

How Did US Banks React to Capital Losses Induced by Real Estate Prices?

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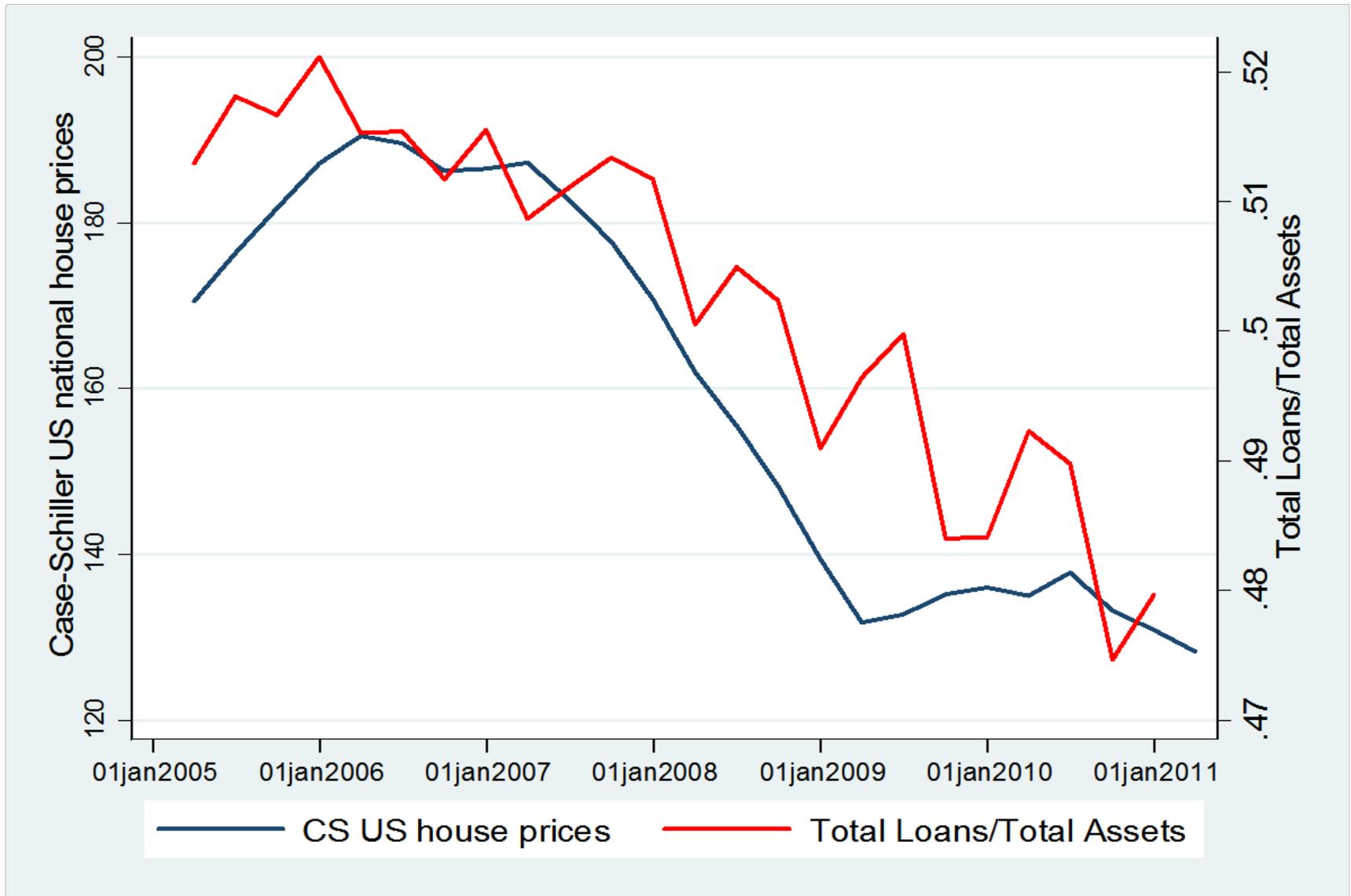
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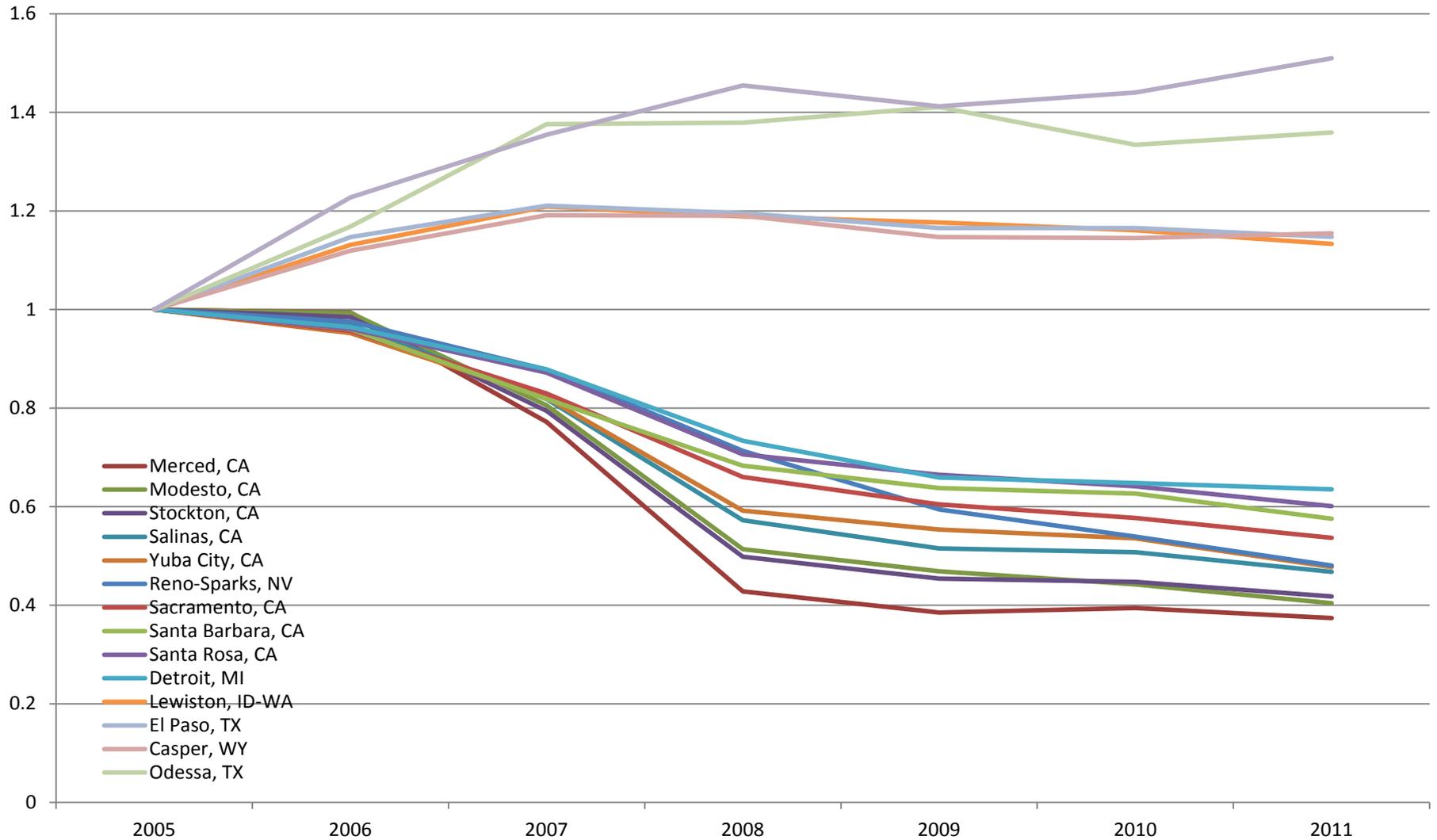
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Real Estate Bubble Burst & Credit Crunch



