Government Guarantees and the Debt Capacity of Housing

This Version: August, 2019

Abstract

This paper shows that the distribution of combined loan-to-value ratios (CLTVs) for home purchase mortgages has been remarkably stable over the last two decades. While the private provision of high-CLTV loans soared during the housing boom of the early 2000s, we show that these loans took away market share from high-CLTV loans which were previously insured by government entities such as the FHA and the VA. FHA/VA loans dropped from 25% of all loans in 1999 to 5% in 2006 and then increased back to 30% after the financial crisis. We show that the same properties that relied heavily on FHA/VA loans before the housing boom were bought with very high leverage private loans during the boom, and then returned to using FHA/VA loans during the crisis and recovery. These findings suggest that the housing boom and subsequent financial crisis cannot be explained by changes in aggregate CLTVs, and instead favor models that rely on changes in collateral values or broad changes in house price expectations.

JEL Classification: D30, E3, G21, G28, R30

Keywords: Household Finance, Mortgages, Loan-to-Value Ratios, Government Guarantee
1 Introduction

Housing markets in the United States and other countries around the world have been marked by recurring boom and bust cycles. Several of these episodes are associated with significant expansions in the amount of mortgage debt that households take on, most notably the 2008 financial crisis. This experience has inspired a large and growing literature to understand the factors leading to house price bubbles and valuation cycles. A growing number of theory papers build on the idea that the relaxation of credit standards can play an important role in fueling house price growth if more generous access to credit allows buyers to bid more aggressively when purchasing. Credit is typically constrained across two dimensions. First, lenders impose a debt-to-income (DTI) constraint to account for a borrower’s ability to pay their mortgage. Second, the amount of housing leverage is also constrained by the lender who, to ensure loan repayment, limits the amount borrowed to some proportion of the collateral value of the house, the so-called loan-to-value (LTV) constraint.

It is by now well understood that during the housing boom of the early 2000s the level of mortgage credit to income rose significantly across all income groups in the United States (see, for example, Adelino et al. (2017), Foote and Willen (2018), and Albanesi et al. (2019)). This means that lenders were willing to relax debt-to-income constraints for all income groups. It is often assumed that this relaxation of DTI constraints went hand in hand with a relaxation in LTV constraints. This paper shows that this was not the case. In fact, the distribution of combined loan-to-value ratios (CLTVs) at origination was stable over the last two decades. While the loan sizes for home purchase varied significantly with the housing cycle (since house values went up and down), the distribution of CLTVs at origination remained largely unchanged. As a result, CLTV constraints in aggregate did not change across the population even during the housing boom of the 2000s.

The reason for the stability in the distribution of CLTVs is that there are two sources of very high CLTV loans (which we define as those above 95%) in the United States. While it has been widely noted that privately supplied high-CLTV credit increased dramatically dur-
ing the housing boom, these private loans replaced similarly high CLTV loans insured by the Federal Housing Administration (FHA) and the Department of Veterans Affairs (VA). After privately supplied high-CLTV loans dried up post-2008, these government-backed FHA and VA loans increased their share significantly. In fact, the use of high-CLTV loans, whether they are provided by government or private sources, is concentrated within the same zip codes and even the same properties. We show that the zip codes that heavily relied on FHA/VA loans pre-2000s are the ones where high-LTV private loans expanded rapidly post-2002 and crowded out FHA loans. These are also the zip codes where FHA share surged back post-2008. Similarly, at the property level, we find remarkable persistence in the use of high LTV loans, i.e., properties that used high-CLTV FHA/VA loans pre-2000 are those that used private, high-CLTV loans during the housing boom and again were more likely to switch back to FHA/VA loans post-crisis.

Why does it matter how credit standards loosened across the housing boom and bust cycle? An influential literature on the credit cycle going back to Bernanke and Gertler (1989) and Kiyotaki and Moore (1997) has emphasized the role of collateral in creating a multiplier-accelerator feedback channel in models with limited credit enforcement. Since firms and households are constrained by the value of their assets in how much they can borrow, a drop in asset values makes it more difficult to borrow, which depresses productivity, and as a result lowers asset values even further, making it harder to borrow. Implicitly, these models assume that the ratio of loan-to-asset values is constant. While collateral in these models has an important externality for the economy, it does not lead to asset bubbles or crashes. In Kiyotaki and Moore (1997), for example, leverage actually rises after a bad shock, dampening any crisis.

A more recent literature has built on the credit cycle models, but emphasizes endogenous changes in leverage. For example, Geanakoplos (1997, 2010) argues that pro-cyclical fluctuations in loan-to-value (LTV) ratios are fundamental for understanding boom-bust cycles in credit markets. When volatility is low for an extended period of time, leverage rises,
both because lenders feel more secure, and because they are willing to stretch the available scarce collateral. More people can afford to purchase housing and are willing to spend more for the collateral because they can use it to borrow. The central assumption is that there is a class of buyers for whom the asset is more valuable than others (possibly because they are more optimistic). A relaxation in LTV constraints allows borrowers to bid prices up. If they lose wealth, or lose the ability to borrow, they will buy less, and the asset will fall into more pessimistic hands and be valued less. In fact, several models of the credit boom of the early 2000s use LTV at origination as the key credit supply variable and include large changes in LTV to fit the observed movements in house prices (Corbae and Quintin, 2015; Favilukis et al., 2017; Landvoigt et al., 2015).

