Discussion of "Financial Heterogeneity and the Investment Channel of Monetary Policy" by Pablo Ottonello and Tom Winberry

Adrien Auclert

Stanford

Conference on Advances in Financial Research
San Francisco Fed
October 6, 2017

This paper

1. Presents a new empirical regularity
   - Firms with low leverage respond more to monetary policy shocks than firms with high leverage
2. Shows that this fact is consistent with a New Keynesian model with heterogeneous firms and financial frictions
   - Firms with low leverage are unconstrained and respond strongly through a neoclassical cost-of-capital channel
   - Firms with high leverage have essentially no response and choose to de-leverage instead

- Contributes to a literature that shows that heterogeneity is important for understanding the m.p. transmission mechanism
  - One of the first to focus on investment

My assessment of the paper

- Potential to become an important paper in this new literature
- Very nice combination of empirics and theory
  - Model is ambitious combination of
    - Bernanke-Gertler-Gilchrist (sticky prices+financial frictions)
    - Khan-Senga-Thomas (het. firms+default, but flexible prices)
  - Nice micro-to-macro approach: matching data and model elasticities
- My discussion:
  1. Review and discuss the empirical findings
  2. Review and discuss the model and intuitions

Empirical finding

- Main specification runs, for Compustat firms over 1990-2007

$$\Delta \log k_{jt} = \alpha_j + \alpha_{st} + \beta l_{jt-1}\epsilon_t^m + \text{Controls}_{jt} + \epsilon_{jt}$$

  where ϵ_t^m are monetary innovations identified using HFI
- Find $\widehat{\beta} \simeq -0.7$:
  - 1sd increase in l (from 26% to 62%) reduces $\frac{d \log k}{d\epsilon^m}$ from 1.4 to 0.7
- Interpretation of $\widehat{\beta}$?
  - Does **not** provide 'causal effect' of leverage l_{jt-1} on sensitivity of investment to mp shocks
  - Lots of reverse causality issues
    - eg firms with high sensitivity to mp might choose not to lever up
  - **Does** provide descriptive evidence of the way in which sensitivity of investment to mp shocks varies in the cross-section of firms with different leverage

Structural interpretation

- **Structural interpretation**:
  - Ex-ante homogeneous firms lever up to grow, putting themselves at risk of default
  - Older firms with low leverage are less at risk, can more freely adjust as their target capital changes

Structural interpretation

- **Structural interpretation**:
  - Ex-ante homogeneous firms lever up to grow, putting themselves at risk of default
  - Older firms with low leverage are less at risk, can more freely adjust as their target capital changes

1. Are firms really ex-ante homogeneous?
   - Industry is an important cross-sectional driver of leverage (eg Lemmon, Roberts, Zender 2008)
   - If industries with systematically low leverage also are more exposed to mp, challenges structural interpretation
   - **1 digit** sic code fixed effects (eg 'Manufacturing', 'Services') unlikely to be granual enough. Does sample size allow to go beyond?
2. Is there supportive evidence for this life cycle story?
   - Firm age as a predictor of leverage?

An alternative view

- **Alternative view**: firms with high (esp. floating-rate) debt respond *more* because of cash flow effects
  - Seems rejected by data: $\widehat{\beta}$ *more negative* when $l \equiv \frac{\text{ST debt}}{\text{Assets}}$

An alternative view

- **Alternative view**: firms with high (esp. floating-rate) debt respond *more* because of cash flow effects
  - Seems rejected by data: $\widehat{\beta}$ *more negative* when $l \equiv \frac{\text{ST debt}}{\text{Assets}}$
- Ippolito-Ozdagli-Perez (2013). Compustat firms, 2003-2008

$$\Delta \log k_{jt} = \beta_0 + \beta_1 \epsilon_t^m + \beta \left(\frac{\text{Bank debt}}{\text{Assets}} \right)_{jt-1} \epsilon_t^m + \text{Controls}_{jt} + \epsilon_{jt}$$

  separately for hedgers and non-hedgers. ϵ_t^m also from HFI.
- Find evidence of $\widehat{\beta} > 0$ for non-hedgers
  - Fairly strong supportive evidence from stock prices, cash holdings, etc
  - Should cite paper and discuss source of differences
    - sample, fixed-effect strategy, etc.

Model idea

- Consider the partial eqbm neoclassical model of investment:

$$V_t(b,k) = \max\left\{ k^\alpha - \underbrace{\left(k' - (1-\delta)k\right)}_{\text{investment}} + \underbrace{\frac{b'}{1+r_t} - b}_{\text{debt issuance}} + \frac{1}{1+r_t} V_{t+1}\left(b', k'\right) \right\}$$

where b is debt, k is capital.

Model idea

- Consider the partial eqbm neoclassical model of investment:

$$V_t\left(b,k\right)=\max\left\{k^{\alpha}-\underbrace{\left(k'-\left(1-\delta\right)k\right)}_{\text{investment}}+\underbrace{\frac{b'}{1+r_t}-b}_{\text{debt issuance}}+\frac{1}{1+r_t}V_{t+1}\left(b',k'\right)\right\}$$

  where b is debt, k is capital. Well-known FOCs:

  1. $V_b=1\Rightarrow$ Modigliani-Miller theorem for capital structure
  2. $\alpha k_{t+1}^{\alpha-1}=r_t+\delta\Rightarrow$ investment **very sensitive** to r_t changes

$$\frac{dk_{t+1}}{k}=\frac{-1}{1-\alpha}\frac{1}{r+\delta}dr_t$$

Model idea

- Consider the partial eqbm neoclassical model of investment:

$$V_t(b,k) = \max\left\{ k^\alpha - \underbrace{\left(k' - (1-\delta)k\right)}_{\text{investment}} + \underbrace{\frac{b'}{1+r_t} - b}_{\text{debt issuance}} + \frac{1}{1+r_t} V_{t+1}\left(b',k'\right) \right\}$$

where b is debt, k is capital. Well-known FOCs:

1. $V_b = 1 \Rightarrow$ Modigliani-Miller theorem for capital structure
2. $\alpha k_{t+1}^{\alpha-1} = r_t + \delta \Rightarrow$ investment **very sensitive** to r_t changes

$$\frac{di_t}{i} = \frac{-1}{1-\alpha}\frac{1}{r+\delta}\frac{1}{\delta}dr_t$$

Model idea

- Consider the partial eqbm neoclassical model of investment:

$$V_t\left(b,k\right)=\max\left\{k^{\alpha}-\underbrace{\left(k'-\left(1-\delta\right)k\right)}_{\text{investment}}+\underbrace{\frac{b'}{1+r_t}-b}_{\text{debt issuance}}+\frac{1}{1+r_t}V_{t+1}\left(b',k'\right)\right\}$$

where b is debt, k is capital. Well-known FOCs:

1. $V_b=1\Rightarrow$ Modigliani-Miller theorem for capital structure
2. $\alpha k_{t+1}^{\alpha-1}=r_t+\delta\Rightarrow$ investment **very sensitive** to r_t changes

$$\frac{di_{t+1}}{i}=\frac{-1}{0.15}\frac{1}{0.01+0.03}\frac{1}{0.03}dr_t$$

Model idea

- Consider the partial eqbm neoclassical model of investment:

$$V_t(b,k) = \max \left\{ k^\alpha - \underbrace{\left(k' - (1-\delta)k\right)}_{\text{investment}} + \underbrace{\frac{b'}{1+r_t} - b}_{\text{debt issuance}} + \frac{1}{1+r_t} V_{t+1}\left(b', k'\right) \right\}$$

where b is debt, k is capital. Well-known FOCs:

1. $V_b = 1 \Rightarrow$ Modigliani-Miller theorem for capital structure
2. $\alpha k_{t+1}^{\alpha-1} = r_t + \delta \Rightarrow$ investment **very sensitive** to r_t changes

$$\frac{di_{t+1}}{i} \simeq 5555 dr_t$$

- If mp moves cost of capital by $dr_t = 25$bps over a quarter
- ... firms adjust their **capital stock next period** by 41% ($6 \to 8.5$)
- ... so their investment rises from $\delta k = 0.18$ to 2.68, ie 1400%

General equilibrium considerations

- Flexible prices (RBC, Khan and Thomas etc): makes dr_t tiny
- Sticky prices with flexible investment choice:
  - Aggregate diminishing returns to K: lowers α
  - **But** endogenous fall in markups $\mu_t \downarrow$ amplifies even more

$$MPK_t = \mu_t \left(r_t + \delta \right)$$

General equilibrium considerations

- Flexible prices (RBC, Khan and Thomas etc): makes dr_t tiny
- Sticky prices with flexible investment choice:
  - Aggregate diminishing returns to K: lowers α
  - **But** endogenous fall in markups $\mu_t \downarrow$ amplifies even more

$$MPK_t = \mu_t \left(r_t + \delta\right)$$

- Solution: add aggregate adjustment costs $\Rightarrow$ q theory

$$\frac{di_t}{i} = \epsilon dq_t = \epsilon \sum_{s=0}^{\infty} \left(\frac{1}{1+r}\right)^{s+1} \left\{dMPK_{t+s+1} - dr_{t+s}\right\}$$

  - Semielasticity now can be calibrated to ϵ (say $\simeq 1$)
  - Should absolutely be the baseline, not just for robustness
  - Partial equilibrium formulas not informative because all the action is in GE endogenous responses of q_t and μ_t to r_t

Adding constrained firms

- Add positive-dividend contraint and convex $C(b)$

$$V_t(b,k) = \max\left\{D + \frac{1}{1+r_t} V_{t+1}\left(b', k'\right)\right\}$$

$$\text{s.t.} \quad D = k^{\alpha} - \left(k' - (1-\delta)k\right) + \frac{b'}{1+r_t} - b + \mathbf{C}(\mathbf{b})$$

$$D \geq 0$$

- FOCs now

$$1 + C'(b_t) = \frac{1+\lambda_t}{1+\lambda_{t+1}} = \frac{\alpha k_{t+1}^{\alpha-1} + 1 - \delta}{1+r_t}$$

1. While $\lambda_t > 0$, reduce b_t and increase k_t
2. Rearrange $\alpha k_{t+1}^{\alpha-1} = r_t\left(1 + C'(b_t)\right) + \delta$

Comments

- Add back productivity shocks z_{t+1}

$$\alpha z_{t+1} k_{t+1}^{\alpha-1} = r_t \left(1 + C'\left(b_t\right)\right) + \delta$$

- **Question**: What special endogenous feature of $C\left(b, k\right)$ schedule can jointly explain lack of sensitivity of constrained firms to r_t, but high sensitivity to productivity z_{t+1}?
- Bond price formulation $Q_t\left(b'\right) - b$ shuts down cash flow effects.
    - Alternative: $q_t\left(b'\right) - \left(1 + r_{t-1}\right) b$
- General equilibrium intuition for het firm model $\simeq$ rep firm model relies on flexible prices.
    - Expect larger differences, the stickier prices are

Wrapping up and suggestions

- Ambitious project on an important topic! My suggestions:
- Empirics: tidy up and compare with existing literature
  - Can you back up your structural interpretation? Can you convincingly rule out the cash flow channel?
- Model: make q theory the baseline, drop formulas for one-period shocks and focus on precise explanation of the key mechanism using combination of FOCs and counterfactuals
- Make empirics-model connection even tighter by matching model and data elasticities