Mortgage Market Concentration, Foreclosures and House Prices*

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Abstract

This paper shows that in mortgage markets with low concentration, lenders have an excessive propensity to foreclose defaulting mortgages. Though rational, foreclosure decisions by individual lenders may increase aggregate losses because they generate a pecuniary externality that causes house price drops and contagious strategic defaults. In concentrated markets, instead, lenders internalize the adverse effects of mortgage foreclosures on local house prices and are more inclined to renegotiate defaulting mortgages. Thus, negative income shocks do not trigger strategic defaults, foreclosure rates are lower, and house prices less volatile. We provide empirical evidence consistent with the theory using U.S. counties during the 2007-2009 housing market collapse.

Keywords: House Prices; Foreclosures; Bank Concentration

JEL Codes: G01; G21; R31; R38

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I Introduction

The recent collapse of the US 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 to. But, setting aside the social implications, has the rate of foreclosure been too high? Put differently, has the rate of foreclosure reduced or amplified the impact of mortgage defaults on the aggregate losses of mortgage lenders? An answer to this question is important because if foreclosures increase the aggregate losses of the banking system, 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 affect the quality of nearby houses (Harding, Rosenblatt, Yao, 2009), or because foreclosures increase the supply of homes in illiquid markets (Anenberg and Kung, 2013). It has been somewhat overlooked that foreclosures can lead to contagious defaults because foreclosures affect the social norm regarding the repayment of mortgages (Guiso, Sapienza and Zingales, 2011), 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 because of a pecuniary externality leading to contagious defaults, in markets where the provision of mortgage credit is less concentrated, foreclosures may amplify the effects of negative shocks on real estate prices. We first present a stylized model of mortgage-debt overhang to illustrate how individual foreclosure decisions cause aggregate house price declines, and how incentives to foreclose are weaker in markets with a concentrated lending structure. Next, we use U.S. county level data on mortgage lending concentration, foreclosure and house prices to test the model's predictions.

In the model, defaults occur when idiosyncratic income shocks make borrowers unable to honor their mortgage debt obligations. 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 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, when the provision of mortgage credit is concentrated, lenders internalize the adverse effects of liquidation decisions, strengthening their incentives to renegotiate defaulting loans. More renegotiations reduce the adverse effects of liquidity defaults on house prices weakening the incentives to strategic default and their adverse effects on house prices.

To test the implications of this theory, we use differences in mortgage lending concentration, foreclosure rates, and housing prices in US counties during the 2004-2009 period. County level data allow us to focus on small geographical areas in which foreclosures are expected to have stronger spillovers on house prices. Consistent with the model's predictions, we find that the volatility of house prices is significantly lower in areas where the mortgage market is more concentrated. House prices decrease more in counties experiencing a negative income shock, but the price changes are smaller in areas where lenders hold larger shares of the local mortgage market. We estimate an elasticity of house price to negative income shocks of 4.5 percent in the least concentrated lending markets, but this elasticity drops to 0.02 percent in counties with an index of market concentration in the 90th percentile. 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.

To strengthen the interpretation of these findings, we test three additional implications of our theory. First, securitization tends to reduce market concentration since securitized mortgages are best thought as held by "atomistic" lenders. We show, however, that our results continue to hold when we control for the proportion of securitized mortgages in local markets or exclude securitized mortgages in computing our indexes of local market concentration. Second, mortgage concentration should have a larger effect on house prices in jurisdictions where foreclosure procedures entail lower transaction costs or, equivalently, renegotiations are less likely. Consistent with this idea, we find that mortgage concentration reduces house price volatility to a larger extent in non-judicial states, where foreclosures are less costly than in judicial states because lenders do not need to go through the courts to foreclose on a property. Finally, and perhaps most importantly, 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, foreclosure rates are higher in counties 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.

The rest of the paper proceeds as follows. Section 1 discusses the related literature. Section 2 introduces the 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 house prices volatility. Section 5 concludes the paper.

II Related Literature

Our work is related to several strands of literature. First, we contribute to the literature exploring the role played by foreclosure laws on house prices. Mian, Sufi, and Trebbi (2012) show that during the 2007-2009 financial crisis foreclosures were more frequent in states where bankruptcy laws decrease the cost of foreclosing for the lender and that higher foreclosure rates lead to larger declines in housing prices.[1] Similarly to Mian, Sufi and Trebbi (2011), we stress the importance of the lenders' incentives to foreclose on house prices volatility. We propose, however, a different mechanism whereby lenders' foreclosure decisions and its effects on house price volatility depend

[1] 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.

on the dispersion in the provision of mortgages credit.

Our paper is also related to the literature that stresses the role of securitization 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 securitization of mortgages inhibits renegotiation of loans at risk of foreclosure. 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.

There is also an older literature exploring the effects of a concentrated banking systems on bank-firm relationships (Petersen and Rajan, 1995) and loan supply (Garmaise and Moskowitz, 2006). These papers, however, study the effects of market concentration on ex ante competition in the provision of credit and contract terms. 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 existing in the literature that competition in the market for credit erodes financial stability because it lowers lenders' profits, distorting their investment and risk-taking decisions (Keely, 1990).

Finally, the paper is related to a smaller literature that explores the role of government interventions in the presence of market externalities. 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 the provision of mortgages is dispersed, foreclosure decisions may generate aggregate losses to the banking system because atomistic banks do not internalize the effects of foreclosures on strategic defaults and house prices. In this context, government intervention favoring renegotiation is desirable.

III Theory and Testable Implications

This section presents a simple model to illustrate how defaults and foreclosures affect house prices in markets with different mortgage lenders' concentration.

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 too poor to repay B:

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

In case of default, banks may partially recover the amount due by repossessing and liquidating the house at the equilibrium price p to be derived below.[2] The final assumption is that housing supply is fixed and equal to $\overline{H} < \overline{\gamma}$.

