Mortgage Market Concentration, Foreclosures and House Prices*

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Abstract

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

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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). One view is that generalized price declines occur when poor maintenance of foreclosed properties affect the quality of nearby houses (Harding, Rosenblatt, Yao, 2009). Another view is that price declines occur when foreclosures increase the supply of homes in illiquid markets. Foreclosures can also lead to contagious defaults not only because house price declines trigger further defaults by borrowers with negative home equity (Elul, Souleles, Chomsisengphet, Glennon, and Hunt, 2010), but also because foreclosures affect the social norm regarding the repayment of mortgages (Guiso, Sapienza and Zingales, 2011).

In this paper, we argue that foreclosures create a pecuniary externality that may lead to contagious defaults, especially in markets with a less concentrated lending structure. We proceed in two steps. First, we present a simple model to illustrate how individual foreclosure decisions cause aggregate house price declines, and how incentives to foreclose are weaker in markets with a highly concentrated lending structure. Next, we use county level data on foreclosure and house prices in the U.S. to test the model's predictions.

In the model, defaults occur when idiosyncratic income shocks make borrowers unable to honor

their 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, liquidation decisions are taken in isolation, and small (atomistic) lenders do not internalize the pecuniary externality that their liquidation decisions have on local housing prices. In these markets, liquidity defaults caused by shocks to borrowers' income are more likely to be followed by strategic defaults, because borrowers who can afford to repay mortgages find it optimal to default if the value of their mortgages exceeds the value of their houses. Thus, defaults by distressed borrowers and strategic defaults depress house prices, leading to large aggregate losses for mortgage lenders.

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 cause foreclosure rates to fall, limiting strategic defaults and their adverse effects on house prices.

To test the implications of this theory, we use differences in mortgage lending concentration and housing price volatility in US counties during the 2007-2009 housing market collapse. By using county level data, we are able 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 during the recent period of market distress the volatility of house prices is significantly lower in areas where the mortgage market is more concentrated. Between 2007 and 2009, house prices decrease more in counties experiencing a negative income shock, but the price changes are muted in areas where lenders hold larger shares of the local mortgage market. We estimate an elasticity of house price to negative income shocks of 0.06 in the least concentrated lending markets; this elasticity drops by half in counties with an index of market concentration evaluated at the cross-sectional median. The results are robust to the inclusion of controls for standard 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 validate the interpretation of these findings, we test two additional implications of our theory. First, for a given market structure, banks have stronger incentives to renegotiate defaulting loans

if the foreclosure procedure involves higher transaction costs. Consistent with this idea, we find that mortgage concentration reduces house price volatility to a large 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. Second, since securitized mortgages are best thought as held by “atomistic” lenders, securitization tends to reduce market concentration. We show, however, that our main results are not driven by securitization, and the mechanism we highlight continues to hold even when we exclude securitized mortgages or control for the proportion of securitized mortgages in local markets.

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 in the collapse of housing prices during the 2007-2009 financial crisis. Mian, Sufi, and Trebbi (2012) show that foreclosures are more frequent in states in which 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 also highlight the importance of the lenders’ incentives to foreclose for house prices volatility. We propose, however, that the concentration of the local market for mortgages is important and that high dispersion in the provision of mortgages may bias foreclosure decisions and exacerbate price volatility.

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, for example,

¹Von 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.

that securitized loans are much less likely to be renegotiated and more likely to be foreclosed because dispersed ownership and potential agency frictions brought about by securitization of residential mortgages inhibit renegotiation of loans at risk of foreclosure. Adelino, Gerardi and Willen (2010a and b), and Ghent (2011) question Piskorski, Seru and Vig's (2010) findings and 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 concentration structure. A low concentration in the local mortgage market can be brought about not only by the entry of a variety of mortgage lenders, but also by securitization.

There is also a large literature exploring the effects of a concentrated banking systems on bank-firm relationships (Petersen and Rajan, 1995) and loan supply (Garmaise and Moskowitz, 2006). While these papers stress 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 (Keely (1990)) that competition in the market for credit erodes financial stability because by lowering lenders' profits, competition distorts their investment and risk-taking decisions.

Finally, the paper is related to a small 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, increases the price of labor and 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

In this section, we present a simple model to illustrate how defaults and foreclosures affect house prices in markets with different mortgage lenders' concentration. The model also shows how the effect of mortgage concentration depends on bankruptcy laws favoring liquidation over renegotiation of defaulting mortgages.

