# Economics 742 Lecture 5: Other Sources of Micro Variation: Bartik, Firms and Banks, Credit and the Great Recession

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# Outline For Today

- I want to now talk through several sources of micro variation in macro that did not fit into the three lectures on housing:

1. Firm-Level Shocks
   - 1.1 Collateral Shocks: Chaney, Sraer, and Thesmar (2012)
   - 1.2 Bank Shocks
     - 1.2.1 Peek and Rosengren (2000)
     - 1.2.2 Khwaja and Mian (2008)
   - 1.3 Granular IV: Gabaix and Koijen (2024)
2. Role of Credit in the Great Recession
   - 2.1 Chodorow-Reich (2014): Syndicated Loans
   - 2.2 Huber (2017): Persistence
   - 2.3 Greenstone, Mas, and Nguyen (2020): Modified Bank Bartik for Small Business Credit

# Collateral Shocks: Chaney, Sraer, and Thesmar (2012)

- Do shocks to real estate collateral value affect investment?
- Chaney, Sraer, and Thesmar (2012) answer using regional variation in real estate values and Compustat data.
  - Compare firms with headquarters in areas with different price changes (Saiz instrument).
  - Within MSA, compare renters and owners.
  - Concern: owning real estate is endogenous.
    1. Controls for observable determinants of owning has no effect.
    2. Same firm looks like renter in terms of investment response before real estate purchase, owner after.
- From 1993-2007, a \$1 increase in collateral value causes the average US public corporation to increase investment \$0.06.
  - Stronger among financially constrained firms.
  - Real estate collateral lets firms issue more debt and more easily pay current debt burden.
  - Surprising because would not expect for large public corporations that have access to equity markets.

# Chaney, Sraer, and Thesmar (2012): Empirical Strategy

$$Inv_{it}^{l} = \alpha_i + \delta_t + \beta \times REValue_{it} + \gamma P_t^l + controls_{it} + \varepsilon_{it}$$

- $Inv_{it}^{l}$ is investment / lagged property, plants, and equipment (PPE) value for firm $i$ in HQ location $l$ at time $t$.
- $REValue_{it}$ = market value of real estate in year $t$ / PPE.
  - Last measured in 1993 in Compustat. So take 1993 value and inflate using commercial/residential real estate price indices.
- $P_t^l$ is control for level of prices in location $l$ in year $t$.
- Controls include cash flows / PPE, book value of assets.
- SE clustered at $MSA \times Year$ level.
- $\beta$: investment response to \$1 change in value of real estate a *firm actually owns*. $\gamma$ picks up general real estate sensitivity.

# Chaney, Sraer, and Thesmar (2012): Empirical Strategy

- Concern 1: RE prices corr with investment opportunities.
  - Instrument $P$ and changes in $REValue$ with Saiz elasticity in location $l$ interacted with interest rate at time $t$.
  - Restrict to small firms in large cities to address worry that firm dominates real estate market.
- Concern 2: RE ownership corr with investment opportunities.
  - Control for initial characteristics $X_i$ that predict subsequent ownership (age, assets, ROA) interacted with real estate prices.
  - Look at sensitivity of investment to RE prices for firms that are about to purchase RE, assuming unobs characteristics that determine both ownership and investment are time invariant.
    - Investment is not sensitive to local real estate values before a firm purchases and becomes sensitive afterwards.
    - Remarkable test that makes the paper convincing.
- Clearly a fact, but hard to aggregate. Does this matter in the long run? For cycles?

# Bank Shocks

- How are shocks to banks transferred to firms and the real economy?
  - Here, direct bank shocks, not monetary policy shocks (next).

1. Peek and Rosengren (2000): Regional approach, foreign shock.
2. Kwaja and Mian (2008): Exogenous shock with firm FE.

# Peek and Rosengren (2000)

- Identification strategy: Use a shock to foreign bank subsidiaries in the U.S.
  - Assumption 1: Shock external to U.S. economy, credit markets
    - Shock: Japanese real estate cycle and its interaction with individual bank balance sheets.
  - Assumption 2: Location of foreign bank subsidiaries (and of "good" vs. "bad" banks) not correlated with local economy.
- Findings:
  - Cutbacks in Japanese subsidiary lending had substantial impact on U.S. real estate.
  - Implies bank relationships "sticky," alternate identical financing hard to find.
- Won't show you much of paper because relative to papers today the data is very crude. But it is the first paper to pilot the idea of a "foreign" bank shock.