[2] This assumption puts an upper bound on households' indebtness: $B \leq p$. If the repayment obbligation were larger than the equilibrium price, households would always default as they have the option to surrender the house to the bank.

The household's budget constraint at $t = 1$ depends on the realization of the income shock and on whether he repays or defaults on his mortgages. If household i repays the mortgage or defaults and the bank repossesses the house, 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

Individual housing demand is given by the following condition

$$\gamma_i \geq p,$$

relating the preference for housing to its market price. Since γ_i is uniformly distributed, the equilibrium price in absence of shocks is pinned down 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)) and the banks seize their houses, a fraction e of households 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.

In this equilibrium, in which banks liquidate the houses of defaulting borrowers, $p^L < B$, also households with a high income realization prefer to default. This equilibrium with liquidation and strategic and liquidity defaults exists if and only if

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

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 and are able to repurchase a home from the bank at a lower price.[3]

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 with a markdown to the loan repayment, households would remain in possession of their houses, and 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:

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

However, since

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

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 the negative shock and protected by limited

[3] This is the only equilibrium. 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.

liability. It follows that for a competitive bank it is always optimal to liquidate rather than to renegotiate.

Proposition 1 *Competitive 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 is large and holds a fraction ξ of the mortgage market. Such a 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 loans, its borrowers will continue to participate in the housing market, 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 banking concentration.

For $\xi \rightarrow 1$, the aggregate housing demand, and the resulting equilibrium price, would be the same as the one prevailing when no income shock occurs. As a result, there would be no strategic defaults. However, if the other atomistic banks liquidate, the house price decrease 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 value of the mortgage 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. We have assumed that endowment shocks are observable even though not verifiable. This assumption is supported by empirical evidence. For instance, in the foreclosure crisis that began around 2007, 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 and agree to modify those mortgage to a different extent (see Ghent (2011) for a similar argument).[4]

Thus, following a negative income shock that affects a fraction e of households, a large bank with a fraction ξ of the mortgage market 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 $\xi \to 1$. Also, if condition (2) holds, not only bank concentration reduces the impact of the negative income shocks on house prices, but also decreases the aggregate losses of the banking system. The reason is that the large bank obtains a higher repayment for the outstanding mortgages, and the remaining smaller banks are able to liquidate the houses of defaulting borrowers at a higher price. This way, 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 (i.e., $\xi < 1$) renegotiates, the other banks

[4] 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.

have even stronger incentives to liquidate as the house price is now higher. Thus, a large bank alone cannot prevent strategic defaults, although it can mitigate the effects of negative income shocks on house prices. However, 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.

The following proposition summarizes this discussion.

Proposition 2 *The effect of negative shocks on house prices is ceteris paribus smaller when the provision of mortgages is more concentrated.*

The main prediction of the model is that mortgage lending concentration mitigates the effect of negative income shocks on house prices volatility 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 foreclosure rates.

IV Empirical Evidence

A Data sources

We combine a variety of data sources. To measure mortgage lending concentration in local markets, we use data from the Home Mortgage Disclosure Act (HMDA). The Home Mortgage Disclosure Act requires depository and non-depository financial institutions that meet a specific asset level to report information on mortgage applications, the loan disposition, including whether it is retained or securitized, and other 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, Loustkina and Strahan, 2011). HMDA is a comprehensive source of information on primary US mortgage originations, covering approximately 90% of the mortgage activity of commercial banks, thrifts, credit unions, and mortgage companies.

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 county 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 RealtyTrac.com. This information is used to classify states depending on whether lenders must receive a judge's approval to foreclose (judicial foreclosure states). From RealtyTrac.com we also obtain information on the estimated number of days required to accomplish a foreclosure, to proxy for the overall cost of a foreclosure procedure.

House price indexes are from Moody's Economy.com, and based on the median house prices for existing single family properties. We prefer this index to those that measures housing prices holding quality constant, because Moody's data is available for a much larger cross-section of geographical units. All results we present hereafter are qualitatively invariant if we use the Corelogic house price index, which holds house quality constant.

We control for local economic, financial and housing conditions using a variety of data sources. Information on income per capita, population and the unemployment rate comes from the Bureau of Economic Analysis. Financial conditions are measured with the delinquency rate on consumer debt balances from Equifax, and the delinquency rate on securitized mortgage loans from Lender Processing Services (LPS). Finally, data on local housing supply conditions are taken from the Census Bureau and the National Association of Realtors. Table 1 lists the variables along with their definitions and data sources.

All data is collected at annual frequency from 2004 to 2009 and, to smooth out year-on-year fluctuations, collapsed into two subperiods, 2004-2006 and 2007-2009, covering the recent boom and bust in the US housing market.

B Measuring lending concentration

We measure bank concentration using county level data, even though the standard definition of local banking market in the literature is the Metropolitan Statistical Area (MSA) (Berger, Saunders, Scalise and Udell, (1998), Berger, Demsetz and Strahan (1999), Black and Strahan (2002)). We choose a measure of local banking market that is narrower than the MSA because we want to focus on geographical areas where foreclosures have stronger spillovers on housing prices. The existing literature (see e.g., Campbell, Giglio and Pathak, 2011) has shown that the negative effects of foreclosures on house prices operate more strongly within narrowly defined markets. There is also evidence that even for commercial real estate loans, banking markets are highly localized within counties (Garmaise and Maskowitz (2004)). Moreover, a county-level definition of banking market allows us to use MSA- or even county-fixed effects in our regressions, to control for other determinants of local mortgage markets and house prices.

