Mortgage Market Concentration, Foreclosures and House Prices*

Giovanni Favara
Board of Governors of the Federal Reserve System
giovanni.favara@frb.gov

Mariassunta Giannetti
Stockholm School of Economics,
CEPR and ECGI
mariassunta.giannetti@hhs.se

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Abstract

Previous work has shown that mortgage foreclosures generate a negative externality on nearby house prices. In this paper, we conjecture that lenders with a larger share of a neighborhood's outstanding mortgages on their balance sheets internalize this externality and thus more inclined to renegotiate defaulting loans. We provide evidence supporting this conjecture using zip code level data on house prices and foreclosures during the 2007-2009 US housing market crisis. We find that zip codes with larger concentration of outstanding mortgages experienced fewer foreclosures and a smaller decline in house prices. These findings are not driven by prior local economic conditions, mortgage securitization or ex-ante lenders characteristics, and hold within geographical areas exposed to common economic shocks, such as MSAs or counties. We also find that the concentration of outstanding mortgages matters more in ZIP codes of non-judicial states where foreclosure procedures are less costly.

Keywords: House Prices; Foreclosures; Bank Concentration

JEL Codes: G01; G21; R31; R38

I Introduction

The recent collapse of the U.S. housing market has been followed by a dramatic increase in mortgage defaults. Most often, mortgage lenders have reacted by foreclosing the homes of defaulting borrowers, instead of renegotiating their repayment schedule. Foreclosures have attracted a lot of attention in the media and the political debate, because of their social implications and the negative large drops in house prices they are associated with. But, setting aside the social implications, has the rate of foreclosure been too high? Put differently, have foreclosures amplified the impact of mortgage defaults on the aggregate losses of mortgage lenders? An answer to this question is important because if foreclosures increase aggregate losses, they may aggravate the negative fiscal implications of bank bailouts. This paper explores these questions both theoretically and empirically.

Recent evidence shows that foreclosures are associated with price declines of neighboring houses (Campbell, Giglio and Pathak, 2011), either because poor maintenance of foreclosed properties affects the quality of nearby houses (Harding, Rosenblatt, Yao, 2009), or because foreclosures increase the supply of homes in illiquid markets (Anenberg and Kung, 2013). Thus, foreclosures appear to create a negative externality. For instance, foreclosures may lead to contagious defaults because they affect the social norm regarding the repayment of mortgages (Guiso, Sapienza and Zingales, 2013), or because house price declines trigger further defaults by borrowers with negative home equity (Elul, Souleles, Chomsisengphet, Glennon, and Hunt, 2010)

This paper shows that the concentration of the mortgages outstanding in a neighborhood on lenders' balance sheets affects the lenders' incentives to foreclose or renegotiate defaulting mortgages. This in turn has an effect on the dynamics of house prices and bank losses in that neighborhood. We first present a stylized model to illustrate how the incentives to foreclose are weaker for a lender that retained a large proportion of the outstanding mortgages in a neighborhood. Next, we use U.S. zip code level data on the concentration of outstanding mortgages, foreclosures and house prices to test the model's predictions.

In the model, defaults occur when negative income shocks make borrowers unable to honor their mortgage debt obligations.[1] These liquidity defaults may lead to renegotiations or foreclosures depending on lenders' stakes in the local mortgage markets. When the provision of credit is dispersed, foreclosure decisions are taken in isolation, and (atomistic) lenders do not internalize the pecuniary externality that their decisions have on local housing prices. In these markets, liquidity defaults are more likely to lead to foreclosures and to be followed by strategic defaults, because borrowers who can afford to repay mortgages find it optimal to default when the value of their mortgages exceeds the value of their houses. In contrast, a lender that retained a large proportion of the outstanding mortgages in a neighborhood internalizes the adverse effects of liquidation decisions and has stronger incentives to renegotiate defaulting loans. More renegotiations reduce the adverse effects of negative shocks on the demand for housing leading to lower rates of house price depreciation and weakening other borrowers' incentives to strategically default. As a consequence, in neighborhoods with high outstanding mortgage concentration, even atomistic banks that foreclose defaulting mortgages experience smaller losses.

To test the implications of this theory, we use differences in mortgage lending concentration, foreclosure rates, and house prices across U.S. zip codes during the 2004-2009 period. Zip codes are the finest geographical units for which we are able to explore price changes in a broad cross-section of areas and within which foreclosures may be expected to have a negative externality on house prices. Using zip code level data, we can exploit variation in outstanding mortgage concentration within broad local areas, such as counties or MSAs, which are affected by common economic shocks. Consistent with the model's predictions, following negative income shocks, house prices drop to a lower extent in areas where few lenders retained a large share of outstanding mortgages on their balance sheets. We estimate an elasticity of house price to negative income shocks of 4.5 percentage points in the least concentrated lending markets, but this elasticity drops to 3.7 percentage points

[1] While we model the externality using strategic defauls, as we explain in Section **xxx**, other mechanisms could generate the same pecuniary externality, which banks that own a large share of the loans in a geographical area are able to internalize.

if the concentration of outstanding mortgages increases by a one standard deviation (0.023).

The results are robust to the inclusion of standard controls for local housing, income and demographic characteristics as well as for aggregate nationwide trends. The results are also robust to the use of alternative indexes of market concentration and are not driven by the fact that counties with high concentration experienced smaller house price appreciation before the negative income shock.

Differences in *ex ante* competition across geographical areas are also unlikely to explain our findings for the following reasons. Not only we control for differences in ex ante mortgage contracts across geographical areas by including the average loan-to-value ratio, mortgage per capita and proxies for borrower creditworthiness, but our results are robust within MSAs and within counties. Since borrowers can approach lenders in larger geographical areas, ex ante competition is expected not to vary within a county or an MSA, while the negative externality due to foreclosures and the mitigating effect of mortgage concentration are expected to be stronger within a smaller geographical area such as the zip code.

To strengthen the interpretation of these findings, we test three additional implications of our theory. First, even lenders without a large share of outstanding mortgages in a zip code should have weaker incentives to foreclose in jurisdictions where foreclosure procedures entail higher transaction costs. Consequently, as is consistent with the empirical evidence we provide, the concentration of outstanding mortgages should mitigate the effects of negative income shocks on house prices to a lower extent in these jurisdictions. Second, we show that the link between house prices and mortgage market concentration goes through lenders' propensity to foreclose defaulting loans. Following a negative income shock, there are more foreclosures in zip codes with more dispersed mortgage provision, and, consistent with the findings on house prices, the effect of mortgage concentration is stronger in jurisdictions where foreclosure procedures are less costly. Third, while mortgage concentration is associated with fewer foreclosures following negative income shocks, it is not associated with lower delinquency rates. This indicates that lenders in these areas have different incentives to solve distress ex post, but do not have better information in selecting borrowers ex ante.

Finally, we explore the role of securitization in driving our findings. Securitization tends to reduce the concentration of outstanding mortgages since securitized mortgages are best thought as held by "atomistic" lenders. Thus, the handling of mortgages by intermediaries (servicers) with weak organizational capabilities to conduct renegotiation may be viewed as an optimal contractual feature because it is consistent with the ex post incentives of securitized lenders. However, securitization may lead to frictions in renegotiation that arise for mechanisms that are alternative to the one we propose. For this reason, we show that our results continue to hold when we control for the proportion of securitized mortgages or exclude securitized mortgages in computing our indexes of local market concentration. Thus, the effects of outstanding mortgage market concentration are distinct from any effects of securitization.

The rest of the paper proceeds as follows. Section 1 discusses the related literature. Section 2 introduces a simple theoretical framework. Section 3 describes the data used in the paper and the empirical strategy. Section 4 presents evidence supporting the mechanisms linking mortgage concentration to changes in house prices. Section 5 concludes the paper.

II Related Literature

Our work is related to several strands of literature. First, we contribute to the burgeoning literature scrutinizing the 2007–2009 real estate crisis. A number of papers in this literature have highlighted the negative externality of foreclosures on housing prices in a neighborhood (Harding, Rosenblatt, Yao, 2009; Calomiris, Longhofer and Miles, 2010; Campbell, Giglio and Pathak, 2011; Mian, Sufi, and Trebbi, 2012; Anenberg and Kung, 2013). Mian, Sufi, and Trebbi (2012) stress that foreclosures are more frequent in states where bankruptcy laws decrease the cost of foreclosing for the lender.[2] We propose that lenders with a large share of outstanding mortgages in a neighborhood may internalize the externality created by foreclosures and that therefore the concentration

[2] Li, White and Zhu (2011) and Von Lilenfeld-Toal and Mookherjee (2011) argue that mortgage defaults became more frequent after the change in personal bankruptcy laws that increase the cost of defaulting on unsecured credit for the borrower.

of outstanding mortgages may mitigate the effect of negative shocks on house price depreciation.

