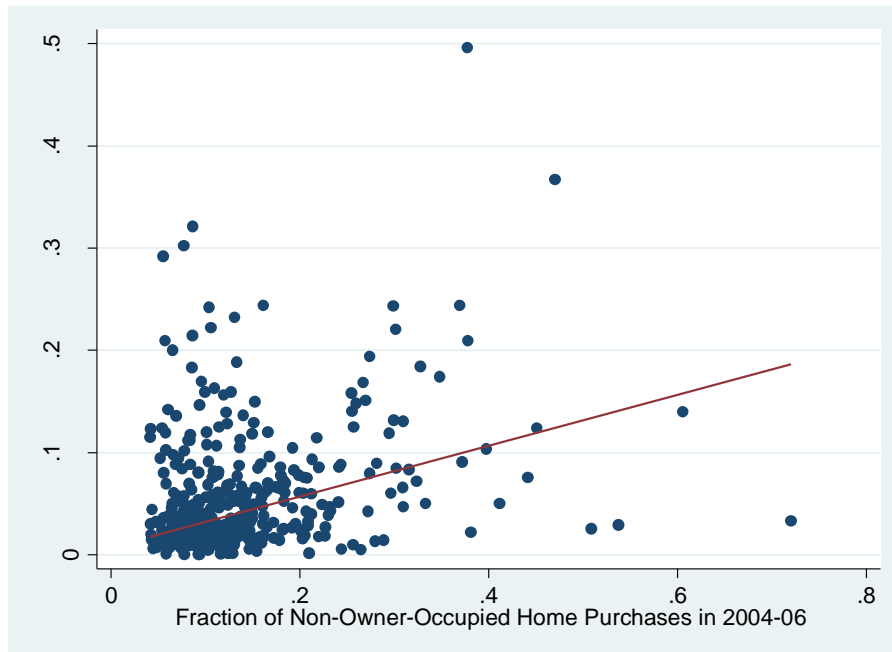


**Panel B:**



**Figure 8: Speculation and New Housing Supply**

This figure plots building permits in 2004 to 2006 relative to the number of housing units in 2000 against the fraction of non-owner-occupied home purchases in 2004 to 2006 at the county level.



**Table 1 Summary Statistics and Correlations**

**Panel A: Summary statistics of the key variables**

VARIABLES	(1) N	(2) Mean	(3) Sd
Fraction of Non-Owner-Occupied Home Purchases in 2004-06	3,975	0.136	0.0987
Real house price change in 2001-03	4,027	0.191	0.135
Real house price change in 2004-06	4,027	0.278	0.191
Real house price change in 2007-09	4,027	-0.413	0.278
Per capita income change in 2003-06	4,027	0.0521	0.125
Per capita income change in 2007-09	4,026	-0.113	0.0957
Change in no. of establishments in 2004-06	3,942	0.0638	0.0870
Change in no. of establishments in 2007-09	3,924	-0.0382	0.0706
Real payroll change in 2004-06	3,942	0.0866	0.179
Real payroll change in 2007-09	3,924	-0.0998	0.191
Employment change in 2004-06	3,942	0.0707	0.158
Employment change in 2007-09	3,924	-0.0831	0.148
Saiz's elasticity	4,027	1.376	0.715
Fraction of subprime mortgages in 2002	3,468	0.0896	0.0725
Fraction of subprime mortgages in 2005	3,975	0.211	0.138
Mortgage denial rate in 2002	3,468	0.111	0.0573
Mortgage denial rate in 2005	3,975	0.139	0.0507
Non-owner-occupied home mortgage denial rate in 2002	3,414	0.115	0.0956
Non-owner-occupied home mortgage denial rate in 2005	3,939	0.130	0.0637
Fraction of GSE mortgages in 2002	3,468	0.376	0.113
Fraction of GSE mortgages in 2005	3,975	0.193	0.103
Fraction of GSE mortgages for non-owner-occupied home in 2002	3,388	0.383	0.170
Fraction of GSE mortgages for non-owner-occupied home in 2005	3,935	0.181	0.114
Ln of population in 2000	4,027	10.32	0.572
Fraction of the college educated in 2000	4,027	28.12	15.63
Fraction of the employed in 2000	4,027	61.14	8.782
Fraction of workforce in 2000	4,027	64.70	8.106
Median household Income in 2000	4,027	49,524	17,274
Poverty rate in 2000	4,027	10.77	7.713
Urban rate in 2000	4,027	94.30	14.21
Fraction of the white in 2000	4,027	71.89	23.05
Number of households in 2000	4,027	12,935	6,235
Fraction of renters in 2000	3,942	0.355	0.964
Fraction of immigrants in past 5 years (2000)	3,942	0.214	0.0703
Fraction of employment in arts entertainment and recreation in 2000	3,942	0.0832	0.0419

**Panel B: Correlations of non-owner-occupied versus subprime housing purchases with control variables during the boom period and the p-values of their differences**

VARIABLES	Fraction of Non-Owner-Occupied Home Purchases in 2004-06	Fraction of subprime mortgages in 2005	p-value
Real house price change in 2004-06	0.277***	0.383***	0.000
Per capita income change in 2003-06	0.206***	-0.388***	0.000
Change in no. of establishments in 2004-06	0.100***	-0.066***	0.000
Real payroll change in 2004-06	0.105***	-0.035*	0.000
Employment change in 2004-06	0.061***	-0.041**	0.000
Mortgage denial rate in 2005	0.199***	0.704***	0.000
Fraction of GSE mortgages in 2005	-0.015	-0.564***	0.000
Non-owner-occupied home mortgage denial rate in 2005	0.199***	0.389***	0.000
Fraction of GSE mortgages for non-owner-occupied home in 2005	-0.015	-0.396***	0.000
Population change in 2003-06	-0.001	0.011	0.592
Ln of population in 2000	-0.028	0.315***	0.000
Fraction of the college educated in 2000	-0.175***	-0.553***	0.000
Fraction of the employed in 2000	-0.453***	-0.323***	0.000
Fraction of workforce in 2000	-0.446***	-0.224***	0.000
Median household Income in 2000	-0.423***	-0.404***	0.428
Poverty rate in 2000	0.393***	0.497***	0.000
Urban rate in 2000	0.078***	0.182***	0.000
Fraction of the white in 2000	-0.113***	-0.636***	0.000
Dummy for states with non-recourse mortgage law	-0.084***	0.201***	0.000
Dummy for sand states	0.318***	0.308***	0.648
Saiz's elasticity	0.034*	-0.208***	0.000
Fraction of renters in 2000	0.236***	0.302***	0.000
Fraction of immigrants in past 5 years (2000)	0.219***	-0.157***	0.000
Fraction of employment in arts entertainment and recreation in 2000	0.580***	0.069***	0.000

**Table 2: Zip codes near borders of states without capital gains taxes**

Panel A of this table presents discontinuity tests for the fraction of non-owner-occupied home purchases in 2004-06 (Column 1) and the fraction of subprime mortgages in 2005 (Column 2) in zip codes near borders of states with no capital gains taxes. Panel B shows discontinuity tests for other control variables in zip codes near borders of states with no capital gains taxes. Distance from borders are divided by 1,000 and is negative on the side of neighboring states with capital gains taxes. We control for distance and its squared and cubic terms in all regressions (their coefficients are omitted to save space). Distance from borders are divided by 1,000 and is negative on the side of neighboring states with capital gains taxes. Standard errors are clustered at the state-border level. \*\*\*, \*\*, \* indicate coefficient estimates statistically distinct from 0 at the 1%, 5%, and 10% levels, respectively.