Our measure of mortgage lending 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 development of the local mortgage market. We first compute for each county an Herfindahl index with market shares defined by the number of mortgage loans originated and retained by individual lenders in any 3-year period (i.e., 2001-2004 and 2004-2006) relative to the total number of loans originated in the same county over the same period. We choose a 3-year window because we want a measure of concentration defined in terms of the stock (not the flow) of bank-held mortgages. Next, we assign to each lender only mortgages retained, because it is likely that losses associated to the default of securitized mortgages are not borne by the original lender but by the multitude of investors holding the securitized asset.[5] Thus, while

[5] Using information from HMDA we classify a mortgage as securitized, if it is sold within a year to a GSE or a non-affiliated institution.

the denominator of each lender's share in the local mortgage market includes both retained and securitized mortgages, the numerator includes only retained loans.

To evaluate the robustness of our results, we also compute two alternative indexes of mortgage concentration. The first one uses market shares based on the volume (instead of the number) of loans originated and retained, in order to capture the monetary exposure of lenders to local housing market developments. The second index computes the market shares excluding securitized mortgages from the denominator. Since the fraction of loans securitized may differ across local markets, this index isolates the role played by mortgage concentration independently from to securitization.

C Descriptive statistics

Our sample consists of roughly 1050 urban counties in continental U.S. for which mortgage data is available. We focus on urban areas because house price dynamics, borrower characteristics, and mortgage lending decisions have different determinants in rural, often poor, areas. For each county, we aggregate HMDA data 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.[6] This data is used to compute our different indexes of local market concentration. Table 2 reports summary statistics for the period 2004-2009.

On average, mortgage provision in our sample of counties and years is very dispersed. By construction, the concentration indexes vary from zero (for markets covered by atomistic lenders) to one (for markets covered by one lender only). Based on either the volume or the number of loans originated and retained, the average concentration indexes suggest that local markets are highly competitive. There is, however, substantial variation in market concentration: In some counties, the concentration index is as high as 30 percent. It is precisely this cross-sectional differences that we exploit in our analysis.

[6] 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.

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 in our indexes of market concentration. For instance, when the market shares used to compute the concentration index exclude from the denominator the total number or volume of securitized loans, local markets become on average more concentrated. Our different measures of market concentration are, however, highly correlated, with a correlation coefficient as large as 0.8.

Between 2004 and 2009, house prices experienced a pronounced boom and bust cycle. On average, however, the annual growth rate decreased by 6 percent, reflecting the generalized house price decline in the 2007-2009 period. The observed variation in house prices is also quite heterogeneous, with some counties experiencing price appreciation close to 15 percent during the two subperiods. The growth rate of income per capita displays comparable cross-sectional variation.

Table 2 also reports summary statistics for the foreclosure rates, defined as the county number of foreclosures for single family properties per homeowner, approximated by the number of loans originated in 2005 according to HMDA. 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 foreclosure rates only for the subperiod 2007-2009. The data is available for a slightly smaller cross section of counties relative to the one for which we observe house price changes. A shown in Table 2, there is large variation in the foreclosure rate, ranging from almost zero to nearly 7 percent.

D Main results

The main prediction of the model is that income shocks have a muted effect on house prices in areas with more concentrated mortgage provision. To test this prediction, we estimate variations of the following reduced form regression:

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

where c is an index for counties and t an index for the two subperiods, i.e. $t = 2004 - 2006$ and $2007 - 2009$. The dependent variable, $\Delta \ln p_{c,t}$, is the log change of house prices in each subperiod, $HHI_{c,t-1}$ the index of banking concentration, $\mathbf{1}_{\Delta \ln y_{i,t}<0}$ an indicator variable equal to one if a county experiences a negative income shock from one period to the next,[7] and $X_{c,t}$ summarizes time-varying county specific controls. We also use period fixed effects, γ_t, to partial out factors common to all counties in each subperiod, and MSA fixed effects, δ_{MSA}, to ensure that omitted time-invariant factors for all counties in the same MSA are accounted for. Since there may be a common unobserved time-varying element to the regression error across all counties in the same MSA, we cluster standard errors at the MSA level.

In most specifications, we use the Herfindahl index measured in the three years preceding the interval in which we measure price changes.[8] We do so to minimize concerns that housing market developments affect the local market concentration, 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 wipe out smaller lenders, increasing concentration and introducing a downward bias in the estimates of our main variables of interest. In some robustness tests, we show that our results do not depend on the use of the predetermined value of the Herfindahl index.

The vector of controls includes variables that account for county-level housing and economic

[7] Specifically, $\mathbf{1}_{\Delta \ln y_{i,t}<0}$ is equal to one if a county experience a negative income growth between 2001-2003 and 2004-2006 or between 2004-2006 and 2007-2009.

[8] For the period 2004-2006, the lagged HHI is based on mortgage data for the period 2001-2003.

conditions. These are the beginning of subperiod-t house price and income per capita, as well as the average per capita stock of single family houses, the average number of single family housing units sold, and the average unemployment rate. 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.

Table 3 reports the results. 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 provide 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, but this drop is less pronounced in areas with higher mortgage lending concentration.

Columns 1 and 2 present estimates of the baseline specification (3) without controls and with the index of lending concentration based, respectively, on the number and volume of loans originated and retained. Consistent with our model, the coefficient on the income shock is negative and the interaction term is positive. Both coefficients are statistically significant at the one percent level. Importantly, mortgage lending concentration is positively related to the change in house prices only in counties experiencing a negative income shock. In other counties, mortgage concentration reduces the increase in house prices suggesting that competition among lenders may increase lending during good times and thus lead to higher house prices.

In columns 3 and 4, the estimates are almost unchanged when we include a host of county level controls. In column 3, the point estimate for α_2 implies that after a negative income shock, as measured by the county dummy for negative income growth, house prices drop by 4.5 percent in perfectly competitive lending markets (i.e. for $HHI = 0$). But house prices drop by only 2.6 percent in areas with an Herfindahl index evaluated at the cross sectional mean ($HHI = 0.013$) and by less than 0.02 percent if the mortgage market concentration reaches the 90th percentile ($HHI = 0.03$). Similar coefficient estimates are obtained in column 4.

