Bank Loan Reliance and Inflation Inattention [1]

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[1] The views expressed here should not be interpreted as representing the views of the Bank of Italy or any other institution with which the authors are affiliated.

Motivation

- Monetary policy targeting at firm's inflation expectations: understand inflation expectation formation of firms
- Dispersed firms' inflation expectation revealed by the survey: limited evidence on driving forces
- **Financing composition is an important determinant for firms' inflation attentiveness and expectation formation**
- Main mechanism: inflation (indicator for credit condition) affects firms' decisions on when and how to get financing

This paper

- **Italian firms: heavily reliant on bank loans**
  corporate bond to total financial debt ratio: 9.8%

- **Casual evidence on how financing composition affects inflation attentiveness**
  - ↑ Loan reliance ⇒ ↑ inflation forecast accuracy
  - ↑ Loan reliance ⇒ ↓ response to provided public-available news

- **A partial equilibrium model with rational inattention**
  - Firms: endogenous financing composition + costly information
  - Economy: ↑ inflation ⇒ ↑ policy rate, higher input price for banks + (sticky price) ⇒ relatively cheaper bank loan

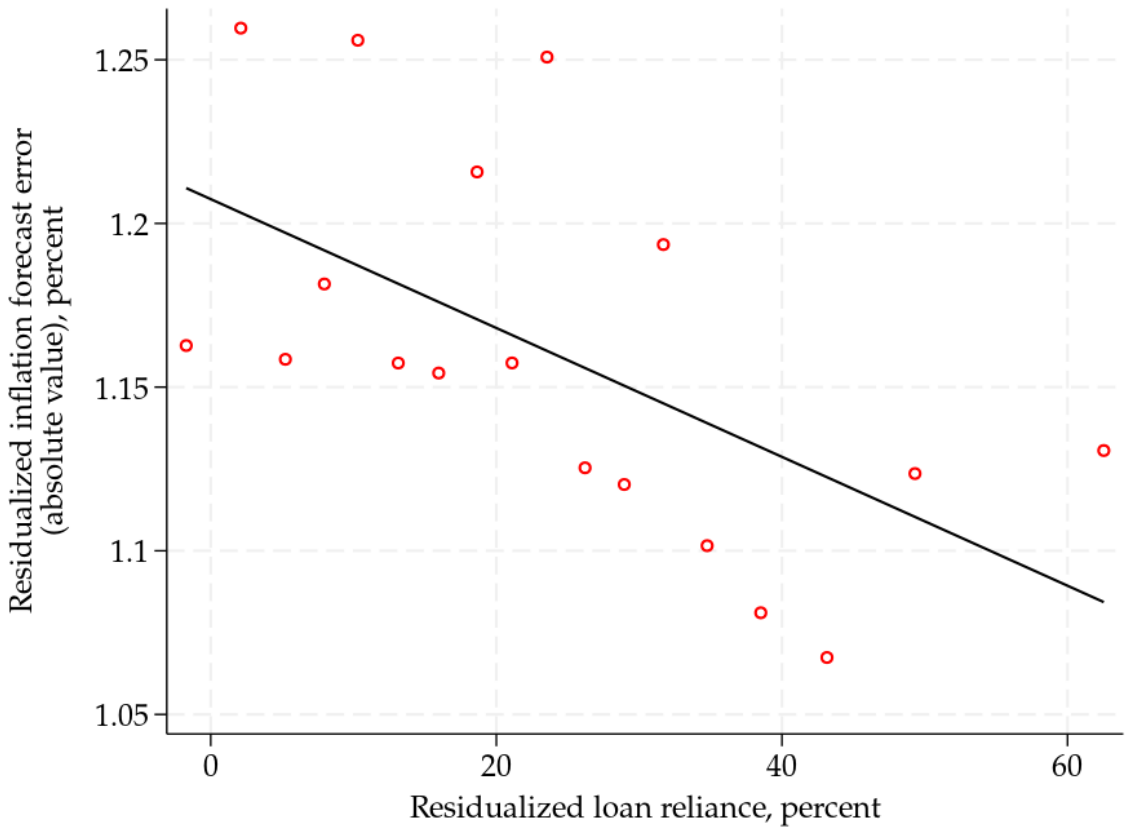
  Mechanism:
  ↑ Loan reliance ⇒ ↑ sensitivity to inflation (financing cost) ⇒ ↑ incentive to acquire information ⇒ better & broader information set

