Bank Coordination and Monetary Transmission: Evidence from India

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Introduction

- Multiple banking can lead to coordination problems (Morris and Shin, 2004).
  - Key drivers of past recessions (Radelet and Sachs, 1998; Fischer, 1999; Bernanke, 2018).
- **Question:** How do coordination failures interact with monetary policy?
- Main findings:
  - Coordination problems amongst lenders dampen monetary transmission.
  - Dampening of transmission is larger when banks expect credit conditions to be tighter.
  - Transmission is less pronounced in more connected banks in multiple banking network.
- Evidence from Indian data on the price and quantity of loans supports these predictions.
- We find that this coordination channel can have large and persistent macroeconomic effects.
  - Reduces transmission by a third relative to standard NK model.

Model

SETUP

- We embed banks that feature lending complementarities in a standard NK model.
- Households, firms, and the monetary authority purposefully mimic that in the NK model.
- Novelty of our framework stems from commercial banks' behavior.
- Firms operate labor-intensive projects while banks finance capital-intensive projects.

Households

- Continuum of households of unit measure.

$$u(C_t, H_t) \equiv \frac{C_t^{1-\gamma}}{1-\gamma} - v\frac{H_t^{1+\varphi}}{1+\varphi}.$$

- Taking prices as given, households solve:

$$\begin{aligned} \max_{C_t, H_t, B_t} \quad & \mathbb{E}_t \sum_{\tau > 0} \beta^{\tau} u(C_{t+\tau}, H_{t+\tau}) \\ \text{s.t.} \quad & \int_0^1 P_t(i) C_t(i) di + B_t = R^h_{t-1} B_{t-1} + W_t H_t. \end{aligned}$$

- Households allocate their consumption expenditures among the different goods by solving

$$\min \int_0^1 P_t(i) C_t(i) di \quad \text{s.t.} \quad C_t = \Big(\int_0^1 C_t(i)^{1-1/\epsilon} di \Big)^{\frac{\epsilon}{\epsilon-1}}.$$

Firms

- Continuum of firms of unit measure.
- All firms have the same technology: $Y_t(i) = N_t(i)\ \forall i \in [0, 1]$.
- A fraction $\theta \in (0, 1)$ of firms are not allowed to reset prices: $P_t = P_{t-1}$
- For remaining firms, $P_t = P_t^\star$, which they solve for using:

$$\max_{P_t^\star} \mathbb{E}_t \sum_{\tau > 0} Q_{t,t+\tau}[P_t^\star - MC_{t+\tau}]Y_{t+\tau|t}$$

subject to the sequence of demand constraints:

$$Y_{t+\tau|t} = \left(\frac{P_t^\star}{P_{t+\tau}}\right) C_{t+\tau}\ \forall \tau \geq 0.$$

Banks

- There are $N < \infty$ banks.
- All banks pool resources to finance single capital-intensive project (relaxed later).
- Probability that the project is successful is given by

$$\mathbb{P}(\sum_{j \neq i} L_{j,t} + L_{i,t}) = (\sum_{j \neq i} L_{j,t} + L_{i,t})^{\mu}, \mu \in (0,1]$$

- Banks cannot observe loans offered by other members of the syndicate but instead observe only a noisy signal given by:

$$s_t = \sum_{j \neq i} L_{j,t} + \eta_t, \text{ where } \eta_t \sim \mathcal{N}(0, \sigma^2).$$

- The objective of bank i is

$$\mathbb{P}\big(\mathbb{E}_i[\sum_{j \neq i} L_{j,t} \mid s_t] + L_{i,t}\big) L_{i,t} R_{i,t} - c(L_{i,t}, R_t^{\star}).$$

where $c(.)$ is mult. increasing in L and $R^{\star}$, and convex in L; Special case: $\frac{L^2 R^{\star}}{2\alpha}$.

Monetary Authority

Standard Taylor Rule:

$$\frac{R_t^\star}{\bar{R}^\star} = \left(\frac{R_{t-1}^\star}{\bar{R}^\star}\right)^\rho \left\{ \left(\frac{\pi_t}{\bar{\pi}}\right)^{\phi^\pi} \left(\frac{Y_t}{\bar{Y}}\right)^{\phi^y} \right\}^{1-\rho} e^{\epsilon_t^p}$$