US Real Estate Prices (Dispersion)



Effect on Banks

Lower (higher) real estate prices imply:

Direct effects

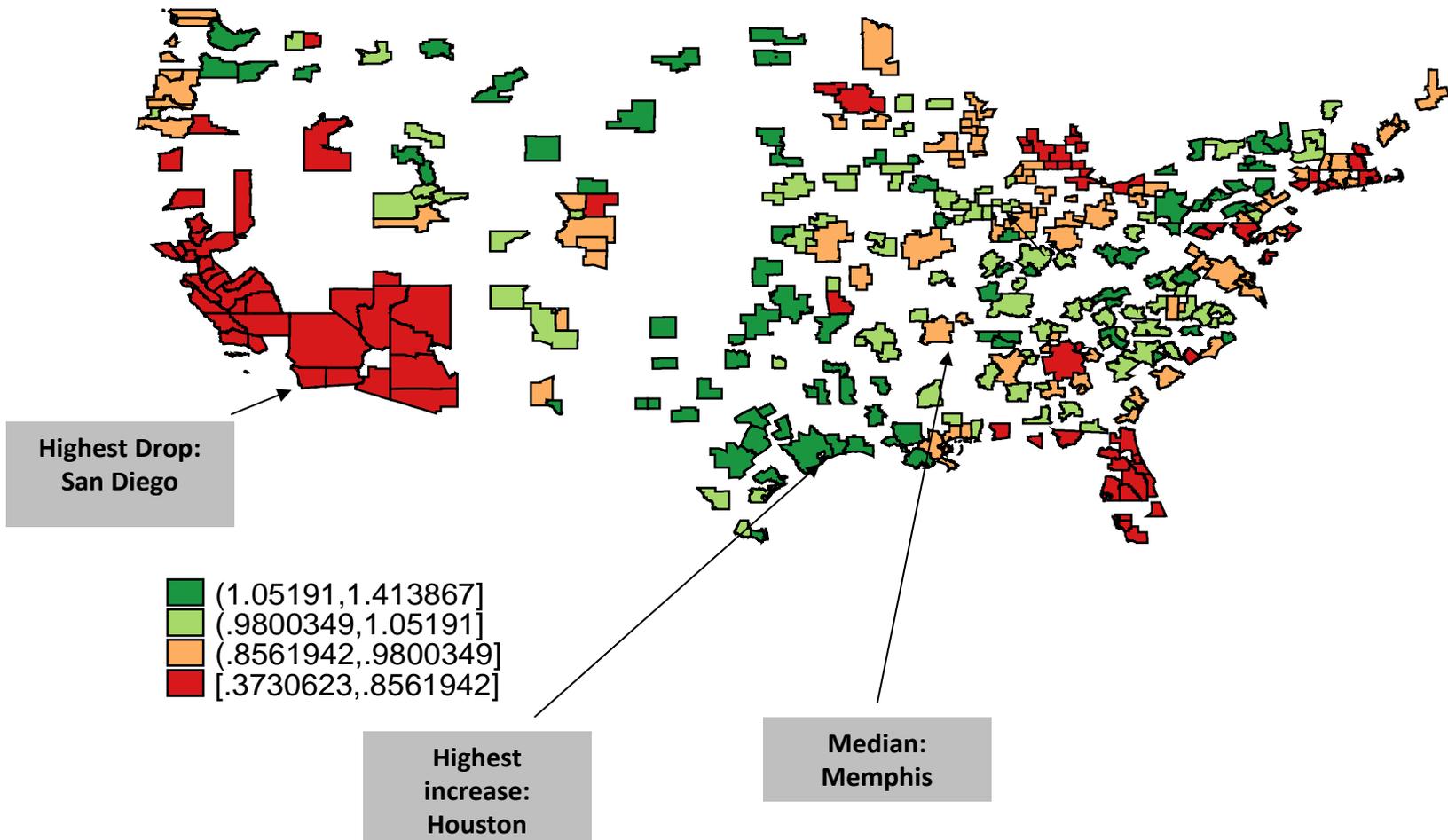
- Losses (gains) in their own real estate holdings

