What is the Role of Firm Balance Sheets in Economic Fluctuations?

Pablo Ottonello
Michigan & NBER

Advancing Macro Finance Workshop,
University of Chicago, October 8th, 2021
Introduction

What is the role of firm balance sheets in economic fluctuations?

1. **Pioneer theories**: link between firms’ net worth, external financing costs, and investment
   (Bernanke Gertler 1989, Kiyotaki Moore 1997)

2. **Quantitatively**: powerful channel amplifying effects of aggregate shocks and policies
   (Bernanke Gertler Gilchrist 1999, Jerman Quadrini 2012, Christiano Eichenbaum Trabandt 2014)

3. **More recently**: “micro-to-macro” approach
   ▶ studies how different firms respond to aggregate shocks in micro data
   ▶ combine data and models to analyze aggregate implications
Motivation: Firms’ Investment During U.S. Recessions

Data source: Compustat
Outline

1. **Theoretical framework**
   Discuss key mechanisms in exiting models in the literature through which aggregate shock affect firms with different financial positions

2. **Empirical evidence**
   Discuss existing evidence linking firms’ financial positions and their responses to aggregate shocks through the lens of the model

3. **From micro evidence to macro implications**
   - Positive analysis
   - Normative analysis
Theoretical Framework
Environment

- No uncertainty, focus on firms’ decisions for given path of prices
- Firms’ objective:
  \[
  \max \sum_{r=0}^{\infty} m_{t,t+r}d\nu_{jt+r}
  \]
- Technology:
  \[
  y_{jt} = A_t z_{jt} k_{jt}^{\alpha}
  \]
- Competitive markets, sells output at price \( p_t \), purchases capital at price \( q_t \)
Financial Frictions

- Firms have access to equity and debt finance, both subject to frictions
- Flow-of-funds constraint:

\[ q_t k_{jt+1} = n_{jt} - \text{div}_{jt} (1 - \mathbb{1}_{\text{div}_{jt} < 0}) C_t (\text{div}_{jt}, k_{jt+1}, \{z_{jt}\}) + Q_t (d_{jt+1}, k_{jt+1}, \{z_{jt}\}) d_{jt+1} \]

where \( n_{jt} \equiv p_t y_{jt} + q_t (1 - \delta) k_{jt} - d_{jt} \)

\( C_t(\cdot) \): cost of raising equity

\( Q_t(\cdot) \): debt price schedule
Financial Frictions

- Flow-of-funds constraint:

\[ q_t k_{jt+1} = n_{jt} - \text{div}_{jt}(1 - \mathbb{I}_{\text{div}_{jt} < 0})C_t(\text{div}_{jt}, k_{jt+1}, \{z_{jt}\}) + Q_t(d_{jt+1}, k_{jt+1}, \{z_{jt}\})d_{jt+1} \]

- \{C_t(.), Q_t(.)\}: govern marginal cost of external finance, nesting detailed financing frictions:
  
  - **Costly equity financing**
    
  
  - Collateral constraints
  
  - Default risk
  
  - Covenants, earnings-based constraints
Financial Frictions

• Flow-of-funds constraint:

\[ q_t k_{jt+1} = n_{jt} - \text{div}_jt \left( 1 - \mathbb{1}_{\text{div}_jt < 0} C_t(\text{div}_jt, k_{jt+1}, \{z_{jt}\}) \right) + Q_t(d_{jt+1}, k_{jt+1}, \{z_{jt}\}) d_{jt+1} \]

• \{C_t(\cdot), Q_t(\cdot)\}: govern marginal cost of external finance, nesting detailed financing frictions:
  ▶ Costly equity financing
  ▶ **Collateral constraints**
    (Kiyotaki Moore 1997, Kahn Thomas 2013)
  ▶ Default risk
  ▶ Covenants, earnings-based constraints
Financial Frictions

- Flow-of-funds constraint:

\[ q_t k_{jt+1} = n_{jt} - d i v_{jt} (1 - \mathbb{I}_{div_{jt}<0}) C_t(d i v_{jt}, k_{jt+1}, \{z_{jt}\}) + Q_t(d_{jt+1}, k_{jt+1}, \{z_{jt}\}) d_{jt+1} \]

