Aggregate Implications of Corporate Lending by Nonfinancial Firms

Miguel H. Ferreira
Queen Mary University of London

ESEM, August 2023
“When you buy a share of Apple stock, you do not simply buy into a $1 trillion technology company. You also buy a share of one of the world’s largest investment companies: Braeburn Capital, a wholly owned subsidiary of Apple. Braeburn manages a $244 billion financial portfolio — 70% of Apple’s total book assets.”

Wall Street Journal on August 23, 2018 “Apple is a Hedge Fund That Makes Phones”
Nonfinancial firms financial assets

- Financial assets as a % of total assets almost doubled in 40-years
- Large heterogeneity in terms of riskiness

How does the portfolio composition affects:
1. Firms’ investment decisions?
2. Aggregate dynamics?
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1. Firms’ investment decisions?
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What I do

- **Empirical**
  - I use existing and collected data on portfolio composition by nonfinancial firms
  - Characterize the heterogeneity in the portfolio composition across firms
  - Establish if the portfolio composition affects firms’ investment decisions

- **Model**
  - Heterogeneous firms using capital to produce
  - Portfolio of financial assets
    - Risk-free asset
    - Risky asset: Corporate bonds
  - Identify micro mechanisms and quantify macro outcomes
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What I find

- **Empirical** - Three stylized facts
  - Share of risky asset holdings increasing over the last 30 years
  - Large heterogeneity in the portfolio composition across firms
  - Investment drop during Great Recession twice as large for firms with high share of risky savings

- **Model**
  - Two important determinants of portfolio composition:
    1. Size
    2. Link between production and financial side of the firms
  - Decrease in interest rate fully explains increase in risky asset holdings over last 30 years
  - Portfolio composition amplifies the aggregate investment decrease by 50% in response to large productivity shock
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Related Literature

  ⇒ Novel channel via the propagation from borrowers to nonfinancial lending firms

- **Firms’ balance sheet composition:** Crouzet (2017); Buera and Karmakar (2018); Lanteri (2018); Jeenas (2018); Xiao (2018); Melcangi (2018); Ottonello and Winberry (2018); Salomao and Begenau (2018)
  ⇒ Implications of portfolio composition on firms decisions and aggregate outcomes

- **Firms’ savings composition:** Almeida et al. (2004); Bates et al. (2009); Riddick and Whited (2009); Nikolov and Whited (2014); Bigio (2015); Cardella et al. (2015); Lyandres and Palazzo (2016); Begenau and Palazzo (2017); Chen et al. (2017); Cunha and Pollet (2017); Duchin et al. (2017); Darmouni and Mota (2020)
  ⇒ Idiosyncratic and aggregate determinants of the composition of savings across the firm distribution
Roadmap

1. Stylized Facts
2. Model
3. Calibration
4. Results and mechanism
5. Conclusion
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Empirical results - 3 stylized facts

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   - Risky securities: Non-money-like assets (Corporate bonds, equity, etc)
   - Share of risky assets grew from 26% to above 40% in 30-years
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2. Share of risky assets increasing on firm size
   - Micro data on U.S. publicly listed firms during the 2000-2018 period
   - Proxy for risky assets - Long-term financial investments
   - Larger firms hold on average a riskier portfolio
   - Robustness: QFR data, which is representative of the universe of U.S. firms

3. Firms with a riskier portfolio dropped investment by more during Great Recession
   - Investment of firms with high vs low share of risky asset holdings during great recession
   - Firms in control group dropped investment on average 9.7%
   - Firms in treatment group dropped investment 7 p.p. more
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Roadmap

1. Stylized Facts
2. Model
3. Calibration
4. Results and mechanism
5. Conclusion
Model overview

- **Heterogeneous firms business-cycle model**

  - Firms invest in productive capital $k$, subject to convex adjustment costs and capital irreversibility

  - Firms save in
    - Risk-free assets $a^{rf}$ at a guaranteed rate $r^{rf}$
    - Corporate bonds $a^r$ at uncertain rate

  - Firms borrow $b$ at a given interest rate $r^b$
    - If a firm fails to pay back its debt $b$, it will default and leave the market

