The Marginal Effect of Lowering Government Mortgage Guarantees on Home Ownership

Serafin Grundl and You Suk Kim*

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March 15, 2018

Abstract

The U.S. federal government guarantees a majority of mortgages through the Government Sponsored Enterprises (GSEs). Although the government's involvement in the mortgage market is controversial, it is often justified as a means to promote home ownership. However, very little is known about the actual effects of government mortgage guarantees on home ownership. In this paper we estimate the effect of lowering government mortgage guarantees on home ownership by using a difference-in-differences design, with detailed property-level data, that exploits regional changes in the conforming loan limit (CLL), the maximum loan size that can be guaranteed by the GSEs. We find that although the CLL affects how house purchases are financed considerably, their effects on the home ownership rate are fairly small. Our preliminary estimates suggest that lowering GSE guarantees by $78 billion annually would lower the home ownership rate by 1 percentage point. Our finding is particularly relevant for several recent housing finance reform plans that propose to gradually lower the government's involvement in the mortgage market by reducing the CLL.

JEL Code: R38, R31

*Federal Reserve Board of Governors, serafin.j.grundl@frb.gov, you.kim@frb.gov. We are grateful to Scott Frame and Felipe Severino for helpful discussions. We also thank seminar participants at the Federal Reserve Board, as well as participants at the FRB Atlanta and Georgia State University Real Estate Finance Conference for helpful comments. The analysis and conclusions set forth are those of the authors and do not indicate concurrence by other members of the staff, by the Board of Governors, or by the Federal Reserve System.

1 Introduction

A majority of residential mortgages in the U.S. are guaranteed or insured by the government through the Government Sponsored Enterprises (GSEs), Freddie Mac and Fannie Mae. The large presence of the government in mortgage financing is controversial because it exposes taxpayers to the risks of the mortgage market and potentially leads to misallocation of capital. Indeed, the two GSEs went into conservatorship during the financial crisis in 2008 and received $187 billion from taxpayers.

The government's involvement in mortgage financing is often justified with the goal of making mortgage credit more available and thereby promoting home ownership. For example, Freddie Mac advertises on their website that it makes "home ownership and renting more accessible and affordable".[1] However, very little is known about whether and how much the government mortgage guarantees increases home ownership. Indeed, in the years after the financial crisis the government's involvement in mortgage financing increased, while the home ownership rate declined from 69% in 2006 to 64% in 2017.

After the financial crisis, several proposals were made to reduce the role of the government in mortgage financing. Several of the reform plans, including the Housing Finance Reform and Taxpayer Protection Act[2] and the plan by the American Enterprise Institute (Wallison et al., 2018), propose to reduce the government's role gradually, by lowering the "Conforming Loan Limits" (CLLs). The CLLs are the upper limits of loan sizes that can be guaranteed by the GSEs and therefore determine the extend of the government's involvement. In light of these reform proposals, estimating the effect of a change in the CLLs on the home ownership rate is therefore highly relevant for the the ongoing policy debate.

In this paper we estimate the marginal effect of changing the CLLs on home ownership by exploiting regional changes in the CLLs: The 2008 Economic Stimulus Act (ESA) temporarily increased the CLLs for counties with high median house prices but remained constant elsewhere. Using these regional changes in the CLLs, we implement a difference-in-differences approach to estimate the effects on home ownership.

Although an increase in the CLLs makes it possible for more loans to be guaranteed by the government, the effects on the home ownership rate are unclear. On the one hand, a typical loan guaranteed by the government favors owner-occupant buyers. For example, loans sold to the GSEs typically have lower interest rates for owner-occupant borrowers. Thus, an increase in loans guaranteed by the government might result in an increase in home buying by owner occupants.

On the other hand, there are at least two plausible reasons why the effect of a CLL increase on

[1] http://www.freddiemac.com/about/. See also http://www.fanniemae.com/portal/about-fm/homeownership.html.

[2] For the complete text of the bill see https://www.corker.senate.gov/public/_cache/files/1bc94e87-5a8a-4f07-a709-30bb19f15873/06-25-13%20BILL%20TEXT.%20Housing%20Finance%20Reform%20&%20Taxpayer%20Protection%20Act%20.pdf

home ownership is unclear. First, repeat buyers might be better situated to take advantage of higher CLLs than first-time buyers: For example first-time buyers may not be able to take advantage of higher CLLs because taking out a larger loan might move their loan-to-value ratio (LTV) or their debt-to-income ratio (DTI) outside of the underwriting standards required by the GSEs. For repeat buyers, however, these constraints may be less likely to be binding because they tend to have higher down-payments and incomes. Second, the effect of the increase in CLLs on home ownership is not only determined by the effect on potential buyers, but also by the effect on potential sellers. If the CLL increase leads to lots of sales by owner-occupants rather than by investors who don't reside in the house they own, the CLL increase might have very limited effects on home ownership or even be negative.

For our empirical analysis, we use the CoreLogic real estate database, which provides information about characteristics of houses and their transactions at the individual property level. This database is particularly suitable for studying home ownership because we are able to track whether a house is owner-occupied over time and whether the owner-occupancy status changed as a result of a property transaction. This feature of the data allows us to measure home ownership at the house level: whether a house is owner-occupied or not. This is an important advantage compared to mortgage data sets for example. Such data sets sometimes record whether the buyer is a first time home buyer, but there is no information about the owner-occupancy status of the seller. Lastly, among houses that were sold we observe not only transactions that were financed with a mortgage but also cash purchases, which could also lead to a change in owner occupancy status. Lastly, the database allows us to control for differential trends for houses with different characteristics, which may be a potential threat to identification with a difference-in-differences approach.

A crucial question for our empirical strategy is "What is the right control group?". The CLLs were increased in counties with high median house prices and remained unchanged in counties with lower median house prices. This raises the concern that we might "pick up" changes in the high price segment of the housing market that were unrelated to the increase in the CLLs.

To overcome this problem, our difference-in-differences approach compares houses in counties where the CLL was raised ("high-cost" counties) to houses with similar values in counties whose CLLs remained unchanged ("non-high-cost" counties). We measure the treatment intensity at the house level by calculating how much the CLL change would increase the fraction of the house value that can be financed with a conforming loan: For example, for houses that have a low value and therefore could be financed with a conforming loan even prior to the CLL increase, the treatment intensity is zero. Houses such that the largest conforming loan prior to the CLL increase would only have covered 80 percent of the assessed house value, but 100 percent after the CLL increase, have treatment intensity of 20 percentage points. In our estimation sample, we only use houses in high-cost counties with positive treatment intensity, and the control group consists of

houses in non-high-cost counties that would have positive treatment intensity if they were in high cost counties.

Our preliminary findings are as follows. Unsurprisingly, we find that the changes in CLLs increased the total amount of mortgages guaranteed by the government. Specifically, we find that the share of loans between the old and new CLLs among treated houses increased by up to 12 percentage points, relative to the trend of controlled houses. These results show that the increase in CLLs had considerable effects on how house purchases are financed.

Then we investigate the effects of the CLL increase on home ownership. We find that the effects on home ownership is marginally statistically significant and that the economic magnitude of the effects is fairly small. The CLL increase increased home ownership rates among treated houses by 0.14 percentage points over the twelve months after the ESA became effective. At the same time, we estimate the additional amount of mortgage guarantees extended by the GSEs amounted to $11 billion over the same time period. Extrapolating this relationship to larger numbers, our finding implies that it takes additional mortgage guarantees of about $78 billion annually–18% of the aggregate mortgage guarantees extended by the GSEs for the twelve months before the ESA–to increase the home ownership rate by 1 percentage point. We view this as a substantial increase in the GSEs' exposure for a relatively small increase in the home ownership rate.

An important caveat to our empirical strategy using the regional CLL changes for high-cost counties is that we cannot determine the overall effect of the GSEs on home ownership. Importantly, as the changes are regional, we cannot study macroeconomic effects that would be present if the CLLs would be changed in the entire country. Moreover, the changes we observe only affect relatively large mortgages (>$417,000) directly. Therefore our results do not rule out the possibility that a large decrease in the CLLs, which would affect other segments of the housing market, would lead to a sizable reduction in home ownership.

Despite these caveats, our results speak to the important question of what would happen to home ownership if the government would start to phase out the GSEs gradually by lowering the CLLs. Moreover, the CLL changes we observe increased the government's exposure substantially because loans that are newly eligible for guarantees by the GSEs are much larger relative to traditional conforming loans. Indeed, up to 20 percent of the mortgage dollars that had government guarantees would not have been eligible for this guarantee prior to the CLL increase in the years after the ESA.

Overall, our estimates suggest that the households benefiting from high CLLs are only in rare cases marginal home owners, and that by lowering the CLLs the government's role would be more focused on smaller loans that are taken out by low and moderate income households, which are more likely to be marginal home owners. Lowering the CLLs would affect only a relatively small fraction of government backed loans, but because these loans are large, it would reduce the GSEs'

exposure in dollar terms substantially.

Literature This paper is related to several strands of the literature. First, this paper is related to papers that study the effects of government mortgage guarantees on the mortgage market. A large body of work studied how GSE-eligibility affected mortgage interest rates by comparing jumbo and conforming rates. Early work includes Passmore et al. (2005) and Sherlund (2008). More recently, Kaufman (2014) used a regression discontinuity design around the CLL to estimate the effect of GSE-eligibility on mortgage characteristics such as interest rates. In addition, Fuster and Vickery (2015) study the effects of securitization on the prevalence of fixed-rate mortgages, exploiting the fact that it is more difficult to securitize a jumbo mortgage above the CLL. To our knowledge, however, there is no existing work that studies the effects of government guarantees on home ownership, which is one of the primary justifications for the government's involvement in mortgage financing.

Second, this paper is also related to the literature that studies the determinants and consequences of home ownership. There are several papers that study the effect of the mortgage interest tax deduction on home ownership, including Poterba (1984), Glaeser and Shapiro (2003), Hilber and Turner (2014), and Sommer and Sullivan (forthcoming). However, there are relatively few papers that study the effect of credit market conditions on home ownership. Fetter (2013) uses the mid-century GI-bills to study the effect of mortgage subsidies on home ownership among veterans. Acolin et al. (2016) and Fuster and Zafar (2016) study the role of borrowing constraints on home ownership using survey data. This paper contributes to this literature by studying the effects of credit availability resulting from changes in government guarantees on home ownership.

A high home ownership rate is often considered desirable due to the potential positive externalities of home ownership. DiPasquale and Glaeser (1999) find some evidence that home owners are "better citizens". Amior and Halket (2014) study the insurance role of home ownership. Home ownership can however also have detrimental effects on the labor market as studied by Blanchflower and Oswald (2013) and Laamanen (2017).

