Q-Monetary Transmission

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by Min Fang

General Research Agenda

Firm investment subject to the costs of capital:

- A direct user cost depends on the real interest rate r_f: $r_f \uparrow \Rightarrow inv. \downarrow$
- A debt-finance cost depends on credit spread r_r: $r_r \uparrow \Rightarrow inv. \downarrow$
- An equity-finance cost depends on equity price Tobin's q: $q \downarrow \Rightarrow inv. \downarrow$

  ** high q means high market value to the replacement cost of capital*

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Monetary transmission mechanisms to firm investment:

- User cost channel: $i \uparrow \Rightarrow r_f \uparrow \Rightarrow inv. \downarrow$

  Almost every paper has this as the basic channel!
- Debt financing channel: $i \uparrow \Rightarrow r_r \uparrow \Rightarrow inv. \downarrow$

  Well studied since the 1990s, i.e., Bernanke, Gertler, Gilchrist'1999
- Equity financing channel: $i \uparrow \Rightarrow q \downarrow \Rightarrow inv. \downarrow$

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  The original paper of Tobin'1969, but no more ever since...

This Paper: Reestablish Tobin's Monetary Transmission

Develop a model of the q-monetary transmission mechanism

- Constrained investment and financing decisions with the stock market and money
- KEY: Stock turnover among outside investors with heterogeneous valuations
- MP affects q: a "bubble-like" resale-value component from the KEY
- Consequently, transmits to $inv.$: $i \uparrow \Rightarrow q \downarrow \Rightarrow inv. \downarrow$

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Provide identification and empirical evidence for the q-channel

- Identification is hard since MP affects q and *inv.* jointly in many channels
- Solution: an IV for exogenous (policy driven) firm-level Tobin's q
- The IV: interacting MPS with (predetermined) firm-specific stock turnover
- Findings: q-monetary transmission exists: about 1/3 of total transmission

Theory: The Mechanism

- Financial sector
  - investors with heterogeneous valuations
  - determine stock prices (ϕ) in monetary OTC-style market
  - ▷ ϕ = dividend value + resale value
  - ▷ monetary policy ⇒ stock price ("turnover-liquidity channel")
- Investment sector
  - entrepreneurs with value of capital (ϕ_e) $\neq$ than investors (ϕ)
  - choose investment (X) and mix of internal/equity financing
  - ▷ $X = f(\phi)$ (unless no need for equity financing and $\phi < \phi_e$)
  - ▷ stock price ⇒ investment ("equity-financing channel")

▶ "Q-Monetary Transmission":
monetary policy ⇒ stock prices ⇒ investment

Evidence: The Issues

- To estimate "Q-Monetary Transmission" need to...
  identify *causal effect* of firm i's stock price on firm i's investment

- Some background: How do shocks to policy rate, r, affect stock prices?
  - (25 bp) surprise $\uparrow r \Rightarrow \downarrow$ stock index (1.4-2.3 pp)
    (Bernanke and Kuttner, 2005)
  - Stock turnover explains differences in cross-sectional responsiveness:
    prices of top 5% turnover group $\downarrow$ 2.5 times *more* than the median
    (Lagos and Zhang, 2020)
    - "turnover-liquidity channel"
      (firm i's stock turnover $\mathcal{T}^i$ affects its stock-price response to Δr)

- Use $(\Delta r \times \mathcal{T}^i)$ as an IV for policy-induced stock-price variation of firm i

Identification assumption

The effect of Δr on firm i's investment through variables other than Tobin's q does not depend on $\mathcal{T}^i$ (nor on omitted firm characteristics correlated with $\mathcal{T}^i$)

Evidence: The Findings

- Higher $\mathcal{T}^i$ predicts stronger effect of Δr on:
  - stock price—for all firms i
  - equity issuance & investment rate—for *equity-dependent firms* (firms with below-median share of liquid assets over all assets)
- Higher stock price predicts (instrumented with $\Delta r \times \mathcal{T}^i$):
  - higher equity issuance: $1\% \uparrow \phi \Rightarrow 0.08$ pp $\uparrow E/A$
  - higher investment: $1\% \uparrow \phi \Rightarrow 1\% \uparrow X/K$

  . . . for *equity-dependent firms*

- ▶ Q-monetary transmission accounts for about 1/3 of the response of aggregate investment to money shocks

The Theory Outcomes in One Page: To Generate Identification Strategy

A Money Search Model: Frictional trade between brokers and investors:

- trade of money and equity with a probability of trade $\alpha \in [0, 1]$
- Nash bargaining with investor bargaining power $\theta \in [0, 1]$
- "bubble-like" resale value depends on the supply of money!

