



An examination of the first-time homebuyer tax credit

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ABSTRACT

A major policy response to the 2008 housing crisis was the First-time Homebuyer Tax Credit, worth up to \$8,000. To estimate the tax credit effects on homeownership, I construct a quarterly first-time homebuyer time-series using American Housing Survey data and utilize a difference-in-difference framework using variation across income levels among first-time homebuyers. I estimate the tax credit induced 399,846 first-time homebuyers and calculate an economic cost of \$27,010 per induced homeowner. Estimating state- and MSA-level effects using variation across homebuyer status, I find a strong correlation between local effect size and average home values, with a doubling in average home values implying a drop in effect size by 18.8 percentage points.

1. Introduction

One of the largest policy responses to the 2008 housing bust was the First-time Homebuyer Tax Credit (FHTC). In an attempt to boost housing demand, this novel program offered up to \$8,000 to first-time homebuyers between April 2008 and September 2010. Over three million households claimed the credit at a monetary cost of \$21.1 billion, but how many of these households bought homes because of the FHTC? Fig. 1 displays annual first-time homebuyer shares. These shares have been relatively smooth over the past 15 years at around forty percent except for a jump to fifty percent during the FHTC eligibility period. This indicates that a sizeable FHTC response occurred and warrants further investigation. This paper measures the FHTC effects by estimating the number of households induced into homeownership at both the national and local levels, and then analyzes these results to determine where and why the policy was most effective.

A federal tax credit targeting first-time homebuyers had never been offered prior to 2008.¹ In theory, a tax credit targeting first-time homebuyers could be a useful tool for policymakers during a housing bust. If house prices drop and induce a rash of foreclosures, these newly vacant homes create a shock to housing supply, driving house prices down further. To bring house prices back towards equilibrium, these vacant homes either need to be filled with new homeowners, turned into rental properties, or else demolished. Offering a tax-credit to first-time buyers helps induce more renters into homeownership, filling these vacant

homes. A homeownership tax credit can additionally boost general housing demand on the intensive margin by prompting first-time buyers to purchase larger homes.

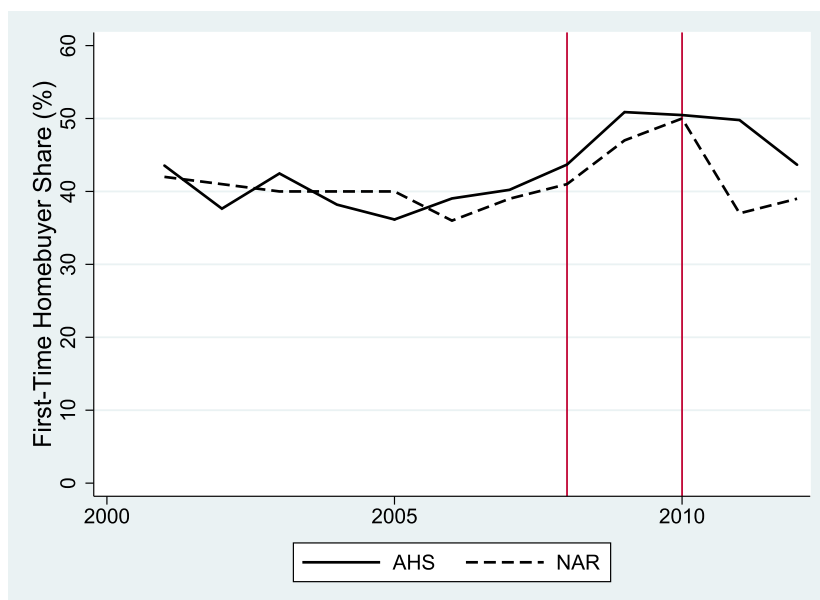
Aside from a housing bust policy tool, a first-time homebuyer tax credit may provide social benefits due to the positive externalities of homeownership. There has been much debate among economists as to the existence and magnitude of homeownership positive externalities. Evidence of these externalities often center around either improved exterior home maintenance, improved outcomes for children, or increased participation in local organizations.² While quantifying the financial value of the homeownership externality has remained difficult, recent work by Coulson and Li (2013) suggests that an additional homeowner creates \$1,300 in annual externality benefits.

Several policies are already in place to subsidize homeownership, including the mortgage-interest deduction, deduction of state and local property taxes, housing capital gains exclusion, and mortgage revenue bonds. According to Keightley (2014), these subsidies cost the United States \$147 billion in 2017, with \$83 billion from the mortgage interest deduction alone. A first-time homebuyer tax credit has several advantages to these alternative homeownership promotion policies. These advantages stem from the fact that the FHTC directly targets the outcome of interest, homeownership, as opposed to indirectly through mortgage finance or property taxes. As a result of subsidizing mortgage interest, Hanson (2012) finds the mortgage-interest deduction does not increase homeownership but instead works on the intensive margin of

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¹ I have found just one instance of a first-time homebuyer tax credit at the local level (Tong (2005)) offering \$5,000 between 1997 and 2001 in Washington, D.C.

² Examples include DiPasquale and Glaeser (1999), Green and White (1997), Rossi-Hansberg et al. (2010), Coulson et al. (2003) and Harding et al. (2000).



Note: This figure compares the percent of homebuyers reporting to be first-time buyers in the AHS survey data and NAR Profile of Homebuyers and Sellers. AHS first-time homebuyer share based on year of moving date. The solid vertical lines represent FHTC start and end dates.

Fig. 1. First-Time Homebuyer Share, NAR vs. AHS.

Source: American Housing Survey, National Association of Realtors Profile of Homebuyers and Sellers.

housing demand by increases home size between 10.9–18.4%. Similarly, [Glaeser and Shapiro \(2003\)](#) uses variation across states in the deductibility of mortgage interest and finds only a small positive relationship to homeownership. By using income tax deductions, the mortgage interest and property tax deductions only benefit households that itemize their tax returns, meaning benefits are mostly realized by higher income households. This regressivity works directly against the motivation for a progressive tax code. Research by [Green and Vandell \(1999\)](#) models the housing tenure choice of households while incorporating tax incentives. [Green and Vandell \(1999\)](#) finds that replacing the mortgage-interest deduction with a similarly sized homeownership tax credit would boost homeownership rates by 3–5%. While [Green and Vandell \(1999\)](#) consider an annual homeownership tax credit as opposed to a first-time homebuyer tax credit, the mechanisms for boosting homeownership are similar. By using a fixed-price subsidy and linking the tax credit directly to homeownership as opposed to indirectly through mortgage financing, a homeownership tax credit provides a more efficient alternative to the mortgage interest deduction.

Against these benefits, policymakers must weigh the expected costs of a homeownership tax credit. As a group, homeowners are wealthier than renters are. This means that the tax credit works against the redistributive goals of progressive taxation. Even if bulk of the FHTC cost is simply a wealth transfer towards homeowners, the FHTC benefits must be weighed against the cost of raising the funds to pay for it. Since the FHTC subsidizes homeownership, it distorts the housing tenure decisions contributing to the economic costs of the program. Further, renters on the margin of homeownership may be higher credit risks and more likely to default on their mortgage. This would increase foreclosures, which are costly to homeowners and the general public.

The effectiveness of the FHTC depends on the elasticity of homeownership, or analogously the “price” of homeowners. By price of homeowners I am referring to cost per induced homeowner. The more elastic renter demand is for homeownership, the cheaper it will be to buy homeowners and fill vacant homes. Ex ante, predicting the response of first-time homebuyers to the FHTC is difficult because it

is a new program with few prior studies to draw from. Research into the effects of the mortgage-interest deduction on housing tenure choice often finds minimal if not zero effects on homeownership. [Hilber and Turner \(2014\)](#) considers state variation in mortgage interest deduction combined with housing supply elasticity and finds only small homeownership effects concentrated among high-income individuals living in less-regulated housing markets, implying a cost of \$28,397 per new homeowner per year.

A difficulty of measuring the homeownership elasticity is quantifying the relative size of a homeownership subsidy. Since \$8,000 is only about three percent of the average home purchase the FHTC could be seen as a trivial subsidy. However, this tax credit incentivizes homeownership consumption but not necessarily housing consumption. Housing consumption is better represented by the “user cost” of housing, which includes the cost of raising the down payment amount, mortgage financing costs, and the transaction costs of moving and selling the home. While the user cost is clearly heterogeneous across households depending on creditworthiness and expected tenure, a useful approximation is to use five percent of the home value annually ([Himmelberg et al. \(2005\)](#)). If an average first-time homebuyer lives in their home for five years, the FHTC would then subsidize ten percent of the user cost (assuming a six percent realtor transaction fee as well). This subsidy rate changes with the size of home purchased. Purchasing a \$100,000 home would imply a subsidy rate of twenty-five percent while purchasing a \$500,000 home would only subsidize five percent of the user cost of homeownership.

Several empirical challenges arise in identifying FHTC effects on homeownership. One challenge is separating FHTC effects from other housing-focused programs enacted during the Great Recession, such as the Home Affordability Modification and Refinancing Programs or quantitative easing (which purchased mortgage-backed securities). These other programs focused on assisting current homeowners. I isolate the FHTC effect by measuring the responsiveness of eligible low-income first-time homebuyers to non-eligible high income first-time homebuyers in a difference-in-difference framework. For robustness, I additionally examine the response of first-time homebuyers, as opposed

Table 1
First-time homebuyer tax credit details.

	Housing and Economic Recovery Act of 2008	American Recovery and Reinvestment Act of 2009	Worker, Homeownership, and Business Assistance Act of 2009
Applicable dates	April 9, 2008–July 1, 2009	January 1, 2009–November 30, 2009	November 7, 2009–June 30, 2010
First-time homebuyer only?	Yes	Yes	No (includes long-term owners)
Maximum amount	\$7500	\$8000	\$8000
Income phase out	Single: \$75,000 - \$95,000 Joint: \$150,000 - \$170,000	Single: \$75,000 - \$95,000 Joint: \$150,000 - \$170,000	Single: \$125,000 - \$145,000 Joint: \$225,000 - \$245,000
Repayable	Yes	No (unless resold within 3 years at a gain)	No (unless resold within 3 years at a gain)
Documentation of purchase required?	No	No	Yes
Maximum purchase price	No	No	\$800,000

Note: This table is taken from the Government Accountability Office report on the FHTC: <http://www.gao.gov/new.items/d101025r.pdf>. The repayable version of the tax credit required claimants to repay the value of the tax credit in equal installments over the following fifteen years through tax returns.

to previous owners, during the tax credit period and perform a triple difference analysis using income level and homebuyer status variation.

Another challenge is tracking first-time homebuyers as a group, which few datasources contain on a systematic, nationwide basis. To overcome this, I construct a national, quarterly time-series of first-time homebuyer purchases. This first-time homebuyer series is constructed by combining data from the American Housing Survey (AHS), which asks households of their homebuyer status and moving date, and the Home Mortgage Disclosure Act (HMDA), which tracks US mortgage originations. AHS data also allows me to investigate other changes to first-time homebuyers during the tax credit period, such as household income, down payment amount, reason for moving, and home size.

A final empirical challenge is identifying local FHTC effects. Local effects are important both for policy analysis and for understanding the homeownership decision. National-level FHTC effects mask significant state- and MSA-level variation. If the FHTC was meant as a policy to counteract local housing busts we should be interested in whether FHTC effects were greater or smaller in areas experiencing larger housing busts. For future potential FHTC policy we are interested in whether other local housing market characteristics, such as the percent of renters, housing supply elasticity, or average home values impact FHTC effectiveness. Average home values in particular are interesting because it provides variation in the effective FHTC homeownership subsidy amount. This is because \$8,000 subsidizes a larger fraction of home purchases lower home value areas such as Nebraska or Alabama than in higher home value areas such as California or Massachusetts, and as such we would expect larger FHTC effect in areas with lower home values.

