Financial Crises and the Transmission of Monetary Policy to Consumer Credit Markets

Sasha Indarte
Wharton

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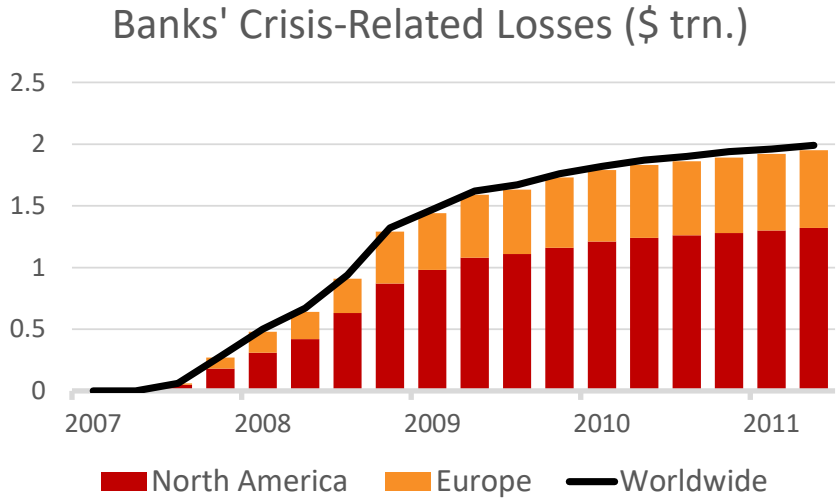
Bank Losses During the Global Financial Crisis



Source: Bank of International Settlements (2018)

This Paper

Q: how do asset losses affect the sensitivity of lending to conventional monetary policy?

- Asset losses can limit pass-though to lending: exacerbate constraints
- Or, asset losses can enhance pass-through: easing alleviates frictions
- Answer is informative about:
  - Mechanics of monetary transmission
  - Nature of financial frictions facing lenders
  - Complementarity/substitutability of conventional policy and tools like LSAPs
- **Approach:** est. causal effects of asset losses and 2-year Treasury rate on lending
  - Use quasi-experimental research design and data on the universe of US credit unions

Contributions

- **State dependence of monetary policy:**
  Kashyap and Stein (1995, 2000); Di Maggio, Kermani, and Palmer (2016); Tenreyro and Thwaites (2016); Scharfstein and Sunderam (2017); Gabriel and Lutz (2017); Berger et al. (2018); Jorda, Schularick, and Taylor (2018); Wieland and Yang (2019); Beraja et al. (2019); Paul (2019); Wong (2019); Benetton and Fantino (2019); Paz (2020)
  - New focus on lender financial health as source of state dependence
  - Separately look at both mortgages and non-mortgage consumer credit

- **Role of financial frictions in monetary transmission:**
  Bernanke, Gertler, and Gilchrist (1999); Gertler and Kiyotaki (2010); Di Maggio et al. (2017); Drechsler, Savov, and Schnabl (2018); Piazzesi, Rogers, and Schneider (2019); Zentefis, (2019); Ottonello and Winberry (2019)
  - New empirical evidence on nature of frictions facing affecting creditor responses

- **Macro consequences of credit supply shocks:**
  Greenstone, Mas, and Ngyuen (2015); Ramcharan, Van den Heuvel, and Verani (2016); Chodorow-Reich and Falato(2017); Di Maggio and Kermani (2017); Mondragon (2018); Benmelech, Frydman, and Papanikolaou (2019)
  - New evidence on how policy can combat credit supply shocks

Theory: Asset Losses and the Credit Channel of Monetary Policy (Summary)

Theoretical Ambiguity

- Simple models generate opposing predictions for the effect of asset losses on pass-thru

- **Model 1:** bank faces a capacity constraint (e.g., leverage constraint)
  - Lowering the policy rate isn't as powerful when a bad balance sheet constrains lending
  - Asset losses weaken the lending response to policy rate changes