A The Model

A.1 Assumptions

The model has two time periods, $t = 0, 1$, and two goods: a divisible consumption good, c_t , and an indivisible housing good h_t . There is a continuum of risk neutral households of mass 1, indexed by i , that value consumption and housing according to:

$$U_i = c_{1i} + \gamma_i h_{1i} + \delta (c_{2i} + \gamma_i h_{2i}),$$

where $c_{ti} \geq 0$ is household i 's consumption of the divisible good at time t , $h_{it} \in \{0, 1\}$ is an indicator function that takes on the value of one for i 's home ownership at time t and zero otherwise, and $\delta \in (0, 1)$ is the discount factor. Households are heterogeneous in the utility they derive from home ownership. This is captured by the parameter, γ_i , which is uniformly distributed:

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

Households enter the first period with income, w_1 , and receive a random income w_{2i} in the second period. With probability q , the realization of this second-period endowment is w_2 . With probability $1 - q$, a fraction e of households receive ϑw_2 , with $0 < \vartheta < 1$. The negative endowment shock is independently distributed from γ_i . There is no rental market and thus owning is the only way to consume housing services (rental housing services can be thought to be part of the consumption good). Houses can be traded in both periods, and the house supply at each t is fixed at $\bar{H}$.

In the first period, households can finance the purchase of a house with a one period mortgage, originated by a continuum of deep pocket investors of mass 1, called banks. Banks compete by offering mortgages of size L , and repayment obligation B . The opportunity cost of extending a loan is $L(1 + r)$, where $r = 1/\delta - 1$.

The final assumption is that households are wealthy enough to afford a down-payment for the house, but too poor to save an amount sufficient to insure against the second period income shock.² Therefore, in the first period, households divide their period income, w_1 , between consumption c_{1i} and the down-payment for the house, $p_1 h_{1i} - L$, where p_1 is the house price in units of the numeraire consumption good, and L is the size of the mortgage loan. Their $t = 1$ budget constraint is:

$$w_1 + L = c_{1i} + p_1 h_{1i},$$

implying that households never save. This is without loss of generality because linear utility and $r = 1/\delta - 1$ imply that any household is indifferent between consuming today and saving at the equilibrium interest rate.

In the second period, the budget constraint depends on the realization of the income shock and on whether households repay or default on their mortgages. In default, the budget constraint depends also on banks' decision to liquidate or renegotiate a mortgage contract. Specifically, if household i repays the mortgage, the $t = 2$ budget constraint is:

$$w_{2i} = c_{2i} + B + p_2 (h_{2i} - h_{1i}).$$

If, instead, household i defaults, and the bank agrees to renegotiate the contract accepting a payment equal to a fraction x of the loan repayment, the budget constraint is:

$$w_{2i} = c_{2i} + xB + p_2 (h_{2i} - h_{1i}).$$

Finally, if household i defaults, the bank liquidates the contract and forecloses the house, the

²This is the case if the realization of period 2 income, θw_2 is sufficiently low. The parameter restrictions that satisfy these assumption are given below.

second-period budget constraint becomes:

$$w_{2i} = c_{2i} + p_2 h_{2i}.$$

Because households always have the option to default and surrender the house to banks, they prefer to default whenever,

$$p_2 h_{1i} < B, \tag{1}$$

which requires that the second period house price is sufficiently low.

A.2 Equilibrium housing prices and bank liquidation strategies

In the first period, the demand for housing is given by the following condition

$$\gamma_i \geq p_1.$$

Since γ_i is uniformly distributed, the equilibrium price is pinned down by equating aggregate demand and supply:

$$p_1 = \bar{\gamma} - \bar{H}.$$

In the second period, the equilibrium house price depends on the realization of the income shock. When there is no shock, the equilibrium price is derived as before:

$$p_2^{NS} = \bar{\gamma} - \bar{H}.$$

Instead, when a negative income shock occurs, defaults take place, and the equilibrium price depends on banks' decisions to renegotiate or liquidate defaulting loans. If banks renegotiate, households remain in possession of their house. As they will not be financing constrained, aggregate demand remains unchanged and the equilibrium house price, p_2^{SR} , will be equal to the one prevailing in the state of the world with no income shocks:

$$p_2^{SR} = p_2^{NS}.$$

In contrast, when banks seize the houses and put them on the market, a fraction e of households becomes unable to participate in the housing market at $t = 2$ (we give the condition under which this is the case in equilibrium below). In this case, the market clearing condition becomes:

$$(1 - e)(\bar{\gamma} - p_2) = \bar{H};$$

and the equilibrium price is:

$$p_2^{SL} = \bar{\gamma} - \frac{\bar{H}}{1 - e}.$$

It follows immediately that p_2^{SL} is strictly lower than p_2^{SR} :

$$p_2^{SL} = \bar{\gamma} - \frac{\bar{H}}{1 - e} < p_2^{SR} = \bar{\gamma} - \bar{H}, \quad (2)$$

because 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.