Our paper is also related to the literature that stresses the role of securitization and the mortgage servicers as an impediment to renegotiation. Piskorski, Seru and Vig (2010) and Agarwal et al. (2011) argue that securitized loans are more likely to be foreclosed because dispersed ownership (brought about by mortgage securitization) and the organizational structure of servicers inhibit loan renegotiation. By contrast, Adelino, Gerardi and Willen (2010a and b), and Ghent (2011) provide evidence that securitization is unlikely to be the main reason why lenders are reluctant to renegotiate mortgages. Relative to this literature, we stress the independent role played by the mortgage market structure and argue that servicers' inability to renegotiate may have been a feature of the optimal contract given that securitized mortgages are best thought as held by atomistic lenders.

The role of securitization and more in general bank diversification has been explored also in relation to information acquisition (Keys, Mukherjee, Seru and Vig, 2010; Loutskina and Strahan, 2011; Keys, Seru and Vig, 2012). Loutskina and Strahan (2011) show that the technology of lenders that diversify their mortgage portfolio across many markets involves less investment in private information. Instead of focusing on lenders' diversification across MSAs, as Loutskina and Strahan (2011) do, we explore the role of mortgage dispersion between many lenders within a zip code, controlling for the lenders' characteristics that may be related to their propensity to acquire information.

An earlier strand of literature explores the effects of a concentrated banking systems on bank-firm relationships (Petersen and Rajan, 1995) and loan supply (Garmaise and Moskowitz, 2006). Scharfstein and Sunderam (2013) argue that a significant increase in the concentration of mortgage origination has decreased the sensitivity of mortgage rates and refinancing activity to mortgage-backed security yields. All these papers study the effects of market concentration on ex ante competition in the origination of loans and contract terms. We focus on the concentration of *outstanding* mortgages, as opposed to the concentration of mortgage *origination*. To the best of our knowledge, we are the first to highlight the role of market structure on lenders' liquidation

incentives and on asset prices. In fact, the mechanism highlighted in this paper has bearings beyond the context of the housing market – it has implications for the price volatility of any collateralized market with dispersed lending structure. By showing that a market with dispersed lenders is more prone to fire sales, we also provide an alternative interpretation to the one in existing literature that competition in the market for credit erodes financial stability because it lowers lenders' profits, distorting their risk-taking decisions (Keely, 1990).

Finally, the paper is related to a smaller literature that explores the role of government interventions following bankruptcy. Bolton and Rosenthal (2002) show that, in the presence of aggregate shocks, (unanticipated) government intervention that gives defaulting borrowers the option to continue to produce, makes the equilibrium more efficient. We show that when outstanding mortgages are dispersed across lenders, foreclosures may increase the aggregate losses of the banking system because atomistic banks do not internalize the negative externality of foreclosures. In this context, government intervention favoring renegotiation would be desirable.

III Theory and Testable Implications

This section presents a simple model to illustrate how negative shocks affect foreclosures and house prices in markets with different concentration of the outstanding mortgages across lenders. At the center of the model is a pecuniary externality of foreclosures, which may magnify the effect of negative shocks on the local housing market. In the model, the pecuniary externality arises because households have incentives to default strategically. However, the effect of mortgage lenders' concentration that we highlight does not rely on the specific mechanism leading to the pecuniary externality. We discuss other possible mechanisms when we introduce the empirical design.

A The model

A.1 Assumptions

We consider a one-period model with two dates and two groups of agents of mass 1, households (indexed by i) and banks. At $t = 0$, some households enter the period with one unit of housing endowment $h_{0i} = 1$ and an outstanding mortgage payment B. At $t = 1$, households enjoy utility from consumption, $c_i \geq 0$, and housing $h_i \in \{0, 1\}$:

$$U_i = c_i + \gamma_i h_i,$$

where γ_i is uniformly distributed:

$$\gamma_i \sim \mathcal{U}\ [0, \overline{\gamma}]\,,$$

and captures heterogeneity in utility from home ownership. It is assumed that agents with housing endowment $h_{0i} = 1$, are those with the highest valuation for housing services.

At $t = 1$ households receive a random income w_i. With probability q, everyone receives w, and with probability $1 - q$, a fraction e of households receive θw, with $0 < \theta < 1$. The income shock is independently distributed from γ_i and those hit by the negative shock are unable to repay B:

$$w > B > \theta w. \tag{1}$$

Thus, households hit by negative shocks default. In this case, banks may partially recover the amount due by repossessing and liquidating the house at the equilibrium price p to be derived below.[3] Housing supply is fixed and equal to $\overline{H} < \overline{\gamma}$.

The household's budget constraint at $t = 1$ depends on the realization of the income shock and on whether the household repays or defaults on the mortgage. In the latter case, the budget constraint is also affected by the bank's liquidation decision. Under the assumption that the bank

[3] This assumption puts an upper bound on households' indebtness: $B \leq p$. If the repayment obligation were larger than the equilibrium price prevailing when no negative shocks occur, households would always default as they have the option to surrender the house to the bank.

liquidates defaulting mortgages, the budget constraint can be written as:

$$w_i = \begin{cases} c_i + B + p(h_{1i} - h_{0i}) & \text{no default} \\ c_i + ph_{1i} & \text{default \& liquidation} \end{cases}.$$

A.2 Equilibrium housing prices, banks' contracts, and strategic defaults

A financially unconstrained household demands a house if:

$$\gamma_i \geq p,$$

Since γ_i is uniformly distributed, the equilibrium price in absence of shocks is determined by equating aggregate demand and supply:

$$p = \overline{\gamma} - \overline{H}.$$

In this case, all households repay B and, under our assumption on the initial distribution of housing, they hold on to their houses.

In contrast, when households are hit by a negative income shock, they cannot repay B (by (1)). If the banks seize their houses, a fraction e of households is financially constrained and cannot participate in the housing market. The market clearing condition becomes:

$$(1 - e)(\overline{\gamma} - p) = \overline{H},$$

and the equilibrium price is:

$$p^L = \overline{\gamma} - \frac{\overline{H}}{1 - e}.$$

It follows immediately that p^L is strictly lower than p, because some households with high housing utility cannot participate in the market. As the aggregate demand is lower, the house price has to fall in order to clear the market.

An equilibrium in which banks liquidate the houses of defaulting borrowers implies that $p^L < B$; otherwise the households hit by negative shocks would sell the house by themselves and pay back the mortgage. This implies that in an equilibrium with liquidation, households with a high income

realization always strategically default because they can purchase a house at a price lower than B. Note that in an equilibrium with liquidation and strategic and liquidity defaults, the following condition always holds:[4]

$$\theta w < \overline{\gamma} - \frac{\overline{H}}{1-e} \leqslant w,$$

meaning that households that suffer a negative shock are unable to participate in the housing market (the first inequality), while non distressed households default strategically.[5]

The above discussion can be summarized in the following Lemma.

Lemma 1 *When defaulting loans are liquidated, a fraction e of households with high utility from housing cannot participate in the housing market. This causes the equilibrium price to drop, leading unaffected borrowers to default strategically.*

A.3 Renegotiation

If, instead of liquidating defaulting mortgages, banks were to renegotiate their loans marking down the loan repayment, households would remain in possession of their houses, and would thus able to participate in the housing market. Aggregate housing demand would remain the same as in absence of shocks, and the equilibrium price under renegotiation p^R would be the same as p:

$$p^R = p = \overline{\gamma} - \overline{H}.$$

In this equilibrium, unaffected households have no incentive to default strategically. However, since

$$\theta w < \overline{\gamma} - \frac{\overline{H}}{1-e} = p^L,$$

[4] This is the only equilibrium with liquidation (and strategic defaults). The condition $p^L < w$ is implied by $p^L < B < w$. An equilibrium in which after a negative shock $p^L > w$ does not exist because no households would be able to purchase a house, causing the house price to fall. Similarly, it cannot be that $p^L < \theta w$. If this were the case, at least as many households as in the state of the world in which no shock occurs would want and would be able to purchase a house, driving the equilibrium house price above θw.

[5] The logic we highlight would go through if intermediaries purchased the houses and provided housing services to households that had strategically defaulted.

the housing price under liquidation will always be larger than the highest payment θw that a bank can obtain if it renegotiates with a borrower hit by a negative shock and protected by limited liability. It follows that for an atomistic bank it is always optimal to liquidate rather than to renegotiate.

Proposition 1 *Atomistic banks always liquidate and never renegotiate with defaulting households.*

A.4 Banking concentration, house prices and strategic defaults

We now consider the case in which one of the mortgage providers holds a large fraction ξ of the outstanding mortgages (henceforth, large bank). The large bank internalizes that its decision to liquidate or renegotiate has an effect on the aggregate demand for housing.