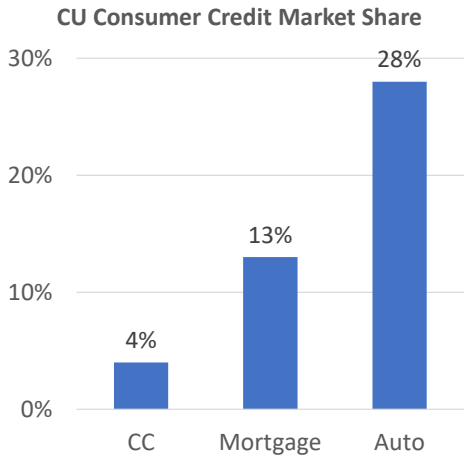
- **Model 2:** bank faces an external finance premium
  - Risk premium magnifies pass-through of policy rate to cost of capital
  - Easing alleviates frictions constraining lenders
  - Asset losses amplify the lending response to policy rate changes

▸ Model 1 ▸ Model 2

Background, Data, & Identification

What's a Credit Union?

- Resemble small banks
- Members often share common affiliation
- Consumer credit (not commercial)
- Restricted direct exposure to risky non-loan assets, including private-label ABS



Source: Equifax (2017)

Data

- **Lender-Level Data:** National Credit Union Administration's Call Reports
  - Quarterly panel of credit unions from 2004-2011
  - 200,000+ observations
  - Loan originations (total and fixed-rate 30-year mortgage) and detailed balance sheets
- **Monetary Policy:**
  - Two-year Treasury rate
  - Daily federal funds futures contract prices

Identification – Instrumental Variables

- **Two distinct identification challenges:**
  - Macro GE: downturns can trigger easing, asset losses, and reduced lending
  - Local GE: asset losses related to both credit supply and demand

- **Solution:** IV Strategy
  - **Assets Losses:** exploit CU asset with plausibly exogenous variation (investment capital)
    - Similar to Ramcharan, Van den Heuvel, and Verani (2016)
  - **Monetary Policy:** high-frequency identification of monetary policy shocks
    - Kuttner (2001); Gürkaynak, Sack, and Swanson (2005); Gertler and Karadi (2015); Gorodnichenko and Weber (2016); Nakamura and Steinsson (2018); Wong (2019)

Investment Capital

- **Investment Capital:** equity position in a Corporate Credit Union
  - Corporates could invest in riskier securities (private-label ABS)
  - Some had no exposure, others invested $>$40% of their balance sheet in private-label ABS

- ABS-related losses were charged against investment capital, losses varied due to...
  - Size of Corporate's exposure
  - Corporate's capital structure
  - The credit union's *relative* share of ownership

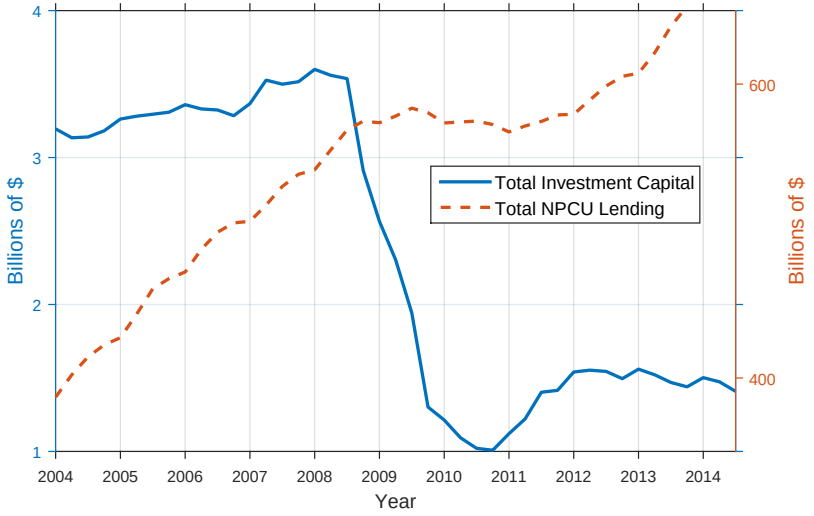
Identifying the Effect of Asset Losses

- Identification requires investment capital losses are exogenous wrt local loan demand