A.3 Banks' contract, strategic default and aggregate losses

Given the second period equilibrium price under liquidation, p_2^{SL} , competitive banks originate loans of size L , as long as they break-even on average, i.e.,

$$qB + (1 - q)\left(\bar{\gamma} - \frac{\bar{H}}{1 - e}\right) = L(1 + r),$$

where the repayment obligations, B , cannot be higher than the equilibrium price with no shocks, p_2^{NS} :

$$B \leq \bar{\gamma} - \bar{H}.$$

Otherwise, condition (1) holds and households always default.

Assuming that households always borrow as much as they can, the equilibrium loan size is:

$$L = \frac{q(\bar{\gamma} - \bar{H}) + (1 - q)\left(\bar{\gamma} - \frac{\bar{H}}{1 - e}\right)}{(1 + r)},$$

which is a weighted average of the return to the lender in case of no default and default and liquidation. Since $L < (\bar{\gamma} - \bar{H})$, and the equilibrium price at $t = 1$, is:

$$p_1 = \bar{\gamma} - \bar{H}.$$

The down payment has to be equal to

$$(\bar{\gamma} - \bar{H}) - \frac{q(\bar{\gamma} - \bar{H}) + (1 - q)\left(\bar{\gamma} - \frac{\bar{H}}{1-e}\right)}{(1 + r)},$$

which is feasible, given the $t = 1$ budget constraint, if and only if

$$w_1 > (\bar{\gamma} - \bar{H}) - \frac{q(\bar{\gamma} - \bar{H}) + (1 - q)\left(\bar{\gamma} - \frac{\bar{H}}{1-e}\right)}{(1 + r)}$$

Also, since with liquidation some households have a utility loss for not being able to participate in the housing market, they might want to borrow less (or save to insure their consumption), to avoid liquidation. For simplicity, we rule out this possibility, i.e., the negative shock is too large for the household to be able to insure it through precautionary saving:

$$(\bar{\gamma} - \bar{H}) - \vartheta w_2 > w_1.$$

These two last conditions imply the following restrictions on the household income:

$$(\bar{\gamma} - \bar{H}) - \vartheta w_2 > w_1 > (\bar{\gamma} - \bar{H}) - \frac{q(\bar{\gamma} - \bar{H}) + (1 - q)\left(\bar{\gamma} - \frac{\bar{H}}{1-e}\right)}{(1 + r)}.$$

In the equilibrium in which banks liquidate the houses of defaulting borrowers, equation (2) implies that (1) holds, and thus even those households with a high second period income realization, prefer to default. This equilibrium with liquidation and default exists if and only if:

$$\vartheta w_2 < \bar{\gamma} - \frac{\bar{H}}{1-e} \leq w_2,$$

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.

The above discussion can be summarized in the following Lemma.

Lemma 1 *When defaulting loans are renegotiated, the equilibrium house price is the same as in absence of income shocks, and there are no strategic defaults. When defaulting loans are liquidated, 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 crucial assumption in Lemma 1 is that banks can distinguish between households that are hit by endowment shocks and households that are not. If this was not possible, unaffected households could strategically ask for a loan modification. Mortgage lenders' inability to distinguish between these two types of households is often been considered a determinants of lenders' reluctance to renegotiate. In what follows, we assume that endowment shocks are observable even if 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 informaton 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.³

Since, in the equilibrium with strategic default,

$$\vartheta w_2 < p_2^{SL},$$

the housing price is always larger than the payment that a bank can obtain in a renegotiation with a household hit by an income shock. It follows readily that for competitive banks it is always optimal to liquidate rather than to renegotiate.

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

Proposition 1 implies that banks that have only a small market share in the mortgage market always liquidate.

So far, we have shown that there exist an equilibrium in which competitive banks, which take housing prices as given, find it optimal to liquidate defaulting households' homes, even if this leads to strategic defaults. Hereafter, we show that even if for an atomistic bank it is individually rational to liquidate, the aggregate losses of the banking system could be lower with renegotiation.

This can be seen as follows. Since the mortgage repayment is $B = \bar{\gamma} - \bar{H}$, the aggregate losses

³It 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.

for the banking system, with renegotiation, are:

$$(B - \vartheta w_2) e = (p^{SR} - \vartheta w_2) e.$$

With liquidation, instead, all mortgages default, as households that are not hit by the shock default strategically. Thus, with liquidation, the aggregate losses for the banking system are:

$$B - p^{SL} = p^{SR} - p^{SL} = \frac{e\bar{H}}{1-e}.$$

Thus, renegotiation can reduce the aggregate losses of the banking system, even if renegotiation is not individually rational for an atomistic bank, when:

$$\frac{e\bar{H}}{1-e} > (\bar{\gamma} - \bar{H} - \vartheta w_2) e$$

or:

$$\frac{(2-e)}{(1-e)}\bar{H} > (\bar{\gamma} - \vartheta w_2), \quad (3)$$

which is true if the housing stock, $\bar{H}$, is relatively large and the fraction of households hit by the shock, e , relatively small, implying that the proportion of strategic defaults is relatively large.