However, our analysis shows that highly levered loans were available throughout the last two decades and did not become more abundantly available throughout the boom period. These findings suggest that the housing boom and subsequent financial crisis cannot be explained by changes in aggregate purchase CLTVs. Instead, lenders expanded credit proportionately with rising house prices, and allowed DTI ratios to go up across the population. These results favor models that rely on changes in collateral values (credit cycle models) or broad changes in house price expectations.

This paper uses the universe of home purchase transactions between 1996 and 2015 from CoreLogic, as well as BlackKnight, to look at the variation of CLTVs over the last two decades, including the housing boom, the crisis, and the subsequent recovery. We show that the distribution of combined loan-to-value ratios (CLTVs) has been remarkably stable over time, with changes in average CLTV of less than two percentage points over the whole period. In fact, even when house values were going up dramatically between 2002 and 2007, the whole distribution of CLTVs at origination remained largely unchanged, consistent with Glaeser et al. (2012) and Ferreira and Gyourko (2015).

Underlying the overall stability in CLTV ratios are large changes in the sources of high-leverage loans over the credit cycle. Specifically, we observe a large shift away from
government-guaranteed Federal Housing Administration (FHA) and Veteran’s Administration (VA) loans starting in 2000 and very dramatic return of these loans after the 2008 financial crisis. In the early part of the sample (before 2000), about 25 percent of all homes were financed with government-insured loans, through the FHA and VA. In 2005, in contrast, less than 5 percent of all homes were in these categories. After the crisis, a full 45 percent of all home purchase loans in the US were made through these programs. Designed to encourage homeownership, government-guaranteed mortgages are available even to low-credit-score borrowers (with credit scores as low as 500) who are able to make only very small down payments. Indeed, between 1996 and 2015, almost all government-guaranteed loans had CLTVs at origination of at least 95%.

We first confirm that the CLTVs of mortgages supplied by the private-sector increased dramatically during the housing boom, consistent with prior work (see Pinto (2010) and Keys et al. (2012)). However, we show that the high-CLTV loans provided by the private-sector displaced high-CLTV loans guaranteed by the government during this time period. On net, this displacement in the sources of high CLTV-credit did not change the fraction of borrowers with mortgages at above 95% CLTV. When private-sector high-CLTV loans once more became unavailable after the financial crisis, the government programs “filled” in their share of the overall market. That is, the pro-cyclical nature of private-sector LTVs is counter-balanced by the share of purchase mortgages that are explicitly guaranteed by the government. As a result, the distribution of CLTVs did not change in aggregate over the last two decades.

However, one might worry that the aggregate stability of the CLTV distribution masks differences in the distribution of zip codes or types of properties that were able to access high-CLTV loans. In particular, it is possible that private-sector high-CLTV loans were given to low-income borrowers (or areas) during the boom, and that these areas could not access such loans outside of the boom. We find that this is not the case.

First, looking within zip codes, we document very high correlations between the share of
purchase loans that were guaranteed by the government before the boom (in 1999) and the share of high-CLTV private-sector loans in 2006. There is a similarly high correlation between high-CLTV loans in 2006 and the share of (highly leveraged) purchases guaranteed by the government in 2013. A similar picture emerges when we look at zip codes grouped into deciles by income: decile-by-decile, the FHA/VA share of loans before the boom is almost exactly offset by high-CLTV private sector loans before the crisis. That is, at the zip-code level, the same areas relied on high-CLTV loans for a significant portion of purchases throughout the two decades we consider.

Second, a possible concern when using zip code level analysis is that the stock of houses financed with high-CLTV loans within an area changed, for example, from old, mostly cheap, homes in non-boom periods, to larger, and more expensive homes, in the boom. This would mean that the type (and possibly the quality) of collateral backing transactions changed over the cycle. We use a novel application of the typical repeat-sales methodology (Case and Shiller, 1989) to show remarkable stability in the use of high-CLTV loans even within properties over time. This approach shares the advantages pointed out when looking at house price increases, namely the fact that the general quality of the asset remains fixed (all features associated with location, for example). We find that during 2000 to 2008, private-sector high-CLTV loans are much more likely to have been used in home purchases that were previously financed with FHA/VA loans. And, following the bust, those same properties that used high-CLTV private loans were financed with FHA/VA loans. While we cannot control for home improvements in the repeat sale analysis, this issue would not differentially affect FHA versus privately backed high-LTV loans.

Finally, we look at the purchase decisions of individual households to better understand if the users of high-CLTV, government loans pre-boom were very different from the users of privately provided, high-CLTV loans during the boom. For example, one might worry that during the housing boom period, high-CLTV loans were taken out by more aggressive or more marginal borrowers than the FHA borrowers before. To speak to this hypothesis, our
final test tracks the borrowing decisions of specific households. We turn to a dataset of deeds records (at the property level) and voter records (at the individual level) to track individuals over time, even as they move from one house to another. We find, consistent with all the evidence thus far, that the same households who used FHA or VA loans between 1996 and 2003, used private-sector loans with CLTVs $\geq 95\%$ during the 2004-2007 period and then switched back to FHA-VA loans after the boom.