- Relevant institutional background:
  - Choice of Corporate is persistent and mainly driven by geography (Ramcharan, Van den Heuvel, and Verani, 2016)
  - Investment capital has minimum duration requirement of up to 20 years

- Variation is similar to that of a shift-share instrument (Bartik shock)
  - Aggregate phenomenon: collapse of ABS market
  - Predetermined, idiosyncratic exposure to shock

Investment Capital and Lending During the Crisis



Empirical Analysis:
The Causal Effects of Asset Losses and Monetary Policy

Econometric Specification

- Goal is to estimate:

$$\Delta \ln L_{i,t} = \beta_1 \Delta R_{t-1} + \beta_2 \Delta \ln A_{i,t-1} + \beta_3 \left(\Delta R_{t-1} \times \Delta \ln A_{i,t-1}\right) + \kappa_i + \tau \text{ Year}_t + \gamma \text{ Quarter}_t + X_{i,t} + \varepsilon_{i,t}$$

(CU i in quarter t; $L_{i,t}$ = loan originations, R_t = 2-year Treasury yield, $A_{i,t}$ = total assets)

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(CU i in quarter t; $L_{i,t}$ = loan originations, R_t = 2-year Treasury yield, $A_{i,t}$ = total assets)

- **Estimation:** Two-Stage Least Squares
  - IV for asset losses w/ investment capital ($C_{i,t}$), Treasury rate w/ monetary surprises ($\Delta \widetilde{R}_t$)
  - **3 Endog. Regressors:** ΔR_{t-1}, $\Delta \ln A_{i,t-1}$, $(\Delta R_{t-1} \times \Delta \ln A_{i,t-1})$
  - **5 Instruments:**
    $\Delta \widetilde{R}_{t-1}$, $\Delta \ln C_{i,t-1}$, $\frac{C_{i,t-2}}{A_{i,t-2}}$, $\Delta \ln C_{i,t-1} \times \frac{C_{i,t-2}}{A_{i,t-2}}$, $\Delta \widetilde{R}_{t-1} \times \Delta \ln C_{i,t-1} \times \frac{C_{i,t-2}}{A_{i,t-2}}$

Econometric Specification

- Goal is to estimate:

$$\Delta \ln L_{i,t} = \beta_1 \Delta R_{t-1} + \beta_2 \Delta \ln A_{i,t-1} + \beta_3 \left(\Delta R_{t-1} \times \Delta \ln A_{i,t-1}\right) + \kappa_i + \tau \text{ Year}_t + \gamma \text{ Quarter}_t + X_{i,t} + \varepsilon_{i,t}$$

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- **Exclusion Restrictions:**
  - Investment capital only affects lending through CU assets
  - Monetary surprises only affect lending through changes in the Treasury rate

Outcome: Total Loan Originations

	TSLS			OLS
	(1)	(2)	(3)	(4)
ΔR_{t-1}	-0.86***	-0.95***	-0.95***	-0.11
	(0.31)	(0.35)	(0.36)	(0.08)
$\Delta \ln A_{i,t-1}$	1.94	1.93	1.47	0.11***
	(1.24)	(1.33)	(1.02)	(0.04)
$\Delta R_{t-1} \times \Delta \ln A_{i,t-1}$	0.18**	0.20**	0.19**	-0.01
	(0.08)	(0.09)	(0.08)	(0.01)
Obs.	166,932	163,775	163,401	163,401
CU Controls		✓	✓	✓
County Controls			✓	✓

Note: Outcomes and asset losses are in log points; coefficients on the policy rate give the effect of 10 BP change. SE's are two-way clustered by credit union and time. Regressions have year, quarter, and CU fixed effects. 10%*, 5%**, and 1%***.