Unfortunately, the AHS sample size is too small to detect local FHTC effects. Instead, I combine loan-level mortgage origination data from Fannie Mae, Freddie Mac, and the Federal Housing Administration to estimate local FHTC effects. Prior to the housing crisis, these three entities comprised just under fifty percent of the first-time homebuyer mortgage originations. During and following the crisis their market share increased to above eighty percent, so a majority of households claiming the FHTC are contained in this sample. The shifting first-time homebuyer market share was a direct response to the housing crisis, making this data suboptimal for estimating national FHTC effects. However, this data is well suited to measure changes in first-time homebuyer originations following the FHTC expiration at the state and MSA levels.

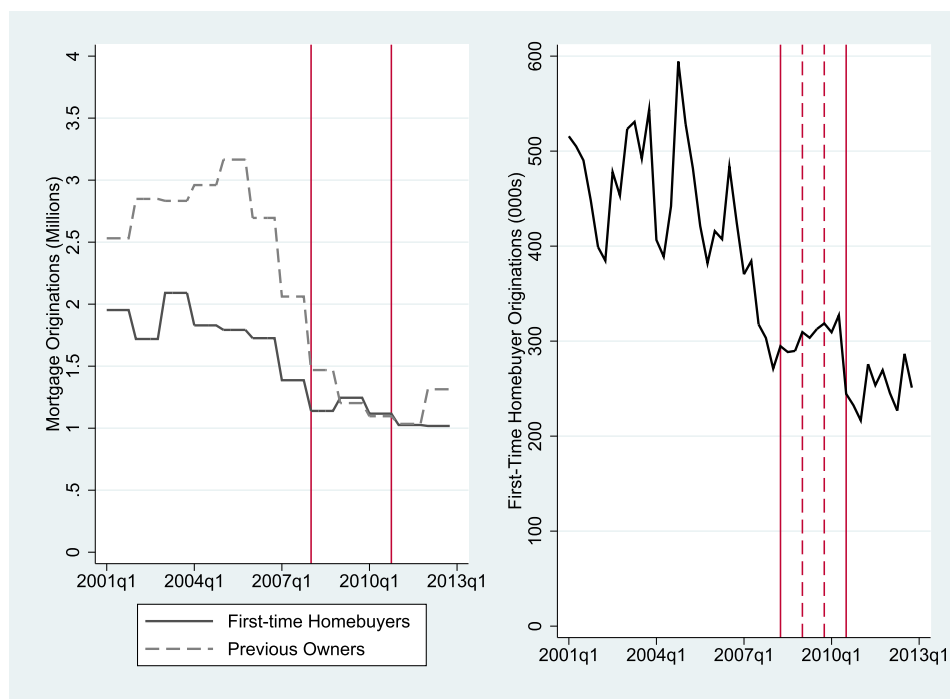
I find that the FHTC increased first-time homebuyer purchases by 399,846 or 16.0 percent between April 2008 and September 2010.

A deadweight loss calculation estimates an FHTC inefficiency cost of \$10.8 billion translates into the government paying \$27,010 per induced homeowner. While this cost is greater than the expected homeownership externality and the cost of demolishing vacant homes, it is considerably lower than previous estimates from using the mortgage interest deduction to boost homeownership. The FHTC effect is concentrated in the second two iterations of the tax credit, after it ceased requiring tax credit repayment and 15 percent of induced homeowners expedited their homeownership transition by a year or less. Induced homeowners were more likely to be younger and use a smaller down payment, but did not spend more on housing or exhibit higher default or prepayment rates. Using a competing risks hazard analysis, I find first-time homebuyers were no more likely to default or prepay their loan relative to previous owners. State- and MSA-level analysis reveal a positive correlation between FHTC effect size and magnitude of housing bust. A main driver of FHTC effect size variation between states is average home values and percent of renters. These findings suggest a moderate to high homeownership elasticity of demand between 0.11 and 1.26 depending specification.

2. The first-time homebuyer tax credit

In July 2008, Congress authorized the Housing Recovery Act that offered first-time homebuyers a tax rebate. Initially set to expire in July 2009, Congress expanded the tax credit as part of the 2009 American Recovery and Reinvestment Act and extended its deadline through November 2009. A final version of the FHTC was included in the Worker, Homeownership, and Business Assistance Act. Details of each iteration of the FHTC are found in Table 1. The initial rebate offered the lesser of 10% of the home purchase price or \$7,500 to first-time homebuyers either making under \$75,000 for single households or \$150,000 for joint filers.³ This iteration of the tax credit had to be repaid to the government over the following fifteen years in equal installments, greatly reducing the value of the tax credit. The second FHTC iteration increased the maximum tax credit to \$8,000 and changed the rebate to non-repayable tax credit, greatly increasing its value. The third FHTC iteration loosened income limits for single households to \$125,000 and to \$225,000 for joint filers, as well as offering the tax credit to previous owners in addition to first-time homebuyers. The tax credit was fully refundable, meaning households could claim the entire benefit amount even if they owed no income taxes.

³ The tax credit is phased out in the \$20,000 income range above each cutoff point for each iteration of the program.



Notes: This figure displays annual home purchases by buyer status (left) and quarterly home purchases by first-time homebuyers (right). Solid vertical lines represent FHTC start and end dates and dashed lines represent each iteration date.

Fig. 2. Annual home purchases by homeowner status and quarterly first-time homebuyer purchases.
Source: American Housing Survey and HMDA data.

An important issue for the FHTC is whether it could be used to alleviate liquidity constraints for first-time homebuyers. Many studies, such as Brueckner (1986), have shown the importance of down payment requirements in the housing tenure choice, where renters must save a significant level of assets before qualifying for a mortgage. In general, the FHTC did not directly relieve this constraint as the credit could only be claimed after purchasing a home. FHA-insured mortgages, which have the lowest government down payment requirement of just 3.5%, stated that lenders could not allow households to borrow against the FHTC in order to meet the minimum down payment requirements, although they could borrow against the credit to increase the down payment above the minimum, buy down the interest rate, or be put towards closing costs.⁴

A 2010 GAO report on the FHTC states that 3.3 million households claimed the federal first-time homebuyer tax credit between 2008 and 2010.⁵ States with the highest utilization level are located in the Mountain and Midwest regions, areas with lower home values and higher homeownership rates on average.⁶ While the FHTC utilization level is important for estimating general consumption responses to the FHTC, this paper is focused on the FHTC housing consumption effects which require estimating the change in first-time homebuyers.

Open debate exists on the effectiveness of the FHTC. In evaluating the FHTC, Baker (2012) states:

There can be little doubt the first-time homebuyer tax credit had a large impact on the country's housing market. Sales took off immedi-

ately after the credit took effect ... The result was that many people were persuaded to buy homes at bubble-inflated prices who would have otherwise purchased them at prices that were more consistent with the longer-term trends in the housing market. This amounted to a substantial transfer of wealth from new homebuyers to home sellers.

Many housing indicators, including home sales, housing starts, housing permits, and vacancy rates, indeed began to recover during the FHTC eligibility period. However separately identifying FHTC effects on these indicators from other housing programs enacted during this time period remains difficult.

Several economic rationales could justify a new homebuyer tax credit as a policy tool during a housing bust. When house prices decline mortgages lose equity, and greater negative equity increases the likelihood of delinquency and foreclosure. When foreclosures rise, this floods the supply of owner-occupied housing without a similar rise in the number of new home-owners, pushing home values down further and in turn inducing more foreclosures.⁷ To fill this glut of vacant homes, families not already living in owner-occupied homes need to move into them. A tax credit for first-time homeowners targets this group. Additionally, the FHTC encourages prospective new homeowners to purchase a larger home as a wealth effect and by relieving credit constraints.

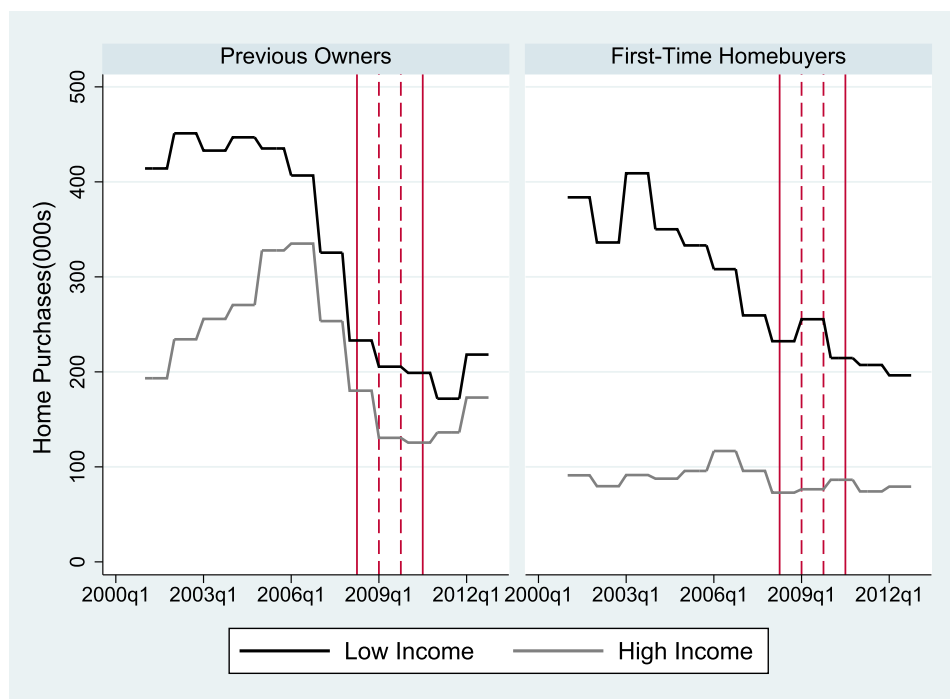
A federal first-time homebuyer tax credit has not previously been implemented in the United States. At the local level, the only homebuyer tax credit I have found a record of was offered in Washington

⁴ This is stated in a letter issued by the FHA on May 29, 2009: <https://www.hud.gov/sites/documents/09-15ml.doc>.

⁵ Note these numbers differ somewhat from what the IRS reports, though the IRS only reports numbers for 2009 and 2010.

⁶ Utilization levels are defined as number of claimed tax credits divided by the number of renter households in the state.

⁷ A source of friction here is that recently foreclosed households are often unable to secure new mortgage financing when they are forced to move, pushing them into the rental market. Molloy and Shan (2013) reports that only between 2006–2008, only two percent of foreclosed households had a mortgage two years after foreclosure.



Notes: This figure displays estimates of the number of homebuyers each month by income level and homebuyer status. Mortgage originations use log scale. High income defined as households reporting above \$85,000 annual income, low income below this threshold. AHS data extrapolated using HMDA annual counts of total first-lien, owner-occupied, purchase mortgages, by income categories. Solid vertical lines represent FHTC start and end dates and dashed lines represent each iteration date.

Fig. 3. Number of homebuyers, by homeowner status and income level.

Source: American Housing Survey

D.C. worth \$5,000 between 1997 and 2001. A policy brief on the tax credit reported an increase to DC house price appreciation of 4.9 percent compared to surrounding areas because of the tax credit, [Tong \(2005\)](#). This minimal previous evidence highlights the importance of a detailed investigation of the current FHTC, especially if it is considered as a policy tool for future housing busts.

While the FHTC targets a unique population, tax credits or rebates are a common policy tool used to influence consumer behavior. Using survey data, [Shapiro and Slemrod \(2001\)](#) examine the 2001 tax rebate and find most households either saved or used the tax rebate of either \$300 or \$600 to pay down existing debt. However, [Agarwal et al. \(2007\)](#) use credit report data to find that while households saved and paid down debt in the short term, their spending increased shortly after with 40% of the tax rebate being spent within nine months of receiving it. Ideally, to boost housing demand, households would use the FHTC either to buy a home they would have otherwise rented or to purchase a larger home. These studies suggest that only a fraction of the tax credit would go towards increased spending, housing or otherwise. Since a large majority of households claimed the FHTC as a lump-sum payment rather than as a percentage of the home value, we expect a greater response on the extensive margin of buying the home rather than the intensive margin of the size of the new home.⁸

A recent tax credit similar to the FHTC is the “Cash for Clunkers” program of 2009, which offered households \$3,500 or \$4,500 to subsidize new car purchases. [Mian and Sufi \(2010\)](#) find the program

significantly boosted auto sales, though this boost was largely an inter-temporal shift in when cars were purchased, and had negligible effects on employment, house prices, or home default rates. A similar worry may exist for the FHTC, whereby a jump in home sales may just be households who would have become homeowners without the tax credit eventually, but just expedited this transition. These expedited homeownership transitions offer only marginal benefits, as they simply shift the timing of decreased homeownership demand.