  - Idiosyncratic $\epsilon$ and aggregate $z$ productivity shocks

  - Continuum of potential entrants, draw productivity signal and enter if value of entering larger than cost of entry
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    - Corporate bonds $a^r$ at uncertain rate
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**Model overview**

- Heterogeneous firms business-cycle model
  - Firms invest in productive capital $k$, subject to convex adjustment costs and capital irreversibility
  - Production

- Firms save in
  - Financial side
    - Risk-free assets $a^{rf}$ at a guaranteed rate $r^{rf}$
    - Corporate bonds $a^r$ at uncertain rate

- Firms borrow $b$ at a given interest rate $r^b$
  - Liabilities
    - If a firm fails to pay back its debt $b$, it will default and leave the market

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  value of entering larger than cost of entry
  - Entrants
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- Heterogeneous firms business-cycle model
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  - Firms save in financial side:
    - Risk-free assets $a^{rf}$ at a guaranteed rate $r^{rf}$
    - Corporate bonds $a^r$ at uncertain rate
  - Firms borrow $b$ at a given interest rate $r^b$.
    - If a firm fails to pay back its debt $b$, it will default and leave the market.
  - Idiosyncratic $\epsilon$ and aggregate $z$ productivity shocks.
  - Continuum of potential entrants, draw productivity signal and enter if value of entering larger than cost of entry.
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- Heterogeneous firms business-cycle model

  - Firms invest in productive capital $k$, subject to convex adjustment costs and capital irreversibility

- Firms save in

  - Risk-free assets $a^r_f$ at a guaranteed rate $r^r_f$
  - Corporate bonds $a^r$ at uncertain rate

- Firms borrow $b$ at a given interest rate $r^b$

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Within period timing

1. Intra-period stage: After observing $\epsilon$, firms can adjust assets.

2. Production stage: After observing $z$ and $r^r$, firms either produce or default.

3. Inter-period stage: Conditional on surviving exit shock, firms adjust debt and assets.

Variables with a hat are intra-period decisions, whereas the non-hat variables are inter-period.
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Roadmap

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Calibration Strategy - Simulated Method of Moments

- **Two objectives**
  1. Discipline portfolio composition across firms
  2. Discipline return on risky assets

- 6 free parameters: $C_f$, $F_e$, $\omega$, $\rho_z$, $\sigma_z$, $\sigma_\epsilon$

- 6 moments to match:
  - Average share of risky savings
  - Standard deviation of share risky savings
  - Mean share risky $k \geq Q3_k$/mean share risky $k \leq Q1_k$
  - Default rate
  - Share of debt in firms age=1
  - Entrants average leverage
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## Calibration Fit

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<th>Moment</th>
<th>Source</th>
<th>Data</th>
<th>Model</th>
</tr>
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<tbody>
<tr>
<td>Average share of risky savings</td>
<td>Flow of Funds</td>
<td>0.2918</td>
<td>0.2925</td>
</tr>
<tr>
<td>Standard deviation of share risky savings</td>
<td>Compustat</td>
<td>0.3504</td>
<td>0.4096</td>
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<tr>
<td>Mean share risky $k \geq Q_{3_k}/\text{mean share risky } k \leq Q_{1_k}$</td>
<td>Compustat</td>
<td>4.3758</td>
<td>4.7373</td>
</tr>
<tr>
<td>Default rate</td>
<td>LBD</td>
<td>0.0824</td>
<td>0.0819</td>
</tr>
<tr>
<td>Share of debt in firms age=1</td>
<td>Compustat</td>
<td>0.1097</td>
<td>0.0682</td>
</tr>
<tr>
<td>Entrants average leverage</td>
<td>Compustat</td>
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<td>0.2207</td>
</tr>
</tbody>
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**Table:** Calibration fit
Roadmap

1. Stylized Facts
2. Model
3. Calibration
4. Results and mechanism
5. Conclusion
Results

1. Two main determinants of portfolio composition
   - Link between production and financial sides
   - Firm size

2. Increase in risky savings fully explained by drop in risk-free interest rate - Lower cost of debt shifts firm size distribution to the right
   - Direct impact: Large firms hold more risky assets - explains 13.2%
   - Indirect impact: Share defaulted debt ↓ → Risky asset excess returns ↑ - explains 86.8%