Data and measurement

- Data (2006 - 2019)
  - Survey of Inflation and Growth Expectations (SIGE): **inflation expectations**, RCT (2013Q1)
  - Central Credit Registry (CCR): **credit position** reported by banks and financial institutions
  - Analytical Survey of Interest Rates (TAXIA): **loan interest rates**
  - Company Accounts Data Service (CADS): firm-level **balance sheet**

- Measures
  1. Bank credit reliance: $\text{Loan Reliance}_{j,t} = \frac{\sum_{i \in \text{banks}} \text{Term Loan}_{i,j,t}}{\text{Asset}_{j,t}}$ plot
  2. Inflation (in)attention: $\text{Attention}_{j,t}^{(\pi)} \equiv \left| \pi_t^{(12m)} - F_j \pi_t^{(12m)} \right|$ plot

Binned scatter plot: loan reliance and inflation inattention



OLS and 2SLS

1. **Benchmark regression**

$$\text{Attention}_{j,t}^{(\pi)} = \beta \text{ Loan Reliance}_{j,t} + \epsilon_{j,t}$$

2. **A Bartik instrument for loan reliance**

$$\bar{\delta}_{j,t} = \sum_{i \in \text{banks}} \underbrace{\frac{\text{Term Loan}_{i,j,t-1}}{\sum_{i \in \text{banks}} \text{Term Loan}_{i,j,t-1}}}_{\textit{Exposure}_{i,j,t-1}} \hat{\delta}_{i,t}$$

- $\textit{Exposure}_{i,j,t-1}$: exposure of firm j to bank i
- $\hat{\delta}_{i,t}$: credit supply shock in bank i at time t (Khwaja and Mian 2008)

$$R_{i,j,t}^{b} - R_{t}^{s} = \delta_{i,t} + \lambda_{j,t} + \epsilon_{i,j,t}$$

Empirical evidence

OLS: reverse causality (better information leads to adjustments in financing composition), omitted variable, $\cdots$

	Dependent variable: Attention$_{j,t}^{(\pi)}$					
	2SLS					OLS
	(1)	(2)	(3)	(4)	(5)	(6)
Loan Reliance	-0.121**	-0.120**	-0.101**	-0.116**	-0.0998**	-0.00206
	(0.0562)	(0.0553)	(0.0467)	(0.0523)	(0.0459)	(0.00128)
log(employees)		0.293*			0.231*	
		(0.151)			(0.117)	
ROE			-0.00385***		-0.00357***	
			(0.00131)		(0.00128)	
Liquid asset ratio				-0.0182***	-0.0163***	
				(0.00568)	(0.00548)	
Observations	16,886	16,886	15,467	15,885	15,282	16,886
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
RCT FE	Yes	Yes	Yes	Yes	Yes	Yes
1st stage F stat	13.33	13.68	16.07	14.76	16.67	
1st stage coeffi.	-0.0540	-0.0550	-0.0660	-0.0580	-0.0660	

Empirical evidence: RCT

- Randomized control trial ▸ Question
  - Treatment: information on current inflation ($\mathbb{I}_j = 1$)
  - Prior: one-year ahead inflation forecast in last quarter
  - Posterior: one-year ahead inflation forecast in this quarter