To provide further evidence that the high-CLTV loans being made were similar except for whether or not they were government guaranteed, we conduct one final test. We ask if the private-sector high-CLTV loans and government-guaranteed loans had very different default rates. If the private-sector loans were somehow different in ways unobservable to us, then we might expect to see some differences in their performance. We find that, while low-CLTV loans are much less likely to ever go into delinquency or default than high-CLTV loans, the performance of all high-CLTV loans were similar within cohort regardless of whether they were government-guaranteed or not.

Our results show a stable overall distribution of CLTVs in the population, with an underlying switch of high-leverage loans from FHA/VA to private sector within zip codes, properties, and households. This raises important questions about how one should model credit cycles: if credit constraints were indeed relaxed during the housing boom it was not because of changes in CLTVs. It is possible that some models use looser CLTV limits as a “stand-in” for a broader relaxation of credit constraints, possibly through higher debt-to-income ratios or weaker documentation requirements, for example. Existing work suggests, however, that different constraints bind in different states of the world. Using a general equilibrium framework, Greenwald (2018) shows important differences in relaxation of payment-to-income standards compared to loan-to-value ratios for explaining boom-bust cycles and the role of monetary policy. In addition, double trigger models of default explicitly consider separately the roles of debt overhang and ability to pay (see Foote and Willen (2018) for a review of this literature). Finally, the manner in which loans are guaranteed may matter.
The fact that high-leverage loans are explicitly guaranteed by the government during some periods (through FHA/VA insurance) and then become implicitly government guaranteed (through too-big-to-fail or other government backstops) may have implications for overall financial stability.

2 Background, Motivation, and Data Description

2.1 Institutional Detail

The government programs designed and operated by the Federal Housing Administration (FHA) and the Veteran’s Administration (VA) share several characteristics. They both seek to encourage homeownership among their target populations: low-income, middle-income, and first-time homeowner households for FHA and military families for VA. The FHA has stricter underwriting standards than the VA, requiring FICO scores to be above 580 in order to qualify for minimum 3.5% down payment, debt-to-income ratios to be below some maximum (31% front-end, 45% back-end), and that the borrower buy mortgage insurance from the FHA. Both the FHA and the VA require that the home be the borrower’s primary residence and that the borrower has some proof of employment. FHA-insured and VA-insured loans together account for almost all of the loans backed by “the full faith and credit guarantee of the US Government.”

Kim et al. (2018) provide an in-depth look at the current origination of FHA and VA mortgages, including the institutional details of this market and the role of nonbank mortgage companies. The paper focuses on the implications of the limited amount of capital of those companies on the stability of the financial sector and the potential need for a government bailout in an adverse event.

The loans are guaranteed by the US Government through the Government National Mortgage Association (Ginnie Mae). Fannie Mae and Freddie Mac (other government-sponsored entities) purchase loans from the issuing lenders and then securitize mortgages.

they purchase. Ginnie Mae, in contrast, gives lenders approval to make FHA- or VA-loans. The lenders themselves then package their government-guaranteed loans into mortgage-backed securities. These securities are then explicitly guaranteed by Ginnie Mae. Any losses are first covered by the insurance premiums the FHA requires borrowers of its guaranteed loans to purchase. Further losses are covered by the US government.

The underlying argument for the existence of the FHA/VA programs is that they grant qualifying borrowers access to mortgage credit that they would not normally have access to in a world where mortgages are provided only by private markets. This paper shows that the share of high-CLTV loans made by the private market was highly pro-cyclical during the last two decades. Importantly, highly leveraged loans were made before the boom, as well as after the financial crisis, but only by government programs that had an explicit mission to encourage homeownership.

### 2.2 Previous Work on CLTVs over the Time Series

One of the most widely used datasets made available to researchers studying mortgages includes only mortgages held in private-label mortgage-backed securities. This dataset, originally published by LoanPerformance and now by CoreLogic, allowed for a thorough examination of subprime and jumbo loans. Using this data, Demyanyk and Van Hemert (2009), Keys et al. (2012), and Gerardi et al. (2008) document a number of important features of these loans, including that their CLTVs increased dramatically in the early 2000’s. This paints the housing boom as a time of unusually lax credit standards. It is important to point out that not included in the LoanPerformance dataset were any loans guaranteed by Fannie Mae, Freddie Mac, or Ginnie Mae, or loans kept in lenders’ portfolios.

Pinto (2010) documents that the share of mortgages purchased by Fannie Mae and Freddie Mac using CLTVs above 97% increased from 5% in 1996 to 40% in 2007. The data used to determine these shares is not analyzed by the paper directly, but rather in the FHA 2009
Actuarial Study which the paper cites.\textsuperscript{2} The actuarial study includes refinance loans and imputes the values for those properties when calculating its loan-to-value ratios.\textsuperscript{3}

The upshot is that the dramatic increase in CLTVs assumed in several models of credit supply and discussed at length in the popular press is often based on data sources that do not include a full picture of the housing market.