**Panel A**

	(1) Fraction of Non-Owner-Occupied Home Purchases in 2004-06	(2) Fraction of subprime mortgages in 2005
Dummy for states with capital gains tax	-0.0487** (0.0212)	0.00182 (0.0248)
Distance	-2.241** (1.039)	0.763 (0.964)
Distance squared	-40.59* (21.32)	-37.77* (19.72)
Distance cubed	1035.5** (397.3)	-66.09 (423.6)
State-border X 10- mile strips FE	Yes	Yes
Observations	1072	1072
R-squared	0.347	0.185



**Panel B**

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	Dummy for states with capital gains tax	Standard errors
Mortgage denial rate in 2005	0.00267	(0.0111)
Fraction of GSE mortgages in 2005	-0.0109	(0.0638)
Non-owner-occupied home mortgage denial rate in 2005	-0.0173	(0.0306)
Fraction of GSE mortgages for non-owner-occupied home in 2005	-0.0690	(0.0602)
Population change in 2003-06	-0.0368	(0.0277)
Ln of population in 2000	0.114	(0.157)
Fraction of the college educated in 2000	-3.478	(2.131)
Fraction of the employed in 2000	-1.560	(1.607)
Fraction of workforce in 2000	-2.025	(1.441)
Median household Income in 2000	-2689.7	(1972.3)
Poverty rate in 2000	0.296	(1.434)
Urban rate in 2000	-0.998	(9.154)
Fraction of the white in 2000	3.712	(4.773)
Fraction of renters in 2000	-.002964	(0.0336)
Fraction of immigrants in past 5 years (2000)	-.0273	(0.0209)
Fraction of employment in arts entertainment and recreation in 2000	-.00983	(0.0180)

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**Table 3: Extrapolation and Housing Speculation**

This table reports coefficient estimates from regressing the fraction of non-owner-occupied home purchases in 2004 to 2006 on the house price change in 2001 to 2003 (Columns 1), the state capital gains tax rate for the median income, and their interaction (Columns 2). All regressions control for the host of lagged variables including the fraction of subprime mortgages in 2002, mortgage denial rate in 2002, the fraction of GSE mortgages in 2002, the mortgage denial rate for non-owner-occupied mortgages in 2002, the fraction of GSE mortgages for non-owner-occupied mortgages in 2002, per capita income change in 2002, the population change in 2002, the change in the number of establishments in 2001 to 2003, the real payroll change in 2001 to 2003, the employment change in 2001 to 2003, the natural logarithm of population in 2000, the fraction of the college educated in 2000, the fraction of the employed in 2000, the fraction of workforce in 2000, median household Income in 2000, poverty rate in 2000, urban rate in 2000, the fraction of the white in 2000, the fraction of employment in arts, entertainment, and recreation in 2000, the fraction of renters in 2000, the fraction of immigrants in 2000, as well as the dummy for states with non-recourse mortgage law and the dummy of sand states. Observations are weighted by the number of households. Standard errors are clustered at the state level. \*\*\*, \*\*, \* indicate coefficient estimates statistically distinct from 0 at the 1%, 5%, and 10% levels, respectively. Observations are weighted by the number of households. Standard errors are clustered at the state level. \*\*\*, \*\*, \* indicate coefficient estimates statistically distinct from 0 at the 1%, 5%, and 10% levels, respectively.

	(1)	(2)
	Fraction of Non-Owner-Occupied Home Purchases in 2004-06	
Real house price change in 2001-03	0.0231 (0.0574)	0.229*** (0.0508)
Interaction		-5.413*** (0.986)
State capital gain tax rate for median income		0.157 (0.288)
Constant	0.283*** (0.0768)	0.260*** (0.0818)
Controls	Yes	Yes
Observations	3379	3379
R-squared	0.552	0.593

**Table 4: Speculation and Housing Price Cycles**

This table reports the two stage least squares regressions of the real house price change in 2004 to 2006 and 2007 to 2009 on the fraction of non-owner-occupied home purchases in 2004 to 2006 instrumented with the state capital gains tax rate for the median income. Column 1 shows the coefficients of the first stage regression of the fraction of non-owner-occupied home purchases in 2004 to 2006 on the state capital gains tax rate for the median income. Columns 2 and 3 show the coefficients of the second stage regression of the real house price changes in 2004 to 2006 and 2007 to 2009 respectively on the instrumented fraction of non-owner-occupied home purchases in 2004 to 2006. The regressions control for the supply elasticity measure, the fraction of subprime mortgages in 2005, the mortgage denial rate in 2005, the fraction of GSE mortgages in 2005, the mortgage denial rate for non-owner-occupied mortgages in 2005, the fraction of GSE mortgages for non-owner-occupied mortgages in 2005, per capita income change in 2003 to 2006, population change in 2003 to 2006, the change in the number of establishments in 2004 to 2006, real payroll change in 2004 to 2006, employment change in 2004 to 2006, the natural logarithm of population in 2000, the fraction of the college educated in 2000, the fraction of the employed in 2000, the fraction of workforce in 2000, median household Income in 2000, poverty rate in 2000, urban rate in 2000, the fraction of the white in 2000, the fraction of employment in arts, entertainment, and recreation in 2000, the fraction of renters in 2000, the fraction of immigrants in 2000, the dummy for states with non-recourse mortgage law, and the dummy of sand states. Observations are weighted by the number of households. Standard errors are clustered at the state level. \*\*\*, \*\*, \* indicate coefficient estimates statistically distinct from 0 at the 1%, 5%, and 10% levels, respectively.

	(1) Fraction of Non-Owner- Occupied Home Purchases in 2004-06	(2) Real house price change in 2004-06	(3) Real house price change in 2007-09
State capital gain tax rate for median income	-0.677** (0.269)		
Fraction of Non-Owner- Occupied Home Purchases in 2004-06		2.685** (1.078)	-3.785*** (0.892)
Constant	0.408*** (0.111)	-0.458 (0.650)	1.532*** (0.517)
Controls	Yes	Yes	Yes
Observations	3935	3935	3935
First stage F statistics	69.93	NA	NA
R-squared	0.617	0.040	0.060

**Table 5: Real Effects of Housing Speculation**

This table reports the two stage least squares regressions of economic outcomes in 2004-2006 (the boom period) and 2007-2009 (the bust period) on the fraction of non-owner-occupied home purchases in 2004-2006 instrumented with the state capital gains tax rate for the median income. All regressions control for the supply elasticity measure, the fraction of subprime mortgages in 2005, the mortgage denial rate in 2005, the fraction of GSE mortgages in 2005, the mortgage denial rate for non-owner-occupied mortgages in 2005, the fraction of GSE mortgages for non-owner-occupied mortgages in 2005, population change in 2003-2006, per capita income change in 2003-2006, the change in the number of establishments in 2004-2006, real payroll change in 2004-2006, employment change in 2004-2006, the natural logarithm of population in 2000, the fraction of the college educated in 2000, the fraction of the employed in 2000, the fraction of workforce in 2000, median household Income in 2000, poverty rate in 2000, urban rate in 2000, the fraction of the white in 2000, the fraction of employment in arts, entertainment, and recreation in 2000, the fraction of renters in 2000, the fraction of immigrants in 2000, the dummy for states with non-recourse mortgage law, and the dummy of sand states. Observations are weighted by the number of households. Standard errors are clustered at the state level. \*\*\*, \*\*, \* indicate coefficient estimates statistically distinct from 0 at the 1%, 5%, and 10% levels, respectively.