- Empirical design

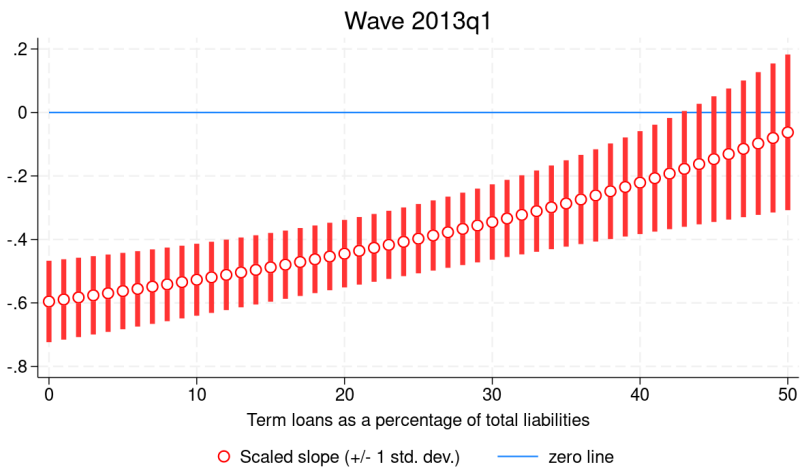
$$\text{posterior}_j = \alpha_1 \times \text{prior}_j + \alpha_2 \times \text{Loan Reliance}_j \times \text{prior}_j + \gamma_1 \times \mathbb{I}_j \times \text{prior}_j + \gamma_2 \times \mathbb{I}_j \times \text{Loan Reliance}_j \times \text{prior}_j + \cdots + \epsilon_j.$$

Changes in the prior-posterior relationship of the treated group:

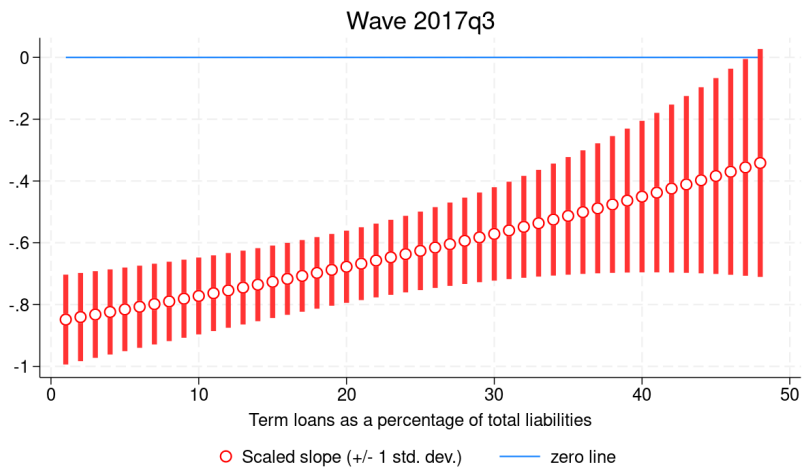
$$\frac{\hat{\gamma}_1 + \hat{\gamma}_2 \text{Loan Reliance}}{\hat{\alpha}_1 + \hat{\alpha}_2 \text{Loan Reliance}}$$

Empirical evidence: RCT

- $\hat{\gamma} < 0$: treatment group places less weight on their priors and more weight on the information received in the treatment
- High loan reliance firms respond less: not news, already in the information set!



(a) First RCT



(b) Reshuffling

Model - firms

- Two-stage problem
  1. Minimize financing cost: a combination of interval funds & bank loans

$$\mathbf{FC_{j,t}} \equiv \min_{\Gamma^I_{j,t},\Gamma^E_{j,t}} \Gamma^I_{j,t} + \frac{R^b_{j,t}}{R^s_t}\Gamma^E_{j,t}, \text{ where: } \frac{R^b_{j,t}}{R^s_t} = \Phi_j \mathcal{F}(\pi_t)$$

  2. Maximize profits: optimal investment rate

$$\max_{\frac{I_{j,t}}{K_{j,t}}} \sum_t^\infty \beta^t \mathbb{E}_t \left\{ AK_{j,t} - \mathbf{FC_{j,t}} \left[\frac{I_{j,t}}{K_{j,t-1}} + \frac{\varphi_k}{2}\left(\frac{I_{j,t}}{K_{j,t-1}} - \delta \right)^2 \right] K_{j,t-1} \right\}$$

- Why do firms care about inflation? $\underbrace{\pi_t \Rightarrow \mathcal{F}(\pi_t)}_{\text{Banking market}} \Rightarrow \frac{I_{j,t}}{K_{j,t}}$

