Bank-Specific Shocks and House Price Growth in the U.S.

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Very preliminary, please do not quote. Comments welcome!

Abstract

The U.S. subprime crisis has demonstrated that developments in the credit market, house prices, and macroeconomic performance are closely linked. This paper investigates the link between mortgage supply shocks at the bank-level and regional house price growth in the U.S. using detailed micro-level data on mortgage markets from the Home Mortgage Disclosure Act (HMDA). Our results suggest that bank-specific mortgage supply shocks indeed drive house price growth at the regional level. The larger the idiosyncratic shocks to newly issued mortgages, the larger has been house price growth. We can show that the positive link between idiosyncratic mortgage shocks and regional house price growth is stronger in regions with inelastic housing supply.

JEL-Classifications: E44, G21, R20

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1 Motivation

The goal of this study is to analyze how bank-specific mortgage supply shocks affect macroeconomic performance in the United States. Building on the concept of granularity (Gabaix, 2011), we investigate which role micro-level mortgage supply shocks play for aggregate house price growth across US regions. The idea is that bank-specific shocks to mortgage origination can have an impact on macroeconomic variables like house prices if concentration in the mortgage market is very high. Thus, in a first step, we examine the degree of concentration in the market for newly issued mortgages.

Second, we are interested in whether bank-specific mortgage supply shocks indeed affect house price movements. Standard asset pricing theory suggests that house prices should equal the sum of expected income payoffs one could earn when renting a house. Hence, the price of the housing assets should depend only on the return one expects from holding the asset, regardless of how the buyer financed the asset purchase. Kindleberger (1978) was the first who challenged that view and argued that the ability to borrow money impacts asset prices. Recent literature confirms that cheaper credit is one of the main factors that drives house price increases. Empirical evidence by Adelino et al. (2014) points to the fact that easier credit supply has a positive effect on house prices. Mian and Sufi (2009) show that securitization has led to an extension in subprime mortgages and finally in increased house price growth in the period 2002-2005. In a similar vein, Di Magio and Kermani (2015) find that US counties with greater mortgage origination have seen higher house price increases in booms, and steeper house price reductions during busts. Based on US branching deregulation as an instrument for credit growth, empirical findings by Favara and Imbs (2015) support that access to credit is an important driver of house prices - both in a statistical and in an economical sense.

In addition, the literature has shown that mortgage lending is an important driver of macroeconomic vulnerabilities. Figure 1 illustrates that mortgage lending accounts for an increasing fraction of the credit business: while mortgages made up for less than one quarter of total loans in the US in the 1990s, the ratio of mortgages to total loans has significantly increased during the run-up to the financial crisis. In 2010, it stood at roughly 45 percent. In a theoretical paper, Justiniano et al. (2015) show that empirical stylized facts of the housing market can be best explained by looser lending constraints in the mortgage market, not borrowing constraints. Based on historical credit data that starts in 1870, Jorda et al. (2016) highlight that the importance of mortgage credit in financial sector activity has significantly increased over time, so that banks and households have levered up substantially. They identify mortgage booms as one important reason for financial as well as real fluctuations. Loutskina and Strahan (2015) show that financial integration within the US has led to a closer link between house price developments and the real economy. This amplified effect of collateral shocks on the economy has increased macroeconomic volatility. According to the household balance sheet view by Mian and Sufi (2014), macroeconomic performance in the US crucially depends on household debt. The evolution of household debt, in turn, has been linked to house prices: The larger the growth in house prices, and hence in home equity, the more leverage builds up in the household sector, so that default risk rises. In case of a sudden drop in house prices, households have to deleverage, which depresses private consumption and hence aggregate demand. Thus, linkages between the credit market and house prices appear to be a crucial determinant of macroeconomic performance.

While previous studies have focused on the effects of *common* credit supply shocks on house prices, this paper extends the literature by shifting the focus towards bank-specific effects: Do *idiosyncratic* changes in the mortgage supply of large banks drive house price growth? That is, do shocks at the level of individual banks translate into house price fluctuations?

At first sight, idiosyncratic bank risk should not matter for aggregate outcomes. Bank-specific events like financial innovations, fine payments, computer glitches or unexpected managerial decisions should not have any far-reaching power beyond the micro-level in an economy with a large number of firms and banks, like the US. If firm sizes were normally distributed, the law of large numbers would smooth out the impact of idiosyncratic shocks which would show negligible effects on aggregate outcomes. However, if markets are highly concentrated, as they are in manufacturing (Di Giovanni et al., 2011) and especially in banking (Bremus et al., 2013), such diversification effects are dampened. Gabaix (2011) demonstrates that a fat-tailed power law distribution of firm sizes implies a significant role of idiosyncratic firm-level shocks for aggregate volatility. He labels this effect as "granularity" and presents evidence that firm-specific shocks hitting the largest players explain about one third of aggregate business cycle fluctuations in the US.

Our study is most closely related to the literature on granular origins of aggregate fluctuations in the banking sector. Blank et al. (2009) were the first to measure granular effects from banking to investigate how high bank concentration affects the stability of the

German banking system. For a panel of Eastern European countries, Buch and Neugebauer (2011) find significant effects of idiosyncratic shocks to large banks on the real economy. Using a linked bank-firm level dataset, Amiti and Weinstein (2016) demonstrate that idiosyncratic credit supply shocks at the level of large banks explain about 40 percent of aggregate loan and investment fluctuations in Japan.

