The Financial Transmission of Housing Bubbles: Evidence from Spain

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Banking, Credit and Macroprudential policy: What Can We Learn from Micro Data?
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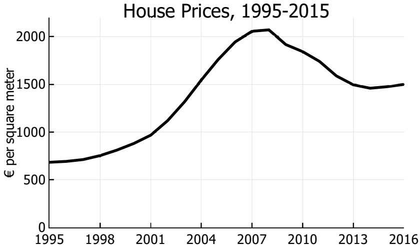
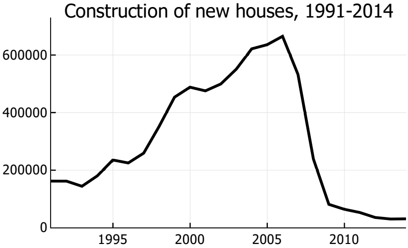
I: The Spanish housing bubble/boom

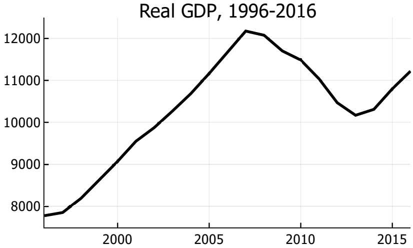
The Spanish housing bubble (1/3)

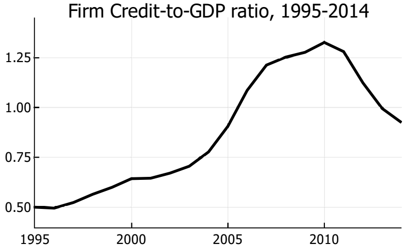




Source: Ministry of Construction.

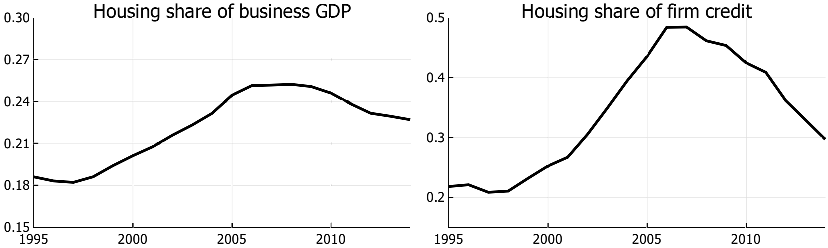
The Spanish housing bubble (2/3)





Source: INE and Bank of Spain.

The Spanish housing bubble (3/3)



Source: INE and Bank of Spain.

II: The why, what, and how of the paper

Housing Bubbles and the Economy

- Many developed and emerging economies have recently experienced boom-bust cycles in housing prices.
- What is the effect of these housing "bubbles" on the broader economy?
- In this paper, we study their transmission through the credit market. The role of this market is a priori unclear.
  - On the one hand, housing bubbles boost housing credit and may crowd out credit for other investments (Chakraborty et al., 2017).
  - On the other hand, they provide collateral (Chaney et al., 2012) and may increase banks' credit supply through securitization (Jimenez et al., 2014).

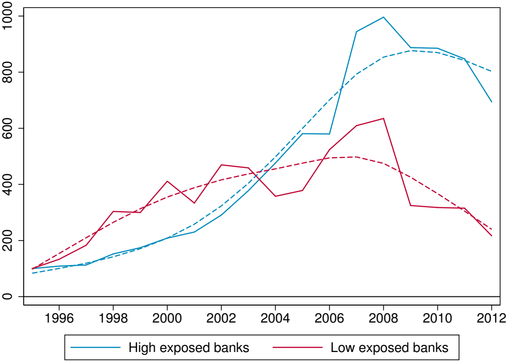
Our contribution: theory

- Simple model of firms, banks and housing bubbles, with one key result: bubbles have crowding-out and crowding-in effects through the credit market, but these occur at different moments in time.
- Our key assumption is that both firms and banks are financially constrained.
  1. Initially, the appearance of a housing bubble increases credit demand for housing, raises the interest rate, and crowds out credit from other sectors.
  2. If the bubble lasts, the housing sector repays its loans and banks' profits and net worth grow. This allows them to intermediate more resources, lower the interest rate and lend more to all sectors (crowding-in).
  3. When the bubble bursts, banks' net worth collapses and there is a generalized credit bust.

Our contribution: empirics

- We provide empirical evidence on these effects using data from the Spanish credit registry, exploiting variation in banks' exposure to the housing bubble.