Market Clearing

- Goods market clearing: $Y_t(i) = C_t(i)$, $\forall i \in [0,1]$ $\forall t \geq 0$

$$\implies Y_t = C_t \quad \forall t \geq 0.$$

- Loanable funds market clearing:

$$L_t = B_t \quad \forall t \geq 0.$$

- Labor market clearing:

$$H_t = \int_0^1 N_t(i)di \quad \forall t \geq 0.$$

- If the no-default probability is close to unity, then

$$R_t^h = R_t \quad \forall t \geq 0.$$

General Equilibrium

- NK Phillips' Curve: $\hat{\pi}_t = \beta \mathbb{E}_t[\hat{\pi}_{t+1}] + \kappa \hat{y}_t$ where $\kappa = \frac{(1-\theta)(1-\theta\beta)}{\theta}(\gamma + \varphi)$.
- Dynamic IS Curve: $\hat{y}_t = \mathbb{E}_t[\hat{y}_{t+1}] - \frac{1}{\gamma}(\hat{r}_t - \mathbb{E}_t[\hat{\pi}_{t+1}])$.
- Monetary policy rule: $\hat{r}^\star_t = \rho \hat{r}^\star_{t-1} + (1-\rho)[\phi^\pi \hat{\pi}_t + \phi^y \hat{y}_t] + \epsilon^p_t$.

Proposition: Suppose savings is a fixed fraction of output and information is complete. Then in all symmetric uncoordinated lending equilibria:

$$\hat{r}_t - \hat{r}^\star_t = (1-\mu)\hat{y}_t.$$

$\Longrightarrow$ lending complementarities introduce a wedge b/w Δ in policy rates and Δ in lending rates, which dampens transmission to inflation and output.

Partial Equilibrium

- We assume a downward-sloping demand for loans, $L^D_{i,t}/R^{\omega}_i$, where $L^D_{i,t} > 0\ \forall i$ and $\omega > 0$.
- Equilibrium in the loanable funds market requires $L_{i,t}R^{\omega}_{i,t} = L^D_{i,t} \implies$ negative relationship between the supply of loans and lending rates.

Question: Does coordination affect monetary transmission?

- Given interest rates, $\{R_{i,t}, R^{\star}_t\}$, the collection $\{L_{i,t}\}$ of loans to capital-intensive projects is a *symmetric uncoordinated equilibrium* if it solves the banks' problem, and $L_{i,t} = L_{j,t}\ \forall i\ \forall j$. $\leftarrow$ denoted by L^{U}_t.
- Compare to *coordinated benchmark* in which banks finance the project collectively and equally share the return ex-post. $\leftarrow$ denoted by L^{C}_t.

Proposition: In all symmetric equilibria with complete information:

(i) $\delta_t \equiv \left|\frac{\partial L^{\mathrm{C}}_t}{\partial R^{\star}}\right| - \left|\frac{\partial L^{\mathrm{U}}_t}{\partial R^{\star}}\right| > 0,$

(ii) $\frac{\partial \delta_t}{\partial N} > 0.$

Partial Equilibrium

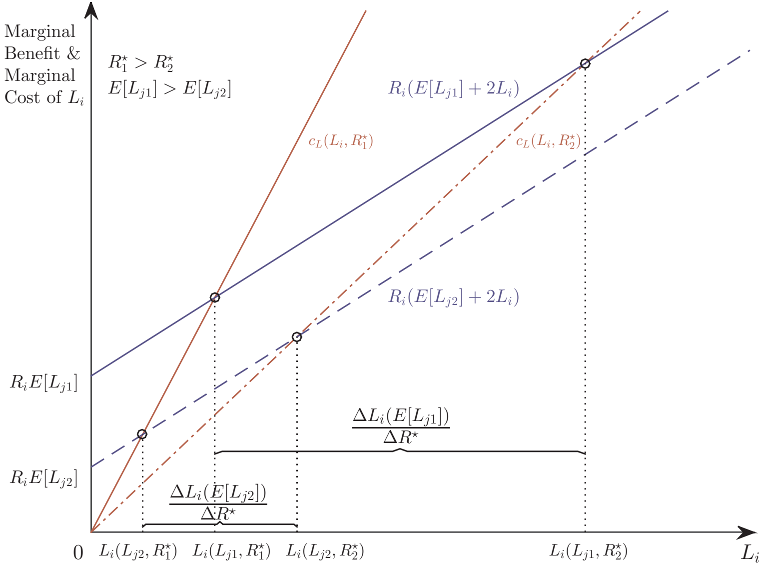
Question: Does information affect monetary transmission?

- Assume $N = 2$.