The intuition behind this result is the following. Atomistic banks do not take into account the effect of liquidation on house prices. Thus, if the housing stock, $\bar{H}$, is relatively large, the housing price will have to drop by a large amount to bring the housing market back to equilibrium. Moreover, as house prices drop, a large mass of households that did not experience the negative shock will default strategically. Relative to the equilibrium with renegotiation, banks that liquidate experience a smaller loss per mortgage, but cause more defaults. Since banks are atomistic, they do not internalize that their liquidation decisions, cause a drop in housing price and increase the number of mortgage defaults (on other banks).

A.4 Banking concentration, strategic defaults and house prices

We now remove the assumption that all banks are atomistic. In particular, we consider the case in which one of the mortgage providers is large and holds a fraction ξ of the mortgage market at

$t = 2$.⁴

Such a bank internalizes that its decision whether to liquidate or to renegotiate has an effect on the aggregate demand for housing. If the bank liquidates, the aggregate demand for housing is identical to the one in the economy with atomistic banks derived above. If the large bank renegotiates, its borrowers will continue to participate in the housing market, and the aggregate housing demand is:

$$(1 - \xi)(1 - e)(\bar{\gamma} - p_2) + \xi(\bar{\gamma} - p_2)$$

For $\xi \rightarrow 1$, this aggregate demand, and the resulting equilibrium price, would be the same as the one prevailing when no income shock occurs. We would thus observe no strategic defaults. The large bank would have an incentive to renegotiate if doing so decreases the losses that it faces on its mortgage portfolio. This is the case if the following condition holds:

$$\frac{e\bar{H}}{1 - e} > (\bar{\gamma} - \bar{H} - \vartheta w_2) e\xi. \quad (4)$$

Thus, for $\xi \rightarrow 1$, a monopolistic bank would always take the socially optimal decision and renegotiate if (3) holds. This would mitigate the effect of negative income shocks on house prices.

Under the assumptions we made so far, if $\xi < 1$, even 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 strategic defaults, although it mitigates the effects of negative income shocks on house prices. However, if we more realistically introduce a cost of strategic defaults for the households, c , the model implies that banking concentration also reduces the extent of defaults and further reduces the effects of negative shocks on house prices.

If a large bank renegotiates when the other atomistic banks liquidate, the equilibrium price at $t = 2$, when a negative shock occurs, is:

$$p_2^{NS'} = \bar{\gamma} - \frac{\bar{H}}{(1 - \xi)(1 - e) + \xi},$$

which is larger than p_2^{NS} . Furthermore, $p_2^{NS'}$ increases in ξ , the parameter capturing banking concentration.

⁴We may think that banks still compete a la Bertrand if the market is contestable by potential entrants.

Also, $\frac{\partial p_2^{NS'}}{\partial \xi}$ is increasing in $\overline{H}$. So mortgage provision concentration mitigates the effects of negative shocks to a larger extent in areas in which the stock of housing is relatively larger with respect to the population. The following proposition summarizes this discussion.

Proposition 2 *The effect of negative shocks is ceteris paribus smaller in areas in which the provision of mortgages is more concentrated.*

IV Empirical Evidence

The main prediction of the model is that mortgage lending concentration mitigates the effect of negative income shocks on house prices volatility. In this section, we design an empirical strategy to test this prediction and investigate the mechanisms linking mortgage concentration to house prices volatility. We first describe the data, and our measures of lending concentration. We then present the empirical strategy and discuss the evidence in support of the model's predictions.

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 that depository and non-depository financial institutions that meet a specific asset level 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 banks, thrifts, credit unions, and mortgage companies.

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 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) or not. 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.

We complement this data with local housing, income and demographic data. House price indexes are from Moody’s Economy.com and Case-Shiller-Weiss. The former is a median house price index for existing single family properties; the latter measures housing prices holding quality constant. The results in the paper are based on Moody’s data, because it is available for a much larger cross section of geographical units. But the results hold also with the Case-Shiller-Weiss index. Income per capita, population, and unemployment rate are taken from the Bureau of Economic Analysis and local information on the stock of single family houses from the Census Bureau. Table 1 lists the variables along with their definitions and data sources.

All data is collected at annual frequency from 2002 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 use county level data to measure bank concentration. Although 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. We do so 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 ex post the lenders’ incentives to foreclose properties. Accordingly, we define a proxy of 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. 2004-2006, and 2007-2009) 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 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. 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 of mortgage concentration from the one that securitization may independently play.

C Descriptive statistics

Our sample consists of roughly 1050 urban counties in continental US 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

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

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 our concentration measures as well as for house prices and local economic and housing conditions during 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 Herfindahl 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.