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Q-Channel: Increase in stock price $\Rightarrow$ increase in investment and equity issuance

- for stock-price variation unrelated to the firm's "fundamentals"
- only for firms who need equity finance to do investment

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Turnover-Liquidity Channel: Cross-sectional variation in (α, θ) induces variation in:

- stock turnover: $\tau = f(\alpha, \theta)$, with $\frac{\partial \tau}{\partial \alpha} > 0$ and $\frac{\partial \tau}{\partial \theta} > 0$
- responsiveness of stock prices to money shocks: $\frac{\partial^2 \phi_t^s}{\partial \alpha \partial r_t} < 0$

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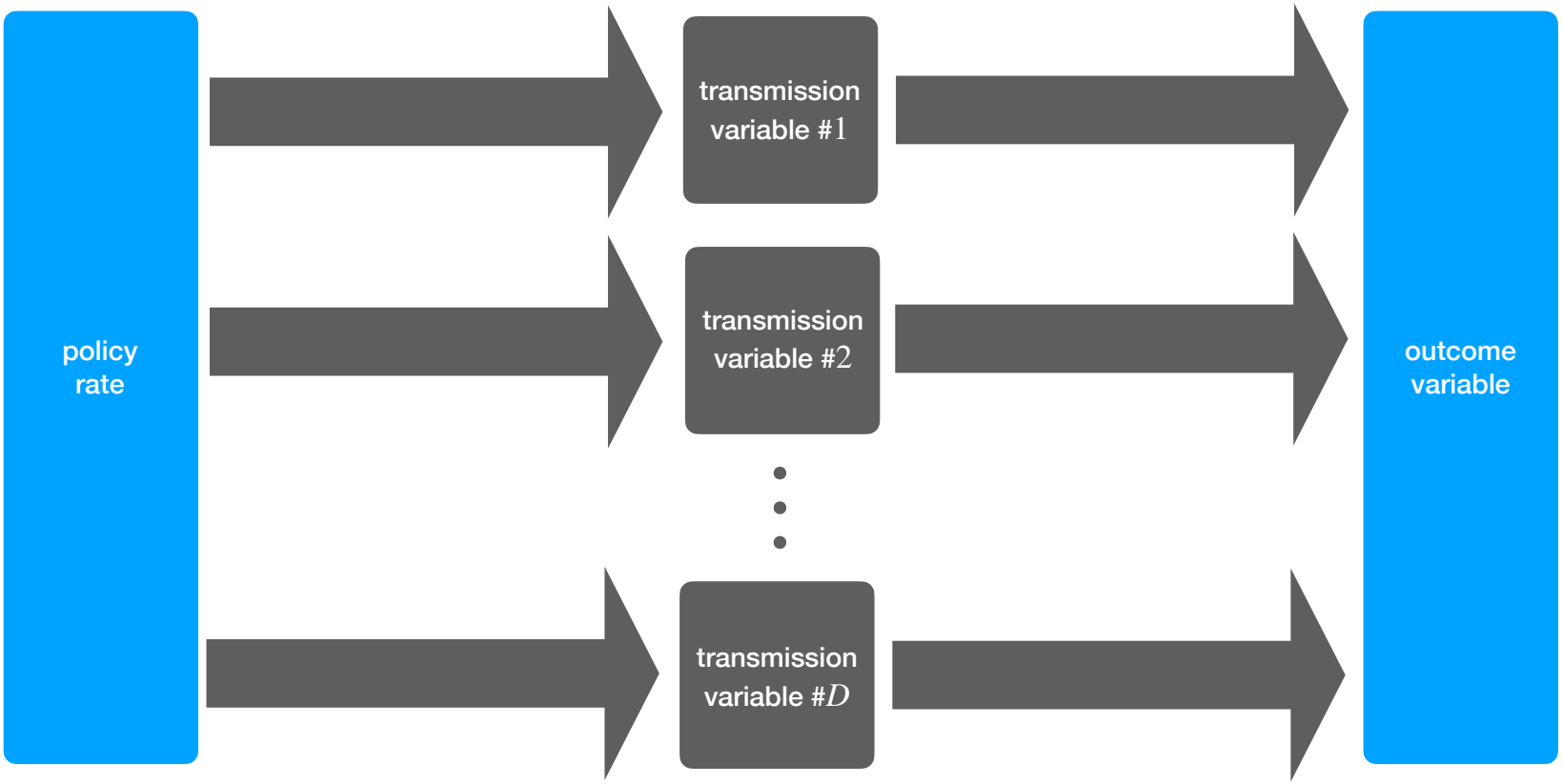
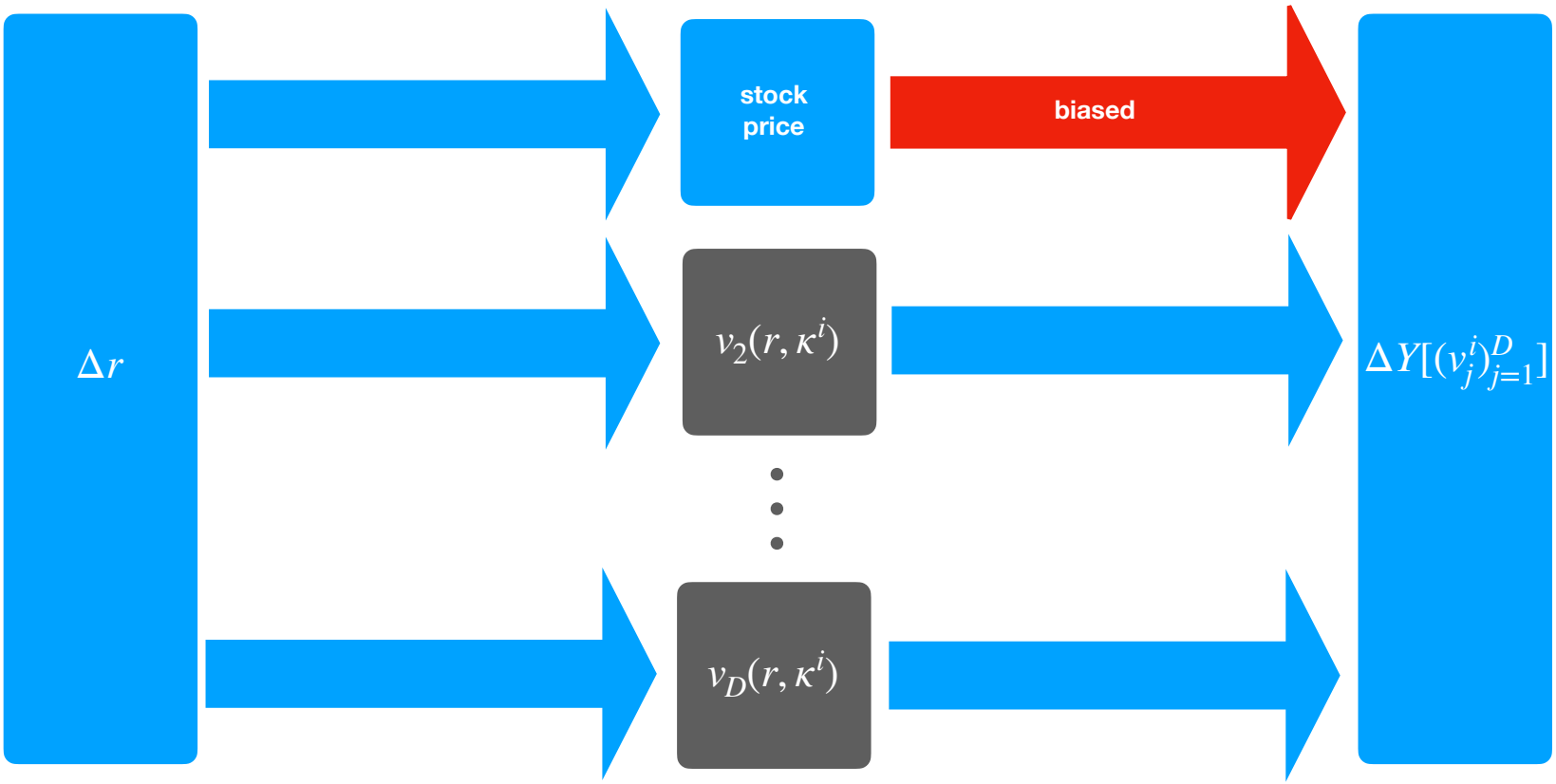
Identification strategy: exploit the interaction between
money shocks and cross-sectional heterogeneity in stock turnover rates