Credit to non-housing firms in different banks



High (low) exposed banks are above (below) the 90th (10th) percentile of the ratio of mortgage-backed credit to total credit before 1995. Dashed lines are HP trends.

Related literature

- **The macroeconomic effects of housing prices**: Mian and Sufi (2011), Chaney et al. (2012), Cuñat et al. (2014), Jimenez et al. (2014), Adelino et al. (2015), Kaplan et al. (2017), Chakraborty et al. (2017).
- **Rational bubbles**: Martin and Ventura (2012, 2015), Arce and Lopez-Salido (2011), Ventura (2011), Basco (2014).
- **Credit booms and busts**: Mendoza and Terrones (2008, 2012), Reinhart and Rogoff (2009, 2014), Jordà et al. (2015).
- **The Spanish boom and bust**: Fernandez-Villaverde et al. (2013), Jimeno and Santos (2014), Akin et al. (2014), Garcia-Santana et al. (2015), Gopinath et al. (2017), Santos (2017).

III: A simple model of housing bubbles and financial transmission

Basic setup

- Small open economy, OLG, discrete time.
- Two sectors: H (housing) and N (non-housing), three domestic agents:
  - N-entrepreneurs: invest in N-capital.
  - H-entrepreneurs: invest in H-capital and are endowed with one unit of land when young. Land is productive when they are old, and never after.
  - Bankers: borrow abroad at the fixed interest rate R^* and lend to entrepreneurs.
- The core of the model is the credit market.
  - Entrepreneurs and bankers face a collateral constraint.
  - We focus on constrained equilibria, in which

$$r_{j,t} > R_t > R^* \quad \text{for } j \in \{N, H\}.$$

Details on assumptions

Credit demand: entrepreneurs

- Entrepreneurs can write state-contingent credit contracts, promising bankers an expected return R_{t+1}.
- Collateral constraint:

$$F_{j,t+1} \leq \lambda_j \left(r_{j,t+1} K_{j,t+1} \right) + \mathbb{1}_H \left(m_{t+1} + V_{t+1} \right),$$

  where m_{t+1} is the marginal product of land in production, and V_t is the value of old land after production.

- In a constrained equilibrium, credit demand is

$$Q_t = \frac{\sum_{j \in \{N,H\}} \lambda_j r_{j,t+1} K_{j,t+1} + m_{t+1} + E_t(V_{t+1})}{R_{t+1}}.$$

Credit supply: banks

- Young bankers help old bankers to collect loans, and get a fraction ϕ of the loan income as compensation.
- Bankers can write also write state-contingent credit contracts, promising the IFM an expected return R^*. Then,

$$Q_t = \phi F_t + \frac{E_t\left(F_{B,t+1}\right)}{R^*}.$$

- Collateral constraint:

$$F_{B,t+1} \leq \lambda_B F_{t+1}.$$

- In a constrained equilibrium, credit supply is

$$Q_t = \frac{R^*}{R^* - \lambda_B R_{t+1}} \phi F_t.$$

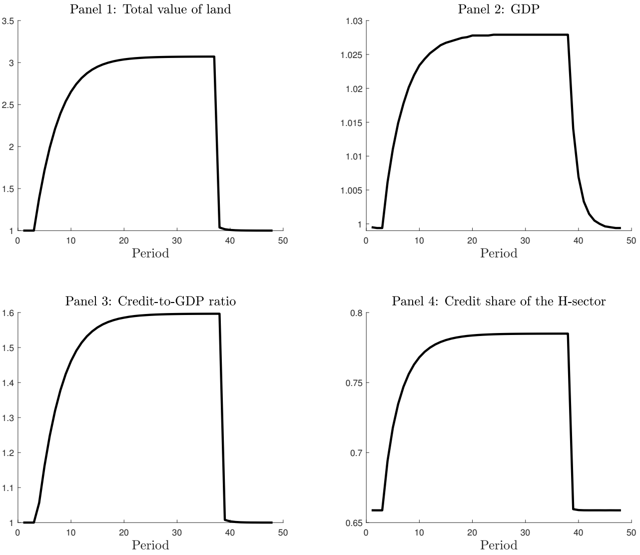
Bubbles and the value of old land

- Old land has no fundamental value. However, young H-entrepreneurs may still buy it if they expect to resell it at a positive price next period.
  - Any process for (V_t) yielding an expected return R_{t+1} is compatible with equilibrium.
- Assume that the economy follows a Markov process z_t with two states, bubbly (B) and fundamental (F).
  - Going from F to B has probability φ, going from B to F has probability ψ.
  - When a bubbly episode starts, bubbles appear on new land and afterwards grow (in expectation) at rate R_{t+1} as long as the bubble lasts.