▸ $\Phi_{j,t}$: micro-foundation

Model - banks

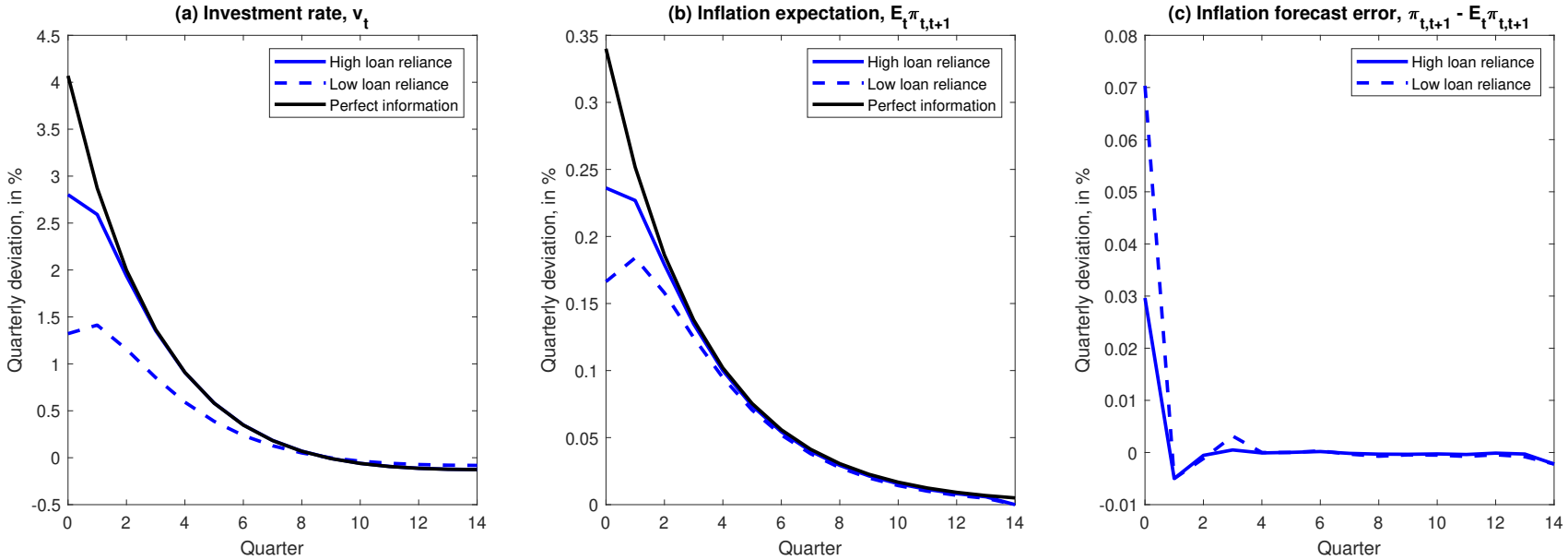
- Input: deposits (R_t^s)
- Output: bank loans (R_t^b)
- Loan market: monopolistic competitive & Calvo price stickiness
- Monetary authority: Policy rate $= R_t^s = R^s \left(\frac{\Pi_t}{\Pi}\right)^{\tau_\pi}$

Channel:

$$\epsilon_t \underbrace{\Longrightarrow}_{①} R_t^s \underbrace{\Longrightarrow}_{②} R_{i,t}^{b,*} \Longrightarrow \frac{R_{j,t}^b}{R_t^s}$$

1. Exogenous inflation shocks trigger increases in the policy rate by the monetary authority
2. Higher policy rate leads to higher operational costs to banks, affecting loan interest rate and markup

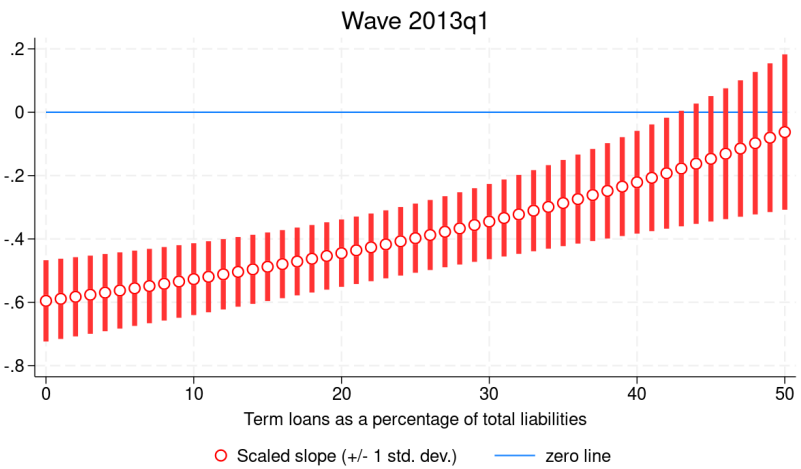
Implication - IRFs: positive inflation shock



