Monetary Policy, Corporate Finance & Investment

James Cloyne (UC Davis, NBER & CEPR)
Clodo Ferreira (Bank of Spain)
Maren Froemel (LBS & BoE)
Paolo Surico (LBS & BoE)

March 2019

The views expressed are those of the authors and do not necessarily reflect the views of the Bank of Spain, the Euro-system, Bank of England, MPC, FPC or PRA. This research has been funded by the European Research Council.
Monetary Policy and Firm Finance

▶ How does monetary policy affect firm investment? Which type of firms are most responsive?

▶ How do firms’ balance sheets respond?

▶ How important are financial frictions?
Our Approach

- Firm-level panel approach for the US and UK
  - Heterogeneity in the dynamic effects of policy across firms.
  - Micro data with macro identification of policy rate changes.

- Which firms change investment the most?

- Which proxies for financial constraints should we focus on?
  - Age
  - Size
  - Growth
  - Leverage
  - Liquidity
  - Dividend status
  - Q

- Multivariate heterogeneity analysis.

- What happens to these firms' balance sheets?
  - Borrowing
  - Equity
  - Earnings/cash flows
  - Share prices.

- Heterogeneity used to examine the transmission mechanism.
Our Approach

■ Firm-level panel approach for the US and UK
  ▶ *Heterogeneity in the dynamic effects of policy across firms.*
  ▶ *Micro data with macro identification of policy rate changes.*

■ Which firms change **investment** the most?
  ▶ *Which proxies for financial constraints should we focus on?*
  ▶ **Age**, size, growth, leverage, liquidity, dividend status, Q
  ▶ *Multivariate heterogeneity analysis.*
Our Approach

- **Firm-level panel approach for the US and UK**
  - Heterogeneity in the dynamic effects of policy across firms.
  - Micro data with macro identification of policy rate changes.

- **Which firms change investment the most?**
  - Which proxies for financial constraints should we focus on?
  - Age, size, growth, leverage, liquidity, dividend status, Q
  - Multivariate heterogeneity analysis.

- **What happens to these firms’ balance sheets?**
  - Borrowing, equity, earnings/cash flows, share prices.
Our Approach

■ Firm-level panel approach for the US and UK
  ▶ Heterogeneity in the dynamic effects of policy across firms.
  ▶ Micro data with macro identification of policy rate changes.

■ Which firms change investment the most?
  ▶ Which proxies for financial constraints should we focus on?
  ▶ Age, size, growth, leverage, liquidity, dividend status, Q
  ▶ Multivariate heterogeneity analysis.

■ What happens to these firms’ balance sheets?
  ▶ Borrowing, equity, earnings/cash flows, share prices.

■ Heterogeneity used to examine the transmission mechanism.
Main Findings

■ Investment

1. Age is a robust predictor: Younger firms respond the most. Quantitatively important to account for the aggregate response.

2. Especially pronounced for firms not paying dividends.

3. Robust to controlling for more traditional characteristics.

■ Firm Finance

4. Younger firms: lower earnings, lower credit scores and leverage. Less likely to pay dividends. Borrowing is more asset-based.

5. After a contractionary monetary policy, net worth falls for all firms. But borrowing falls the most for younger firms paying no dividends.

■ Interpretation of the evidence/channel: higher interest rates→ lower asset values → borrowing falls → investment falls.
Main Findings

■ Investment

1. **Age** is a robust predictor: **Younger firms** respond the most. Quantitatively important to account for the aggregate response.

2. Especially pronounced for firms **not paying dividends**.

3. **Robust** to controlling for **more traditional** characteristics.

■ Firm Finance

4. **Younger firms**: lower earnings, lower credit scores and leverage. Less likely to pay dividends. **Borrowing** is more **asset-based**.

5. After a contractionary monetary policy, **net worth falls** for all firms. But **borrowing** falls the most for younger firms paying no dividends.
Main Findings

**Investment**

1. **Age** is a robust predictor: Younger firms respond the most. Quantitatively important to account for the aggregate response.

2. Especially pronounced for firms **not paying dividends**.

3. **Robust** to controlling for *more traditional* characteristics.

**Firm Finance**

4. Younger firms: lower earnings, lower credit scores and leverage. Less likely to pay dividends. **Borrowing** is more asset-based.