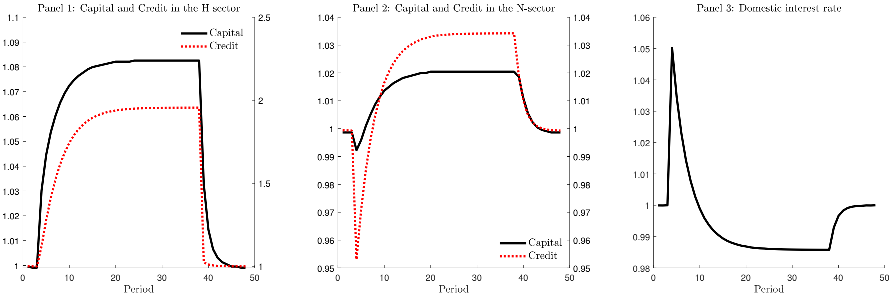
$$V_{\tau,t+1} = \begin{cases} 0 & \text{if } z_t = F \text{ or } z_{t+1} = F \\ N & \text{if } \tau = t\,,\ z_t = B \text{ and } z_{t+1} = B \\ \dfrac{R_{t+1}}{1-\psi} V_{\tau,t} & \text{if } \tau < t\,,\ z_t = B \text{ and } z_{t+1} = B \end{cases} .$$

Detailed equilibrium conditions

A bubbly episode: aggregate effects



A bubbly episode: sectoral effects



Parameter values

Understanding financial transmission

- To understand financial transmission, we need to understand how the bubble affects credit demand and credit supply.
- On impact,
  - Credit demand shifts out, because the bubble gives young housing entrepreneurs collateral against which they can borrow.
  - Credit supply is unchanged: banks' net worth depends on yesterday's loans.

  $\Rightarrow$ Crowding-out: $\uparrow R_{t+1}$, $\downarrow Q_{N,t}$, $\downarrow K_{N,t+1}$.
- As the bubble goes on,
  - Credit demand shifts out, because of the collateral effect and because housing entrepreneurs get richer.
  - Credit supply shifts out, too, as higher loan repayments increase banks' net worth. Details
  - What is the net effect?

Understanding financial transmission

- Credit market clearing:

$$\frac{R_{t+1} \cdot R^*}{R^* - \lambda_B \cdot R_{t+1}} = \frac{\sum_{j \in \{N,H\}} \left(\lambda_j \cdot r_{j,t+1} \cdot K_{j,t+1}\right) + m_{t+1} + E_t\left(V_{t+1}\right)}{\phi \cdot \left(\sum_{j \in \{N,H\}} \left(\lambda_j \cdot r_{j,t} \cdot K_{j,t}\right) + m_t + V_t\right)},$$

- Consider a bubbly episode that lasts so long that all variables converge to a (pseudo) steady state, such that $V_t = V_{t+1} = V$. Then,

$$E_t\left(V_{t+1}\right) = \left(1 - \psi\right) V < V_t$$

- Bank net worth depends on the **realization** of the bubble, while entrepreneur collateral depends on its **expected value**.
  - As there is some probability that the bubble may burst, the realization is always larger than the expected value.
  - Thus, supply eventually expands more than demand: $\downarrow R_{t+1}$, $\uparrow K_{N,t+1}$.

The role of bubble riskiness

IV: Taking the model to the data

Bank heterogeneity and testable implications

- To test our model's predictions, we use data from Spain, which had a massive housing price boom and bust between 1995 and 2015.
- We rely on cross-sectional evidence, exploiting the fact that not all Spanish banks were equally exposed to the bubble.
- In an extended model with heterogeneous banks, we show that:
  - Non-housing firms initially have lower credit growth at more exposed banks, but eventually, this reverses. With the burst of the bubble, non-housing firms have again lower credit growth at more exposed banks.
  - When firms face costs for switching banks (relationship lending), these predictions carry over to the firm level: firms that borrow from more exposed banks have first lower and eventually higher credit growth rates, and contract credit more during the bust.

Model details

Data

- **Spanish Credit Registry (CIR).** Monthly information on all outstanding loans over 6,000 euros to non-financial firms granted by all banks operating in Spain.
  - We define annual credit by aggregating outstanding loans for each bank-firm-year pair.
  - The CIR also contains information about banks' balance sheets.
- **Spanish Commercial Registry.** Annual accounting data covering more than 90% of all Spanish firms (around 1m observations per year).
  - This data can be matched to the credit registry.
  - Coverage starts to be comprehensive in 2003, so we start our analysis in that year.