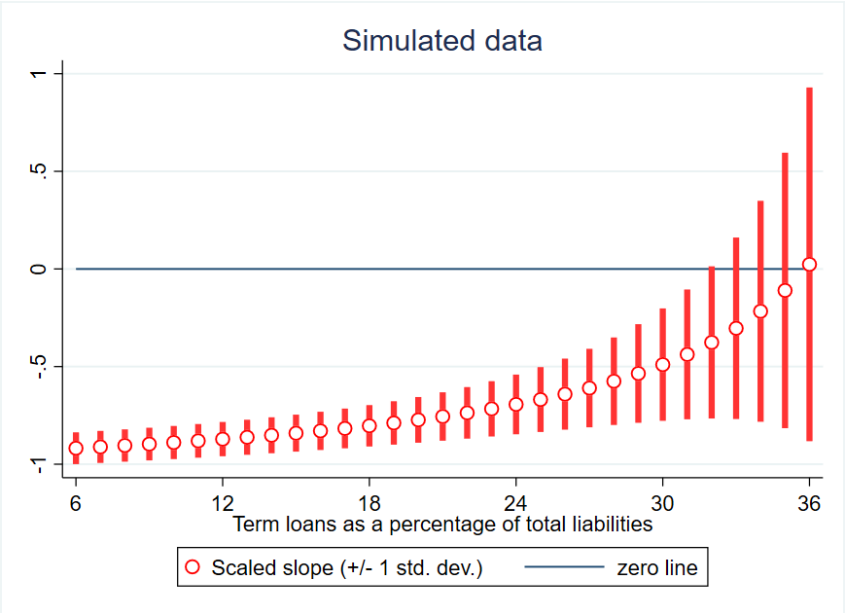
Notes: The figures display the impulse response functions to 1 positive standard deviation shock in (0.0034) $\epsilon_{\pi,t}$, which increases the annualized inflation by 1.35%. The autoregressive coefficient of the inflation process is 0.74. The solid (dashed) blue line is under the parameter values with an average loan reliance of 24% (11%).