For the large and well diversified US economy, the evidence on granular effects from the banking sector is so far very limited. One exception is Landier et al. (2016) who demonstrate that - due to high concentration and hence granular effects - financial integration is an important driver of the increased synchronization of house prices across states. We add to this literature by studying how market structure in the US mortgage market affects regional economic performance in terms of house price developments.

Using a micro-level dataset from the Home Mortgage Disclosure Act (HMDA) on newly issued mortgage credits, we test whether house price growth at the level of US Metropolitan Statistical Areas (MSAs) is linked to bank-specific mortgage supply shocks. The advantage of using the HMDA-data is that it provides information on newly issued mortgages, whereas the bank balance sheet data used in several previous studies only provides outstanding amounts of loans, from which newly issued loans can only be proxied. Moreover, the HMDA-data allows to assign mortgages to the region they are supplied to, such that bank-specific shocks can be precisely linked to the region they affect. Again, locational information on loan issuance is not available from bank balance sheet data like Bankscope. Thus, we can significantly refine the estimation of granular effects from the banking sector.

Our preliminary results are threefold. Firstly, we have tested whether the necessary condition for granular effects to emerge from the mortgage market at the MSA-level is fulfilled. Estimations of the power law coefficients of the size distributions of new mortgages show that the mortgage market is highly concentrated at the regional level. Indeed, newly issued mortgages follow a power-law with a fat right tail in all MSAs. As a consequence, the necessary condition for granular effects from the mortgage market is fulfilled.

Second, our estimation results reveal a positive and statistically significant link between idiosyncratic shocks to newly issued mortgages and house price growth in MSAs. This result is in line with previous findings from the granularity-literature and confirms that credit shocks at the microeconomic level can translate into aggregate movements. The larger shocks to mortgage lending at the bank-level are, the higher is house price growth.

Third, we can show that the effect of bank-specific shocks to mortgage origination on house prices depends on the elasticity of housing supply. The more inelastic housing supply is, the more do bank-specific mortgage supply shocks drive house prices. Intuitively, in regions where the extension of housing supply is limited, e.g. for geographical reasons, a positive housing demand shock triggered by easier mortgage supply drives up house prices more than in regions where housing supply can be extended more easily.

The following section presents the data used as well as the empirical methodology. Section 3 discusses the estimation results, while Section 4 concludes and provides an outlook on the next steps.

2 Data and Methodology

2.1 Granular effects from the mortgage market

To construct a measure of bank-specific shocks at the regional level, we proceed in two steps. First, we calculate idiosyncratic shocks to mortgage supply. Second, a measure of granular effects from the mortgage market is constructed using banks' regional mortgage market shares.

Intuitively, the idea behind granular effects from the mortgage market is that idiosyncratic shocks matter for aggregate house prices only if concentration is high enough. If the market shares of the players in the loan origination market are relatively equal, idiosyncratic shocks cancel out across a large number of banks. Yet, when concentration is high, such that the market shares of the largest players dominate the market, they contribute to aggregate movements in house prices.

2.1.1 Measuring mortgage supply shocks

To measure regional mortgage supply shocks, we rely on the HMDA-data. This dataset provides annual information on every newly issued mortgage loan from an individual bank to an individual household. To determine whether institutions are serving the housing finance needs of their local communities, the Home Mortgage Disclosure Act from 1975 requires approximately 80 percent of all mortgage lending institutions nationwide to disclose information about the geographic location and other characteristics of the mortgage loans they originate, like the year of application, the dollar amount of the loan, and the application outcome. Most depository institutions (commercial banks, savings associations, and credit unions) with home or branch offices in an MSA are required to report. Exempted are only small institutions with assets less than $35 million for the 2006 reporting year, lenders that are not in the home-lending business, or those which have offices exclusively in rural areas (non-MSAs). Non-depository consumer- and mortgage-finance companies do have to report if they originate one hundred or more home purchase or home refinancing loans per year covered.

The data are provided for each single mortgage application at annual frequency. We aggregate all accepted mortgage loans for each bank according to the location of the purchased property, namely by MSA. Our regression sample covers mortgages for 346 MSAs over the period 1990 to 2014. In each MSA included in the sample, at least thirty banks are active per year (Table 1).

To identify the idiosyncratic mortgage supply shocks, we take a similar approach to the one presented by Greenstone et al. (2015), and regress the natural logarithm of the volume of newly issued mortgage credits of bank b in MSA m at time t on a set of bank-, time-, and MSA-fixed effects:

$$ln(NL_{bmt}) = \alpha_b + \beta_t + \gamma_m + \delta_{mt} + \epsilon_{bmt} \quad (1)$$

The goal is to purge bank b's new mortgages extended to MSA m from all macroeconomic and common mortgage market factors. Extracting the residual from this specification yields the bank-specific mortgage lending shock at the MSA-level. While α_b purges newly issued mortgages from all time-invariant characteristics of bank b, β_t controls for all time-varying factors that affect all MSAs, like common changes in credit, general funding conditions, or economic growth. To control for demand effects, we apply the approach proposed by Khwaja and Mian (2008) and define a mortgage loan as a bank-MSA pair. Since every MSA borrows from multiple banks, including an MSA-fixed effect accounts for time-invariant differences in demand by the same MSA for the different suppliers of credit. In addition, the combined MSA-and-year fixed effects included account for time-varying credit demand changes across regions. Thus, our shock measure is purged from MSA-specific demand changes. The first panel of Table 1 presents summary statistics for this mortgage origination shock ϵ_{bmt}. It reveals that even if the sample mean of bank-specific mortgage supply shocks is zero, the measure takes on negative and positive values with a standard deviation of 1.7. As shown by equation (1), positive values present positive deviations of newly issued mortgages (by bank b to MSA m in year t) due to bank-MSA-specific events like technological advances, whereas negative values reflect negative deviations in mortgage origination, e.g. due to idiosyncratic funding shortages.