Third, another related body of work is the literature that studies the effects of credit conditions on the housing market more generally. There are many papers that study the effects of interest rates on various market outcomes: mortgage size (DeFusco and Paciorek (2017)), housing market dynamics (Anenberg and Kung 2017), and home buying (Bhutta et al. 2017). Moreover, Adelino et al. (2012) and Kung (2014) study the effects of credit availability on house prices, exploiting an increase in CLLs at different times, and Anenberg et al. (2016) study the effects of credit availability on construction as well as house prices using a different identification approach.

Lastly, this paper is also related to work in macroeconomics that studies the effects of the GSEs on the broader economy and financial system. Jeske et al. (2013) and Gete and Zecchetto (2017)

study the distributional impacts of the government mortgage guarantees in the economy. Elenev et al. (2016) study the effects of phasing out the GSEs on the mortgage, housing and financial markets, allowing for rich interactions between the markets.

The rest of the paper is organized as follows. In Section 2, we present the background on the GSEs, the FHA and the policy change we use for our main analysis. In Section 3, we discuss the data. In Section 4, we discuss our empirical strategy. In Section 5.1 and 5.2, we present the results on home ownership. In Section 6, we conclude.

2 Conforming Loan Limits and Empirical Strategy

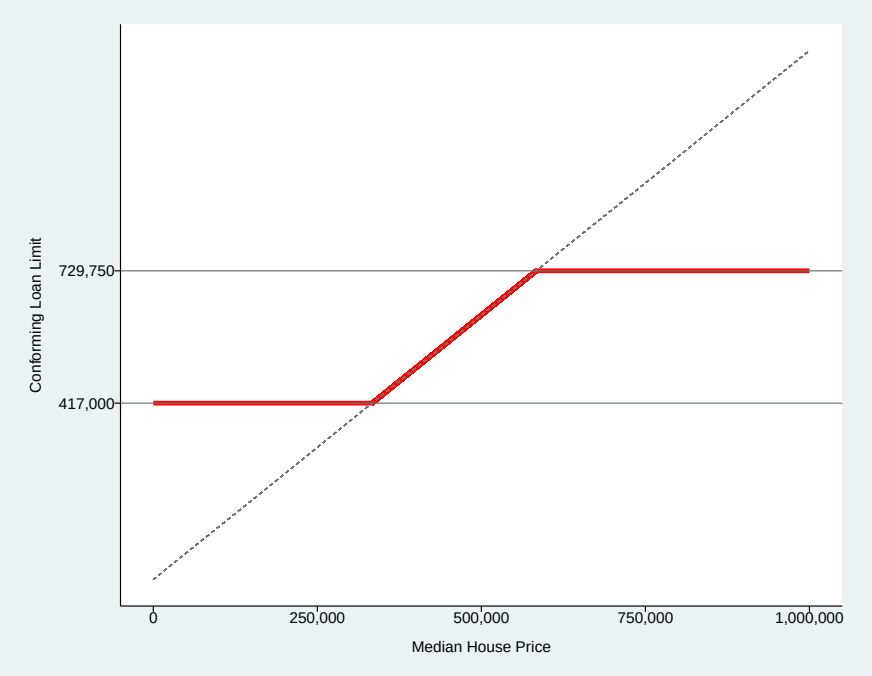
2.1 Changes in Conforming Loan Limits

The GSEs can only purchase mortgage loans below a certain limit for the mortgage principal, called the conforming loan limit (CLL). Loans that are above this limit are called jumbo loans and either have to stay on the balance sheets of the lender or have to be privately securitized. The CLL therefore limits the government's involvement in the financing of mortgages to loans smaller than the limit.

Before March 2008, the conforming loan limit was set at the same level across the nation except for Alaska, Guam, Hawaii, and the U.S. Virgin Islands. The national limit can change each year depending on the national house price level. In fact, the national limit gradually increased over time, and the 2008 national limit was initially set at $417,000. As the housing market started to collapse, however, the U.S. Congress passed multiple legislations that increased conforming loan limits for regions with high house prices.

The Economic Stimulus Act (ESA), which was passed in February 2008, increased the CLL temporarily for loans originated in the period from March to December 2008. Under the ESA, a county's CLL was set at the higher of 125 percent of a county's median house price and $417,000 with a cap of $729,750 as graphically shown in Figure 1. The increase in CLLs made it possible for the GSEs to purchase a loan larger than the pre-ESA national CLL ($417,000), commonly referred to as a "jumbo-conforming" loan, as long as the loan is not larger than the post-ESA county-level CLL.

Figure 1: **Conforming Loan Limit Formula under the Economic Stimulus Act.** This figure describes how the CLL is determined under the ESA. The horizontal line at $417,000 denotes the national CLL before the ESA, and the horizontal line at $729,750 denotes the maximum CLL under the CLL. The red line denotes the CLL depending on a county's median house price under the ESA.



The formula under the ESA increased CLLs for counties whose higher median house prices were greater than $333,600, and we will refer to these counties as "high-cost" counties for the rest of this paper. Figure 2 shows the geographical distribution of median house prices in 2008. It is clear that houses in coastal areas tend to more expensive. The map of treated counties shown in Figure 3 shows that counties, whose CLLs increased, are those with higher median house prices in Figure 2.

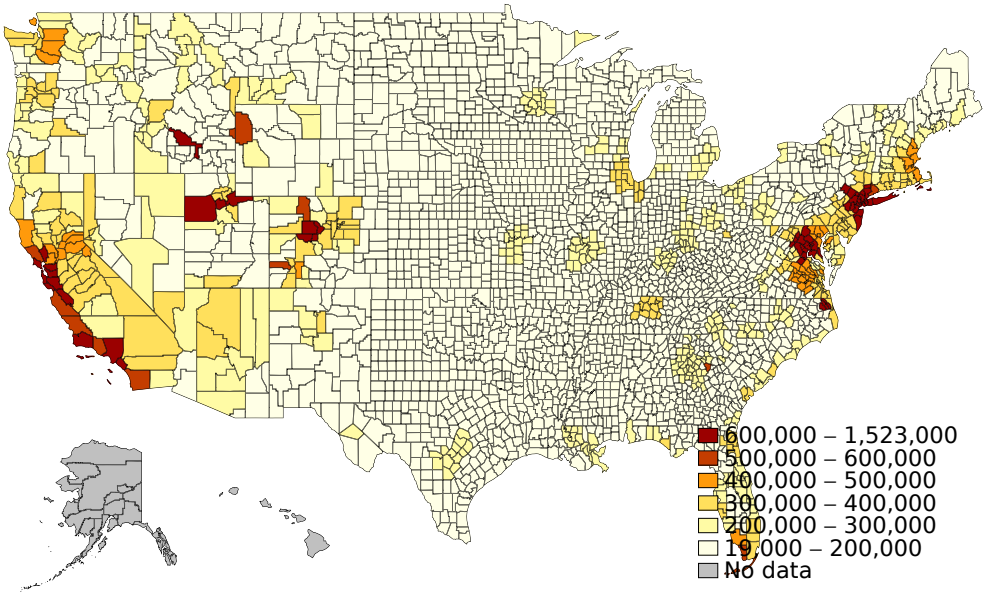


Figure 2: **County-level Median House Prices.** This figure shows county-level median house prices based on data from Zillow.com for 2006. Counties highlighted in darker red have higher median house prices. "No Data" refers to counties for which Zillow does not have county-level median house prices.

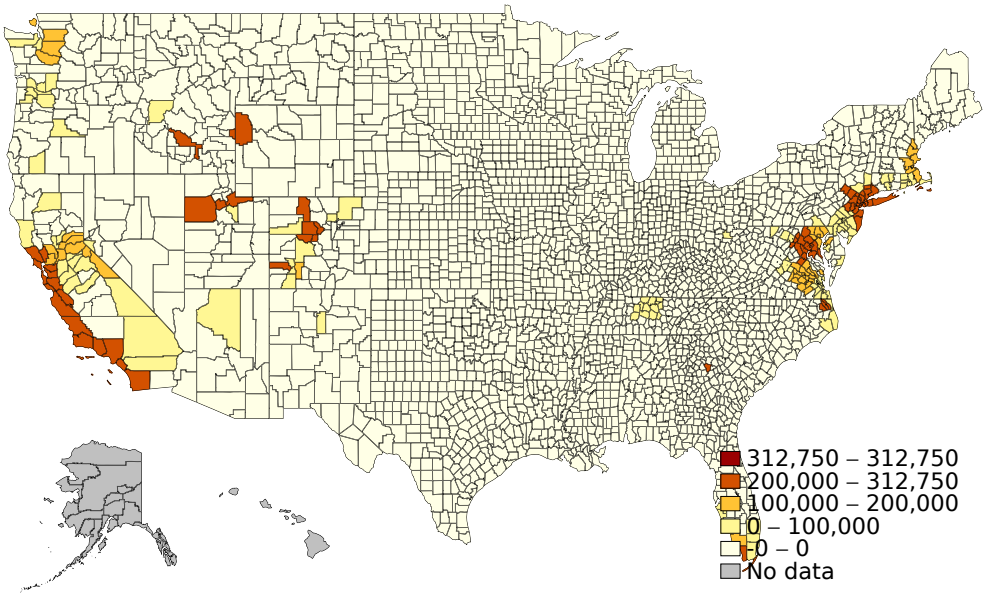


Figure 3: **High-cost Counties.** Counties in white did not experience an increase in the conforming loan limit, whereas red counties did.

As mentioned earlier, the ESA originally increased the CLL for high-cost counties until the end of 2008. However, Congress passed subsequent legislations that kept the CLL higher than

the national limit even after 2008. In October 2008, the Housing and Economic Recovery Act (HERA) was passed. The HERA permanently increased the CLL to the higher of 115 percent of a county's median house price and $417,000 with a cap of $625,500. Once the ESA expired, the new CLL under the HERA was planned to become effective. In February 2009, however, the American Recovery and Reinvestment Act (ARRA) was passed, which set the CLL at the higher of the limit under the ESA and that under the HERA. Because the former is at least as high as the latter for every county, the ARRA effectively increased the CLL back to the level set by the ESA. This higher limit was effective until the end of October 2011, and then the CLL decreased to the level set by the HERA in November 2011.

In this paper, the main variation we exploit for our empirical analysis is the change in the CLL under the ESA in March 2008. Thus, we track the housing market for the time period from March 2007 to February 2009 – twelve months before and after when the increase in the CLL under the ESA became effective. Although the CLL decreased slightly temporarily in 2009 before the ARRA passed, we do not exploit this temporary decrease for our analysis because the lower CLLs were effective only for the last two months of the sample period. We discuss my empirical strategy in details in Section 2.2.