Indirect effects

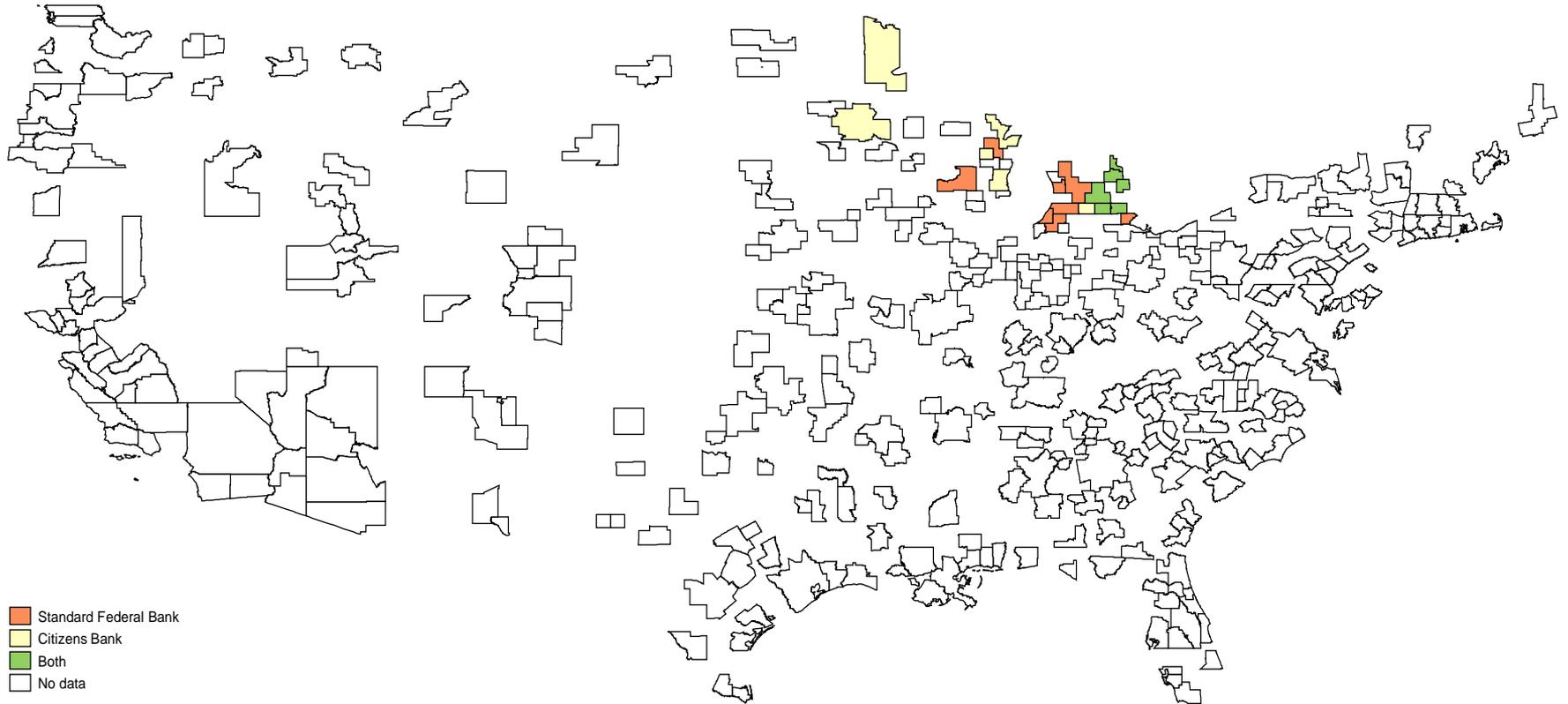
- Lower (higher) expected repayments and recovery rates
 - Lower (higher) demand for loans
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- Challenge: Isolate the changes that are net of demand for loans effects.