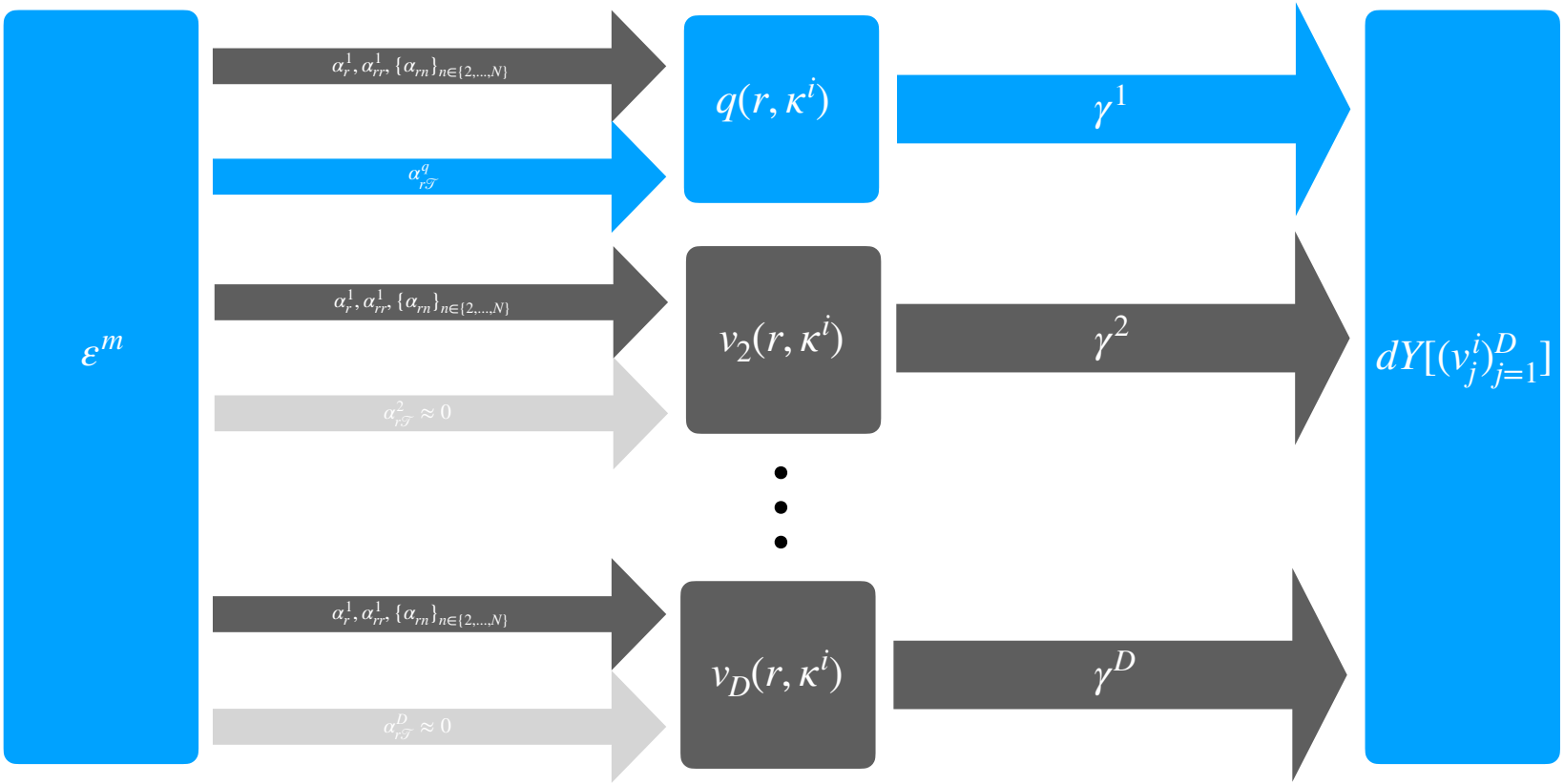
Monetary transmission mechanisms



Identification problem



Identification via turnover heterogeneity



Identification strategy

- Use $\mathcal{T}^i \times \varepsilon_t^m$ as an instrument for variation in q_t^i

Identification assumption

Effect of ε_t^m on y_t^i through transmission variables other than Tobin's q does not depend on $\mathcal{T}^i$ (nor on omitted firm characteristics that are correlated with $\mathcal{T}^i$)

In words...

Turnover (and any unobserved correlated characteristic) does not affect the responsiveness to money shocks of transmission variables other than Tobin's q

Identification strategy: usefulness and challenges

- can deal with channels that operate through non-firm-specific transmission variables (such as a baseline interest rate)
- cannot deal with channels that operate through transmission variables whose response to money shocks depends on $\mathcal{T}^i$
- cannot deal with channels that operate through transmission variables whose response to money shocks depends on some firm characteristic κ^i correlated with $\mathcal{T}^i$

  but in this case:

  - find empirical proxy $\tilde{\kappa}^i$ for characteristic κ^i, and control for $\tilde{\kappa}^i \times \varepsilon_t^m$ in the regression

feedbacks

Data

- Compustat: universe of publicly listed non-financial firms incorporated in the US that are in the dataset for at least 40 consecutive quarters between 1990Q1–2016Q4
  - Tobin's q details
  - net equity issuance details facts
  - investment rate details
  - liquidity ratio details
  - controls: age, size, leverage, etc. details
- CRSP: common stock for each firm in our Compustat sample
  - stock price and *turnover rate* details facts
- Gürkaynak et al. (2005), Jarociǹski and Karadi (2020):
  - fed funds surprises around FOMC announcements details

Panel local projections – Jordá (2005)

- Dependent variables:
  - net equity issuance details facts
  - log investment rate details
  - capital structure details

- IV with q_t^i as a regressor instrumented with $\mathcal{T}_{t-1}^i \varepsilon_t^m$

- Several specifications:
  - not distinguising between *non-* and *equity-dependent* firms
  - allowing coefficients to differ conditional on *liquidity ratio*

    $\ell_t^i \equiv \frac{(\text{cash + short-term investments})_{t-1}^i}{(\text{book value of total assets})_{t-1}^i}$ above or below median facts
  - robustness to:
    - other money-shock series, alternative transformations of variables
    - additional controls: age, size, leverage, liquid assets, firm-level demand cyclicality, stock exposure to financial risk factors, investor disagreement on firm valuation, financial distress

IV regressions: equity issuance, investment

Local-projection approach to an *instrumented* q-regression

- Baseline specification:

$$y^i_{t+h} = f^i_h + d_{h,s,t+h} + \rho_h y^i_{t-1} + \Lambda_h Z^i_{t-1} + \beta_h \mathcal{T}^i_{t-1} + \gamma_h \log(q^i_t) + u^i_{h,t+h}$$

$$y^i_{t+h} \in \left\{ \mathrm{e}^i_{t+h},\ \log(x^i_{t+h}/k^i_{t+h}) \right\}$$

$$\mathcal{T}^i_{t-1}\varepsilon^m_t \text{ as instrument for } \log(q^i_t)$$

- $h \in \{0, 1, ..., 12\}$ quarters
- f^i_h : fixed effect for firm i at horizon h
- $d_{h,s,t+h}$: dummy for industry s and quarter $t+h$ at horizon h
- Z^i_t : firm-level controls (baseline: size, leverage, liquidity ratio)
- $\mathcal{T}^i_t$: stock i average turnover rate in quarter t (normalized by SD)
- ε^m_t : (sum of) fed funds rate shocks in quarter t (normalized by SD)

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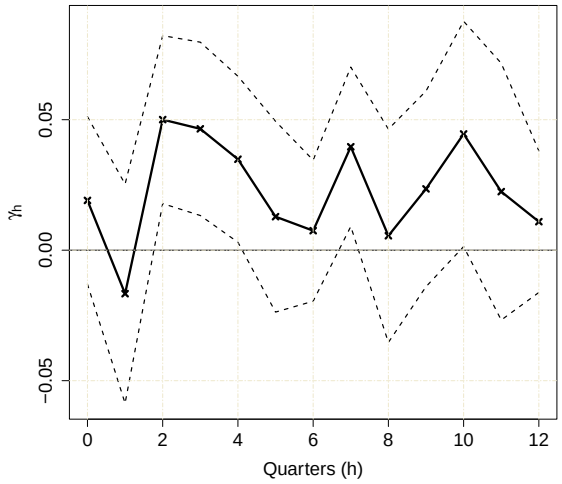
- Conditional on liquidity:

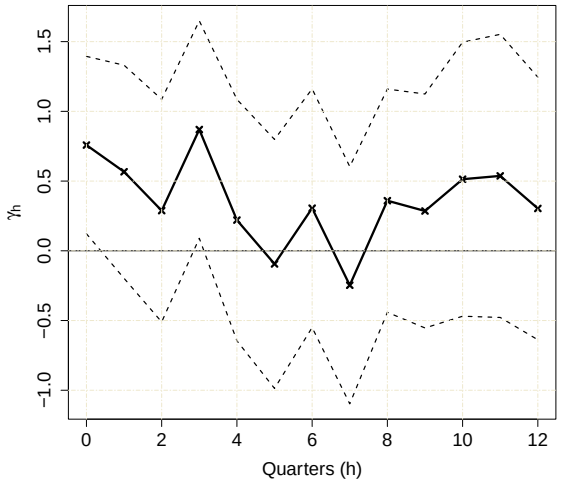
$$\begin{aligned} y^i_{t+h} = {} & f^i_h + \tilde{f}^i_h \mathbb{I}^i_{L,t-1} + d_{h,s,t+h} + \tilde{d}_{h,s,t+h}\mathbb{I}^i_{L,t-1} + \alpha_h \mathbb{I}^i_{L,t-1} \\ & + \left(\rho_h + \tilde{\rho}_h \mathbb{I}^i_{L,t-1}\right) y^i_{t-1} + \left(\Lambda_h + \tilde{\Lambda}_h \mathbb{I}^i_{L,t-1}\right) Z^i_{t-1} \\ & + \left(\beta_h + \tilde{\beta}_h \mathbb{I}^i_{L,t-1}\right) \mathcal{T}^i_{t-1} + \left(\gamma_h + \tilde{\gamma}_h \mathbb{I}^i_{L,t-1}\right) \log(q^i_t) + u^i_{h,t+h} \end{aligned}$$

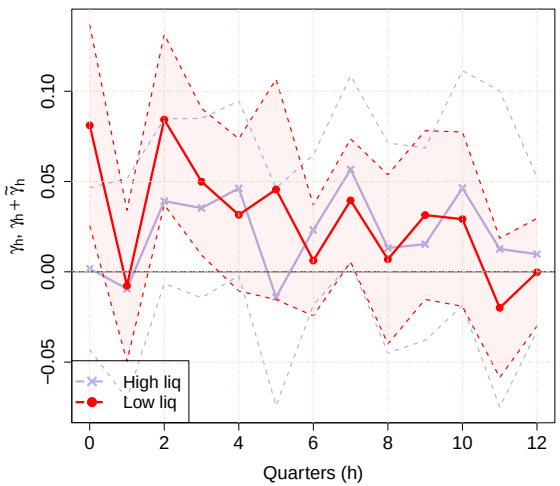
▷ $\mathbb{I}^i_{L,t-1} = 1$ if firm i's liquidity ratio is below median in quarter $t-1$

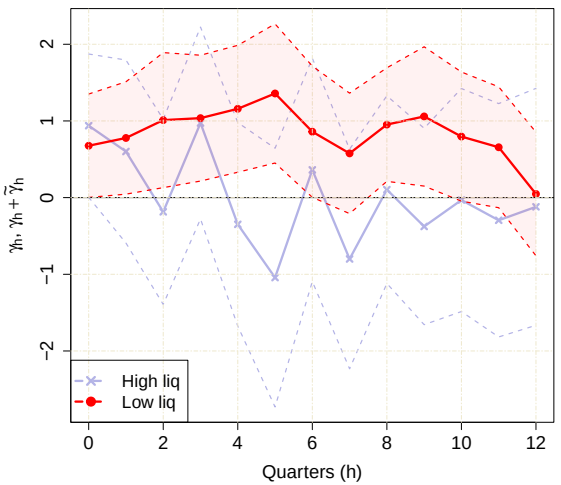
IV estimates: equity issuance, investment

robustness OLS for q









$$y^i_{t+h} = \mathrm{e}^i_{t+h}$$

$$y^i_{t+h} = \log(x^i_{t+h}/k^i_{t+h})$$

IV regressions: Q-channel and capital-structure dynamics

- So far:

  Q-channel implications for equity issuance and investment

- Next:

  Do "exogenous" (e.g., policy-driven) changes in Tobin's q affect firms' capital structure?

IV regressions: Q-channel and capital-structure dynamics

- So far:

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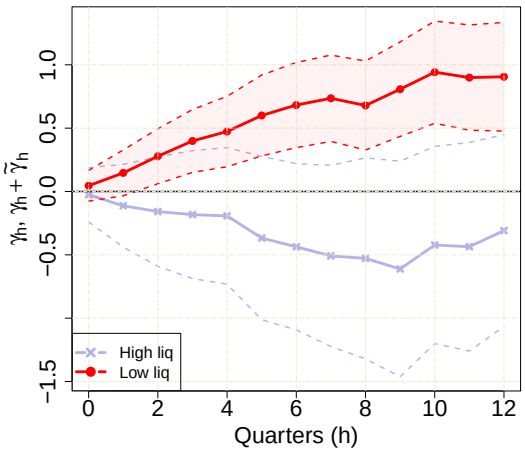
- Next:

  Do "exogenous" (e.g., policy-driven) changes in Tobin's q affect firms' capital structure?