Columns 5 to 6 report the estimates of the same baseline specification without MSA fixed effects.

None of the coefficients are affected by this exclusion. Similar results obtain in column 7 and 8 where we use county fixed effects, instead of MSA dummies. While the inclusion of county dummies affects some control variables, the estimates of the main coefficient of interest are invariant. The robustness of the result to the rather limited within-county variation in the HHI suggests that our main findings are not driven by unobservable local housing and lending factors.

In Table 4 we check the robustness of our main results to different measures of the mortgage concentration index. As noted above, in the main specification, we include the predetermined value of this index at period $t-1$, to minimize concerns of reverse causality. The first two columns in Table 4 use instead the period-t Herfindahl index. We find that using the current period index of concentration does not affect the coefficient on the interaction term. The economic magnitude of the change in house prices following a negative income shock is comparable to the one based on the estimates in columns 3 and 4 of Table 3.

Our theoretical model assume that lenders bear the credit risk on the loans they originate and retain. In reality, a large fraction of loans are securitized. If the effect of concentration were to be entirely driven by securitization, 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.[9] 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, Columns 3 and 4 add the average securitization rate as an additional control. This is defined as the period-t county average fraction of loans originated and then securitized. As can be seen, none of the results are affected by the inclusion of this additional control. Columns 5 and 6, explore further the role played by securitization. The previous spec-

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

ification is amended to include a measure of concentration based on market shares that exclude securitized loans from the computation of the total number or volume of loans originated in a county. Consistent with the results reported in the other columns, we find that counties hit by a negative income shock experience a drop in house prices, but this effect is mitigated in markets with a more concentrated mortgage provision. The drop in house price following a negative income shock is 6.3 percent in markets with atomistic mortgage lenders ($HHI = 0$), but only to 2.6 in markets with an index of lending concentration close to the sample average ($HHI = 0.09$).

In a further attempt to control for any effect of foreclosures due to securitized loans we include controls for the delinquency rate of securitized loans in column 7 and 8. This variable, together with the 60-days delinquency rate on consumer credit, allows us to control for differences in the intensity of the negative shock to real estate prices across counties. Our estimates are unaffected and continue to indicate that mortgage lending concentration mitigates the effect of negative income shocks on house prices.

E Mortgage concentration and judicial foreclosure

In Table 3 and 4, equation (3) is estimated using panel regressions, controlling for geographic, demographic, and economic determinants of house prices. Those specifications allow us to include **MSA fixed** effects and other county characteristics that could be correlated with our indexes of lending concentration and house price changes. The main concern with this analysis is that there may be an omitted factor that is correlated with the response of house prices to negative shocks in areas with high lending concentration, leading to inconsistent estimates of the coefficients of interest.

To mitigate these concerns, we now test further cross-sectional implications of our theory on the relation between changes in house prices following negative shocks and mortgage market concentration. Specifically, we focus on the cross-section of price changes during the 2007-2009 subperiod, when the majority of U.S. counties experienced a negative income shock. This test also allow us to assure that our main results hold even in the sample period for which we can estimate the effect of mortgage lending concentration on foreclosures (see Subsection IV.F.)

According to the model, lenders with larger market shares internalize more 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 counties 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 US housing market collapse.

Building on this evidence, we refine our empirical strategy to allow the interaction term $HHI_{c,t-1} \times \mathbf{1}_{\Delta \ln y_{i,t}<0}$ in equation (3) to vary with a dummy variable for judicial foreclosure states. Since states also differ in terms of the number of days it takes to seize a property from a delinquent borrower, we also use a dummy variable that is equal to one if the average length of time required to accomplish a foreclosure in a given state is larger than the cross-sectional median.

As in Mian, Sufi and Trebbi (2012), we focus only on the post-2006 housing collapse, and estimate a modified version of equation (3), with $t = 2007 - 2009$:

$$\begin{aligned} \Delta \ln p_{c,t} &= \alpha_1 HHI_{c,t-1} + \alpha_2 \mathbf{1}_{\Delta \ln y_{i,t}<0} + \alpha_3 HHI_{c,t-1} \times \mathbf{1}_{\Delta \ln y_{i,t}<0} \\ &+ \alpha_4 HHI_{c,t-1} \times \mathbf{1}_{\Delta \ln y_{i,t}<0} \times \mathbf{1}_{Jud=1,Days=1} \\ &+ \beta_5 X_{c,t} + \varepsilon_{c,t}, \end{aligned} \qquad (4)$$

where $\mathbf{1}_{Jud=1,Days=1}$ is an indicator function for states with judicial foreclosure or for states with a lengthy foreclosure procedure. Since even during the period 2007-2009 not all counties experience negative income growth, we include the indicator function $1_{\Delta \ln y_{i,t}<0}$ capturing counties more severely hit by the shock. The coefficients of interest are now α_2, α_3 and α_4. We expect $\alpha_2 < 0$,

$\alpha_3 > 0$ and $\alpha_4 < 0$, meaning that income shocks have smaller effects on house prices in areas with larger banking concentration, but less so if the foreclosure procedures are more costly or lengthier.

The results are in Table 5. Estimates in columns 1 and 3 are based on the full sample of counties with available data. Columns 2 and 4 focus on a subsample of counties in MSAs straddling between two or more state borders. By definition MSAs regroup counties with a high level of social and economic integration. Therefore, this subsample includes counties with different foreclosure laws, but likely to share observed and unobserved characteristics. In particular, this counties are likely to have experienced economic shocks of similar intensity. Such a sample selection provide a rigorous way to minimize concerns of omitted variables in our regressions.