Empirical strategy: loan-level regressions

$$\text{Credit\_growth}_{fbt} = \beta_t \mathsf{E}_{b0} + \theta_t X_{bt-1} + \delta_t W_{fbt-1} + \eta_{ft} + u_{fbt}$$

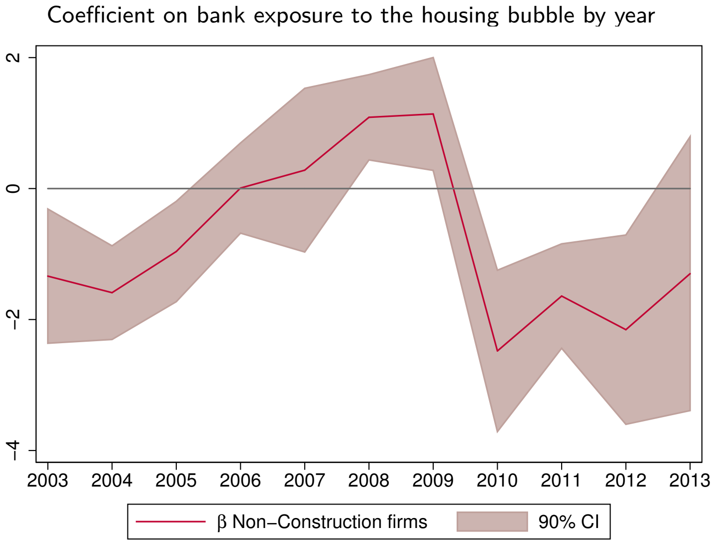
- Two key issues:

1. Isolate changes in credit that are driven by banks' supply rather than by firms' demand.
   - Firm-time FE η_{ft} (as in Khwaja and Mian, 2008).
   - Coefficients are identified by comparing the same firm's credit growth across different banks, and thus cannot be driven by demand.
2. Exogenous measure of bubble exposure.
   - We measure exposure by bank specialization before the start of the bubble.

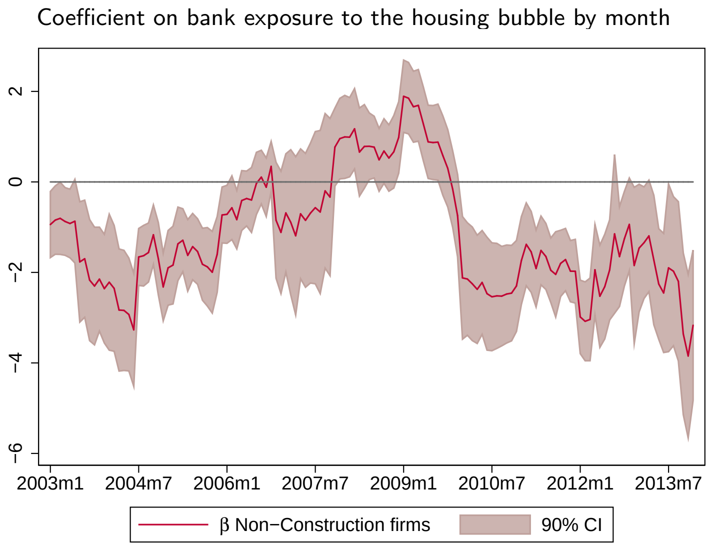
$$\mathrm{E}_{b0} = \frac{\text{Mortgage-backed credit}_{b,1992-1995}}{\text{Total credit}_{b,1992-1995}}.$$

   - This might be correlated with other bank characteristics. We use bank controls X_{bt-1}, bank-firm controls W_{fbt-1}, and two alternative measures of exposure.

Baseline regression results



Baseline regression results at the monthly level



Baseline regression results

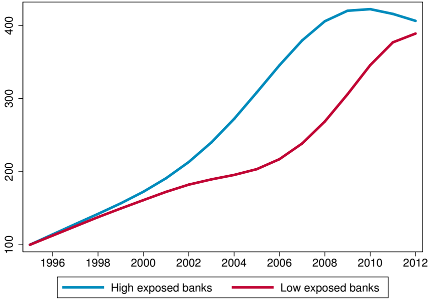
	2004	2008	2012
	(1)	(2)	(3)
Bank bubble exposure	-1.59***	1.09***	-2.15**
(s.e.)	(0.48)	(0.43)	(0.96)
Average dep. variable	8.62	3.51	-2.88
R-sq	0.37	0.35	0.34
# observations	549,964	666,849	504,233
# firms	179,423	207,796	160,736
# banks	118	111	62