2.1.2 Granularity in the mortgage market

To compute a measure of granular effects from the mortgage market at the MSA-level, the Banking Granular Residual (BGR), we weigh the idiosyncratic mortgage shocks from the previous section with the respective market share of the bank in a Metropolitan Statistical Area. Following the theoretical considerations by Gabaix (2011) and Bremus et al. (2013), we then aggregate these weighted shocks, in this case at the MSA level:[1]

$$BGR_{mt} = \sum_{b=1}^{B} \frac{\mathrm{NL}_{bm,t-1}}{\mathrm{NL}_{m,t-1}} \epsilon_{bmt} , \tag{2}$$

where $NL_{bm,t-1}/NL_{m,t-1}$ is the lagged market share in mortgage origination of bank b, in MSA m at year $t-1$, and ϵ_{bmt} is the contemporaneous regional mortgage supply shock of bank b. This yields our measure of granular effects from the mortgage market at the MSA level, which is available at annual frequency for the period 1990-2014.

According to the concept of granularity, we expect the effect of the BGR on aggregate house price growth to be positive. If concentration in mortgage origination is high enough, the higher bank-specific shocks or concentration - and thus the larger the BGR - the stronger should be the link to aggregate house price growth.

2.2 House price growth and control variables

House price growth is computed based on the Freddie Mac House Price Index (FMHPI) which is available for 367 MSAs and the period 1975 to 2015. The FMHPI is based on an ever expanding database of loans purchased by either Freddie Mac or Fannie Mae. It is constructed using a repeat transactions methodology, which has become a common practice in housing research. The FMHPI index is estimated with data including transactions on one-family detached and townhome properties serving as collateral on loans originated between January 1, 1975 and the end of the most recent index month, where the loan has been purchased by Freddie Mac or Fannie Mae. Given that the original data is published

[1]See Mondragon (2015) for a similar approach.

at monthly frequency, we take the median to get to annual frequency.

A set of control variables at the MSA-level that will be included in the regression model for house price growth presented below. Following Favara and Imbs (2015), we include per capita personal income growth, population growth, and total full- and part-time employment, as well as the first lags. These data are available for 382 MSAs from the Bureau of Economic Analysis (BEA). Information on housing supply elasticities for each MSA is available from Saiz (2010). The elasticities are based on the amount of developable land in MSAs. This is motivated by the observation that most regions where housing supply is inelastic are strongly land-constrained for topographic reasons.

2.3 Concentration in mortgage origination

Before testing whether bank-specific mortgage supply shocks affect house price growth in US region, we have to check whether the necessary condition for granular effects from the mortgage market is fulfilled. To that goal, the dispersion of the distribution of newly issued mortgages has to be high enough, such that idiosyncratic shocks do not cancel out across a large number of mortgage suppliers. Hence, following previous literature, we test whether the distribution of newly issued mortgages follows a fat-tailed power law. This is the case if the power law coefficient of the distribution is less than one.

Following Gabaix and Ibragimov (2011), we estimate the dispersion parameter of the distribution of newly issued mortgages for each MSA:

$$ln(\text{Rank}_{bm} - 0.5) = \alpha + \beta ln(\text{NL}_{bm}) + \epsilon_{bm} \tag{3}$$

where $Rank_{bm}$ is the rank of bank b's newly issued mortgages in MSA m, and NL_{bm} is the corresponding volume of newly issued mortgages. β is the power law coefficient, i.e. the parameter of interest here.

Figure 2 illustrates the estimation results. It plots the histogram of the estimated power law coefficients. All coefficients are significant at the 1percent level. The figure reveals that all estimates are below one (also in absolute values), meaning that the distribution of newly issued mortgages is indeed extremely dispersed with infinite variance. The distribution of newly issued mortgages thus follows a fat-tailed power law in all MSAs in our sample, such that the necessary condition for granular effects from the mortgage market is fulfilled: Idiosyncratic shocks can play a role for house price growth given that concentration in mortgage origination is high enough for large banks to affect the macroeconomy.

Additionally, the U.S. mortgage lending market is dominated by large banks. Figure 3 reports mortgage lending activity of the top 10, 50 and 100 banks as a fraction of total mortgage lending. For example, mortgage origination of the top 10 banks is almost at 50% of total mortgage activity in 2010, while home lending of the top 100 banks hits the peak at 80% of overall lending in 2007.