A potential concern about using this variation induced by the ESA is that it affected only a small segment of a housing market. Thus, one might be concerned that findings from this paper have limited policy-implications. However, because a jumbo-conforming loan is much larger than a typical GSE loan, the GSEs have a sizable exposure to jumbo-conforming loans in terms of the dollar-weighted share.

Figure 4 displays the share of jumbo conforming loans among purchase loans originated in each month that are eventually sold to the GSEs. After the CLL increased for high-cost counties in March 2008, the GSEs' exposure to jumbo-conforming loans increased over time. In terms of the number of loans, the share of jumbo-conforming loans reached a level around 7%. In terms of dollar amounts, the share of jumbo-conforming loans eventually reached a level around 17% because a jumbo-conforming loan is much larger than a typical GSE loan. Thus, although the variation we exploit in this paper might be relevant only to a small segment of the housing market, the segment still has quite a sizable implication for the GSEs.

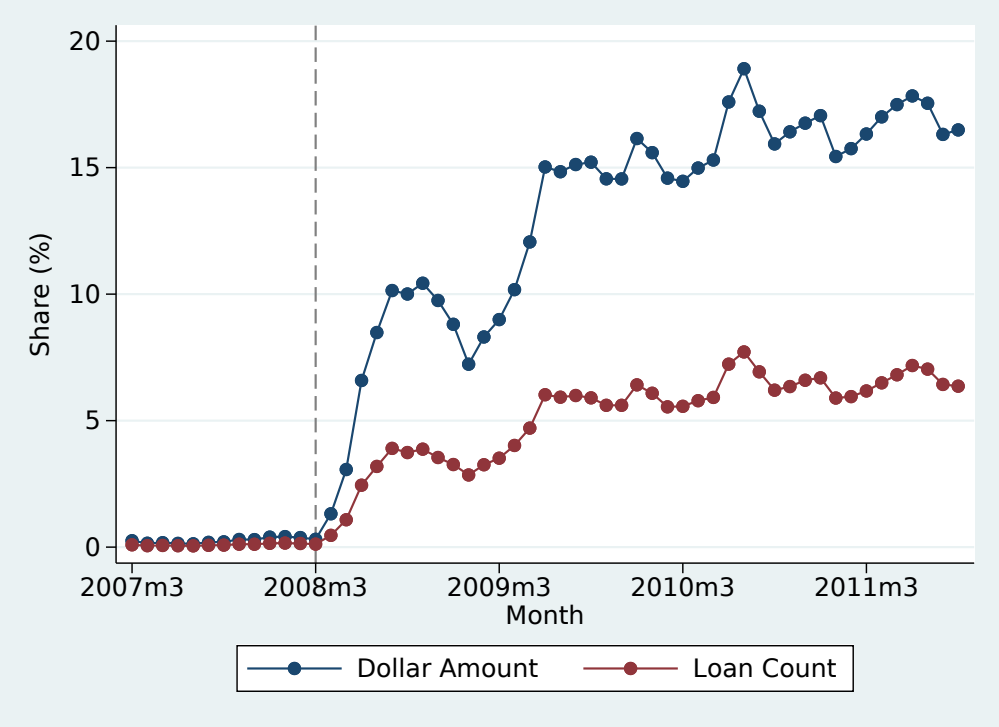


Figure 4: **GSEs' Exposures to Jumbo-conforming Loans.** This figure displays the share of jumbo-conforming loans among purchase loans originated in each month that are eventually sold to the Freddie Mac or Fannie Mae. The vertical gray line denotes March 2008 when the CLLs increased for high-cost counties. The source of underlying data is LPS.

2.2 Treatment and Control Groups

The counties where the CLLs were increased (high-cost counties) were not chosen at random, but instead were determined by the level of the county-level house price. The CLL increased only for counties whose median house prices were sufficiently high. Random assignment of treatment is not necessary for a difference-in-differences approach as long as the "parallel trends" assumption is satisfied. However, the way the treatment was assigned raises the potential concern that we might pick up changes in the home ownership rate in high-cost counties that are unrelated to the increase in the CLLs but occurred simultaneously, so the "parallel trends" assumption is violated. To overcome this potential problem we exploit the fact that the policy of CLL-increases was assigned based on the county-level median house price, but there is substantial variation in house prices within counties. This allows us to compare houses in house-cost counties to similar houses in non-high-cost counties.

Figure 5 shows a histogram of values of houses assessed for the tax purpose in high-cost counties in green and for non-high-cost counties in white. Naturally, prices in treated counties tend to be higher than in untreated counties. However, there is significant overlap between both distributions.

This overlap allows us to compare houses in high-cost counties that are affected by the increase in CLLs to similar houses in non-high-cost counties.

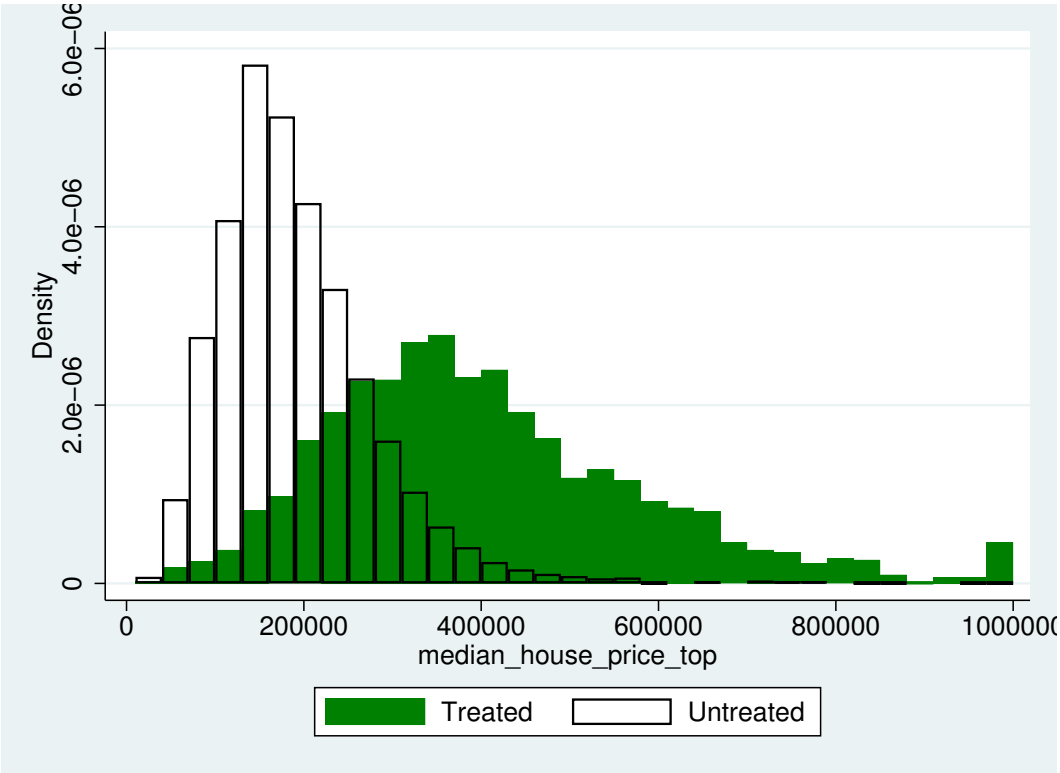


Figure 5: **Overlap in Zipcode-level House Prices in Treated and Untreated Counties.** The data used for this histogram comes from Zillow.com and uses zipcode-level median house prices from 2006. Median house price above $1 million are top coded as $1 million. The distributions highlighted in green and white are for zipcodes belonging to treated and untreated counties, respectively.

In our empirical analysis, a house is considered treated if the house is located in a high-cost county and if the house can be financed with a larger GSE loan with the new CLL under the ESA, assuming that the house is sold at a price equal to its assessed value with a down payment equal to 20% of the house value. Mathematically, house i in a high-cost county can be financed with a larger GSE loan if

$$0.8V_i > \$417,000, \tag{1}$$

where V_i is the assessed value of house i, and $417,000 is the national CLL before the ESA.

A control group should ideally be consisted of otherwise comparable houses that the ESA did not made it possible to be financed with a larger GSE loan. We select as a control group houses in non-high-cost counties that satisfy inequality (1). These are houses that would be treated if they were located in high-cost counties.

Another potential candidate for a control group is houses in high-cost counties such that $0.8V_i \leq \$417,000$. At least in partial equilibrium, the ESA would not have any effects on these houses. However, because demands for different houses will be inter-correlated with each other, the ESA would probably have general equilibrium effects on such houses. Then if we use those houses as a control group, difference-in-differences estimates will capture differential effects of the ESA between houses that are directly and indirectly affected by the policy. Therefore, we do not use as a control group houses in high-cost counties such that $0.8V_i \leq \$417,000$.

3 Data

The main data set we use for our analysis is the CoreLogic Real Estate Data (CoreLogic data, henceforth). This data set provides multiple files that contain different types of information. For this paper, we use the file with information about individual house transactions (the transaction file) and the file with information about characteristics of individual houses in many counties (the tax file).

The transaction file provides detailed information about individual house transactions such as the date of house sale, mortgage characteristics associated with the sale, whether a buyer occupies the house, etc. Important variables from the tax file are whether a house is owner-occupied and the assessed value of a house by tax authorities. Information about whether a house is owner-occupied is crucial for studying home ownership. We need to observe the owner-occupancy status of a house before and after its sale to see whether a house sale leads to a net increase or decrease in home ownership. Thus, this data set allows us to measure home ownership at the house level: whether a house is owner-occupied or not.[3]

This is an important advantage compared to typical mortgage data sets for example. Such data sets sometimes record whether the buyer is a first time home buyer, but there is no information about the owner-occupancy status of the seller. Moreover, among houses that were sold we observe not only transactions that were financed with a mortgage but also cash purchases, which could also lead to a change in owner occupancy status.

Another important variable that is available in this data set is the assessed value of a house by tax authorities. This variable is important for predicting the loan size necessary to purchase a house. Thus, we can investigate whether the effects of the CLL increase are larger for houses that

[3]This definition of home ownership is similar to the definition of home ownership used by the U.S. Census Bureau that is the ratio of owner-occupied housing units and total occupied housing units. The only difference between our definition and the Census definition is the denominator. Because we cannot distinguish occupied and unoccupied houses, our denominator includes more houses.. For example, houses used as vacation homes are included in our denominator, whereas they are excluded in the Census denominator. Our definition of home ownership is likely to understate the homeownership rate slightly, compared with the Census definition. See the following link for more information about the definition of home ownerships used by the Census: https://www.census.gov/housing/hvs/definitions.pdf.

have assessed values that would require loans greater than the pre-treatment CLLs. Many previous papers on related topics used appraisal values or list prices, which are only available for houses that are on the market. Moreover, the assessed value also allows us to control for potential differential trends for different segments of the housing market.