▸ First Stage ▸ Weak IV and Overidentification Tests

Outcome: Mortgage Originations

	(1)	(2)	(3)
ΔR_{t-1}	-4.43***	-4.46***	-4.37**
	(1.58)	(1.69)	(1.73)
$\Delta \ln A_{i,t-1}$	3.24	3.58	3.95
	(4.16)	(4.12)	(3.39)
$\Delta R_{t-1} \times \Delta \ln A_{i,t-1}$	0.88**	0.89**	0.88**
	(0.35)	(0.36)	(0.38)
Obs.	70,886	69,767	69,726
CU Controls		✓	✓
County Controls			✓

Note: Outcomes and asset losses are in log points; coefficients on the policy rate give the effect of 10 BP change. SE's are two-way clustered by credit union and time. Regressions have year, quarter, and CU fixed effects. 10%*, 5%**, and 1%***.

Intensive vs. Extensive Margins (Total Lending)

	Number of Loans		Loan Size	
	(1)	(2)	(3)	(4)
ΔR_{t-1}	-0.32	-0.37	-0.69***	-0.67***
	(0.23)	(0.25)	(0.20)	(0.21)
$\Delta \ln A_{i,t-1}$	1.98**	1.30*	0.36	0.51
	(0.96)	(0.69)	(0.96)	(0.76)
$\Delta R_{t-1} \times \Delta \ln A_{i,t-1}$	0.13*	0.12**	0.09	0.08
	(0.07)	(0.06)	(0.06)	(0.06)
Obs.	150,317	147,163	150,317	147,163
CU Controls		✓		✓
County Controls		✓		✓

Note: Outcomes and asset losses are in log points; coefficients on the policy rate give the effect of 10 BP change. SE's are two-way clustered by credit union and time. Regressions have year, quarter, and CU fixed effects. 10%*, 5%**, and 1%***.

Intensive vs. Extensive Margins (Mortgage Lending)

	Number of Loans		Loan Size		Mortgage Share	
	(1)	(2)	(3)	(4)	(5)	(6)
ΔR_{t-1}	-4.34***	-4.36***	-0.19	-0.19	-2.80**	-2.83**
	(1.46)	(1.49)	(0.38)	(0.45)	(1.20)	(1.42)
$\Delta \ln A_{i,t-1}$	5.29*	5.12*	0.42	0.19	2.56	3.43
	(3.20)	(3.09)	(0.91)	(0.76)	(2.90)	(2.29)
$\Delta R_{t-1} \times \Delta \ln A_{i,t-1}$	0.90***	0.90***	0.06	0.06	0.63**	0.66**
	(0.31)	(0.31)	(0.09)	(0.10)	(0.26)	(0.30)
Obs.	70,575	69,903	70,602	69,453	70,844	69,692
CU Controls		✓		✓		✓
County Controls		✓		✓		✓

Note: Outcomes and asset losses are in log points; coefficients on the policy rate give the effect of 10 BP change. SE's are two-way clustered by credit union and time. Regressions have year, quarter, and CU fixed effects. 10%*, 5%**, and 1%***.

Robustness & Interpretation

- **Placebo Tests:**
  - Asset losses in 2008-2010 do not predict pre-crisis lending More
  - Asset losses in 2008-2010 do not explain policy rate sensitivity in 2001 recession More
- **Alternative Determinants of Sensitivity:**
  - Robust to including interactions of ΔR_{t-1} with controls More
- **Persistence:** Negative effect on lending of rate hikes and asset losses persist 1-2 years More

Conclusion

Summary & Policy Implications

- Document asset losses increase sensitivity of lending to monetary policy
  - Effect depends on nature of financial frictions facing lender
  - Consistent with easing alleviating frictions that impede lending
- Mechanics of monetary policy
  - Extra benefit of easing: reduces lending sensitivity to asset losses
  - Lending response is lumpy – easing ↑ lending along the extensive margin
  - Easing induces substitution towards mortgages
- Constraints on conventional policy may be extra costly in financial crises
- Implies conventional and unconventional policies like LSAPS are substitutes

Thanks!