2.4 Estimating the effect of idiosyncratic mortgage supply shocks on house prices

We now turn to the link between idiosyncratic mortgage supply shocks and house price growth at the MSA-level. In order to analyze whether granular effects from the mortgage market have aggregate effects on house prices in US regions, we run the following regression model:

$$\widehat{HP}_{mt} = \lambda_m + \gamma_t + \beta BGR_{mt} + \Gamma X_{mt} + \epsilon_{mt} \quad (4)$$

where $\widehat{HP}_{mt}$ is annual house price growth, computed by the log-difference of the house price index described above. Standard errors clustered at the MSA level. To control for region-specific differences in house prices as well as common time trends that affect house prices in all MSAs, a set of regional (λ_m) and time fixed effects (γ_t) is included in each regression. BGR_{mt} is the banking granular residual, and X_{mt} includes a set of the time-varying MSA-specific control variables. We follow Favara and Imbs (2015) and include per capita personal income growth, population growth, and employment here. It is well known that house prices display considerable geographic heterogeneity in the U.S (Ferreira and Gyourko, 2011). Such heterogeneity can arise from the demand side of the market, simply because income, demographic factors, and amenities are geographically heterogeneous (Lamont and Stein, 1999; Gyourko et al., 2013; Glaeser and Gyourko, 2007; Glaeser et al., 2008; Favara and Song, 2014). Yet, house price developments across regions can also be the result of differences in housing supply elasticities, for instance because of local costs, land use regulation, or geographical restrictions (Gyourko and Saiz, 2006; Gyourko et al., 2008; Saiz, 2010).

To investigate how housing supply elasticities affect the link between idiosyncratic mortgage supply shocks and house price growth, we include an interaction term between the BGR and the housing supply elasticity at the regional level, HSE_m, such that the regression model becomes:

$$\widehat{HP}_{mt} = \lambda_m + \gamma_t + \beta_1 BGR_{mt} + \beta_2 BGR_{mt} \times HSE_m + \Gamma X_{mt} + \epsilon_{mt} \quad (5)$$

Note that the individual effect of the housing supply elasticity is absorbed by the MSA-fixed effects λ_m, given that our elasticity measure is time-invariant. Based on the analyses of Favara and Imbs (2015), the idea is that changes in mortgage supply impact housing demand, which in turn affects house prices - and this the more so the lower the elasticity of housing supply is. Put differently, the more limited the reaction of housing supply to changes in demand is, the stronger the adjustment in prices should be. Hence, we expect β_2 to be negative.

3 Estimation results

Table 2 summarizes the regression results based on equation (4). When including a crisis dummy which equals one for the period 2007 to 2009 and zero otherwise as the only control variable, its coefficient is negative and statistically significant (column (1)). Not surprisingly, house prices have been depressed during the crisis years. When adding further variables, the crisis dummy looses its significance as variables like income and employment growth have been depressed during the crisis as well so that they take up the crisis effect. The standard control variables have statistically significant effects on house price growth with the expected positive signs: The higher income, population and employment growth in an MSA is, and hence the higher demand for housing and the higher rents tend to be, the higher is house price growth.

Regarding our main variable of interest, the BGR, Table 2 supports the expectation that idiosyncratic changes in mortgage lending have a positive and statistically significant impact on house price growth at the MSA level (according to column (5), a 8% increase in terms of standard deviations). Hence, given that concentration in mortgage origination is very high, meaning that a few banks dominate the market, idiosyncratic shocks to mortgage supply have aggregate affects at the regional level.

When adding the average ratio of declined mortgages to total mortgages (column (7)), the results for the BGR remain qualitatively unaffected. Moreover, column (7) reveals that MSAs with stricter mortgage standards, i.e. with banks that have a greater mortgage rejection rate, have experienced slower house price growth during the sample period.

What about the effects of the housing supply elasticity on the relation between idiosyncratic mortgage supply shocks and house prices at the MSA level? When splitting the regression sample at the median of the housing supply elasticity, the BGR looses its significance for MSAs with a high housing supply elasticity (i.e. above the median), while it shows higher economic significance compared to baseline scenario for MSAs where housing supply elasticity is low.

Taking this observation as a starting point, Table 3 investigates the role of different housing supply elasticities across MSAs in greater detail. In all regressions which are based on equation (5), the BGR retains its positive and statistically significant effect on house price growth. The interaction effect with the housing supply elasticity is negative as expected, but mostly not statistically significant. Yet, when adding the average ratio of declined to total mortgages (column (4)), the effect of the BGR on house price growth is weaker the more elastic housing supply is, also in a statistical sense.

Figure 4 illustrates the marginal effect of the BGR on house price growth, depending on the elasticity of housing supply (based on Table 3, column (4)). It reveals that idiosyncratic mortgage supply shocks affect house price growth only if housing supply is relatively inelastic, for example in regions where supply extension is geographically limited like in the Rocky Mountains. In contrast, in regions where supply can react more to changes in housing demand, price effects resulting from idiosyncratic mortgage supply shocks are weaker and eventually disappear.