# Khwaja and Mian (2008): Innovations

1. *Firm fixed effects* after first differencing loan level data to identify bank lending channel separately from firm credit demand.
   - Compare *relative* lending growth of *same* firm borrowing at multiple banks with *different* shocks.
   - Identifying assumption: *Firm's credit demand shock is same across lenders*.

2. Exogenous variation: Cross-bank liquidity differences due to unanticipated nuclear test in Pakistan.
   - Freezing of withdrawals of dollars acted as shocks to banks with more dollar deposits.

# Khwaja and Mian (2008): Findings

- 1% $\downarrow$ in bank liquidity $\Rightarrow$ 0.6% $\downarrow$ in lending.
- Compare Firm FE with no FE: no FE is under-estimate.
  - Negative corr between credit supply and demand shocks, because better banks lending to better firms had more dollars and thus larger liquidity shock.
  - Because of direction of bias, can use specification without FE to put lower bound on firm demand channel.
  - When do this, find that small firms cannot substitute away from bank shocks but large firms can.
    - 1% bigger bank shock $\Rightarrow$ 2% $\uparrow$ in likelihood of firm financial distress for small firms, 0% for large.

# Khwaja and Mian (2008): Model to Motivate Strategy

- For loan $L_{ij}$ from bank $i$ to firm $j$, linear credit supply with slope $\alpha_B$, linear credit demand with slope $-\alpha_L$.
  - See paper for microfoundation.
- Shocks to credit supply: $\bar{\delta}$ economy-wide, $\delta_i$ bank-specific.
- Shocks to credit demand: $\bar{\eta}$ economy-wide, $\eta_j$ firm-specific.
- Solve and first difference (assuming not at corner)

$$\Delta L_{ij} = \frac{1}{\alpha_L + \alpha_B}\left(\alpha_B \bar{\delta} + \bar{\eta}\right) + \frac{\alpha_B}{\alpha_L + \alpha_B}\delta_i + \frac{1}{\alpha_L + \alpha_B}\eta_j$$

# Khwaja and Mian (2008): Regression Strategy

$$\Delta L_{ij} = \frac{1}{\alpha_L + \alpha_B}\left(\alpha_B \bar{\delta} + \bar{\eta}\right) + \frac{\alpha_B}{\alpha_L + \alpha_B}\delta_i + \frac{1}{\alpha_L + \alpha_B}\eta_j$$

- OLS with bank shock $\Delta D_i$:

$$\Delta L_{ij} = \beta_0 + \beta_1 \Delta D_i + \eta_j + \varepsilon_{ij}$$

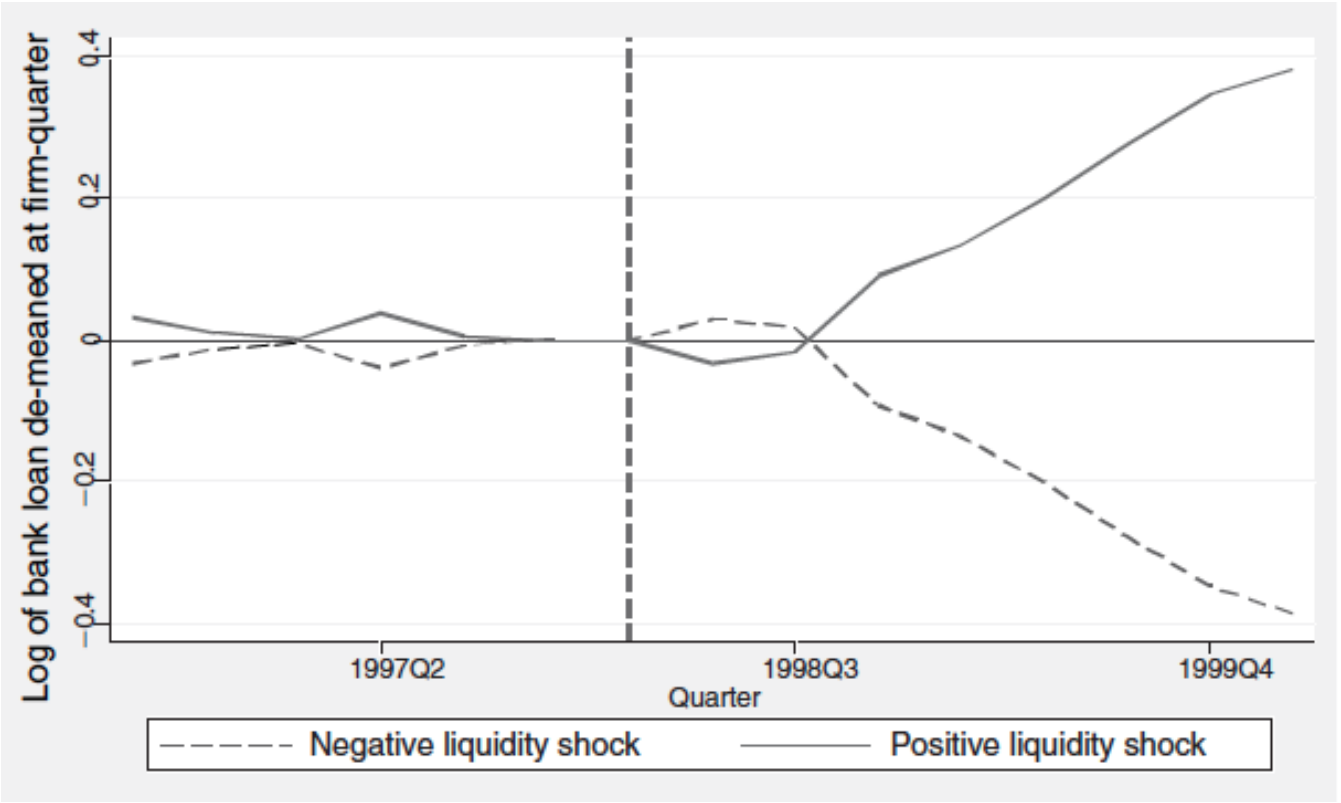
  - Biased if $corr\left(\Delta D_i, \eta_j\right) \neq 0$. Usually positive correlation due to positive assortative matching of firms and banks.

- Khwaja-Mian Solution: FE after first differencing

$$\Delta L_{ij} = \beta_j + \beta_1 \Delta D_i + \varepsilon_{ij}$$

  - Need multiple banking relationships and $\eta_j$ same at all banks.

# Khwaja and Mian (2008): Regression Results



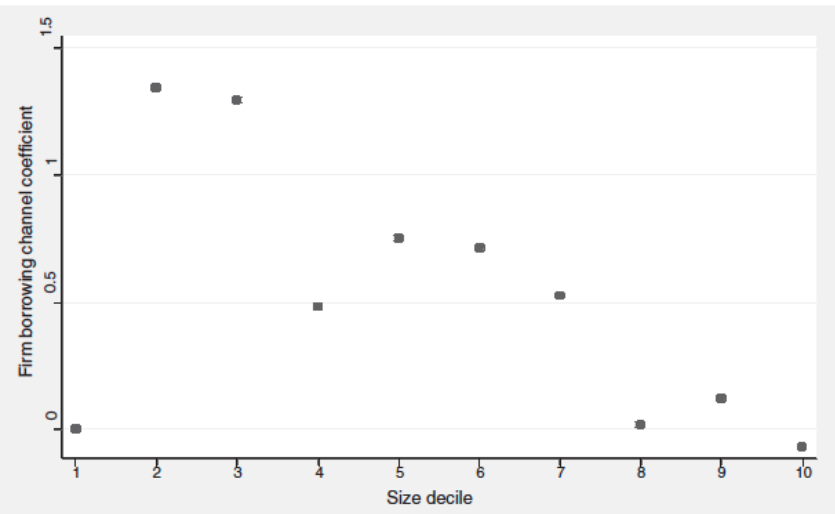

| | Δ Log loan size | | | |
|---|---|---|---|---|
| Dependent variable | FE (1) | FE (2) | FE (3) | OLS (4) |
| Δ Log bank liquidity | 0.60 | 0.63 | 0.64 | 0.46 |
| | (0.09) | (0.10) | (0.11) | (0.14) |
| Fixed effects | Firm | Firm | Firm × loan-type | |