5. After a contractionary monetary policy, net worth falls for all firms. But **borrowing** falls the most for younger firms paying no dividends.

**Interpretation of the evidence/channel:** higher interest rates→
→ lower asset values → **borrowing falls** → investment falls.
Literature

Empirics...

- **Age & employment** (Haltiwanger et al., 2013, Bahaj et al., 2018)
- **Age, size, leverage & business cycles**
  (Dinlersoz et al., 2018, Crouzet & Mehrotra 2018)
- **Firm Finance & business cycles**
  (Covas & den Haan, 2011, Begenau & Salomao, 2018)
- **Investment & financial frictions** (Fazzari et al. 1988, Gertler & Gilchrist 1994, Ottonello & Winberry 2018, Jeenas, 2018)
- **Firm borrowing constraints** (Lian & Ma, 2018, Drechsel, 2018)

Financial frictions...

- **Age & growth prospects** (Cooley-Quadrini, 2001, Cooper et al. 2006)
- **Leverage, asset prices/collateral values & monetary policy**
  (Bernanke, Gertler & Gilchrist, 1999, Kiyotaki & Moore, 1997, etc.)
Outline

Data & Approach

Age as a Proxy for Financial Constraints

Heterogeneity in the Response of Investment

Firm Finance and Balance Sheet Response

Concluding remarks
Firm Data: Panel of Public Firms


- Also make use of corporate bonds and asset price data (CRSP and Thomson Reuters)

- Key variables of interest:
  - **Investment**: capital expenditure/net PPE.
  - **Age**: Worldscope years since incorporation.
  - **Other variables**: assets, debt, leverage (debt/assets), liquidity, Tobin’s Q, equity, share prices, earnings/sales, dividends paid, interest payments.
Monetary Policy: Identification

- Gertler-Karadi approach: High frequency surprises in short rate futures around policy announcements.

- Instrument available since 2001 for the U.K. (Gerko-Rey) and 1991 for the U.S. (Gertler-Karadi).


- Identifies a series of monetary policy shocks for the full sample.
Empirical Specification

\[ \Delta_h X_{i,t+h} = \gamma_i^h + \sum_{g=1}^G \beta_g^h \cdot I [Z_{i,t-1} \in g] \cdot R_t + \sum_{g=1}^G \alpha_g^h \cdot I [Z_{i,t-1} \in g] + \epsilon_{i,t+h} \]

- **Baseline** \( X_{i,t+h} \): capex/net PPE at horizon \( h \). Also look at equity, borrowing, earnings, share prices etc.

- **\( Z_{i,t-1} \)**: variable defining a group: age, size, growth, leverage, beta, paying dividends in previous year. Could be multivariate.

- **\( R_t \)**: interest rate in GK/GR instrumented with structural shocks.
Response of the investment ratio to a 25 basis point increase in interest rates. Confidence bands 90%. Firm-time clustering.

Consistent with using data from national statistics. IRFs even more similar when reporting at the same frequency.
Outline

Data & Approach

Age as a Proxy for Financial Constraints

Heterogeneity in the Response of Investment

Firm Finance and Balance Sheet Response

Concluding remarks
Younger firms are smaller, have lower cash-flows but grow faster

Regressions of the variable of interest on age, squared age, sectorsXtime fixed effects (and size).
Financial Characteristics by **AGE**

Younger firms: lower credit scores/less likely to pay dividends.

**Credit scores**
- United States: Shows a decrease in credit scores with increasing age, with lower ratings for younger firms.
- United Kingdom: Shows a linear increase in credit scores with increasing age, with higher ratings for younger firms.

**Dividends & Bonds**
- United States: Shows an increase in the probability of issuing bonds and paying dividends with increasing age, with a slight increase in the probability of buybacks.
- United Kingdom: Shows a slight increase in the probability of issuing bonds and paying dividends with increasing age, with no significant increase in the probability of buybacks.

Based on regressions of the variable of interest on age, squared age, sectorsXtime fixed effects (and size).
Leverage and Liquidity by **AGE**

Younger firms are less leveraged/hold more liquid assets

Based on regressions of the variable of interest on age, squared age, sectorsXtime fixed effects (and size).
Summary: What Does Age Capture?