For brevity, Table 5 reports only estimates with the index of lending concentration based on the number of loans originated and retained. Similar results obtain with the index of concentration based on the volume of loans retained. The estimates in column 1 suggest that the mechanism identified in the model is at work: for counties experiencing a negative income shock the change in house prices is smaller if mortgage lending is concentrated, but less so in jurisdictions where foreclosures are less likely. Importantly, lending concentration does not appear to affect counties that do not experience a negative shock.

As shown in column 2, coefficient estimates are statistically significant, and increase in economic magnitude in the sample of bordering counties. Such an improvement is remarkable, given the considerably reduced sample size. The estimates in columns 3 and 4, where states are classified based on the average number of days it takes to complete a foreclosure deliver the same message: banks with larger market share internalize the effects of foreclosures on house prices, but this effects is muted as the foreclosure procedure becomes lengthier and incentives to foreclose weaken for all banks.

F 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.

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 equation (3) with the foreclosure rate, instead of the house price change, as dependent variable. Thus, 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.

Table 6 reports the results using the index of banking concentration based on the number of loans originated and retained.[10] The estimates in column 1 support the prediction that higher mortgage credit concentration is associated with lower foreclosure rates 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, the foreclosure rate increases by over 40 percent in counties with average foreclosure rate and perfectly competitive mortgage markets and by less than 15 percent if the same county has an average concentration index.

The magnitude and the statistical significance of the estimated coefficients do not change in column 2 where we use a sample of counties belonging to MSAs that straddle between two or more states, even though the number of observations is drastically reduced.

In columns 3 and 4, we control for the 60-days delinquency rate of securitized loans, which are more likely to be foreclosed. We continue to find that mortgage lending concentration mitigates the effect of negative income shocks on foreclosures (although the effect is not statistically significant at conventional levels when we consider only bordering counties), thus confirming that the effect we uncover is not entirely driven by securitization. We include this control in the remaining

[10] Similar results obtain when we use the index of banking concentration based on the volume of loans originated and retained

specifications.

In columns 5 to 8, we refine the previous findings by exploiting exogenous state level differences in foreclosure costs. The estimated coefficients are based on the regression model in equation (4), but with the foreclosure rate as dependent variable. 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 more strongly influenced by their market share. Our estimates support this prediction. In counties hit by a negative income shock, foreclosure rates increase less when the mortgage market is highly concentrated, but the effect of concentration is attenuated in jurisdictions with costly foreclosure procedures. The triple interaction terms in Table 6 have the expected signs and are all statistically significant with the exception of the coefficient in column 5.

Overall, these results support the causal mechanism of our theory.

V Conclusion

We show that in mortgage markets with a dispersed lending structure, 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 a sample of US counties during the recent housing market collapse. We find that following negative shocks house prices drop to a lower extent in markets in which the provision of mortgages is more concentrated. 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' losses because tend to strengthen their incentives to renegotiate defaulting loans. This in turn mitigates the effects of negative shocks on house prices reducing strategic defaults.

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 concentrated lenders is an exciting venue for future research.

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Table 1
Variable Description and Data Sources

Variable name	Variable description	Source
Consumer Credit 60 days-delinquency rate	County proportion of consumer debt balances (mortgage debt, debt on credit cards, auto loans and student loans) that is between 60 and 89 days delinquent	Federal Reserve Bank of New York/Equifax
Days Dummy	Dummy variable that takes value equal to one if the average length of time required to accomplish a foreclosure for counties in a given state is larger than the cross sectional median number of days for a foreclosure to be completed.	RealtyTrac.com
Foreclosure Rate	The county's number of foreclosures, defined as the sum of notices of trustee sale, foreclosure sales, and real estate owned (REO) properties divided by the number of homeowners approximated using the HMDA number of mortgages originated in 2005.	RealtyTrac.com
HHI-Volume	Sum of squared shares of the mortgage loans provided by different banks in a county. The shares are based on the volume of loans originated and retained by a lender in a county relative to the total volume of loans originated in the same county. Unless otherwise noted in the text, loans (originated and/or retained) are measured over a three-year period preceding the one in which the 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.	Home Mortgage Disclosure Act Database (HMDA)
HHI-Number	Defined as HHI-Volume, but using the number of loans, instead of the volume of loans, to compute the sum of squared shares.	HMDA
HHI-Volume-No Securitized	Defined as HHI-Volume, but considering only the volume of loans originated and retained in a county to compute the denominator of the shares.	HMDA
HHI-Number-No Securitized	Defined as HHI-Number, but considering only the number of loans originated and retained in a county to compute the denominator of the shares.	HMDA
House price growth	Logarithmic change of the county level house price index for single-family owner-occupied houses.	Economy Moody's.com
Housing Stock per Capita	The number of existing single family owner occupied houses in a county, divided by the county's population.	U.S. Bureau of Census
Housing Units Sold	The county's number of single-family owner-occupied units sold	National Association of Realtors (NAR)
Income per Capita	County personal income per capita.	U.S. Bureau of Census
Judicial Foreclosure	Dummy variable that takes value 1 for counties in states with a judicial requirement for foreclosure	RealtyTrac.com
Negative Income Growth	Dummy variable that takes value equal to 1 if the county's change in per capita personal income is negative during the time period.	U.S. Bureau of Census
Population	The county's population	U.S. Bureau of Census
Securitized Loans	Fraction of county loans originated for purchase of single family owner occupied houses sold within the year of origination to other non-	HMDA

Variable name	Variable description	Source
	affiliated financial institutions or government-sponsored housing enterprises.	
Securitized Loans- 60days delinquency rate	County fraction of securitized mortgage loans for the purchase of owner occupied houses that is between 60 and 89 days delinquent.	Lender Processing Services (LPS)
Unemployment	The county’s unemployment rate	U.S. Bureau of Census

Table 2
Summary Statistics

Summary statistics of the main variables. We present county-time pooled data, over two time periods: 2004-2006 and 2007-2009. All variable are defined in Table 1. The market shares of the HHI indexes are defined as the number (or the volume) of mortgage loans originated and retained by individual lenders over the sub-periods 2004-2006 and 2007-2009 relative to the total number of loans originated in the same county over the same period. When we consider the predetermined HHI we consider loans originated over the periods 2001-2003 and 2004-2006. All other variables are averaged within the sub-periods.