Implication - replicate RCT

1. Simulated firms with loan reliance matching the empirical distribution
2. RCT: one-time increase in signal precision



(c) First RCT



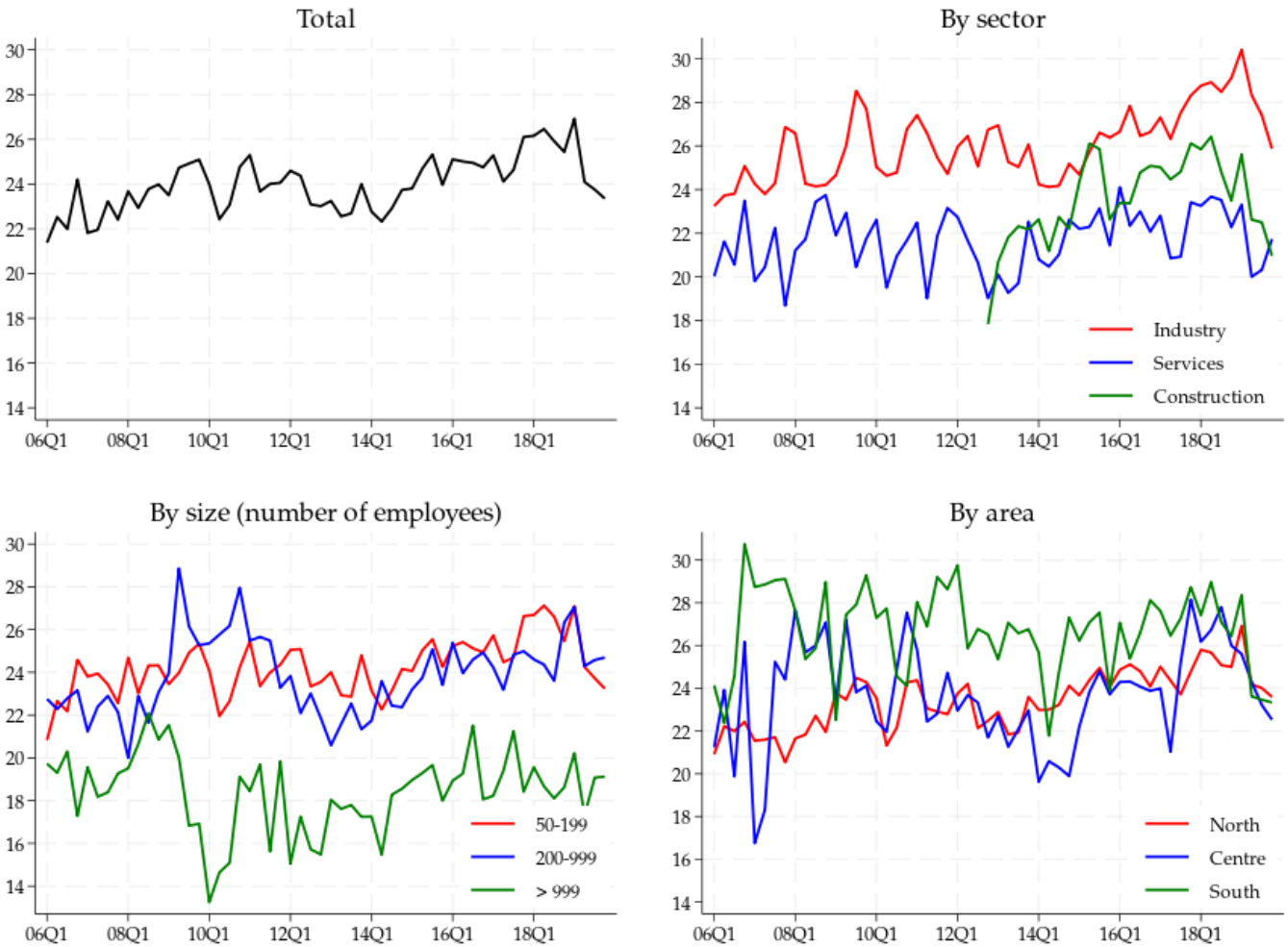
(d) Model implied

Conclusion

1. Financing composition as an important determinant for firms' inflation expectations (suggestive evidence for rational inattention theory)
   - Incentive to acquire information
   - How firms learn from new information

2. An analytical model featuring endogenous financing composition and attention allocation
   - Explain the inflation-financing-cost channel
   - Replicate the RCT results
   - Interesting implications: effectiveness of monetary policy