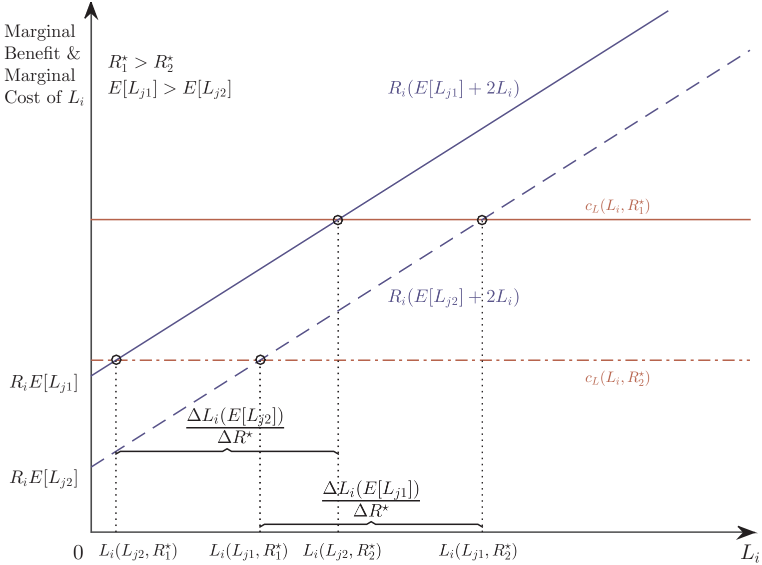
Proposition: Suppose $\mu = 1$ and information is incomplete. Then

$$
\begin{aligned}
&(i) && \frac{\partial L_{i,t}(L,\sigma)}{\partial R^\star} < 0 \;\forall (L,\sigma) \gg \mathbf{0} \;\forall t, \\
&(ii) && \left| \frac{\partial L_{i,t}(L,.)}{\partial R^\star} \right| > \left| \frac{\partial L_{i,t}(\tilde{L},.)}{\partial R^\star} \right| \forall L > \tilde{L} \;\forall t, \\
&(iii) && \left| \frac{\partial L_{i,t}(.,\sigma)}{\partial R^\star} \right| < \left| \frac{\partial L_{i,t}(.,\tilde{\sigma})}{\partial R^\star} \right| \forall \sigma > \tilde{\sigma} \;\forall t.
\end{aligned}
$$

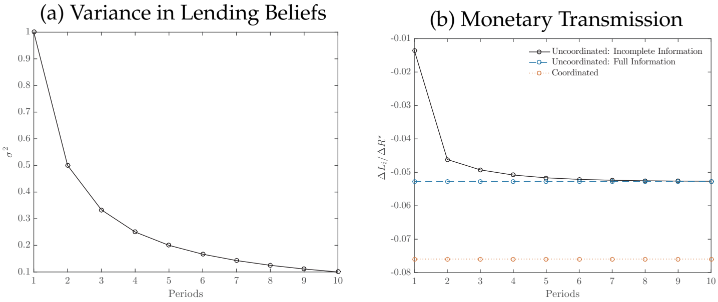
Dependence of Transmission on Lending Moments



What if lending costs were linear?



Effect of Coordination and Information on Transmission



Notes: The prior mean of lending of other banks in the incomplete information case is set to the full information level in the uncoordinated equilibrium. We assume unit variance in the noise. We compute the change in lending in response to a change in the policy rate from 1 percent to 2 percent. The lending rate is fixed at one for this exercise.

- Monetary transmission is highest in the coordinated equilibrium.
- Incomplete information in the uncoordinated equilibrium dampens monetary transmission.
    - This muted response of lending to a policy rate change persists for a few periods.

Decomposition of Network Effects

- Consider static setting where N banks finance M projects.
- Notation:
  - L_{ji}: bank i's loan for project j.
  - R_{ji}: return of bank i from project j
  - $\hat{R}_{ji} \equiv R_{ji} / R^{\star} \; \forall i \, \forall j$.

Proposition: Suppose $\mu = 1$. Then

$$\frac{dL_{ji}}{dR^{\star}} = \underbrace{\frac{\alpha \sum_{k \neq i} \frac{dL_{jk}}{dR^{\star}}}{\hat{R}_{ji}^{-1} - 2\alpha}}_{\text{Network Effect}} \underbrace{- \frac{\{\sum_{l=1}^{M} L_{li} + \hat{R}_{ji}^{-1} \sum_{l \neq j} \frac{dL_{li}}{dR^{\star}}\}}{\hat{R}_{ji}^{-1} - 2\alpha}}_{\text{Direct Effect}} \; \forall i \, \forall j.$$

- This first term on the RHS links monetary transmission in one bank to monetary transmission in other banks.

Transmission in Core vs. Periphery Banks

In the data, some banks are more connected than others.