**Panel A: The boom period**

	(1) Per capita income change in 2003-06	(2) Change in no. of establishments in 2004-06	(3) Real payroll change in 2004-06	(4) Employment change in 2004-06
Fraction of Non-Owner-Occupied Home Purchases in 2004-06	1.305*** (0.347)	0.687*** (0.245)	1.383*** (0.431)	0.850*** (0.301)
Constant	-0.0314 (0.238)	-0.284* (0.166)	-0.704*** (0.242)	-0.497*** (0.154)
Controls	Yes	Yes	Yes	Yes
Observations	3935	3935	3935	3935
R-squared	0.211	0.251	0.102	0.082

**Panel B: The bust period**

	(1) Per capita income change in 2007-09	(2) Change in no. of establishments in 2007-09	(3) Real payroll change in 2007-09	(4) Employment change in 2007-09
Fraction of Non-Owner-Occupied Home Purchases in 2004-06	-0.794*** (0.199)	-0.877*** (0.205)	-1.563*** (0.356)	-1.475*** (0.341)
Constant	0.591*** (0.0921)	0.305*** (0.116)	0.489*** (0.181)	0.493*** (0.175)
Controls	Yes	Yes	Yes	Yes
Observations	3934	3904	3904	3904
R-squared	0.237	0.241	0.095	0.074

**Table 6: Speculation and New Housing Supply**

This table reports the two stage least squares regressions of building permits in 2004 to 06 relative to the housing units in 2000 on the fraction of non-owner-occupied home purchases in 2004 to 2006 instrumented with the state capital gains tax rate for the median income. Column 1 shows the coefficients of the first stage regression of the fraction of non-owner-occupied home purchases in 2004 to 2006 on the state capital gains tax rate for the median income. Column 2 shows the coefficients of the second stage regression of building permits in 2004 to 2006 relative to the housing units in 2000 on the instrumented fraction of non-owner-occupied home purchases in 2004 to 2006. All regressions control for the supply elasticity measure, the fraction of subprime mortgages in 2005, the mortgage denial rate in 2005, the fraction of GSE mortgages in 2005, the mortgage denial rate for non-owner-occupied mortgages in 2005, the fraction of GSE mortgages for non-owner-occupied mortgages in 2005, per capita income change in 2003 to 2006, population change in 2003 to 2006, the change in the number of establishments in 2004 to 2006, real payroll change in 2004 to 2006, employment change in 2004 to 2006, the natural logarithm of population in 2000, the fraction of the college educated in 2000, the fraction of the employed in 2000, the fraction of workforce in 2000, median household Income in 2000, poverty rate in 2000, urban rate in 2000, the fraction of the white in 2000, , the fraction of employment in arts, entertainment, and recreation in 2000, the fraction of renters in 2000, the fraction of immigrants in 2000, the dummy for states with non-recourse mortgage law, and the dummy of sand states. Observations are weighted by the number of households at the county level. Standard errors are clustered at the state level. \*\*\*, \*\*, \* indicate coefficient estimates statistically distinct from 0 at the 1%, 5%, and 10% levels, respectively.

	(1) Fraction of Non-Owner-Occupied Home Purchases in 2004-06	(2) Building permits in 2004-06 relative to the housing units in 2000
State capital gain tax rate for median income	-0.822*** (0.138)	
Fraction of Non-Owner-Occupied Home Purchases in 2004-06		0.428*** (0.105)
Constant	0.656*** (0.104)	-0.263** (0.114)
Controls	Yes	Yes
Observations	309	309
First stage F statistics	19.75	NA
R-squared	0.563	0.455

**Table 7: Effects of Housing Speculation on Construction and Non-construction Sectors**

This table reports the two stage least squares regressions of the employment change in the construction (Column 1) and non-construction sectors (Column 2) in 2007 to 2009 on the fraction of non-owner-occupied home purchases in 2004 to 2006 instrumented with the state capital gains tax rate for the median income. All regressions control for the supply elasticity measure, the fraction of subprime mortgages in 2005, the mortgage denial rate in 2005, the fraction of GSE mortgages in 2005, the mortgage denial rate for non-owner-occupied mortgages in 2005, the fraction of GSE mortgages for non-owner-occupied mortgages in 2005, population change in 2003 to 2006, per capita income change in 2003 to 2006, the change in the number of establishments in 2004 to 2006, real payroll change in 2004 to 2006, employment change in 2004 to 2006, the natural logarithm of population in 2000, the fraction of the college educated in 2000, the fraction of the employed in 2000, the fraction of workforce in 2000, median household Income in 2000, poverty rate in 2000, urban rate in 2000, the fraction of the white in 2000, the fraction of employment in arts, entertainment, and recreation in 2000, the fraction of renters in 2000, the fraction of immigrants in 2000, the dummy for states with non-recourse mortgage law, and the dummy of sand states. Observations are weighted by the number of households. Standard errors are clustered at the state level. \*\*\*, \*\*, \* indicate coefficient estimates statistically distinct from 0 at the 1%, 5%, and 10% levels, respectively.

	(1) Construction employment change in 2007-09	(2) Non-construction employment change in 2007-09
Fraction of Non-Owner-Occupied Home Purchases in 2004-06	-3.422*** (0.720)	-1.253*** (0.330)
Constant	1.034*** (0.345)	0.459*** (0.167)
Controls	Yes	Yes
Observations	3933	3902
R-squared	0.089	0.065

**Table 8: Effect of Housing Speculation: Demand Channel**

This table reports the two stage least squares regressions of the employment change in non-tradable and tradable sectors in 2007 to 2009 on the fraction of non-owner-occupied home purchases in 2004 to 2006 instrumented with the state capital gains tax rate for the median income. Columns 1 and 2 present the coefficients for non-tradable and tradable industries respectively defined by Mian and Sufi (2014). Columns 3 and 4 present the results for retail and restaurant sectors and industries other than these two sectors, respectively. All regressions control for the supply elasticity measure, the fraction of subprime mortgages in 2005, the mortgage denial rate in 2005, the fraction of GSE mortgages in 2005, the mortgage denial rate for non-owner-occupied mortgages in 2005, the fraction of GSE mortgages for non-owner-occupied mortgages in 2005, population change in 2003 to 2006, per capita income change in 2003 to 2006, the change in the number of establishments in 2004 to 2006, real payroll change in 2004 to 2006, employment change in 2004 to 2006, the natural logarithm of population in 2000, the fraction of the college educated in 2000, the fraction of the employed in 2000, the fraction of workforce in 2000, median household Income in 2000, poverty rate in 2000, urban rate in 2000, the fraction of the white in 2000, the fraction of employment in arts, entertainment, and recreation in 2000, the fraction of renters in 2000, the fraction of immigrants in 2000, the dummy for states with non-recourse mortgage law, and the dummy of sand states. Observations are weighted by the number of households. Standard errors are clustered at the state level. \*\*\*, \*\*, \* indicate coefficient estimates statistically distinct from 0 at the 1%, 5%, and 10% levels, respectively.

	(1) Employment change in non- tradable industries in 2007-09	(2) Employment change in tradable industries in 2007-09	(3) Retail and restaurant employment change in 2007-09	(4) Employment change in industries other than retail and restaurant in 2007-09
Fraction of Non- Owner-Occupied Home Purchases in 2004-06	-1.534*** (0.408)	-0.297 (0.680)	-1.585*** (0.590)	-1.131*** (0.417)
Constant	0.577** (0.227)	-0.467 (0.376)	0.569* (0.314)	0.381** (0.184)
Controls	Yes	Yes	Yes	Yes
Observations	3934	3851	3935	3899
R-squared	0.067	0.005	0.037	0.010

# Economic Consequences of Housing Speculation

## Internet Appendix

Zhenyu Gao, Michael Sockin, Wei Xiong

In this Internet appendix, we provide the following robustness analyses to supplement the results reported in the main paper.