A.1: Loan reliance



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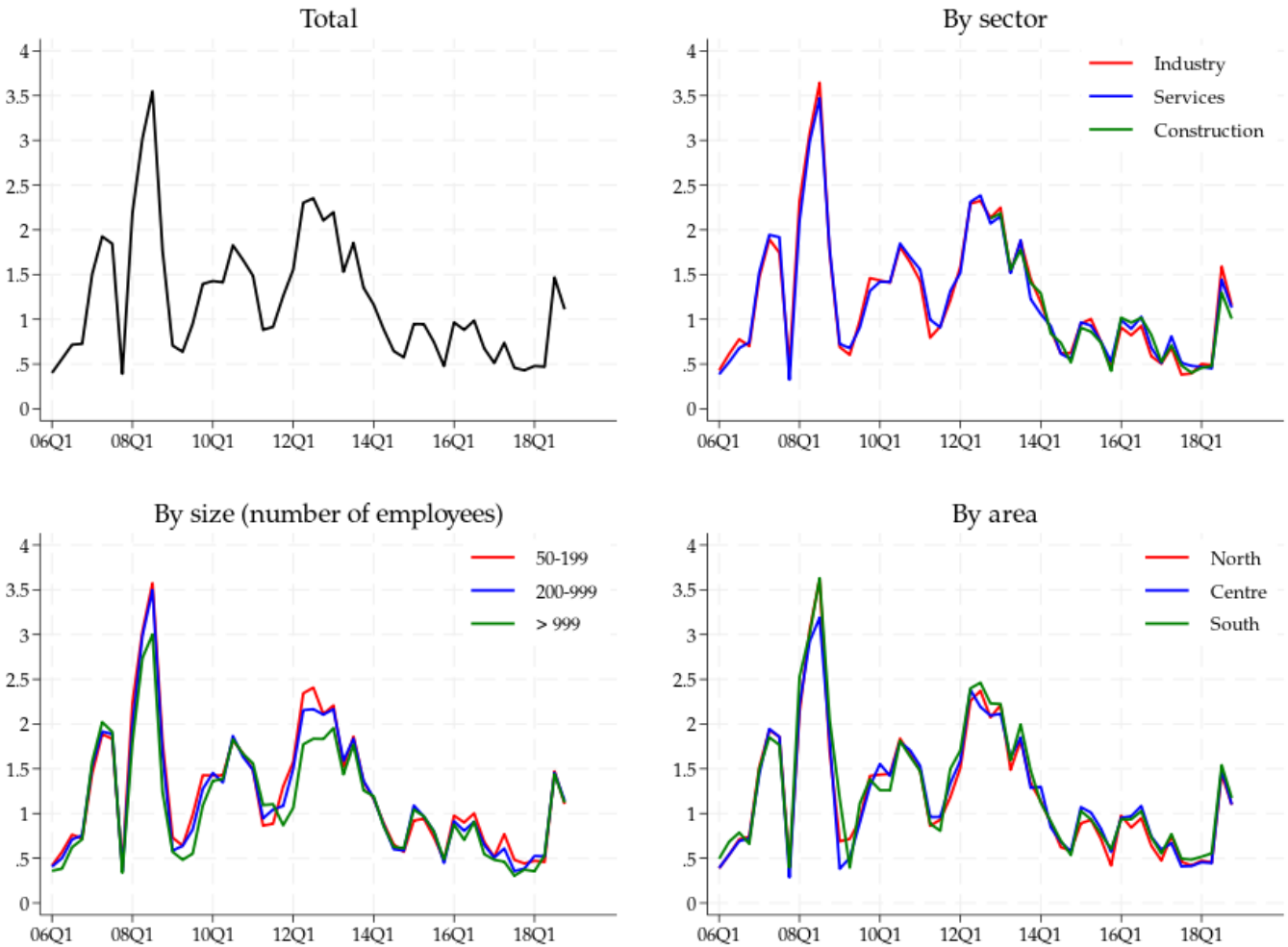
A.2: Inflation (in)attention



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A.3: RCT

- "In [previous month], consumer price inflation measured by the 12-month change in the Harmonized Index of Consumer Prices was [X.X]% in Italy and [Y.Y]% in the Euro area. What do you think it will be in Italy ... six-month ahead, one-year ahead, and two-year ahead."
- "What do you think consumer price inflation in Italy, measured by the 12-month change in the Harmonized Index of Consumer Prices, will be ... "

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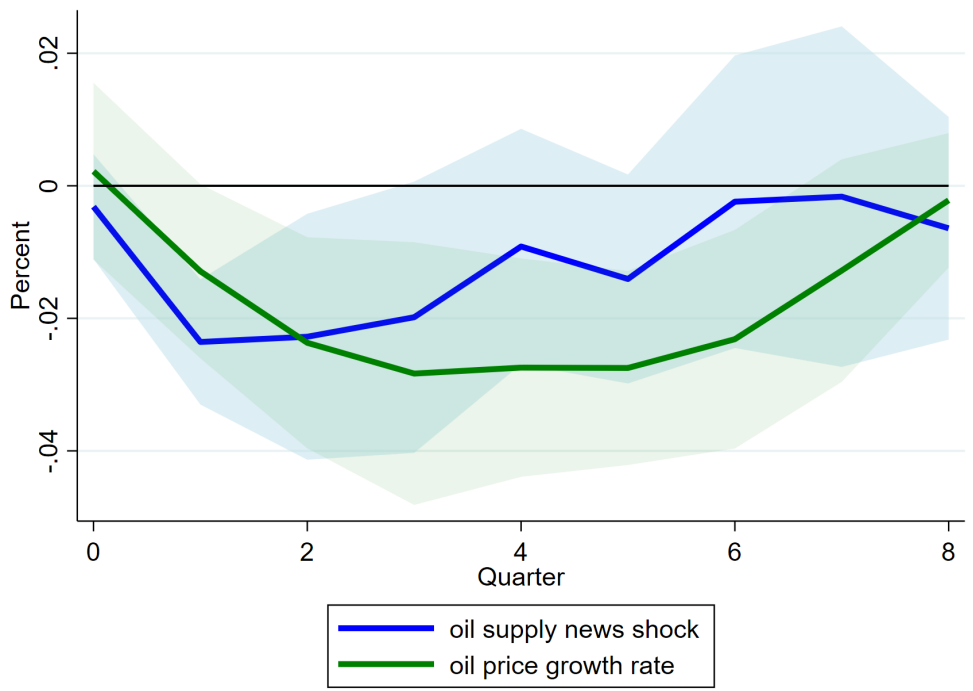
A.4: Inflation and loan markup