# Khwaja and Mian (2008): Firm Borrowing Channel Strategy

- Compare OLS to FE to get sign of $corr\,(\Delta D_i, \eta_j)$.
- Estimate OLS with $\Delta \bar{D}_j$ average shock of firm $j$s banks.

$$\Delta Y_j = \beta_0^F + \beta_1^F \Delta \bar{D}_j + \eta_j$$

- Sign of $corr\,(\Delta D_i, \eta_j)$ gives bound on true $\beta_1^F$.
  - Negative corr due to nuclear shock hurting better banks, so lower bound on $\beta_1^F$



# Gabaix and Koijen (2024): Granular IV

- New and increasingly popular method to generate instrumental variables in broad class of environments.
  - Want you to be exposed to this.
- Idea from Gabaix (2011):
  - Firm (and other) size distributions are often thick tailed.
  - This means LLN failed and idiosyncratic shocks to large firms can have aggregate effects.
- Gabaix and Koijen (2024) apply this to IV:
  - Use idiosyncratic shocks from large players as an instrument for aggregate outcomes.
  - Provide method to extract these shocks to form such "granular instrumental variables" which you can use to estimate causal elasticities and multipliers.
- Provide a number of extensions and ways one can use.
  - Here, a simplified version.

# Gabaix and Koijen (2024): Granular IV

- Simultaneous equations setup
- Demand is $D_{it} = \bar{Q} S_i (1 + y_{it})$ where $\bar{Q}$ is average demand, $S_i$ is unit $i$'s size share, and $y_{it}$ is unit $i$'s demand shift, which is related to price, aggregate factors, and an idiosyncratic factor:

$$y_{it} = \phi^d p_t + \eta_t + u_{it}$$

  - $p_t = \frac{P_t - \bar{P}}{\bar{P}}$ is the proportional deviation from $\bar{P}$
  - $\phi^d$ is the elasticity of demand
  - $\eta_t$ is a common shock (GK generalize to $\eta_t \lambda_i$ where $\lambda_i$ are heterogenous loadings on common shock vector)
  - $u_{it}$ is an idiosyncratic shock
- Supply is $Q_t = \bar{Q} (1 + s_t)$ where supply shift is:

$$s_t = \phi^s p_t + \varepsilon_t$$

  - $\phi^s$ is elasticity of supply.
  - $\varepsilon_t$ is supply shock.

# Gabaix and Koijen (2024): Granular IV

- Denote $X_E$ as an equally-weighted sum and $X_S$ as a size weighted sum.
- Then aggregate demand is $D_t = \sum_i D_{it} = \bar{Q}(1 + y_{St})$ and in equilibrium:

$$D_t = Q_t \Rightarrow \bar{Q}(1 + y_{st}) = \bar{Q}(1 + s_t) \Rightarrow y_{St} = s_t$$

- This implies:

$$\phi^s p_t + \varepsilon_t = \phi^d p_t + \eta_t + U_{s_t}$$

or

$$p_t = \frac{u_{St} + \eta_t - \varepsilon_t}{\phi^s - \phi^d} = \mu u_{St} + \varepsilon_t^p$$

  - $\mu = \frac{1}{\phi^s - \phi^d}$ is the price impact of a demand shock $u_{St}$
  - $\varepsilon_t^p = \frac{\eta_t - \varepsilon_t}{\phi^s - \phi^d}$ is a purely aggregate quantity.