Sample Selection We select our sample in the following way. First, we keep only residential properties such as single-family houses or condos in the sample. Throughout the paper, we will refer to all residential properties, including condos, as "houses". Second, we only keep houses that are already included in the tax file in 2006, so we know their occupancy status before our sample period, which will be discussed in the next paragraph . Lastly, we excluded high-cost counties that border at least one non-high-cost counties, and non-high-cost counties that border at least one high-cost county.

The reason for the last restriction is that we want to minimize the possibility of moving between treated and untreated houses as a result of the CLL increase. If we were to interpret coefficients for difference-in-differences terms in our regressions as treatment effects, we want ideally the CLL increase not to have any effects on untreated houses. If the treatment causes some households to move between high-cost and non-high-cost counties, then the estimated difference-in-differences coefficients would capture differential treatment effects, not actual treatment effects. For example, if the CLL increase makes potential owner-occupants of houses more likely to purchase houses in high-cost counties instead of untreated counties, then estimated difference-in-differences coefficients might overstate the actual treatment effects of the CLL increase on home ownership. By excluding houses on the borders between treated and untreated counties, we exclude houses in treated counties that are subsititutable for houses in nearby untreated counties, and vice versa. Thus, the sample restriction will reduce the possibility that the estimated effects reflect moving between treated and untreated counties.

The time window we consider is March 2007 to February 2009. This period covers twelve months prior to March 2008, the first month when the treatment was effective for the entire month, and twelve months afterwards.

3.1 Summary Statistics

Summary stat of CoreLogic Data Table 1 presents descriptive statistics in the pre-treatment period. The unit of observation is a pair of a house and a month. Columns (1) and (2) present statistics for houses in untreated and treated houses in the pre-treatment sample period. The table shows that at least 82% of all houses are owner-occupied in both untreated and treated counties, and the owner-occupancy rate is higher in treated counties than in untreated counties.

Treated counties also have a greater share of houses with large assessed values ($> \$403,100$) than untreated counties. We chose the threshold of $403,100 because it is the price of a house that can be bought with an FHA loan with a 10% down payment. Borrowers considering purchasing houses above $\$403,100$ would directly benefit from the increase in CLLs because they can now make smaller down payments. We find that the share of such houses is considerable at around 13% overall. Treated counties have a greater share of such houses than untreated counties.

Note that the share of houses with assessed values above $403,100 is still greater in treated counties than in untreated counties, although our sample restrictions make treated and untreated groups similar to each other in terms of average house sale prices in 2006 and 2007, as shown in Table **??**. Depending on the distribution of individual house values in treated and untreated counties, it is still possible to have different shares of house with values above $403,100 across treated and untreated groups while the two groups have similar average house sale prices in 2006 and 2007.[4]

Lastly, about 0.2% of houses are sold in each month, which is translated to the annual rate of 2.4% of houses sold.Houses in untreated counties are more likely to be sold in a given month.

Table 1: **Descriptive Statistics of Houses from the Pre-Treatment Period.** This table presents average house characteristics from the pre-treatment period (September 2007 to February 2008). The unit of observation for this table is at the house-month level. Columns (1) and (2) present statistics for houses in untreated and treated counties, respectively. Column (3) presents overall statistics, pooling both treated and untreated counties. The variables in the first two rows are static and do not change their values over time. The variable in the third row (% Sale) can potentially have time-varying values of either zero of one.

	(1) Untreated	(2) Treated	(3) Overall
% Owner-Occupied	0.817	0.852	0.839
% Assessed House Value > $403,100	0.080	0.161	0.131
% Sale	0.003	0.002	0.002
ΔCLL ($100K)	0.000	2.201	1.377
N. Obs.	23,879,220	39,890,028	63,769,248

Table 2 presents descriptive statistics of house transaction characteristics in the pre-treatment period. This table is different from Table 1 in that the former provides descriptive statistics of transactions, whereas the latter provides descriptive statistics of house-month pairs regardless of whether each pair was transacted or not.

Table 2 shows that a majority of houses (73.6%) are bought with mortgages smaller than the old GSE CLL ($417,000). The share of houses bought with FHA loans and the share of houses

[4] Although not reported in the draft, the sample restrictions we impose dramatically reduces the difference in shares of houses with assessed values above $403,100 between treated and untreated counties.

bought with loans with sizes between the old and new CLLs are just above 5%. Both shares are slightly higher in treated counties than in untreated counties.

The next three variables are related to changes in home ownership. We find that both the shares of owner occupants as buyers and sellers are around 70% and that treated counties have larger shares for both buyers and sellers. At the house level, the variable called "Changes in Owner Occupancy Status given a Sale" takes three values: 1, 0, and -1. The variable is equal to 1 if a house is sold by a non-owner-occupant to an owner-occupant, -1 if a house is sold by an owner-occupant to a non-owner-occupant, and 0 if the owner-occupancy status does not change. That is, more houses would become owner-occupied if the variable takes on a higher value. The table presents the average values of the variable across houses within treated and untreated counties. We find that there are very little net changes in the owner occupant status, with the average around 0.6%. Together with the average monthly sale probability of 0.2% from Table 1, these numbers imply that about 0.012% of houses become owner-occupied additionally every month. Annually, the rate is 0.144%, which implies that it will take about 7 years for the homeownership rate to increase by 1% with the rate.

Lastly, the overall share of houses with assessed values greater than $403,100 that are sold is 13%, which is very similar to the share of the such houses shown in Table 1.

Table 2: **Descriptive Statistics of House Transactions from the Pre-Treatment Period.** This table presents average house transaction characteristics from the pre-treatment period (September 2007 to February 2008). The unit of observation for this table is at the house-month level, conditional on a house transaction. Columns (1) and (2) present statistics for houses in untreated and treated counties, respectively. Column (3) presents overall statistics, pooling both treated and untreated counties. Only the variable in the last row is static and does not change its value over time. All other variables have potentially time-varying values.

	(1) Untreated	(2) Treated	(3) Overall
% Loan <= $417,000	0.679	0.787	0.736
% FHA loans	0.030	0.073	0.053
% Loan between Old and New CLLs	0.039	0.062	0.051
% Owner occupant as buyer	0.632	0.773	0.707
% Owner occupant as seller	0.627	0.767	0.701
Changes in Owner Occupancy Status Given a Sale	0.004	0.007	0.006
% Assessed House Value > $403,100	0.079	0.176	0.130
ΔCLL ($100K)	0.000	2.074	1.103
N. Obs.	69,150	78,560	147,710

4 Regression Specification

We investigate how the changes in loan limits affected various outcomes of interest with a difference-in-differences approach as follows:

$$y_{i,ym} = \beta_0 \Delta GSE_i \times Post_{ym} + \beta_1 Post_{ym} + \beta_2 \Delta GSE_i + X_{i,ym}\beta_x + \xi_{c(i)} + \varepsilon_{i,ym}. \tag{2}$$

The unit of analysis is at the level of a house (i) and year-month (ym) pair. $Post_{ym}$ is a dummy variable that is equal to one for months when the increased CLLs were effective ($ym \geq$ 2008m3). ΔGSE_i measures an additional proportion of value of house i (V_i) that can be financed with a GSE loan due to the increase in CLLs, assuming a borrower makes the down payment of at least 20% of the house value. Precisely, the variable is defined as follows:

$$\Delta GSE_i = \frac{\min\left\{0.8V_i, CLL_{c(i),post}\right\} - \min\left\{0.8V_i, CLL_{c(i),pre}\right\}}{V_i}$$

Note that $\min\left\{0.8V_i, CLL_{c(i),t}\right\}$ refers to the largest loan size that can be purchased by the GSEs if the CLL for county $c(i)$ is equal to $CLL_{c(i),t}$, assuming a borrower makes the down payment of at least 20% of the house value.[5] This formula implies that if house i is located in a non-high-cost county, then $\Delta GSE_i = 0$ because $CLL_{c(i),post} = CLL_{c(i),pre}$. Thus, $\Delta GSE_i > 0$ only for houses that are located in high-cost counties. As described in Section 2, CLLs slightly decreased in high-cost counties under the HERA in the last two months of the sample period before the ARRA increased the limits back to the level under the ESA. In calculating ΔGSE_i, however, we only use CLLs stipulated by the ESA because the limits under the ESA were effective for most of the sample period.

Moreover, $X_{i,ym}$ contains a set of control variables, which we discuss in detail later. $\xi_{c(i)}$ are county fixed effects. The main coefficient of interest is β_0.

We also estimate a more flexible version of the difference-in-differences regressions, where the treatment effect is allowed to vary by month:

$$\begin{aligned} y_{i,ym} = &\sum_{ym'=\text{2007m3}}^{\text{2009m2}} (\beta_{0,ym}\Delta GSE_i \times 1[ym = ym'] + \beta_{1,ym} 1[ym = ym']) \\ &+ \beta_2 \Delta GSE_i + X_{i,ym}\beta_x + \xi_{c(i)} + \varepsilon_{i,ym}. \end{aligned} \tag{3}$$

The only difference between equations (2) and (3) is that $Post_{ym}$ is replaced with a set of dummy variables $1[ym = ym']$. With the more flexible specification, we can see more accurately when the

[5] 80% is the maximum initial loan-to-value ratio of a loan that the GSEs can purchase without private mortgage insurance.

treatment started to have effects on our outcomes of interests.

Control Variables A potential threat to the identifying assumption with a usual difference-in-differences approach are time-varying unobserved differential trends for houses in treated and untreated groups. Thus, we additionally include $X_{i,ym}$ in our specifications to control for potential differential trends in $y_{i,ym}$ that are related to observed characteristics of a house. We include zipcode and house characteristics in $X_{i,ym}$.

Zipcode-level characteristics in $X_{i,ym}$ are interaction terms between the month dummies ($1[ym = ym']$) and pre-determined characteristics for each zipcode. The characteristics include the share of jumbo mortgages, the share of loans originated and privately securitized and the average combined loan-to-value ratio for each zipcode during the period from January 2006 to February 2007. This allows us to control for differential time trend between treated and untreated houses that are related to these pre-determined characteristics. For example, the financial crisis was unfolding during this period. One of the important events related to the mortgage market was the collapse of the private securitization market. As a result, the mortgage market contracted substantially especially for regions that relied heavily on private securitization. The characteristics included in $X_{i,ym}$ are meant to capture potential heterogeneous impacts of the unfolding crisis on different counties depending on how much they relied on private securitization.

In addition, $X_{i,ym}$ includes an interaction between the month dummies and the position of house i's assessed house value in the national distribution of assessed house values as of 2006. Each house is assigned to one of 20 values depending on its location in the distribution, and each bin is interacted with the month dummies. Similarly, we include another set of interactions based on the position of house i's assessed house value within the county where the house is located as of 2006. By including these interaction terms, we can control for any differential trends for different segments of the housing market.