A few papers have looked at the time series of average LTVs in the whole population and found stable averages over time. Glaeser et al. (2012) show, using a similar deeds dataset to ours, that down payments did not change in the years between 1998 and 2008 and are therefore an unlikely culprit for the dramatic increase in house prices. Ferreira and Gyourko (2015) also use deeds data to show a time series of combined loan-to-value ratios for prime loans, subprime loans (those made by subprime lenders), FHA/VA and small lenders. More recently, Adelino et al. (2018) also show that the distribution of purchase CLTVs over time has been stable. To the best of our knowledge no previous work has considered the role of FHA and VA guarantees in supplying high-CLTV loans over the cycle, and how this interacted with the supply of those loans by the private sector along the distribution of households and properties.

\subsection*{2.3 Deeds Data}

To overcome the limitations discussed in Section 2.2, we require a dataset that meets three requirements. First, it must include every loan (including second and third mortgages) that the borrower used to finance the purchase of their home. Second, the data must include a value of the home at the time the mortgage was originated. Third, the dataset must include the universe of mortgages, and not just those packaged in private-label securities or originated by one bank. The deeds data, kept in county recorder’s offices and then collected and published by data company CoreLogic, meet all three of these criteria.

\textsuperscript{2}The 2009 FHA Actuarial Study is available here: https://www.hud.gov/sites/documents/DOC_16571.pdf.

\textsuperscript{3}This imputation may lead to measurement error in CLTVs (see Aragon et al. (2010) for a more thorough explanation).
In this project we focus on purchase transactions. An important limitation of the deeds data – and indeed almost every dataset on mortgages – is that measures of value are only reliable at time purchase. The mortgage document itself does not include a value of the house, but only a value of the loan. Only when combined with the document recording the transaction which lists the value of the home, can we construct our loan-to-value ratio measure. If the outstanding mortgage at a given parcel is refinanced, we can see the amount of the loan, but do not observe either a market value of the home or an appraised value. One potential solution is to use data from a lender as in Bernstein (2018), but then we no longer observe the universe of loans. And, even if we did have the universe of loans, we must still make the assumption that appraised values are “correct.” To the extent that lenders might have been manipulating their estimates of “V” during either the boom or bust, any measures of loan-to-value ratio that use appraised “V’s” would be subject to bias.

The deeds data also has two other important limitations of which to be aware. Namely, we cannot observe the income or FICO scores of the borrowers. No dataset currently includes information on each of: income, FICO score, every lien, loan amount, and home value for the universe of all loans. As datasets improve in scope, questions that consider the role for all of these contemporaneously will become tractable. In this project we focus on one specific set of questions that can be answered using a dataset that includes the value of the home at the time of purchase and the amount of every loan used to purchase that home for nearly the universe of purchase transactions.

3 Two Key Features of the Data

Using the deeds data for all US counties covered by CoreLogic, we calculate the CLTV of every purchase loan and whether that loan was an FHA- or VA-guaranteed loan. The CLTV is defined as follows: we sum the loan amounts for each loan, up to three loans, used to finance the purchase and then divide that sum by the sale price. Cash purchases (those that
did not use any leverage) are not included in any of the results presented below.

3.1 A Steady Distribution of CLTVs over the Time Series

The first presentation of our findings is shown in Figure 1. To create this figure we took all purchases with mortgages originated in a given year and then calculated the mean CLTV of those loans along with the 5th, 25th, 75th, and 95th percentile CLTV. These five statistics are plotted every year between 1996 and 2015. The figure illustrates a remarkably steady distribution of CLTVs over the entire time series. During this same period, house prices experienced a large run-up (up to 2005) and subsequent collapse and recovery. That is, even while “V” was changing dramatically, the debt per dollars of housing collateral being used to finance purchases hardly changed. Importantly, it is not the case that the mean stayed the same while the tails of the distribution moved around. Specifically, what we do not see is a distribution where the 75th and 95th percentiles of the distribution increased during the bubble.

3.2 A Changing Share of Government-Guaranteed Loans

The steadiness of the CLTVs is perhaps unexpected given the huge increase in originations of private-sector mortgages with very low down payments documented during the housing boom. This increase can be clearly seen in Panel A of Figure 2. The share of private-sector loans with CLTVs ≥ 95% increases from less than ten percent of all originations to nearly thirty percent of all purchase loans at the height of the housing boom in 2006. How can the share of such high CLTV mortgages have increased so dramatically with no contemporaneous increase in the distribution of CLTVs? The answer becomes clear in Panel B of the same Figure.
Panel B plots the share of all purchase loans guaranteed by the FHA and the VA that also had CLTVs ≥ 95%. What this figure shows is that the share of all loans (both government guaranteed and private-sector) with CLTVs ≥ 95% hardly budged during the housing boom. And the steadiness of the CLTVs documented in Figure 1 becomes clear in light of this fact.

[FIGURE 3 HERE]

Figure 3 provides another look at the role of government guaranteed loans in the mortgage market. To create this figure we classified loans into one of five types. FHA- and VA-guaranteed loans with CLTV either below 95% or not, and then all other loans. The key takeaways from this figure are twofold. First, as seen in Panel B of Figure 2, the share of loans guaranteed by FHA or VA dropped from 25% before the boom to about 5% during the boom and then up to nearly 50% of all purchase loans in 2010. The second takeaway is that almost all of the loans guaranteed by these two programs are very high CLTV loans. In no year are fewer than 90% of FHA- and VA- insured loans mortgages with CLTVs of at least 95%.