# Gabaix and Koijen (2024): Granular IV

- We wish to estimate $\phi^s$.
  - OLS biased because $\varepsilon_t$ and $p_t$ are correlated by classic simultaneity as $p_t = \frac{u_{St}+\eta_t-\varepsilon_t}{\phi^s-\phi^d}$.
- Assume $\eta_t$, $\varepsilon_t$, and $u_t$ have finite second moments and zero mean. $\varepsilon_t$ and $\eta_t$ can be correlated but the $u_{it}$ are idiosyncratic so $E\left[u_{it}\left(\eta_t, \varepsilon_t\right)'\right] = 0$.
  - From this we see the $u_{it}$ are valid instruments for the price.
  - But we don't know them. So exploit granularity!
- Define the GIV $z_t = y_{St} - y_{Et} = u_{St} - u_{Et}$.
  - Difference between *size-weighted* and *equally weighted* quantities.
  - Differences out the common shock and common price sensitivity, leaving linear combination of idiosyncratic shocks.
  - Relies on $y_{St} - y_{Et} \neq 0$, which holds with heavy tailed distributions and aggregate effects of granularity.

# Gabaix and Koijen (2024): Granular IV

- Define the GIV $z_t = y_{St} - y_{Et} = u_{St} - u_{Et}$.
  - Intuition: *Extracts variation in the aggregate firm shock series attributed to "granular" agents purging common factors*.
  - GK show this maximizes power in a set of potential weights on the idiosyncratic shocks that purge the common factor.
    - Mathematically, any weighting $\Gamma$ with $\Gamma'\iota = 0$ is a GIV and purges the common factors. $\Gamma_i = S_i - \frac{1}{N}$ maximizes power.
    - $\Gamma' S \neq 0$ implies relevant instrument.
- $s_t - \phi^s p_t = \varepsilon_t$ and $E[u_t \varepsilon_t] = 0 \Rightarrow E[(s_t - \phi^s p_t) z_t] = 0$ which is a GMM condition that gives an estimate for $\phi^s$ of:

$$\phi^s = \frac{E[s_t z_t]}{E[p_t z_t]}.$$

  - Can also estimate demand elasticity and multipliers.
- G-K provide a "cookbook" procedure for the case with heterogenous loadings on aggregate shocks.
  - Assumption: Characteristics $X_i$ s.t. $\lambda_i = X_i \dot{\lambda}$ for matrix $\dot{\lambda}$.
  - Concern: Unobservable loadings.

# Credit Applications of GIV

- Beginning of GK paper is review of literature *that already uses their method*!
- Examples related to credit:
  - Galaasen et al. (2023): Granular credit risk on bank balance sheets to show spillovers from banks to firms and real outcomes.
  - Kundu and Vats (2022): Non-capital shocks transmit through bank networks and loan supply 1% increase in loan supply leads to .05-.26pp increase in economic growth.
  - Kundu, Park, and Vats (2022); Bank deposits geographically concentrated and county-level deposit shocks generate aggregate fluctuations through bank credit supply.

# Credit and the Great Recession

- To what extent did credit supply shocks to businesses and households reduce employment in the great recession?

1. Chodorow-Reich (2014): Syndicated Loans
2. Huber (2017): Persistence
3. Greenstone, Mas, and Nguyen (2020): Modified Bank Bartik for Small Business Credit

# Chodorow-Reich (2014): Overview

- What was size of 2008-9 credit crunch on employment?
- New data:
  - BLS firm-level employment matched to syndicated loan history.
  - 2,000 private and public firms from 50-10,000 employees.

1. Shows banking relationships are sticky.
2. Argues that health of pre-crisis lender is exogenous
   - Origins of crisis in mortgages not corporate loans.
3. Employment of firms with lender in 10th percentile of bank health fell 4-5 percentage points less than 90th percentile.
   - Stronger effects at smaller firms.
4. Aggregates to 1/3-1/2 of emp decline at small firms in 2008-9.