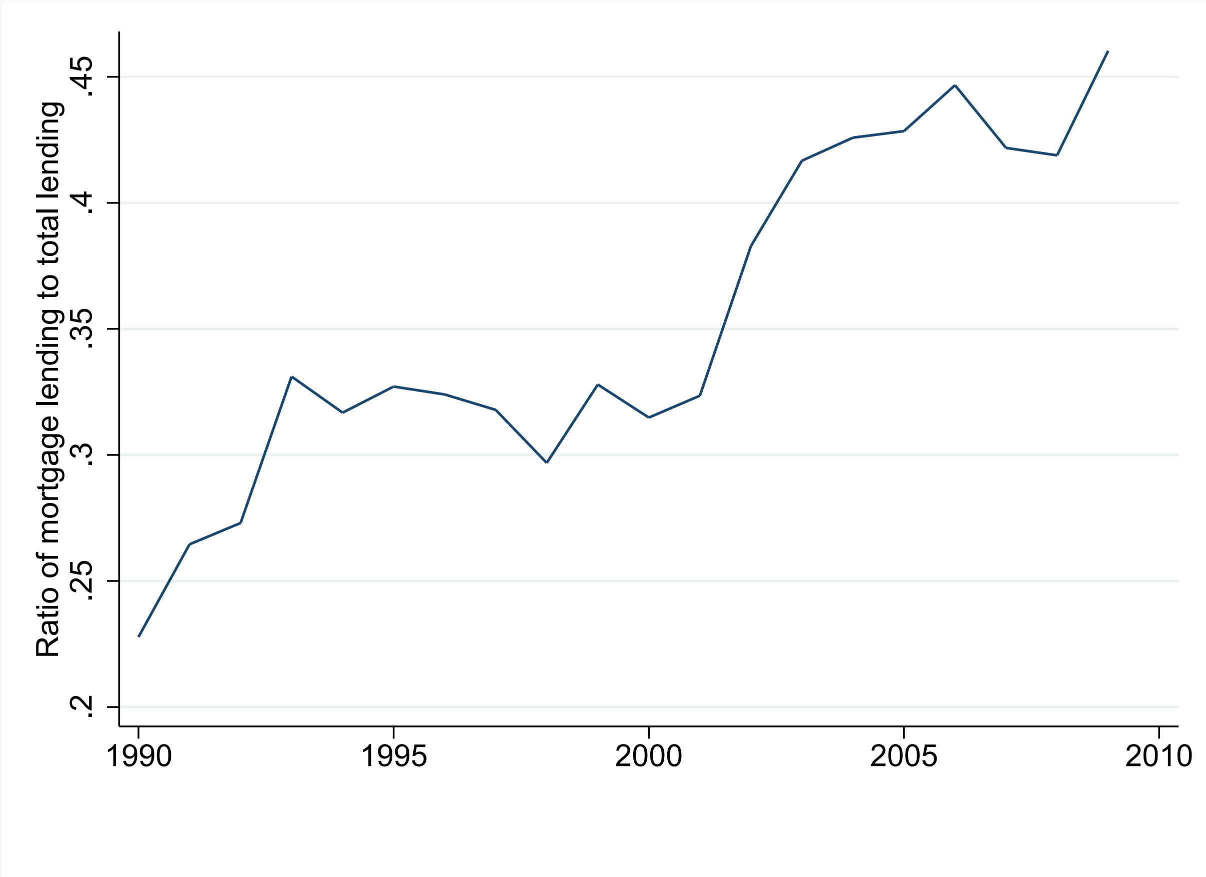
4 Conclusions and outlook

Our preliminary analysis of the US mortgage market yields three key findings: First, mortgage origination at the MSA-level is highly concentrated. The distribution of newly issued mortgages follows a fat-tailed power law, meaning that a small number of players dominate mortgage origination. Second, idiosyncratic mortgage supply shocks are a driver of house price growth. The larger the increase in mortgage supply due to bank-specific events is, the faster house prices grow. And third, in MSAs where housing supply elasticity is low, the link between bank-specific mortgage shocks and house price growth is stronger than in MSAs where housing supply can better adjust to increased demand. If housing supply is very flexible, events at the bank-MSA-level do not matter much for regional house prices.

There are several potential implications of this study. Bank-specific mortgage supply shocks - and hence risk at the level of individual (large) banks - are a driver of fluctuations in house price growth. Since house prices, in turn, affect real outlays via home-equity based borrowing (Mian and Sufi, 2011), our next step will consist in testing whether there is a direct link from idiosyncratic bank supply shocks to fluctuations in private consumption. If we can confirm, in addition, a direct link between idiosyncratic mortgage supply shocks and private consumption growth, we would identify another channel through which large banks affect macroeconomic performance, namely through fluctuations in aggregate demand. This would imply that there is no clear separation between the *household balance sheet view* and the *bank lending view*, but that both views are intertwined.