3. Portfolio of savings affects firms’ investment and generates large non-linearities at the macro level
   - Minimizes the impact of small shocks
   - Amplifies the effects of large shocks
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- Two determinants of the nonfinancial firms savings portfolio
  - Size
  - Real production frictions

- Nonfinancial firms risky asset holdings have been increasing since early 1990s
  - Real interest rate decrease fully accounts for this increase

- Firms holding corporate bonds creates a financial link between nonfinancial firms

- Financial link propagates large shocks from defaulting borrowers to lenders, amplifying aggregate investment drop by 50% more
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- Aggregate data from U.S. flow of funds between 1980 and 2019

- Financial assets:
  - Risk-free securities: Money-like assets (Treasuries, commercial paper, etc)
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- Data on U.S. publicly listed firms during the 2000-2018 period
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Stylized fact 3 - Impact on investment

- Dif and dif method to assess effect of portfolio composition on investment during the Great Recession
- Crisis dummy equal to one from 2008 to 2010
- Risky asset dummy, if share of risky assets above 70% in the period before the stock market crash
- Non parametric
- Coefficient of interest is the interaction between the two dummies

\[ \ln(\text{Inv})_{ijt} = \gamma_{\text{crisis}_t} + \alpha_{\text{risky}_{ij2008Q2}} + \beta_{\text{crisis}_t} \times \text{risky}_{ij2008Q2} + \lambda_i + \theta_{jt} + \epsilon_{ijt} \]
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Robustness test

1. Size: U.S. publicly listed firms not representative of universe of firms

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2. Long term financial investments just a proxy for risky assets

- Corporate debt holdings by publicly listed firms from firms’ financial reports (2009-2018 period)
  - Web scraping code to collect corporate bond holdings from firms’ financial reports.
  - Corporate bonds represent more than 50% of risky assets.
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Assets histogram
Static Model: Intra period firm’s problem

Firm chooses \( k, a^{rf} \) and \( a^r \) to maximize expected profits, given \( z, b \) and \( e_0 \)

\[
\begin{align*}
\max_{k, a_r, a_{rf}} & \quad E_{z_2, r_r} [\Pi(e, b, z_1)] = \int_{z_2} \int_{r_r} \left[ z_1 z_2 k^\alpha + (1 + r^{rf}) a^r f + (1 + r^r) a^r \right. \\
& \quad - \left. (1 + r^b) b \right] dF(z_2) dF(r^r) \\
& \quad + \int_{z_2} \int_{r^r} -D dF(z_2) dF(r^r)
\end{align*}
\]

s.t.: \( k + a^r + a^{rf} = e + b \)
Firm chooses $b$ to maximize expect profits, given $e_0$ and optimal policies $k^*(b, z)$, $a^{rf*}(b, z)$ and $a^{r*}(b, z)$

$$\max_b E_{z_1, z_2, r'} [\Pi|e] = \int_{z_1} \int_{z_2} \left[ z_1 z_2 k^\alpha + (1 + r^{rf}) a^{rf} + (1 + r') a^r \right.$$ $$\left. - (1 + r^b) b \right] dF(z_2) dF(z_1) + \int_{z_1} \int_{z_2} -D dF(z_2) dF(z_1)$$
Potential Entrants

- Continuum of potential entrants
- Potential entrants draw a signal for their productivity tomorrow $\epsilon_0$
- Firms will decide to enter if value larger than entry cost

$$V_e(\epsilon_0, k_0, 0, S) = \max(0, V^1(\epsilon_0, k_0, 0, S) - f_e)$$

- Among feasible set of firms, a subset is randomly chosen to keep number of firms constant (Arellano et al. 2018)
Firm defaults if

\[ z < z = \frac{C_f + b - (1 + r^{rf})a^{rf} - (1 + r')\hat{a}_f - p_k(1 - \delta)\hat{k}}{\epsilon k^\alpha} \]

\[ r^r < r'^r = \frac{C_f + b - (1 + r^{rf})a^{rf} - p_k(1 - \delta)\hat{k} - y(z)}{\hat{l}_f} - 1 \]
Real Frictions

- Convex adjustment costs

\[ g(k', k) = \frac{p_k}{2} \left( \frac{k' - (1 - \delta)k}{k} \right)^2 k \]

- Partial irreversibility

\[ 0 < p_k^- < p_k^+ \]

- Firms distribute dividends if unconstrained

\[ D = \kappa y^{\kappa_y} k^{\kappa_k} \]
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Within period timing

Why this specific timing?