Younger firms tend to:

► be smaller
► have lower earnings
► have lower
  ► credit scores
  ► probability of paying dividends

But younger firms also have:

► lower leverage and higher liquid assets
► faster growth and higher (average) Tobin’s Q
Outline

Data & Approach

Age as a Proxy for Financial Constraints

Heterogeneity in the Response of Investment

Firm Finance and Balance Sheet Response

Concluding remarks
Response of Investment by AGE

United States

Younger

Middle-aged

Older

United Kingdom

United States

25 basis point increase in interest rates. Standard errors clustering by firm and time. Confidence band: 90%.
Investment Response by **AGE & DIVIDENDS**: U.S.

25 basis point increase in interest rates. Standard errors clustering by firm and time. Confidence band: 90%.
Investment Response by **AGE & DIVIDENDS: U.K.**

Younger

![Graph showing investment response for Younger with dividends and no dividends.]

Older

![Graph showing investment response for Older with dividends and no dividends.]

25 basis point increase in interest rates. Standard errors clustering by firm and time. Confidence band: 90%.
## YOUNGER Firms Drive the Average Effect

<table>
<thead>
<tr>
<th>Younger</th>
<th>Older</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>No Div</td>
<td>Paid Div</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>U.S.</td>
<td>75.5%</td>
</tr>
<tr>
<td></td>
<td>[68.1, 82.8]</td>
</tr>
<tr>
<td>U.K.</td>
<td>83.6%</td>
</tr>
<tr>
<td></td>
<td>[70.4, 96.8]</td>
</tr>
</tbody>
</table>

Notes: 95% CI in square brackets
Age is correlated with a range of other factors. Do our IRFs simply capture one of these other factors? No.

Results are robust to conditioning on:

1. Size [charts]
2. Leverage [charts]
3. Liquidity [charts]
4. Firm growth [charts] and Tobin’s Q [charts]
5. Risk [see section 7.2 in the paper]
Outline

Data & Approach

Age as a Proxy for Financial Constraints

Heterogeneity in the Response of Investment

Firm Finance and Balance Sheet Response

Concluding remarks
BORROWING responds most for Younger/No Div.

25 basis point increase in interest rates. Standard errors clustering by firm and time. Confidence band: 90%.

Muted, more homogeneous and less persistent response of interest payments.
Borrowing: Asset vs. Earning-Based

\[ \Delta B_{i,t} = \sum_{g=1}^{G} \beta_{1,g} \cdot I[Z_{i,t-1} \in g] \cdot COLL_{i,t-1} + \sum_{g=1}^{G} \beta_{2,g} \cdot I[Z_{i,t-1} \in g] \cdot EBITDA_{i,t-1} + X'_{i,t} \gamma + \epsilon_{i,t} \]

<table>
<thead>
<tr>
<th>COLLABERAL</th>
<th>U.K.</th>
<th>U.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Young / No Div</td>
<td>Old / Div</td>
<td>Young / No Div</td>
</tr>
<tr>
<td>EBITDA</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Dependent variable: \( \Delta \) long-term debt

Note: regressions include time-sector, group and firm fixed effects, plus a range of other lagged firms’ characteristics as controls. Standard errors are clustered by time and firm.
Borrowing: Asset vs. Earning-Based

\[
\Delta B_{i,t} = \sum_{g=1}^{G} \beta_{1,g} \cdot I[Z_{i,t-1} \in g] \cdot COLL_{i,t-1} + \sum_{g=1}^{G} \beta_{2,g} \cdot I[Z_{i,t-1} \in g] \cdot EBITDA_{i,t-1} + X'_{i,t} \gamma + \epsilon_{i,t}
\]

<table>
<thead>
<tr>
<th>COLLATERAL</th>
<th>U.K.</th>
<th>U.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Young / No Div</td>
<td>Old / Div</td>
</tr>
<tr>
<td>COLLATERAL</td>
<td>0.025***</td>
<td>0.012</td>
</tr>
<tr>
<td></td>
<td>(0.009)</td>
<td>(0.009)</td>
</tr>
<tr>
<td>EBITDA</td>
<td>-0.013</td>
<td>0.069***</td>
</tr>
<tr>
<td></td>
<td>(0.011)</td>
<td>(0.019)</td>
</tr>
</tbody>
</table>

