Firms’ Finance, Cyclical Sensitivity, and the Role of Monetary Policy

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Italian Treasury,
November 25, 2014
Limited Participation and Segmented Markets

Framework

- Emphasize different to sticky price friction.
- Monetary Policy operates through financial markets.
- Connectivity to financial markets $\Rightarrow$ connectivity to monetary policy.
- Not all entities similarly connected to financial markets $\Rightarrow$ not all entities similarly connected to monetary policy.
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Limited Participation Models

- Part of the economy, usually firms, connected to financial markets $\Rightarrow$ firms directly affected by monetary policy.
- Working capital idea: firms need to borrow in order to operate.
- Firms pay interest.
- Monetary policy affects the external finance premium.
- Monetary policy has real effects that matter.
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- Monetary expansion increases cash available to firms.
- Firms buy more labor, expand production and increase real wage.
- These are real effects: agents are better off.
- Also, there is liquidity effect: Monetary policy expansion increases supply of loanable funds, and thus decreases interest rate (price of loanable funds).
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This paper: Questions

- Firms’ financial structure, productivity shocks and the role of monetary policy.
- How productivity shocks affect firms with different financial structure?
- How monetary policy shocks transmit across firms with different financial structure?
- How optimal monetary policy reacts to productivity shocks?
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Motivation

- Recent experience suggests countercyclical monetary policy’s reaction.
- Productivity shocks might affect differently firms that participate in the financial markets and firms that do not.
- Also, monetary policy affects differently firms that participate in the financial markets and firms that do not.
- Optimal monetary policy with new consideration.
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Empirical Evidence: Small firms: Gertler and Gilchrist (QJE, 1994)

Sales Small Firms

Inv Small Firms
Empirical Evidence: Differential: Gertler and Gilchrist (QJE, 1994)

![Graphs showing sales and inventory differences](image-url)
This Paper

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This Paper

The household decides

▶ how much to work,

▶ how much to consume of two goods produced by two industries,

▶ the supply of loanable funds, also affected by monetary transfer.
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The last two decisions are subject to cash-in-advance constraints.
This Paper

Two industries:

- **Cash-constrained firms:**
  - need to borrow in order to operate,
  - pay interest.
- **Cash-unconstrained firms:**
  - operate as usually.
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Preview of Main Findings

Negative Productivity Shock:

- The cash-unconstrained firms decrease labor demand.
- The cash-constrained firms increase labor demand. This is because:
  - wage decreased, lower wage to finance.
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So the cash-constrained firms get larger and the cash-unconstrained firms become smaller.
Preview of Main Findings

Increase in Money Supply:

- Good news for cash-constrained firms.
- Supply of loanable funds increases, lower interest rate.
- Production and employment of cash-constrained firms increases.
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This would make cash-constrained firms larger.
Preview of Main Findings

Optimal Monetary Policy

- Tight in response to negative productivity shock.
- Expansionary in response to positive productivity shock.
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Literature

- Effects of cycle: Moscarini and Postel-Vinay (*AER*, 2012)
- Effects of Monetary shocks: Gertler and Gilchrist (1994, *QJE*)
- Costly state verification, idiosyncratic shocks and monetary policy: Carlstrom, Fuerst and Paustian (2010, *JMCB*), De Fiore, Teles and Tristani (2011, *AEJ : Macro*)
The Model

Two Industries:

- Firms in cash unconstrained industry finance operation through credit, and produce $f^u(h^u, \theta) = \theta h^u$ units of good, using $h^u$ units of labor.

- Firms in cash constrained industry borrow to operate, and pay interest $R$. They produce $f^c(h^c, \theta) = \theta h^c$ units of good, hiring $h^c$ units of labor.
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The Model

- Infinitely lived large family seeking to maximize:

\[ E_0 \left\{ \sum_{t=0}^{\infty} \beta^t [U(c_t^1) + V(c_t^2) - D(H_t)] \right\}, \quad (1) \]

where:

- \( U' > 0, V' > 0, D' > 0, D'' > 0, U'' < 0, V'' < 0. \)
The Model graphical

Framework
Motivation
The Model Economy
Results
Optimal Monetary Policy
Conclusions

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Timing

- Receive $m_t$.
- Decide fraction $x_t$ for consumption.
- Decide fraction $n_t$ for loans.

Productivity shock $\theta_t$, and monetary shock $\mu_t$ are realized.

Family separate:
- Shopper ($x_t$): goods market.
- Worker: labor market.

Family meet: consumes and keeps next period’s money holdings.

Financial transactor ($n_t$): loanable funds market. There, gets monetary transfer $\tau_t$. 
CIA Constraints

- In transactions ($\gamma$):
  \[ m \geq x + n \]  

- In consumption ($\gamma_1$):
  \[ x \geq p^1 c^1 + p^2 c^2 \]  

- In the supply of loanable funds ($\gamma_2$):
  \[ n + \mu \geq b^s \]
Budget Constraint

Family’s Budget Constraint ($\delta$):

$$m + \mu + (1 + R)b^s + wH + \pi \geq m'(1 + \mu) + p^1 c^1 + p^2 c^2 + b^s. \quad (5)$$

Note:

$$[(m - x - n) + (x - p^1 c^1 - p^2 c^2) + wH + n(1 + R) + \pi] +$$

$$[\left(n + \mu - b^s\right) + b^s(1 + R) - n(1 + R)] \geq m'.$$
First Order Conditions

With respect to $x$ and $n$:

$$\gamma = E_{\{\theta, \mu\}}(\gamma_1) = E_{\{\theta, \mu\}}(\gamma_2) \quad (6)$$