Existing literature examining the FHTC is limited. [Dynan et al. \(2013\)](#) evaluates the FHTC in two ways, first by comparing housing indicators to FHTC dates and second using state variation in home values within a difference-in-difference strategy. Using forecasting techniques, [Dynan et al. \(2013\)](#) finds a large positive effect of the tax credit, though forecasting during the turbulent 2008–2010 period is difficult, and reports mixed results using the difference-in-difference approach. [Dynan et al. \(2013\)](#) then uses state variation of offered supplemental policies to find states which offered short-term loans or credits to have a positive effect on the housing market. While state-level supplemental policies are interesting, there are drawbacks from using them in this analysis. Primarily, the state programs are of only small monetary value. Most just offered short-term, low-interest loans to finance the home purchase. Only a few states offered additional tax credits. Georgia only offered \$1,800, while Maine and Utah offered between \$2,500 and \$6,000 for less than a year each. California offered the up to \$10,000, but was geared towards new homes instead of first-time buyers and also quickly ran out of funds for the credit. The short-term duration and varying eligibility requirements of these state plans raises also raises questions about their salience to potential homeowners, limiting their likely observed impact.

⁸ The FHTC is \$8,000 as long as the home value is greater than \$80,000. If less than \$80,000 the tax credit is offered at 10% of the home value. The 2010 GAO report finds that the average credit claimed by first-time homebuyers was for \$7,393.

3. Methodology

This section outlines the research methodology used to estimate FHTC effects. I employ both a difference-in-difference and a difference-in-difference-in-difference approach, using variation over time, income level, and homebuyer status.

The difference-in-difference estimation of FHTC effects uses the following equation:

$$Y_{it} = \beta_0 + \beta_1 \text{Group} + \beta_2 \text{Treat} + \delta(\text{Treat} \times \text{Group}) + \lambda \mathbb{X} + \varepsilon_{it} \quad (1)$$

where Y_{it} is the outcome of interest, log homebuyer purchases at time t for group i where $i = \{\text{low} - \text{income}, \text{high} - \text{income}\}$, or $i = \{\text{first} - \text{time homebuyers}, \text{previousowners}\}$ depending on specification. \mathbb{X} contains control variables and ε_{it} is an iid error term. Control variables include a quadratic time trend by group, lagged unemployment rate and lagged house price index changes, the average mortgage interest rate and interest rate spread, and the log of US population by age groups. The variable Group is a dummy equal to one for the treated group, either for low-income if data grouped by income level or first-time buyer if groups by buyer status. Treat and δ are a two-dimensional vectors, allowing the treatment effect to vary by FHTC iteration, since the tax credit level and eligibility vary across implementations. Specifically, $\delta = [\delta_1, \delta_2]$. When estimating a single effect, $\delta_1 = \delta_2 = \bar{\delta}$ and Treat is:

$$\text{Treat} = \begin{cases} 1 & \text{if } 2008q2 \leq t \leq 2009q4 \\ 0 & \text{otherwise} \end{cases}$$

When estimating separate effects by implementation, Treat is:

$$\text{Treat} = \begin{cases} [1, 0] & \text{if } 2008q2 \leq t \leq 2008q4 \\ [0, 1] & \text{if } 2009q1 \leq t \leq 2009q4 \\ [0, 0] & \text{otherwise} \end{cases}$$

In using my difference-in-difference framework, I consider two aspects of FHTC eligibility: by income level and by buyer status. Of the two groups, income level variation between first-time homebuyers is a more appropriate control group given that previous owners likely received a negative wealth shock during the housing crisis, which may influence their mobility decisions. However, I additionally estimate Equation (1) using homebuyer variation both as a robustness check and because household income is not reported for local-level data.

I additionally run a difference-in-difference-in-difference specification defined as:

$$Y_{it} = \beta_0 + \beta_1 \text{Group1} + \beta_2 \text{Group2} + \beta_3 \text{Treat} + \beta_4 (\text{Group1} \times \text{Group2}) + \beta_5 (\text{Group1} \times \text{Treat}) + \beta_6 (\text{Treat} \times \text{Group2}) + \delta (\text{Treat} \times \text{Group1} \times \text{Group2}) + \lambda \mathbb{X} + \varepsilon_{it} \quad (2)$$

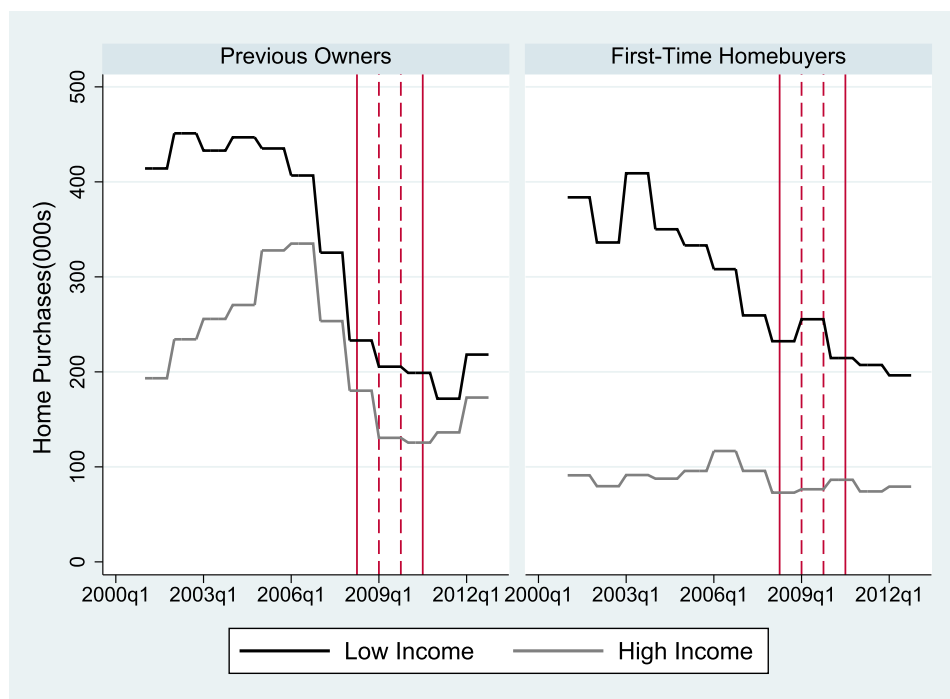
where Treat is as defined above and Group1 , Group2 are indicators for low-income and first-time homebuyer households respectively.

One concern in using periods following, or directly prior to the FHTC in estimation is that households may have shifted home purchases across time, either in anticipation of or in reaction to the policy. However, due to the structural shift in first-time homebuyer purchases prior to and following the housing crash, it is vital to include post periods to observe equilibrium following the crash. I address inter-temporal shifting in two ways. The first is to directly estimate the number of households which expedited their home purchase. I do this by assuming the inter-temporal substitution effect decays linearly during the four quarters following FHTC expiration. This approximation of the inter-temporal shifters imposes strong assumptions, that no one shifts their home purchase by more than a year and that the effect decays linearly, but reflects the reasonable assumption that the cost of shifting is smallest immediately following the FHTC eligibility period. I

Table 2
Summary statistics relative to FHTC eligibility dates.

	(1) Pre-FHTC mean/sd	(2) FHTC Period mean/sd	(3) Post-FHTC mean/sd
First-time Homebuyers (Quarterly)	460,275 (77,345.8)	321,452 (12,744.9)	285,934 (33,387.0)
First-time Homebuyer Share	37.6 (3.2)	46 (4.4)	45.6 (5.0)
Ln HPI	5.15 (0.2)	5.09 (0.1)	5.05 (0.0)
Lag Unemployment Rate	5.17 (0.6)	7.93 (1.8)	8.88 (0.7)
Mortgage Rate	6.22 (0.5)	5.44 (0.5)	4.22 (0.5)
Mortgage Rate Spread	3.48 (1.1)	4.07 (2.4)	1.97 (1.1)
Ln Population 20–39	18.9 (0.0)	18.9 (0.0)	19.6 (0.0)
Ln Population 40–59	18.9 (0.0)	19 (0.0)	19.7 (0.0)
Ln Population 60+	18.4 (0.0)	18.5 (0.0)	19.3 (0.0)
Ln Average Home Value	183,585 (0.0)	183,585 (0.0)	183,585 (0.0)
Rental Percentage	.23 (0.0)	.23 (0.0)	.23 (0.0)
Housing Supply Elasticity	1.54 (0.0)	1.54 (0.0)	1.54 (0.0)
FHTC	0 (0.0)	1 (0.0)	0 (0.0)
Substitution Effect	0 (0.0)	0 (0.0)	.833 (1.4)
Observations	29	7	12

Sources: American Housing Survey, Bureau of Labor Statistics, Census Bureau, Case-Shiller House Price Index, Freddie Mac Mortgage Market Survey, Saiz (2008), and 2009 American Community Survey.



Notes: This figure displays estimates of the number of homebuyers each month by income level and homebuyer status. Mortgage originations use log scale. High income defined as households reporting above \$85,000 annual income, low income below this threshold. AHS data extrapolated using HMDA annual counts of total first-lien, owner-occupied, purchase mortgages, by income categories. Solid vertical lines represent FHTC start and end dates and dashed lines represent each iteration date.

Fig. 4. New housing tenure shares, by previous tenure.
Source: American Housing Survey

add a “Substitution Effect” variable to incorporate this effect in the estimation.⁹ My second approach is to run regression specifications taking out the adjacent time periods to the FHTC eligibility which would have been most affected by these inter-temporal substitutions. These dates include the quarter prior to two quarters following the tax credit.

4. Data and empirical implementation

A key component to identifying FHTC effects is isolating the response of first-time homebuyers. Few datasources track first-time homebuyers as a group, especially at a national scale. A commonly cited source for first-time homebuyer data is from the Profile of Homebuyers and Sellers, produced by the National Association of Realtors since the mid-1980s. However, this data is not well suited to estimate FHTC effects due to the potential selection bias given its low response rate, small sample size, and because it can only track annual, not quarterly, variation in home purchases.¹⁰ Instead I track first-time homebuyers using the American Housing Survey (AHS). Fig. 1 compares the share of first-time homebuyers in the National Association of Realtors survey versus the AHS. The two data sources report very similar levels and trends of first-time homebuyer shares between 2001 and 2012, beginning near forty percent, increasing to almost fifty percent in 2009 and dropping back closer to forty percent in 2012. The AHS is a rich dataset

which includes both a flag for first-time homebuyers and the moving date. This allows me to estimate the quarterly rate of first-time homebuyers at the national level. For local level first-time homebuyers I construct a time-series using loan-level origination data from Freddie Mac, Fannie Mae, and the Federal Housing Administration.