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 Herfindahl 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 volatility 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.

⁶We 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.

D Methodology

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

$$\begin{aligned} \Delta \ln p_{c,t} = & \alpha_1 HHI_{c,t-1} + \alpha_2 \mathbf{1}_{\Delta \ln y_{i,t} < 0} + \alpha_3 HHI_{c,t-1} \times \mathbf{1}_{\Delta \ln y_{i,t} < 0} \\ & + \beta X_{c,t} + \gamma_t + \delta_{MSA} + \varepsilon_{c,t}, \end{aligned} \quad (5)$$

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 lagged 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, and $X_{c,t}$ summarizes period-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 operating in the same MSA, we cluster standard errors at the MSA level.

In the specification above, we use the Herfindahl index measured in the three years preceding the interval in which we measure price changes. We do so to minimize concerns that housing market developments affect the local market concentration.⁷ In our analysis, however, this reverse causality argument is not a big concern. If concentration were driven by house price changes we would in fact expect that large shocks wipe out smaller lenders and increase concentration, inducing 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 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

⁷For the period 2004-2006, the lagged HHI is based on mortgage data for the period 2001-2003.

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 matter, correcting for the usual house price determinants.

E Results

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 (5) 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. The estimates are almost unchanged when we include a host of county level controls in columns 3 and 4. In column 3, the point estimate for α_2 implies that a one percent negative income shock causes house prices to drop by 0.06 per cent in perfectly competitive lending markets (i.e. for $HHI = 0$). But this effect is halved in areas with an Herfindahl index evaluated at the cross sectional mean ($HHI = 0.013$). Similar coefficient estimates are obtained in column 4.

Columns 5 to 6 report the estimates of the same baseline specification without MSA fixed effects. We find that 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 these geographic dummies affects some control variables, the estimates of the main coefficient of interest are very robust, suggesting our results 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. The first two columns use the period- t Herfindahl index. As noted above, the benchmark specification includes the predetermined value of this index, to minimize concerns of reverse causality. 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 originated 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 may 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.⁸ 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 baseline specification 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. As in the benchmark specification of Table 3, we

⁸Mortgage servicers are not only responsible for collecting payments from mortgage borrowers, but also for handling defaulted loans, including prosecuting foreclosures.

estimate that the drop in house price is reduced by half when a negative income shock is evaluated in markets with an index of lending concentration close to the sample average.

F Mortgage concentration and judicial foreclosure

In Table 3 and 4, equation (5) is estimated using pooled regressions after correcting for geographic, demographic, and economic determinants of house prices. The main concern with this analysis is that there may be an omitted factor that is correlated with both house prices and lending concentration, leading to inconsistent estimates of the coefficients of interest.

Given the limitations of this exercise, we now exploit exogenous variations in state mortgage laws to provide additional evidence that lending concentration reduces the adverse effect of income shocks on house prices. 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 on delinquent loans 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 requires 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 (no-judicial foreclosure states). As discussed in Pence (2006) the first procedure imposes on lenders more costs and more lengthy foreclosure timelines. Accordingly, lenders' propensity to foreclose is likely to be lower in judicial foreclosure states. Mian, Sufi and Trebbi (2012) find supportive evidence that foreclosures were twice as likely in non-judicial states 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 (5) 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 (5), with $t = 2007 - 2009$,

$$\begin{aligned}\Delta \ln p_{c,t} = & \alpha_1 HHI_{c,t-1} + \alpha_2 \mathbf{1}_{\Delta \ln y_{i,t} < 0} + \alpha_3 HHI_{c,t-1} \times \mathbf{1}_{\Delta \ln y_{i,t} < 0} \\ & + \alpha_4 HHI_{c,t-1} \times \mathbf{1}_{\Delta \ln y_{i,t} < 0} \times \mathbf{1}_{Jud=1, Days=1} \\ & + \beta_5 X_{c,t} + \varepsilon_{c,t},\end{aligned}\tag{6}$$

where $\mathbf{1}_{Jud=1, Days=1}$ is an indicator function for states with judicial foreclosure or for states with a lengthy foreclosure procedure. The coefficients of interest are now α_2 , α_3 and α_4 . We expect $\alpha_2 < 0$, $\alpha_3 > 0$ and $\alpha_4 < 0$. This means that income shocks have smaller effects on house prices in areas with larger banking concentration, but less so in areas with a costly or a lengthy foreclosure procedures.

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 located in the same MSA, but straddling 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. Such a sample selection provide a rigorous way to minimize concerns of omitted variables in our regressions.

To conserve space, 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 states where foreclosures are less likely. 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.