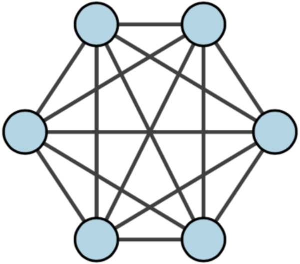
Question: Do differences in connectedness have different implications for monetary transmission?

Consider the following extension of the static baseline framework:

- $m > 1$ core banks connected to each other via a loan syndication.
- Each core bank serves as lead bank in a separate loan syndication with $n > 1$ periphery banks.
- Periphery banks bear a lower cost of loan provision than do core banks.
  - $\omega > 0$ captures the differential cost of loan provision between core and periphery banks.
  - Solution is indeterminate when $\omega = 0$.

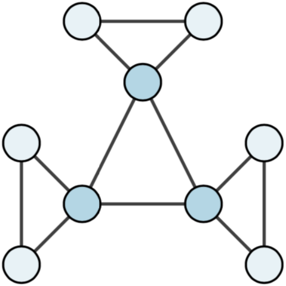
(a) **Baseline:** Mesh Network

(with $N = 6$)



(b) **Extension:** Core-periphery Network

(with $m = 3$ and $n = 2$)



Transmission in Core vs. Periphery Banks

Lemma: If $\mu = 1$, then optimal allocations in a symmetric uncoordinated lending equilibrium are given by:

$$\begin{aligned} L_{pp} &= \omega\left\{1 - \frac{R\alpha}{p}\left[1 + m\left(\frac{R^\star/R\alpha - 1}{R^\star/R\alpha - 2}\right)\right]\right\}^{-1}, \\ L_c &= L_{pp}\frac{m}{1+n-2\chi}, \\ L_p &= \chi L_c, \\ &\quad \text{where } \chi \equiv \frac{R\alpha[1+n]}{R^\star} - 1. \end{aligned}$$

Proposition: Suppose $\mu = 1$ and α is small enough. Then in all symmetric uncoordinated equilibria, the decrease in credit due to a monetary policy shock is larger in periphery banks than in core banks:

$$\min\left\{\frac{\partial(L_c + L_p)}{\partial R^\star}, 0\right\} > \frac{\partial L_{pp}}{\partial R^\star}.$$

Empirical Findings

DATA

Sources

- RBI: interest rates, deposit maturity profile, regulatory restrictions, breakdown of bank assets/liabilities
- CMIE: bank characteristics and multiple banking network linkages.
- MCA: size of secured loans to registered firms, bank characteristics, and firm identities

Sample Selection

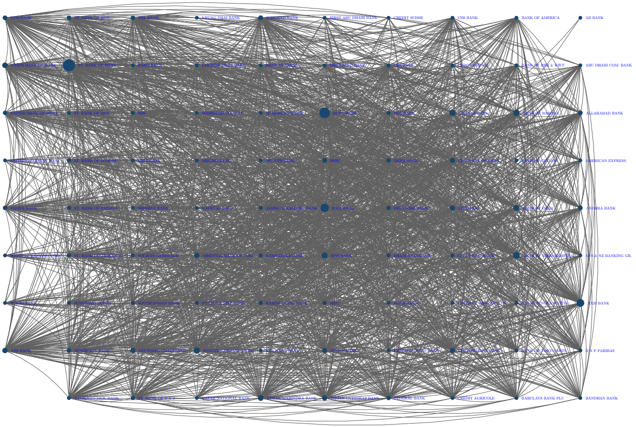
- Universe of public, private-domestic and private-foreign banks in India.
- 2016M6 (start of MCLR system) to 2020M2 (start of pandemic).

Measures

- Monetary transmission:
  - Regression coefficient on policy rate where outcome variable is the lending rate.
  - Credit spread (MT): lending rate - policy rate.
- Exposure to coordination channel: centrality of multiple banking network.

Multiple Banking Network in India

$$\boldsymbol{\mathcal{A}} = \begin{bmatrix} \mathcal{A}_{1,1} & \mathcal{A}_{1,2} & \cdots \\ \vdots & \ddots & \\ \mathcal{A}_{89,1} & & \mathcal{A}_{89,89} \end{bmatrix}, \text{ where } \quad \mathcal{A}_{i,j} = \begin{cases} \sum_{l=1}^{17{,}761} \mathbb{1}_{L_{li}>0, L_{lj}>0} & \text{if } i \neq j \\ 0 & \text{if } i = j \end{cases}.$$



IDENTIFICATION

Determinacy:

- Models featuring strategic complementaries can lead to multiple equilibria.

Proposition: Under contemporaneous data interest rate rules, a necessary and sufficient condition for uniqueness is $\kappa(\phi^{\pi} - 1) + (1 - \beta)(\phi^{y} + 1 - \mu) > 0$.