4.1. First-time homebuyers nationally

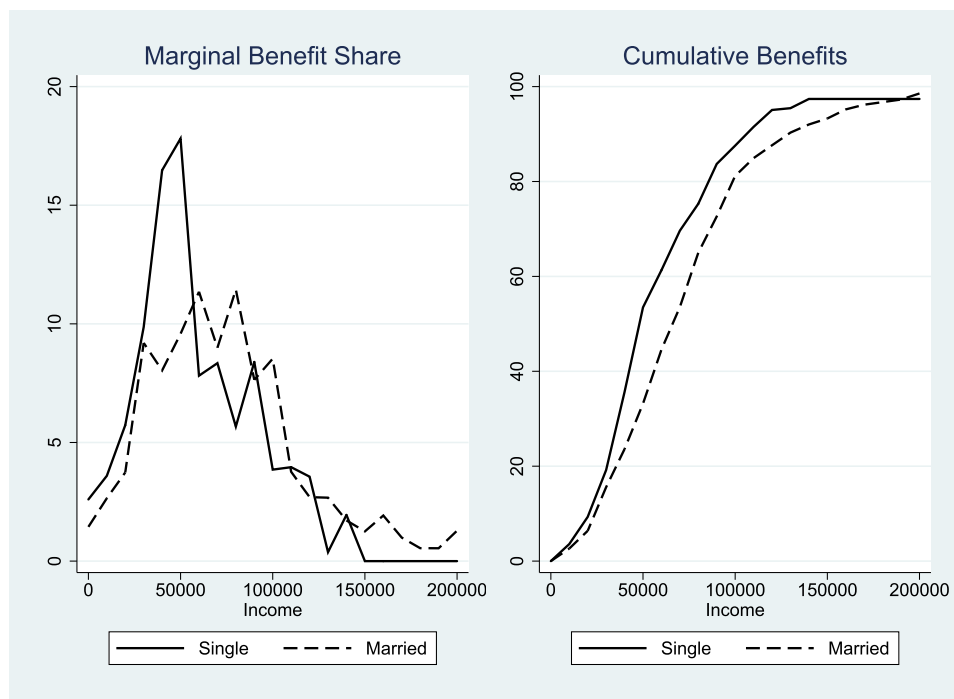
Data for the primary analysis of the FHTC comes from the AHS. This biennial survey began in 1973 and following roughly 55,000 nationally representative housing units. The AHS asks respondents if and when they moved within the past two years, whether they ever owned a home before moving and their current tenure status. Between 2001 through 2013, 23,162 AHS households reported moving, creating a sample of about 500 movers per quarter.¹¹

The first and most important task in determining FHTC effects is to create a quarterly count of first-time homebuyers. One way to report the number of first-time homebuyers each quarter would be to count the number of AHS respondents claiming to be first-time buyers each quarter. This approach has two problems. One is the survey only asks about first-time buyer status for the most recent move. If a household moved more than once in the prior two years and if the first move was a first-time purchase, then this would not be reflected in the data. This negatively biases first-time buyer counts in months further away from the survey date. Adding to the problem is that surveys occur unevenly over a four to five month period. This adds noise to the time series

⁹ The substitution effect is set equal to four in the first period following the FHTC and decays each period down to one a year after the FHTC expire. To estimate the total number of households shifting their home purchase, multiply the Substitution Effect coefficient by ten ($4 + 3 + 2 + 1$).

¹⁰ For example, the 2011 Profile of Homebuyers and Sellers had a response rate of just 7.3 percent.

¹¹ Both FHTC eligibility and the other housing agency datasources consider households that have not owned a home in the past three years to be “first-time homebuyers”. This is slightly different than my definition based on the AHS, where first-time means “never have owned a home before”.



Notes: This figure displays the marginal and cumulative estimated incidence of FHTC benefits by income and marital status.

Fig. 5. Incidence of FHTC benefits, by income and marital status.

Source: American Housing Survey

by weighting some time periods more than others and is a difficult problem to correct properly given the small number of movers each quarter.

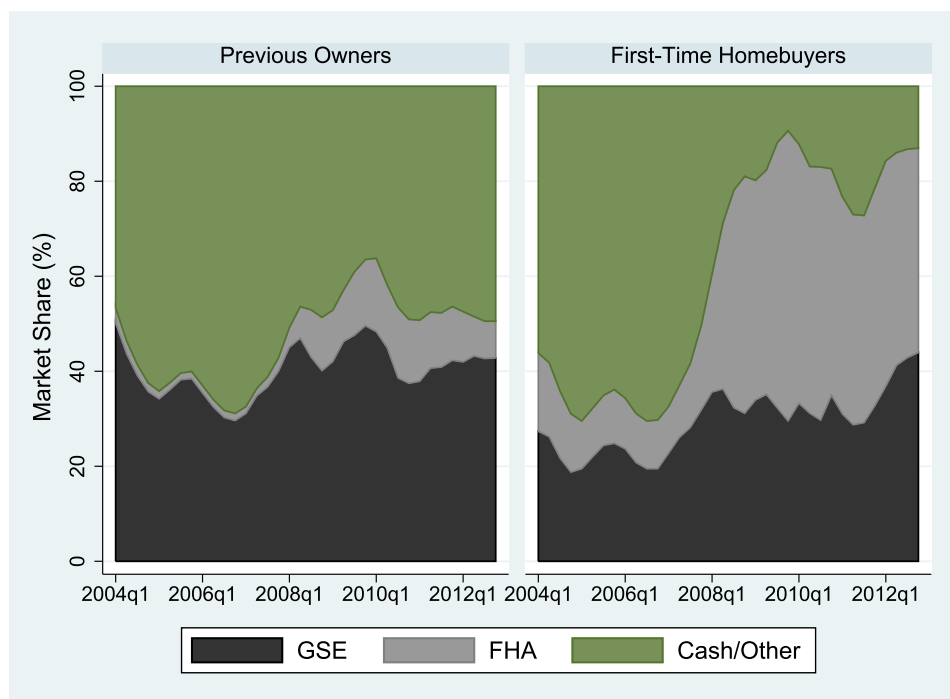
Instead of taking first-time homebuyer counts from the AHS, I construct my first-time homebuyer time-series estimates using a three-step procedure. For each year I first calculate the quarterly share of movers obtaining a mortgage for each group, using AHS sample weights to reflect a nationally representative sample. Groups include buyer status (first-time buyer or previous owner) and income status (high or low income). Using group shares instead of counts reduces the error arising from the uneven staggering of interviews each quarter. Next, the quarterly group shares are scaled by the total number of mortgages originated each year. Total mortgage originations come from the Home Mortgage Disclosure Act data.¹² Scaling quarterly group shares by total annual mortgages gives an estimate of the total number mortgages originated for each quarter-group status. Lastly, to account for cash purchases, the quarterly mortgage originations by buyer type are divided by the percent of movers who used mortgage financing by homebuyer type and quarter in the AHS. For income groups, I divide the AHS sample into “high” and “low” income levels using a household income cutoff of \$85,000. Income eligibility cutoffs for the FHTC vary over time and tax filer status. Initially, a single household with an income under \$75,000 can claim the full tax credit, but later on this threshold is raised to \$125,000. Joint filers are initially fully eligible with incomes of \$150,000 and then \$225,000. The tax credit is phased out over the \$20,000 income range above each income threshold. I split households into high- and low-income samples using an income threshold of \$85,000 so that all households defined as low-income are always eligible for at least half of the tax credit in all FHTC periods. Since I do not observe income filer sta-

tus, I am unable to split the sample differently for joint and single households. Because some households in the high-income sample are eligible for the FHTC, my estimate will understate the true effect size.

Fig. 2 displays national home purchases by homebuyer status at an annual rate, and the first-time homebuyer quarterly series, with vertical lines marking FHTC implementation dates. The left-hand panel shows that first-time homebuyer purchases peaked in 2004 before declining each year until 2010. Home purchases by previous owners dropped significantly more than first-time buyers. The right-hand panel zooms in on the seasonally adjusted quarterly rate of first-time homebuyer purchases between 2003 and 2012. While FHTC effects appear subtle in 2008, there is an increase in 2009 and 2010 before the tax credit expired. The 2009 increase is not observed among previous owners, hinting at the role of the FHTC. Fig. 3 shows first-time and previous owner home purchases split by income level. Here we see that the 2009 increase in first-time homebuyers is concentrated among lower-income households, while high income households home purchases increase in 2010 after the income eligibility requirements are relaxed. This provides supporting evidence of the FHTC effect since there is no similar pattern among previous owners.

Table 2 presents summary statistics of first-time homebuyers and control variables used in estimation, separated by time period relative to FHTC eligibility. Lagged values of house price and unemployment rate variables are used to avoid policy endogeneity issues. While the quarterly rate of first-time homebuyers dropped by thirty percent during the FHTC eligibility relative to the 2001–2008 average, the share of purchases to first-time homebuyers actually increased by ten percentage points. Notably, both the number and share of first-time homebuyers dropped by fourteen percent and three percentage points respectively in the two years following FHTC eligibility. Among other macro-economic indicators, house prices dropped and unemployment jumped during FHTC eligibility. Mortgage rates dropped by one percentage point during FHTC eligibility, though its spread over inflation remained similar.

¹² Home Mortgage Disclosure Act mortgage origination counts are restricted to owner-occupied, first-lien, purchase mortgages. This data do not report first-time homebuyer status, and prior to 2003 do not report lien status.



Notes: This figure displays the home purchase financing share of the GSEs, FHA, and other sources such as private label or cash-only purchases. Other share is calculated as the difference between the estimated total quarterly home purchases in the AHS and the sum of GSE and FHA originations.

Fig. 6. Home purchase financing shares of GSE, FHA, and other sources, by buyer status.

Source: Authors calculations using American Housing Survey data, Fannie Mae, Freddie Mac, and FHA loan-level mortgage origination data.

Following the tax credit, mortgage rates dropped by another percentage point following the tax credit and the spread over inflation dropped to only 1.6 percent. The US population age distribution only changed slightly over this time period, with a slightly increasing share of middle-aged and elderly households.

In addition to counts of first-time and previous owner home purchases, AHS data provides insight into characteristics of the FHTC induced homeowners and to potential intensive margin housing effects. For instance, increased first-time homebuyer purchases could either arise from the extensive margin of inducing more renters to move, or along the intensive margin of enticing renters who were already planning to move to choose homeownership over continued renting. Fig. 4 shows the share of mover households becoming renters or homeowners, split by whether the household previously owned or rented their home. Here we see that during the FHTC eligibility period, previous renters chose homeownership of 2.1 percentage points during the FHTC eligibility. Alternatively, previous owners remained owners upon moving at only a slightly lower rate, less than one percentage point different during the FHTC, suggesting previous owners were less affected by the policy and remain a valid control group.

Fig. 5 displays the incidence of the FHTC by income and marital status based on AHS data. While I cannot directly observe whether households claim the tax credit or not, the incidence rate is computed assuming all eligible first-time homebuyers claim the credit. More than half of FHTC benefits go towards single households making \$50,000 or less, and to married households making \$70,000 or less. This distribution highlights a relative benefit of the FHTC compared to the mortgage-interest deduction from which, according to Keightley (2014), more than half of benefits accrue to households making over \$100,000.

The AHS asks recent movers what their primary reason for moving was. During the first and second iterations of the FHTC, thirty percent of first-time homebuyers claimed “Changing Tenure Status” as the pri-

mary reason for moving, an increase of nearly fifty percent relative to the two years surrounding FHTC eligibility. Other reasons for moving such as “Establishing a New Household” or “Moving to a Bigger or Better House” did not display similar spikes during the FHTC eligibility period, suggesting changes in household formation or household size was driving increased first-time home purchases. AHS data also includes household age information. Over the past decade, the average age of first-time homebuyers has increased steadily by nearly three years to over thirty-five years old. However, during the second FHTC iteration the average first-time homebuyer age dropped by a full year suggesting homeowners induced by the FHTC were younger than typical first-time homebuyers.

4.2. First-time homebuyers locally

Equally as interesting as the national FHTC effects is the variation across local markets in FHTC effect sizes. The tax credit was created in direct response to the housing and financial crisis, but these crises hit some states, such as California, Florida, Arizona, and Nevada, much harder than other states. I estimate state- and MSA-level effects and compare these effects to local housing market conditions, such as average home values, renter share, and housing supply elasticity.

Since the AHS sample size is too small to track local effects, I instead utilize mortgage origination data from the Federal National Mortgage Association, the Federal Home Loan Corporation, and the Federal Housing Administration (also known as Fannie Mae, Freddie Mac, and the FHA respectively). These agencies account for a majority of owner-occupied, first-lien, purchase mortgage originated since 2008, particularly among first-time homebuyers.

Fannie Mae and Freddie Mac are government-sponsored enterprises which guarantee mortgages made by financial institutions. Both Fannie Mae and Freddie Mac report annual mortgage originations to the Fed-

eral Housing Finance Authority which include property location information and a first-time homebuyer indicator. This data is publicly available. To estimate the distribution among quarters within the annual data, I use a large sample of loan-level data provided by each company which includes the date of first mortgage payment, property location, and a first-time homebuyer indicator. This data also tracks monthly loan performance including whether the loan has been prepaid or delinquent.