	Mean	SD	Min	Max	10th pc	90th pc	Number of Counties
Consumer Credit 60 days- delinquency rate	0.0082	0.0041	0.0007	0.065	0.0039	0.0132	997
Foreclosure rate	0.0452	0.0611	0	0.4076	0.0017	0. 1183	777
HHI-Number	0.0137	0.0245	0.0006	0.3272	0.0020	0.0312	1055
HHI-Volume	0.0119	0.0194	0.0005	0.2275	0.0019	0.0282	1055
Securitized Loans	0.5887	0.1076	0.0949	0.8611	0.4367	0.6984	1055
HHI-Number-No Securitized Loans	0.0859	0.0589	0.0183	0.5347	0.0380	0.1486	1055
HHI-Volume-No Securitized Loans	0.0920	0.0600	0.0193	0.5570	0.0419	0.1589	1055
House price growth	-0.0618	0.1805	-1.2245	0.4422	-0.2472	0.1445	1072
Log change in income per capita	0.0080	0.0217	-0.1688	0.2616	-0.0175	0.0321	1072
Log income per capita	9.6854	0.2239	9.0607	10.9557	9.4327	9.9748	1072
Unemployment rate	5.7206	1.6966	2.2177	22.7390	3.8646	7.9209	1072
Log of single family housing stock per capita	0.2391	0.0401	0.0022	0.3715	0.1892804	0.2854019	1072

	Mean	SD	Min	Max	10th pc	90th pc	Number of Counties
Log of single family housing units sold	7.4514	1.4090	2.8998	11.4348	5.4659	9.1900	1062
Negative income growth	0.508	0.5000	0	1	0	1	1072
Securitized Loans- 60days delinquency rate	0.0009	0.0010	0	0.0066	0	0.002	1028

Table 3
House price growth and lending concentration, pooled regressions

County level pooled regressions of the log change in house prices on the lagged Herfindahl index and its interaction with a dummy for negative income growth. Control variables include the beginning of period log house prices, the period average housing stock per capita, the period average number of housing units sold, the beginning of period log income, the period average unemployment rate and a time dummy for the period 2007-2009. All variables and sources are defined in Table 1. Columns (1) to (4) include MSA dummies; columns (7) and (8) county dummies. Standard errors in parenthesis are clustered at the MSA level in columns (1) to (6) and at the county level in columns (7) and (8). Estimates followed by ***, **, and * are statistically different from zero with 0.01, 0.05 and 0.10 significance levels, respectively.

	Dependent Variables: House price growth							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Negative income growth	-0.053***	-0.053***	-0.045***	-0.044***	-0.049***	-0.047***	-0.016	-0.014
	(0.013)	(0.013)	(0.011)	(0.011)	(0.010)	(0.010)	(0.015)	(0.016)
HHI-Number	-0.563**		-0.678**		-0.708**		-0.767	
	(0.267)		(0.277)		(0.274)		(1.124)	
HHI-Number*Negative income growth	1.365***		1.438***		1.519***		1.821**	
	(0.363)		(0.384)		(0.330)		(0.788)	
HHI-Volume		-0.653*		-0.746**		-0.751**		-0.179
		(0.337)		(0.330)		(0.310)		(1.226)
HHI-Volume*Negative income growth		1.394***		1.314***		1.354***		1.406*
		(0.437)		(0.465)		(0.372)		(0.777)
Log house prices			-0.328***	-0.329***	-0.103***	-0.103***	-0.841***	-0.844***
			(0.044)	(0.044)	(0.012)	(0.012)	(0.084)	(0.084)
Housing stock per capita			-0.177	-0.177	-0.298***	-0.296***	9.008***	8.980**
			(0.161)	(0.161)	(0.098)	(0.098)	(3.455)	(3.480)
Housing units sold			0.008*	0.007	-0.000	-0.001	0.146***	0.149***
			(0.005)	(0.005)	(0.003)	(0.003)	(0.051)	(0.051)
Income per capita			0.083***	0.084***	0.038*	0.038*	-0.898***	-0.894***
			(0.030)	(0.030)	(0.021)	(0.021)	(0.243)	(0.243)
Unemployment rate			-0.059***	-0.059***	-0.032***	-0.032***	-0.111***	-0.111***
			(0.008)	(0.008)	(0.004)	(0.004)	(0.014)	(0.014)
Period dummy, 07-09	-0.229***	-0.229***	-0.147***	-0.148***	-0.187***	-0.189***	0.004	0.006
	(0.015)	(0.015)	(0.016)	(0.016)	(0.013)	(0.013)	(0.026)	(0.027)
Constant	0.081***	0.082***	0.964***	0.965***	0.388**	0.393**	9.645***	9.599***
	(0.011)	(0.011)	(0.283)	(0.285)	(0.181)	(0.181)	(2.214)	(2.225)
Observations	1847	1847	1835	1835	1835	1835	1835	1835
N. of counties	1044	1044	1044	1044	1044	1044	1044	1044
Fixed effects	MSA	MSA	MSA	MSA	--	--	County	County
Standard errors clusters	MSA	MSA	MSA	MSA	MSA	MSA	County	County
R2	0.667	0.667	0.738	0.737	0.556	0.554	0.854	0.853

Table 4
Robustness

County level pooled regressions of the log change in house prices on the Herfindahl index and its interaction with a dummy for negative income growth. Control variables include the beginning of period log house prices, the period average housing stock per capita, the period average number of housing units sold, the beginning of period log income, the period average unemployment rate, the period average securitization rate, the 60 days delinquency rate on securitized mortgage loans, the 60 days consumer credit delinquency rate ,and a time dummy for the period 2007-2009. All variables and sources are defined in Table 1. All columns include MSA dummies. Standard errors in parenthesis are clustered at the MSA level. Estimates followed by ***, **, and * are statistically different from zero with 0.01, 0.05 and 0.10 significance levels, respectively.