3.3 Revisiting the Distribution of CLTVs

[FIGURE 4 HERE]

In Figure 4, we revisit the distribution of CLTVs. Instead of plotting just the mean and four percentiles of the distribution, we plot the entire cumulative density function. In Panel A, we plot the CDFs of purchase-loan CLTVs in 1999 and 2006. In 1999, we see that fewer than 10% of loans have CLTVs above 95%, about 30% of loans have CLTVs over 90%, and roughly half of all loans have CLTVs above 80%. The story, as expected given Panel A of Figure 2, is dramatically different in 2006. In 2006, 30% of loans not guaranteed by the FHA or the VA had CLTVs above 95% (compared with fewer than 10% in 1999). Similarly, the share of loans with CLTVs of at least 90% increases from 30% to more than 40%.
Panel B of Figure 4 illustrates the importance of using the universe of purchase loans if we want to know the economy-wide importance of debt for home purchases. First, the CDF of CLTVs of all purchase loans in 1999 shifts significantly to the right when compared to the CDF of private-sector loans. This is because the private-sector only 1999 distribution of loans does not include 25% of loans originated 1999, almost all of which were very high CLTV loans. Second, the “All loans, 2006” and “Private loans, 2006” lines are very similar. Given the tiny share of loans guaranteed by the FHA or VA in 2006, this is not surprising. Finally, and most importantly, comparing the two lines in Panel B tells a very different story than would be told using only Panel A. Specifically, when looking at all purchase loans, we see that approximately 30% of loans in both years have CLTVs above 95% and approximately 40% of loans in both years had CLTVs above 90%. That is, the share of loans with low down payments did not change.

### 4 Evidence of Switching

Section 3.1 shows that the share of purchase loans with high CLTV ratios did not change over the time series, nor did the overall distribution of CLTVs. Despite wildly changing house prices and dramatic shifts in purchase and mortgage origination activity, the debt capacity of housing did not change. What did change was the share of the high-CLTV loans that were explicitly guaranteed by the government through the FHA and VA programs. This section of the paper asks an important follow-up question. Were the high-CLTV loans that were being guaranteed by the government before the boom and then being displaced by the private-sector going to the same types of borrowers? Or does the steadiness of the CLTV distributions mask shifts in where the high-CLTV loans were going. To answer this question we subdivide our sample of purchase mortgages in three different ways: by zip code, by parcel, and by specific borrower. In all cases we find compelling evidence that it is the same parts of the country and same types of borrowers, and indeed even the exact same
properties and exact same borrowers, that use government-guarantees to access high-CLTV loans pre- and post-boom but switch to the private sector during the years 2003-2007.

4.1 Switching within Zip Codes

Our first test uses publicly available IRS data from 1998 to divide zip codes into ten population-weighted deciles of adjusted gross income.

To create Figure 5, we compute the share of purchase loans in each income decile that are FHA/VA and private, high-CLTV. We compute these shares at three different points in time: pre-boom (1999), boom (2006), and post-boom (2013). There are three key takeaways from this figure. First, there is a downward trend in the use of high-CLTV mortgages as income increase. Second, this downward trend stays roughly the same over the whole time series. That is, within each income decile over time, the share of purchase loans that are high-CLTV remains similar. Third, in contrast to the smoothness of the first two takeaways, within each income decile over time the share of high-CLTV loans that are government guaranteed goes from almost all of them, to almost none of them, and then back to almost all of them.

The results for zip codes split into income deciles are also present within zip codes themselves.

Panel A of Figure 6 plots zip codes with at least five purchase transactions with mortgages in both 1999 and 2006. The figure shows a positive relationship between the share of loans that were in 1999 guaranteed by either the FHA or the VA and the increase between 2006 and 1999 of the share of private-sector high-CLTV loans. The correlation between these two variables is .464 and demonstrates that, within 5-digit zip codes, knowing the importance of
government-guaranteed loans in the mortgage market is strongly predictive of the share of the 2006 cohort of purchase loans that will be private-sector high-CLTV loans. This result helps to rule out the possibility that the steadiness of the CLTV distribution is masking shifts in the geographic distribution of high-CLTV loans. For example, it could have been that high-CLTV, government-guaranteed loans were going to some parts of the country in 1999 (zip codes not in the sand states of AZ, CA, FL, and NV) and then, during the boom, the private-sector’s high-CLTV loans were all made to borrowers buying homes in the sand states. But this is not consistent with the results in Panel A of Figure 6.

Panel B of the figure moves along the time series and plots an analogous scatter plot comparing the increase in share of purchase loans insured by the FHA or the VA during the recovery to the share of loans that were in 2006 high-CLTV, private-sector mortgages. As before, we document a strong correlation consistent with the idea that zip codes are switching their source of high-CLTV loans from the government, to the private sector, and then back to the government.