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. While a large fraction of mortgage loans are today securitized, and securitization contributes to make the provision of mortgages highly dispersed, we show that market concentration matters for house price volatility even if we use only loans that are kept on lenders' balance sheets. Thus, market concentration plays a role independently from securitization.

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. We believe that exploring other areas in which the pecuniary externality we highlight may apply is an exciting area for future research.

References

- Adelino, M., K. Gerardi, and P. S. Willen. 2010a. What Explains Differences in Foreclosure Rates? A Response to Piskorski, Seru, and Vig. Working Paper 10-2, Federal Reserve Bank of Boston.
- Adelino, M., K. Gerardi, and P. S. Willen. 2010b. Why Don't Lenders Renegotiate More Home Mortgages? The Effect of Securitization. Working Paper 2009-17a, Federal Reserve Bank of Atlanta.
- Agarwal, S., G. Amromin, I. Ben-David, S. Chomsisengphet, and D. Evanoff, 2011, The Role of Securitization in Mortgage Renegotiation, *Journal of Financial Economics* 102(3), 559-578.

- Berger, A. N., A. Saunders, J. M. Scalise, G. F. Udell, 1998, The effects of bank mergers and acquisitions on small business lending, *Journal of Financial Economics* 50, 187-229.
- Berger, A. N., R. S. Demsetz and P. E. Strahan 1999, The consolidation of the financial services industry: Causes, consequences, and implications for the future, *Journal of Banking and Finance* 23, 291-299.
- Black, S. E., and P. E. Strahan, 2002, Entrepreneurship and bank credit availability, *Journal of Finance* 57, 2807-2834.
- Bolton, P. and H. Rosenthal, 2002, Political Intervention in Debt Contracts, *Journal of Political Economy* 110, 1103-1134.
- Campbell, J. Y., S. Giglio, and P. Pathak, 2011, Forced sales and house prices, *American Economic Review* 101, 2108-2131.
- Elul, R., N. Souleles, S. Chomsisengphet, D. Glennon, and R. Hunt, 2010, What “Triggers ” Mortgage Default, *American Economic Review* 100, 490-494.
- Favara, G. and J. Imbs, 2010, Credit Supply and the Price of Housing, Working Paper, Board of Governors of the Federal Reserve System.
- Garmaise, M., and T. Moskowitz, 2006, Bank mergers and crime: The real and social effects of credit market competition, *Journal of Finance* 61, 495–538.
- Ghent, A. C., 2011, Securitization and Mortgage Renegotiation: Evidence from the Great Depression, *Review of Financial Studies* 24, 1814–1847.
- Glaeser, E., J. D. Gottlieb and J. Gyourko, 2010, Can Cheap Credit Explain the Housing Boom?, Working Paper, Harvard University
- Guiso, L., P. Sapienza, and L. Zingales, 2011, The Determinants of Attitudes towards Strategic Default on Mortgages, forthcoming *Journal of Finance*.
- Keeley, Michael, 1990, ?Deposit Insurance, Risk and Market Power in Banking?, *American Economic Review* 80, 1183-1200.

- Keys, B., T. Mukherjee, A. Seru, and V. Vig, 2010, Did securitization lead to lax screening? Evidence from subprime loans 2001-2006, *Quarterly Journal of Economics* 125, 307-62.
- Keys, B. J., A. Seru, and V. Vig, 2012, Lender Screening and the Role of Securitization: Evidence from Prime and Subprime Mortgage Markets, *Review of Financial Studies* 25, 2071–2108.
- Lilienfeld-Toal, U. V., and D. Mookherjee, 2011, How Did the US Housing Slump Begin? Role of the 2005 Bankruptcy Reform, Working Paper Stockholm School of Economics.
- Loutskina, E., and P. E. Strahan, P. E., 2011, Informed and uninformed investment in housing: The downside of diversification, *Review of Financial Studies*, 24, 1447–1480.
- Mian, A. R. and A. Sufi, 2010, House Prices, Home Equity-Based Borrowing, and the U.S. Household Leverage Crisis, *American Economic Review*, forthcoming
- Mian, A., A. Sufi, and F. Trebbi, 2012, Foreclosures, House Prices, and the Real Economy, mimeo University of Chicago.
- Petersen, M. A. and R. G. Rajan, 1995, The Effect of Credit Market Competition on Lending Relationships. *Quarterly Journal of Economics*, 60, 407–444.
- Piskorski, T., A. Seru, and V. Vig, 2010, Securitization and distressed loan renegotiation. Evidence from the subprime mortgage crisis, *Journal of Financial Economics* 97, 369-397.