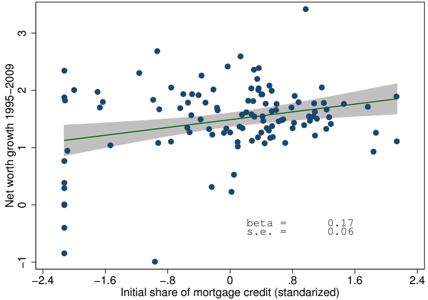
Bank controls are the natural logarithm of total assets, capital ratio, liquidity ratio, and default rate. Firm-bank controls are the length of firm-bank relationship in months and a dummy for past defaults. The bank bubble exposure regressor has zero mean and unit variance. Standard errors multi-clustered at the bank and firm level.

Firm controls | Extensive margin | Alternative measure of bubble exposure I | Alternative measure of bubble exposure II | Placebo 90s

Bank net worth

- Are the dynamics driven by bank net worth, as in the model?





Regression results

Empirical strategy: firm-level regressions

- Are there differences in the cross-section of non-housing firms?
- To analyze this, we consider now credit growth at the firm-level.

$$\text{Credit\_growth}_{ft} = \beta_t \mathsf{E}_{ft} + \theta_t X_{ft-1} + v_{ft}$$

- E_{ft} is a firm-level measure of exposure to exposed banks:

$$\mathsf{E}_{ft} = \sum_b \frac{\text{credit}_{fbt}}{\text{credit}_{ft}} \mathsf{E}_{b0}$$

- Results do not change when using lagged (firm) exposure.

Firm-level results

	All firms			Multibank firms		
	2004	2008	2012	2004	2008	2012
	(1)	(2)	(3)	(4)	(5)	(6)
Bubble exposure	-1.03**	1.16***	-2.39***	-1.87**	1.07***	-3.06***
(s.e.)	(0.51)	(0.29)	(0.73)	(0.68)	(0.32)	(1.01)
Avg. dep. variable	19.11	10.65	4.21	26.93	16.39	11.64
Firm controls	YES	YES	YES	YES	YES	YES
Firm-bank controls	YES	YES	YES	YES	YES	YES
Ind-municip. FE	YES	YES	YES	YES	YES	YES
R-sq	0.30	0.26	0.33	0.31	0.29	0.35
# observations	153,030	187,920	158,287	87,468	107,646	93,290

Notes: Firm-bank controls: length of firm-bank relationship in months, dummy for past defaults. Firm controls: total assets, number of employees, own funds over total assets, return on assets, a dummy for young firms (less than three years old), exporter dummy. Bubble exposure has zero mean and unit variance. Standard errors multi-clustered at the main bank and industry-municipality level.

Real effects: value-added growth at the firm level

	2004	2008	2012
	(1)	(2)	(3)
Firm bubble exposure (E_{f0})	-0.28**	0.42**	-0.52***
(s.e.)	(0.12)	(0.20)	(0.11)
Average dep. variable	1.57	-13.43	-6.86
Firm controls	YES	YES	YES
Firm-bank controls	YES	YES	YES
Firm FE	YES	YES	YES
R-sq	0.44	0.45	0.45
# observations	147,082	178,942	170,973

Notes: Firm-bank controls: length of firm-bank relationship in months, dummy for past defaults. Firm controls: total assets, number of employees, own funds over total assets, return on assets, a dummy for young firms (less than three years old), exporter dummy. Bubble exposure has zero mean and unit variance. Standard errors multi-clustered at the main bank and industry-municipality level.

V: Concluding remarks

Conclusions

- How are bubbles transmitted through credit markets? Using a simple model, we show that
  - Initially, they crowd out credit to other sectors.
  - However, if they last long enough, they allow banks to expand their credit supply to all sectors.
  - When they burst, there is a general credit crunch.
- Empirical evidence from Spain is consistent with these predictions.
- These insights are not limited to housing bubbles.
  - As long as the financial system faces collateral constraints, the expansion of one sector first reduces the availability of credit for others, but eventually stimulates it.