1. Empirical evidence suggests firms adjust more often the asset side than the liability side (Xiao, 2019)

2. Allows for gross and not net positions to play a role
Within period timing

1. Choose assets
2. Produce and realize $r^f$
3. Choose assets and debt

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Liabilities side

- Firms issue one period bonds at a given interest rate $r^b = r^f + \omega$

- If a firm fails to pay back its debt $b$, it will default and leave the market.

- Default happens if either productivity or the return on risky assets fall below a given threshold $\bar{z}$ and $r^r$.
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Firms use issued debt $b$ and beginning of period cash $x$ to invest in capital $k$ to produce according to

$$y = z\epsilon k^\alpha$$

Subject to two real frictions:

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Financial side

- Firms can save in
  1. A risk free security $a^{rf}$ that provides a guaranteed return $r^{rf}$
  2. A corporate bond $a^{r}$, that provides an uncertain return $r^{r}$

- Corporate bonds riskiness arises from
  - Not idiosyncratic risk: Well diversified portfolio
  - Systemic risk: Default rate in each period determines the return
  - Defaults losses: In case of default, lender only recovers

$$
\min(\chi, \underbrace{(x' + p_k^- (1 - \delta) k')}_{\text{Recovery rate}}{(1 - \delta) k'}), b)
$$

Liquidation value of the firm
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Recovery rate Liquidation value of the firm
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    - $\chi$: Recovery rate
    - $x'$: Liquidation value of the firm

Back
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Recovery rate Liquidation value of the firm
Financial side

The return on bonds is given by

\[ 1 + r' = \frac{(1 + r^b) \text{Non-defaulted debt + Defaulted debt recovered}}{\text{Total debt}} \]

Given the state of the economy today, firms form expectations on the return according to

\[ S' = \Gamma^{S'}(S) \]

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Firm’s problem

At the end of period, given $\epsilon, \hat{k}, \hat{x}$ and $S$ firms choose $k', b', a^{rf'}, a'r'$ and $D$

$$V^1(\epsilon, \hat{k}, \hat{x}, S) = \max_{k', b', a^{rf'}, a'r', D} D + \beta E[\hat{V}^0(\epsilon', k', x', b', S)]$$

where $V^0$ is given by

$$V^0(\epsilon', \hat{k'}, \hat{x'}, S') = (1 - \eta)V^1(\epsilon', \hat{k'}, \hat{x'}, S') + \eta(\hat{x'} + p_k^- (1 - \delta)\hat{k'})$$

In the middle of the period firms are allowed to readjust assets

$$\hat{V}^0(\epsilon', k', x', b', S) = \max_{\hat{k'}, \hat{a}^{rf'}, \hat{a}'r'} \left[ \int_{r'} \int_{z'} V^0(\epsilon', \hat{k'}, \hat{x'}, S') dF(z') dF(S') \right]$$

Subject to adjustment costs, price of capital, aggregate law of motion, expected return on risk asset and the budget constraint
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$$V^1(\epsilon, \hat{k}, \hat{x}, S) = \max_{k', b', a^{rf'}, a', D} \left( D + \beta E\left[ \hat{V}^0(\epsilon', k', x', b', S') \right] \right)$$

In the middle of the period firms are allowed to readjust assets

$$\hat{V}^0(\epsilon', k', x', b', S) = \max_{\hat{k'}, a^{rf'}, a'} \left[ \int_{r'} \int_{z'} V^0(\epsilon', \hat{k'}, \hat{x'}, S')dF(z')dF(S') \right]$$

Where $V^0$ is given by

$$V^0(\epsilon', \hat{k'}, \hat{x'}, S') = (1 - \eta)V^1(\epsilon', \hat{k'}, \hat{x'}, S') + \eta(\hat{x'} + p^-_k (1 - \delta)\hat{k'})$$