If this bank liquidates, the aggregate demand for housing is identical to the one in the economy with atomistic banks derived above. However, if this large bank renegotiates, its borrowers will continue to participate in the housing market. Under the assumption (which will be verified in equilibrium) that atomistic banks continue to liquidate, the aggregate housing demand is:

$$(1-\xi)(1-e)(\overline{\gamma}-p^{L'})+\xi(\overline{\gamma}-p^{L'});$$

and the equilibrium price is:

$$p^{L'}=\overline{\gamma}-\frac{\overline{H}}{(1-\xi)(1-e)+\xi},$$

which is larger than p^L. Furthermore, $p^{L'}$ increases in ξ, the parameter capturing outstanding mortgage concentration.

For values of ξ sufficiently close to 1, the aggregate housing demand, and the resulting equilibrium price, could be such that $p^{L'} > B$. No (strategic or liquidity) defaults would occur, but households hit by the negative shock that are client of the large bank would experience a debt write down; the remaining households hit by the negative shock would sell their house and repay the mortgage.

For smaller values of ξ , the house price may decrease below B and also the borrowers of the large bank that have not been hit by the shock would want to default. Under the assumption that

the large bank can distinguish between households that have and have not been hit by the shock, the large bank can offer to write down the mortgages of the households that have not been hit by a shock to $B' = p^{L'}$. Households would find it optimal to accept the offer.

The assumption that banks can distinguish between households that are hit by income shocks and households that are not is crucial. If this was not possible, intact households could strategically ask for a loan modification. Mortgage lenders' inability to distinguish between these two types of households has often been considered a determinant of lenders' reluctance to renegotiate. Instead, we assume that endowment shocks are observable even though not verifiable.[6] This assumption is supported by empirical evidence. For instance, during the foreclosure crisis of 2008-2009, lenders had easy access to a wealth of information about households and should have been able to at least identify pools of households particularly likely to have experienced a negative shock. Lenders could thus have agreed to modify mortgages to a different extent depending on household characteristics (see Ghent (2011) for a similar argument).[7]

Following a negative income shock that affects a fraction e of households, a large bank with a fraction ξ of the mortgage market that renegotiates its mortgages would be able to obtain repayment:

$$\xi \left[(1-e) \left(\overline{\gamma} - \frac{\overline{H}}{(1-\xi)(1-e)+\xi} \right) + e\theta w_2 \right],$$

which is larger than what the bank could obtain by liquidating, $\xi \left(\overline{\gamma} - \frac{\overline{H}}{1-e}, \right)$, if the following condition holds:

$$\frac{\xi}{(1-\xi)(1-e)+\xi} \frac{\overline{H}}{1-e} > \overline{\gamma} - \frac{\overline{H}}{(1-\xi)(1-e)+\xi} - \theta w_2. \tag{2}$$

As can be easily seen, the incentives to renegotiate become stronger when ξ is larger. Also, if condition (2) holds, not only bank concentration reduces the impact of the negative income

[6] The model could be extended to allow banks to distinguish between the households that are hit by income shocks and households that are not with noise.

[7] It is also relevant to note –even though it remains outside our model– that in concentrated mortgage markets, lenders are also likely to have much more soft information about the borrowers that would help in the decision whether to modify the mortgage. This would reinforce the results we present hereafter.

shocks on house prices, but also decreases the aggregate mortgage losses. The reason is that the *all* banks, not only the bank with a large fraction of outstanding mortgages, obtain a higher average repayment, because even atomistic banks are able to liquidate the houses of defaulting borrowers at a higher price. Thus, a smaller fraction of the outstanding mortgages must be written down by both large and atomistic banks.

Under the assumptions made so far, if a "large" bank renegotiates, the other banks have even stronger incentives to liquidate as the house price is now higher. Thus, a large bank alone cannot prevent foreclosures and strategic defaults, although it can mitigate the effects of negative income shocks on house prices.[8]

The following proposition summarizes this discussion.

Proposition 2 *The effect of negative shocks on house prices is ceteris paribus smaller when the concentration of outstanding mortgages is higher.*

The main prediction of the model is that mortgage lending concentration mitigates the effect of negative income shocks on house prices by reducing lenders' propensity to foreclose the mortgages of defaulting borrowers. In the next section, we design an empirical strategy to test this prediction, and investigate the mechanisms linking mortgage concentration to the changes in house prices and foreclosures.

IV Empirical Evidence

A Empirical Design

The model suggests that a negative shock may be amplified by lenders' liquidation decisions in geographical areas with dispersed mortgage lending. The effect arises because of a pecuniary externality of foreclosures, which existing literature documents to operate more strongly within

[8] If we more realistically introduce a cost of strategic defaults for the households, the model implies that banking concentration also reduces the extent of defaults and further reduces the effects of negative shocks on house prices.

narrowly defined geographical areas and that we will be able to document at the zip code level, like Mian, Sufi and Trebbi (2012). The pecuniary externality may operate through strategic defaults that accompany liquidity defaults and amplify the effect of negative shocks on house prices, as illustrated by our stylized model. Although the notion that foreclosures may cause strategic defaults is supported by empirical evidence (Elul, Souleles, Chomsisengphet, Glennon, and Hunt, 2010; Guiso, Sapienza and Zingales, 2013), the concentration of outstanding mortgages could mitigate the effect of negative shocks even if the pecuniary externality operated through different mechanisms. For instance, a given income shock may be amplified if the households whose homes are foreclosed are forced to move out of the neighborhood thus decreasing the income of local retailers that may in turn default on their own mortgages. Lenders with a large exposure to a geographical area may internalize these effects and avoid foreclosures.

Since the intensity of the shock may endogenously depend on these feedback effects, it is important to isolate *exogenous* income shocks. We achieve this in two ways. First, we recognize that industries are differently distributed across the U.S. and that employment in some industries declined more dramatically during the crisis. Following Bartik (1991), we thus use early employment levels at the two-digit SIC level in a geographical area and national growth rates in each industry over the relevant period to measure the intensity of the shock. That is, we predict expected income growth in a geographical area between periods t and $t+k$ based on the initial industry mix in that geographical area at time t and the change in industry earnings for the entire U.S. between t and $t+k$. This measure has been widely used in the literature (see, for instance, Blanchard and Katz, 1992; Saiz, 2010; Guerrieri, Hartley and Hurst, 2013) and is less sensitive than actual income growth to feedback effects as the ones described above. Since our theory has predictions for negative income shocks only, we capture negative shocks by defining a dummy that takes a value equal to 1 if the predicted expected income growth using the Bartik methodology is negative.

Second, while the pecuniary externality and therefore the mitigating effect of the outstanding mortgage concentration are expected to be stronger within limited geographical areas, such as the

zip codes, income shocks are common to larger geographical areas because households commute to jobs within an MSA. Not only we compute our measure of shock at the MSA level, but we also perform large part of our analysis within geographical areas that are expected to have experienced common shocks (such as MSAs and even counties). Thus, we ask whether within an MSA (or a county) that has experienced an (identical) negative economic shock, zip codes with higher concentration of outstanding mortgages experience smaller house price depreciations and fewer foreclosures, as our theory would imply.

B Data sources

We combine a variety of data sources. To measure mortgage lending concentration and other characteristics of the local housing market, we use data from the Home Mortgage Disclosure Act (HMDA). The Home Mortgage Disclosure Act requires depository and non-depository financial institutions with more than $30 million in assets to report information on mortgage applications, the loan disposition, including whether it is retained or securitized, and other mortgage characteristics that can be used to track lending trends (see, e.g., Mian and Sufi, 2009; Glaeser, Gottlieb and Gyourko, 2010; Favara and Imbs, 2011, Loutskina and Strahan, 2011). HMDA is a comprehensive source of information on primary U.S. mortgage originations, covering over 90% of the mortgage activity of commercial banks, thrifts, credit unions, and mortgage companies. Since HMDA does not report zip codes, for each lender, we aggregate HMDA data up to the census tract level and match census tracts to ZIP codes using Census Tract Crosswalks, a match provided by Population Studies Center, as Mian and Sufi (2009) do.

We obtain foreclosure data on residential properties from RealtyTrac.com, one of the leading online marketplace for foreclosure properties, covering over 92% of housing units in the U.S.. RealtyTrac.com collects information on distressed properties from the moment a borrower defaults on payments, and a lender files a notice of default, to the moment a lender submits a notice of sale, and the property is sold at a public action. Using information on the location of a distressed property, we keep track of the number of foreclosure auctions and construct a zip code level measure of forced

sales.

As banks' propensity to foreclose or renegotiate mortgages in default may also depend on the mortgage law prevailing in the state where they operate, we also gather information on bankruptcy procedures from Rao and Walsh (2009). This information is used to classify states depending on whether lenders must receive a judge's approval to foreclose (judicial foreclosure states). From Cutts and Merrill (2008), we also obtain information on the estimated number of days required to accomplish a foreclosure, another proxy for the overall cost of a foreclosure procedure.