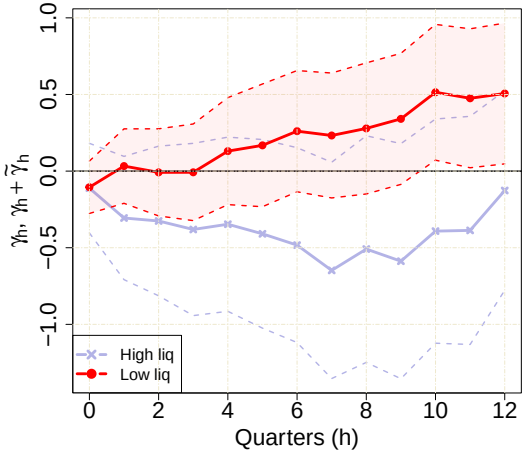
- Run the same specification as before but with balance-sheet items as dependent variables:
  - ratio of total liabilities to total assets
  - log book value of total assets and liabilities
  - assets decomposition: physical capital, liquid assets
  - liabilities decomposition: debt, other liabilities

Q-channel and capital-structure dynamics: assets

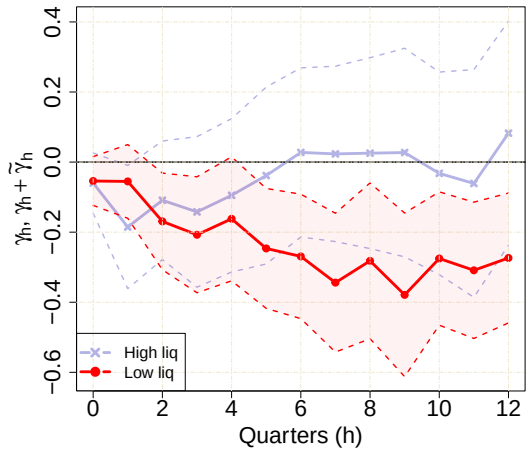
assets (log)



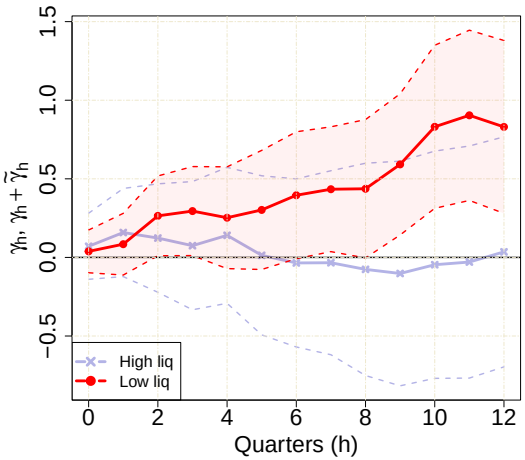
liabilities (log)



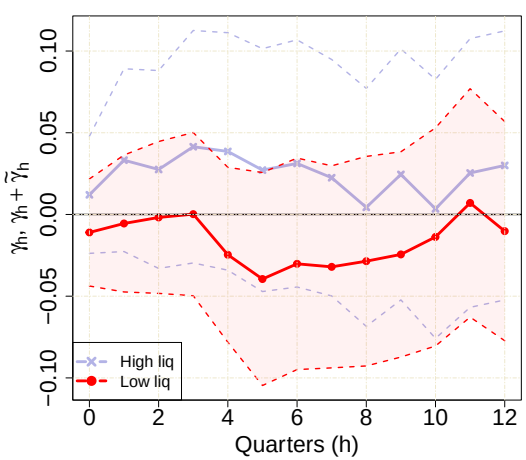
liabilities/assets



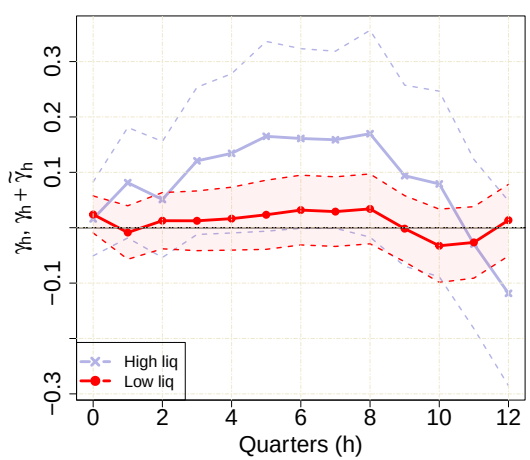
physical capital (log)