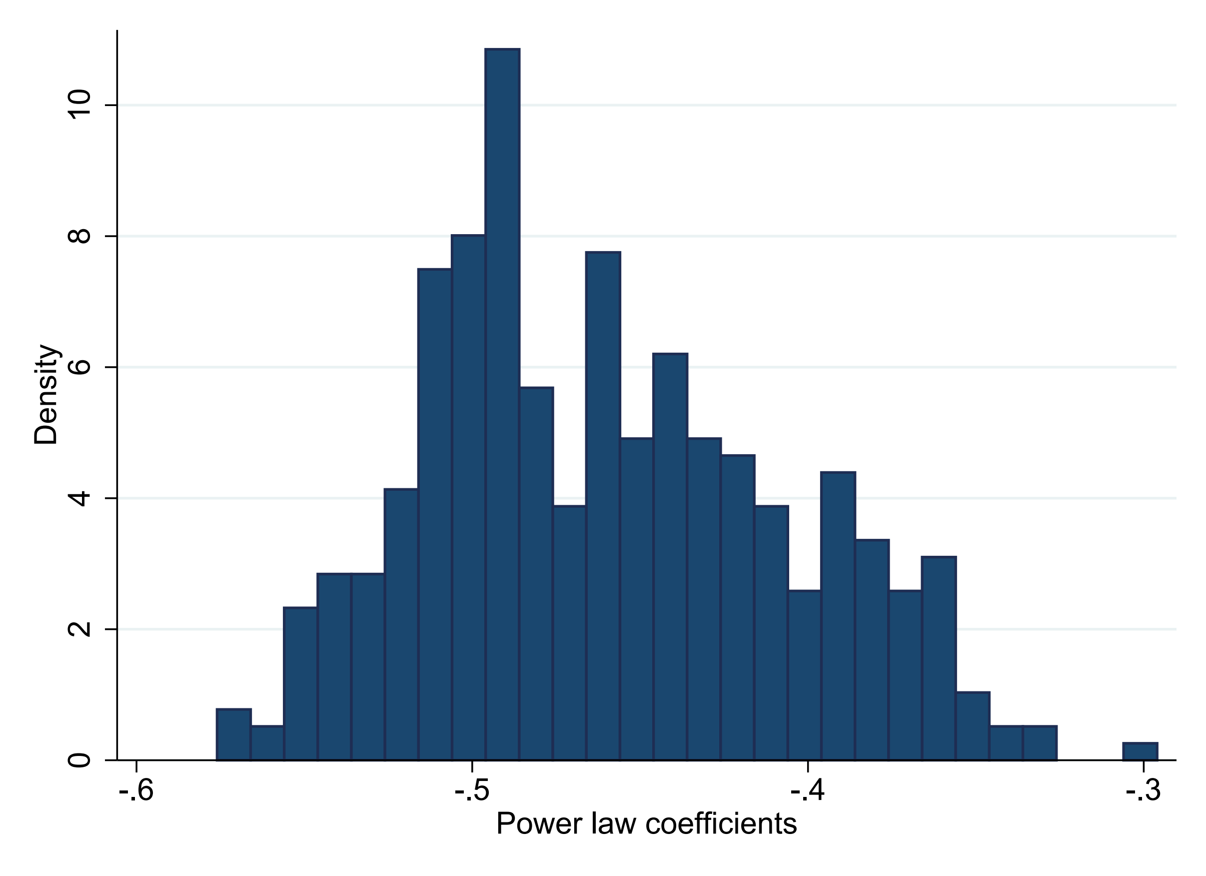
Figures

Figure 1: US mortgage loans to total loans



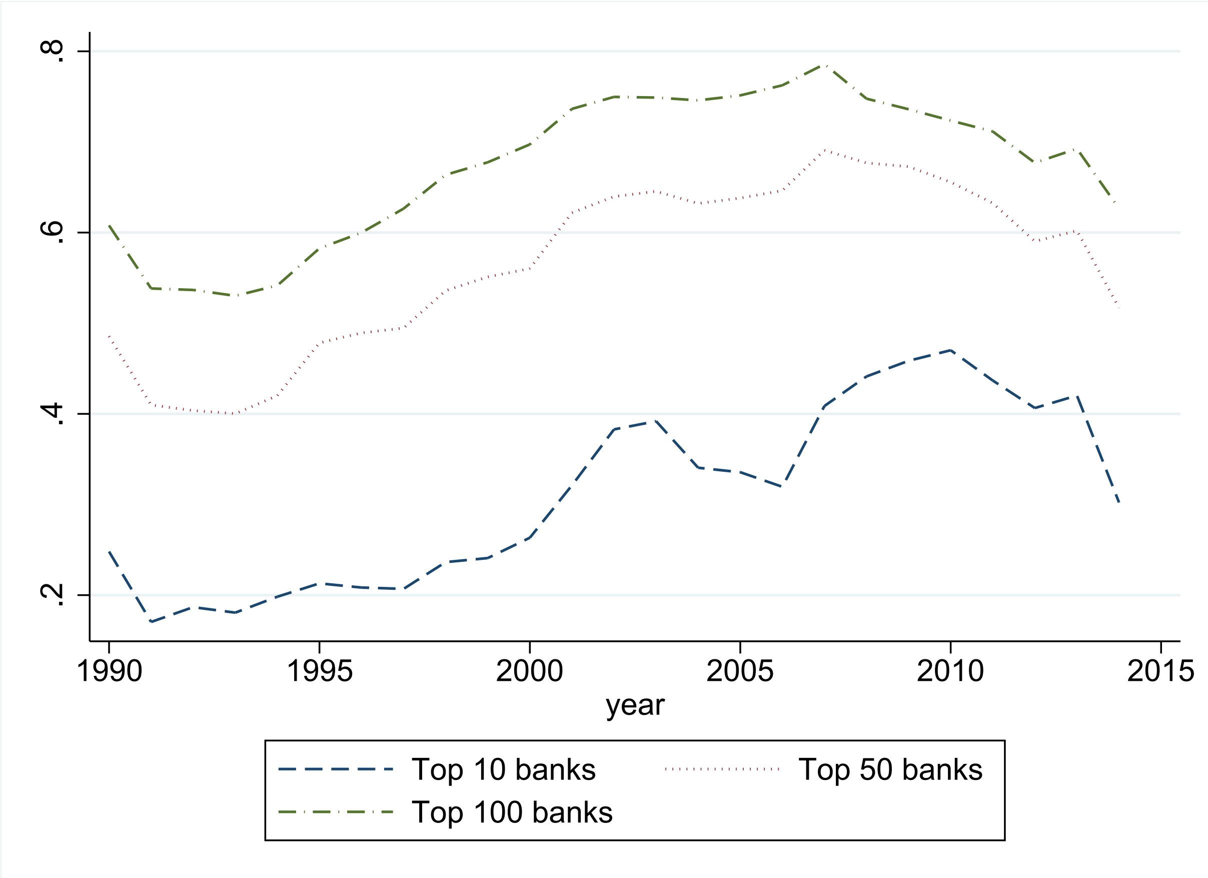
Source: Call Reports. *Notes:* This figure plots the ratio of mortgages to total loans for the period 1990-2009. Mortgages are defined as the total stock of 1-4 family and 5+ (multifamily) real estate mortgages. Total loans is measured as aggregate gross book value of total loans (before deduction of valuation reserves). The Call Reports data cover all banks regulated by the FRS, FDIC, and the OCC.