Table 1
Description of Variables and Data Sources

Variable name	Variable description	Source
Days Dummy	A dummy variable that takes value equal to one if the average length of time required to accomplish a foreclosure in the state in which the county is located is larger than the cross sectional median number of days for a foreclosure to be completed.	RealtyTrac.com
HHI-Volume	Sum of squared shares of mortgage loans. The shares are based on the volume of loans originated and retained by a lender in a county relative to the total number (or volume) of loans originated in a county. Unless otherwise noted, we consider loans retained and/or originated over a three year period, preceding the one in which our 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.	HMDA
HHI-Number	Defined as HHI-Volume, but using the number of loans, instead of the volume of loans, in defining the sum of shares	HMDA
HHI-Volume-No Securitized	Defined as HHI-Volume, but considering only 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 loans originated and retained in a county to compute the denominator of the	HMDA
Home Sales	County level number of existing single family owner occupied units sold.	National Association of Realtors
House Price Change	Logarithmic change in house prices over the time period.	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. It is defined as an average over each time period.	U.S. Bureau of Census
Income per Capita	County level personal income per capita, average over the time period.	U.S. Bureau of Census
Judicial Foreclosure	Dummy variable that takes value 1 for counties located in states with a judicial requirement for foreclosure	RealtyTrac.com
Negative Income Growth	Dummy variable that takes value equal to 1 if the change in per capita personal income in a county is negative during the time period.	U.S. Bureau of Census
Population	The population of the county	U.S. Bureau of Census
Securitized Loans	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. It is defined as an average over each time period.	HMDA
Unemployment	The unemployment rate of the county	U.S. Bureau of Census

Table 2
Summary Statistics

Summary statistics of county-time pooled data. We consider two time periods: 2004-2006 and 2007-2009. All variable are defined in Table 1.

	Mean	SD	Min	Max	10th pc	90th pc	Number of Counties
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
Log change of house price index	-0.0618	0.1805	-1.2245	0.4422	-0.2472	0.1445	1072
Log house price index	4.2661	0.4801	3.0463	6.4890	3.7426	4.9086	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 familiy housing stock per capita	0.2391	0.0401	0.0022	0.3715	0.1892804	0.2854019	1072
Log of single family housing units sold	7.4514	1.4090	2.8998	11.4348	5.4659	9.1900	1062
Negative income growth	0.3694	0.4828	0	1	0	1	1072

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 (3) and (4) include county dummies; columns (5) and (6) MSA dummies. Standard errors in parenthesis are clustered at the county level in columns (3) and (4) and at the MSA level in columns (5) and (6). Estimates followed by ***, **, and * are statistically different from zero with 0.01, 0.05 and 0.10 significance levels, respectively.

	<i>Dependent Variables: House price growth</i>							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Negative Income Growth	-0.0788*** (0.013)	-0.079*** (0.013)	-0.059*** (0.012)	-0.058*** (0.012)	-0.066*** (0.009)	-0.065*** (0.009)	-0.035* (0.021)	-0.033 (0.020)
HHI-Number * Negative Income Growth	2.381*** (0.456)		2.251*** (0.417)		2.518*** (0.327)		3.057** (1.200)	
HHI-Volume * Negative Income Growth		2.699*** (0.519)		2.405*** (0.531)		2.721*** (0.402)		2.258** (0.905)
HHI-Number	-0.939*** (0.332)		-0.820*** (0.298)		-0.902*** (0.254)		-0.129 (1.060)	
HHI-Volume		-1.063*** (0.339)		-0.915*** (0.315)		-1.014*** (0.234)		0.540 (1.187)
Log house price			-0.317*** (0.043)	-0.317*** (0.043)	-0.101*** (0.012)	-0.101*** (0.012)	-0.829*** (0.084)	-0.832*** (0.084)
Housing stock per capita			-0.176 (0.016)	-0.183 (0.158)	-0.300*** (0.007)	-0.301*** (0.007)	8.596** (3.436)	8.629** (3.492)
Housing units sold			0.009* (0.005)	0.008* (0.004)	0.001 (0.003)	0.001 (0.003)	0.138*** (0.050)	0.143*** (0.050)
Income per capita			0.082*** (0.029)	0.081*** (0.029)	0.042* (0.024)	0.040 (0.024)	-0.837*** (0.228)	-0.838*** (0.230)
Unemployment rate			-0.058*** (0.008)	-0.058*** (0.008)	-0.032*** (0.003)	-0.032*** (0.003)	-0.108*** (0.013)	-0.109*** (0.013)
Period dummy, 07-09	-0.205*** (0.015)	-0.207*** (0.015)	-0.133*** (0.017)	-0.136*** (0.017)	-0.170** (0.009)	-0.173*** (0.009)	0.006 (0.026)	0.01 0 (0.026)
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 within	0.67	0.67	0.74	0.74	0.56	0.56	0.85	0.85

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, 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.