We use CoreLogic quality-adjusted house price indexes for existing single family properties to measure the house price level in a zip code and exclude any zip codes in HMDA or RealtyTrack.com that have no match with Corelogic.

From Equifax, we obtain zip code level annual data for outstanding credit and mortgage delinquency rates.

We control for local economic, financial and housing conditions using a variety of data sources. Zip code level information on income per capita and population is from the Bureau of Census. Industry income and employment and the county level unemployment rate are from the Bureau of Economic Analysis. Finally, data on local housing supply conditions are from the National Association of Realtors.

All data are collected at annual frequency from 2001 to 2009 and, to smooth out year-on-year fluctuations, collapsed into three subperiods, 2001-2003, 2004-2006 and 2007-2009, covering the recent boom and bust in the U.S. housing market.

C Measuring the concentration of outstanding mortgages

Our measure of outstanding mortgage concentration is based on the model's prediction that concentration matters not for its ex ante effects on contract terms, but for the way in which it affects lenders' ex-post incentives to foreclose properties. Accordingly, we define a proxy for concentration that measures a lender's exposure to the local mortgage market. We aggregate HMDA data at the zip code level keeping track of the number and the dollar amount of conventional loans originated

for the purchase of single-family, owner-occupied houses, as well as the fraction of these loans that are securitized.[9] We then compute for each zip code an Herfindahl index with market shares defined as the volume of mortgage loans originated and retained by individual lenders in any 3-year period (i.e., 2001-2004) relative to the total volume of loans originated in the same zip code over the same period. We choose a 3-year window because we want a measure of concentration in terms of the stock (not the flow) of retained mortgages. Importantly, we assign to each lender only mortgages retained, because losses associated to the default of securitized mortgages are unlikely to be borne by the original lender. Thus, while the denominator of each lender's share in the local mortgage market includes both retained and securitized mortgages, the numerator includes only retained loans. We classify a mortgage as securitized, if it is sold within a year to a GSE or a non-affiliated institution. Since the process of securitization takes two to three months, in constructing this and the other outstanding mortgage concentration indexes we present below, we consider only mortgages originated in the first three quarters of the year as mortgages issued at the end of the year may be securitized at the beginning of the following year and incorrectly classified as retained.[10]

To evaluate the robustness of our results, we also consider an alternative index of outstanding mortgage concentration. We compute market shares excluding securitized mortgages from the denominator in order to isolate the role played by mortgage concentration independently from to securitization.

To avoid simultaneity problems, we use indexes of outstanding mortgages concentration com-

[9] We exclude loans for the purchase of multi-family dwellings, second and vacation homes because we observe only house prices indexes for single-family owner-occupied houses. We also exclude loans for refinancing and home improvement, although this is not crucial for our results.

[10] All results are similar to the ones we present hereafter if we compute market shares based on the number (instead of the volume) of loans originated and retained or if we include the loans originated in the last quarter in the computation of the market shares. The coefficient of correlation between the same index of concentration computed with and without the mortgages originated in the last quarter of each year is always in excess of 85%.

puted over the period $(t, t+2)$ to explain the change in house prices during the interval $(t+3, t+5)$.[11] Thus, in practice we explore changes in house prices over the two subperiods 2001-2004 and 2004-2006. We do so to minimize concerns that housing market developments affect the concentration of outstanding mortgages, even though this reverse causality argument is not a big concern in our analysis. If concentration were driven by house price changes, large shocks would be more likely to wipe out smaller lenders, increasing concentration and introducing a downward bias in the estimates of the outstanding mortgage concentration coefficient.

D Descriptive statistics

Our sample consists of 15,430 zip codes in 200 counties, which in turn belong to 84 MSAs in continental U.S., for which zip code level price indexes and mortgage data are available. As common in the literature, we focus on urban areas because house price dynamics, borrower characteristics, and mortgage lending decisions have different determinants in rural, often poor, areas.

Table 1 reports summary statistics together with variable definitions and data sources. On average, outstanding mortgages in our sample are very dispersed. While the indexes vary little over time, there is substantial cross-sectional variation in the concentration of outstanding mortgages: In some zip codes, the concentration index a takes value equal to zero indicating that all outstanding mortgages have been securitized (and therefore it is as if the markets were covered by atomistic lenders), while in others it is equal to 1 indicating that there is only one lender. It is precisely these differences that we exploit in our analysis.

During the period under consideration, a large fraction of loans, 60 percent on average, were securitized, either with GSEs or private institutions, introducing some differences between our two indexes of market concentration. When the market shares used to compute the index of outstanding mortgage concentration exclude from the denominator the volume of securitized loans, zip codes naturally exhibit a higher concentration of outstanding mortgages. Our different measures of market

[11] The results we present hereafter are invariant if we compute the indexes of outstanding mortgages over the same period as the house price changes.

concentration are, however, highly correlated, with a correlation coefficient larger than 40%.

Between 2004 and 2009, house prices experienced a pronounced boom and bust cycle. On average, however, prices decreased by almost 8 percent, reflecting the generalized house price decline in the 2007-2009 period. The observed variation in house prices is, however, quite heterogeneous, with very few zip codes experiencing price appreciation even in the second subperiod. This partially reflects the fact that even in the second subperiod only 60% of the zip codes experienced a negative income shock, defined using the Bartik methodology.

Table 1 also reports summary statistics for the number of foreclosure of single family properties. Even though a foreclosure process starts when a lender files a default notice (through a notice of default or a lis pendens), we compute the number of foreclosures using only RealtyTrac.com's records for properties that either receive a notice of sale (NOS) or a notice of trustee sale (NTS) and for real estate owned (REO) properties, i.e., properties that are repossessed by lenders after a notice of default. We follow this strategy because a notice of default may not necessarily lead to a forced sale, given that a defaulting borrower can always reinstate loan payments during a grace period that varies from state to state. As RealtyTrac.com provides reliable data on foreclosure from 2006, we are able to compute average yearly foreclosures only for the subperiod 2007-2009. A shown in Table 1, there is large variation in the foreclosures, with 10% of the zip codes experiencing just one or two foreclosures. As we show in the empirical analysis, the variation in the number of foreclosure remains significant after controlling for the number of outstanding mortgages and the number of 60 days mortgage delinquencies in the zip code.

E Main results

The main prediction of the model is that income shocks have a muted effect on house prices in areas with higher outstanding mortgage concentration. To test this prediction, we estimate variations of

the following reduced form regression:

$$\begin{aligned}\Delta \ln p_{z,t} &= \alpha_1 HHI_{z,t-1} + \alpha_2 \mathbf{1}_{\Delta \ln y_{i,t}<0} + \alpha_3 HHI_{z,t-1} \times \mathbf{1}_{\Delta \ln y_{i,t}<0} \\ &\quad + \beta X_{z,t} + \gamma_t + \delta_{MSA} + \varepsilon_{z,t},\end{aligned} \tag{3}$$

where z is an index for zip codes and t an index for the two subperiods, i.e. $t = 2004 - 2006$ and $2007 - 2009$. The dependent variable, $\Delta \ln p_{z,t}$, is the log change of house prices in each subperiod, $HHI_{z,t-1}$ the index of banking concentration, $\mathbf{1}_{\Delta \ln y_{i,t}<0}$ an indicator variable equal to one if the MSA to which a zip code belongs experiences a negative income shock during period t,[12] and $X_{z,t}$ summarizes time-varying zip code or county specific controls, accounting for differences in housing and economic conditions. These are the beginning of subperiod-t house price and income per capita in the zip-code, as well as the change in house prices over the previous period, the average per capita stock of single family houses, the average number of single family housing units sold, and the average unemployment rate in the county during the period. Some of these variables are predetermined, but none are truly exogenous. Their inclusion is only an attempt to ensure that our proxies for lending concentration have explanatory power, correcting for the usual house price determinants.

We also include period fixed effects, γ_t, to partial out factors common to all zip codes in each subperiod. We explore the robustness of our results to the inclusion of different sets of fixed effects capturing common unobserved time-invariant and time-varying elements as follows: First, as indicated in (3), we include MSA fixed effects, δ_{MSA}, to ensure that omitted time-invariant factors for all zip codes in the same MSA are accounted for. Second, we substitute county fixed effects to δ_{MSA};controlling for unobserved characteristics in finer geographical units helps to evaluate to what extent omitted cross-sectional differences may be driving our results. Finally, we include interactions of MSA and period fixed effects or, alternatively, county and period fixed effects thus absorbing common shocks affecting all zip codes within an MSA and a county, respectively. We

[12] Specifically, $\mathbf{1}_{\Delta \ln y_{i,t}<0}$ is equal to one if the income growth in a geographical area, predicted using the Bartik methodology, is negative during period t; $\mathbf{1}_{\Delta \ln y_{i,t}<0}$ is equal to zero otherwise.

cluster errors at the zip-code level.