The FHA insures mortgages typically targeted towards lower-income and down payment constrained households. The agency has seen its role in mortgage financing increase dramatically following the housing bust and the collapse of the private subprime lending market, filling a critical need for first-time homebuyers. Data on all FHA mortgage originations and their performance between 2003 and 2013 was obtained from the Department of Housing and Urban Development through a freedom of information act request. The dataset includes thirteen million mortgages insured by the FHA between 2003 through 2013, and includes a flag for first-time homebuyer status, origination date, and property location.

Combining data from the FHA and from Freddie Mac and Fannie Mae, which are Government-Sponsored Enterprises or GSEs, covers a large share of the US mortgage market. Fig. 6 shows the quarterly market share of the GSE, the FHA, and other lenders by homebuyer status.¹³ The GSE/FHA market share changed significantly between 2007 and 2009 as the FHA relaxed its lending standards and attracted many first-time homebuyers. I use previous owners as a control group for first-time homebuyers to measure local FHTC effects. As Fig. 6 shows, this data provides excellent coverage of the first-time homebuyer market. Since 2009 the combined GSE/FHA market share has consistently remained above 80 percent for first-time homebuyer purchases.

5. Results

In this section I present FHTC effect estimates. I begin by discussing national-level estimation results. These provide an estimate of the total number of households the FHTC induced into homeownership, which are then used to calculate the total cost per new homeowner. I then present intensive margin effects, including effects on purchase price, down payment amount, and mortgage outcome variables. I lastly present state- and MSA-level FHTC estimates. The size and distribution of these effects are then compared with various housing and economic measures to understand where and why the tax credit was most effective.

5.1. National FHTC effects

Table 3 reports regression results estimating the FHTC effect on seasonally adjusted first-time homebuyer purchases using the difference-in-difference framework outlined in Equation (1) with two groups, low-income and high-income first-time homebuyers. In the table, “FTHC” is an indicator variable for the treatment period, 2008q2-2009q4, and “Low Income” is an indicator variable for the low-income sample of households with annual income under \$85,000. I find that the FHTC increased first-time homebuyers by 16.0 percent or 255,356 new homeowners during the first two FHTC iterations. The effect is statistically significant and includes controls for lagged unemployment rate and house prices, mortgage rate, rate spread over inflation, population age distribution, and a quadratic time trend. The “Substitution Effect”, which estimates the share of households expediting their home purchase by a year or less due to the tax credit finds that 15 percent of the increase in first-time homebuyers was from households who would

Table 3
Diff-in-Diff FHTC Effect using Income Level.

	(1)
FHTC X Low Income	0.160* (0.096)
FHTC Eligibility Period	0.077 (0.135)
Lag HPI	1.445*** (0.529)
Lag Unemployment	0.062* (0.032)
Mortgage Rate	-0.033 (0.043)
Mortgage Rate Spread	-0.005 (0.015)
Substitution Effect	-0.019 (0.033)
Ln Population 20–39	2.991 (3.947)
Ln Population 40–59	-1.232 (4.230)
Ln Population 60+	-1.637 (2.875)
Low Income	9.837 (6.664)
_cons	27.070 (16.812)
Observations	96

* p < 0.10, ** p < 0.05, *** p < 0.010.

Note: Table reports income level diff-in-diff estimates of FHTC effect on the log number of seasonally-adjusted first-time homebuyers. Low-income is a dummy variable equal to one if annual household income under \$85,000. Sample period is 2001q1-2012q4 and FHTC eligibility period is 2008q2 through 2009q4. Regression includes quadratic date time trend by income level.

Source: Author’s calculations based on American Housing Survey and HMDA data.

have made their first-time purchase within a year after the tax credit expired.¹⁴

Table 4 builds on Table 3 first by allowing the FHTC effect to vary by iteration in the lower panel. In Column (1), as expected, when estimating separately by iteration the FHTC effect is concentrated in the second iteration where the effect is 2.3 times stronger than during the first iteration. The stronger second iteration effect is expected since the tax credit became much more valuable because it no longer required repayment. Since the third iteration is not identified using income differences, as high-income households became eligible for the FHTC, an extrapolation of the second iteration effect to the third iteration implies 399,846 households were induced into homeownership. Columns (2) through (5) test the robustness of the FHTC effect. Columns (2) and (3) of Table 4 remove the Substitution Effect and remove period adjacent to the FHTC policy. These specifications exclude observations which may be particularly tainted with anticipatory or responses related to the FHTC, but only alter the FHTC effect slightly. Columns (4) and (5) remove control variables and adjacent periods, similarly alternating the FHTC effect and the Substitution Effect only slightly.

Table 5 estimates Equation (1) using previous owners as a control group for first-time homebuyers which are represented by the variable “FTHB”, and indicator for the first-time homebuyer group.

¹⁴ To calculate this share of inter-temporal substituting households, I set the Substitution Effect equal to four in the quarter following the FHTC expiration, and dropping in value one each quarter over the next year. A regression coefficient of -0.019 means the quarter after expiration, first-time homebuyers dropped by seven percent relative to expectations.

¹³ The “Other” share is calculated using AHS total quarterly home purchase counts by homebuyer status and subtracting off the FHA and GSE origination counts.

Table 4
Diff-in-Diff FHTC Effects using Income Level, Alternate Specifications.

	(1)	(2)	(3)	(4)	(5)
FHTC X Low Income	0.160* (0.096)	0.168* (0.095)	0.190** (0.094)	0.153 (0.102)	0.190** (0.095)
FHTC Eligibility Period	0.077 (0.135)	0.079 (0.134)	-0.025 (0.153)	-0.176** (0.072)	-0.224*** (0.067)
Substitution Effect	-0.019 (0.033)			-0.035 (0.033)	
Low Income	9.837 (6.664)	9.672 (6.630)	10.866 (6.575)	9.972 (7.095)	10.866 (6.665)
<i>FHTC X LowInc First</i>	0.092 (0.134)	0.098 (0.133)	0.120 (0.132)	0.086 (0.144)	0.120 (0.133)
<i>FHTC X LowInc Second</i>	0.212* (0.119)	0.219* (0.117)	0.242** (0.116)	0.204 (0.127)	0.242** (0.118)
Substitution Effect	-0.017 (0.033)			-0.034 (0.033)	
Controls	x	x	x		
No Adjacent Periods			x		x
Observations	96	96	90	96	90

* p < 0.10, ** p < 0.05, *** p < 0.010.

Note: Table reports income diff-in-diff estimates of FHTC effect on the log number of seasonally-adjusted first-time homebuyers. Low-income is a dummy variable equal to one if annual household income under \$85,000. Sample period is 2001q1-2012q4 and FHTC eligibility period is 2008q2 through 2009q4. Top level reports combined FHTC effect. Bottom level reports separate FHTC effects by iteration. No Adjacent Periods indicator excludes the quarter prior and two quarters following the FHTC eligibility period. Regressions include quadratic date time trend by income level.

Source: Author’s calculations based on American Housing Survey and HMDA data.

Table 5
Diff-in-Diff FHTC Effects using Buyer Status.

	(1)	(2)	(3)	(4)	(5)
FHTC x FTHB	0.225*** (0.075)	0.223*** (0.074)	0.238*** (0.074)	0.203* (0.102)	0.238** (0.094)
FHTC Eligibility Period	0.035 (0.106)	0.035 (0.105)	-0.067 (0.121)	-0.306*** (0.072)	-0.354*** (0.067)
Substitution Effect	0.005 (0.026)			-0.051 (0.033)	
FTHB	10.741** (5.209)	10.785** (5.173)	11.401** (5.202)	11.215 (7.103)	11.401* (6.584)
<i>FHTC x FTHB First</i>	0.089 (0.104)	0.087 (0.103)	0.101 (0.103)	0.069 (0.144)	0.101 (0.132)
<i>FHTC x FTHB Second</i>	0.327*** (0.092)	0.324*** (0.091)	0.339*** (0.091)	0.302** (0.127)	0.339*** (0.116)
Controls	x	x	x		
No Adjacent Periods			x		x
Observations	96	96	90	96	90

* p < 0.10, ** p < 0.05, *** p < 0.010.

Note: Table reports buyer status diff-in-diff estimates of FHTC effect on the log number of seasonally-adjusted first-time homebuyers. Sample period is 2001q1-2012q4 and FHTC eligibility period is 2008q2 through 2009q4. FTHB is a dummy variable equal to one for first-time homebuyers. Top level reports combined FHTC effect. Bottom level reports separate FHTC effects by iteration. No Adjacent Periods indicator excludes the quarter prior and two quarters following the FHTC eligibility period. Regressions include quadratic date time trend by income level.

Source: Author’s calculations based on American Housing Survey and HMDA data.

Previous owners provide a useful alternative control group for first-time homebuyers since they could not claim the first two iterations of the FHTC. However, a potential limitation of using buyer status is that previous owners received a negative wealth shock from falling house prices during the FHTC eligibility period which would not have effect first-time homebuyers who were previously renting. This wealth shock could induce a differential mobility response among previous owners. Table 5 results confirm the findings of Table 3, where first-time homebuyers purchased more homes during the FHTC than previous owners by 22.5 percent, relative to expectations, and that this difference was largest in the second iteration of the FHTC.

Combining the income level and buyer status treatment variation, Table 6 uses a triple difference estimation strategy to identify the FHTC effect. This strategy yields a positive, though smaller and statistically insignificant, effect of 6.2 percent. However, Table 6 similarly finds a much larger effect of the second FHTC relative to the first.

5.2. Intensive margin effects

Aside from measuring the extensive margin effects of the FHTC on homeownership, the FHTC could impact intensive margin choices such as home size, down payment, and mortgage default and prepayment. Policymakers would care about the loan outcomes because if the

Table 6
Diff-in-Diff-in-Diff FHTC Effects using Income Level and Buyer Status.

	(1)	(2)	(3)	(4)	(5)
FHTC X Low Income X FTHB	0.062 (0.139)	0.054 (0.139)	0.028 (0.136)	0.040 (0.172)	0.028 (0.158)
FHTC X FTHB	0.202** (0.098)	0.202** (0.098)	0.230** (0.096)	0.202* (0.121)	0.230** (0.112)
FHTC X Low Income	0.113 (0.098)	0.113 (0.098)	0.162* (0.096)	0.113 (0.121)	0.162 (0.112)
FHTC Eligibility Period	-0.023 (0.110)	-0.024 (0.110)	-0.163 (0.121)	-0.377*** (0.086)	-0.454*** (0.079)
Substitution Effect	0.019 (0.033)			-0.035 (0.040)	
FTHB X High Income	18.308*** (6.873)	18.308*** (6.860)	18.929*** (6.742)	18.308** (8.490)	18.929** (7.823)
Non-FTHB X Low Income	20.999*** (6.873)	20.999*** (6.860)	22.356*** (6.742)	20.999** (8.490)	22.356*** (7.823)
FTHB X Low Income	27.813*** (6.879)	27.979*** (6.860)	29.795*** (6.742)	28.279*** (8.497)	29.795*** (7.823)
FHTC X LowInc X FTHB First	-0.075 (0.160)	-0.082 (0.159)	-0.108 (0.156)	-0.094 (0.198)	-0.108 (0.182)
FHTC X LowInc X FTHB Second	0.164	0.155	0.129	0.140	0.129
Controls	x	x	x		
No Adjacent Periods			x		x
Observations	192	192	180	192	180

* p < 0.10, ** p < 0.05, *** p < 0.010.

Note: Table reports income and buyer status diff-in-diff-in-diff estimates of FHTC effect on the log number of seasonally-adjusted first-time homebuyers. Low-income is a dummy variable equal to one if annual household income under \$85,000. Sample period is 2001q1-2012q4 and FHTC eligibility period is 2008q2 through 2009q4. FTHB is a dummy variable equal to one for first-time homebuyers. Top level reports combined FHTC effect. Bottom level reports separate FHTC effects by iteration. No Adjacent Periods indicator excludes the quarter prior and two quarters following the FHTC eligibility period. Regressions include quadratic date time trend by income level and FTHB status.