Fixed Effects:

- Bank FE absorb cross-sectional differences in the way banks respond to monetary shocks (Kashyap and Stein, 2000; Bhaumik et al., 2011; Cetorelli and Goldberg, 2012; Jimenez et al., 2012; Ioannidou et al., 2015; Dell'Ariccia et al., 2017; Acharya et al., 2020)
- Time FE absorb all observed and unobserved changes in aggregate demand.

Borrower-specific risk:

- Credit rationing could confound estimates.
- We focus on the MCLR instead of WALR, which does not include the premium charged by banks on lending to risky borrowers.

Hypothesis 1

Hypothesis 1: Monetary transmission is less pronounced in more connected banks.

- Multiple banking relationships in India exhibit a core-periphery architecture.
- Our theory predicts that the coordination channel should be more pronounced in the densely connected core relative to the sparsely connected periphery.
- We identify core and periphery banks using a k-shell decomposition
  $\Longrightarrow$ 47 core banks (with eigenvector centrality of 0.15) and 42 periphery banks.
- To test for differential interest rate pass-through according to connectedness, we use a difference-in-differences strategy:

$$MCLR_{i,t} = \beta_1 REPO_t \times \mathcal{C}_i + \boldsymbol{\beta_2 B}_{i,t} + \xi_i + \Xi_t + \epsilon_{i,t}. \tag{1}$$

- Hypothesis 1 is

$$\beta_1 = \left.\frac{\partial MCLR_{i,t}}{\partial REPO_t}\right|_{\text{High } \mathcal{C}_i} - \left.\frac{\partial MCLR_{i,t}}{\partial REPO_t}\right|_{\text{Low } \mathcal{C}_i} < 0.$$

Table: Effect of Connectedness on Monetary Transmission

	(1)	(2)	(3)	(4)	(5)	(6)
Connectedness Measure ($\mathcal{C}_i$)	Degree Centrality		Eigen. Centrality		Core Indicator	
Panel A: Levels						
$REPO \times \mathcal{C}$	-0.306*	-0.285*	-0.297*	-0.278*	-0.249***	-0.255***
	(0.155)	(0.161)	(0.160)	(0.166)	(0.0765)	(0.0787)
Observations	3664	3558	3664	3558	3664	3558
R^2	0.840	0.838	0.840	0.838	0.842	0.840
Panel B: First Differences						
$\Delta REPO \times \mathcal{C}$	-0.232*	-0.242*	-0.239*	-0.245*	-0.160**	-0.178**
	(0.136)	(0.138)	(0.137)	(0.139)	(0.0759)	(0.0784)
Observations	3575	3473	3575	3473	3575	3473
R^2	0.132	0.134	0.132	0.134	0.132	0.135
Bank FE	Y	Y	Y	Y	Y	Y
Month FE	Y	Y	Y	Y	Y	Y
Bank Level Controls	N	Y	N	Y	N	Y

Hypothesis 2: Interest rate pass-through is lower when the mean and dispersion of the price of external credit are higher.

$$MCLR_{i,t} = \beta_1 REPO_t \times \mathcal{C}_i \times \bar{R}_{j\neq i,t} + \beta_2 REPO_t \times \mathcal{C}_i \times \sigma(R)_{j\neq i,t} + \boldsymbol{\beta}_3 \boldsymbol{B}_{i,t} + \xi_i + \Xi_t + \epsilon_{i,t}.$$

	(1)	(2)	(3)	(4)	(5)	(6)
Connectedness Measure ($\mathcal{C}_i$)	Degree Centrality		Eigen. Centrality		Core Indicator	
Panel A: Levels						
$REPO \times \mathcal{C} \times$ LR Mean	-0.0307**	-0.0288**	-0.0307**	-0.0288**	-0.0201***	-0.0204***
	(0.0135)	(0.0139)	(0.0139)	(0.0144)	(0.00664)	(0.00681)
$REPO \times \mathcal{C} \times$ LR SD	0.496**	0.478**	0.512**	0.497**	0.203***	0.196***
	(0.207)	(0.209)	(0.223)	(0.224)	(0.0690)	(0.0712)
Observations	3664	3558	3664	3558	3664	3558
R^2	0.842	0.840	0.843	0.840	0.842	0.840
Bank FE	Y	Y	Y	Y	Y	Y
Month FE	Y	Y	Y	Y	Y	Y
Bank Level Controls	N	Y	N	Y	N	Y

