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

Janet Yellen (2016): How (firms') expectations are formed has taken on heightened importance . . . many central banks have adopted policies that are directly aimed at influencing expectations of future interest rates and inflation.

$\Longrightarrow$ Dispersed inflation expectations among firms
$\Longrightarrow$ Limited evidence on expectation formation

Christopher A. Sims (2010): If I were continually dynamically optimizing, I would be making fine adjustments in portfolio . . . why I don't, the benefits would be slight, and I have more important things to think about.

$\Longrightarrow$ Incentive to acquire information uncovers expectation formation

This paper

- **Casual empirical evidence on how financing composition affects inflation attentiveness and inflation expectations**
  - Data: merged microdata on Italian firms
  - Identification: Bartik-type instrument and RCT
  - Findings:
    1. $\uparrow$ Loan reliance $\Rightarrow$ $\uparrow$ inflation forecast accuracy
    2. $\uparrow$ Loan reliance $\Rightarrow$ $\downarrow$ response to provided public-available news

- **A stylized model with rational inattention can replicate the empirical results**
  1. Inflation as an indicator of credit condition
  2. $\uparrow$ Loan reliance $\Rightarrow$ $\uparrow$ exposure to inflation (financing) $\Rightarrow$ $\uparrow$ incentive to acquire information

- **(Not today) Policy implications**

Empirics

Data and Measure

2SLS with Bartik Instrument

RCT

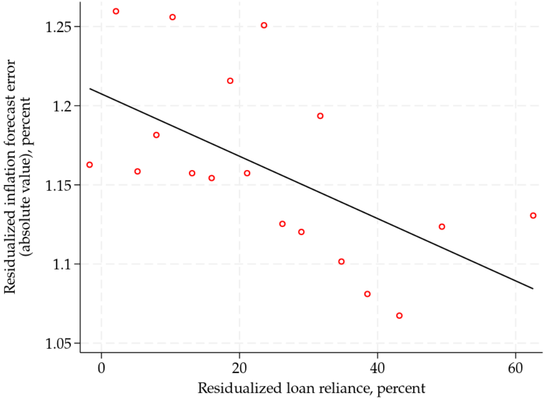
Theory

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 inattention: $\text{Inattention}^{(\pi)}_{j,t} \equiv \left| \pi^{(12m)}_t - F_j \pi^{(12m)}_t \right|$ ▸ plot

Suggestive evidence: loan reliance and inflation inattention

Takeaway: higher loan-reliant firms exhibit lower forecast errors



Notes: loan reliance and inattention are residualized by controlling for observable fixed effects, including size, region, sector, and treatment status.

Causal evidence I: Bartik instrument

1. **Benchmark regression**

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

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

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

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

$$R^b_{i,j,t} - R^s_t = \delta_{i,t} + \lambda_{j,t} + \epsilon_{i,j,t}$$

Causal evidence I: 2SLS

	Dependent variable: Inattention$_{j,t}^{(\pi)}$					
	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	

Takeaway: 1 std ↑ in loan reliance (17%) → 2 std ↓ in inattention (2%).

▸ Descriptive statistics

Causal evidence II: 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
  - Two waves: (1) RCT first introduced; (2) treated firms redrawn

- Empirical design

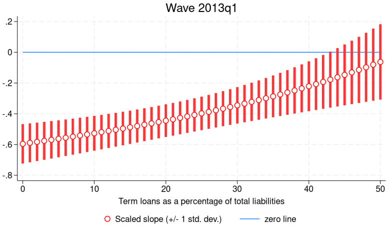
$$\text{Posterior}_j = \alpha_1 \times \text{Prior}_j + \alpha_2 \times \text{Loan Reliance}_j \times \text{Prior}_j + \gamma_1 \times \mathbb{I}_j \times \text{Prior}_j + \gamma_2 \times \mathbb{I}_j \times \text{Loan Reliance}_j \times \text{Prior}_j + \cdots + \epsilon_j.$$