Source: Author’s calculations based on American Housing Survey and HMDA data.

marginal household induced into homeownership is less financially prepared to manage homeownership costs, they could be more likely to enter foreclosure. Foreclosures are costly to local governments, banks, and residential neighbors. Similarly, the benefit of the induced homeowners is limited if they prepay their quickly prepay their mortgage and transition back to renting.

Using AHS data, Figs. 7 and 8 display the log of average home price and down payment size by homebuyer status over time in relation to the FHTC. On average, first-time homebuyers did not buy more expensive houses during the FHTC eligibility period than the year before or after the tax credit, nor did the difference in purchase price between previous owners and first-time homebuyers differ from its time trend. Similarly, Fig. 8 shows first-time homebuyers were not more likely to put more money down on their home purchase during the tax credit. In fact, putting down five percent or less is more common during the eligibility period than after. This indicates the households did not affect intensive margin housing decisions but instead resulted either increased non-housing consumption or savings.

An important aspect in calculating FHTC welfare effects is to consider the outcomes of FHTC-induced first-time homebuyers. A concern is that induced homeowners are less financially prepared for homeownership, perhaps through higher income volatility or lower creditworthiness, and in turn would default more often on their mortgages. Mortgage default leads to a costly foreclosure process for households, lenders, and local governments. Since the FHTC only requires households remain homeowners for three years to claim the full value of the credit, we might also expect claimants to prepay their mortgage and exit homeownership soon after three years, limiting the benefits to increased homeownership.

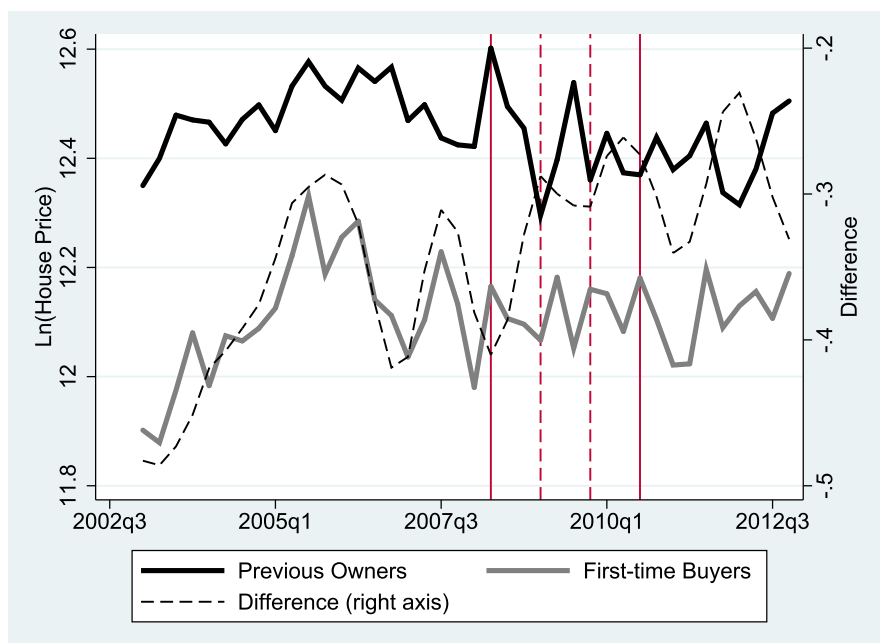
To test whether the FHTC claimants had differential prepayment or default outcomes, I run a competing risk proportional hazard model

on mortgage performance comparing first-time homebuyers to previous owners during the FHTC to before and after the FHTC using the following equation:

$$\lambda^r(t | \mathbb{X}) = \exp\{\lambda_0^r(t) + \beta_{1,r}Treat_r + \beta_{2,r}FTHB_r + \beta_{3,r}TreatxFTHB_r + \beta_{4,r}\mathbb{X}(t)\} \tag{3}$$

where λ^r represents the cause-specific hazard function (the probability of a mortgage observation termination at time t conditional on survival to time t), $\lambda_0^r(t)$ is the cause-specific baseline hazard risk for risk r , $Treat$ is an indicator variable equal to one during the FHTC eligibility period, and $FTHB$ is an indicator variable equal to one if the households is a first-time homebuyer, $\mathbb{X}(t)$ is a set of possibly time-varying covariates, and $r = D, P$ for default or prepayment. Competing risk proportional hazard models are commonly used to estimate the exercise of mortgage termination options. A more in-depth discussion of the modeling assumptions and interpretation can be found in Deng (1997), Deng et al. (2000), and Pennington-Cross and Ho (2010).

Data on mortgage performance comes from Freddie Mac and Fannie Mae, which each make publicly available a large random sample of mortgages originated since 1999. Combined this dataset consists of over 48 million mortgages with mortgage performance through the first quarter of 2017, however for computational feasibility the estimation is performed on a random sample of 100,000 mortgages originated between 2007 and 2012 for a total of 3,427,159 monthly-mortgage observations. Mortgages are observed monthly and indicate whether the mortgage has defaulted, prepaid, or is still current. I additionally include a full set of time-varying characteristics which have been shown to impact mortgage outcomes. These variables include the number of borrowers, second mortgage indicator, and local unemployment rate as well as 5-point splines in mark-to-market loan-to-value ratio, fico score, and debt-to-income ratio. Appendix Table A.1 provides summary statis-



Notes: This figure displays the log average new house price of recent movers, by buyer status and log difference between previous owners and first-time homebuyers house price. House prices are winsorized at the five percent level. Solid vertical lines represent FHTC start and end dates and dashed lines represent each iteration date.

Fig. 7. New home price, by buyer status.

Source: American Housing Survey

tics of these variables.¹⁵

To test whether FHTC claimants had differential mortgage outcomes, I run a difference-in-difference specification in Equation (3) using variation across buyer status, where the coefficient $\beta_{3,r}$ represents the FHTC effect for both $r=D, P$. Table 7 reports results of this difference-in-difference estimation, with Columns (1) and (2) reporting results from using the 90-days delinquency as the measure for default outcome variable and Columns (3) and (4) using loan prepayment as the mortgage outcome. Both with and without control variables, no specification finds a statistically significant relationship between first-time homebuyers and previous owners during the FHTC relative to non-eligibility periods, and the coefficient magnitude is small ranging between a 0.001 and 0.033 percent increase in the default and prepayment hazard rate. The similarity in mortgage outcomes of first-time homebuyers during the FHTC compared to non-eligibility periods means we can ignore changes to default and prepayment rates in our welfare calculation.

5.3. FHTC costs and benefits

Policy makers considering responses to housing busts must consider the cost effectiveness of their choices. I present two calculations of the “price of homeowners” paid by the government using the FHTC first from an accounting perspective and second from a deadweight-loss perspective. Nationally, I estimate the program induced 399,846 new first-time homebuyers. With around 3.3 million first-time homebuyers eligible to claim the credit, direct expenditures are roughly \$21.1 billion.¹⁶

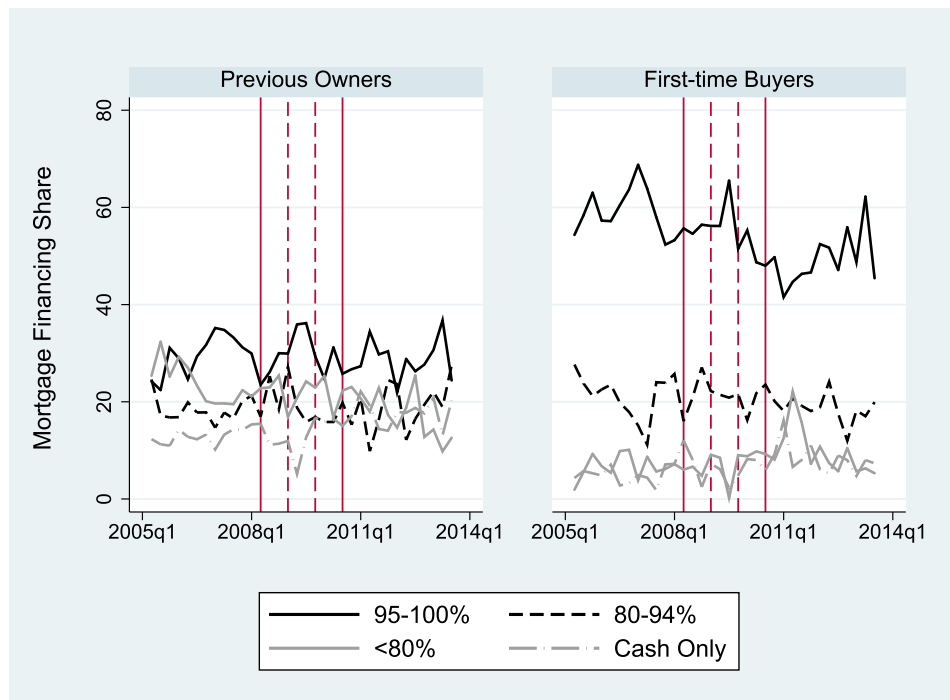
¹⁵ For splined variables, the loan-to-value ratio has cut points at 70, 80, 90, 100, and 120, debt-to-income at 20, 30, 40, and 50, and fico score at 600, 650, 700, 750, and 800.

¹⁶ Note that the first iteration of the tax credit is repayable over fifteen years. I discount claims during this iteration at a discount rate of 0.95. Consistent with the rest of the study, I exclude any effects or costs of the tax credit expansion to previous owners in the third FHTC iteration.

This translates into paying \$52,770 per new homeowner. A caveat to this price measure is that a majority of this price is a direct wealth transfer to first-time homebuyers but that it also ignores the inefficiencies subsidies generate.

The second price measure I consider is the deadweight loss or excess burden cost of the FHTC. A key consideration is that the FHTC is a housing subsidy in addition to existing homeownership subsidies from the federal income tax deduction of mortgage interest and state- and local-property taxes. Thus the FHTC deadweight loss is represented by the “Harberger trapezoid” Harberger (1964), which includes both the inefficiency from altering renters housing choice as well as the total subsidies utilized by the induced homeowners. To estimate of the deadweight loss from altering renters housing decisions, I use half the claimed tax credit value. The logic is as follows: assume all renters begin some $\$X$ distance from preferring to be homeowners. The tax credit induces those with an X less than \$8,000 to switch to homeownership. The deadweight loss is then the sum of $\$X$ across induced homeowners only. If we assume a uniform distribution across $\$X$ between \$0 and \$8,000 among induced homeowners, the deadweight loss is half the value of the claimed credit, totaling \$1.2 billion. We must add to this the expected subsidy from the mortgage interest and property tax deductions, which requires knowledge of itemization and marginal tax rates along with the difference in expected ownership tenure. As an approximation, I assume that half of induced first-time homebuyers itemize their deductions with a marginal income tax rate of 28% and an average increase in ownership tenure of five years.¹⁷ Given the average first-time homebuyer interest rate is 5.4 percent with an origination balance of \$157,000 in my sample, this yields an additional mortgage interest subsidy cost of \$2.3 billion and rises to \$3.3 billion with expected property tax deductions. Lastly, Ballard et al. (1985) finds the

¹⁷ I choose an expected ownership increase of five years from assuming twenty percent of the induced sample drops out each year as implied by the Substitution Effect estimate.



Notes: This figure displays new homebuyer mortgage downpayment size share, by homebuyer status and moving date. Based on American Housing Survey data using sample weights. Solid vertical lines represent FHTC start and end dates and dashed lines represent each iteration date.

Fig. 8. Size of mortgage downpayment by buyer status.
Source: American Housing Survey

Table 7
 FTHC effect on default and prepayment.

	(1)	(2)	(3)	(4)
FHTC X FTHB	0.020 (0.072)	0.033 (0.076)	0.019 (0.019)	0.001 (0.022)
FHTC Eligibility	-0.002 (0.053)	-0.124** (0.058)	0.362*** (0.013)	0.060*** (0.017)
FTHB	0.138*** (0.041)	-0.072 (0.044)	-0.269*** (0.012)	-0.033** (0.014)
Controls		x		x
Observations	3,427,159	3,231,339	3,427,159	3,231,339

* p < 0.10, ** p < 0.05, *** p < 0.010.