4.2 Switching within Parcels

Of course, correlation within zip codes is not itself sufficient evidence that the same types of borrowers or geographies switch their source of high-CLTV loan from the government guaranteed part of the market to the private market. New construction in zip codes, the types of homes and properties that are listed for sale and eventually sold, or the people looking to buy and the properties they are interested in all might change over the time series in ways correlated with preferences for type of mortgage. To rule out some of the geography-related alternative hypotheses, we focus on the sample of properties that traded both pre-boom and during the boom or both during the boom and post-boom. The regression results from this new application of the repeat-sales methodology are presented in Table 1.
The sample used in the first model includes more than two million properties across the United States. These properties were all purchased by one household at some point between 1996 and 2003 (pre-boom) and by a different household between 2004 and 2007 (boom). We restrict the sample to properties where both trades were at arm’s length and utilized a mortgage. Our specification asks what the relationship is between the likelihood a property is purchased with a high-CLTV private-sector loan during the boom if it was financed with a government-guaranteed loan (FHA or VA) when purchased pre-boom. We run regressions of the following form for each property $i$:

$$ HighCLTV_{i,2004-2007} = GovtGuarantee_{i,1996-2003} + \eta_t + \eta_{t+1} + \eta_{County} + \varepsilon_i $$  \hspace{1cm} (1)

Where $\eta_{County}$ represents county fixed effects to absorb differences across the country the average use of government-guaranteed mortgages, and $\eta_t$ and $\eta_{t+1}$ represent year fixed effects for the first and second transactions to absorb overall changes in the rate that borrowers used different types of loans over time. We run regressions of a similar form for the crisis and recovery period, where we are interested in the switching back from private high-CLTV loans to government-guaranteed loans.

$$ GovtGuarantee_{i,2008-2015} = HighCLTV_{i,2004-2007} + \eta_t + \eta_{t+1} + \eta_{County} + \varepsilon_i $$  \hspace{1cm} (2)

We find a statistically significant and economically meaningful relationship. A property is 11.4 percentage points more likely to be purchased with a high-CLTV private mortgage if the property was purchased pre-boom with a government-guaranteed loan. To illustrate the economic importance of this estimated magnitude, we present some simple summary statistics in Table 2. We show that, among loans taken out in the period 2004-2007 for this sample, 24% $((379,697 + 193,464) / (2,362,748))$ were private, high-CLTV loans. So an 11.4 percentage point increase is equivalent to a nearly 50% increase. The unconditional results presented in Table 2 tell a similar story. Of properties financed with FHA/VA loans during
the pre-boom, 33.1% of them are financed with high-CLTV private loans during the boom, compared to just 21.4% of properties that were not financed with government-guaranteed loans pre-boom.

[TABLE 2 HERE]

The second model in Table 1 and second panel of Table 2 are analogous and focus on those properties traded first during the boom and then again during the recovery (2008-2015). The results are qualitatively very similar. In short, even at the property level, we document a striking switching between a government-guaranteed, high-CLTV mortgage and a high-CLTV mortgage provided by the private-sector. While it can be argued that the zip code correlations might not be evidence of switching if the types of houses trading are dramatically different pre- and post-boom compared to during the boom, that same argument cannot explain the results just presented.

4.3 Switching within Individual Borrowers

Even with the evidence on zip codes and properties, the results can be explained with something other than strict switching between two different types of providers of high-CLTV mortgages. Consider, for example, the possibility that the only people purchasing during the boom were the high-earners in each zip code and high-earners only use private-sector loans. In order to show results within-households, we use a subsample of the deeds data within which we can track households moving across the state. To build this dataset, we merge the North Carolina deeds data with the North Carolina voter registration records. The voter rolls data includes the address of the registered voter, and, if that voter moves, their address is updated in their voter registration record. The results presented in Table 3 and Table 4 are analogous to those in Table 1 and Table 2 except instead of focusing on properties that transact twice, we use borrowing households that purchase twice at two different properties for documenting switching.

4See a more thorough description of the construction of this dataset in McCartney (2017).
The sample used to estimate the models is small but still produces magnitudes that are both statistically and economically significant. Borrowing households that use government-guarantees for access to high-CLTV loans pre-boom switch to private, high-CLTV loans during the boom. And those households that first purchase during the boom and use high-CLTV, private mortgages switch to government-guaranteed mortgages post-boom. Specifically, looking at the first specification we see that borrowers are 11.3 percentage points more likely to use a private-sector loan with a high CLTV if their pre-boom loan was FHA- or VA-guaranteed. 17.1% \( \frac{(1,026 + 282)}{(7660)} \) of in-sample purchase mortgages originated in NC during the boom were private, high-CLTV mortgages. So an 11.3 percentage point increase amounts to a 66% increase from the mean. The model estimating switching in the second half of the time series finds a 6.74 percentage point increase or 34.7% increase from the mean.

As with the property switching results, the unconditional results for borrower switching presented in Table 2 tell the same story. In North Carolina, 15.5% of households who did not use FHA or VA loans for their pre-boom mortgage used a high-CLTV, private mortgage during the boom compared to 27% of households who did. Similarly, the rate of use FHA or VA loans during the post-boom was 24.7% for those borrowers that used high-CLTV, private mortgages for the boom purchase, compared to a smaller 18% of borrowers that did not.

5 Performance of Government-Guaranteed vs. Private

The last section of this paper uses the ex-post performance of high-CLTV loans guaranteed by the government versus those provided by the private-sector to provide further evidence

\[ \frac{0.0674}{(1,686 + 613) / (11,858)} \]
that two types of mortgages were being used interchangeably by the same types of borrowers in the same types of places.