Subject to adjustment costs, price of capital, aggregate law of motion, expected return on risk asset and the budget constraint
Firm’s problem

At the end of period, given $\epsilon, \hat{k}, \hat{x}$ and $S$ firms choose $k', b', a^{rf'}, a^r'$ and $D$

$$V^1(\epsilon, \hat{k}, \hat{x}, S) = \max_{k', b', a^{rf'}, a^r', D} D + \beta E[\hat{V}^0(\epsilon', k', x', b', S)]$$

Intraperiod value function

In the middle of the period firms are allowed to readjust assets

$$\hat{V}^0(\epsilon', k', x', b', S) = \max_{\hat{k}', \hat{a}^{rf'}, \hat{a}^r'} \left[ \int_{\epsilon'}^\infty \int_{z'} \hat{V}^0(\epsilon', \hat{k}', \hat{x}', S') dF(z') dF(S') \right]$$

Where $V^0$ is given by

$$V^0(\epsilon', \hat{k}', \hat{x}', S') = (1 - \eta) V^1(\epsilon', \hat{k}', \hat{x}', S') + \eta (\hat{x}' + p_k^- (1 - \delta) \hat{k}')$$

Subject to adjustment costs, price of capital, aggregate law of motion, expected return on risk asset and the budget constraint

Budget constraint
Recursive Competitive Equilibrium

i. Firm value and policy functions solve its optimization problem

ii. Financier value and policy functions solve the financier problem

iii. Debt price satisfies equation

\[ q^r = q^{rf} - \omega \]

and return on debt satisfies equation

\[ 1 + r^r = (1 + r^b) \frac{\int_{nd} b_{nd} d\mu}{\int bd\mu} + \frac{\int_d \min(b_d, \chi((\hat{x}_d + p^- \hat{k}_d))) d\mu}{\int bd\mu} \]

iv. The measure of firms evolves according to

\[ \mu' = \eta \int (1 - 1_{\text{default}}(z, k, x, S)) \phi d[z \times k \times x] + \mu_e \]
Algorithm

I. Start by guessing specification coefficients and initialize the forecast rules

\[
\begin{bmatrix}
\log B^f' \\
\log K' \\
r_r
\end{bmatrix} = A + B \begin{bmatrix}
\log B^f \\
\log K
\end{bmatrix} + C \log(z)
\] (1)

II. Solve both the incumbent and potential entrant problems for different \( E(r^r) \) using the Howard’s improvement step and multivariate splines.

III. Simulate the economy for \( T=2000 \).

IV. Check if the guess for specification (1) coefficients converged. If not, update and go back to ii.
Return on bonds

The return on bonds is given by

\[ 1 + r^r = (1 + r^b) \left( \frac{\int b d\mu_{nd}}{\int b d\mu} \right) + \frac{\int \min(b, \chi((x + p_k^- k))) d\mu_{de}}{\int b d\mu} \]

- Share of non-defaulted debt
- Defaulted debt recovered
Budget constraint

At the end of period, firm has the following amount of cash

\[ \hat{x} = y - C_f - b + (1 + r^{rf})\hat{a}^{rf} + (1 + r^{r})\hat{a}^{r} \]

Subject to adjustment costs, price of capital, aggregate law of motion, expected return on risk asset and the following budget constraint

\[ x' = \hat{x} + b' - D - g(k', \hat{k}) \geq 0 \]

In the middle of the period, the firm is subject to the following budget constraint

\[ \hat{a}^{r'} + a^{rf'} + g(\hat{k}', k') \leq x' \]
Budget constraint

At the end of period, firm has the following amount of cash

\[ \hat{x} = y - C_f - b + (1 + r^{rf})\hat{a}^{rf} + (1 + r^r)\hat{a}^r \]

Subject to adjustment costs, price of capital, aggregate law of motion, expected return on risk asset and the following budget constraint

\[ x' = \hat{x} + b' - D - g(k', \hat{k}) \geq 0 \]

In the middle of the period, the firm is subject to the following budget constraint