Sumstats Housing and MSAs

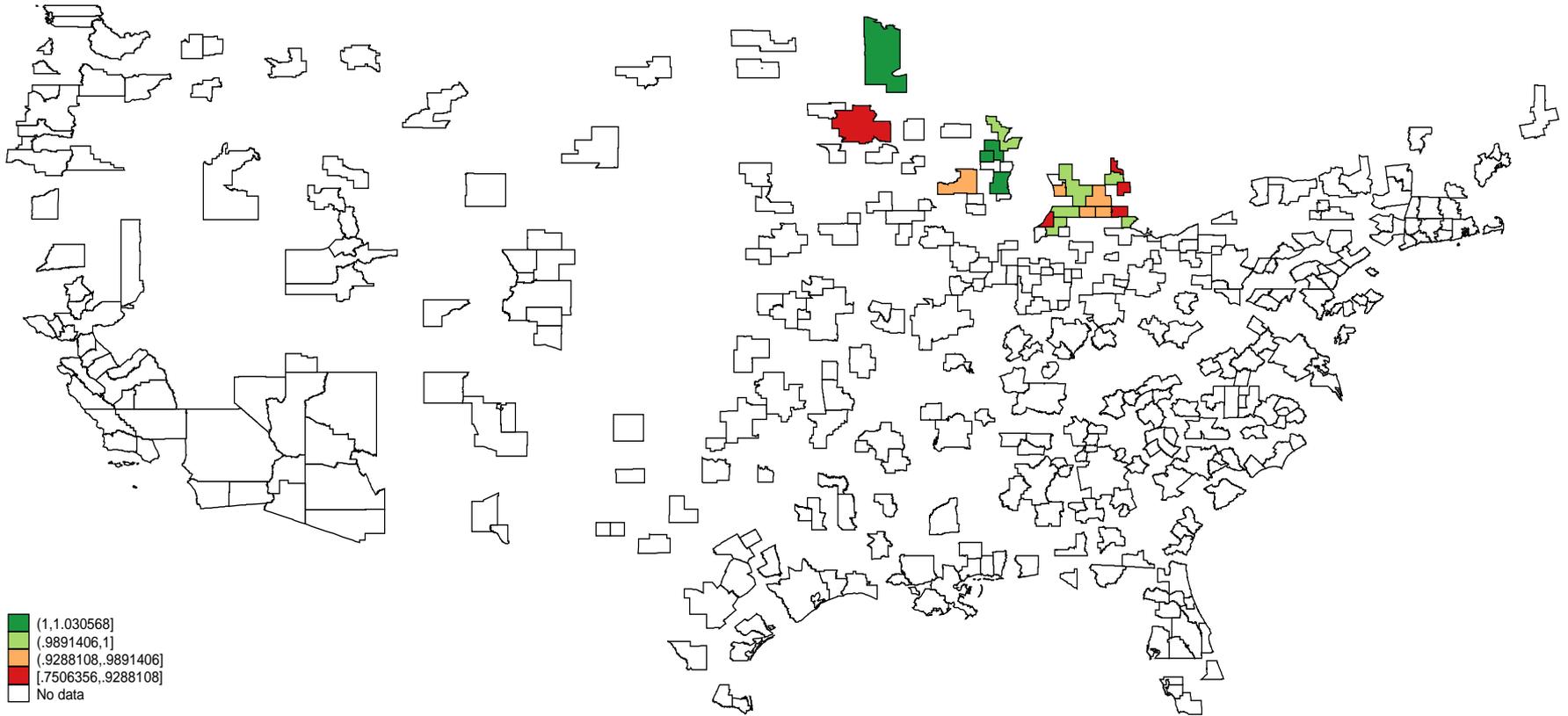
US CBSA House Price Growth 2006-11



Bank Locations Partially Overlap



Different Exposure on “Other Locations”



Objectives of this paper

- Measure the effect of direct real estate shocks on banks' capital.
- Show the adjustment of lending, funding and other policies in response to real estate shocks.
- Contagion within bank, across geographical regions and across business lines.
- Which part of aggregate credit can be attributed banks credit supply changes? Can we identify a channel through the depletion of capital in the banks' balance sheets? Can we net-out the demand for credit effects?

Literature

- Real estate and bank lending (*Gan, 2007; Chackraborty et al. 2013 Ramcharan et al. 2012, Loutskina and Strahan 2012*).
- Bank balance sheet contagion (*Peek and Rosengren 1997, Paravisini, 2008; Mian and Khwaja 2008, Peydro 2012, Murfin 2012*).
- Real estate and financing (*Cvijanović 2012*).
- Real estate and investment (*Channey, Sraer, Thesmar, 2012*).
- Macro – Banks' balance sheet channel (*Bernanke and Gertler, 1995; Allen and Gale, 2000; Diamond and Rajan, 2001; Shleifer and Vishny, 2010*).