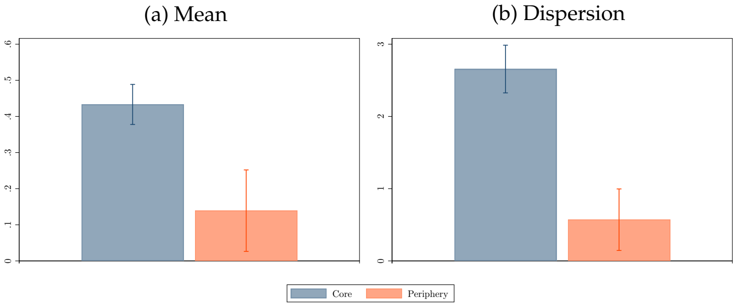
Hypothesis 2

- In the absence of lending complementarities, credit spreads should be constant and neutral to changes in external credit conditions.

$$MCLR_{i,t} - REPO_t = \alpha + \beta_1 \mathcal{C}_i \times \bar{R}_{j \neq i,t} + \beta_2 \mathcal{C}_i \times \sigma(R)_{j \neq i,t} + \boldsymbol{\beta}_3 \boldsymbol{X}_t + \boldsymbol{\beta}_4 \boldsymbol{B}_{i,t} + \xi_i + \xi_i t + \epsilon_{i,t}.$$

	(1)	(2)	(3)	(4)	(5)	(6)
Connectedness Measure ($\mathcal{C}_i$)	Extensive Margin		Degree Centrality		Eigen. Centrality	
$\mathcal{C}\times$ LR Mean	0.345***	0.255***	0.456***	0.304***	0.433***	0.287***
	(0.0558)	(0.0691)	(0.0612)	(0.0756)	(0.0573)	(0.0720)
$\mathcal{C}\times$ LR SD	2.285***	1.927***	2.990***	2.715***	2.745***	2.510***
	(0.203)	(0.234)	(0.225)	(0.251)	(0.213)	(0.240)
Observations	3901	3705	3664	3476	3664	3476
R^2	0.758	0.762	0.763	0.772	0.763	0.772
Bank FE	Y	Y	Y	Y	Y	Y
Bank-specific Time Trends	Y	Y	Y	Y	Y	Y
Aggregate Controls	N	Y	N	Y	N	Y
Bank Level Controls	N	Y	N	Y	N	Y

- Impact of external credit conditions on credit spread is larger in core banks



Hypothesis 3: A bank's lending to a project responds more to monetary policy shocks when other banks lend more to that project.

$$L_{i,k,t} = \beta_1 REPO_t \times \sum_{j \neq i} L_{j,k,t} + \boldsymbol{\beta_2 B}_{i,t} + \xi_i + \xi_i t + f_{k,t} + g_{i,k} + \epsilon_{i,k,t},$$

- At bank (i)-firm (k)–month (t) level.
- Firm-by-month fixed effects ($f_{k,t}$) absorb variations in borrower risk and time-dependent confounders.
- Bank-by-firm fixed effects ($g_{i,k}$) absorb variations in credit relationships.

	(1)	(2)	(3)	(4)
REPO × Total Loans to Firm by Other Banks	-0.139***	-0.139***	-0.139***	-0.139***
	(0.0158)	(0.0158)	(0.00471)	(0.00469)
Firm FE	Y	Y	Y	Y
Bank FE	Y	Y	Y	Y
Month FE	Y	Y	Y	Y
Bank-specific TT	Y	Y	Y	Y
Firm x Bank FE	Y	Y	Y	Y
Firm x Month FE	Y	Y	Y	Y
Bank Level Controls	N	Y	N	Y
Observations	150143	148969	13295	13183

Dynamic Effects

- Following Holtz-Eakin et al. (1988) and Canova and Ciccarelli (2013), we also use a panel vector autoregression (PVAR):

$$\boldsymbol{Y}_{i,t} = \boldsymbol{Y}_{i,t-1}\boldsymbol{\beta}_1 + \boldsymbol{X}_{i,t}\boldsymbol{\beta}_2 + \boldsymbol{\xi}_i + \boldsymbol{e}_{i,t}, \text{ where}$$

$$\boldsymbol{Y}_{i,t} = [\Delta MCLR_{i,t}, \Delta REPO_t, \Delta REPO_t \times \bar{R}_{i\neq j,t}, \Delta REPO_t \times \sigma(R)_{i\neq j,t}]'.$$

- Allows us to simultaneously capture:
  - Dynamic interdependencies across interest rates
  - Cross-sectional heterogeneity across banks
  - Evolving pattern of monetary transmission