5 Results

5.1 Effects on Loan Size

First of all, we investigate whether the increase in CLLs due to the ESA affected the loan size. By purchasing loans smaller than CLLs in the secondary market, the GSEs make the mortgage market more liquid, which is likely to make loans under CLLs more available and affordable. Thus, the increase in CLLs was likely to make more liquid the market for loans in between old and new CLLs. Therefore, we expect that the increase in CLLs led to an increase in loans between the old and new CLLs in high-cost counties. If we do not find meaningful impacts on the loan size, then

the increase in CLLs is not likely to have meaningful impacts on other housing market outcomes, including home ownership in particular. Thus, we first estimate the effects of the treatment on these loan characteristics before investigating the effects on home ownership.

Specifically, we estimate how much the ESA led to an increase in loans that can be sold to the GSEs as jumbo-conforming loans. For this analysis, the dependent variable is a dummy variable that is equal to one if the following conditions are met: (i) a buyer of house i in a high-cost county $c(i)$ originates a loan greater than the pre-ESA national limit ($417,000) but not greater than the post-ESA limit for the county ($CLL_{c(i),post}$), or (ii) a buyer of house i in a non-high-cost county $c(i)$ originates a loan greater than the pre-ESA national limit ($417,000) but not greater than the average post-ESA limit across high-cost counties.[6]

For a house in a non-high-cost county, we do not use the post-ESA limit in constructing the dummy variable because the ESA did not increase the CLL for a non-high-cost county. Otherwise, the dependent variable would be zero for all untreated houses. Moreover, the dependent variable does not depend on whether a loan is eventually sold to the GSEs because any loan larger than the pre-ESA limit in a non-high-cost county would be ineligible for securtization through the GSEs.[7] With this dependent variable, we are estimating how much the ESA led to an increase in loans that can be securitized as a jumbo-conforming loan, relative to trends in origination of loans with similar sizes in non-high-cost counties.

We estimation the regression specifications given by equations (2) and (3), conditional on a sale of a house. The coefficients β_0 in equation (2) and $\beta_{0,ym}$ in equation (3) measure how much the ESA led to an increase in loans that can be newly eligible loans.

The results from regressions using equation (2) are presented in Table 3. We find that coefficient estimates of β_0 are statistically significant and robust to different specifications. The coefficient estimates from the flexible regression as in equation (3) are displayed in Figure 6. The figure shows that that treated and control groups have parallel pre-trends and that the coefficient estimates become statistically significant after two months upon when the ESA became effect in the beginning of March 2008. This result provides convincing evidence that it was the ESA that affected a borrower's loan size choice.

Based on the estimate in our preferred specification in column (4) and the average value of ΔGSE_i is 0.16, we find that the ESA increased origination of loans that would be qualified as jumbo-conforming loans by about 10 percentage points. Moreover, the flexible estimates show that the full effects of the ESA reached a level around 0.75 after the initial few months of adjustment, which implies an increase in loans that would be qualified as jumbo-conforming loans by about 12

[6]The average post-ESA limit for high-cost counties are computed using the number of houses in a county as the weight.

[7]The CoreLogic data does not provide information about whether a loan is securitized by a GSE. Thus, we would not be able to condition on whether a loan is sold to the GSEs in the first place.

percentage points. Given the average value of the dependent variable before the ESA is 0.15, the estimate suggests that the ESA affected a borrower's loan size choice substantially.

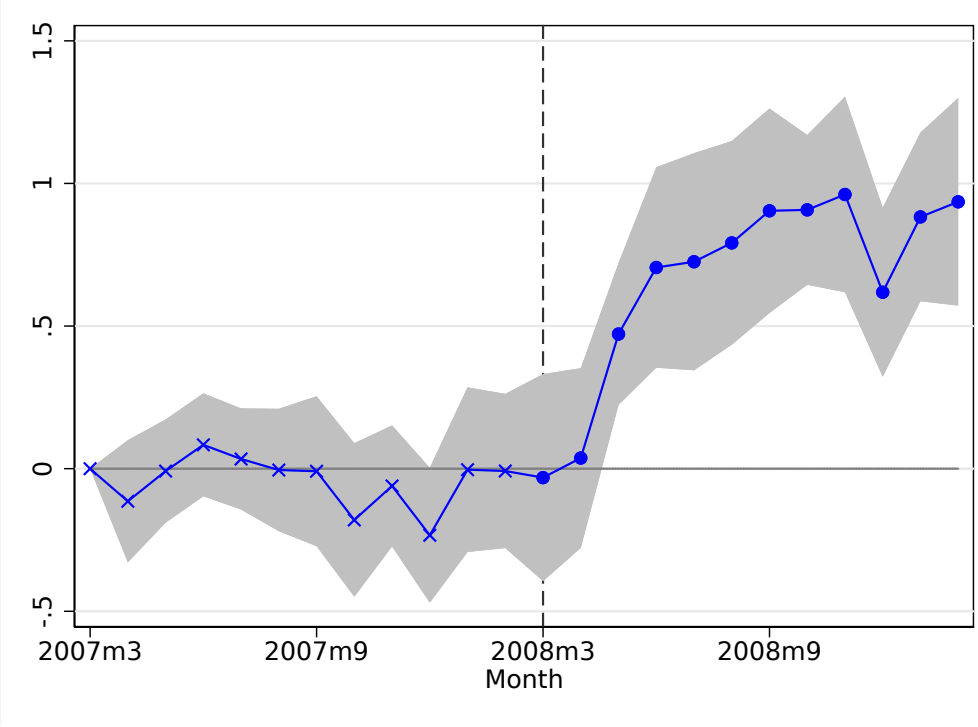
The coefficient estimates ($\beta_{0,ym}$) from the more flexible version (equation (3)) are displayed in Figure 6. In Figure 6 we see that the effect of the CLL change increased gradually from March 2008, when the policy was enacted, to about July 2008. Therefore the estimates in Table 3 somewhat understate the effect the policy had after July 2008. These graphs do not show any effect prior to March 2008, which suggests that it is reasonable to attribute the estimated increases to the increase in the CLL due to the ESA.

This finding is perhaps not very surprising, but it establishes that the ESA did have an effect on the mortgage market in high-cost counties.

Table 3: **Effects on Loan Size – Simple Specification.** This table presents selected coefficients of simple difference-in-differences regressions given by Equation (2). The dependent variable is the dummy variable indicating whether the loan size is between old and new CLLs. The regression specification for each column is different in terms of whether county fixed effects are included and whether additional controls are included. All specifications include year-month fixed effects. Standard errors in all specifications are clustered at the county level.

	(1)	(2)	(3)	(4)
Post=1	-0.141***	-0.140***	1.561***	1.056***
	(0.034)	(0.031)	(0.347)	(0.296)
Post=1 $\times$ ΔGSE_i	0.559***	0.590***	0.668***	0.656***
	(0.114)	(0.113)	(0.101)	(0.102)
Other Controls	N	N	Y	Y
County FE	N	Y	N	Y
Year-Month FE	Y	Y	Y	Y
N. Obs.	72,946	72,946	72,488	72,488
Adj. R^2	0.062	0.158	0.203	0.216

Figure 6: **Effects on Loan Size – Flexible Specification.** This figure plots estimated difference-in-differences coefficients with the regression given by Equation (3). The dependent variable is the dummy variable indicating whether the loan size is between old and new CLLs. The marker is the coefficient point estimate, and the shaded area shows the 95% confidence interval of each estimate. The regression contains year-month fixed effects, county fixed effects, and the additional control variables described in the main text. Standard errors are clustered at the county level.



5.2 Effects on Home Ownership

In Section 5.1, we showed that the treatment had significant effects on the loan size. In this section, we investigate the effects of the ESA on home ownership, which is the eventual goal of this paper.

5.2.1 Level of Home Ownership

As mentioned earlier, we measure home ownership at the house level: whether a house is owner-occupied or not. The owner-occupancy status of a house changes either when an owner-occupied house is sold to a buyer that does not live in the house or when a non-owner-occupied house is sold to a buyer that lives in the house.

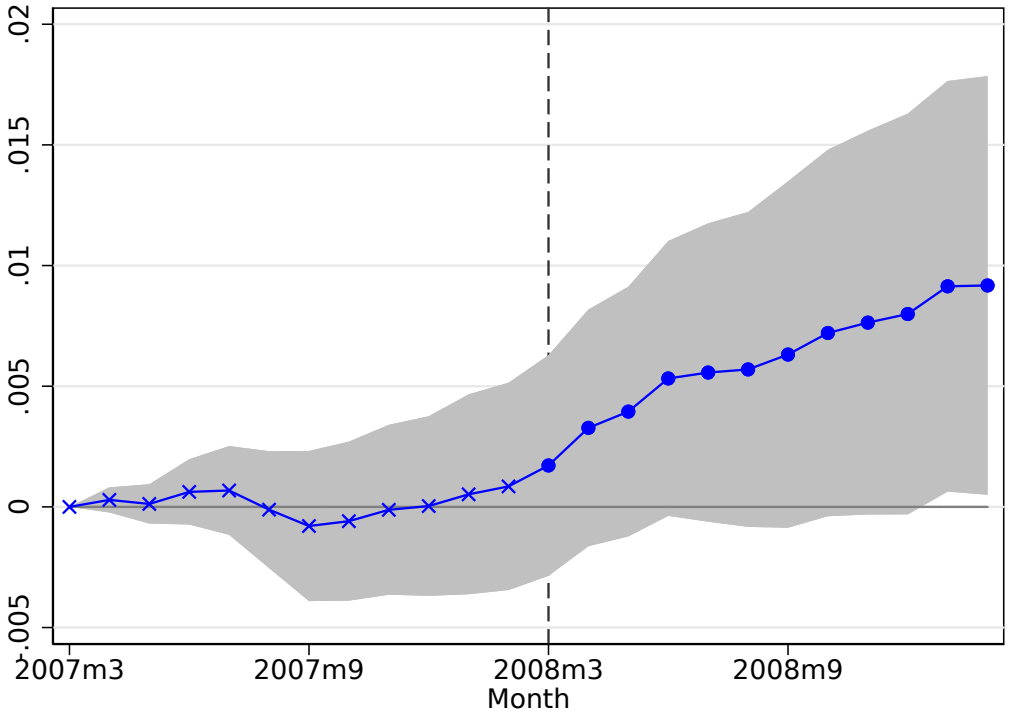
Table 4 shows that the ESA had a statistically positive effect on home ownership. The effects are significant in all four specifications considered in the table, but the effects are larger when we include additional control variables. Figure 7, which displays the estimated coefficients from

the flexible regression as in equation (3), the pre-trends between treated and controlled houses are parallel, and home ownership gradually increased among treated houses relatively to trends among controlled houses. At the end of the sample period, home ownership reached a level that is higher than the pre-ESA level by 0.14 percentage points on average, given the average value of ΔGSE_i equal to 0.15.