Within the treated group, how much they update posterior expectations:

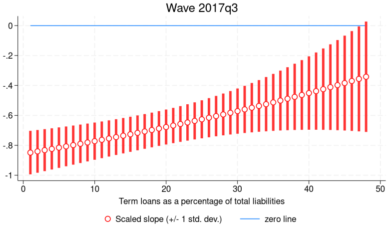
$$\frac{\hat{\gamma}_1 + \hat{\gamma}_2 \text{Loan Reliance}}{\hat{\alpha}_1 + \hat{\alpha}_2 \text{Loan Reliance}}$$

Empirical evidence: RCT

- Response to treatment, $\hat{\gamma} < 0$: treatment group places less weight on priors, more weight on the information treatment
- High loan reliance firms respond less: already known!



(a) First RCT



(b) Reshuffling

Empirics

Theory

- Rational inattentive firms
- Banking market and inflation passthrough
- Implications: IRF, simulated RCT, comparative statistics

The model: firms

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

$$\mathbf{M_{j,t}} \equiv \min_{\Gamma^I_{j,t}, \Gamma^E_{j,t}} \Gamma^I_{j,t} + \Phi_{j,t}\Gamma^E_{j,t}, \text{ where: } \Phi_{j,t} \equiv \frac{R^b_{j,t}}{R_t} = \mathcal{F}(\pi_t, \cdots)$$

  2. Maximize profits: optimal investment rate

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

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

Φ_t: micro-foundation | Rational inattention

The model: banks

The banks operate in a monopolistically competitive market with

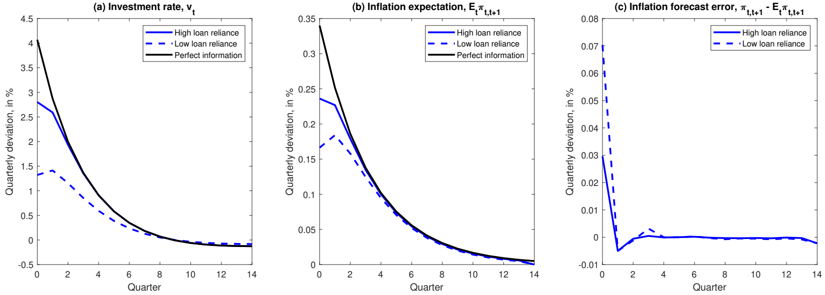
- Input: deposits (R_t)
- Output: bank loans (R_t^b)
- Calvo-type stickiness in setting loan interest rate
- Taylor rule: $R_t = R\left(\frac{\Pi_t}{\Pi}\right)^{\tau_\pi}$, where $\Pi_t = \rho_\pi \Pi_{t-1} + \epsilon_{\pi,t}$

Channel:

$$\text{Inflation shock } \epsilon_{\pi,t} \underbrace{\Longrightarrow}_{①} \text{Policy rate } R_t \underbrace{\Longrightarrow}_{②} \text{Loan rate } R_{i,t}^{b,*} \Longrightarrow \frac{R_t^b}{R_t}$$

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

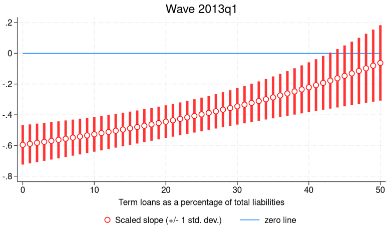
Implication 1 - IRFs: positive inflation shock



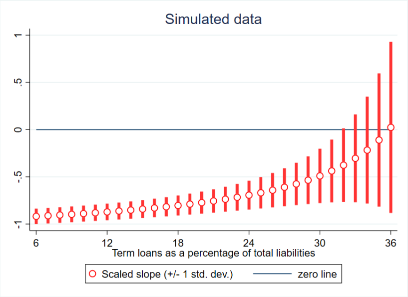
Notes: The figures display the impulse response functions to 1 positive standard deviation shock in (0.0034) $\epsilon_{\pi,t}$, which increases the annualized inflation by 1.35%. The autoregressive coefficient of the inflation process is 0.74. The solid (dashed) blue line is under the parameter values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