physical capital/assets

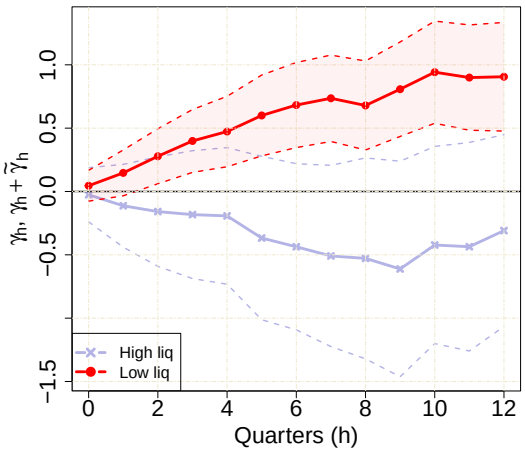


liquid assets/assets

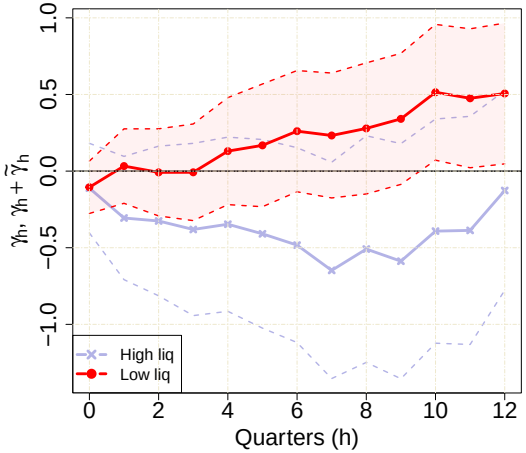


Q-channel and capital-structure dynamics: liabilities

assets (log)



liabilities (log)



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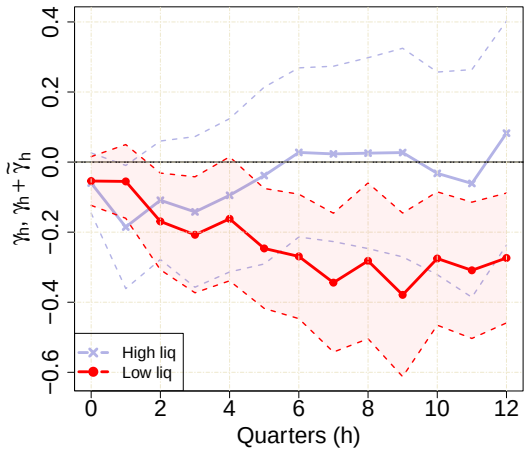
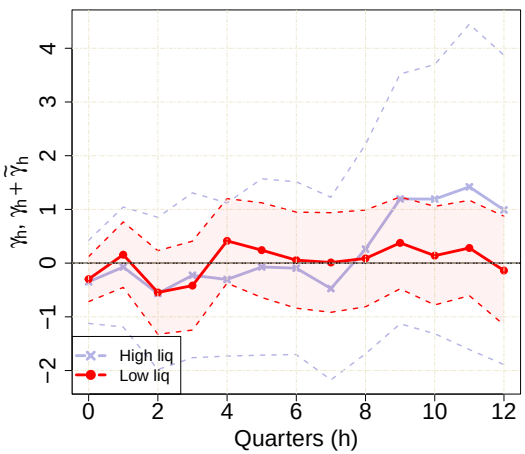
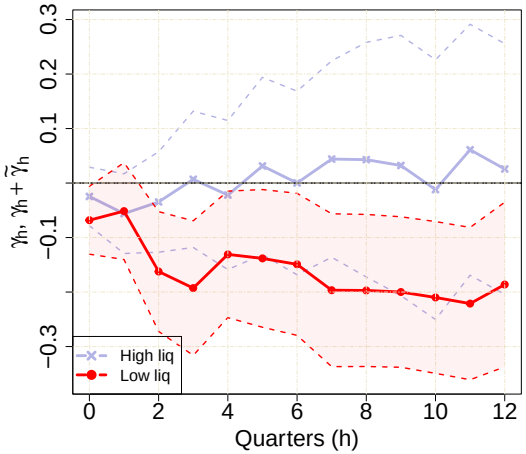


debt (log)



debt/assets



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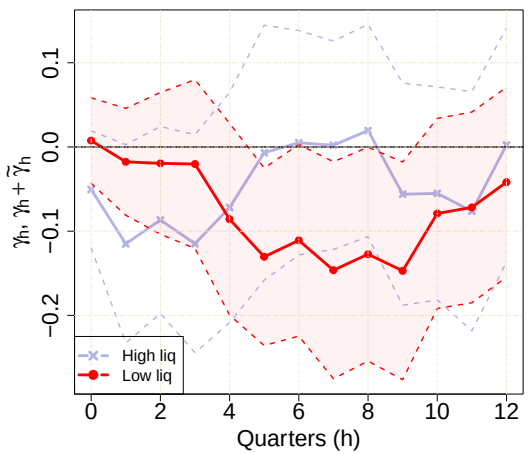

Q-monetary transmission: cross-sectional estimates

$$\frac{d \log(I^i_{t+h}/K^i_{t+h})}{d\varepsilon^m_t} = \frac{d \log(I^i_{t+h}/K^i_{t+h})}{d \log\left(q^i_t\right)} \frac{d \log\left(q^i_t\right)}{d\varepsilon^m_t}$$

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$$\log(I^i_{t+h}/K^i_{t+h}) = \text{controls} + \left(\gamma_h + \tilde{\gamma}_h \mathbb{I}^i_{L,t-1}\right) \log(q^i_t) + u^i_{h,t+h}$$

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Q-monetary transmission: cross-sectional estimates

$$\frac{d\log(I^i_{t+h}/K^i_{t+h})}{d\varepsilon^m_t} = \frac{d\log(I^i_{t+h}/K^i_{t+h})}{d\log\left(q^i_t\right)}\frac{d\log\left(q^i_t\right)}{d\varepsilon^m_t}$$

$$= \left(\gamma_h + \tilde{\gamma}_h \mathbb{I}^i_{L,t-1}\right)\left(\beta_2 + \beta_3 \mathcal{T}^i_{t-1}\right)$$