# Chodorow-Reich (2014): Unobserved Heterogeneity Test

- Shows covariate balance across quantiles of bank health dist.
- Khwaja-Mian-style test for unobserved heterogeneity in matching of borrowers to lenders.
  - Regresses log-change in lending in borrower-lender pair over crisis on loan supply measure and borrower fixed effects.
  - Then regresses using only a few covariates.
  - Gap between loan supply coefficients captures bias induced by non-random borrower-lender matching on unobservables.

| | | |
|---|---|---|
| %Δ loans to other borrowers ($\Delta \tilde{L}_i$) | 1.05** | 1.07** |
| | (0.33) | (0.32) |
| 1-digit SIC, loan year FE | No | Yes |
| Bond market access/public/private FE | No | Yes |
| Additional Dealscan controls | No | Yes |
| Borrower FE | Yes | No |

# Chodorow-Reich (2014): Credit and Bank Health

| | Firm obtains a new loan or positive modification | | | | | |
|---|---|---|---|---|---|---|
| | Probit | | $\Delta\tilde{L}_{i,s}$ instrumented using | | | |
| | | | Lehman exposure | ABX exposure | Bank statement items | All |
| Explanatory variables | | | | | | |
| %Δ loans to other firms ($\Delta\tilde{L}_{i,s}$) | 2.19** | 2.00** | 3.65** | 2.33* | 2.28** | 2.32** |
| | (0.79) | (0.53) | (1.28) | (1.12) | (0.64) | (0.63) |
| 2-digit SIC, state, loan year FE | No | Yes | Yes | Yes | Yes | Yes |
| Bond access/public/private FE | No | Yes | Yes | Yes | Yes | Yes |
| Additional Dealscan controls | No | Yes | Yes | Yes | Yes | Yes |
| | Change in interest rate spread | | | | | |
| Explanatory variables | | | | | | |
| %Δ loans to other firms ($\Delta\tilde{L}_{i,s}$) | −14.6** | −12.2** | −23.1* | −20.0 | −17.2* | −17.6** |
| | (5.26) | (4.15) | (11.2) | (13.3) | (7.63) | (6.68) |

# Chodorow-Reich (2014): Employment and Bank Health

| | Employment growth rate 2008:3–2009:3 | | | | | |
|---|---|---|---|---|---|---|
| | OLS | | $\Delta\tilde{L}_{i,s}$ instrumented using | | | |
| | | | Lehman exposure | ABX exposure | Bank statement items | All |
| Explanatory variables | | | | | | |
| %Δ loans to other firms ($\Delta\tilde{L}_{i,s}$) | 1.17* | 1.67** | 2.49* | 3.17* | 2.13* | 2.38** |
| | (0.58) | (0.61) | (1.00) | (1.35) | (0.88) | (0.77) |
| Lagged employment growth | | 0.0033 | 0.0039 | 0.0045 | 0.0036 | 0.0039 |
| | | (0.019) | (0.019) | (0.019) | (0.019) | (0.019) |
| Emp. change in firm's county | | 0.89* | 0.85+ | 0.86+ | 0.87+ | 0.89+ |
| | | (0.43) | (0.46) | (0.48) | (0.45) | (0.46) |
| 2-digit SIC, state, loan year FE | No | Yes | Yes | Yes | Yes | Yes |
| Firm size bin FE | No | Yes | Yes | Yes | Yes | Yes |
| Firm age bin FE | No | Yes | Yes | Yes | Yes | Yes |
| Bond access/public/private FE | No | Yes | Yes | Yes | Yes | Yes |
| Additional Dealscan controls | No | Yes | Yes | Yes | Yes | Yes |

# Chodorow-Reich (2014): Employment and Bank Health

| Employment growth rate 2008:3–2009:3 | |
|---|---|
| Explanatory variables | |
| $\Delta\tilde{L}_{i,s}$ * Large | 0.54 |
| | (0.97) |
| $\Delta\tilde{L}_{i,s}$ * Medium | 1.84+ |
| | (0.97) |
| $\Delta\tilde{L}_{i,s}$ * Small | 2.16** |
| | (0.79) |

TOTAL EFFECT OF CREDIT AVAILABILITY AT SMALL AND MEDIUM FIRMS IN THE SAMPLE

| | 2008:3–2009:3 (%) |
|---|---|
| Total employment decline | 7.0 |
| Share of losses due to credit availability, $\tau = 90$ | 34.4 |
| Share of losses due to credit availability, $\tau = 95$ | 47.3 |