The key variable of interest is the interaction term with coefficient α_3. Since the interaction term is constructed using a continuous measure of lending concentration, the coefficient estimate provides a tight link between cross sectional variation in lending concentration and our model's comparative static results. The null hypothesis is that $\alpha_2 < 0$ and $\alpha_3 > 0$, meaning that a negative income shock causes house prices to decline for all zip codes within the MSA, but this drop is less pronounced in zip codes with higher outstanding mortgage concentration.

The results in Table 3 provide clear support to the hypothesis that the concentration of outstanding mortgages mitigates the effect of negative shocks on house prices. Consistent with our model, the coefficient on the income shock is negative and the interaction term is positive. The estimates are largely unchanged when we include a progressively larger set of controls, starting from a baseline specification without a limited number of controls (column 1), to MSA fixed effects (column 2), MSA fixed effects and zip code and county level time-varying controls (column 3), county fixed effects together with the time-varying controls (column 4), interaction of MSA and time fixed effects (column 5) as well as interactions of county and time fixed effects (column 6). The robustness of the result to the rather limited within-county variation in the outstanding mortgage concentration suggests that our main findings are unlikely to be driven by unobservable local housing and credit market factors.

It is important to note that only in counties experiencing a negative income shock, mortgage lending concentration appears to be positively related to the change in house prices in a consistent way. The coefficient of the outstanding mortgage concentration has otherwise a mixed effect on house price appreciations: Its effect is not statistically significant in columns 2 to 4 or even negative in column 1.

In column 3, the point estimate of α_2 implies that after a negative income shock, house prices drop by 4.5 percentage points in perfectly competitive lending markets (i.e. for $HHI = 0$), but by only 3.7 percentage points if the HHI increases by one standard deviation (0.023).

F Evaluating alternative explanations

F.1 Are zip codes with higher outstanding mortgage concentration different?

Zip codes with higher outstanding mortgage concentration may differ along a number of other dimensions that could drive our findings. For instance, these zip codes may have been less bubble-prone and for this reason they may have experienced lower house price appreciation in the period leading to the real estate crisis.

Economic forces leading to aggregate changes in the demand and supply for housing are most likely to operate at the county or even the MSA level. Therefore, the control for the past change in housing prices in the county (as well as the within MSA and within county specifications) should already control for this alternative mechanism. Nevertheless, in column 1 of Table 3, we control for the lagged change in house prices in the zip code. Our results remain invariant indicating that the magnitude of the bubble in a given zip code is unlikely to drive our findings.

Another concern is that outstanding mortgage concentration is correlated with ex ante concentration in mortgage origination. The latter may affect competition and ex ante contract characteristics (Scharfstein and Sunderam, 2013). However, the fact that our results hold within MSA and even within county should once again mitigate this concern, because borrowers can approach lenders in broader geographical areas and competition is therefore generally believed to operate in areas that are larger than zip codes.

To further mitigate this concern, we control for borrower average creditworthiness in the zip code by including the average FICO score, the percentage of subprime borrowers, and the 60 days delinquency rate (column 2) and outstanding mortgage characteristics, using the average loan-to-value ratio and the mortgage per capita in the zip code (column 3). Controlling for these characteristics leaves the effect of outstanding mortgage concentration following negative shocks unchanged. Results are equally invariant if we control for the proportion of deposits extended by the top 3 banks in the zip code, a common measure of bank competition, generally computed at the MSA or county level (estimates unreported for brevity).

F.2 Securitization and informed lending

While the estimates reported so far are consistent with our maintained hypothesis, alternative mechanisms could lead to a similar association between outstanding mortgage concentration and house price depreciation following negative shocks.

A first concern is that the effect of our index of outstanding mortgage concentration is entirely driven by securitization. In this case, there could be other channels, alternative to the one suggested by our model, that explain our findings. For instance, securitized loans are managed by third-party mortgage servicers and thus likely to be serviced differently from those kept on the balance sheet of the originating institution.[13] As argued by Piskorski, Seru, Vig (2010) and Agarwal et al, (2011), dispersed ownership and agency problems brought about by securitization could weaken mortgage servicers' incentives to renegotiate mortgage contracts relative to bank-held loans.

To minimize the concern that securitized loans drive the relationship between our proxies for concentration and house prices, in column 4 of Table 3, we control for the securitization rate, defined as the period-t zip code average fraction of loans originated and then securitized, and the interaction of the securitization rate with our negative shock proxy. As is consistent with previous studies showing that securitization hampers renegotiation, in zip codes with more securitized mortgages, house prices drop to a larger extent following a negative income shocks. However, outstanding mortgage concentration continues to mitigate the effect of negative income shocks.

We further attempt to isolate the role of the outstanding mortgage concentration from alternative mechanisms related to securitization by considering a measure of outstanding mortgage concentration that excludes securitized loans from the total volume of loans originated in a zip code, used in the denominator of the market shares. Consistent with our previous results, outstanding mortgage concentration continues to mitigate the effect of negative income shocks. In column 5, the drop in house price following a negative income shock is 4.8 percentage points in markets with atomistic mortgage lenders ($HHI = 0$), but only to 4.3 percentage points in markets with an index

[13] Mortgage servicers are not only responsible for collecting payments from mortgage borrowers, but also for handling defaulted loans, including prosecuting foreclosures.

of lending concentration close to the sample average ($HHI = 0.1$).

The economic effect of the outstanding mortgage concentration appears even larger if we consider only mortgages retained by commercial banks (column 6) thus abstracting from the mortgages retained by independent mortgage lenders, which may have had limited ability to renegotiate ex post. Such a measure excludes also saving banks and credit unions that some argue may have had more information on the borrowers and extended fewer mortgages that eventually became insolvent. It is thus comforting that our results appear robust.

The concern may arise however that commercial banks had invested more in information collection, especially in zip codes with high outstanding mortgage concentration. For instance, Loutskina and Strahan (2011) show that the extent to which a lender's mortgage portfolio is diversified across MSAs is inversely correlated with the lender's investment in private information. The concentration of the outstanding mortgages in a zip code and the average portfolio diversification of the lenders in a zip code could be correlated in a way that drives our results. To evaluate the merit of this alternative explanation, we compute the portfolio diversification of each lender in our sample as Loutskina and Strahan (2011) do, and then compute an average portfolio diversification for all lenders in a zip code. In column 1 of Table 4, we control for the average bank diversification in the zip code and the interaction of the latter with the negative income shock. The effect of the outstanding mortgage concentration is unaffected suggesting that private information is unlikely to drive our main finding.

The lending technology and its reliance on private, especially soft, information is often believed to be related to the size of the lender (Berger, Miller, Petersen, Rajan, and Stein, 2005). If zip codes with small lenders were to have higher outstanding mortgage concentration, the soft information of these lenders, rather than their ex post incentives due to their share of outstanding mortgages, may allow them to renegotiate or improve their ex ante lending decisions. For this reason, we include, along with our index of outstanding mortgage concentration, an index in which we compute the market shares considering only the mortgages retained by commercial banks which are in the lowest quartile of the lenders distribution by asset size. We would expect the interaction of the latter with

the negative income shock to capture most of the effect of the outstanding mortgage concentration if the banks' organizational structure and soft information matter. We find no evidence that this is the case.

Results are equally invariant if we control for salient characteristics of the banks originating loans in the zip code, such as average bank size, profitability, capitalization (column 4).

Overall, the empirical evidence does not support the hypothesis that in zip codes with higher concentration of outstanding mortgages, lenders may have selected more creditworthy borrowers. Such an interpretation is also consistent with the ex post performance of the mortgages in zip codes with high concentration. Lenders with private information would be expected to extend mortgages to borrowers that are less likely to default ex post if negative shocks occur. However, the estimates in column 1 of Table 4 show that our proxy for outstanding mortgage concentration that excludes securitized loans is positively, not negatively, correlated to the 90 days delinquency rate in the zip code, demonstrating that lenders in these zip codes do not have better information.

G Mortgage concentration and judicial foreclosure

To sharpen the interpretation of our findings, we test further cross-sectional implications of our theory on the relation between changes in house prices following negative shocks and mortgage market concentration. According to the model, lenders with larger market shares internalize to a larger extent the effects of foreclosures on house prices. A corollary of this prediction is that lending concentration should have a smaller effect on house prices in areas where foreclosures are less likely. To evaluate this additional prediction, we study the differential effect of market concentration on house prices in zip codes with different foreclosure procedures. In the U.S., some states require that a foreclosed sale takes place through the court (judicial foreclosure states), while other states give lenders the automatic right to sell the property of the defaulting borrower (power-of-sale states). As discussed in Pence (2006), the first procedure imposes on lenders more costs and more lengthy foreclosure timelines. Accordingly, lenders' incentives to foreclose are weaker in judicial foreclosure states. Mian, Sufi and Trebbi (2012) provide supportive evidence for this prediction during the

recent U.S. housing market collapse.