Table 4: **Effects on Home Ownership – Simple Specification.** This table presents selected coefficients of simple difference-in-differences regressions given by Equation (2). The dependent variable is the dummy variable indicating whether a house is owner-occupied. The regression specification for each column is different in terms of whether county fixed effects are included and whether additional controls are included. All specifications include year-month fixed effects. Standard errors in all specifications are clustered at the county level.

	(1)	(2)	(3)	(4)
Post=1	-0.00219***	-0.00219***	-0.01330***	-0.01086***
	(0.00052)	(0.00052)	(0.00431)	(0.00383)
Post=1 $\times$ ΔGSE_i	0.00380**	0.00380**	0.00596**	0.00596**
	(0.00172)	(0.00172)	(0.00254)	(0.00254)
Other Controls	N	N	Y	Y
County FE	N	Y	N	Y
Year-Month FE	Y	Y	Y	Y
N. Obs.	27,620,616	27,620,616	27,426,024	27,426,024
Adj. R^2	0.011	0.210	0.039	0.214

Figure 7: **Effects on Home Ownership – Flexible Specification.** This figure plots estimated difference-in-differences coefficients with the regression given by Equation (3). The dependent variable is the dummy variable indicating whether a house is owner-occupied. The marker is the coefficient point estimate, and the shaded area shows the 95% confidence interval of each estimate. The regression contains year-month fixed effects, county fixed effects, and the additional control variables described in the main text. Standard errors are clustered at the county level.



How should we think about this change in home ownership in the twelve month period since the ESA? To put the increase in home ownership by 0.14 percentage points in perspective, we compare the increase in home ownership to the amount of the GSEs' additional exposures due to the ESA. On one hand, the securitization through the GSEs for jumbo-conforming loans results in a positive outcome in forms of an increase in home ownership, which is an increase in 0.14 percentage points on average over twelve months. On the other hand, it also entails costs in forms of additional mortgage guarantees by the GSEs.

To calculate the latter, we turn to the LPS data, which provides information about whether a loan was sold to one of the two GSEs. Table 5 presents the aggregate amount of loans for treated and controlled houses that are sold to the GSEs in twelve months before and after the ESA.[8]The table shows that based on the LPS data, the ESA resulted in the additional mortgage guarantees of

[8]The exact definition of controlled and treated houses cannot be applied to the houses in the LPS data because the data do not provide information about assessed house value in 2006. Instead, we use the appraisal value of each house to determine whether the house is included in the sample.

$5.2 billion for treated houses relative to the trend for controlled houses.[9] Because LPS covered about 48% of the agency mortgage market during the sample period, the actual additional mortgage guarantees for treated houses increased by about $11 billion, assuming that LPS is nationally representative.

Putting together numbers for home ownership and additional mortgage guarantees, we find that it takes an increase in mortgage guarantees by $11 billion to increase home ownership by 0.14 percentage points. Extrapolating this relationship to larger numbers, it takes about mortgage guarantees of $78 billion to increase home ownership by 1 percentage points. $78 billion is about 18 percent of the aggregate mortgage amounts sold to the GSEs in twelve months before the ESA, which we view as a substantial increase in the GSEs' exposure for a 1 percent increase in home ownership. Therefore, we conclude that the marginal increase in mortgage guarantees due to the ESA was not very effective in increasing home ownership.

Table 5: **Mortgage Guarantees for Treated and Controlled Houses by the GSEs.** This table shows the aggregate amount of loans for treated and controlled houses that are sold to the GSEs in twelve months before and after the ESA. Source: LPS.

	Controlled	Treated
Pre-ESA	$9.4 billion	$17.9 billion
Post-ESA	$8.2 billion	$21.9 billion

5.2.2 Reasons for the Increase in Home Ownership

There are two possible factors through which home ownership changes. First, changes in the transition matrix of owner-occupancy of houses will affect home ownership. The transition matrix has probabilities assigned to four possibilities depending on whether the buyer and seller of a house are owner occupants. The four possibilities are laid out in Table 6, where "+1" refers to the transition of a house from being not owner occupied to being owner occupied, and "-1" for vice versa. Lastly, "0" refers to a transition that does not result in changes in the owner-occupancy status. If the transition probabilities are changed for treated houses relative to controlled houses, then home ownership among treated houses will likely change.

Table 6: Transition Matrix of Owner Occupancy Status

		Buyer	
		Owner Occupied	Not Owner Occupied
Seller	Owner Occupied	0	-1
	Not Owner Occupied	+1	0

[9] Note that 5.2 = (21.9 - 17.9) - (8.2 - 9.4).

Second, another factor that affects home ownership is through changes in probabilities of house sales among treated houses relative to controlled houses. If the owner occupancy status of a typical treated house transitions in a certain way, an increase or decrease in probabilities of sales of a treated house relative to a controlled house may result in a change in home ownership even without a change in the transition matrix of the owner occupancy status. For example, if a treated house is typically sold from an non-owner occupant to an owner occupant during the sample period, then an increase in probabilities of sales of a treated house relative to a controlled house will increase home ownership.

Change in the Transition Matrix To investigate how the ESA changed the transition matrix of the owner occupancy status, we construct the dependent variable, we construct the dependent variable $y_{i,ym}$ such that:

$$y_{i,ym} = \begin{cases} 1 & \text{if house } i\text{'s status transitions from owner-occupied to investor-owned} \\ 0 & \text{if house } i\text{'s status does not change as a result of a sale} \\ -1 & \text{if house } i\text{'s status transitions from investor-owned to owner-occupied} \end{cases} \tag{4}$$

Note that $y_{i,ym} = 0$ in either of the two following cases: (i) a transition from an owner-occupant seller to an owner-occupant buyer or (ii) from a non-owner-occupant seller to a non-owner-occupant buyer. The dependent variable is defined only for a house-time pair (i, ym) such that house i is sold at time ym.

We estimate the difference-in-differences regressions with the dependent variable conditional on house sales. Table 7 shows regression results using the the simple regression, given by equation (2), and Figure 8 presents the estimated coefficients of the flexible regression given by equation (3).

Table 7 shows that the ESA had statistically significant effects on changing the the transition matrix in a way that increases owner-occupancy rates. A positive coefficient for β_0 implies that there are more transitions from investors to owner occupants than those from owner occupants to investors, which increases home ownership. Figure 8 shows that trends are parallel in months before the ESA became effective. Although coefficient estimates for a majority of post-ESA months are not statistically significant, the estimates from simple regressions in Table 7 are significant possibly because of statistical efficiency gains.

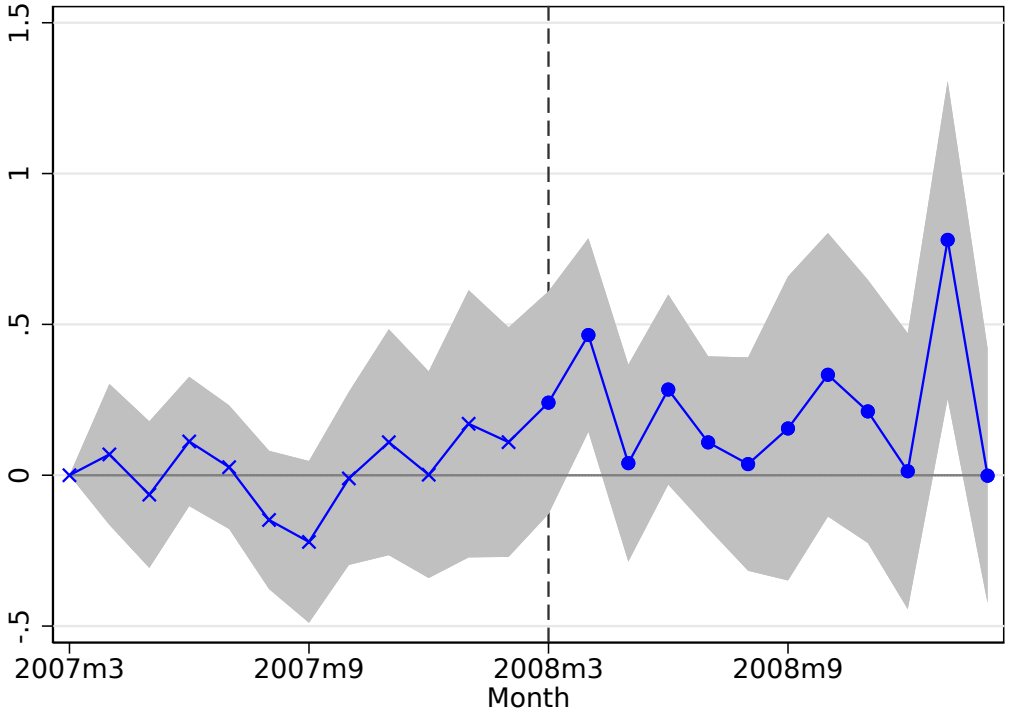
Given the average value of ΔGSE_i equal to 0.15, we find that the ESA increased transitions from investors to owner occupants by 3 percentage points, based on the estimate in column (4), net of transitions from owner occupants to investors. The number means that home ownership will increase by 0.0093 percentage points each month on average given the monthly house sales

probability of 0.0031. Then over the twelve months since the ESA, home ownership will increase by 0.11 percentage points, which is of a similar magnitude of the estimate from the regressions of the level of home ownership. The similar magnitudes of the two numbers hint that a change in the matrix matrix was probably the main driver that led to home ownership

Table 7: **Effects on Changes in the Transition Matrix of the Owner Occupancy Status–Simple Specification.** This table presents selected coefficients of simple difference-in-differences regressions given by Equation (2). The dependent variable is the dependent variable that captures transition of the owner occupancy status defined in equation (4). The regression specification for each column is different in terms of whether county fixed effects are included and whether additional controls are included. All specifications include year-month fixed effects. Standard errors in all specifications are clustered at the county level.

	(1)	(2)	(3)	(4)
Post=1	-0.010	-0.007	-0.193	-0.148
	(0.016)	(0.016)	(0.235)	(0.256)
Post=1 $\times$ ΔGSE_i	0.132***	0.125***	0.223***	0.201**
	(0.043)	(0.043)	(0.077)	(0.077)
Other Controls	N	N	Y	Y
County FE	N	Y	N	Y
Year-Month FE	Y	Y	Y	Y
N. Obs.	72,946	72,946	72,488	72,488
Adj. R^2	0.002	0.026	0.006	0.027

Figure 8: **Effects on Changes in the Transition Matrix of the Owner Occupancy Status–Flexible Specification.** This figure plots estimated difference-in-differences coefficients with the regression given by Equation (3). The dependent variable is the dependent variable that captures transition of the owner occupancy status defined in equation (4). The marker is the coefficient point estimate, and the shaded area shows the 95% confidence interval of each estimate. The regression contains year-month fixed effects, county fixed effects, and the additional control variables described in the main text. Standard errors are clustered at the county level.