$$\phi_{t,t+h} = \sum_{q=1}^{4} \phi_{t-q} + \sum_{m=0}^{4} \beta_{0,m}^{(h)} \epsilon_{t-m}^{\pi} + \sum_{n=1}^{4} \text{control}_{t-n} + u_{t+h|t},$$



Notes: The oild supply new shocks are from Känzig (2021). The Φ_t is constructed from the decomposition by taking the average across banks. The shaded areas are 90% confidence intervals.

A.5: Microfoundation for $\Phi_{j,t}$

Relative cost $\Phi_{j,t}$ between bank loans (R_t^b) and internal financing (opportunity cost R_t^s)

$$\max \mathbb{E}_0 \left[\sum_{t=0}^{\infty} \beta^t \frac{\Lambda_t}{\Lambda_0} \left(\text{Revenue}_{j,t} - R_{t-1}^b \gamma \text{Borrowing}_{j,t-1} - (1-\gamma) \text{Borrowing}_{j,t} \right) \right]$$

$$= C_{-1} + \max \mathbb{E}_0 \left[\sum_{t=0}^{\infty} \beta^t \frac{\Lambda_t}{\Lambda_0} \left(\text{Revenue}_{j,t} - \left[(1-\gamma) + \beta \frac{\Lambda_{t+1}}{\Lambda_t} R_t^b \gamma \right] \text{Borrowing}_{j,t} \right) \right]$$

$$= C_{-1} + \max \mathbb{E}_0 \left[\sum_{t=0}^{\infty} \beta^t \frac{\Lambda_t}{\Lambda_0} \left(\text{Revenue}_{j,t} - \left[(1-\gamma) + \gamma \frac{R_t^b}{R_t^s} \right] \text{Borrowing}_{j,t} \right) \right]$$

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A.6: Model - rational inattention

Following Mackowiak, Matejka, and Wiederholt (2018),

$$\min_{\kappa_j, h_j} \sum_{t=0}^{\infty} \beta^t \mathbb{E}_{-1}\left[(v_{j,t} - v^*_{j,t})^2\right] + \lambda_\kappa \kappa_j$$

subject to:

$$\begin{aligned}
v^*_{j,t} &= (\omega_b + \rho_\pi) v^*_{j,t-1} - \omega_b \rho_\pi v^*_{j,t-2} + C_1 \epsilon_{\pi,t} + C_2 \epsilon_{\pi,t-1} + C_3 \epsilon_{\pi,t-2} \\
v_{j,t} &= \mathbb{E}(v^*_{j,t} | \mathcal{I}_t) \\
S_{j,t} &= h'_j z_{j,t} + \psi_t \text{ , with } z_{j,t} = (v^*_{j,t} \; v^*_{j,t-1} \; \epsilon_{\pi,t} \; \epsilon_{\pi,t-1})' \\
\mathcal{I}_{j,t} &= \mathcal{I}_{-1} \cup \{S_{j,0}, \ldots, S_{j,t}\} \\
\kappa_j &= \lim_{T \to \infty} \left[\mathcal{H}(v^*_{j,t} | \mathcal{I}_{j,t-1}) - \mathcal{H}(v^*_{j,t} | \mathcal{I}_{j,t})\right]
\end{aligned}$$

A.7: Model implication - comparative statistics

- Steady-state κ (amount of information processed) varies across parameter values
  1. Less loan-reliant firms
  2. More aggressive central bank
  3. Higher information processing cost