Figure 2: Histogram of estimated power law coefficients of the mortgage size distribution



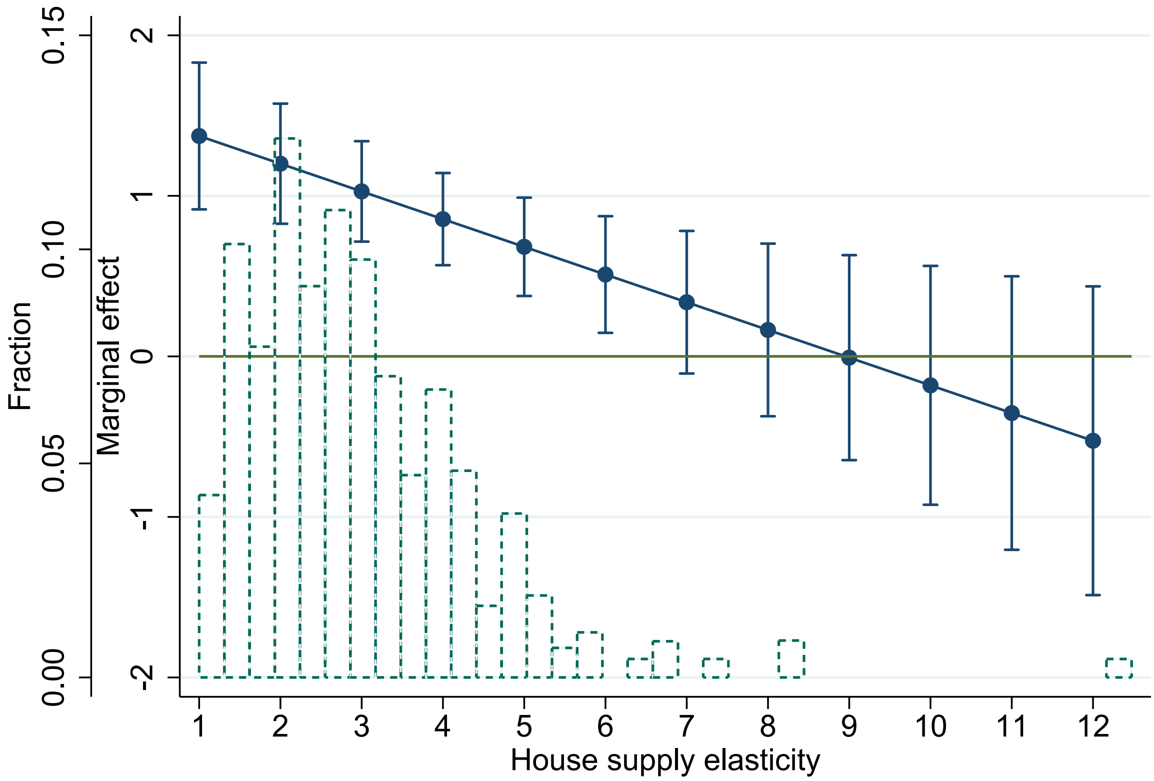
Notes: This graph shows the histogram of power law coefficients of the distribution of newly issued mortgages loans per MSA between 1990 and 2014. Following Gabaix and Ibragimov (2011), for each of the 387 MSAs we regress the log of rank (based on newly issued mortgages) on the log of newly issued mortgages. The resulting coefficient indicates whether the bank size distribution in each MSA market follows a power law. This is the case if the absolute value is below one.

Figure 3: Mortgage lending of the top 10, 50 and 100 banks to total mortgage lending



Source: HMDA. *Notes:* The figure above illustrates the sum of newly issued mortgages of the top 10, 50 and 100 banks in HMDA, as a fraction of total mortgage lending for the period 1990-2014. HMDA data cover 80% of bank home lending activity nationwide.