The transition matrix of the owner-occupancy status can change because of two reasons: changes in the probability that a house buyer is an owner occupant and changes in the probability that a house seller is an owner occupant. We now investigate which of these two factors led to changes in the transition matrix of the owner occupancy status.

We estimate the difference-in-differences regressions of the two following dependent variables conditional on a house sale: a dummy variable that equals to one if the house buyer is an owner occupant, and a dummy variable that equals to one if the house seller is an owner occupant. Estimates of these regressions will inform us about whether the ESA increased home ownership rate because it induced more owner occupants to buy houses relative to non-owner occupants or because it induced more non-owner occupants to sell their houses relative to owner occupants.

Coefficient estimates of the simple regressions for buyers and sellers are reported in Tables 8 and 9, and those of the dynamic regressions are displayed in Figure 9. It is clear form the estimates that the ESA did not affect the buyer side but affected the seller side. These results imply that the

main reason that home ownership increased was because owner occupants constituted a smaller share of house sellers while the share of owner occupants as buyers did not change.

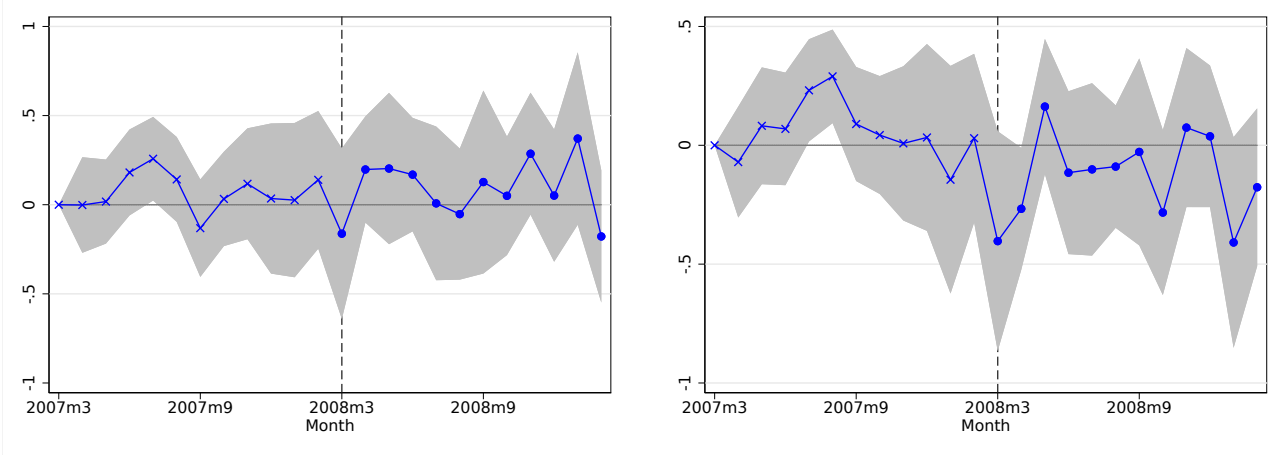
Table 8: **Effects on Owner-Occupant Buyers–Simple Specification.** This table presents selected coefficients of simple difference-in-differences regressions given by Equation (2). The dependent variable is the dummy variable indicating whether the house buyer is an owner occupant. The regression specification for each column is different in terms of whether county fixed effects are included and whether additional controls are included. All specifications include year-month fixed effects. Standard errors in all specifications are clustered at the county level.

	(1)	(2)	(3)	(4)
Post=1	-0.013	0.008	-0.324	-0.282
	(0.015)	(0.011)	(0.203)	(0.175)
Post=1 $\times$ ΔGSE_i	0.046	0.031	0.060	0.009
	(0.035)	(0.028)	(0.105)	(0.095)
Other Controls	N	N	Y	Y
County FE	N	Y	N	Y
Year-Month FE	Y	Y	Y	Y
N. Obs.	72,946	72,946	72,488	72,488
Adj. R^2	0.023	0.176	0.061	0.179

Table 9: **Effects on Owner Occupant Sellers–Simple Specification.** This table presents selected coefficients of simple difference-in-differences regressions given by Equation (2). The dependent variable is the dummy variable indicating whether the house seller is an owner occupant. The regression specification for each column is different in terms of whether county fixed effects are included and whether additional controls are included. All specifications include year-month fixed effects. Standard errors in all specifications are clustered at the county level.

	(1)	(2)	(3)	(4)
Post=1	-0.003	0.015	-0.131	-0.134
	(0.017)	(0.016)	(0.171)	(0.160)
Post=1 $\times$ ΔGSE_i	-0.086**	-0.094**	-0.163**	-0.191***
	(0.043)	(0.041)	(0.078)	(0.071)
Other Controls	N	N	Y	Y
County FE	N	Y	N	Y
Year-Month FE	Y	Y	Y	Y
N. Obs.	72,946	72,946	72,488	72,488
Adj. R^2	0.018	0.160	0.046	0.163

Figure 9: **Effects on Changes in the Transition Matrix of the Owner Occupancy Status–Flexible Specification.** This figure plots estimated difference-in-differences coefficients with the regression given by Equation (3). The dependent variable are the dummy variable indicating whether the house buyer is an owner occupant for panel (a) and the dummy variable indicating whether the house buyer is an owner occupant for panel (b). The marker is the coefficient point estimate, and the shaded area shows the 95% confidence interval of each estimate. The regression contains year-month fixed effects, county fixed effects, and the additional control variables described in the main text. Standard errors are clustered at the county level.



(a) Owner-occupant as buyer

(b) Owner-occupant as seller

House Sale Next, we investigate how the ESA changed the probability of sales of treated houses relative to controlled houses. In this analysis, we consider the following dependent variable $y_{i,ym}$ such that:

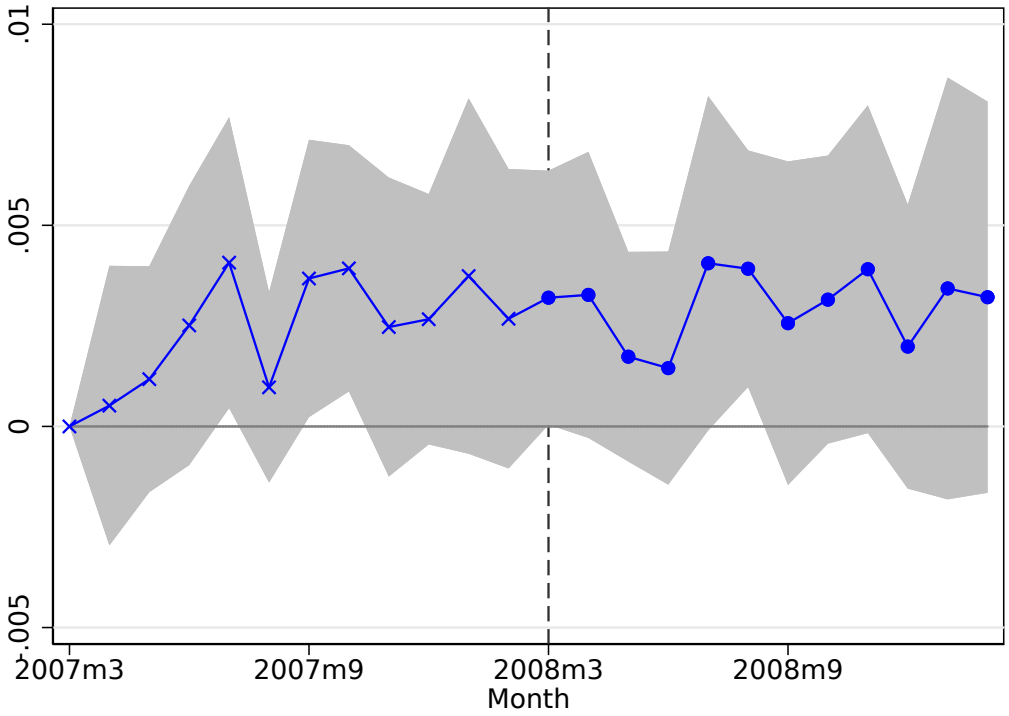
$$y_{i,ym} = \begin{cases} 1 & \text{if house } i \text{ is sold at time } ym \\ 0 & \text{otherwise.} \end{cases}$$

Estimates from the difference-in-differences regressions are reported in Table 10 and Figure 10. The results suggest that the ESA did not change the probability that treated houses are sold relative to controlled houses. Thus, as the results on the transition matrix of the owner-occupancy suggested, the main reason that home ownership increased was because the ESA led to a smaller share of owner occupants as house sellers.

Table 10: **Effects on Sale–Simple Specification.** This table presents selected coefficients of simple difference-in-differences regressions given by Equation (2). The dependent variable is the dummy variable indicating whether a house is sold in a given month. The regression specification for each column is different in terms of whether county fixed effects are included and whether additional controls are included. All specifications include year-month fixed effects. Standard errors in all specifications are clustered at the county level.

	(1)	(2)	(3)	(4)
Post=1	-0.00241***	-0.00241***	-0.00308	-0.00410**
	(0.00021)	(0.00021)	(0.00281)	(0.00172)
Post=1 $\times$ ΔGSE_i	0.00009	0.00009	0.00062	0.00062
	(0.00042)	(0.00042)	(0.00070)	(0.00070)
Other Controls	N	N	Y	Y
County FE	N	Y	N	Y
Year-Month FE	Y	Y	Y	Y
N. Obs.	27,620,616	27,620,616	27,426,024	27,426,024
Adj. R^2	0.000	0.001	0.000	0.001

Figure 10: **Effects on Sale–Flexible Specification.** This figure plots estimated difference-in-differences coefficients with the regression given by Equation (3). The dependent variable is the dummy variable indicating whether a house is sold in a given month. The marker is the coefficient point estimate, and the shaded area shows the 95% confidence interval of each estimate. The regression contains year-month fixed effects, county fixed effects, and the additional control variables described in the main text. Standard errors are clustered at the county level.



5.3 Effects on Other Housing Market Outcomes

Results we have presented so far show that the increase in the CLL due to the ESA led to an increase in the share of loans that can be sold to the GSEs as jumbo-conforming loans, where as there was a small increase in home ownership and almost no change in house sales. In this section, we investigate whether the ESA led to changes in other housing market outcomes of interest: house prices and loan-to-value ratios.