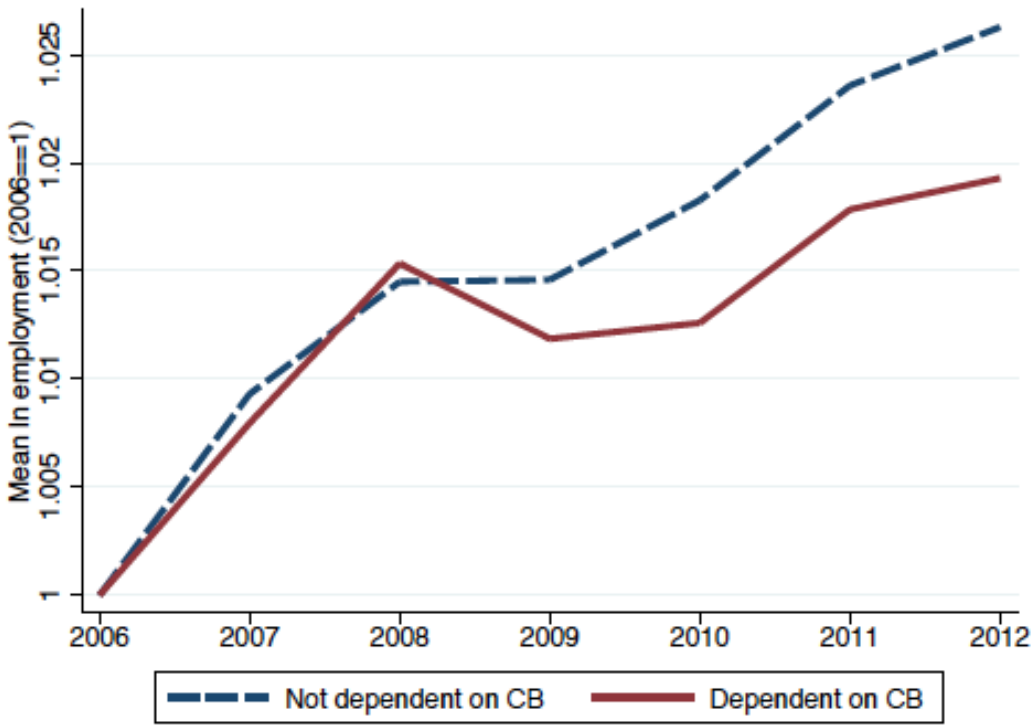
*Notes.* The table reports the fraction of employment losses due to credit availability at small and medium firms, as described in the text. $\tau$ refers to the percentile of the lending syndicate identified as the most liberal syndicate.

# Chodorow-Reich and Falato (2022): Covenants Channel

- Essentially all commercial loans are long-term commitments.
  - Under 10% of loans have maturity of $< 1$ year.
  - Insulates borrowers from health of their bank.
- What explains magnitude of Chododrow-Reich's results?
- Chodorow-Reich and Falato (2022): Covenants.
  - Condition in a commercial loan that requires the borrower to fulfill certain conditions or which forbids the borrower from undertaking certain actions.
  - If fail to meet, bank can force renegotiation.
- Chodorow-Reich and Falato find covenant violators explain essentially all of transmission of lender distress to borrowers.
  - Conditional on breaching covenant, borrower of distressed lender is more likely to have credit reduced, less likely to receive waiver or obtain new credit.
  - Substantial reduction transmits to non-financial outcomes.
  - Explains 4.9% decline in credit in 2008 and 5.2% 2009 (essentially all of agg).

# Huber (2018): Persistence

- In Lecture 1 we talked about Huber (2018), who extends Chodorow-Reich using German data.
  - Similar magnitude for exposure to Lehman in C-R and exposure to Commerzbank in Huber.
- Finds highly persistent effect of CB exposure:



# Huber (2018): Persistence

- Huber's explanation is decline in innovation and productivity:

| OUTCOME | (1) Growth rate of patents | (2) Patents post lending cut | (3) Patents pre lending cut |
|---|---|---|---|
| Patenting*Firm CB dep | -0.548 | -0.770 | 0.206 |
| | (0.245) | (0.409) | (0.409) |
| Non-patenting*Firm CB dep | 0.037 | | |
| | (0.065) | | |
| Ln Patents 1990-2004 | | 0.671 | 0.687 |
| | | (0.088) | (0.116) |
| Observations | 2,011 | 382 | 382 |