Q-monetary transmission: cross sectional estimates

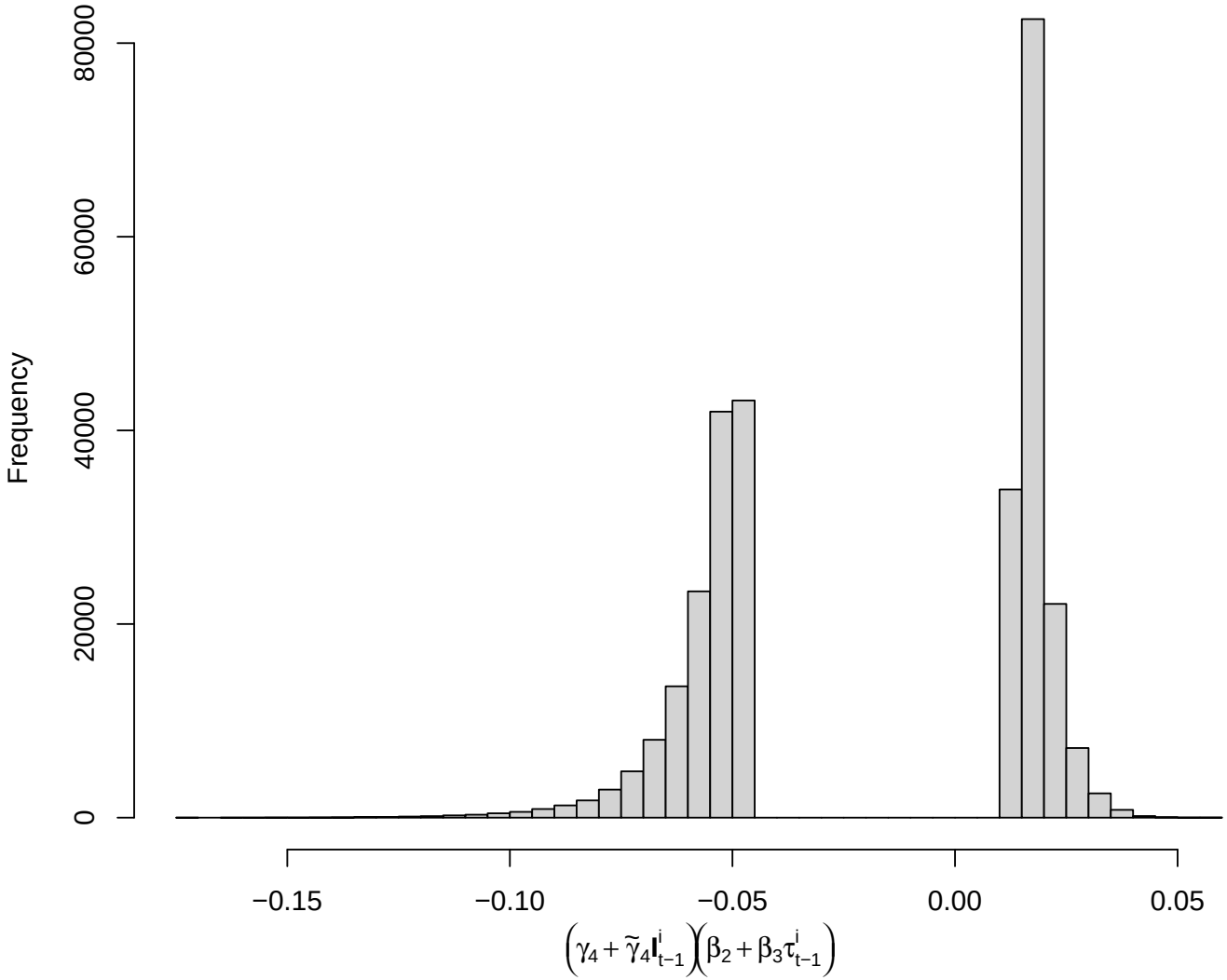

Figure: Distribution (across firms and quarters) of semi-elasticity of investment rate at horizon $h = 4$ to a 1 bp surprise increase in the fed funds rate.

Q-monetary transmission: aggregate investment, $\bar{I}_t = \sum_i I_t^i$

$$\frac{d \log (\bar{I}_{t+h})}{d\varepsilon_t^m} \leq \sum_i \frac{I_{t+h}^i}{\bar{I}_{t+h}} \frac{d \log(I_{t+h}^i / K_{t+h}^i)}{d\varepsilon_t^m} = \sum_i \frac{I_{t+h}^i}{\bar{I}_{t+h}} \left(\gamma_h + \tilde{\gamma}_h \mathbb{I}_{L,t-1}^i\right) \left(\beta_2 + \beta_3 \mathcal{T}_{t-1}^i\right)$$

According to our micro estimates:
25 bp $\uparrow$ FFR $\Rightarrow$ $\frac{d \log(\bar{I}_{t+4})}{d\varepsilon_t^m} \approx -0.31\%$ (for Compustat firms)

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Q-channel accounts for 35% of conventional estimate of the peak response of aggregate investment to monetary policy shocks

Takeaways

Paper-wise: Interesting "ignored" "new" channel of monetary transmission

- equity financing channel is overlooked
- it is also aggregately important

Learning-wise: How to run applied-micro regressions for macro study?

- cross-sectional variations could be used as a clean IV
- the clean IV could potentially link to "only one" specific channel
- helps to identify a clean transmission of macro shocks