VI: Additional slides

Model details: Preferences and technology

- Agents live for two periods and maximize old-age consumption $E_t\left(C_{i,t+1}\right)$.
- Firms produce two nontradable intermediates N and H and a tradable final good, under perfect competition.

$$Y_{j,t} = A_{j,t}\left(L_{j,t}\right)^{1-\alpha_j-\beta_j}\left(K_{j,t}\right)^{\alpha_j}\left(T_{j,t}\right)^{\beta_j} \quad \text{for } j \in \{N, H\}\text{, with } \beta_N = 0.$$

$$Y_t = \left[\tau\left(Y_{N,t}\right)^{\frac{\varepsilon-1}{\varepsilon}} + (1-\tau)\left(Y_{H,t}\right)^{\frac{\varepsilon-1}{\varepsilon}}\right]^{\frac{\varepsilon}{\varepsilon-1}}$$

- Young entrepreneurs inelastically supply one unit of sector-specific labour when young. They also invest into sector-specific capital, which they rent out when old. Capital fully depreciates.
- Young H-entrepreneurs are endowed with one unit of new land. This land is productive when they are old, and never after.

Model details: Factor markets

- In equilibrium, $L_{N,t} = L_{H,t} = T_{H,t} = 1$. As factor markets are competitive,

$$w_{j,t} = (1 - \alpha_j - \beta_j) p_{j,t} A_{j,t} \left(K_{j,t}\right)^{\alpha_j},$$

$$r_{j,t} = \alpha_j p_{j,t} A_{j,t} \left(K_{j,t}\right)^{\alpha_j - 1},$$

$$m_t = \beta_H p_{H,t} A_{H,t} \left(K_{H,t}\right)^{\alpha_H}.$$

- The final good is the numeraire. Cost minimization by final goods producers implies

$$\frac{Y_{N,t}}{Y_{H,t}} = \left(\frac{\tau}{1-\tau} \frac{p_{N,t}}{p_{H,t}}\right)^{-\varepsilon}.$$

$$\left[\tau^{\varepsilon} \left(p_{N,t}\right)^{1-\varepsilon} + (1-\tau)^{\varepsilon} \left(p_{H,t}\right)^{1-\varepsilon}\right]^{\frac{1}{1-\varepsilon}} = 1.$$

- Using these equations, once we know the capital stock in both sectors, we can deduce all other endogenous variables.

Back

Model solution: key equations

- Given the (exogenous) bubble process, equilibrium is pinned down by a system of three equations in three unknowns ($K_{N,t+1}$, $K_{H,t+1}$ and R_{t+1}).

$$(1) \quad K_{N,t+1} = \frac{R_{t+1}}{R_{t+1} - \lambda_N r_{N,t+1}} \left(w_{N,t} \right).$$

$$(2) \quad K_{H,t+1} = \frac{R_{t+1}}{R_{t+1} - \lambda_H r_{H,t+1}} \left(w_{H,t} + m_{t+1} + \frac{E_t(V_{t+1})}{R_{t+1}} - V_t \right).$$

$$(3) \quad \frac{1}{R_{t+1}} \left(\lambda_N r_{N,t+1} K_{N,t+1} + \lambda_H r_{H,t+1} K_{H,t+1} + m_{t+1} + E_t(V_{t+1}) \right) = \frac{R^*}{R^* - \lambda_B R_{t+1}} \phi \left(1 - \lambda_B\right) \left[\lambda_N r_{N,t} K_{N,t} + \lambda_H r_{H,t} K_{H,t} + m_t + V_t \right].$$

Back

Understanding financial transmission

- On impact,

$$\frac{1}{R_{t+1}}\left(\lambda_N r_{N,t+1}K_{N,t+1}+\lambda_H r_{H,t+1}K_{H,t+1}+m_{t+1}\quad\underbrace{+E_t(V_{t+1})}_{\uparrow\text{ Entrepreneur collateral}}\right)=$$

$$\frac{R^*\phi\left(1-\lambda_B\right)}{R^*-\lambda_B R_{t+1}}\left(\lambda_N r_{N,t}K_{N,t}+\lambda_H r_{H,t}K_{H,t}+m_t\quad\underbrace{+V_t}_{\text{Land created before } t \text{ is unaffected}}\right)$$

- The credit demand curve shifts out, while the credit supply curve is unaffected: $\uparrow R_{t+1}$, $\downarrow Q_{N,t}$, $\downarrow K_{N,t+1}$.