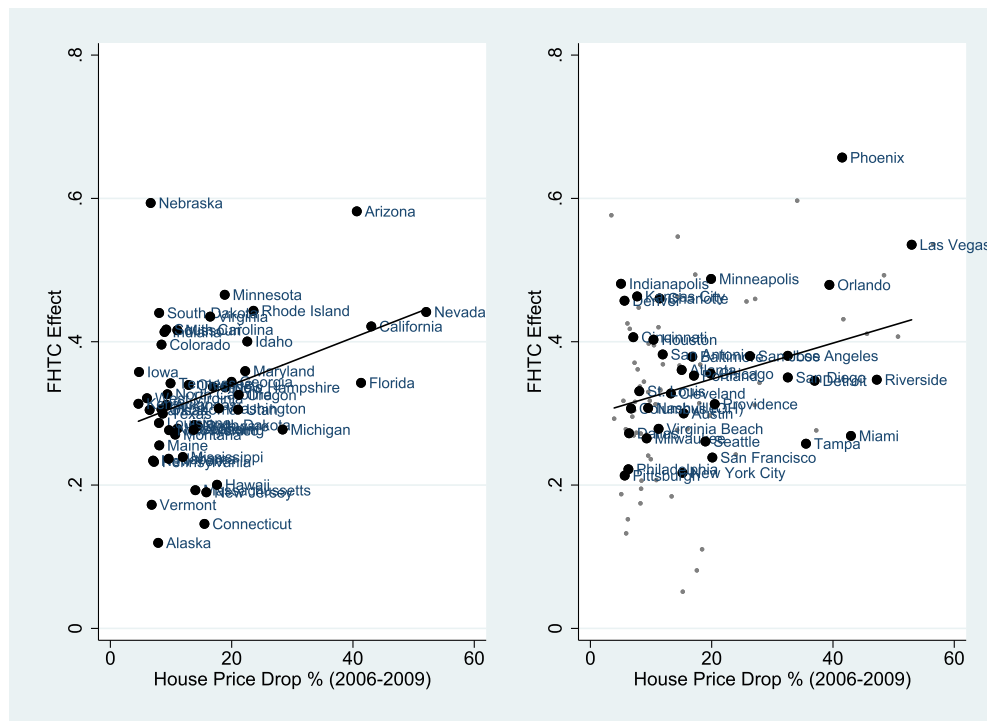
Note: This table presents estimates from estimating a competing hazard model of mortgage default and prepayment using mortgages originated between 2007 and 2012. Each specification includes quarter-by-homebuyer fixed effects. These effects are grouped by first-time homebuyer status (FTHB) and eligibility period (FHTC Eligibility period). The FHTC treatment effect (FTHB X FHTC Eligibility) reports the difference in first-time homebuyer outcomes relative to previous owner outcomes during the FHTC eligibility period relative to non-eligibility periods. For specifications using control variables, these include five-point splines in loan-to-value ratio, fico score, and debt-to-income ratio, mortgage interest rate, inflation rate, local unemployment rate, and indicators for a second mortgage and a single borrower.

Source: Fannie Mae and Freddie Mac loan-level mortgage performance data.

deadweight loss of raising tax revenue to be between seventeen and fifty-six cents on the dollar. I approximate this as thirty cents, meaning that raising \$21 billion costs \$6.3 billion. Altogether, the deadweight loss of the FHTC totals \$10.8 billion and translates to \$27,010 per new homeowner.

Two important policy questions arise from this result. The first is whether the FTHC benefits exceed its cost. Based on the homeownership externality value alone this seems unlikely. As found by Coulson et al. (2003), homeownership benefits to neighborhood home values are roughly \$1300 per year or \$6,500 over five years, which translates to

only about a quarter of the cost per induced homeowner. The number and financial benefit of prevented foreclosures from the FHTC is difficult to measure and would improve this cost-benefit ratio, however is unlikely to fully make up the difference given the relatively low cost of simply demolishing excess housing supply as opposed to using tax incentives to fill these homes. A recent evaluation of the Neighborhood Stabilization Program by Spader et al. (2015) finds that on average it costs local governments around \$11,000 to demolish vacant homes, much lower than the cost to induce a new homeowner. On a positive note though, the FHTC price per homeowner compares favorably to



Notes: This figure displays the estimated FHTC effect size against the peak-to-trough house price drop between 2006 and 2010 for each area. Effect size of the second iteration of the FHTC only. House price data comes from FHFA purchase-only house price index. Dark line is a linear fit of the data.

Fig. 9. FHTC effect size and house price drop 2006–2009.

the similar measure from the mortgage interest deduction. Hilber and Turner (2014) calculates the mortgage interest deduction pays \$28,397 per year per induced homeowner. This equals \$141,985 over five years which is considerably higher than the FHTC cost of \$27,010, indicating that a homebuyer tax credit would be more efficient mechanism to increase homeownership.

5.4. State and MSA FHTC effects

While I find the FHTC increased first-time homebuyers by 16.0 percent nationally, we are also interested in the geographic distribution of FHTC effects. For example, did areas hit harder by the housing crisis have larger responses to the tax credit period? What characteristics of local housing markets predict a higher response?

To answer these questions I use the combined Fannie, Freddie, and FHA mortgage originations aggregated to the state- and MSA-level by first-time homebuyer status between 2005q1 and 2012q4. To obtain the local FHTC effects I utilize variation by buyer status by estimating the following local-level equation:

$$Y_{jt} = \beta_0 + \beta_1 Treat_j + \lambda X_{jt} + \epsilon_{jt} \tag{4}$$

where j represents location, either state or MSA, and t represents the quarter of observation. $Treat$ is a dummy variable equal to one during the FHTC eligibility period and varies by location. Other control variables in X_{jt} include the mortgage interest rate, lagged change in house prices, rate spread, population by age category and geographic-specific quadratic time trends and ρ_j represents location fixed-effects. Y_{jt} is the difference in logged mortgage originations between first-time homebuyer and previous owners in location j for quarter t .

Estimates from Equation (4) can be found in Appendix Tables A.2 and A.3. Comparing the average FHTC effect by region, Midwestern states had the largest FHTC average effect at 37.5 percent while North-eastern states had the smallest average effect at 24.5 percent. A pri-

mary reason for the FHTC was to boost housing markets, particularly in areas hit hardest by the housing crash. Fig. 9 plots both state- and MSA-level FHTC effects against the peak-to-trough house price drop between 2006 and 2009. This figure shows a positive correlation between FHTC effect and housing crash size. This relationship is statistically significant in a univariate regression at both the state and local level, with a ten percentage point increase in house price drop being associated with a 3.3 and 2.5 percentage point increase in FHTC effect respectively.

Aside from distributional considerations, variation in FHTC effects across geographic locations related to housing market characteristics is interesting. For instance, the FHTC provided the lesser of \$8,000 or 10% of the home purchase price. Since only eighteen percent of homeownership live in houses valued at less than \$80,000, implies that most households claiming the credit received the full \$8,000.¹⁸ Home values differ greatly across local housing markets meaning that lower home value areas received a higher effective treatment than higher home value areas. Analyzing how households responded to this treatment variation provides a measure of the homeownership elasticity of demand and informs us as to how alternative FHTC benefit levels would fare. Similarly, one might expect areas with a larger renter population to have a larger FHTC response. Other housing market characteristics such as housing supply elasticity and regulatory environment may impact FHTC effects. Previous work by Hilber and Turner (2014) has shown that the mortgage interest deduction only impacts homeownership in less regulated areas.

Table 8 reports results from regressing FHTC effects on state and local housing market characteristics using the equation:

$$Y_i = \beta_0 + \beta_1 Ln(HomeVal)_i + \beta_2 X_i + \epsilon_i \tag{5}$$

¹⁸ Home value distribution data comes from the 2009 American Community Survey.

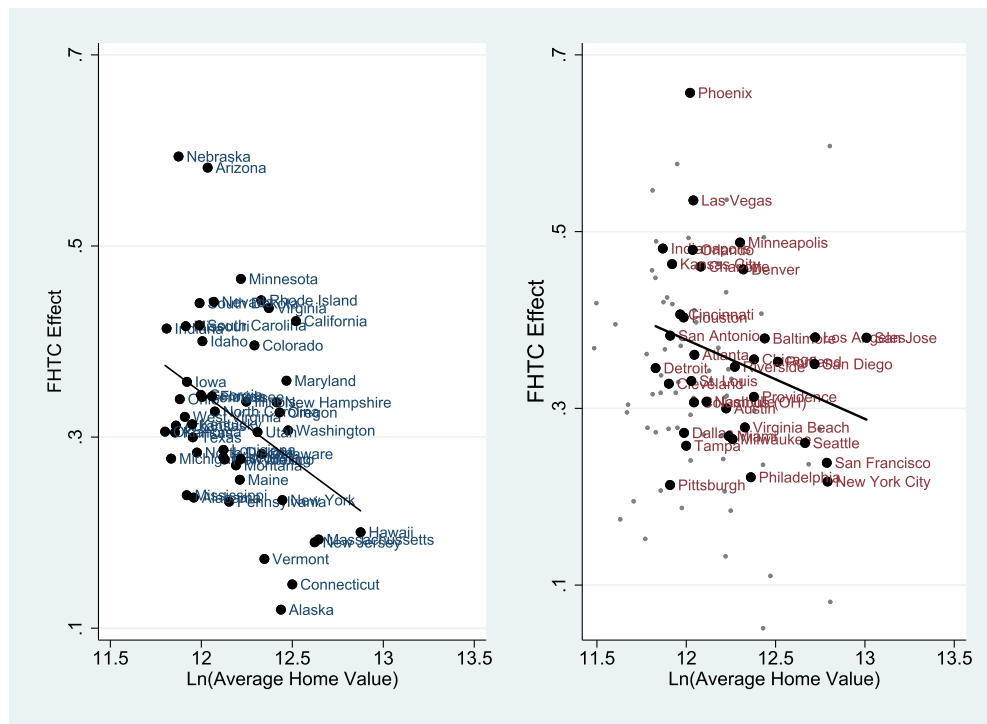
Table 8
State and MSA level regression of FHTC effects on housing market characteristics.

	(1)	(2)	(3)	(4)	(5)
Ln(Average Home Value)	-0.142*** (0.051)	-0.188*** (0.054)	-0.052 (0.036)	-0.094** (0.040)	-0.092* (0.053)
Rental Percentage		0.692** (0.328)		0.580** (0.275)	0.577** (0.280)
Housing Supply Elasticity					0.001 (0.017)
_cons	2.046*** (0.624)	2.450*** (0.633)	0.969** (0.432)	1.333*** (0.458)	1.304** (0.635)
Observations	50	50	102	102	102

* p < 0.10, ** p < 0.05, *** p < 0.010.

Note: This table presents regression results comparing local FHTC effects to housing market characteristics. FHTC effects estimated using difference-in-difference with buyer status between 2005q1 and 2012q4. Columns (1) and (2) use state-level variation and Columns (3)–(5) use MSA-level variation. Average home value represents average from 2009 mortgage originations in Fannie Mae and Freddie Mac public-use loan-level data.

Source: Author’s calculations based on Fannie Mae, Freddie Mac, and FHA data, Saiz (2008), 2009 American Community Survey.



Notes: This figure displays the estimated FHTC effect size against the log of the average home value by state and MSA. Effect size of the second iteration of the FHTC only. Average home values are average 2009 origination home values from Fannie Mae and Freddie Mac loan-level data. Dark line is a linear fit of the data.

Fig. 10. FHTC effect size and average home values.

where Y_i is the FHTC effect estimated in Equation (4) for location i , $\ln(\text{HomeVal})_i$ is the log of average home values in location i , and X_i includes other market characteristics including the renter percentage and housing supply elasticity of location i . Column (1) reports a statistically significant relationship between home values and FHTC effect size at the state level, with a doubling in home value being associated with a fourteen percent decrease in FHTC effect size. Column (2) adds the covariate state rental percentage, according to the 2009 American Community Survey. States with a ten percentage point larger share of renters experienced a 6.9 percentage point increase in FHTC effect and controlling for renter share increases the home value FHTC effect esti-

mate to nineteen percent. Columns (3) and (4) repeat this analysis at the MSA-level. These results similarly suggest a negative relationship between home value and FHTC effect size, although the magnitude is smaller than the state-level and statistically insignificant when renter share is not controlled for (see Fig. 10). Column (5) includes the measure of housing supply elasticity reported for selected MSAs by Saiz (2008). The supply elasticity coefficient is near zero and not statistically significant.