	Dependent Variables: House price growth							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Negative Income Growth	-0.042***	-0.043***	-0.045***	-0.043***	-0.063***	-0.060***	-0.038***	-0.037***
	(0.010)	(0.010)	(0.011)	(0.011)	(0.017)	(0.017)	(0.010)	(0.010)
HHI-Number (current)	-0.221							
	(0.173)							
HHI-Number (current) * Negative Income Growth	0.773***							
	(0.226)							
HHI-Volume (current)		-0.306						
		(0.224)						
HHI-Volume (current)* Negative Income Growth		0.939***						
		(0.300)						
HHI-Number			-0.653**				-1.377***	
			(0.295)				(0.464)	
HHI-Number*Negative Income Growth			1.448***				1.277**	
			(0.387)				(0.536)	
HHI-Volume				-0.757**				-1.224**
				(0.353)				(0.509)
HHI-Volume *Negative Income Growth				1.311***				1.028*
				(0.466)				(0.523)
HHI -Number-No Securitized					0.018			
					(0.134)			
HHI -Number-No Securitized *Negative Income Growth					0.428***			
					(0.164)			
HHI -Volume-No Securitized						0.075		
						(0.118)		
HHI -Volume-No Securitized *Negative Income Growth						0.351**		
						(0.150)		
Log house prices	-0.313***	-0.314***	-0.329***	-0.329***	-0.328***	-0.325***	-0.322***	-0.322***
	(0.041)	(0.041)	(0.046)	(0.046)	(0.046)	(0.046)	(0.046)	(0.046)
Housing stock per capita	-0.166	-0.175	-0.182	-0.175	-0.186	-0.171	-0.138	-0.141
	(0.152)	(0.150)	(0.163)	(0.163)	(0.166)	(0.167)	(0.184)	(0.186)

Housing units sold	0.013***	0.013***	0.007	0.007	0.008	0.008*	0.008	0.008
	(0.004)	(0.004)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Income per capita	0.071**	0.071**	0.084***	0.083***	0.080***	0.076**	-0.006	-0.005
	(0.029)	(0.028)	(0.031)	(0.031)	(0.031)	(0.031)	(0.033)	(0.033)
Unemployment rate	-0.058***	-0.058***	-0.059***	-0.059***	-0.059***	-0.059***	-0.046***	-0.046***
	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)	(0.008)
Securitized Loans			0.012	-0.005	0.055	0.045	-0.043	-0.035
			(0.066)	(0.064)	(0.064)	(0.061)	(0.077)	(0.073)
Securitized Loans- 60days							-0.136**	-0.132**
delinquency rate							(0.062)	(0.062)
Consumer Credit 60 days-							-0.149***	-0.151***
delinquency rate							(0.028)	(0.028)
Period dummy, 07-09	-0.140***	-0.140***	-0.146***	-0.148***	-0.142***	-0.142***	-0.096***	-0.096***
	(0.014)	(0.014)	(0.017)	(0.017)	(0.017)	(0.017)	(0.018)	(0.018)
Constant	0.949***	0.956***	0.956***	0.968***	0.951***	0.974***	1.850***	1.842***
	(0.267)	(0.264)	(0.283)	(0.284)	(0.286)	(0.287)	(0.321)	(0.321)
Observations	2087	2087	1835	1835	1835	1835	1672	1672
N. of counties	1044	1044	1044	1044	1044	1044	1044	1044
Fixed effects	MSA	MSA	MSA	MSA	MSA	MSA	MSA	MSA
Standard errors clusters	MSA	MSA	MSA	MSA	MSA	MSA	MSA	MSA
R2	0.724	0.724	0.738	0.737	0.738	0.739	0.775	0.775

Table 5
House price growth, lending concentration and judicial foreclosures

County cross sectional regressions of the log change in house prices between 2007 and 2009 on the Herfindahl index and its interaction with a dummy for negative income growth and a dummy for judicial foreclosure states. Control variables include the beginning of period log house prices, the period average housing stock per capita, the period average number of housing units sold, the beginning of period log income, and the period average unemployment rate. In columns (2) and (4) the sample includes only counties that are in MSA bordering two or more US states. All variables and sources are defined in Table 1. Standard errors in parenthesis are clustered at the MSA level. Estimates followed by ***, **, and * are statistically different from zero with 0.01, 0.05 and 0.10 significance levels, respectively.