Understanding financial transmission

- As the bubble goes on,

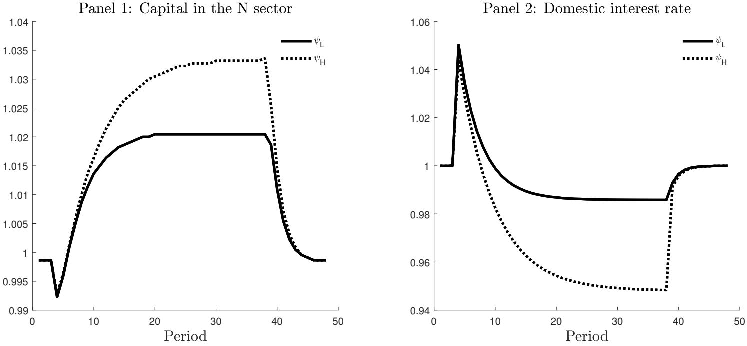
$$\frac{1}{R_{t+1}}\left(\underbrace{\lambda_N r_{N,t+1}K_{N,t+1}+\lambda_H r_{H,t+1}K_{H,t+1}+m_{t+1}+E_t(V_{t+1})}_{\uparrow\text{ Entrepreneur expected income and collateral}}\right)=$$

$$\frac{R^*\phi\left(1-\lambda_B\right)}{R^*-\lambda_B R_{t+1}}\left(\underbrace{\lambda_N r_{N,t}K_{N,t}+\lambda_H r_{H,t}K_{H,t}+m_t+V_t}_{\uparrow\text{ Repayments \& bank net worth}}\right)$$

- Both the credit demand and the credit supply curve shift out. Back

Bubble riskiness

- Bubbles that are more likely to burst have a greater crowding-in effect conditional on lasting.



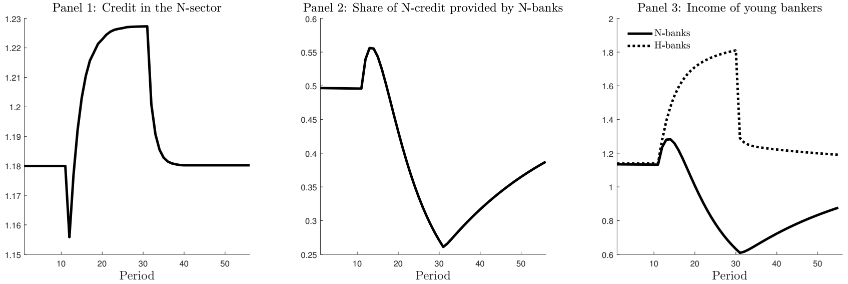
Back

An extended model with bank heterogeneity

- We assume that there are two types of bankers, N-bankers and H-bankers, and three different kinds of entrepreneurs in the non-housing sector:
  - a mass θ_N of entrepreneurs can only borrow from N-banks
  - a mass θ_H of entrepreneurs can only borrow from H-banks
  - a mass $1 - \theta_N - \theta_H$ of entrepreneurs can borrow from both banks.
- Bankers of type j receive an arbitarily small exogenous endowment of x^j units of the final good when they are young.
- The model can be solved as before, distinguishing three cases (depending on whether or not interest rates are equalized across banks)
- Aggregate results are unchanged, but there are now cross-sectional implications.

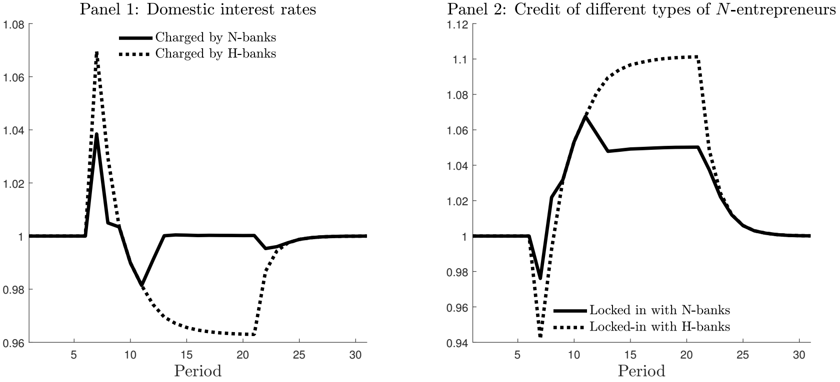
Bank heterogeneity: results

- Consider first $\theta_N = \theta_H = 0$.



Bank heterogeneity: results

- Now, assume some firms are "locked in" ($\theta_N, \theta_H > 0$).