Dependent variable: \( \Delta \) long-term debt

Note: regressions include time-sector, group and firm fixed effects, plus a range of other lagged firms’ characteristics as controls. Standard errors are clustered by time and firm.
Borrowing: Asset vs. Earning-Based

\[ \Delta B_{i,t} = \sum_{g=1}^{G} \beta_{1,g} \cdot I[Z_{i,t-1} \in g] \cdot \text{COLL}_{i,t-1} + \sum_{g=1}^{G} \beta_{2,g} \cdot I[Z_{i,t-1} \in g] \cdot \text{EBITDA}_{i,t-1} + X'_{i,t} + \epsilon_{i,t} \]

<table>
<thead>
<tr>
<th></th>
<th>U.K.</th>
<th>U.S.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Young / No Div</td>
<td>Old / Div</td>
</tr>
<tr>
<td>COLLATERAL</td>
<td>0.025*** (0.009)</td>
<td>0.012 (0.009)</td>
</tr>
<tr>
<td>EBITDA</td>
<td>-0.013 (0.011)</td>
<td>0.069*** (0.019)</td>
</tr>
</tbody>
</table>

Dependent variable: \( \Delta \) long-term debt

Note: regressions include time-sector, group and firm fixed effects, plus a range of other lagged firms’ characteristics as controls. Standard errors are clustered by time and firm.
EQUITY (MKT. VALUE) falls

Younger & NO dividends

United States

Older & Paying dividends

United Kingdom

25 basis point increase in interest rates. Standard errors clustering by firm and time. Confidence band: 90%.
Response of EARNINGS

Younger & NO dividends

Older & Paying dividends

25 basis point increase in interest rates. Standard errors clustering by firm and time. Confidence band: 90%.
Transmission Mechanism

To recap:
- Net worth falls for all groups.
- Borrowing of younger-no dividend firms is more correlated with asset values than with earnings.
- Borrowing only significantly falls for these firms.

Other channels?
1. Demand
2. Growth and profitability
3. Liquidity
4. Risk
Sensitivity analysis

Results are robust to

- survival bias
- information effect
- sectoral heterogeneity
- ending the sample in 2007
Our contribution: **FIVE NEW FINDINGS**...

1. Younger firms respond more than any other group and **drive the aggregate response** of investment to interest rate changes

2. Results are more pronounced for young firms **paying no dividends** and robust to controlling for other firm characteristics
Our contribution: **Five New Findings...**

1. Younger firms respond more than any other group and **drive the aggregate response** of investment to interest rate changes.

2. Results are more pronounced for young firms **paying no dividends** and robust to controlling for other firm characteristics.

3. Younger firms’ **borrowing is more asset-based** (than earning-based).

4. **Net worth and share prices** move for all firms.

5. **Borrowing responds most** for younger firms.
Younger firms tend to borrow against the value of their assets to fund capital expenditure.

Rate increases push down asset prices and collateral values.

Borrowing constraints tighten: borrowing and investment falls.

Younger firms account for a sizable part of the aggregate response of investment.

Young firms face financial frictions. Fluctuations in collateral and asset values can play a key role in the MTM.
Extra Slides
Monetary Policy Surprises and Shocks