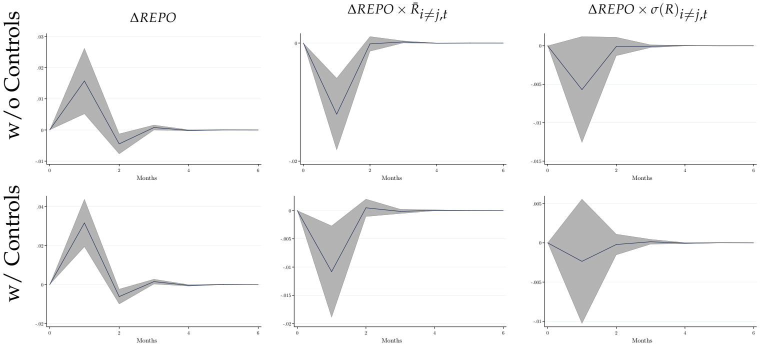


Figure: PVAR Impulse Responses of $\Delta MCLR$ w/ Lending Rate Moment Interactions

Measuring Network Effects

$$\Delta \boldsymbol{MCLR}_t = \zeta \boldsymbol{\mathcal{A}}\, \Delta \boldsymbol{MCLR}_t + \boldsymbol{\beta}\, \Delta \boldsymbol{REPO}_t + \boldsymbol{\mu} + \boldsymbol{\epsilon}_t \implies \Delta \boldsymbol{MCLR} = S(\boldsymbol{\mathcal{A}})\boldsymbol{\beta}\, \Delta \boldsymbol{REPO} + S(\boldsymbol{\mathcal{A}})(\boldsymbol{\mu} + \epsilon),$$

where $S(\boldsymbol{\mathcal{A}}) = (\boldsymbol{I}_N - \zeta \boldsymbol{\mathcal{A}})^{-1}$. The diagonal elements of $S(\boldsymbol{\mathcal{A}})$ capture the direct effects, and the off-diagonal elements capture the network effects.

	$\Delta MCLR$	$\Delta MCLR$	$\Delta MCLR$	$\Delta MCLR$
$\Delta REPO$	0.102^{***}	0.101^{***}	0.0804^{**}	0.0808^{**}
	(0.0301)	(0.0300)	(0.0323)	(0.0322)
ζ	0.648^{***}	0.650^{***}	0.622^{***}	0.623^{***}
	(0.0329)	(0.0328)	(0.0346)	(0.0346)
Direct Effect	0.105^{***}	0.105^{***}	0.0829^{**}	0.0833^{**}
	(0.0314)	(0.0313)	(0.0337)	(0.0336)
Network Effect	0.187^{***}	0.185^{***}	0.133^{**}	0.131^{**}
	(0.0566)	(0.0557)	(0.0560)	(0.0537)
Total Effect	0.292^{***}	0.290^{***}	0.216^{**}	0.215^{**}
	(0.0857)	(0.0848)	(0.0882)	(0.0857)
Estimator	RE	FE	RE	FE
Deposit Maturity Controls	N	N	Y	Y
Monetary Stance Controls	N	N	Y	Y
SLR Controls	N	N	Y	Y
Bank Level Controls	N	N	Y	Y
Observations	3053	3053	3053	3053

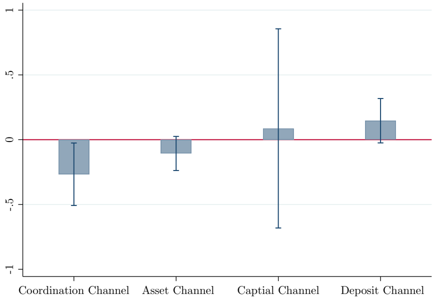
- Network effects are about twice as large as direct effects.

Alternate Mechanisms

Three alternate bank balance sheet channels emphasized in literature:

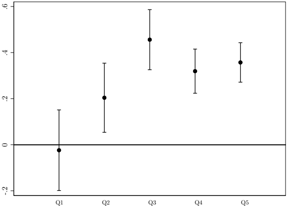
- Assets channel (Kashyap and Stein, 1995)
- Capital channel (Kashyap and Stein, 2000; ...)
- Deposits channel (Drechsler et al., 2017)

$$MCLR_{i,t} = REPO_t \times [\beta_1 \mathcal{C}_i + \beta_2 A_{i,t} + \beta_3 CA_{i,t} + \beta_4 D_{i,t}] + \boldsymbol{\beta_5 B}_{i,t} + \xi_i + \Xi_t + \epsilon_{i,t}$$

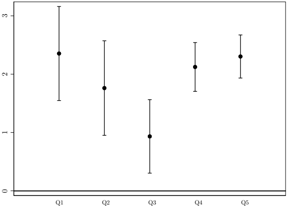


- No systematic patterns or differences in lending moment interactions across bins by size or Lerner index.