Data

- Bank balance sheet data: Quarterly Call reports 2005-2011.
- Housing prices 369 CBSA level. From the Federal Housing Finance Association's (FHFA)
- Cass-Schiller aggregate US housing prices (2005-2011).
- Land supply elasticities at an MSA level. From Saiz 2012, inverted to create a measure of price inelasticity.
- FDIC (2005) deposits by CBSA: construct weights of exposure of each bank to each CBSA location.

Sumstats Banks – Rescaled

Panel B: Bank summary statistics, scaled by total assets (as of Q42005)

| | mean | sd | min | max | p25 | p50 | p75 |
|-------------------|-------|-------|-------|-------|-------|-------|-------|
| Total Loans | 0.669 | 0.150 | 0.000 | 1.020 | 0.599 | 0.691 | 0.762 |
| Real Estate Loans | 0.463 | 0.170 | 0.000 | 0.952 | 0.337 | 0.471 | 0.577 |
| Individ. Loans | 0.059 | 0.094 | 0.000 | 1.018 | 0.015 | 0.037 | 0.077 |
| Agri Loans | 0.009 | 0.026 | 0.000 | 0.362 | 0.000 | 0.001 | 0.006 |
| C&I loans | 0.000 | 0.006 | 0.000 | 0.427 | 0.000 | 0.000 | 0.000 |
| Lease fin. | 0.009 | 0.020 | 0.000 | 0.504 | 0.000 | 0.000 | 0.009 |
| Credit Card | 0.049 | 0.083 | 0.000 | 0.991 | 0.011 | 0.033 | 0.062 |
| MBS | 0.081 | 0.084 | 0.000 | 0.842 | 0.010 | 0.062 | 0.125 |
| PP&E | 0.017 | 0.014 | 0.000 | 0.251 | 0.008 | 0.013 | 0.022 |
| Tier 1 Capital | 0.092 | 0.058 | 0.032 | 0.941 | 0.067 | 0.081 | 0.096 |
| Tier 2 Capital | 0.013 | 0.009 | 0.000 | 0.069 | 0.007 | 0.009 | 0.015 |

Identification Strategy

- Aim, study the effect of real estate prices on bank policies.
- Problem: local factors may drive both bank policies and real estate prices. (e.g. driven by the same demand factors).
- Approach - Consider banks as portfolios of locations: Compare banks in a given location with different exposure elsewhere. Control for local conditions.
 - Use shocks to real estate prices independent of local credit supply.
 - Effects measured across bank branches within msa-quarter. Identification assumption: demand fluctuations and other omitted variables are the same for branches within msa-quarter.

Identification Strategy - Elasticities

Static weights w_{ji} measure each bank's exposure to a local market.

Construct a measure of the impact of real estate shocks at a point in time t , for a bank i : $\sum_{j=1}^M w_{ji} P_{jt}$

w_{ji} is the weight of each CBSA on bank's business (deposits)

Specification 1: $\log(y_{imt}) = \alpha + \beta_1 \log\left(\sum_{j=1}^M w_{ji} P_{jt}\right) + \delta_{tm} + \gamma_{mi}$

Where y_{itm} are outcome variables constructed with the same weighting, δ_{tm} is a location-time dummy and γ_{mi} is a bank-location fixed effect.

Banks in the same location with different shocks in other location(s).

Elasticities

| | (1) | (2) | (3) | (4) |
|-----------------------------------|------------------|----------|------------------|-------------------|
| | Log | Log | Log | Log |
| | (Tier 1 Capital) | (Loans) | (Tier 2 Capital) | (Equity Issuance) |
| Log(House Prices _{m,t}) | 0.135** | 0.174*** | -0.0409 | -0.0961** |
| | (2.217) | (3.518) | (-0.418) | (-2.061) |
| Bank*MSA fixed effect | Yes | Yes | Yes | Yes |
| MSA*quarter fixed effect | Yes | Yes | Yes | Yes |
| Observations | 98,938 | 98,611 | 98,404 | 56,634 |
| R-squared | 0.985 | 0.986 | 0.983 | 0.899 |

Elasticities

| | (1) | (2) | (3) | (4) | (5) |
|-----------------------------------|---------------------|---------------------------|---------------------|----------------------|--------------------------|
| | Log (RE Loans) | Log (Individual Loans) | Log (Agri Loans) | Log (Credit Card) | Log (Lease Financing) |
| Log(House Prices _{m,t}) | 0.197*** (3.237) | 0.348*** (3.625) | -0.365 (-1.189) | 0.320*** (2.605) | -0.302 (-0.524) |
| Bank*MSA fixed effect | Yes | Yes | Yes | Yes | Yes |
| MSA*quarter fixed effect | Yes | Yes | Yes | Yes | Yes |
| Observations | 97,735 | 99,539 | 99,539 | 99,539 | 99,539 |
| R-squared | 0.538 | 0.732 | 0.882 | 0.737 | 0.923 |

Elasticities

- For an average real estate price decrease over the period (35%)
 - 4.5% drop in Tier 1 capital,
 - Issuance of 3.5% more equity
 - Reduction of 6.1% in lending
 - 6.8% in real estate loans
 - 12.8% in personal loans
 - 10.5% in credit card loans.