- Section A provides tables of placebo tests for the period of 1999-2001.
- Section B provides the regression results in Tables 4 and 5 in the main paper for two subsamples: 1) zip codes within 50 miles of state borders (Table B1), and 2) zip codes further than 50 miles from state borders (Table B2).
- Section C provides tables to present the results from the reduced form and OLS regressions of Tables 4 and 5 in the main paper.
- Section D provides tables using specifications after controlling the misreporting measure from Piskorski, Seru, and Witkin (2015) to repeat Tables 4 and 5 in the main paper.
- Section E provides panel regression results of the lead-lag relationship between capital gains taxes and economic performance at state level.
- Section F provides regression results using the Zillow house price index.
- Section G provides tables to verify the results reported in Tables 4 and 5 in the main paper by excluding the four sand states.
- Section H reports the coefficients of all controls in Tables 4 and 5 of the main paper.
- Section I provides tables using specifications without the controls during the boom period to repeat Tables 4 and 5 in the main paper.

### References:

Piskorski, Tomasz, Amit Seru, and James Witkin (2015), Asset Quality Misrepresentation by Financial Intermediaries: Evidence from the RMBS Market, *Journal of Finance*, 70(6), 2635-2678.



**Section A:**

**Table A1: Placebo Tests for the Period of 1999-2001**

This table reports placebo tests of the reduced-form regressions of our main analyses for the period of 1999-2001.

	(1)	(2)	(3)	(4)	(5)
	Real house price change in 1999-2001	Per capita income change in 1999-2001	Change in no. of establishments in 1999-2001	Real payroll change in 1999-2001	Employment change in 1999-2001
	0.00791	0.00223	0.00245	0.00191	0.00288
State capital gain tax rate for median income in 2000	(0.00507)	(0.00163)	(0.00242)	(0.00129)	(0.00241)
Constant	0.180	-0.414***	-0.316**	-0.0703	-0.329***
	(0.123)	(0.0567)	(0.112)	(0.0666)	(0.101)
Controls	Yes	Yes	Yes	Yes	Yes
Observations	3421	3421	3377	3377	3377
R-squared	0.455	0.363	0.103	0.192	0.117

**Section B:**

**Table B1: Zip Codes within 50 Miles of State Borders**

This table repeats Tables 4 and 5 in the main text for the subsample of zip codes within 50 miles of state borders.

**Panel A: House price cycle**

	(1)	(2)	(3)
	Fraction of Non-Owner-Occupied Home Purchases in 2004-06	Real house price change in 2004-06	Real house price change in 2007-09
State capital gain tax rate for median income	-0.538* (0.297)		
Fraction of Non-Owner-Occupied Home Purchases in 2004-06		1.243*** (0.241)	-2.448** (1.171)
Constant	0.255** (0.0969)	0.833* (0.448)	0.863* (0.461)
Controls	Yes	Yes	Yes
Observations	1815	1815	1815
R-squared	0.625	0.376	0.102

**Panel B: Real effects during the boom period**

	(1)	(2)	(3)	(4)
	Per capita income change in 2003-06	Change in no. of establishments in 2004-06	Real payroll change in 2004-06	Employment change in 2004-06
Fraction of Non-Owner-Occupied Home Purchases in 2004-06	0.991* (0.533)	0.268** (0.115)	1.088** (0.543)	0.465* (0.245)
Constant	0.215 (0.165)	-0.137*** (0.0498)	-0.291* (0.176)	-0.263** (0.106)
Controls	Yes	Yes	Yes	Yes
Observations	1815	1815	1815	1815
R-squared	0.287	0.354	0.032	0.112

**Panel C: Real effects during the bust period**

	(1)	(2)	(3)	(4)
	Per capita income change in 2007-09	Change in no. of establishments in 2007-09	Real payroll change in 2007-09	Employment change in 2007-09
Fraction of Non-Owner- Occupied Home Purchases in 2004-06	-0.716* (0.404)	-0.986*** (0.274)	-1.627*** (0.429)	-1.472*** (0.353)
Constant	0.535*** (0.0975)	0.109 (0.134)	0.391 (0.256)	0.271 (0.176)
Controls	Yes	Yes	Yes	Yes
Observations	1815	1804	1804	1804
R-squared	0.228	0.065	0.033	0.027

**Table B2: Zip Codes Further than 50 miles from State Borders**

This table repeats Tables 4 and 5 in the main text for the subsample of zip codes further than 50 miles from state borders.

**Panel A: House price cycle**

	(1) Fraction of Non-Owner- Occupied Home Purchases in 2004-06	(2) Real house price change in 2004- 06	(3) Real house price change in 2007- 09
State capital gain tax rate for median income	-0.681*** (0.157)		
Fraction of Non-Owner- Occupied Home Purchases in 2004-06		4.119*** (1.102)	-6.798*** (2.116)
Constant	0.360** (0.163)	-1.254 (0.779)	2.305* (1.249)
Controls	Yes	Yes	Yes
Observations	2120	2120	2120
R-squared	0.658	0.213	0.283

**Panel B: Real effects during the boom period**

	(1) Per capita income change in 2003-06	(2) Change in no. of establishments in 2004-06	(3) Real payroll change in 2004-06	(4) Employment change in 2004-06
Fraction of Non-Owner- Occupied Home Purchases in 2004-06	1.423*** (0.236)	0.907*** (0.208)	1.630*** (0.467)	1.083*** (0.257)
Constant	-0.0385 (0.210)	-0.302 (0.210)	-0.833*** (0.284)	-0.616*** (0.189)
Controls	Yes	Yes	Yes	Yes
Observations	2120	2120	2120	2120
R-squared	0.268	0.150	0.062	0.068

**Panel C: Real effects during the bust period**

	(1) Per capita income change in 2007-09	(2) Change in no. of establishments in 2007-09	(3) Real payroll change in 2007-09	(4) Employment change in 2007-09
Fraction of Non-Owner- Occupied Home Purchases in 2004-06	-1.277*** (0.490)	-1.045*** (0.378)	-1.886*** (0.696)	-1.808*** (0.616)
Constant	0.691*** (0.212)	0.397** (0.182)	0.535* (0.314)	0.586* (0.310)
Controls	Yes	Yes	Yes	Yes
Observations	2119	2100	2100	2100
R-squared	0.201	0.103	0.024	0.031

**Section C:**

**Table C1: Reduced Form Regressions for Tables 4 and 5**

This table reports reduced form regressions for Tables 4 and 5 in the main text.

**Panel A: House price cycle**

	(1) Real house price change in 2004-06	(2) Real house price change in 2007-09
State capital gain tax rate for median income	-1.789** (0.660)	2.581** (0.972)
Constant	0.619** (0.235)	-0.0361 (0.222)
Controls	Yes	Yes
Observations	3935	3935
R-squared	0.693	0.629

**Panel B: Real effects during the boom period**

	(1) Per capita income change in 2003- 06	(2) Change in no. of establishments in 2004-06	(3) Real payroll change in 2004-06	(4) Employment change in 2004-06
State capital gain tax rate for median income	-1.055*** (0.346)	-0.593** (0.227)	-1.129*** (0.242)	-0.712*** (0.207)
Constant	0.566*** (0.0880)	0.0378 (0.0559)	-0.0761 (0.119)	-0.109 (0.0975)
Controls	Yes	Yes	Yes	Yes
Observations	3941	3935	3935	3935
R-squared	0.482	0.418	0.155	0.157

**Panel C: Real effects during the bust period**

	(1) Per capita income change in 2007- 09	(2) Change in no. of establishments in 2007-09	(3) Real payroll change in 2007-09	(4) Employment change in 2007-09
State capital gain tax rate for median income	0.528** (0.241)	0.586*** (0.174)	1.039*** (0.335)	1.003*** (0.289)
Constant	0.272*** (0.0667)	-0.0527 (0.0392)	-0.144 (0.113)	-0.110 (0.0970)
Controls	Yes	Yes	Yes	Yes
Observations	3940	3910	3910	3910
R-squared	0.370	0.284	0.097	0.152

**Table C2: OLS Regressions for Tables 4 and 5**

This table reports OLS regressions for Tables 4 and 5 in the main text.