Building on this evidence, we would expect a stronger effect of outstanding mortgage concentration on house prices following negative shocks in the subsample of zip codes located in non-judicial foreclosure states. Since the number of days it takes to seize a property from a delinquent borrower also significantly increases the cost of foreclosure in a state, we expect our results to be stronger in the subsample of zipcodes in states with an average length of time required to accomplish a foreclosure below the cross-sectional median.

Table 5 presents the estimates of equation (3) in subsamples of zip codes with high and low costs of foreclosures, respectively. We still expect that income shocks have smaller effects on house prices in areas with larger outstanding mortgage concentration, but less so if the foreclosure procedures are more costly or lengthier.

Estimates in Panel A are based on our baseline measure of outstanding mortgage concentration. The estimates suggest that the mechanism identified in the model is at work: The mitigating effect of outstanding mortgage concentration on negative shocks is smaller and not statistically different from zero in the subsamples of zip codes with higher cost of foreclosure (columns 2 and 4). The coefficients of the interaction term of interest are however not statistically significant between columns 1 and 2 and columns 3 and 4, respectively.

The differences in coefficients are statistically significant at 1% level in Panel B in which we consider only the retained mortgages of commercial banks in defining the measure of outstanding mortgage concentration. Commercial banks, differently from independent mortgage lenders, may not only have the ex post incentives, but also the organizational structure that allows them to renegotiate defaulting mortgages. Thus, they have a mitigating effect on the impact of negative shocks in zip codes in which they retained a large share of outstanding mortgages and the cost of foreclosure are low. The concentration of outstanding mortgages does not matter in zip codes where high cost of foreclosures weaken all lenders' incentives to foreclose. Not only this evidence supports the mechanism of our model, but it would be hard to rationalize with alternative explanations or omitted factors.

H Foreclosure rates and mortgage concentration

The mechanism outlined in our model suggests that mortgage concentration mitigates the effects of negative shocks on house prices because it limits a lender propensity to foreclose defaulting loans. In this subsection, we test the validity of this mechanism using foreclosure data for the period 2007-2009.

While the focus on the previous section was on the reduced form effects of mortgage concentration on house prices, we now test whether this effects occurs via lenders decisions to foreclose. Since we do not observe foreclosures in the period preceding the financial crisis, we have to rely on cross-sectional variation across U.S. counties during 2007-2009. The regression analysis is therefore based on the following equation:

$$\begin{aligned} \Delta \ln frcl_{z,t} &= \alpha_1 HHI_{z,t-1} + \alpha_2 \mathbf{1}_{\Delta \ln y_{i,t}<0} + \alpha_3 HHI_{z,t-1} \times \mathbf{1}_{\Delta \ln y_{i,t}<0} \\ &\quad + \beta X_{z,t} + \delta_{MSA} + \varepsilon_{z,t}, \end{aligned} \tag{4}$$

The set of controls include proxies for the scale of the zip code such as the number of outstanding mortgages and the total population.

The estimates in column 1 of Table 6 support the prediction that higher outstanding mortgage concentration is associated with fewer foreclosures following negative shocks. Importantly, mortgage market concentration does not reduce foreclosures in counties that do not experience negative shocks.

The effects are also economically significant. After a negative income shock, a zip code with an average outstanding mortgage concentration experiences 36% fewer foreclosures than a zip code in which the outstanding mortgages are held by atomistic lenders.[14]

The magnitude and the statistical significance of the estimated coefficients do not change as we include MSA, county fixed effects and a larger set of controls. Results are invariant in column 2

[14] The economic effect is computed by noting that the parameter estimates imply that there are on avarage 11 more foreclosures in a zip code in which outstanding mortgages are dispersed across atomistic lenders, but only 7 in zip codes with an average outstanding mortgage concentration.

when we exclude securitized mortgages from the computation of the outstanding mortgage concentration. Estimates are also unaffected in column 5, as we control for the 60-days delinquency rate of mortgages, as well as the extent of securitization, FICO score, and other mortgage characteristics.

Finally, in columns 6 to 9, we exploit state level differences in foreclosure costs. As argued above, lenders have stronger incentives to foreclose if the process does not require a judicial intervention. In these areas, lenders' decisions to foreclose are expected to be influenced by their market share to a larger extent. Our estimates support this prediction. In counties hit by a negative income shock, foreclosures increase less when outstanding mortgages are highly concentrated, but the effect of concentration is attenuated in jurisdictions with costly foreclosure procedures, where all lenders are less likely to foreclose, independently from their share of outstanding mortgages. Overall, these results support the causal mechanism of our theory.

V Conclusion

We show that in markets with low outstanding mortgage concentration, lenders exhibit an excessive propensity to foreclose because they do not internalize the effects of foreclosures on house prices. We provide micro-evidence supporting this mechanism using cross-sectional differences in housing price depreciation and concentration of outstanding mortgages in the U.S. during the recent housing market collapse. We find that following negative shocks, house prices drop to a lower extent in markets with higher outstanding mortgage concentration. Moreover, mortgage markets with high concentration experience fewer foreclosures.

These findings have important policy implications. In taking foreclosure decisions, lenders are affected by the outstanding mortgages on their balance sheets. When income shocks limit borrowers' ability to repay, measures favoring the consolidation of impaired mortgage lenders with similar geographic exposure may increase the concentration of outstanding mortgages. Our findings suggest that these measures may reduce lenders' aggregate losses because tend to strengthen their incentives to renegotiate defaulting loans. This in turn mitigates the effects of negative shocks on

house prices reducing foreclosures. Similar effects may be achieved with the creation of bad banks that collect impaired loans at times of crises.

Our model can also explain why banks may be offering refinancing at time of crisis. Our model would predict that banks are more likely to do so in neighborhoods in which they have a high share of the outstanding mortgages in order to limit the negative externalities due to foreclosures.

The mechanism highlighted in this paper has bearings beyond the context of the housing market. It has implications for the price volatility of any collateralized market with dispersed lending structure. Exploring other areas in which the pecuniary externality can be internalized by lenders with a high share of the outstanding claims is an exciting venue for future research.

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Table 1
Variables' Description and Data Sources

Variable name	Variable description	Source	Mean	Standard deviation	Obs.
60 Days Delinquency Rate	Zip code proportion of the outstanding mortgages that is between 60 and 89 days delinquent	Federal Reserve Bank of New York/Equifax	.0184725	.0188671	31463
Bank Capital	Average bank equity capital ratio in a zip code	Call Report	.10095	.0139	31259
Bank ROA	Average bank return on asset in a zip code	Call Report	.03203	.0045	31259
Bank Size	Average bank log asset in a zip code	Call Report	19.276	1.231	31259
Lender Diversification	Zip code average of the lender diversification index, defined as the sum of squared shares for mortgage volume originated by each lender in each MSAs in which it operates relative to the total volume of loans originated by same lender. Lenders include commercial banks, thrifts, credit unions and mortgage companies.	Home Mortgage Disclosure Act Database (HMDA)	.08289	.08310	31439
Days Dummy	Dummy variable that takes value equal to one if the average length of time required to accomplish a foreclosure for zip codes in a given state is larger than the cross sectional median number of days for a foreclosure to be completed.	Crews Cutts and Merrill (2008)	.4304541	.4951476	31490
FICO score	Average risk core in a zip code	Equifax	689.79	37.443	31468
Foreclosures	The zip code's yearly number of foreclosures, defined as the sum of notices of trustee sale, foreclosure sales, and real estate owned (REO) properties.	RealtyTrac.com	57.50432	94.4256	15446
Lagged HHI - retained over total	Sum of squared shares of the mortgage loans retained in the balance sheet of different lenders in a zip code. The shares are based on the volume of loans originated and retained by a lender in a zip code relative to the total volume of loans originated in the same zip code. Unless otherwise noted in the text, loans (originated and/or retained) are measured over a three-year period preceding the one in which the	Home Mortgage Disclosure Act Database (HMDA)	.007986	.0229802	31418