Identification Strategy – Different Exposures

Specification 2:

$$y_{imt} = \alpha + \beta_1 \sum_{j=1}^M w_{ji} P_{jt} + \beta_2 \sum_{j=1}^M w_{ji} P_{jt} \text{Exp}_{i0} w_{mi} + \delta_{tm} + \gamma_{mi}$$

Construct a measure of the impact of real estate shocks at a point in time t , for a bank i , in CBSA m as: $\sum_{j=1}^M w_{ji} P_{jt} \text{Exp}_{i0}$

Where:

y_{it} – Outcome variable, (lending levels, lending %, quarterly Δ lending).

Exp_{i0} – Exposure variable in 2005 (real estate lending, PPE).

P_{jt} – Instrumented (predicted) level of housing prices (CBSA).

δ_{tm} – CBSA x Quarter dummies.

γ_{mi} – Branch(es) fixed effect.

Identification Strategy

Main specification

Specification 2:

$$y_{imt} = \alpha + \beta_1 \sum_{j=1}^M w_{ji} P_{jt} + \beta_2 \sum_{j=1}^M w_{ji} P_{jt} \text{Exp}_{i0} w_{mi} + \delta_{tm} + \gamma_{mi}$$

y_{it} – Outcome variables:

- Capital (tier 1)
- Total lending levels
- Lending by type of loan
- Equity issuance
- Non interest expense
- Sources of liquidity

Exp_{i0} – Exposure to housing prices

- Total real estate lending – 2005Q4.
- Property plant & equipment – 2005Q4.

Property Plant & Equipment and Bank Losses

Exp_{i0} – Property plant & equipment in 2005 q4

- By default PPE at historical purchase value in books.
- If market value moves under book value, “An impairment loss shall be measured as the amount by which the carrying amount of a long-lived asset (asset group) exceeds its fair value.” (SFAS 144)
- When banks sell their office space they recognize the full gain/loss from its book value.
- Effects both on taxable profits and capital.
- NB: These rules leave banks a fair amount of flexibility. How much they actually recognize is ultimately an empirical question.

Real Estate Loans and Bank Losses

Exp_{i0} – Total real estate lending in 2005 q4.

- Decreases in real estate prices deplete the value of collateral.
- Higher increase of default. Especially in non-recourse loans.
- Lower recovery rates if the asset is repossessed and sold.
- Some of these losses need to be recognized before the asset is repossessed (e.g. increases in non performing loans).

Identification Strategy - IVs

Potential reverse causality: local lending causes prices.

IV approach:

P_{jt} and $P_{jt}Exp_{i0}w_{mi}$ instrumented using as omitted variables:

- US aggregate housing price x Land supply inelasticity:

$$P_{.t}\varepsilon_{m0}$$

- $P_{.t}\varepsilon_{m0} * Exp_{i0}w_{mi}$

Time dummies, msa*quarter dummies, other second stage controls included in first stage.

Land supply elasticity: Index of geographical and legal characteristics that influence land supply (from Saiz 2012)

Exp=PPE – Total Capital

| | Tier 1 Capital (bank-location) | | | |
|--|--------------------------------|-----------|-----------|-----------|
| | (1) | (2) | (3) | (4) |
| | OLS | OLS | IV | IV |
| House Prices _{m,t} * PPE _{branch,2005} | 0.0374*** | 0.0374*** | 0.0371*** | 0.0372*** |
| | (27.43) | (26.82) | (25.96) | (25.91) |
| Bank fixed effect | Yes | Yes | Yes | Yes |
| MSA fixed effect | Yes | Yes | Yes | Yes |
| Quarter fixed effect | Yes | Yes | Yes | Yes |
| MSA*quarter fixed effect | | Yes | | Yes |
| Bank*MSA fixed effect | | Yes | | |
| Observations | 97,522 | 97,522 | 97,522 | 97,522 |
| R-squared | 0.720 | 0.859 | 0.718 | 0.722 |

Exp=RE Lending – Total Capital

| | Tier 1 Capital (bank-location) | | | |
|--|--------------------------------|-------------|-------------|-------------|
| | (1) | (2) | (3) | (4) |
| | OLS | OLS | IV | IV |
| House Prices _{m,t} * RELoans _{branch,2005} | 0.000960*** | 0.000962*** | 0.000958*** | 0.000961*** |
| | (8.604) | (8.433) | (8.578) | (8.584) |
| Bank fixed effect | Yes | Yes | Yes | Yes |
| MSA fixed effect | Yes | Yes | Yes | Yes |
| Quarter fixed effect | Yes | Yes | Yes | Yes |
| MSA*quarter fixed effect | | Yes | | Yes |
| Bank*MSA fixed effect | | Yes | | |
| Observations | 97,522 | 97,522 | 97,522 | 97,522 |
| R-squared | 0.674 | 0.834 | 0.672 | 0.679 |