**Panel A: House price cycle**

	(1) Real house price change in 2004-06	(2) Real house price change in 2007-09
Fraction of Non-Owner-Occupied Home Purchases in 2004-06	0.247** (0.0950)	-0.482*** (0.129)
Constant	0.467* (0.261)	0.231 (0.216)
Controls	Yes	Yes
Observations	3935	3935
R-squared	0.670	0.611

**Panel B: Real effects during the boom period**

	(1) Per capita income change in 2003-06	(2) Change in no. of establishments in 2004-06	(3) Real payroll change in 2004-06	(4) Employment change in 2004-06
Fraction of Non-Owner-Occupied Home Purchases in 2004-06	0.288*** (0.0768)	0.140*** (0.0322)	0.273*** (0.0613)	0.182*** (0.0579)
Constant	0.426*** (0.0595)	-0.0316 (0.0442)	-0.211* (0.118)	-0.199* (0.0957)
Controls	Yes	Yes	Yes	Yes
Observations	3935	3935	3935	3935
R-squared	0.479	0.412	0.150	0.155



**Panel C: Real effects during the bust period**

	(1) Per capita income change in 2007-09	(2) Change in no. of establishments in 2007-09	(3) Real payroll change in 2007-09	(4) Employment change in 2007-09
Fraction of Non-Owner- Occupied Home Purchases in 2004-06	-0.212*** (0.0310)	-0.114*** (0.0249)	-0.224*** (0.0385)	-0.198*** (0.0308)
Constant	0.368*** (0.0559)	0.00947 (0.0389)	-0.0361 (0.0928)	-0.00288 (0.0864)
Controls	Yes	Yes	Yes	Yes
Observations	3934	3904	3904	3904
R-squared	0.379	0.270	0.093	0.143

**Section D:**

**Table D: Speculation, Housing Price Cycle and Real Effects**

(After controlling the misreporting measure from Piskorski, Seru, and Witkin (2015))

This table uses specifications after controlling the misreporting measure from Piskorski, Seru, and Witkin (2015) to repeat Tables 4 and 5 in the main paper.

**Panel A: House price cycle**

	(1) Fraction of Non-Owner- Occupied Home Purchases in 2004-06	(2) Real house price change in 2004- 06	(3) Real house price change in 2007- 09
State capital gain tax rate for median income	-0.671** (0.268)		
Fraction of Non-Owner- Occupied Home Purchases in 2004-06		2.656** (1.041)	-3.761*** (0.863)
Misreporting	0.219*** 0.128*** (0.0294)	-0.360 -0.413 (0.258)	-0.138 -0.165 (0.248)
Constant	0.409*** (0.114)	-0.458 (0.646)	1.518*** (0.530)
Controls	Yes	Yes	Yes
Observations	3819	3819	3819
R-squared	0.621	0.062	0.069

**Panel B: Real effects during the boom period**

	(1) Per capita income change in 2003-06	(2) Change in no. of establishments in 2004-06	(3) Real payroll change in 2004-06	(4) Employment change in 2004-06
Fraction of Non-Owner- Occupied Home Purchases in 2004-06	1.280*** (0.339)	0.704*** (0.258)	1.388*** (0.420)	0.860*** (0.306)
Misreporting	-0.283*** (0.103)	0.124** (0.0633)	0.0141 (0.106)	0.234** (0.108)
Constant	-0.00763 (0.238)	-0.296* (0.175)	-0.741*** (0.240)	-0.532*** (0.157)
Controls	Yes	Yes	Yes	Yes
Observations	3819	3819	3819	3819
R-squared	0.233	0.243	0.074	0.085

**Panel C: Real effects during the bust period**

	(1) Per capita income change in 2007-09	(2) Change in no. of establishments in 2007-09	(3) Real payroll change in 2007-09	(4) Employment change in 2007-09
Fraction of Non-Owner- Occupied Home Purchases in 2004-06	-0.773*** (0.192)	-0.877*** (0.209)	-1.573*** (0.379)	-1.494*** (0.367)
Misreporting	0.0605 (0.0651)	0.0544 (0.0533)	-0.0912 (0.140)	0.118 (0.119)
Constant	0.584*** (0.0933)	0.311** (0.123)	0.503*** (0.191)	0.503*** (0.184)
Controls	Yes	Yes	Yes	Yes
Observations	3818	3792	3792	3792
R-squared	0.245	0.093	0.031	0.038

## Section E:

**Table E: Capital gains taxes and economic performances**

This table provides the state level panel regressions of marginal state capital gains tax rate for 50,000 in income (in 2005 USD) on contemporaneous, lagged (one or five years), or leading (one or five years) changes in housing prices, and economic performance including wages and salaries, number of establishments, employment, per capita income, and unemployment rate. We also control for corporate rate, sales tax rate and the year fixed effect.

	State capital gains tax rates for 50000 USD (2005)				
	The same year	One year lagged	Five years lagged	One year leading	Five years leading
Change in wages and salaries	-2.396 (9.310)	-1.777 (8.408)	-0.187 (7.465)	-0.116 (8.817)	2.291 (10.87)
Real house price change	2.860 (5.103)	3.654 (5.005)	3.338 (5.380)	2.631 (5.041)	1.347 (5.435)
Change in no. of establishments	2.896 (11.58)	5.971 (11.67)	12.01 (11.22)	2.422 (11.42)	1.448 (13.74)
Employment changes	-3.470 (13.82)	-8.185 (12.70)	-11.27 (10.99)	-6.283 (12.83)	-5.850 (14.86)
Per capita income change	-3.623 (4.637)	-3.461 (4.274)	-2.188 (4.154)	-5.895 (4.287)	-3.539 (5.190)
Unemployment rate	-0.0131 (0.178)	-0.0159 (0.176)	-0.0237 (0.170)	-0.0154 (0.181)	-0.0577 (0.203)
Corporate Rate	0.318*** (0.0792)	0.313*** (0.0781)	0.308*** (0.0747)	0.318*** (0.0806)	0.332*** (0.0891)
Statutory Sales Tax Rate	-0.0663 (0.228)	-0.0656 (0.226)	-0.0670 (0.218)	-0.0666 (0.231)	-0.0705 (0.243)
Observations	1500	1500	1400	1500	1350
R-squared	0.240	0.252	0.280	0.228	0.176

**Section F:****Table F1: Speculation and Housing Price Cycles (Zillow Index)**

This table repeats Table 3 using Zillow house price index.

	(1) Fraction of Non-Owner- Occupied Home Purchases in 2004-06	(2) Real house price change in 2004- 06	(3) Real house price change in 2007- 09
State capital gain tax rate for median income	-0.457** (0.191)		
Fraction of Non-Owner- Occupied Home Purchases in 2004-06		2.302** (1.011)	-2.561** (1.281)
Constant	0.352*** (0.102)	-0.457 (0.514)	-0.271* (0.160)
Controls	Yes	Yes	Yes
Observations	6238	6177	6240
R-squared	0.536	0.314	0.473

**Table F2: Housing Speculation and Extrapolation (Zillow Index)**

This table repeats Table 10 using Zillow house price index.