Model 1: Lending Constraint

- Consider a monopolist bank/CU with a lending constraint who can borrow at the policy rate R:

$$\begin{aligned} \max_{L \geqslant 0} \quad & R^L L - RL \\ \text{s.t.} \quad & R^L = a - bL \quad \text{(inv. demand)} \\ & L \leqslant \bar{L}(B) \quad \text{(capacity constraint)} \end{aligned}$$

- Assume $\bar{L}(\cdot)$ is an increasing function
- Equilibrium credit supply:

$$L^*(R, B) = \min \left\{ \frac{a - R}{2b}, \bar{L}(B) \right\}$$

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Model 1: Lending Constraint

Lemma 1

In model 1, equilibrium loan supply $L^*(R, B) = \min\left\{\frac{a-R}{2b}, \bar{L}(B)\right\}$ *has increasing differences in* $(-R, B)$*:* $R' < R$ *and* $B' > B \Rightarrow$

$$\underbrace{L^*(R', B') - L^*(R, B')}_{\text{pass-thru with strong balance sheet}} \geqslant \underbrace{L^*(R', B) - L^*(R, B)}_{\text{pass-thru with weak balance sheet}} .$$

Intuition: lowering the policy rate isn't as helpful if a bad balance sheet constrains lending

Corollary: lending response to asset losses is stronger with low policy rate

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Model 2: External Finance Premium

- Monopolist bank/CU
  - Borrows from external creditors at $\tilde{R}$
  - Lends to households at rate R^L
- External creditors
  - Risk neutral
  - Own cost of capital given by policy rate R
  - Believe bank repays with Pr(repay lenders)$= 1 - \Delta(B)$, which is *increasing* in assets B
- No arbitrage pins down marginal cost of funds:

$$\tilde{R} = \frac{R}{1 - \Delta(B)}$$

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Model 2: External Finance Premium

- Bank/CU's problem:

$$\begin{aligned} \max_{L \geqslant 0} \quad & R^L L - \tilde{R} L \\ \text{s.t.} \quad & R^L = a - bL \quad \text{(inv. demand)} \\ & \tilde{R} = \frac{R}{1 - \Delta(B)} \quad \text{(no arb.)} \end{aligned}$$

- Assume $\Delta(\cdot)$ is a decreasing function
- Equilibrium credit supply:

$$L^*(R, B) = \frac{a - R[1 - \Delta(B)]^{-1}}{2b}$$

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Model 2: External Finance Premium

Lemma 2

In model 2, equilibrium loan supply $L^*(R, B) = \frac{a - R[1-\Delta(B)]^{-1}}{2b}$ *has decreasing differences in* $(-R, B)$*:* $R' < R$ *and* $B' > B \Rightarrow$

$$\underbrace{L^*(R', B) - L^*(R, B)}_{\text{pass-thru with weak balance sheet}} \geqslant \underbrace{L^*(R', B') - L^*(R, B')}_{\text{pass-thru with strong balance sheet}} .$$

Intuition: risk premiums magnify pass-thru of risk-free rate to effective cost of capital

Corollary: lending response to asset loss is weaker with low policy rate

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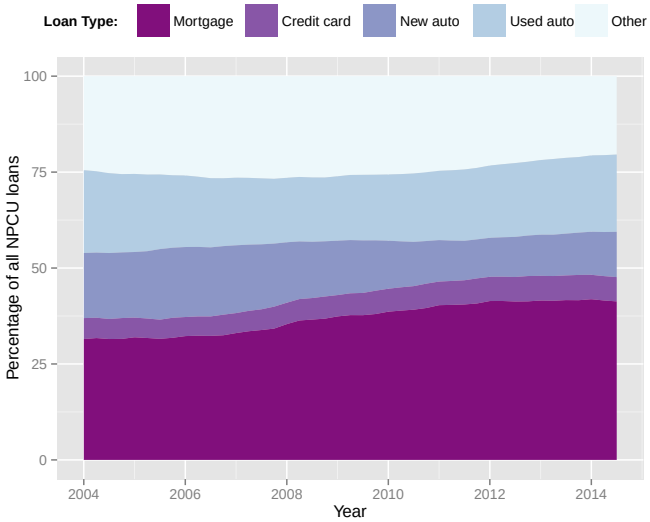
NPCU Lending Composition



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Identification: Asset Losses