- \( \{C_t(.), Q_t(.)\} \): govern marginal cost of external finance, nesting detailed financing frictions:
  - Costly equity financing
  - Collateral constraints
  - **Default risk**
  - Covenants, earnings-based constraints
**Financial Frictions**

- Flow-of-funds constraint:

\[ q_t k_{jt+1} = n_{jt} - div_{jt}(1 - \mathbb{1}_{div_{jt} < 0}) C_t(div_{jt}, k_{jt+1}, \{z_{jt}\}) + Q_t(d_{jt+1}, k_{jt+1}, \{z_{jt}\})d_{jt+1} \]

- \{C_t(.), Q_t(.)\}: govern **marginal cost of external finance**, nesting detailed financing frictions:
  - Costly equity financing
  - Collateral constraints
  - Default risk
  - **Covenants, earnings-based constraints**
  (Chodorow-Reich Falato 2020, Lian Ma 2021, Greenwald 2019, Drechsel 2021)
Financial Frictions

- Flow-of-funds constraint:

\[ q_t k_{jt+1} = n_{jt} - \text{div}_{jt}(1 - \mathbb{I}\{\text{div}_{jt} < 0\}) C_t(\text{div}_{jt}, k_{jt+1}, \{z_{jt}\}) + Q_t(d_{jt+1}, k_{jt+1}, \{z_{jt}\}) d_{jt+1} \]

- \{C_t(.), Q_t(.)\}: govern marginal cost of external finance, nesting detailed financing frictions

- Parameterize with \( C_t(.) = \phi_t x_{jt}^{\eta_t} \) with \( \phi_t > 0, \eta_t > 1, d_{jt+1} \leq \bar{d}_t \)
Firms’ Differential Response to Aggregate Shocks

- Consider unanticipated expansionary aggregate shock to either
  - Productivity $A_t$
  - Other exogenous variables (e.g., monetary policy shocks or financial shocks), which affect $P_t \equiv [p_t, q_t, m_{t,t+1}]$

- Discuss channels through which shock affect firms with different financial positions in MC/MB diagram, as in Ottonello and Winberry (2020)
Firms’ Optimal Investment

(a) Unconstrained Firms

\[ q_t = m_{t,t+1} \left( p_{t+1} A_{t+1} z_{t+1} \alpha (k_{t+1})^{\alpha - 1} + (1 - \delta) q_{t+1} \right) \]
Firms’ Optimal Investment

(a) Unconstrained Firms

\[ q_t = m_{t,t+1} \left( p_{t+1} A_{t+1} z_{jt+1} \alpha (k_{t+1})^\alpha - 1 + (1 - \delta) q_{t+1} \right) \]

(b) Constrained Firms

\[ q_t \tilde{C}(k_{jt+1}) = m_{t,t+1} \left( p_{t+1} A_{t+1} z_{jt+1} \alpha (k_{t+1})^\alpha - 1 + (1 - \delta) q_{t+1} \right) \]
Firms’ Differential Response: Shift in MB curve

(a) Unconstrained Firms

(b) Constrained Firms

\[ q_t = m_{t,t+1} \left( p_{t+1} A_t z_{t+1} k_t^{\alpha-1} + (1 - \delta) q_{t+1} \right) \]

\[ q_t \tilde{C}(k_{j+1}) = m_{t,t+1} \left( p_{t+1} A_t z_{t+1} k_t^{\alpha-1} + (1 - \delta) q_{t+1} \right) \]
Firms’ Differential Response: Shift in MC curve – Price of Capital

(a) Unconstrained Firms

(b) Constrained Firms

\[ q_t = m_{t,t+1} \left( p_{t+1} A_{t+1} z_{jt+1} \alpha(k_{t+1})^{\alpha-1} + (1 - \delta) q_{t+1} \right) \]

\[ q_t \tilde{C}_t(k_{jt+1}) = m_{t,t+1} \left( p_{t+1} A_{t+1} z_{jt+1} \alpha(k_{t+1})^{\alpha-1} + (1 - \delta) q_{t+1} \right) \]
Firms’ Differential Response: Shift in MC curve – Cash Flows