**Panel B:**

	(1)	(2)
	Fraction of Non-Owner-Occupied Home Purchases in 2004-06	
Real house price change in 2001-03	0.0190 (0.0656)	0.310*** (0.0567)
Interaction		-6.832*** (1.128)
State capital gain tax rate for median income		-0.287** (0.141)
Constant	0.264*** (0.0777)	0.251*** (0.0712)
Controls	Yes	Yes
Observations	5370	5370
R-squared	0.512	0.550

**Section G:**

**Table G: Speculation, Housing Price Cycle and Real Effects Excluding Sand States**

This table repeats Tables 4 and 5 excluding the “Sand States” of Arizona, California, Florida, and Nevada from our sample.

**Panel A: House price cycle**

	(1) Fraction of Non-Owner- Occupied Home Purchases in 2004-06	(2) Real house price change in 2004- 06	(3) Real house price change in 2007- 09
State capital gain tax rate for median income	-0.472* (0.233)		
Fraction of Non-Owner- Occupied Home Purchases in 2004-06		3.374** (1.545)	-4.816*** (1.369)
Constant	0.477*** (0.122)	-0.751 (1.023)	1.984*** (0.760)
Controls	Yes	Yes	Yes
Observations	2984	2984	2984
R-squared	0.636	0.081	0.012

**Panel B: Real effects during the boom period**

	(1) Per capita income change in 2003-06	(2) Change in no. of establishments in 2004-06	(3) Real payroll change in 2004-06	(4) Employment change in 2004-06
Fraction of Non-Owner- Occupied Home Purchases in 2004-06	1.744*** (0.485)	0.890** (0.392)	1.632** (0.668)	0.881** (0.432)
Constant	-0.323 (0.339)	-0.473* (0.265)	-0.832** (0.374)	-0.515** (0.246)
Controls	Yes	Yes	Yes	Yes
Observations	2984	2984	2984	2984
R-squared	0.346	0.114	0.135	0.044

**Panel C: Real effects during the bust period**

	(1) Per capita income change in 2007-09	(2) Change in no. of establishments in 2007-09	(3) Real payroll change in 2007-09	(4) Employment change in 2007-09
Fraction of Non-Owner- Occupied Home Purchases in 2004-06	-0.686** (0.321)	-1.167*** (0.323)	-1.940*** (0.539)	-1.812*** (0.500)
Constant	0.512*** (0.149)	0.459*** (0.170)	0.670** (0.265)	0.651** (0.265)
Controls	Yes	Yes	Yes	Yes
Observations	2983	2962	2962	2962
R-squared	0.314	0.057	0.049	0.033



**Section H:**

**Table H: Speculation, Housing Price Cycle and Real Effects**

This section reports the coefficients of all controls used in Tables 4 and 5 of the main text.

**Panel A: House price cycle**

	(1) Fraction of non-owner- occupied home purchases in 2004-06	(2) Real house price change in 2004- 06	(3) Real house price change in 2007- 09
State capital gain tax rate for median income	-0.677** (0.269)		
Fraction of non-owner-occupied home purchases in 2004-06		2.685** (1.078)	-3.785*** (0.892)
Saiz's elasticity	0.0170*** (0.00472)	-0.114*** (0.0228)	0.106*** (0.0231)
Fraction of subprime mortgages in 2005	-0.216*** (0.0402)	0.901*** (0.286)	-1.691*** (0.256)
Mortgage denial rate in 2005	0.509*** (0.0819)	-1.938*** (0.642)	1.086 (0.780)
Fraction of GSE mortgages in 2005	-0.175*** (0.0362)	0.620** (0.301)	-0.682*** (0.260)
Non-owner-occupied home mortgage denial rate in 2005	-0.133*** (0.0323)	0.225 (0.213)	-0.623*** (0.208)
Fraction of GSE mortgages for non-owner-occupied home in 2005	0.0177 (0.0198)	-0.0616 (0.0765)	0.107 (0.164)
Per capita income change in 2003-06	0.0954** (0.0375)	0.0599 (0.185)	0.395* (0.239)
Population change in 2003-06	-0.0417** (0.0193)	0.134 (0.0894)	-0.349*** (0.112)
Change in no. of establishments in 2004-06	0.0481* (0.0243)	0.223* (0.124)	0.254 (0.204)
Real payroll change in 2004-06	0.0204*** (0.00560)	0.0113 (0.0296)	0.0959* (0.0490)
Employment change in 2004-06	-0.00610 (0.0106)	-0.0101 (0.0300)	-0.0813* (0.0490)
Ln of population in 2000	-0.0161***	0.0352	-0.0706**

	(0.00535)	(0.0288)	(0.0348)
Fraction of the college educated in 2000	0.00119*** (0.000241)	-0.00488*** (0.00146)	0.00339* (0.00197)
Fraction of the employed in 2000	-0.000672 (0.00196)	-0.00875 (0.00869)	-0.00339 (0.0171)
Fraction of workforce in 2000	-0.00140 (0.00227)	0.0114 (0.00968)	-0.00239 (0.0171)
Median household Income in 2000	-0.00000234*** (0.000000261)	0.00000587** (0.00000285)	-0.00000811*** (0.00000289)
Poverty rate in 2000	0.00233** (0.000919)	-0.00657* (0.00397)	0.00632 (0.00449)
Urban rate in 2000	0.000827*** (0.000205)	-0.00204* (0.00120)	0.00249** (0.00113)
Fraction of the white in 2000	-0.000266 (0.000249)	0.0000601 (0.000989)	-0.00307*** (0.000936)
Fraction of renters in 2000	-0.156*** (0.0253)	0.511** (0.202)	-0.268 (0.265)
Fraction of immigrants in 2000	0.191*** (0.0346)	-0.412 (0.289)	0.401 (0.387)
Fraction of employment in arts entertainment and recreation in 2000	0.742*** (0.117)	-1.983** (0.840)	2.339*** (0.798)
Dummy for states with non-recourse mortgage law	0.0123 (0.0176)	-0.0155 (0.0409)	0.0976* (0.0523)
Dummy for sand states	-0.0227 (0.0190)	0.229*** (0.0525)	-0.383*** (0.0658)
Constant	0.408*** (0.111)	-0.458 (0.650)	1.532*** (0.517)
Observations	3935	3935	3935
R-squared	0.617	0.040	0.060