Implication 2 - Replicate RCT

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



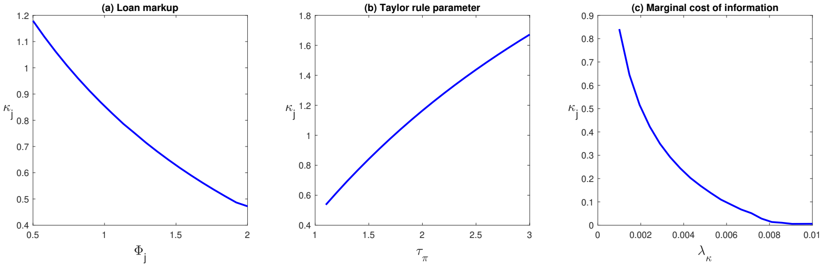
(c) First RCT



(d) Model implied

Implication 3 - Comparative statistics

- Steady-state κ (amount of information processed) varies under:
  1. Less loan-reliant firms (more expensive bank loans)
  2. More aggressive central bank
  3. Higher information processing cost

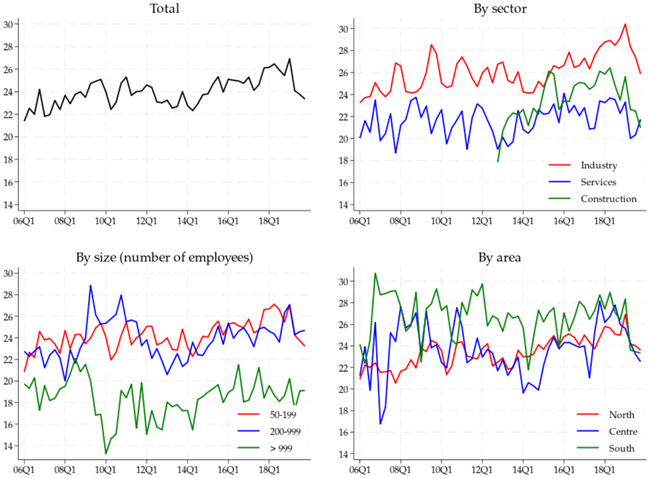


Conclusion

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 inattention

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A.3: Descriptive statistics

Table 1: Descriptive statistics

	p25	p50	p75	Mean	SD	N
Expected inflation (1-year ahead)	0.600	1.400	2.200	1.531	1.236	29793
Inflation inattention (in %)	0.400	1.000	1.700	1.160	0.997	26376
Term loan reliance (in %)	9.767	22.376	35.470	24.105	17.497	24805
Bank credit to debt ratio (in %)	58.156	94.649	100.000	73.184	36.817	27027
log(employees)	4.060	4.635	5.209	4.840	0.961	35316
ROE	0.102	4.105	11.924	4.119	25.967	28457
Liquid asset ratio (in %)	0.556	2.748	8.948	6.505	8.688	29091

Notes: The loan reliance based on term loans is calculated at the firm level. The summary statistics are computed with the sampling weights. The sample period is from 2006Q1 to 2019Q4.

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A.4: 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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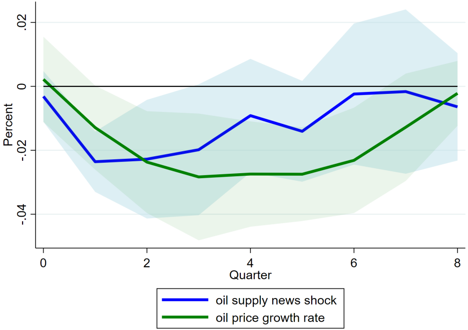
A.5: Inflation and loan markup

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



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.6: 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.7: 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:

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

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