Variable name	Variable description	Source	Mean	Standard deviation	Obs.
	dependent variables are defined. Loans are conventional mortgages for purchase of single-family owner-occupied houses. Lenders include commercial banks, thrifts, credit unions and mortgage companies.				
HHI-Volume-retained over retained	Defined as HHI-Volume, but considering only the volume of loans originated and retained in a zip code to compute the denominator of the shares.	HMDA	.099175	.0963594	31273
House price growth	Logarithmic change of the zip code house price index for single-family owner-occupied houses.	CoreLogic	-.0784767	.2298554	31004
Housing Stock per Capita	Log of the number of existing single family owner occupied houses in a county, divided by the county's population.	U.S. Bureau of Census	.2204872	.0499967	31304
Housing Units Sold	Log of the number of single-family owner occupied units sold in a county	National Association of Realtors (NAR)	9.607904	1.118108	31304
Judicial Foreclosure	Dummy variable that takes value 1 for zip codes in states with a judicial requirement for foreclosure	Rao and Walch (2009)	.3834334	.4862302	31304
LTV ratio	Average loan to value ratio in a zip code	Lender Processing Servicer (LPS)	79.308	6.156	30520
Median Income	Median income in the zip code	U.S. Bureau of Census	60709.93	26435.73	31254
Mortgage per capita	The zip code’s number of first mortgages and home equity lines outstanding divided by the number of households	Equifax	68991.74	45517.44	31468
Negative Shock	Dummy variable that takes value equal to 1 if the Bartik index predicts negative income growth in the MSA during the time period.	U.S. Bureau of Census	.2969289	.4569122	31324
Number of mortgages	Number of first mortgages and home equity lines outstanding	Equifax	2372.30	1267.31	31468
Population	The zip code’s population	U.S. Bureau of Census	4533.407	2116.76	31307

Variable name	Variable description	Source	Mean	Standard deviation	Obs.
Securitized Loans	The zip code's fraction of loans originated for purchase of single family owner occupied houses sold within the year of origination to other non-affiliated financial institutions or government-sponsored housing enterprises.	HMDA	.6134236	.1168599	31324
% Subprime Borrowers	Fraction of households in a zipcode with FICO score below 620	Equifax	.2663	.1338	31468
Unemployment	The county's unemployment rate	U.S. Bureau of Census	5.903347	1.551022	31304

Table 2
Changes in House Prices and Outstanding Mortgage Concentration

Zip code level pooled regressions of the log change in house prices on the lagged Herfindahl index and its interaction with the negative shock dummy that equals 1 if the change in the Bartik index of the MSA in which a zip code is located during the period is negative. All variable definitions and sources are reported in Table 1. All regressions include a time dummy for the period 2007-2009, a constant and other fixed effects as indicated in the table, whose coefficients we do not report. Columns 2 and 3 include MSA dummies; column 4 includes county dummies; column 5 includes interactions of MSA and county dummies and column 6 interactions of county and time dummies. Standard errors in parenthesis are clustered at the zip code level and corrected for heteroskedasticity. Estimates followed by ***, **, and * are statistically different from zero with 0.01, 0.05 and 0.10 significance levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Negative Shock	-0.038***	-0.046***	-0.045***	-0.051***		
	(0.001)	(0.002)	(0.002)	(0.002)		
Lagged HHI - retained over total *	0.319***	0.287***	0.282***	0.222**	0.122*	0.141*
Negative Shock	(0.098)	(0.097)	(0.099)	(0.089)	(0.070)	(0.072)
Lagged HHI - retained over total	-0.041**	-0.013	-0.007	0.020	0.036***	0.023**
	(0.020)	(0.016)	(0.016)	(0.014)	(0.013)	(0.011)
Log house prices	-0.139***	-0.229***	-0.238***	-0.228***	-0.100***	-0.048***
	(0.002)	(0.004)	(0.004)	(0.005)	(0.004)	(0.005)
Total population census tract			-0.000	-0.000	-0.000**	-0.000**
			(0.000)	(0.000)	(0.000)	(0.000)
Census median income of census tract			-0.000***	-0.000***	0.000	0.000***
			(0.000)	(0.000)	(0.000)	(0.000)
Lagged Growth in County House Prices	1.006***	0.921***	0.912***	0.946***	0.848***	
	(0.004)	(0.005)	(0.005)	(0.006)	(0.017)	
Housing units sold			0.006***	0.105***	0.002***	
			(0.001)	(0.004)	(0.000)	
Housing stock per capita			-0.110***	-5.699***	-0.082***	
			(0.012)	(0.486)	(0.011)	
Unemployment rate			-0.003***	0.003**	-0.006***	
			(0.001)	(0.001)	(0.001)	
Obs	30735	30735	30685	30685	30685	30721
Zip Codes	15430	15430	15396	15396	15396	15414
FE		MSA	MSA	County	MSA*Time	County*Time
R2	.92	.931	.932	.937	.95	.958

Table 3
Are Zip Codes with Higher Outstanding Mortgage Concentration Different?

Zip code level pooled regressions of the log change in house prices on the lagged Herfindahl index and its interaction with the negative shock dummy that equals 1 if the change in the Bartik index of the MSA in which a zip code is located during the period is negative. All variable definitions and sources are reported in Table 1. All regressions include a time dummy for the period 2007-2009, a constant and other fixed effects as indicated in the table, whose coefficients we do not report. Standard errors in parenthesis are clustered at the zip code level and corrected for heteroskedasticity. Estimates followed by ***, **, and * are statistically different from zero with 0.01, 0.05 and 0.10 significance levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)
Negative Shock	-0.046***	-0.044***	-0.045***	0.016***	-0.048***	-0.046***
	(0.001)	(0.002)	(0.002)	(0.005)	(0.002)	(0.002)
Lagged HHI - retained over total * Negative Shock	0.177***	0.256***	0.273***	0.228**		
	(0.039)	(0.095)	(0.097)	(0.091)		
Lagged HHI - retained over retained * Negative Shock					0.047***	
					(0.009)	
Lagged HHI - retained over total-Banks * Negative Shock						0.154***
						(0.031)
Securitized Loans				0.081***		
				(0.004)		
Securitized Loans* Negative Shock				-0.099***		
				(0.007)		
Lagged HHI number - retained over total	-0.048***	-0.006	-0.009	0.016		
	(0.018)	(0.016)	(0.017)	(0.012)		
Lagged HHI volume - retained over retained					0.010***	
					(0.003)	
Lagged HHI number - retained over total-Banks						-0.006
						(0.006)

	(1)	(2)	(3)	(4)	(5)	(6)
Lagged Growth in County House Prices	0.879***					
	(0.004)					
% Subprime Borrowers		0.220***				
		(0.020)				
FICO score		0.000***				
		(0.000)				
60 Days Delinquency Rate		-1.668***				
		(0.103)				
LTV ratio			0.000			
			(0.000)			
Mortgage per capita			0.000***			
			(0.000)			
Log house prices	-0.301***	-0.241***	-0.244***	-0.238***	-0.237***	-0.238***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Total population census tract	-0.000	0.000	-0.000	-0.000**	0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Census median income of census tract	-0.000***	-0.000***	-0.000***	-0.000	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Lagged Growth in County House Prices		0.907***	0.913***	0.907***	0.914***	0.910***
		(0.005)	(0.006)	(0.005)	(0.005)	(0.005)
Housing units sold	0.006***	0.007***	0.007***	0.005***	0.006***	0.006***
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Housing stock per capita	-0.156***	-0.109***	-0.115***	-0.128***	-0.112***	-0.107***
	(0.010)	(0.012)	(0.012)	(0.012)	(0.012)	
Unemployment rate	-0.005***	-0.001	-0.003***	-0.003***	-0.003***	-0.003***
	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
Obs	30701	30660	29793	30685	30685	30531
N-Clust	15404	15392	15336	15396	15396	15340
FE	MSA	MSA	MSA	MSA	MSA	MSA
R2	.954	.933	.932	.933	.932	.932

Table 4
Does Information Drive the Effect of the Outstanding Mortgage Concentration?

In columns 1 to 4, we present zip code level pooled regressions of the log change in house prices on the lagged Herfindahl index and its interaction with the negative shock dummy that equals 1 if the change in the Bartik index of the MSA in which a zip code is located during the period is negative. In column 5, dependent variable is the 90 days delinquency rate. All variable definitions and sources are reported in Table 1. All regressions include a time dummy for the period 2007-2009, a constant and other fixed effects as indicated in the table, whose coefficients we do not report. Standard errors in parenthesis are clustered at the zip code level and corrected for heteroskedasticity. Estimates followed by ***, **, and * are statistically different from zero with 0.01, 0.05 and 0.10 significance levels, respectively.