High-frequency Surprises

Policy Shocks

United States

United Kingdom
Investment: National Statistics vs Micro data

**Levels**

**United States**

- **1985**
  - National Statistics: 6
  - Aggregated Micro Data: 6.5

- **1990**
  - National Statistics: 6.5
  - Aggregated Micro Data: 7

- **1995**
  - National Statistics: 7
  - Aggregated Micro Data: 7.5

- **2000**
  - National Statistics: 8
  - Aggregated Micro Data: 8

- **2005**
  - National Statistics: 8
  - Aggregated Micro Data: 8

- **2010**
  - National Statistics: 8
  - Aggregated Micro Data: 8

- **2015**
  - National Statistics: 8
  - Aggregated Micro Data: 8

**United Kingdom**

- **1985q1**
  - National Statistics: 8.5
  - Aggregated from Micro-Data: 9

- **1990q1**
  - National Statistics: 9
  - Aggregated from Micro-Data: 9.5

- **1995q1**
  - National Statistics: 10
  - Aggregated from Micro-Data: 10

- **2000q1**
  - National Statistics: 10.5
  - Aggregated from Micro-Data: 10.5

- **2005q1**
  - National Statistics: 10.5
  - Aggregated from Micro-Data: 10.5

- **2010q1**
  - National Statistics: 10.5
  - Aggregated from Micro-Data: 10.5

- **2015q1**
  - National Statistics: 10.5
  - Aggregated from Micro-Data: 10.5

**Growth rates**

**United States**

**United Kingdom**
The response of aggregate investment

United Kingdom

United States


Back to average effect
The response of aggregate investment

**United Kingdom**

**United States**

**Monetary Policy shock: 25 basis point increase. Bootstrapped Standard errors.**

▶ Back to average effect
The response of selected macro variables

United States

Employment

Credit Spread

IP

United Kingdom


Back to average effect
The U.S. average effect reported at annual frequency

**United States**

**United Kingdom**

25 basis point increase in interest rates. Standard errors clustering by firm and time. Confidence band: 90%.

Back to average effect
Investment responses by **Paying Dividends**

**United States**

- **NO dividends paid**

**Dividends paid**

**United Kingdom**

25 basis point increase in interest rates. Standard errors clustering by firm and time. Confidence band: 90%.
Investment response by **SIZE**

**United States**

**Smaller**

**Medium**

**Larger**

**United Kingdom**

25 basis point increase in interest rates. Standard errors clustering by firm and time. Confidence band: 90%.
‘Controlling’ for (SMALLER) size

NO dividends & Younger

PAY dividends & Older

United States

United Kingdom

25 basis point increase in interest rates. Standard errors clustering by firm and time. Confidence band: 90%.

Back to robustness summary
Investment response by **ASSET GROWTH**

**Faster-growing**

United States

**Slower-growing**

United Kingdom

25 basis point increase in interest rates. **Standard errors clustering by firm and time. Confidence band: 90%.**
‘Controlling’ for (FASTER) asset growth

25 basis point increase in interest rates. Standard errors clustering by firm and time. Confidence band: 90%.
Investment response by LEVERAGE

25 basis point increase in interest rates. Standard errors clustering by firm and time. Confidence band: 90%.
‘Controlling’ for (LOWER) leverage

25 basis point increase in interest rates. Standard errors clustering by firm and time. Confidence band: 90%.
25 basis point increase in interest rates. Standard errors clustering by firm and time. Confidence band: 90%.
‘Controlling’ for (HIGHER) liquidity

NO dividends & Younger

United States

PAY dividends & Older

United Kingdom

25 basis point increase in interest rates. Standard errors clustering by firm and time. Confidence band: 90%.

Back to robustness summary ▶️ ▶️ Back to mechanism
Investment response by **TOBIN’S Q**

25 basis point increase in interest rates. Standard errors clustering by firm and time. Confidence band: 90%.
‘Controlling’ for (HIGHER) Tobin’s Q

NO dividends & Younger

PAY dividends & Older

United States

United Kingdom

25 basis point increase in interest rates. Standard errors clustering by firm and time. Confidence band: 90%.

Back to robustness summary  Back to mechanism
US Investment Response by **BETA** and **ALPHA**

- **Beta**
  - Low
  - Medium
  - High

- **Alpha**
  - Low
  - Medium
  - High

25 basis point increase in interest rates. Standard errors clustering by firm and time. Confidence band: 90%.
‘Controlling’ for (HIGH) Alpha/Beta (US)

NO dividends & Younger  PAY dividends & Older

25 basis point increase in interest rates. Standard errors clustering by firm and time. Confidence band: 90%.
Firms Who Grow Old

Young & NO dividends

Old & Paying dividends

United States

25 basis point increase in interest rates. Standard errors clustering by firm and time. Confidence band: 90%.

Back to robustness summary  Back to mechanism
More homogeneous **INTEREST PAYMENTS** response

25 basis point increase in interest rates. Standard errors clustering by firm and time. Confidence band: 90%.
SHARE PRICE falls

United States

Younger & NO dividends

Older & Paying dividends

United Kingdom

Monetary Policy shock: 25 basis point increase. Standard errors clustering: by firms and time. Confidence band: 90%.
Response of EBITDA

Younger & NO dividends

Older & Paying dividends

United States

Percent

Quarters

United Kingdom

Percent

Year end (Q4)

25 basis point increase in interest rates. Standard errors clustering by firm and time. Confidence band: 90%.