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Baseline regressions with firm controls

	All firms			Multibank firms		
	2004	2008	2012	2004	2008	2012
	(4)	(5)	(6)	(7)	(8)	(9)
Bank exposure	-1.57***	1.18**	-2.32**	-1.74***	1.22**	-2.46**
(s.e.)	(0.60)	(0.55)	(1.03)	(0.64)	(0.57)	(1.15)
Avg. dep. variable	11.30	5.58	-2.13	11.53	5.87	-1.58
Firm controls	YES	YES	YES	YES	YES	YES
Ind-municip. FE	YES	YES	YES	YES	YES	YES
R-sq	0.18	0.15	0.19	0.19	0.17	0.20
# observations	410,624	499,585	389,384	352,070	426,772	331,267
# firms	179,509	214,419	177,449	120,955	141,606	119,332
# banks	115	110	61	114	108	61

Back

The extensive margin

- New dependent variables: growth rate taking into account changes to and from zero ($\frac{\text{Credit}_{fbt} - \text{Credit}_{fbt-1}}{0.5 \cdot (\text{Credit}_{fbt} + \text{Credit}_{fbt-1})}$), and a dummy for dropped loans.

	Extensive_Credit_growth			Dropped_loan		
	2004	2008	2012	2004	2008	2012
	(1)	(2)	(3)	(4)	(5)	(6)
Bank exposure	-1.50**	2.32***	-3.81***	0.002	-0.01***	0.01***
(s.e.)	(0.73)	(0.63)	(1.47)	(0.002)	(0.00)	(0.00)
Avg. dep. variable	8.51	-0.08	-4.11	0.13	0.13	0.15
R-sq	0.48	0.35	0.34	0.47	0.35	0.34
# observations	641,480	781,875	596,034	638,658	784,769	608,198
# firms	204,764	240,195	187,181	203,998	240,671	189,574
# banks	117	110	62	117	110	62

Back

Alternative exposure measure (I)

- Following Chakraborty et al. (2017), we define an exposure measure based on bank location:

$$\mathrm{E}_b^{HSE} = \sum_m \omega_{bm} HSE_m$$

- HSE_m is the housing supply elasticity for municipality m in 1995 (potential plot surface over built urban surface, from Basco and Lopez-Rodriguez (2017)).
- ω_{bm} is the share of total credit of bank b in municipality m before 1995.
- Results are unchanged.

Alternative exposure measure (I)

	2004	2008	2012
	(1)	(2)	(3)
Bank exposure	-1.09**	0.73**	-1.24**
(s.e.)	(0.48)	(0.34)	(0.53)
Avg. dep. variable	8.59	3.52	-3.21
R-sq	0.36	0.35	0.33
# observations	566,026	673,608	581,531
# firms	182,724	209,515	180,053
# banks	155	148	117

Back

Alternative exposure measure (II)

- We also define an exposure measure based on the share of credit to construction firms over credit to all firms:

$$\mathrm{E}^{C}_{b0} = \frac{\text{Credit to construction firms}_{b,1995}}{\text{Credit to all firms}_{b,1995}}.$$

- Results are unchanged.

Alternative exposure measure (II)

	2004	2008	2012
	(1)	(2)	(3)
Bank exposure	-1.33***	0.90**	-2.18***
(s.e.)	(0.47)	(0.42)	(0.53)
Avg. dep. variable	8.59	3.52	-3.21
R-sq	0.37	0.35	0.33
# observations	559,976	665,343	576,152
# firms	181,935	208,625	179,895
# banks	164	156	124

Back

Placebo from the 90s

	1996	1997	1998
	(1)	(2)	(3)
Bank exposure	-0.25	-0.29	-0.31
(s.e.)	(0.65)	(0.51)	(0.43)
Avg. dep. variable	4.20	7.60	10.26
R-sq	0.35	0.36	0.37
# observations	349,653	413,850	433,383
# firms	108,730	129,792	137,307
# banks	165	161	156

Back

Bank net worth regressions

	(1)	(2)
Bank bubble exposure	0.17***	0.12**
(s.e.)	(0.06)	(0.05)
Average Dep. Variable	1.48	1.48
Bank controls	NO	YES
R-sq	0.08	0.27
# observations	113	113

Notes: Dependent variable is the growth rate of banks net worth over the 1995-2009 period. Bank controls: log total assets, capital ratio, liquidity ratio, and default rate. In order to ease interpretation, bank bubble exposure refers to initial bank bubble exposure normalized to have zero mean and unit variance.

Back

Parameter values

Table: Parameter values for the simulations

Parameter	Value	Parameter	Value
τ	0.5	ϕ	0.6
ε	2	λ_N	0.1
α_N	0.55	λ_H	0.1
α_H	0.55	λ_B	0.2
β_H	0.05	R^*	0.28
$A_{N,t}$	0.5	ψ	0.08
$A_{H,t}$	0.5	N	0.0004

Back