	(1)	(2)	(3)	(4)
Dependent Variable:		Change House Prices		90 days Delinquency rate
Negative Shock	-0.056***	-0.047***	-0.045***	0.000*
	(0.002)	(0.002)	(0.002)	(0.000)
Lagged HHI - retained over total * Negative Shock		0.616***	0.288***	
		(0.122)	(0.106)	
Lagged HHI - retained over retained * Negative Shock	0.050***			0.002***
	(0.009)			(0.000)
Lagged HHI - retained over total-Small Banks * Negative Shock		0.017		
		(0.034)		
Lagged HHI number - retained over total		-0.044**	-0.006	
		(0.022)	(0.016)	
Lagged HHI - retained over retained	0.010***			0.001***
	(0.003)			(0.000)
Lagged HHI - retained over total-Small Banks		0.003		
		(0.011)		
Lender Diversification	0.027***			
	(0.006)			
Lender Diversification* Negative Shock	0.100***			
	(0.011)			
Zip Bank Capital			-0.015	
			(0.025)	
Zip Bank ROA			-0.070	
			(0.065)	
Zip Bank Size			0.000	
			(0.000)	
Log house prices	-0.239***	-0.237***	-0.239***	-0.001***
	(0.004)	(0.004)	(0.004)	(0.000)
Total population census tract	0.000	-0.000	-0.000	
	(0.000)	(0.000)	(0.000)	
Census median income of census tract	-0.000***	-0.000***	-0.000***	
	(0.000)	(0.000)	(0.000)	

Dependent Variable:	(1)	(2)	(3)	(4)
		Change House Prices		90 days Delinquency rate
Lagged Growth in County House Prices	0.905***	0.911***	0.911***	-0.003***
	(0.006)	(0.005)	(0.005)	(0.000)
Housing units sold	0.007***	0.006***	0.006***	
	(0.001)	(0.001)	(0.001)	
Housing stock per capita	-0.113***	-0.108***	-0.112***	
	(0.012)	(0.012)	(0.012)	
Unemployment rate	-0.003***	-0.003***	-0.003***	
	(0.001)	(0.001)	(0.001)	
Lagged HHI volume - retained over retained	0.016***	0.017***	0.017***	0.000***
	(0.002)	(0.002)	(0.002)	(0.000)
Obs	30685	30513	30465	30709
N-Clust	15396	15335	15284	15425
FE	MSA	MSA	MSA	MSA
2	.932	.932	.931	.209

Table 5
Changes in House Prices, Outstanding Mortgage Concentration and Judicial Foreclosures

Zip code level pooled regressions of the log change in house prices on the lagged Herfindahl index and its interaction with the negative shock dummy that equals 1 if the change in the Bartik index of the MSA in which a zip code is located during the period is negative. Column 1 report the estimates for the subsample of zip codes in states that allow non-judicial foreclosure, column 2 for the subsample of zip codes in states that only allow judicial foreclosures; column 3 for the subsample of zip codes in states in which the foreclosure procedure takes a number of days below the mean; and column 4 for the subsample of zip codes in states in which the foreclosure procedure takes a number of days above the median. All variable definitions and sources are reported in Table 1. All regressions include a time dummy for the period 2007-2009, interactions of county and time fixed effects and a constant, whose coefficients we do not report. Standard errors in parenthesis are clustered at the zip code level and corrected for heteroskedasticity. Estimates followed by ***, **, and * are statistically different from zero with 0.01, 0.05 and 0.10 significance levels, respectively.

Panel A. Herfindahl computed considering all mortgage lenders

Subsamples:	(1) Non Judicial Foreclosures	(2) Judicial Foreclosures	(3) No. Days<Mean	(4) No. Days>Mean
Lagged HHI - retained over total * Negative Shock	0.203*	0.031	0.202*	0.031
	(0.122)	(0.059)	(0.121)	(0.058)
Lagged HHI number - retained over total	0.006	0.053***	0.006	0.053***
	(0.015)	(0.015)	(0.015)	(0.015)
Log house prices	-0.074***	0.005	-0.079***	0.010*
	(0.006)	(0.006)	(0.006)	(0.006)
Total population census tract	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Census median income of census tract	0.000***	-0.000	0.000***	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Obs	18993	11708	17632	13089
Zip Codes	9527	5877	8844	6570
FE	County*Time	County*Time	County*Time	County*Time
R2	.963	.938	.962	.944

Panel B. Herfindahl computed considering only commercial banks

Subsamples:	(1) Non Judicial Foreclosures	(2) Judicial Foreclosures	(3) No. Days<Mean	(4) No. Days>Mean
Lagged HHI - retained over total * Negative Shock	0.151***	-0.001	0.152***	-0.003
	(0.047)	(0.020)	(0.047)	(0.019)
Lagged HHI number - retained over total	0.010	-0.000	0.010	0.001
	(0.008)	(0.006)	(0.009)	(0.005)
Log house prices	-0.071***	0.005	-0.077***	0.010
	(0.006)	(0.006)	(0.006)	(0.006)
Total population census tract	-0.000	-0.000	-0.000	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Census median income of census tract	0.000***	-0.000	0.000***	-0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Obs	18901	11646	17545	13022
Zip Codes	9495	5853	8812	6546
FE	County*Time	County*Time	County*Time	County*Time
R2	.963	.937	.962	.944

Table 6
Foreclosures

Zip-code level cross sectional regressions of the average number of foreclosures between 2007 and 2009 on the Herfindahl index, and its interaction with the negative shock dummy that equals 1 if the change in the Bartik index of the MSA in which a zip code is located during the period is negative. All variables and sources are defined in Table 1. All regressions include a time dummy for the period 2007-2009, a constant and other fixed effects as indicated in the table, whose coefficients we do not report. Column 6 report the estimates for the subsample of zip codes in states that allow non-judicial foreclosure, column 7 for the subsample of zip codes in states that only allow judicial foreclosures; column 8 for the subsample of zip codes in states in which the foreclosure procedure takes a number of days below the mean; and column 9 for the subsample of zip codes in states in which the foreclosure procedure takes a number of days above the median. Standard errors in parenthesis are corrected for heroskedasticity. Estimates followed by ***, **, and * are statistically different from zero with 0.01, 0.05 and 0.10 significance levels, respectively.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Subsamples:	Whole Sample	Whole Sample	Whole Sample	Whole Sample	Whole Sample	Non Judicial Foreclosures	Judicial Foreclosures	No. Days<Mean	No. Days>Mean
Negative Shock	11.719***	14.173***							
	(1.592)	(1.890)							
Lagged HHI - retained over total * Negative Shock	-453.266***		-473.683***	-314.847***	-153.392**	-427.466***	-164.772***	-462.056***	-189.578***
	(89.237)		(106.086)	(76.713)	(63.905)	(116.139)	(45.426)	(128.062)	(47.023)
Lagged HHI - retained over retained * Negative Shock		-48.191***							
		(12.574)							
Lagged HHI - retained over total	335.925***		350.333***	214.091***	93.724	340.438***	65.785***	379.273***	91.041***
	(82.824)		(100.043)	(71.771)	(59.358)	(111.422)	(22.581)	(123.854)	(25.750)
Lagged HHI - retained over total		50.206***							
		(8.064)							
60 Days Delinquency Rate					2.991***				
					(0.098)				
Securitized Loans					10.484*				
					(5.916)				
Securitized Loans*Negative Shock					-14.205*				
					(7.565)				

Subsamples:	(1) Whole Sample	(2) Whole Sample	(3) Whole Sample	(4) Whole Sample	(5) Whole Sample	(6) Non Judicial Foreclosures	(7) Judicial Foreclosures	(8) No. Days<Mean	(9) No. Days>Mean
FICO Score					-0.001				
					(0.001)				
LTV Ratio					-0.153***				
					(0.055)				
Mortgages per capita					0.000***				
					(0.000)				
Subprime Borrowers					5.000				
					(32.404)				
Number of Mortgages	0.014***	0.014***	0.014***	0.013***	-0.004***	0.019***	0.002***	0.020***	0.003***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.000)
Log house prices	-38.239***	-38.805***	55.445***	105.098***	62.151***	119.417***	-2.528	119.596***	-0.497
	(2.729)	(2.724)	(9.117)	(9.642)	(7.679)	(13.701)	(3.581)	(14.203)	(3.390)
Total population census tract	0.001***	0.002***	0.001***	0.001**	0.000	0.001**	-0.000***	0.001**	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Census median income of census tract	-0.001***	-0.001***	-0.001***	-0.001***	-0.000	-0.001***	-0.000***	-0.001***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Lagged Growth in County House Prices	-417.009***	-418.710***	-513.857***	-568.391***	-328.608***	-686.027***	-106.419***	-694.591***	-103.631***
	(11.320)	(11.345)	(20.180)	(23.044)	(14.473)	(28.059)	(9.213)	(28.524)	(8.707)
Housing units sold	7.290***	7.079***	4.375***						
	(0.578)	(0.584)	(0.656)						
Housing stock per capita	35.793***	32.620***	-18.954						
	(12.706)	(12.649)	(14.104)						
Unemployment rate	-5.146***	-5.194***	9.160***						
	(0.774)	(0.774)	(1.068)						
Obs	15165	15165	15165	15165	14394	9389	5776	8722	6443
FE			MSA	County	County	County	County	County	County
R2	.384	.384	.52	.579	.744	.564	.713	.556	.715