- Concern: spurious time series correlation between investment capital losses and loan demand
- Mitigated by addition of year fixed effects
- 95 % of variation in $\Delta \ln C_{i,t} \times \frac{C_{i,t-2}}{A_{i,t-2}}$ is in the cross-section
- Significant cross-sectional heterogeneity during the crisis 2008 Map

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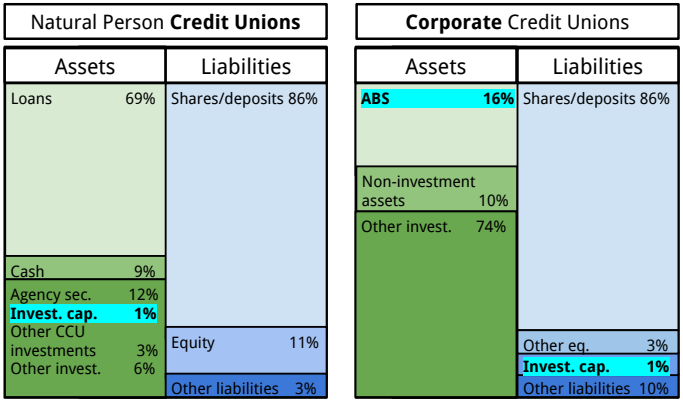
Investment Capital



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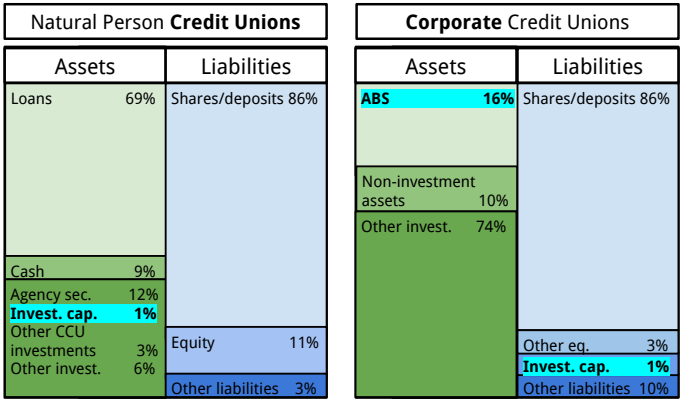

Variation in invest. capital comes from:

- CCU's ABS exposure
- CCU reliance on debt vs. equity
- NPCU's relative ownership

Investment capital subject to minimum duration requirements up to 20 years

Identifying assumption: losses plausibly exogenous w.r.t. credit demand

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Computation of Shocks

Futures spot price:

$$f_t = \frac{d}{M}\bar{R} + \frac{M-d}{M}\mathbb{E}_t\widehat{R}$$

As in Kuttner (2001), monetary surprises:

$$\mu_t = \mathbb{E}_t\widehat{R} - \mathbb{E}_{t-\Delta t}\widehat{R} = \frac{M}{M-d}(f_t - f_{t-\Delta t})$$

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First Stage

Dependent variable:	(1) ΔR_{t-1}	(2) $\Delta \ln A_{i,t-1}$	(3) $\Delta R_{t-1} \times \Delta \ln A_{i,t-1}$
$\Delta \widetilde{R}_{t-1}$	1.50***	-1.07	5.88***
	(0.46)	(0.81)	(1.54)
$\Delta \ln C_{i,t-1}$	-0.23*	0.12	-0.03
	(0.14)	(0.35)	(0.29)
$\frac{C_{i,t-2}}{A_{i,t-2}}$	0.14	8.65**	1.59
	(0.53)	(3.44)	(2.45)
$\frac{C_{i,t-2}}{A_{i,t-2}} \times \Delta \ln C_{i,t-1}$	-1.38	28.87***	11.60
	(2.22)	(7.97)	(15.99)
$\Delta \widetilde{R}_{t-1} \times \Delta \ln C_{i,t-1} \times \frac{C_{i,t-2}}{A_{i,t-2}}$	72.65	-421.57*	1073.26*
	(199.20)	(224.39)	(575.31)
R^2	0.60	0.24	0.18
F statistic	29.44	6.29	4.33
Observations	166,932	166,932	166,932