**[FIGURE 7 HERE]**

Figure 7 plots the share of loans of each type by origination-year cohort that are at some point 90+ days delinquent within three years of origination. As expected, private-sector loans with CLTVs < 95% have significantly lower delinquency rates than any loan with a CLTV ≥ 95%. Strikingly, though, is the finding that within cohort the rates of delinquency for FHA/VA loans is the same as for private loans with CLTVs ≥ 95%. These results are completely unconditional and we interpret them with caution.

### 6 Conclusion

This paper shows that the distribution of purchase mortgage CLTVs has been steady for the last two decades. Underlying this stability is a large change in the way high-leverage mortgages are supplied. Specifically, before the large housing boom of the 2000s, high-CLTV mortgages were guaranteed by the government primarily through the FHA and VA programs. The boom saw an increase in the supply of private-sector high-CLTV loans, which then dried up again in the crisis, with a return of the FHA/VA for a significant share of the market.

The findings in the paper show that, despite the large expansion in the volume of credit during the boom, and the increase and drop in house prices in this time period, the share of high-CLTV loans is stable but provided by different sources. The fact that the government *explicitly* guarantees high-leverage loans during certain times, and then *implicitly* guarantees them during others through too-big-to-fail or other government backstops for financial institutions can have implications for overall financial stability.

Our paper also shows that empirical models of the housing market will be broadly accurate in assuming relatively stable “collateral rates” (in the language of Geanakoplos [2010])
As is the case of Kiyotaki and Moore (1997). As a matter for future research it is important, however, to consider two facts related to this paper: first, when and why does the private sector “drive-out” the government in supplying high-leverage loans, and, second, how do different sources of high-CLTV loans influence the path of house prices and the indebtedness of households.
References


Table 1: Properties in the United States that Transacted Twice

This table uses CoreLogic data. The first sample includes all those properties we observe trade at arms-length exactly one time in the period 1996-2003 and exactly one time in the period 2004-2007. The second sample is analogous for the periods 2004-2007 and 2008-2015. Standard errors clustered at the county level are reported in parentheses. Coefficients significant at the 10%, 5%, and 1% levels are marked with a *, **, and ***, respectively.

<table>
<thead>
<tr>
<th>Sample:</th>
<th>Properties with 1 purchase in 96-03 and 1 purchase in 04-07</th>
<th>Properties with 1 purchase in 04-07 and 1 purchase in 08-15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent Variable:</td>
<td>04-07 Loan is Private with CLTV ≥ 95%</td>
<td>08-15 Loan is FHA/VA</td>
</tr>
<tr>
<td>96-03 Loan FHA or VA</td>
<td>0.114*** (0.007)</td>
<td>0.0941*** (0.006)</td>
</tr>
<tr>
<td>04-07 Loan Private with CLTV ≥ 95%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed Effects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>County</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Year of First Loan</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Year of Second Loan</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>N</td>
<td>2,362,748</td>
<td>634,495</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.098</td>
<td>0.088</td>
</tr>
</tbody>
</table>
Table 2: Properties in the United States that Transacted Twice

This table uses CoreLogic data and presents counts and shares of certain types of mortgages originated in the 1996-2003, 2004-2007, and 2008-2015 periods for those properties that saw exactly one transaction during the boom and exactly one transaction pre-boom (panel A) or post-boom (panel B).

<table>
<thead>
<tr>
<th>Sample: Properties with 1 purchase in 96-03 and 1 purchase in 04-07</th>
<th>04-07 Loan</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>NOT Private, CLTV ≥ 95%</td>
<td>IS Private, CLTV ≥ 95%</td>
</tr>
<tr>
<td>NOT FHA/VA</td>
<td>1,398,185</td>
<td>379,697</td>
</tr>
<tr>
<td></td>
<td>78.6%</td>
<td>21.4%</td>
</tr>
<tr>
<td>IS FHA/VA</td>
<td>391,460</td>
<td>193,464</td>
</tr>
<tr>
<td></td>
<td>66.9%</td>
<td>33.1%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sample: Properties with 1 purchase in 04-07 and 1 purchase in 08-15</th>
<th>08-15 Loan</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Not FHA/VA</td>
<td>IS FHA/VA</td>
</tr>
<tr>
<td>NOT Private, CLTV ≥ 95%</td>
<td>286,135</td>
<td>164,593</td>
</tr>
<tr>
<td></td>
<td>63.5%</td>
<td>36.5%</td>
</tr>
<tr>
<td>IS Private, CLTV ≥ 95%</td>
<td>95,383</td>
<td>88,417</td>
</tr>
<tr>
<td></td>
<td>51.9%</td>
<td>48.1%</td>
</tr>
</tbody>
</table>
This table uses CoreLogic and voter registration data from North Carolina. The first sample includes all those households we observe take out exactly one loan in the period 1996-2003 at one property and exactly one loan in the period 2004-2007 at another property in North Carolina. The second sample is analogous for the periods 2004-2007 and 2008-2015. Standard errors clustered at the county level are reported in parentheses. Coefficients significant at the 10%, 5%, and 1% levels are marked with a *, **, and ***, respectively.