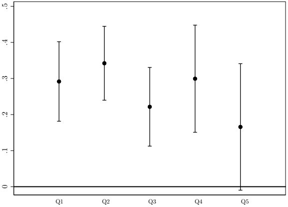
(a) Mean Effects across Asset Quintiles



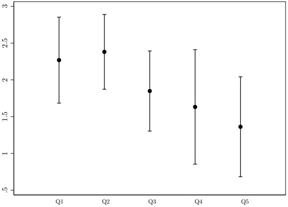
(b) Dispersion Effects across Asset Quintiles



(c) Mean Effects across LI Quintiles



(d) Dispersion Effects across LI Quintiles



Quantitative Results

Quantifying the Effect of Coordination Failures

Question: How important is the coordination channel relative to the traditional interest rate channel of monetary policy?

Parameterization

1. Set β and ρ^p independently of equilibrium conditions.
2. Externally estimate the Taylor rule coefficients, $\{\phi^\pi, \phi^y\}$, using OLS.
3. Internally estimate the deep parameters of the model, $\{\gamma, \varphi, \theta, \mu, \epsilon^p\}$, using Bayesian techniques.
4. Use mean of estimated parameters in NK model and those in model featuring lending complementarities (NK-LC) to remain agnostic about underlying DGP.

Details

- NK-LC model fits data better in terms of implied volatilities of inflation & output.

Table: Standard Deviation of Simulated Variables vs. Data

	Data	NK Model	NK-LC Model
Inflation ($\hat{\pi}$)	0.007	0.009	0.006
Output ($\hat{y}$)	0.04	0.07	0.05

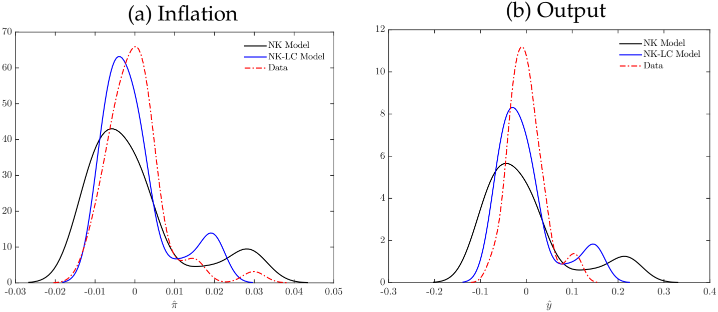


Figure: Distributions of Inflation and Output: Model(s) vs. Data

- Lending complementarities reduce monetary transmission to inflation & output by about a third under the baseline calibration.

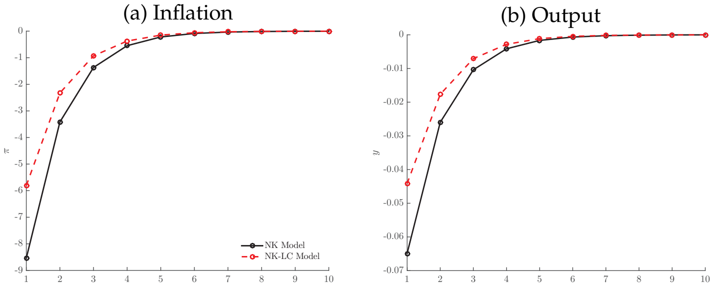


Figure: Impulse Responses to Monetary Policy Shock

Notes: The scale on the y-axis in plot (a) is 10^{-3}.

Counterfactual Experiments

Baseline estimate for dampening of transmission ($\mathcal{D}$) due to coordination failures is 32%.

- Price Inertia
  - Reducing fraction of firms that cannot alter prices from 0.81 to 0.5 reduces $\mathcal{D}$ to 18%.
- Risk Aversion
  - Increasing the coefficient of relative risk aversion from 1.1 to 2 reduces $\mathcal{D}$ to 23%.
- Taylor Rule
  - Endogenous policy responses cushion output deviations from steady state.
  - Raising coefficient on output from 0.4 to 1 reduces $\mathcal{D}$ to 24%.
  - Raising coefficient on inflation from 1.4 to 3 reduces $\mathcal{D}$ to 29%.

Conclusion

- We propose and test a new channel of monetary policy.
- We show that lack of coordination in multiple banking relationships dampens monetary transmission.
- When credit is uncoordinated, informational frictions reduce monetary transmission further.
- Our analysis highlights a tradeoff between financial stability and macroeconomic stability.