(a) Unconstrained Firms

\[ q_t = m_{t,t+1} \left( p_{t+1} A_{t+1} z_{j,t+1} \alpha (k_{t+1})^{\alpha - 1} + (1 - \delta) q_{t+1} \right) \]

(b) Constrained Firms

\[ q_t \tilde{C}_{t}(k_{j,t+1}) = m_{t,t+1} \left( p_{t+1} A_{t+1} z_{j,t+1} \alpha (k_{t+1})^{\alpha - 1} + (1 - \delta) q_{t+1} \right) \]
Firms’ Differential Response: Shift in MC curve – Financing Cost

(a) Unconstrained Firms

\[ q_t = m_{t,t+1} \left( p_{t+1} A_{t+1} z_{jt+1} \alpha(k_{t+1})^{\alpha-1} + (1 - \delta)q_{t+1} \right) \]

(b) Constrained Firms

\[ q_t \tilde{C}_t(k_{jt+1}) = m_{t,t+1} \left( p_{t+1} A_{t+1} z_{jt+1} \alpha(k_{t+1})^{\alpha-1} + (1 - \delta)q_{t+1} \right) \]
Theoretical Framework: Main Takeaways

1. Which firms are more responsive
   - is an empirical question:
     - Constrained firms face steeper MC curves, which dampens their responses
     - Constrained firms exhibit additional shifts in MC curves, which amplifies their responses
   - depends on the aggregate shock considered

2. Heterogeneity in firms’ responses can be used to inform about degree of financial frictions: steepness and responsiveness of MC curve in financial-frictions models
Empirical Evidence
Firms’ Differential Responses by Size and Age

- **Small firms** tend to exhibit larger responsiveness to aggregate shock
  - Gertler and Gilchrist (1994): monetary policy shocks
  - Crouzet and Mehrotra (2020): cyclicality

- **Young firms** tend to exhibit larger responsiveness to aggregate shock
  - Cloyne et al. (2018): monetary policy shocks

- **Financial-frictions interpretation**: small/young firms face a steeper MC curve than large/old firms, but small/young firms’ MC curve are more sensitive to aggregate shocks
Firms’ Differential Responses by Size and Age

- **Small/young firms** tend to exhibit larger responsiveness to aggregate shock

- Alternative interpretation:
  - Small/young firms’ MB curves are more sensitive to aggregate shocks
  - For size, Crouzet and Mehrotra (2020) argue that size effects are not driven by financial covariates
  - An illustration for age:

<table>
<thead>
<tr>
<th>Age quartile</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Uber Technologies</strong></td>
<td>Plain GP Holdings</td>
<td>Dell Technologies</td>
<td>McKesson Corp.</td>
<td></td>
</tr>
<tr>
<td>Howmet Aerospace</td>
<td>NBC Universal</td>
<td>Costco</td>
<td>CVS Health</td>
<td></td>
</tr>
<tr>
<td>Carrier Global</td>
<td>T-Mobile</td>
<td>Alphabet</td>
<td>Apple</td>
<td></td>
</tr>
<tr>
<td>Dow Inc.</td>
<td>Facebook</td>
<td>AmerisourceBergen</td>
<td>Berkshire Hathaway</td>
<td></td>
</tr>
<tr>
<td>Albertsons</td>
<td>Phillips 66</td>
<td>Amazon</td>
<td>Walmart</td>
<td></td>
</tr>
</tbody>
</table>

Data source: Compustat, Datastream
Firms’ Differential Responses by Balance-Sheet Components

- **Advantages** of balance-sheet based measures
  - Easier to link to a particular mechanism in existing models (e.g., debt and default risk)
  - Exhibit substantial within-firm variation

- **Limitations** of balance-sheet based measures
  - Data availability, especially to extract permanent differences across firms
  - Multidimensionality of balance sheet, e.g.:
    - Leverage
    - Liquidity (Jeenas 2020)
    - Credit lines (Greenwald Krainer Paul 2021)
Firms’ Differential Responses by Leverage and Default Risk