	Dependent Variable: House price growth			
	Full Sample (1)	Bordering (2)	Full Sample (3)	Bordering (4)
Negative income growth	-0.019	-0.037*	-0.004	-0.039**
	(0.016)	(0.019)	(0.016)	(0.015)
HHI-Number	-0.415	-0.156	-0.627*	0.043
	(0.356)	(0.330)	(0.379)	(0.306)
HHI-Number*Negative income growth	1.318***	0.984*	1.321***	0.993**
	(0.374)	(0.492)	(0.392)	(0.402)
HHI-Number*Negative income growth*Judicial foreclosure	-1.503**	-1.668		
	(0.686)	(1.188)		
HHI-Number*Negative income growth*Days dummy			-1.437**	-1.960*
			(0.711)	(1.045)
Negative income growth*Judicial foreclosure	0.024	0.060*		
	(0.022)	(0.035)		
HHI-Number*Judicial dummy	-0.371	-0.219		
	(0.487)	(0.368)		
Negative income growth*Days dummy			-0.009	0.067**
			(0.022)	(0.029)
HHI-Number*Days dummy			0.049	-0.491
			(0.427)	(0.393)
Judicial foreclosure	0.029	0.001		
	(0.021)	(0.021)		
Days dummy			0.038*	0.013
			(0.020)	(0.026)
Log house prices	-0.204***	-0.129***	-0.216***	-0.132***
	(0.020)	(0.035)	(0.019)	(0.031)
Housing stock per capita	-0.148	-0.118	-0.201	-0.094
	(0.139)	(0.129)	(0.149)	(0.123)
Housing units sold	-0.009*	0.004	-0.007	0.003
	(0.005)	(0.006)	(0.005)	(0.006)
Income per capita	0.098***	0.028	0.119***	0.036
	(0.031)	(0.039)	(0.033)	(0.037)
Unemployment rate	-0.034***	-0.008	-0.035***	-0.008
	(0.004)	(0.008)	(0.004)	(0.007)
Constant	0.044	0.163	-0.098	0.089
	(0.256)	(0.315)	(0.276)	(0.309)
Observations	1044	232	1044	232
Standard errors clusters	MSA	MSA	MSA	MSA
R2	.492	.449	.485	.485

Table 6
Foreclosures and lending concentration

County cross sectional regressions of the average number of foreclosures (per homeowner) between 2007 and 2009 on the Herfindahl index, and its interaction with a dummy for negative income growth and a dummy for judicial foreclosure states. Control variables include the beginning of period log house prices, the period average housing stock per capita, the period average number of housing units sold, the beginning of period log income, the period average unemployment rate, and the 60 days delinquency rate on securitized loans. In columns (2), (4), (6) and (8) the sample includes only counties that are in MSA bordering two or more US states. All variables and sources are defined in Table 1. Standard errors in parenthesis are clustered at the MSA level. Estimates followed by ***, **, and * are statistically different from zero with 0.01, 0.05 and 0.10 significance levels, respectively.

	Dependent Variable: Foreclosure rate							
	Full sample (1)	Bordering (2)	Full sample (3)	Bordering (4)	Full sample (5)	Bordering (6)	Full sample (7)	Bordering (8)
Negative income growth	0.019***	0.026***	0.020***	0.026**	0.028***	0.044***	0.037***	0.041***
	(0.006)	(0.008)	(0.006)	(0.010)	(0.010)	(0.014)	(0.009)	(0.013)
HHI-Number	0.517**	0.906	0.454**	0.589	0.465**	2.168***	0.609***	1.844***
	(0.202)	(0.609)	(0.205)	(0.726)	(0.221)	(0.472)	(0.207)	(0.522)
HHI-Number*Negative income growth	-0.896***	-1.298**	-0.911***	-1.057	-1.616***	-3.064***	-1.802***	-2.765***
	(0.200)	(0.626)	(0.292)	(0.932)	(0.490)	(0.679)	(0.441)	(0.702)
HHI-Number*Negative income growth*Judicial foreclosure					1.241*	4.379**		
					(0.722)	(1.963)		
HHI-Number*Negative income growth*Days dummy							2.276***	3.993**
							(0.807)	(1.877)
Negative income growth*Judicial foreclosure					-0.017	-0.038*		
					(0.011)	(0.019)		
HHI-Number*Judicial foreclosure					0.124	-2.616***		
					(0.505)	(0.564)		
Negative income growth*Days dummy							-0.037***	-0.035*
							(0.012)	(0.019)
HHI-Number*Days dummy							-0.734	-2.208***
							(0.625)	(0.655)
Judicial foreclosure					-0.009	0.018*		
					(0.010)	(0.010)		
Days dummy							0.011	0.015
							(0.011)	(0.012)
Securitized Loans 60days delinquency			0.013	-0.045	0.028	-0.022	0.021	-0.021
			(0.031)	(0.051)	(0.031)	(0.049)	(0.030)	(0.049)
House price growth	-0.150***	-0.004	-0.147***	-0.005	-0.131***	0.017	-0.141***	0.016
	(0.033)	(0.029)	(0.030)	(0.031)	(0.027)	(0.037)	(0.027)	(0.042)
Housing stock per capita	-0.055	-0.066	-0.044	-0.037	-0.033	-0.037	-0.018	-0.041
	(0.055)	(0.115)	(0.053)	(0.101)	(0.048)	(0.087)	(0.049)	(0.090)
Housing units sold	0.011***	0.005	0.012***	0.005	0.013***	0.005	0.012***	0.006
	(0.002)	(0.005)	(0.002)	(0.005)	(0.002)	(0.005)	(0.002)	(0.005)
Income per capita	-0.046***	-0.019	-0.045***	-0.019	-0.038***	-0.010	-0.042***	-0.010

	Dependent Variable: Foreclosure rate							
	Full sample	Bordering	Full sample	Bordering	Full sample	Bordering	Full sample	Bordering
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	(0.017)	(0.016)	(0.015)	(0.017)	(0.014)	(0.017)	(0.015)	(0.018)
Unemployment rate	0.006***	0.005**	0.006***	0.006**	0.006***	0.006**	0.006***	0.006**
	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)
Constant	0.336**	0.141	0.310**	0.135	0.245*	0.040	0.275*	0.032
	(0.169)	(0.190)	(0.155)	(0.184)	(0.142)	(0.185)	(0.147)	(0.194)
Observations	774	157	756	154	756	154	756	154
Standard errors clusters	MSA	MSA	MSA	MSA	MSA	MSA	MSA	MSA
R2	0.371	0.114	0.378	0.122	0.399	0.151	0.4	0.148