	<i>Dependent Variables: House price growth</i>					
	(1)	(2)	(3)	(4)	(5)	(6)
Negative Income Growth	-0.067*** (0.012)	-0.068*** (0.012)	-0.060*** (0.012)	-0.058*** (0.012)	-0.090*** (0.018)	-0.085*** (0.018)
HHI-Number	-0.409** (0.201)					
HHI-Number * Negative Income Growth	1.310*** (0.262)					
HHI-Volume		-0.527** (0.252)				
HHI-Volume* Negative Income Growth		1.679*** (0.315)				
HHI-Number			-0.756** (0.316)			
HHI-Number*Negative Income Growth			2.285*** (0.420)			
HHI-Volume				-0.896** (0.350)		
HHI-Volume *Negative Income Growth				2.412*** (0.539)		
HHI -Number-No Securitized					-0.008 (0.128)	
HHI -Number-No Securitized *Negative Income Growth					0.723*** (0.182)	
HHI -Volume-No Securitized						0.043 (0.115)
HHI -Volume-No Securitized *Negative Income Growth						0.606*** (0.172)
Log house price	-0.305*** (0.040)	-0.305*** (0.040)	-0.319*** (0.045)	-0.318*** (0.045)	-0.316*** (0.045)	-0.313*** (0.045)
Housing stock per capita	-0.172 (0.149)	-0.185 (0.146)	-0.188 (0.162)	-0.186 (0.160)	-0.188 (0.164)	-0.170 (0.165)
Housing units sold	0.014*** (0.004)	0.014*** (0.004)	0.008* (0.005)	0.008* (0.005)	0.009* (0.005)	0.009* (0.005)
Income per capita	0.072** (0.028)	0.071** (0.027)	0.084*** (0.030)	0.081*** (0.030)	0.078*** (0.030)	0.072*** (0.030)
Unemployment rate	-0.057*** (0.008)	-0.057*** (0.008)	-0.058*** (0.008)	-0.058*** (0.008)	-0.058*** (0.008)	-0.058*** (0.008)
Securitized Loans			0.031 (0.065)	0.008 (0.064)	0.069 (0.065)	0.046 (0.062)
Period dummy, 07-09	-0.117*** (0.016)	-0.117*** (0.016)	-0.132*** (0.018)	-0.136*** (0.018)	-0.128*** (0.018)	-0.131*** (0.018)
Observations	2087	2087	1835	1835	1835	1835
N. of counties	1044	1044	1044	1044	1044	1044
Fixed effects	MSA	MSA	MSA	MSA	MSA	MSA
Standard errors clusters	MSA	MSA	MSA	MSA	MSA	MSA
R2 within	0.72	0.72	0.74	0.74	0.74	0.74

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. 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.

	<i>Dependent Variables: House price growth</i>			
	Full sample	Bordering Counties	Full sample	Bordering Counties
	(1)	(2)	(3)	(4)
Negative Income Growth	-0.019 (0.015)	-0.037** (0.015)	-0.004 (0.014)	-0.039* (0.020)
HHI-Number	-0.415 (0.301)	-0.156 (0.318)	-0.627* (0.338)	-0.043 (0.303)
HHI-Number * Negative Income Growth	1.318*** (0.369)	0.984** (0.428)	1.321*** (0.396)	0.993** (0.450)
HHI Number * Negative Income Growth * Judicial Dummy	-1.503** (0.620)	-1.668** (0.719)		
HHI-Number * Negative Income Growth * Days Dummy			-1.437*** (0.633)	-1.960*** (0.694)
Negative Income Growth * judicial dummy	0.024 (0.019)	0.060*** (0.021)		
HHI-Number * judicial dummy	-0.0371 (0.458)	-0.219 (0.324)		
Negative Income Growth * Days Dummy			-0.009 (0.018)	-0.067*** (0.022)
HHI-Number * Days Dummy			0.049 (0.402)	-0.491 (0.324)
Judicial Foreclosure State	0.029* (0.015)	0.001 (0.015)		
Days dummy			0.038*** (0.015)	0.013 (0.018)
Log house price	-0.204*** (0.014)	-0.129*** (0.017)	-0.216*** (0.013)	-0.132*** (0.016)
Housing stock per capita	-0.148 (0.099)	-0.118 (0.124)	-0.201** (0.101)	-0.094 (0.118)
Housing units sold	-0.009** (0.004)	0.004 (0.006)	-0.007* (0.004)	0.003* (0.006)
Income per capita	0.098*** (0.029)	0.028 (0.041)	0.119*** (0.029)	0.036 (0.039)
Unemployment rate	-0.034*** (0.003)	-0.008** (0.004)	-0.035*** (0.003)	-0.008** (0.004)
Observations	1044	232	1044	232
N. of counties	1044	232	1044	232
Standard errors clusters	MSA	MSA	MSA	MSA
R2 within	0.49	0.44	0.48	0.48