**Panel B: Real effects during the boom period**

	(1) Per capita income change in 2003-06	(2) Change in no. of establishments in 2004-06	(3) Real payroll change in 2004-06	(4) Employment change in 2004-06
Fraction of non-owner-occupied home purchases in 2004-06	1.305*** (0.347)	0.687*** (0.245)	1.383*** (0.431)	0.850*** (0.301)
Saiz's elasticity	-0.0410*** (0.00887)	-0.0301*** (0.00605)	-0.0290*** (0.00502)	-0.0218*** (0.00408)
Fraction of subprime mortgages in 2005	0.0962 (0.0961)	0.128 (0.0887)	0.296* (0.152)	0.182* (0.101)
Mortgage denial rate in 2005	-0.747*** (0.211)	-0.390** (0.156)	-0.869*** (0.296)	-0.552** (0.224)
Fraction of GSE mortgages in 2005	0.0665 (0.0746)	0.196** (0.0831)	0.324*** (0.106)	0.247*** (0.0888)
Non-owner-occupied home mortgage denial rate in 2005	0.160** (0.0756)	0.0629 (0.0402)	0.153* (0.0805)	0.0556 (0.0485)
Fraction of GSE mortgages for non-owner-occupied home in 2005	-0.0686* (0.0384)	0.0410 (0.0256)	-0.00600 (0.0483)	0.0341 (0.0418)
Population change in 2003-06	-0.0635 (0.0688)	0.324*** (0.0460)	0.300*** (0.0540)	0.300*** (0.0623)
Ln of population in 2000	0.00197 (0.0103)	0.0186*** (0.00629)	0.0273*** (0.00909)	0.0193*** (0.00571)
Fraction of the college educated in 2000	0.00167** (0.000693)	-0.000693 (0.000507)	-0.00243*** (0.000912)	-0.00208*** (0.000766)
Fraction of the employed in 2000	-0.00263 (0.00324)	0.000487 (0.00201)	0.00130 (0.00383)	0.000343 (0.00333)
Fraction of workforce in 2000	0.00210 (0.00374)	0.00184 (0.00233)	0.00306 (0.00413)	0.00318 (0.00362)
Median household Income in 2000	0.00000304*** (0.000000819)	0.00000104 (0.000000665)	0.00000394* ** (0.00000129)	0.00000265* ** (0.000000996)
Poverty rate in 2000	-0.00121 (0.00152)	-0.00243*** (0.000771)	-0.00137 (0.00189)	-0.00108 (0.00119)
Urban rate in 2000	-0.00191*** (0.000306)	-0.000832** (0.000346)	-0.00129*** (0.000422)	-0.000929*** (0.000322)

Fraction of the white in 2000	0.00109*** (0.000375)	-0.0000902 (0.000209)	0.000475 (0.000314)	0.000386 (0.000275)
Fraction of employment in arts entertainment and recreation in 2000	-0.792** (0.402)	-0.397* (0.217)	-0.868** (0.365)	-0.438* (0.262)
Fraction of renters in 2000	0.181*** (0.0684)	-0.0167 (0.0457)	0.112 (0.102)	0.0291 (0.0700)
Fraction of immigrants in 2000	-0.284*** (0.0996)	0.0968 (0.0747)	0.0958 (0.0819)	0.108* (0.0641)
Dummy for states with non-recourse mortgage law	-0.00485 (0.0165)	-0.00965 (0.0108)	0.00965 (0.0207)	0.00197 (0.0134)
Dummy for sand states	0.0481** (0.0234)	0.0511*** (0.0149)	0.0883*** (0.0233)	0.0684*** (0.0175)
Constant	-0.0314 (0.238)	-0.284* (0.166)	-0.704*** (0.242)	-0.497*** (0.154)
Observations	3935	3935	3935	3935
R-squared	0.211	0.251	0.102	0.082

**Panel C: Real effects during the bust period**

	(1) Per capita income change in 2007-09	(2) Change in no. of establishments in 2007-09	(3) Real payroll change in 2007-09	(4) Employment change in 2007-09
Fraction of non-owner-occupied home purchases in 2004-06	-0.794*** (0.199)	-0.877*** (0.205)	-1.563*** (0.356)	-1.475*** (0.341)
Saiz's elasticity	-0.00524 (0.00614)	0.00724* (0.00393)	0.0281*** (0.00596)	0.0246*** (0.00611)
Fraction of subprime mortgages in 2005	-0.284*** (0.0544)	-0.232*** (0.0489)	-0.378*** (0.108)	-0.369*** (0.0910)
Mortgage denial rate in 2005	0.0191 (0.164)	0.325*** (0.115)	0.730*** (0.225)	0.688*** (0.195)
Fraction of GSE mortgages in 2005	-0.141*** (0.0480)	-0.112** (0.0503)	-0.265*** (0.0997)	-0.230*** (0.0891)
Non-owner-occupied home mortgage denial rate in 2005	-0.0828** (0.0378)	-0.147*** (0.0410)	-0.277*** (0.0893)	-0.202** (0.0792)
Fraction of GSE mortgages for non-owner-occupied home in 2005	0.0387 (0.0416)	0.0205 (0.0152)	0.0363 (0.0437)	0.0123 (0.0314)
Per capita income change in 2003-06	-0.184** (0.0836)	0.134*** (0.0370)	0.261*** (0.0692)	0.195*** (0.0740)
Population change in 2003-06	-0.159*** (0.0514)	0.164*** (0.0238)	0.119** (0.0505)	0.115** (0.0476)
Change in no. of establishments in 2004-06	0.182*** (0.0450)	0.191*** (0.0516)	0.479*** (0.0996)	0.523*** (0.0964)
Real payroll change in 2004-06	0.0300 (0.0194)	0.0326** (0.0126)	-0.107** (0.0503)	0.162*** (0.0327)
Employment change in 2004-06	-0.0113 (0.0157)	-0.0134 (0.0126)	-0.0133 (0.0357)	-0.308*** (0.0290)
Ln of population in 2000	-0.0217*** (0.00579)	-0.0144*** (0.00537)	-0.0249** (0.0109)	-0.0279*** (0.00872)
Fraction of the college educated in 2000	-0.000532 (0.000473)	0.00115*** (0.000349)	0.00379*** (0.000561)	0.00277*** (0.000407)

Fraction of the employed in 2000	-0.00271 (0.00275)	-0.00450** (0.00223)	-0.0110*** (0.00395)	-0.00777*** (0.00281)
Fraction of workforce in 2000	0.00259 (0.00277)	0.00295 (0.00239)	0.00809** (0.00401)	0.00526 (0.00324)
Median household Income in 2000	- 0.00000261*** (0.000000690)	-0.00000178*** (0.000000616)	- 0.00000479* ** (0.00000111)	- 0.00000376* ** (0.000000854)
Poverty rate in 2000	0.00161 (0.00115)	0.00182 (0.00122)	0.00331 (0.00204)	0.00325* (0.00190)
Urban rate in 2000	0.0000585 (0.000221)	0.000813*** (0.000210)	0.00190*** (0.000413)	0.00151*** (0.000408)
Fraction of the white in 2000	-0.00143*** (0.000278)	-0.000621*** (0.000191)	-0.000887* (0.000460)	-0.000764** (0.000342)
Fraction of employment in arts entertainment and recreation in 2000	0.252* (0.152)	0.642*** (0.165)	1.115*** (0.297)	1.091*** (0.333)
Fraction of renters in 2000	-0.120** (0.0570)	-0.113** (0.0482)	-0.277*** (0.0950)	-0.239*** (0.0739)
Fraction of immigrants in 2000	-0.0908* (0.0545)	0.0276 (0.0587)	0.0368 (0.107)	0.0523 (0.0905)
Dummy for states with non-recourse mortgage law	-0.000547 (0.0115)	0.0126* (0.00749)	0.0349** (0.0144)	0.0366*** (0.0141)
Dummy for sand states	-0.0332* (0.0175)	-0.0324*** (0.0119)	-0.0883*** (0.0231)	-0.0877*** (0.0249)
Constant	0.591*** (0.0921)	0.305*** (0.116)	0.489*** (0.181)	0.493*** (0.175)
Observations	3934	3904	3904	3904
R-squared	0.237	0.241	0.095	0.074

**Section I:**

**Table I: Speculation, Housing Price Cycle and Real Effects**  
**(Without the controls during the boom period)**

This table uses specifications without the controls during the boom period to repeat Tables 4 and 5 in the main paper.