With respect to $c^1, c^2$:

$$\frac{U'(c^1)}{p^1} = \frac{V'(c^2)}{p^2} = \gamma_1 + \delta \quad (7)$$

With respect to $H$:

$$\frac{D'(H)}{w} = \delta \quad (8)$$

With respect to $b^s$:

$$\gamma_2 = \delta R \quad (9)$$

With respect to $m'$:

$$-\delta(1 + \mu) + \beta \gamma' + \beta E_{\{\theta', \mu'\}}(\delta') = 0. \quad (10)$$
Firms Profit Maximization

- firms in unconstrained industry:
  \[ \pi^u = p_2 \theta h^u - wh^u, \]
  FOC:
  \[ p^2 \theta = w. \]  \hspace{1cm} (11)

- firms in constrained industry:
  \[ \pi^c = p_1 \theta h^c - wh^c - Rb^d, \]
  or
  \[ \pi^c = p_1 \theta h^c - (1 + R)wh^c, \]
  FOC:
  \[ p^1 \theta = w(1 + R). \]  \hspace{1cm} (12)

- A price wedge:
  \[ p^1 = (1 + R)p^2. \]  \hspace{1cm} (13)
Equilibrium

- The goods markets clear (Note: $H^c = \lambda h^c$ and $H^u = \kappa h^u$):
  
  $$c^1 = \theta H^c,$$
  
  $$c^2 = \theta H^u.$$  (14)

- The labor market clears:
  
  $$H^c + H^u = H.$$  (16)

- The loanable funds market clears:
  
  $$wH^c = b^s.$$  (17)

- The money market clears:
  
  $$m = m' = 1.$$  (18)

- and from (17), (18) and (2):
  
  $$1 + \mu - x = wH^c.$$  (19)
Equilibrium—More

- In equilibrium $m = m' = 1$, so the decision of $x$, $n$ depends only on the expectation of the economy’s shocks.
- Assuming $iid$, uncorrelated shocks, then $x$, $n$ is the same every period.
- Then, from FOC:

$$
\beta E_{\{\theta', \mu'\}} \left[ \frac{U'(c'^1)}{p'^1} \right] = \beta E_{\{\theta', \mu'\}} \left[ \frac{V'(c'^2)}{p'^2} \right] = \beta \psi = (1 + \mu) \frac{D'(H)}{w} 
$$

(20)
Equilibrium-More

- From (7):
  \[ \frac{U'(c^1)}{V'(c^2)} = \frac{p_1}{p_2}. \]  
  \[ (21) \]

- Equations (3) with equality, (11), (12), (14), (15), (16), (19), (20) and (21) solve for 9 unknowns.
Negative Productivity Shock

- Bad for both industries: $c^1 = \theta H^c$, $c^2 = \theta H^u$,
- Unconstrained industry decreases labor demand and decreases wage.
- Constrained industry finds the lower wage attractive.
- Constrained industry increases labor demand.
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\[ \frac{dc^1}{d\theta} > 0, \quad \frac{dc^2}{d\theta} > 0, \quad \frac{dp^1}{d\theta} < 0, \quad \frac{dp^2}{d\theta} < 0, \quad \frac{d(1+R)}{d\theta} < 0, \quad \frac{dw}{d\theta} > 0, \quad \frac{dH^c}{d\theta} < 0, \]

\[ \frac{dH^u}{d\theta} > 0, \quad \frac{dH}{d\theta} > 0. \]
Positive Monetary Shock: Homogenous Firms

- All firms cash constrained.
- Positive monetary shock: Good news.
- Supply of loanable funds increases: $1 + \mu - x = wH$.
- Interest rate decreases in order firms to accept extra cash.
- Firms increase production and employment.
- Real wage increases in order workers to work more.
- Prices decrease in order consumers buy more good.
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- Supply of loanable funds increases: \( 1 + \mu - x = wH^c \).
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- Cash constrained firms increase employment and production.
- But: Now more degrees of freedom.
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Case 1:

- Given lower interest, constrained firms might decrease their price, might increase wage.
- Then, unconstrained firms might decrease employment and production, and increase their price.
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Case 3:

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Positive Monetary Shock: Heterogenous Firms

- Effects on nominal wages, prices of unconstrained firms, employment and production of unconstrained firms, is ambiguous.
  - Empirical evidence (CEE, EER 1997):
    - The aggregate price level initially responds very little.
    - Aggregate output increases.
    - Interest rates initially fall.
    - Real wages increase (weak).
  - Empirical evidence (Gilchrist et al, 2012):
    - In crisis, weak firms increased prices and strong decreased prices.
    - So after good shock, weak firms decrease prices and strong increase prices.
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Case 2:
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Optimal Monetary Policy

- Maximize lifetime utility of household.
- FOC:
  \[ U'(c^*) = V'(c^*) = \frac{D'(H)}{\theta}. \]
- \[ R = 0. \]
Optimal Monetary Policy

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Optimal Monetary Policy and Productivity Shock

\[ \frac{d(1+\mu^*)}{d\theta} > 0. \]

- Monetary policy tightens in response to negative productivity shock.
- Monetary policy expands in response to positive productivity shock.
- Monetary policy works through the allocation of the factors across industries.
- Bad times, not that bad for cash-constrained firms for monetary policy to subsidize them.
- Good times, not too good for cash-constrained firms for monetary policy to tax them.
- Small firms fuel job creation during recessions.
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- Welfare maximizing optimal monetary policy with new consideration.
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Thank you!