<table>
<thead>
<tr>
<th>Sample:</th>
<th>NC Households with 1 purchase in 96-03 and 1 purchase in 04-07</th>
<th>NC Households with 1 purchase in 04-07 and 1 purchase in 08-15</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dependent Variable:</td>
<td>04-07 Loan is Private with CLTV ≥ 95%</td>
<td>08-15 Loan is FHA/VA</td>
</tr>
<tr>
<td>96-03 Loan FHA or VA</td>
<td>0.113*** (0.014)</td>
<td>0.0674*** (0.011)</td>
</tr>
<tr>
<td>04-07 Loan Private with CLTV ≥ 95%</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fixed Effects</td>
<td></td>
<td></td>
</tr>
<tr>
<td>County</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Year of First Loan</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>Year of Second Loan</td>
<td>Y</td>
<td>Y</td>
</tr>
<tr>
<td>N</td>
<td>7,660</td>
<td>11,858</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.031</td>
<td>0.054</td>
</tr>
</tbody>
</table>
Table 4: Households in North Carolina that Borrowed Twice

This table uses CoreLogic data and voter registration data from North Carolina. The table presents counts and shares of certain types of mortgages originated in the 1996-2003, 2004-2007, and 2008-2015 periods for those households that made exactly one purchase transaction during the boom and exactly one purchase transaction pre-boom (panel A) or post-boom (panel B).

<table>
<thead>
<tr>
<th>Sample:</th>
<th>NC Households with 1 purchase in 96-03 and 1 purchase in 04-07</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>04-07 Loan</td>
</tr>
<tr>
<td></td>
<td>NOT Private, CLTV ≥ 95%</td>
</tr>
<tr>
<td>96-03 Loan</td>
<td>5,593</td>
</tr>
<tr>
<td>NOT FHA/VA</td>
<td>84.5%</td>
</tr>
<tr>
<td>IS FHA/VA</td>
<td>763</td>
</tr>
<tr>
<td>73.0%</td>
<td>27.0%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Sample:</th>
<th>NC Households with 1 purchase in 04-07 and 1 purchase in 08-15</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>08-15 Loan</td>
</tr>
<tr>
<td></td>
<td>Not FHA/VA</td>
</tr>
<tr>
<td>04-07 Loan</td>
<td>7,690</td>
</tr>
<tr>
<td>NOT Private, CLTV ≥ 95%</td>
<td>82.0%</td>
</tr>
<tr>
<td>IS Private, CLTV ≥ 95%</td>
<td>1,874</td>
</tr>
<tr>
<td>75.4%</td>
<td>24.7%</td>
</tr>
</tbody>
</table>
Figure 1: A Steady Distribution of Purchase Loan CLTV Ratios Over Time

This figure plots the combined loan-to-value ratios (CLTVs) of the universe of purchase transactions financed with at least some debt covered in the CoreLogic deeds data between 1996 and 2015. Each purchase transaction includes data on up to three mortgages, one primary mortgage and up to two piggyback mortgages. The percentiles and mean are calculated using all purchase loans originated in the calendar year.
Figure 2: Share of all Purchase Loans by Year

In this figure purchase loans are grouped into one of four types: FHA- with CLTV ≥ 95%, VA-guaranteed with CLTV ≥ 95%, and all other loans with CLTV ≥ 95%. The top figure plots the share of all purchase loans were not explicitly government guaranteed and had CLTV ratios ≥ 95%. The second plot adds the share of high-CLTV loans explicitly guaranteed by the government.
Figure 3: A Changing Share of Government-Guaranteed Mortgages

To produce this figure, purchase loans are grouped into one of five types, the four explicitly plotted below and everything else. The figure plots the share of each type totaling up to 100% of all purchase loans. Data is from CoreLogic.
Figure 4: Cumulative Distribution Functions of CLTVs

This figure shows cumulative distribution of combined loan-to-value ratios in CoreLogic that are not classified as either FHA or VA loans (Panel A) and all transactions (Panel B). This includes Fannie Mae and Freddie Mac, any privately securitized loans, or loans held on the portfolios of private financial institutions.
To produce this graph we created ten deciles of 1998-zip code income. Deciles are population weighted such that each decile contains ten percent of the population of the United States. For each year, we calculate the share of purchase loans that are guaranteed by the government and the share that private-sector with CLTVs ≥ 95%. The zip-code level income data is from the IRS, https://www.irs.gov/statistics/soi-tax-stats-individual-income-tax-statistics-zip-code-data-soi.
Figure 6: Change in Zip Code Level Share of Loan Types

This first panel of this figure plots zip codes based on the share of 1999 purchase loans in that zip code that were FHA- or VA-guaranteed (on the x-axis) and the difference between the share 2006 purchase loans in that zip code that were not FHA or VA and had CLTVs ≥ 95% and the share of such loans in 1999 (on the y-axis). The second panel of this figure plots zip codes based on the share of 2006 purchase loans in that zip code that were not FHA or VA and had CLTVs ≥ 95% (on the x-axis) and the difference in the share of 2013 purchase loans guaranteed by either the FHA or VA and the share of such loans in 2006. (on the y-axis).
This figure uses McDash data starting in the second half of 2005. Year by year, we calculate the share of loans originated within a category that were 90+ days delinquent at some point in the three years after origination.

Figure 7: Share 90+ Days Delinquent Within 3 Years of Origination