**Panel A: House price cycle**

	(1) Fraction of non-owner-occupied home purchases in 2004-06	(2) Real house price change in 2004-06	(3) Real house price change in 2007-09
State capital gain tax rate for median income	-0.778** (0.321)		
Fraction of non-owner-occupied home purchases in 2004-06		3.184*** (1.095)	-3.933*** (1.049)
Saiz's elasticity	0.0109* (0.00558)	-0.116*** (0.0132)	0.107*** (0.0158)
Ln of population in 2000	-0.0228*** (0.00643)	0.0633* (0.0367)	-0.111*** (0.0396)
Fraction of the college educated in 2000	0.00182*** (0.000272)	-0.00607*** (0.00211)	0.0111*** (0.00193)
Fraction of the employed in 2000	0.000977 (0.00221)	-0.0168 (0.0108)	0.0122 (0.0208)
Fraction of workforce in 2000	-0.00355 (0.00267)	0.0214 (0.0131)	-0.0222 (0.0208)
Median household Income in 2000	-0.00000214*** (0.000000330)	0.00000592** (0.00000280)	-0.00000793** (0.00000325)
Poverty rate in 2000	0.00283** (0.000998)	-0.00940* (0.00540)	0.00666 (0.00607)
Urban rate in 2000	0.000553** (0.000199)	-0.00189* (0.000985)	0.00113 (0.00124)
Fraction of the white in 2000	-0.000271 (0.000273)	0.000720 (0.00106)	-0.000227 (0.000790)
Fraction of employment in arts entertainment and recreation in 2000	0.825*** (0.130)	-2.539** (1.001)	3.167*** (1.017)
Fraction of renters in 2000	-0.128*** (0.0359)	0.393 (0.250)	-0.0878 (0.318)

Fraction of immigrants in 2000	0.233*** (0.0476)	-0.511 (0.360)	0.529 (0.430)
Dummy for states with non-recourse mortgage law	0.00991 (0.0203)	0.00495 (0.0496)	0.0990 (0.0633)
Dummy for sand states	-0.00204 (0.0207)	0.191*** (0.0507)	-0.364*** (0.0744)
Constant	0.474*** (0.124)	-0.770 (0.718)	1.442** (0.639)
Observations	3975	3975	3975
R-squared	0.563	0.036	0.051

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**Panel B: Real effects during the boom period**

	(1) Per capita income change in 2003-06	(2) Change in no. of establishments in 2004-06	(3) Real payroll change in 2004-06	(4) Employment change in 2004-06
Fraction of non-owner-occupied home purchases in 2004-06	1.212*** (0.376)	0.700** (0.330)	1.402** (0.547)	0.874** (0.393)
Saiz's elasticity	-0.0364*** (0.00877)	-0.0243*** (0.00601)	-0.0204*** (0.00522)	-0.0149*** (0.00460)
Ln of population in 2000	0.00440 (0.0113)	0.0140* (0.00815)	0.0279** (0.0121)	0.0172** (0.00767)
Fraction of the college educated in 2000	0.00239*** (0.000727)	-0.000823 (0.000673)	-0.00252** (0.00122)	-0.00214** (0.000893)
Fraction of the employed in 2000	-0.00386 (0.00368)	0.00106 (0.00245)	0.000173 (0.00509)	0.000319 (0.00423)
Fraction of workforce in 2000	0.00300 (0.00452)	0.00137 (0.00351)	0.00437 (0.00624)	0.00335 (0.00505)
Median household Income in 2000	0.00000276*** (0.000000836)	0.000000824 (0.000000749)	0.00000355* *	0.00000236* *
Poverty rate in 2000	-0.00184 (0.00179)	-0.00210* (0.00111)	-0.00161 (0.00247)	-0.00105 (0.00158)
Urban rate in 2000	-0.00166*** (0.000244)	-0.00107*** (0.000407)	-0.00137*** (0.000442)	-0.00110*** (0.000314)
Fraction of the white in 2000	0.00156*** (0.000414)	0.0000432 (0.000215)	0.000807** (0.000349)	0.000645** (0.000278)
Dummy for states with non-recourse mortgage law	0.000991 (0.0180)	-0.000847 (0.0125)	0.0221 (0.0230)	0.0125 (0.0152)
Dummy for sand states	0.0295 (0.0205)	0.0365*** (0.0139)	0.0586** (0.0242)	0.0483*** (0.0171)
Fraction of employment in arts entertainment and recreation in 2000	-0.698 (0.446)	-0.498* (0.282)	-0.987** (0.485)	-0.544 (0.344)
Fraction of renters in 2000	0.156** (0.0694)	-0.0575 (0.0546)	0.0444 (0.112)	-0.0199 (0.0781)
Fraction of immigrants in 2000	-0.308*** (0.109)	0.190* (0.106)	0.149 (0.133)	0.180 (0.114)
Constant	-0.146	-0.182	-0.668**	-0.434**

	(0.239)	(0.176)	(0.289)	(0.188)
Observations	3941	3941	3941	3941
R-squared	0.232	0.213	0.083	0.074

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**Panel C: Real effects during the bust period**

	(1) Per capita income change in 2007-09	(2) Change in no. of establishments in 2007-09	(3) Real payroll change in 2007-09	(4) Employment change in 2007-09
Fraction of non-owner-occupied home purchases in 2004-06	-0.988*** (0.167)	-0.648** (0.262)	-1.175*** (0.396)	-1.053*** (0.350)
Saiz's elasticity	-0.000514 (0.00499)	-0.000374 (0.00328)	0.00818 (0.00628)	0.00655 (0.00621)
Ln of population in 2000	-0.0241*** (0.00589)	-0.0221*** (0.00531)	-0.0348*** (0.0106)	-0.0353*** (0.00744)
Fraction of the college educated in 2000	0.000194 (0.000459)	0.00181*** (0.000480)	0.00489*** (0.000744)	0.00371*** (0.000593)
Fraction of the employed in 2000	0.000250 (0.00353)	-0.00137 (0.00173)	-0.00695** (0.00314)	-0.00345* (0.00206)
Fraction of workforce in 2000	-0.000379 (0.00358)	-0.000295 (0.00211)	0.00383 (0.00318)	0.000911 (0.00250)
Median household Income in 2000	- 0.00000303*** (0.000000592)	- -0.00000123* (0.000000645)	- 0.00000394* ** (0.00000107)	- 0.00000292* ** (0.000000839 )
Poverty rate in 2000	0.00139 (0.00141)	0.00202 (0.00132)	0.00318 (0.00235)	0.00308 (0.00212)
Urban rate in 2000	0.000199 (0.000224)	0.0000540 (0.000157)	0.000755** (0.000324)	0.000392* (0.000230)
Fraction of the white in 2000	-0.00116*** (0.000197)	-0.000316** (0.000138)	-0.000614* (0.000365)	-0.000577** (0.000247)
Fraction of employment in arts entertainment and recreation in 2000	0.495** (0.195)	0.523** (0.217)	0.929*** (0.298)	0.855*** (0.288)
Fraction of renters in 2000	-0.128** (0.0610)	-0.0868* (0.0474)	-0.226*** (0.0852)	-0.190*** (0.0711)
Fraction of immigrants in 2000	-0.00259 (0.0633)	0.142* (0.0745)	0.161 (0.119)	0.185* (0.0970)
Dummy for states with non-recourse mortgage law	0.000267 (0.00976)	0.0146 (0.00998)	0.0299** (0.0136)	0.0330*** (0.0127)
Dummy for sand states	-0.0301*** (0.0117)	-0.0133 (0.0137)	-0.0471** (0.0189)	-0.0516*** (0.0178)

Constant	0.488*** (0.0952)	0.342*** (0.116)	0.551*** (0.177)	0.537*** (0.144)
Observations	3974	3924	3924	3924
R-squared	0.250	0.217	0.081	0.063

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