Figure 4: Marginal effects of BGR depending on housing supply elasticity



Notes: The graph above shows the average marginal effect of the Banking Granular Residual on house price growth and conditional on Saiz's Index of Housing Supply Elasticity (Saiz, 2010). The estimated marginal effects are denoted by dots enclosed by 95% confidence bands. The second Y-axis depicts the distribution of the housing supply elasticity measure.

Table 1: Summary statistics for the regression sample

	Obs.	Mean	SD	Skewness	Kurtosis	Min	Max
HMDA Data - bank level variables							
Idiosyncratic shock	2,537,540	0.00	1.72	0.10	3.63	-11.48	8.64
Idiosyncratic shock (w/o bank fixed effects)	2,538,846	0.00	2.14	0.29	2.77	-9.11	9.16
Accepted mortgages ($ mill.)	2,622,051	21.90	195.30	52.88	5148.322	0.00	35,677.24
Declined mortgages ($ mill.)	2,622,051	2.65	32.69	65.50	8151.987	0.00	8,865.07
Number of banks per MSA	2,622,051	442.13	225.28	0.89	3.43	30	1,264
HMDA Data - MSA level variables							
Banking Granular Residual (BGR)	6,418	1.92	0.72	0.22	3.85	-1.53	5.32
BGR (w/o bank fixed effects)	6,418	3.41	0.70	0.51	3.92	0.45	6.17
Call reports - bank level variables							
Total Assets ($ mill,)	1,588,455	28,022	123,729	8	74	0	1,746,242
Stock of 1-4 family real estate mortgages ($ mill.)	1,588,455	6,258	25,811	7	67	0	377,065
Stock of 5+ unit real estate mortgages ($mill.)	1,588,455	288	1,516	14	245	0	33,451
BEA - MSA level variables							
House price index (% change)	6,418	2.27	6.37	-0.90	11.09	-53.41	34.07
Income per capita (% change)	6,418	3.63	2.90	-0.26	11.12	-21.80	33.70
Income (% change)	6,418	4.70	3.20	-0.10	7.62	-19.50	35.70
Employment (% change)	6,418	1.29	2.12	-0.38	5.00	-14.30	11.10
Population (% change)	6,418	1.03	1.14	-1.23	48.19	-25.00	8,10
Housing supply elasticity (%)	264	2.61	1.41	2.00	11.23	0.67	12.15

Table 2: Determinants of house price growth

	(1)	(2)	(3)	(4)	(5)	(6)
Banking Granular Residual (BGR)	1.487***	1.281***	0.991***	0.956***	0.751***	0.515***
	(0.160)	(0.163)	(0.134)	(0.132)	(0.139)	(0.121)
BGR x Crisis dummy		2.252***			2.273***	1.977***
		(0.796)			(0.696)	(0.659)
Income per capita growth			0.650***	0.576***	0.592***	0.547***
			(0.050)	(0.052)	(0.052)	(0.047)
Lagged income per capita growth			0.494***	0.431***	0.431***	0.412***
			(0.035)	(0.039)	(0.038)	(0.035)
Population growth			1.183***	0.947***	0.968***	0.850***
			(0.211)	(0.208)	(0.210)	(0.190)
Lagged population growth			0.905***	0.794***	0.810***	0.740***
			(0.091)	(0.096)	(0.099)	(0.096)
Employment growth				0.268***	0.243***	0.217***
				(0.055)	(0.057)	(0.053)
Lagged employment growth				0.152***	0.141***	0.092**
				(0.047)	(0.047)	(0.047)
Crisis dummy	-8.480***	-12.127***	-3.459***	-2.812***	-6.500***	-4.236***
	(0.389)	(1.428)	(0.396)	(0.428)	(1.291)	(1.186)
Declined mortgages/Total mortgages						-0.660***
						(0.052)
Year fixed effects	yes	yes	yes	yes	yes	yes
MSA fixed effects	yes	yes	yes	yes	yes	yes
Observations	6,418	6,418	6,418	6,418	6,418	6,418
R-squared	0.472	0.477	0.585	0.589	0.594	0.625
Number of MSAs	346	346	346	346	346	346

Robust standard errors in parentheses, *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 3: Interactions with housing supply elasiticity

	(1)	(2)	(3)	(4)
Banking Granular Residual (BGR)	2.420***	1.561***	1.489***	1.287***
	(0.382)	(0.260)	(0.265)	(0.215)
BGR x housing supply elasticity	-0.283***	-0.185***	-0.173***	-0.203***
	(0.093)	(0.055)	(0.059)	(0.051)
Income per capita growth		0.677***	0.609***	0.553***
		(0.058)	(0.059)	(0.054)
Lagged income per capita growth		0.541***	0.476***	0.453***
		(0.042)	(0.046)	(0.043)
Population growth		1.196***	0.952***	0.845***
		(0.287)	(0.280)	(0.257)
Lagged population growth		0.931***	0.808***	0.751***
		(0.121)	(0.121)	(0.118)
Employment growth			0.232***	0.212***
			(0.062)	(0.057)
Lagged employment growth			0.167***	0.111**
			(0.054)	(0.052)
Declined mortgages/Total mortgages				-0.661***
				(0.063)
Year fixed effects	yes	yes	yes	yes
MSA fixed effects	yes	yes	yes	yes
Observations	4,935	4,935	4,935	4,935
R-squared	0.468	0.584	0.588	0.619
Number of MSAs	253	253	253	253

Robust standard errors in parentheses
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

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