- Firms with higher leverage and lower distance to default tend to be **less responsive** to monetary policy shocks (Ottonello Winberry 2020)
  - Financial-frictions interpretation: default risk leads to steeper MC curve
  - Interpretation based on MB curve has to account for within firm results
Firms’ Differential Responses by Leverage and Default Risk

- Firms with higher leverage and lower distance to default tend to be **less responsive** to monetary policy shocks (Ottonello Winberry 2020)
  - Financial-frictions interpretation: default risk leads to steeper MC curve
  - Interpretation based on MB curve has to account for within firm results
- Firms with higher leverage and lower distance to default tend to be **more responsive**:
  - to financial shocks (Ottonello Song 2021)
  - to monetary policy shock in the post-Great Recession period (Lakdawala Moreland 2021, Caglio Darst Kalemli-Ozcan 2021):
Empirical Evidence: Main Takeaways

1. Evidence shows substantial heterogeneity in firms’ responses to aggregate shocks
   - Can be used to inform steepness and responsiveness of MC curve

2. Differences in severity of financial frictions are not easy to isolate
   - Effects of confounders (e.g., permanent differences across firms)
   - Multidimensionality of balance sheet

3. **Models** are critical to interpret empirical findings
   - Evidence is ultimately descriptive (due to endogeneity of financial positions)
   - Firms’ heterogeneous responses vary depending on the aggregate shock
From Micro Evidence to Macro Implications
From Micro Evidence to Macro Implications

- Models consistent with microlevel evidence show that firms’ financing frictions amplify effects of aggregate shocks and policies
  - E.g.: Khan and Thomas 2013, Arellano Bai Kehoe 2019, Ottonello Winberry 2020, ...
From Micro Evidence to Macro Implications

- Models consistent with microlevel evidence show that firms’ financing frictions amplify effects of aggregate shocks and policies.

Remarks:

1. Positive side: quantitative conclusions significantly depend on model elements that are hard to measure:
   - sensitivity of capital prices to shocks, share of unconstrained firms, decreasing returns (e.g., Guo 2021)

Complementary approaches that would help inform macro implications:

- Direct estimation of regional / GE effects (Huber 2018)
- Semi-structural methods (Wolf 2020, Guren McKay Naramura Steinsson 2020)
From Micro Evidence to Macro Implications

- Models consistent with microlevel evidence show that firms’ financing frictions amplify effects of aggregate shocks and policies

- Remarks:
  1. Positive side: quantitative conclusions significantly depend on model elements that are hard to measure
     - sensitivity of capital prices to shocks, share of unconstrained firms, decreasing returns (e.g., Guo 2021)

Complementary approaches that would help inform macro implications:
- Direct estimation of regional / GE effects (Huber 2018)
- Semi-structural methods (Wolf 2020, Guren McKay Naramura Steinsson 2020)
From Micro Evidence to Macro Implications

- Models consistent with microlevel evidence show that firms’ financing frictions amplify effects of aggregate shocks and policies

- Remarks:

  2. **Normative side:**

  - Financial amplification is not sufficient for borrowing inefficiencies (Davila Korinek 2017)
  - Inefficiencies critically depend on specific form of debt contracts (Ottonello Perez Varraso 2021)
    - Inefficient when contracts involve **current prices**: \( d_{t+1} \leq \theta_t q_t k_{t+1} \) (Bianchi Mendoza 2018)
    - Efficient when contracts involve **future prices**: \( d_{t+1} \leq \theta_t q_{t+1} k_{t+1} \) (Kiyotaki Moore 1997)
  - Both type of models lead to similar macro dynamics
  - Micro-evidence on the form of debt contracts is essential ingredient for policy design (e.g., Chodorow-Reich Falato 2020, Lian Ma 2021, Greenwald 2019, Drechsel 2021)
Conclusions

- Firms balance sheets appear at the center of economic fluctuations
- Evidence shows substantial heterogeneity in the response of firms with different financial positions to aggregate shocks
- Quantitative models are necessary to interpret empirical findings, but not sufficient to assess GE effects and policies
- Additional measurement would help models by answering:
  - what are the GE effects of changes in firms’ financial positions
  - how prices affect debt contracts