Exp=PPE – Total Loans

| | Total loans (bank-location) | | | |
|--|-----------------------------|----------|----------|----------|
| | (1) | (2) | (3) | (4) |
| | OLS | OLS | IV | IV |
| House Prices _{m,t} * PPE _{branch,2005} | 0.304*** | 0.304*** | 0.301*** | 0.305*** |
| | (11.04) | (10.77) | (10.37) | (10.39) |
| Bank fixed effect | Yes | Yes | Yes | Yes |
| MSA fixed effect | Yes | Yes | Yes | Yes |
| Quarter fixed effect | Yes | Yes | Yes | Yes |
| MSA*quarter fixed effect | | Yes | | Yes |
| Bank*MSA fixed effect | | Yes | | |
| Observations | 97,522 | 97,522 | 97,522 | 97,522 |
| R-squared | 0.743 | 0.835 | 0.743 | 0.741 |

Exp=RE Lending – Total Loans

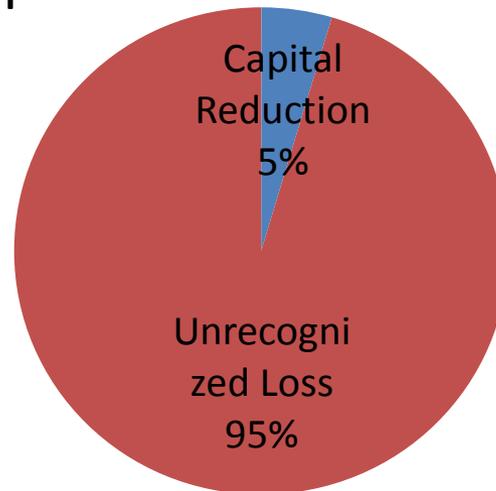
Total loans (bank-location)

| | (1) | (2) | (3) | (4) |
|---|------------|------------|------------|------------|
| | OLS | OLS | IV | IV |
| House Prices _{m,t} * RE Loans _{branch,2005} | 0.00844*** | 0.00845*** | 0.00848*** | 0.00851*** |
| | (16.34) | (16.07) | (15.03) | (15.10) |
| Bank fixed effect | Yes | Yes | Yes | Yes |
| MSA fixed effect | Yes | Yes | Yes | Yes |
| Quarter fixed effect | Yes | Yes | Yes | Yes |
| MSA*quarter fixed effect | | Yes | | Yes |
| Bank*MSA fixed effect | | Yes | | |
| Observations | 97,522 | 97,522 | 97,522 | 97,522 |
| R-squared | 0.782 | 0.861 | 0.781 | 0.780 |

Loss Recognition

Using the following average values and the PPE exposure:

- Real-estate = 80% of PP&E
- Loans = 7x tier 1 capital



The reduction in loans is 116% the one that would keep loans proportional to tier 1 capital, but just 6% of the notional loss in creditworthiness.

Contagion across business lines

Do shocks to one business area of the bank translate to others?

Is there an internal capital market for banks?

Our identification strategy implicitly assumes contagion within a bank across geographical locations (similar to Lamont and Polk, 2002 or Matvos and Seru 2013 for firms).

We can show contagion across business lines.

- Novel extension of conglomerate results to banks.
- Reinforces our identification strategy (cross sorting less likely)

Loan Types

Panel A: Panel A: PP&E exposure measure

| | Total Loans | RE Loans | Individual Loans | Agri Loans | Personal loans (credit card) | Lease financing receivables |
|--|---------------------|---------------------|---------------------|----------------------|------------------------------|-----------------------------|
| House Prices _{m,t} * PPE _{branch,2005} | 0.304*** (10.77) | 0.170*** (7.356) | 0.0364*** (15.4) | 0.00101** (2.381) | 0.0276*** (16.13) | 0.00787*** (3.105) |
| Bank fixed effect | Yes | Yes | Yes | Yes | Yes | Yes |
| MSA*quarter fixed effect | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 97,522 | 97,522 | 97,522 | 97,522 | 97,522 | 97,522 |
| R-squared | 0.835 | 0.79 | 0.756 | 0.571 | 0.787 | 0.608 |

Panel B: Real estate loans exposure measure

| | Total Loans | RE Loans | Individual Loans | Agri Loans | Personal loans (credit card) | Lease financing receivables |
|---|-----------------------|----------------------|------------------------|------------------------|------------------------------|-----------------------------|
| House Prices _{m,t} *RELoans _{branch,2005} | 0.00845*** (16.07) | 0.00490*** (21.1) | 0.000933*** (7.482) | 3.15e-05*** (2.722) | 0.000721*** (11.45) | 0.000238*** (6.546) |
| Bank fixed effect | Yes | Yes | Yes | Yes | Yes | Yes |
| MSA*quarter fixed effect | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 97,522 | 97,522 | 97,522 | 97,522 | 97,522 | 97,522 |
| R-squared | 0.861 | 0.862 | 0.753 | 0.605 | 0.773 | 0.699 |