# Greenstone, Mas, and Nguyen (2020): Overview

- Did a credit supply shock reduce small business employment in the Great Recession?
- Exploit heterogeneity within states in county exposure to banks with differing national credit supply shocks.
  - Citigroup cut small business lending 84%, US Bankcorp 3%.
  - Do counties with more Citi exposure do worse?
- Modified "Bank Bartik Shock" approach:
  - Isolate credit supply-component by constructing Bartik with shift *purged of county average shift for all banks*.
  - Note Bartik here is a structural shock, *not an instrument*.
- Find that their purged instrument affects loans but not employment.
- Bounding exercise: Small business lending crunch accounts for *at most* .5% decline in employment (16% of agg decline).

# Greenstone et al. (2020): Research Design

- Concern: Bank Bartik combines credit supply and demand shocks in national bank shift.
- Approach: project the shift in credit onto bank and county FE:

$$\Delta \log Q_{ij} = d_i + s_j + \varepsilon_{ij}$$

  - $Q_{ij}$ is small business lending by bank $j$ in county $i$.
  - Weight by base period lending.
  - $s_j$ re-centered so bank asset-weighted mean is zero.

- $d_i$: weighted average change in *all* lenders quantities in county $i$ ("demand" component).
- $s_j$: lender's weighted average national shock *net of county weighted-average change for all lenders* ("supply shock").
  - Intuition: rel change in lending of banks *in same counties*.

# Greenstone et al. (2020): Research Design (Continued)

- Construct modified Bartik shock for each year pair:

$$p_i = \sum_j \omega_{ij} \hat{s}_j$$

  - $\omega_{ij}$ is bank $j$'s market share in county $i$ in prior year.

- Identifying assumption:
  - Banks with different national shocks not systematically sorted into regions based on their demand shocks or outcomes.
    - Concern: Some banks entered worse counties, made worse loans, and consequently had a worse national shocks.
    - Banks sort *within counties* (e.g., specialize in low-income lending or neighborhoods).
  - They will test directly, but this is a major concern.

# Small Business Employment and Credit: Evaluation

- Chodorow-Reich (C-R) and Greenstone et al. (GMN) come to surprisingly different conclusions.
  - Chodorow-Reich: 1/3-1/2 of small business employment decline due to credit.
  - Greenstone et al.: At most 16% due to credit.

- I cannot fully account for the gap. Some notable differences:
  1. C-R limited to syndicated loans, GMN not.
  2. GMN attempt to capture "aggregate" supply shock, C-R uses specific measures of bank health.
     - GMN need assumptions to purge demand, isolate supply.
     - Worried about within-county sorting.
     - Worried about drawdowns of lines of credit.
  3. GMN aggregate to county level so capture some local GE effects, but still partial equilibrium.
  4. C-R looks at small firms, whereas for data reasons GMN look at small establishments.

# Mortgage Credit

- Mondragon (2020) and Gilchrist, Siemer, and Zakrasek (2019) argue bank shocks to *mortgage* credit significant in bust.
- Mondragon: Instrument for bank credit in southeast with Wachovia, which had big presence in southeast and failed because purchased bank in CA with bad loans.
- Gilchrist, Siemer, Zakrajsek: Orthogonalized bank balance sheet with respect to local demand conditions as in GMN.
  - Like GMN, find limited small business lending effects.
  - Many outcomes: construction, employment, wages and income, retail sales, auto purchases, house prices.
  - Big mortgage lending effects in bust, not in boom.
  - Concentrated at small and young firms.

# Credit and the Great Recession: Evaluation

- Clear credit supply matters and played important role in Great Recession.
- Still an ongoing debate about relative importance of credit supply and household balance sheets.
  - I leave it to you to decide where you weigh in (or if you think there is a tension between the two at all).
  - See, e.g., Mian and Sufi, Krugman vs. Gertler-Gilchrist, Bernanke
- Also some debate about importance of contraction in business lending relative to household lending.
  - Evidence seems stronger for household lending than small business lending.
  - But aggregate financial conditions may have a role that is nation-wide and does not show up in regional analysis.