Measuring the effectiveness of the FHTC provides insight into a key housing policy parameter: the elasticity of homeownership demand. The homeownership elasticity is important for several reasons. First,

the efficiency of housing tax incentives as a policy response during a housing bust depends on the responsiveness of households to the size of the subsidy. A higher homeownership elasticity implies a cheaper policy intervention or cost of inducing homeownership. Alternatively, an inelastic homeownership demand curve implies homeownership tax credits could be an efficient source of wealth redistribution through tax credits. The empirical strategy of this paper allows for two measures of the homeownership elasticity of demand, first at the national level and second at the local level. The homeownership elasticity of demand, ϵ_D^{HO} is defined as:

$$\epsilon_D^{HO} = \frac{\% \Delta HO}{\% \Delta P^{own}} \quad (6)$$

That is, the percentage change in homeownership, HO , in response to a percentage change in the price of homeownership, P^{own} . While regression results provide estimates of $\% \Delta HO$, I must make some simplifying assumptions to calculate $\% \Delta P^{own}$, since as discussed earlier, the price of homeownership is approximated by the user cost of housing plus transaction costs. To approximate the percentage change in the price of homeownership at the national level I divide the FHTC amount, \$8,000, by the user cost of living in the average home value for three years (the minimum time required to receive the full tax credit value) plus the expected transaction cost of a six percent realtor fee. This approximates the change in homeownership cost to be 15.2 percent. Combined with our change in homeownership demand of 16.0 percent, this estimates ϵ_D^{HO} to be relatively elastic at 1.26. My second measure of the homeownership elasticity utilization variation across locations in $\% \Delta P^{own}$ stemming from differences in home values. We can rearrange Equation (6) to give $(\epsilon_D^{HO}) * (\% \Delta P^{own}) = \% \Delta HO$, thus regressing $\% \Delta P^{own}$ on the FHTC effect yields an estimate of the homeownership elasticity. Running this regression at the state level produces a homeownership elasticity estimate of 0.7. While lower than the national elasticity estimate, cross-state variation indicates a strong demand response to the FHTC. Using cross-MSA variation, the same regression yields a much lower elasticity measure of 0.11. The evidence of a significant homeownership elasticity in response to the FHTC using both an average national effect and using cross-location variation in the price subsidy bolsters the argument set by Green and Vandell (1999) that a homeownership tax credit is a more efficient homeownership subsidy than the mortgage interest deduction.

6. Conclusion

This paper investigated the effects of the First-time Homebuyer Tax Credit. At a national level, I find the tax credit increased first-time homebuyers by 16.0 percent for a total of 399,846 households induced into homeownership between April 2008 and September 2010. With total program expenditures of \$21.1 billion, I approximate the deadweight loss of raising that revenue combined with altering households decisions and additional homeownership subsidies to be \$10.8 billion which translates into paying \$27,010 per induced homeowner.

Considering whether \$27,010 is a reasonable price to pay for homeowners is an open question, however this cost compares unfavorably to the expected homeownership externality benefits or to an alternative of demolishing vacant housing. This paper begins to answer the FHTC welfare analysis by measuring the extensive and intensive margin housing responses and examining first-time homebuyers loan performance. Quantifying the macroeconomic effects

remains an important though difficult, next step in FHTC evaluation.

Additional analysis provides no evidence that first-time homebuyers receiving the tax credit were more likely to default or prepay their mortgage, bought bigger houses or put more money in the down payment relative to before or after the tax credit. These households were younger on average and cited “Changing Tenure Status” more frequently as the primary reason for moving. State- and MSA-level analysis find the tax credit was more effective in areas with lower housing values and with more renters, while land use regulation and house supply elasticity were not predictors of effect size after accounting for home value.

The FHTC has also lent insight into the decision homeowners face between purchasing or renting their home. The own or rent housing decision is a research area in need of further exploration as the US homeownership rate has receded to its lowest rate since 1995. The differential cost between owning and renting housing can be difficult to measure and certainly heterogeneous by expected tenure and creditworthiness. A deeper look at the FHTC considering credit history, expected tenure duration, income trajectory and uncertainty could provide a better understanding and estimation of the homeownership cost.

For policy relevance, the mortgage interest deduction remains a hot political issue and one of the largest US tax breaks now costing \$83 billion in 2017. An important point to consider is that if \$52,770 per homeowners is too high a price, remember that this number cuts both ways. That is, the federal government could receive a similarly high price for “selling” homeowners by reducing or eliminating the mortgage interest deduction or other homeownership incentives. Moreover, if we wish to keep homeownership incentives in place, this research suggests that replacing the mortgage interest deduction with a permanent first-time homebuyer tax credit would be more cost-effective and have increased redistributive properties.

While the housing bust of the Great Recession was the largest the nation had seen in eighty years, regional housing busts occur on a much more frequent basis. Often times, these regional housing busts can devastate local economies and local leaders have little evidence of effective policy remedies. From a policy perspective, the Great Recession provided a treasure trove of potential new weapons that governments can utilize to combat housing busts. While disentangling FHTC effects from other housing programs during the same period is difficult, this paper has found evidence of the household response to the program and quantified the costs associated with it. While additional FHTC benefits, such as its stimulus effects on consumer spending, not considered here could also be important, future policymakers have better evidence now the value the FHTC provides.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.regsciurbeco.2018.10.002>.

A. Appendix

Table A.1
Summary statistics for competing hazard model.

	(1) mean/sd
Default	0.036 (0.19)
Prepayment	0.48 (0.50)
Mark-to-Market LTV	76.8 (16.7)
Debt-to-Income Ratio	34.9 (10.9)
FICO Score	752.3 (46.9)
Interest Rate	5.14 (0.99)
Inflation Rate	1.79 (0.70)
National Mortgage Rate	4.55 (0.65)
Unemployment Rate	7.73 (1.98)
Number of Borrowers	1.48 (0.51)
Second Mortgage Indicator	1.25 (4.75)
Observations	100,000

Notes: Mortgage originations between 2007 and 2012. Outcomes as of September 2015.

Sources: Freddie Mac and Fannie Mae loan-level data.

Table A.2
State-level FHTC effects.

State	FHTC Effect	StdErr
Nebraska	.5936	.0882
Arizona	.5819	.0882
Minnesota	.4655	.0882
Rhode Island	.4431	.0882
Nevada	.4415	.0883
South Dakota	.4401	.0882
Virginia	.4350	.0882
California	.4213	.0882
South Carolina	.4170	.0882
Missouri	.4161	.0882
Indiana	.4135	.0882
Idaho	.4003	.0883
Colorado	.3959	.0882
Maryland	.3589	.0883
Iowa	.3578	.0882
Georgia	.3440	.0883
Florida	.3426	.0883
Tennessee	.3419	.0882
Ohio	.3396	.0882
Illinois	.3371	.0882
New Hampshire	.3363	.0882
North Carolina	.3267	.0882
Oregon	.3258	.0883
West Virginia	.3211	.0883
Kentucky	.3134	.0882
Arkansas	.3120	.0882
Washington	.3069	.0883
Oklahoma	.3056	.0882
Utah	.3052	.0884
Kansas	.3048	.0882
Texas	.2997	.0882
Louisiana	.2866	.0882
North Dakota	.2837	.0883
Delaware	.2824	.0882

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Table A.2 (continued)

State	FHTC Effect	StdErr
Wisconsin	.2787	.0882
Michigan	.2774	.0882
Wyoming	.2769	.0884
New Mexico	.2766	.0883
Montana	.2704	.0882
Maine	.2553	.0882
Mississippi	.2391	.0882
Alabama	.2366	.0634
New York	.2340	.0882
Pennsylvania	.2323	.0882
Hawaii	.2004	.0882
Massachusetts	.1928	.0882
New Jersey	.1898	.0882
Vermont	.1724	.0882
Connecticut	.1458	.0882
Alaska	.1193	.0893

Sources: Author's estimates based on data from Freddie Mac, Fannie Mae, and Federal Housing Administration.

Table A.3
MSA-level FHTC effects.

State	FHTC Effect	StdErr
Phoenix	.6570	.2440
Oxnard	.5968	.2505
Omaha	.5765	.2440
Toledo	.5467	.2528
Stockton	.5360	.2512
Las Vegas	.5353	.2440
Nashua	.4936	.2440
Madera	.4928	.2515
Anderson	.4890	.2456
Minneapolis	.4876	.2440
Indianapolis	.4808	.2578
Orlando	.4793	.2536
Kansas City	.4632	.2440
Charleston	.4632	.2545
Charlotte	.4604	.2440
Tucson	.4597	.2440
Denver	.4572	.2440
Monroe	.4561	.2569
Spartanburg (SC)	.4476	.2553
Fresno	.4314	.2506
Burlington, NC	.4255	.2440
Akron	.4202	.2557
Anderson, IN	.4191	.2503
Little Rock	.4179	.2440
Bakersfield	.4110	.2512
Vallejo	.4071	.2474
Cincinnati	.4063	.2562
Houston	.4028	.2481
Knoxville	.3974	.2440
Springfield, OH	.3951	.2563
San Antonio	.3822	.2495
Los Angeles	.3803	.2466
San Jose	.3799	.2513
Baltimore	.3791	.2440
Columbia	.3706	.2528
Baton Rouge	.3685	.2440
Muskegon	.3681	.2496
El Paso	.3668	.2488
Dayton	.3614	.2508
Atlanta	.3606	.2440
Chicago	.3554	.2490
Portland	.3526	.2440
San Diego	.3501	.2488
Riverside	.3470	.2527
Detroit	.3455	.2583
Springfield (MA)	.3442	.2601
Hagerstown	.3427	.2440
Tulsa	.3374	.2440

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Table A.3 (continued)

State	FHTC Effect	StdErr
Richmond	.3333	.2586
Albuquerque	.3319	.2440
St. Louis	.3310	.2709
Memphis	.3298	.2440
Cleveland	.3278	.2556
Greenville	.3176	.2584
Rochester (NY)	.3175	.2562
Oklahoma City	.3160	.2440
Ogden	.3142	.2440
Providence	.3130	.2630
Raleigh	.3127	.2440
Jacksonville	.3117	.2611
Nashville	.3075	.2440
Columbus (OH)	.3068	.2557
Birmingham	.3046	.2440
Hidalgo	.3041	.2466
Austin	.2999	.2440
Salt Lake City	.2971	.2440
Fort Wayne (IN)	.2954	.2512
Louisville	.2926	.2582
Virginia Beach	.2785	.2440
Grand Rapids	.2780	.2534
Greensboro	.2780	.2440
Mobile	.2768	.2440
Napa	.2763	.2446
Buffalo	.2730	.2598
Dallas	.2722	.2440
Durham	.2719	.2440
Harrisburg	.2704	.2504
Colorado Springs	.2692	.2440
Miami	.2685	.2495
Milwaukee	.2651	.2440
Seattle	.2608	.2440
Tampa	.2577	.2604
Ann Arbor	.2427	.2492
Lebanon, PA	.2410	.2467
San Francisco	.2384	.2488
Boston	.2368	.2480
Hartford	.2361	.2440
Philadelphia	.2220	.2443
New York City	.2171	.2579
Holland	.2164	.2564
Pittsburgh	.2132	.2470
Scranton	.2069	.2470
New Orleans	.2061	.2440
Wichita	.1948	.2440
Winston-Salem	.1873	.2440
Allentown	.1842	.2440
Youngstown	.1745	.2699
Syracuse	.1523	.2616
Albany	.1326	.2541
Worcester (MA)	.1104	.2557
Bridgeport (CT)	.0809	.2440
New Haven	.0512	.2440

Sources: Author's estimates based on data from Freddie Mac, Fannie Mae, and Federal Housing Administration.

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