Loan Types - IV

Panel A: PP&E exposure measure

| | Total Loans | RE Loans | Individual Loans | Agri Loans | Personal loans (credit card) | Lease financing receivables |
|--|-------------|----------|------------------|------------|------------------------------|-----------------------------|
| House Prices _{m,t} * PPE _{branch,2005} | 0.301*** | 0.168*** | 0.0353*** | 0.00101** | 0.0271*** | 0.00799*** |
| | (10.37) | (7.128) | (14.00) | (2.483) | (16.79) | (3.146) |
| Bank fixed effect | Yes | Yes | Yes | Yes | Yes | Yes |
| MSA*quarter fixed effect | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 97,522 | 97,522 | 97,522 | 97,522 | 97,522 | 97,522 |
| R-squared | 0.762 | 0.743 | 0.748 | 0.139 | 0.365 | 0.617 |

Panel B: Real estate loans exposure measure

| | Total Loans | RE Loans | Individual Loans | Agri Loans | Personal loans (credit card) | Lease financing receivables |
|---|-------------|------------|------------------|-------------|------------------------------|-----------------------------|
| House Prices _{m,t} *RELoans _{branch,2005} | 0.00848*** | 0.00493*** | 0.000925*** | 3.15e-05*** | 0.000711*** | 0.000244*** |
| | (15.03) | (17.92) | (7.581) | (2.92) | (11.48) | (6.44) |
| Bank fixed effect | Yes | Yes | Yes | Yes | Yes | Yes |
| MSA*quarter fixed effect | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 97,522 | 97,522 | 97,522 | 97,522 | 97,522 | 97,522 |
| R-squared | 0.781 | 0.832 | 0.13 | 0.416 | 0.593 | 0.655 |

Contagion across business lines

- Spillovers of shocks to real estate business into other parts of business.
- Contrasts with Chakraborty, Goldstein and MacKinlay (2013), which find a substitution effect across bank business lines during the real estate boom.
- Financing constraints may be very different when driven by an expansion (funding needs growing faster than sources) or a contraction (funding sources contracting).
- In relative terms, the most affected line of business is real estate loans, followed by agricultural loans, individual loans, credit cards and lease receivables.

Funding and Operations

| VARIABLES | (1) | (2) | (3) | (4) | (5) | (6) | (7) |
|---|------------------------|----------------------------|----------------------------|---|-------------------|--------------------------|----------------------|
| | Equity issuance | Expenses on premises | Non interest expense | Interest and non- interest expense | Trading assets | Investment securities | Cash and balances |
| House Prices _{m,t} * PPEbranch,2005 | -0.0694*** (-4.519) | 0.00168*** (3.440) | 0.0159*** (3.451) | 0.00139 (0.267) | 0.0215 (0.950) | 0.0845*** (12.77) | 0.0261*** (7.027) |
| MSA fixed effect | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Quarter fixed effect | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| MSA*quarter fixed effect | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Bank*MSA fixed effect | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 95,243 | 97,522 | 97,522 | 97,522 | 97,522 | 93,048 | 97,522 |
| R-squared | 0.517 | 0.780 | 0.785 | 0.779 | 0.880 | 0.714 | 0.453 |

Funding and Operations

- Banks reduce operational costs
- Decrease their holdings of liquid assets
- Increase the issuance of equity.

Overall depletion of liquidity that gets compensated by lower operational costs.

Capital and Size

Loans

| <i>Interactions</i> | T1Cap Low | T1Cap Middle | T1Cap High |
|---------------------|---------------------|---------------------|---------------------|
| TA low | 0.152*** (2.981) | 0.0618 (0.484) | 0.201** (2.562) |
| TA middle | 0.175*** (9.755) | 0.114*** (4.160) | 0.197*** (4.142) |
| TA high | 0.315*** (10.06) | 0.107*** (2.880) | 0.150** (2.559) |

Tier 1 Capital

| <i>Interactions</i> | T1Cap Low | T1Cap Middle | T1Cap High |
|---------------------|----------------------|----------------------|----------------------|
| TA low | 0.0165*** (2.818) | 0.0286*** (2.747) | 0.0428*** (3.641) |
| TA middle | 0.0187*** (9.964) | 0.0156*** (6.143) | 0.0301*** (4.732) |
| TA high | 0.0385*** (26.63) | 0.0186*** (7.798) | 0.0237*** (6.348) |

Equity Issuance

| <i>Interactions</i> | T1Cap Low | T1Cap Middle | T1Cap High |
|---------------------|------------------------|------------------------|-----------------------|
| TA low | -0.0113 (-1.506) | -0.00614* (-1.877) | -0.00296 (-0.758) |
| TA middle | -0.0153*** (-6.403) | -0.0105*** (-8.853) | -0.000875 (-0.970) |
| TA high | -0.0554*** (-24.85) | -0.0181*** (-4.107) | -0.00109 (-0.559) |

Capital and Size

Loans

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|---------------------|---------------------|---------------------|---------------------|
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Capital and Size

- Effects on large banks are slightly smaller than on small banks.
- Interaction of capital and size shows patterns that are hidden on a pure size analysis
- Total loans and loss recognition effect is highest among:
 - High capital, small banks (most disciplined?)
 - Low capital large banks (most visible?)
- Equity issuance effect is stronger among large low-capitalized banks.

Conclusions I

- New methodology that uses banks as portfolios of locations to control for local effects
- Identify a balance sheet contagion channel for a broad population of US banks during the current crisis.
- Evidence of an internal capital market within banks that generates contagion:
 - Across geographical locations
 - Across business lines

END