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Testing TSLS Assumptions

	Value	Null Hypothesis
Kleibergen-Paap LM Statistic	14.25***	H_0: under-identification (instruments
p-value	0.0026	uncorrelated with regressors)
Cragg-Donald Wald Statistic	12.28	H_0: weak identification (instruments
Kleibergen-Paaap Wald Statistic	5.26	weakly correlated with regressors)
Hansen J Statistic	1.04	H_0: *not* over-identified (instruments
p-value	0.5952	uncorrelated with error term, excluded instruments correctly excluded)

Note: The Stock and Yogo (2005) 5% critical value for Cragg-Donald statistic is 9.53. The null hypothesis associated with this statistic formally is that the maximal bias due to weak instruments exceeds 10%.

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OLS: Total Lending

	(1)	(2)	(3)	(4)
ΔR_{t-1}	-1.44	-1.12	-1.43	-1.1*
	(0.92)	(0.82)	(0.91)	(0.81)
$\Delta \ln A_{i,t-1}$	0.11***	0.11***	0.11***	0.11***
	(0.04)	(0.04)	(0.04)	(0.04)
$\Delta R_{t-1} \times \Delta \ln A_{i,t-1}$	-0.08	-0.09	-0.09	-0.1
	(0.07)	(0.07)	(0.07)	(0.07)
$\text{UR}_{i,t-2}$		-0.39**		-0.40**
		(0.16)		(0.16)
$\Delta \ln \text{ZHVI}_{t-1}$		21.85**		22.25**
		(9.55)		(9.62)
CU Controls		✓	✓	✓
Observations	166,932	163,775	166,553	163,401

Other Sensitivity Determinants

Dependent variable: Δ ln total loan originations YTD

	Coef.	SE	Coef. $\times \Delta R_{t-1}$	SE
ΔR_{t-1}	6.11	(4.01)		
$\Delta \ln A_{i,t-1}$	1.16	(0.86)	1.18*	(0.67)
Unemp. Rate$_{i,t-2}$	0.12	(0.25)	-1.11	(0.70)
Δ ln House Prices$_{i,t}$	9.23	(14.46)	-34.70	(24.34)
% Mortgage Delinq.$_{i,t-1}$	0.02	(0.15)	0.76**	(0.37)
ln members$_{i,t-1}$	-2.79	(1.76)	-1.87***	(0.50)
$\frac{\text{Net Worth}_{i,t-1}}{\text{Assets}_{i,t-1}}$	0.41	(0.35)	0.37***	(0.06)
$\Delta \ln \text{LLA}_{i,t-1}$	0.23	(0.31)	0.35	(1.23)
Observations				150,293

Note: Coefficients (and SE's) are multiplied by 100. SE's are two-way clustered by credit union and time. Year, quarter, and CU fixed effects are present in each regression. Statistical significance: 10%*, 5%**, and 1%***.

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Placebo Test

- Were CUs that experienced large investment capital losses systematically different? E.g., less risk averse?
- Relevant for exclusion restriction to hold
- Test if ABS-related losses during The Great Recession (*TGR*) explain pre-crisis (*PC*) lending:

$$\Delta \ln L_i^{PC} = \zeta \, \Delta \ln A_i^{TGR} + \lambda \, \text{County}_i + \phi \, \text{FOM}_i + \varepsilon_i$$

Note: I estimate the above for a variety windows defining *PC* and *TGR* for both total and mortgage lending (volume). Standard errors are clustered by state.