House Price An important housing market outcome to consider is the house price. In fact, one criticism against having the GSEs in the housing finance system is that their implicit subsidies just lead to an increase in house prices without increasing home ownership. Moreover, how credit conditions in general affects on the house price is an important topic on its own, and there are indeed existing papers written on this topic including the two recent ones that exploit changes in

the CLL (Adelino et al., 2012 and Kung, 2014).[10]

In this analysis, our dependent variable is $y_{i,ym} = \frac{P_{i,ym}}{V_i}$, where $P_{i,ym}$ is the price of house i that was sold at time ym, and V_i is the value of house i in 2006. With the dependent variable, we measure the effects of the ESA on house prices relative to their value in 2006. Estimates from the difference-in-differences regressions are shown in Table 11 Figure 11.

The table show that the ESA had positive effects on sale prices of treated houses relative to controlled houses. Magnitudes of the estimates are larger when we control for characteristics of different zipcodes and houses. The figure shows that the positive effects of the ESA on house prices become statistically significant after the ESA, which makes it reasonable to attribute the positive effects to the ESA.

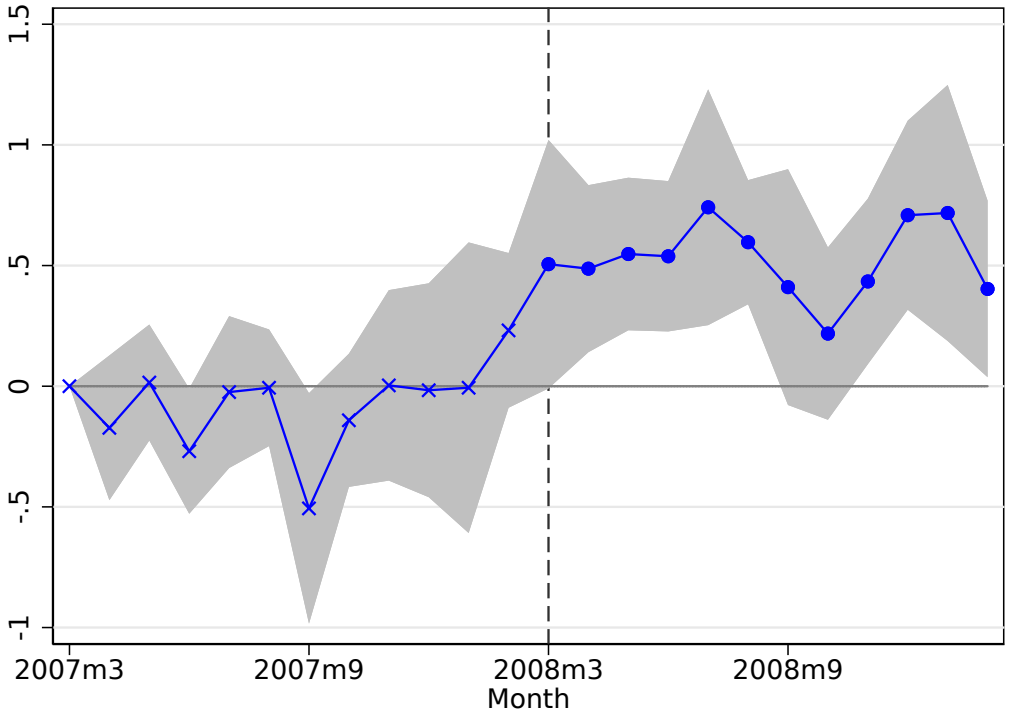
The results suggest that although the ESA probably improved a credit condition for potential buyers treated houses, they might not benefit very much from the improved credit condition because of associated house price increases.

Table 11: **Effects on House Price–Simple Specification.** This table presents selected coefficients of simple difference-in-differences regressions given by Equation (2). The dependent variable is the house sale price relative to its assessed value in 2006. The regression specification for each column is different in terms of whether county fixed effects are included and whether additional controls are included. All specifications include year-month fixed effects. Standard errors in all specifications are clustered at the county level.

	(1)	(2)	(3)	(4)
Post=1	-0.297***	-0.272***	1.258***	0.817***
	(0.025)	(0.025)	(0.279)	(0.227)
Post=1 $\times$ ΔGSE_i	0.256***	0.211***	0.670***	0.611***
	(0.069)	(0.067)	(0.105)	(0.090)
Other Controls	N	N	Y	Y
County FE	N	Y	N	Y
Year-Month FE	Y	Y	Y	Y
N. Obs.	69,669	69,669	69,213	69,213
Adj. R^2	0.033	0.214	0.126	0.257

[10] Adelino et al. (2012) uses changes in the national CLL in a pre-crisis period, and Kung (2014) uses the change in the CLL due to the ESA.

Figure 11: **Effects on House Price–Flexible Specification.** This figure plots estimated difference-in-differences coefficients with the regression given by Equation (3). The dependent variable is the house sale price relative to its assessed value in 2006. The marker is the coefficient point estimate, and the shaded area shows the 95% confidence interval of each estimate. The regression contains year-month fixed effects, county fixed effects, and the additional control variables described in the main text. Standard errors are clustered at the county level.



Loan-to-Value Ratio In addition, we also investigate whether the ESA led to any changes in loan-to-value ratios (LTVs). Because the ESA probably improved a credit condition, borrowers might take our a larger loan. If the house price does not change, then a borrower would be more indebted relative to the house value, which will lead to a higher LTV. As shown earlier, however, the ESA increased the house price, which will offset the force that would lead to a higher LTV with an increase in the denominator.

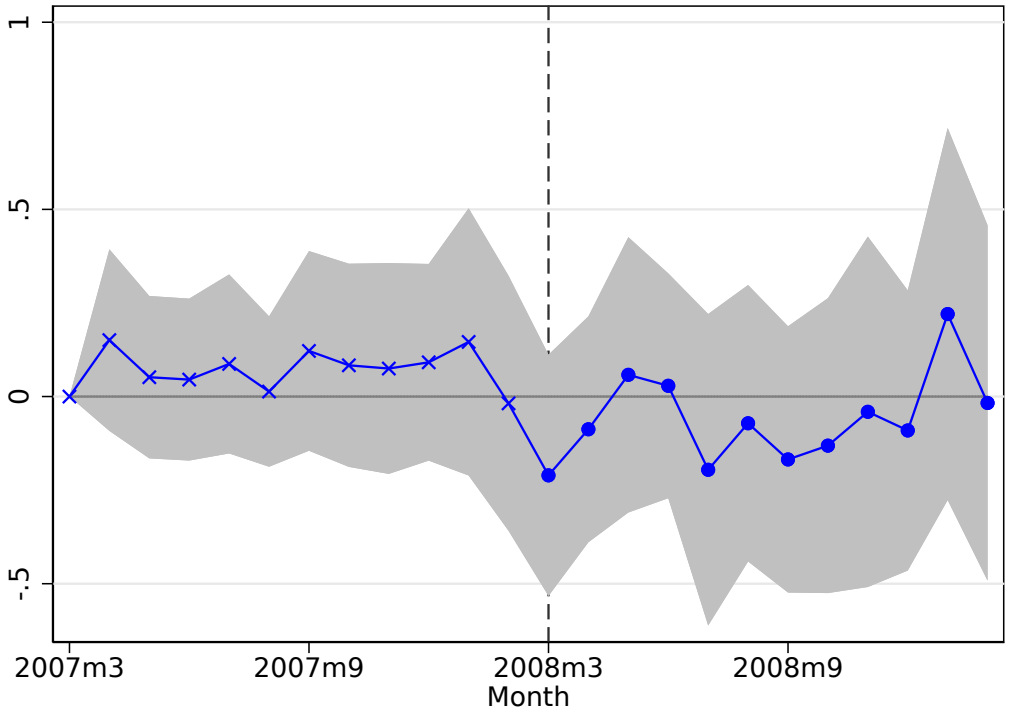
We present estimates from difference-in-differences regressions of the LTV in Table 12 and Figure 12. The table shows that the ESA did not lead to statistically significant changes on the LTV. Without additional variables that control for heterogeneous zipcode- and house-level characteristics shown in columns (1) and (2), estimates are negative and statistically significant. However, estimates are not statistically different from zero once the additional control variables are included, as shown in columns (3) and (4). These results suggest that buyers of treated houses increased loan sizes by an amount similar to how much the house price increased. Thus, the LTV of a buyer of a

treated house remains unchanged relative to the LTV of a buyer of a controlled house.

Table 12: **Effects on Loan-to-Value Ratio–Simple Specification.** This table presents selected coefficients of simple difference-in-differences regressions given by Equation (2). The dependent variable is the loan-to-value ratio The regression specification for each column is different in terms of whether county fixed effects are included and whether additional controls are included. All specifications include year-month fixed effects. Standard errors in all specifications are clustered at the county level.

	(1)	(2)	(3)	(4)
Post=1	-0.058**	-0.041*	0.030	0.014
	(0.024)	(0.025)	(0.191)	(0.133)
Post=1 $\times$ ΔGSE_i	-0.180**	-0.205**	-0.072	-0.133
	(0.073)	(0.081)	(0.101)	(0.104)
Other Controls	N	N	Y	Y
County FE	N	Y	N	Y
Year-Month FE	Y	Y	Y	Y
N. Obs.	69,436	69,436	68,979	68,979
Adj. R^2	0.010	0.149	0.058	0.158

Figure 12: **Effects on Loan-to-Value–Flexible Specification.** This figure plots estimated difference-in-differences coefficients with the regression given by Equation (3). The dependent variable is the loan-to-value ratio. The marker is the coefficient point estimate, and the shaded area shows the 95% confidence interval of each estimate. The regression contains year-month fixed effects, county fixed effects, and the additional control variables described in the main text. Standard errors are clustered at the county level.



6 Conclusion

The U.S. federal government guarantees a majority of mortgages through the Government Sponsored Enterprises (GSEs). Although the government's involvement in the mortgage market is controversial, it is often justified as a means to promote home ownership. However, very little is known about the actual effects of government mortgage guarantees on home ownership. In this paper we estimate the effect of lowering government mortgage guarantees on home ownership by using a difference-in-differences design, with detailed property-level data, that exploits regional changes in the conforming loan limit (CLL), the maximum loan size that can be guaranteed by the GSEs. We find that although the CLL affects how house purchases are financed considerably, their effects on the home ownership rate are fairly small. Our preliminary estimates suggest that lowering GSE guarantees by $78 billion annually would lower the home ownership rate by 1 percentage point. Our finding is particularly relevant for several recent housing finance reform plans

that propose to gradually lower the government's involvement in the mortgage market by reducing the CLL.

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