- Significant once at the 10% level in 1 out of 16 regressions; generally ζ is close to 0

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General Equilibrium

- "Global" GE: credit crunch amplified
- "Local" GE: What if people switch from CUs to banks?
  - Bank-level lending decreases $\Rightarrow$ decrease in loan originations within a county (Greenstone, Mas, and Nguyen, 2014)
  - Most households and firms live within 25 miles of their lender (Amel, Kennickel, and Moore, 2008; Brevoort, Holmes, and Wolken, 2010)
  - NPCU market share in auto and mortgage loans rose during 2006-2010

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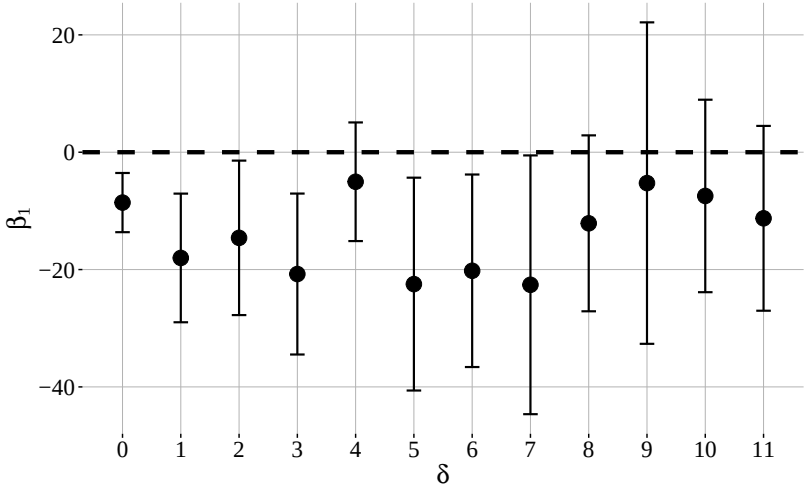
Policy Rate Coefficient



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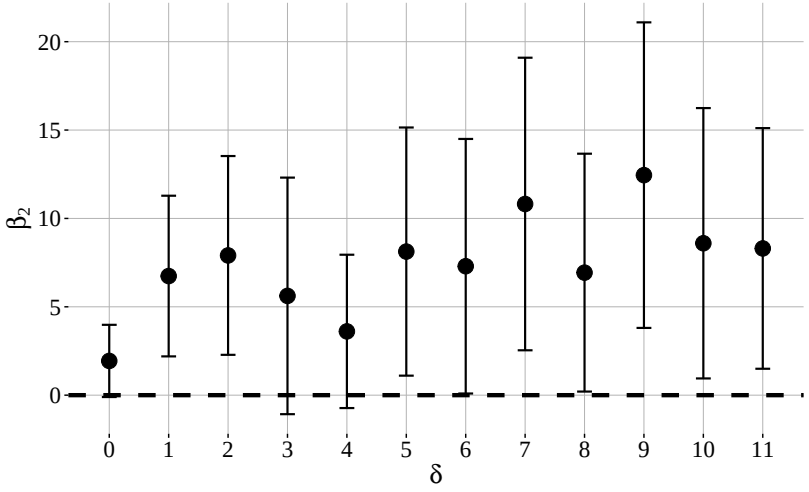
Asset Loss Coefficient



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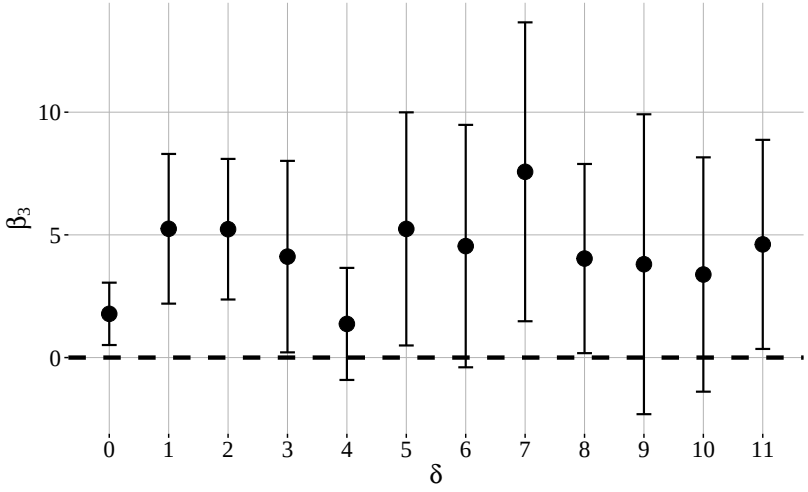
Interaction Coefficient



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