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Budget constraint

At the end of period, firm has the following amount of cash

$$\hat{x} = y - C_f - b + (1 + r^{rf})\hat{a}^{rf} + (1 + r^r)\hat{a}^r$$

Subject to adjustment costs, price of capital, aggregate law of motion, expected return on risk asset and the following budget constraint

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In the middle of the period, the firm is subject to the following budget constraint

$$\hat{a}^{r'} + a^{rf'} + g(\hat{k}', k') \leq x'$$
### Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$C_f$</td>
<td>8.006</td>
<td>Fixed cost of production</td>
</tr>
<tr>
<td>$f_e$</td>
<td>2.414</td>
<td>Entry cost</td>
</tr>
<tr>
<td>$\omega$</td>
<td>0.01</td>
<td>Risk premium</td>
</tr>
<tr>
<td>$\sigma_\epsilon$</td>
<td>0.15</td>
<td>Volatility of idiosyncratic shock</td>
</tr>
<tr>
<td>$\sigma_z$</td>
<td>0.074</td>
<td>Volatility of aggregate shock</td>
</tr>
<tr>
<td>$\rho_z$</td>
<td>0.949</td>
<td>Persistence of aggregate shock</td>
</tr>
</tbody>
</table>

**Table:** Endogenous Parameters
# Parameters

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
<th>Description</th>
<th>Source</th>
</tr>
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<tbody>
<tr>
<td>Preferences</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>$\beta$</td>
<td>0.96</td>
<td>Household discount factor</td>
<td>Literature</td>
</tr>
<tr>
<td>Production</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\alpha$</td>
<td>0.66</td>
<td>Return on capital</td>
<td>Literature</td>
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<tr>
<td>$p_k$</td>
<td>0.57</td>
<td>Price of sold capital</td>
<td>Bloom (2009)</td>
</tr>
<tr>
<td>$\delta$</td>
<td>0.06</td>
<td>Depreciation rate</td>
<td>Literature</td>
</tr>
<tr>
<td>$k_0$</td>
<td>0.171</td>
<td>Entrants share of incumbents average capital</td>
<td>Compustat</td>
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<tr>
<td>$\eta$</td>
<td>0.065</td>
<td>Exogenous probability of exit</td>
<td>LBD</td>
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<tr>
<td>Financial intermediary</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\chi$</td>
<td>0.64</td>
<td>Recovery rate of defaulted debt</td>
<td>Xiao (2018)</td>
</tr>
<tr>
<td>Idiosyncratic productivity</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$\rho_\epsilon$</td>
<td>0.6</td>
<td>Persistence of the idiosyncratic shock</td>
<td>Khan and Thomas (2013)</td>
</tr>
<tr>
<td>Dividend Policy</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>$\kappa$</td>
<td>0.727</td>
<td>Constant</td>
<td>Compustat</td>
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<tr>
<td>$\kappa_k$</td>
<td>0.070</td>
<td>Dividend sensitivity to capital</td>
<td>Compustat</td>
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<tr>
<td>$\kappa_y$</td>
<td>0.479</td>
<td>Dividend sensitivity to sales</td>
<td>Compustat</td>
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</table>

**Table: Exogenous Parameters**
- **Idiosyncratic risk**
- **Expected return**
# Regressions Fit

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Log(Debt)</th>
<th>Log(Capital)</th>
<th>Risky Return</th>
</tr>
</thead>
<tbody>
<tr>
<td>$B$</td>
<td>-0.743***</td>
<td>1.053***</td>
<td>0.623***</td>
</tr>
<tr>
<td>$C$</td>
<td>0.627***</td>
<td>0.049***</td>
<td>0.099***</td>
</tr>
<tr>
<td>$D$</td>
<td>-0.379***</td>
<td>0.058***</td>
<td>0.130***</td>
</tr>
<tr>
<td>R-squared</td>
<td>0.980</td>
<td>0.978</td>
<td>0.853</td>
</tr>
</tbody>
</table>

*** p<0.01, ** p<0.05, * p<0.1
Real Interest Rate
Risk premium
IRF: Productivity and Financial shock

![Graphs showing Investment, Capital, Default rate, and \( r \) with Policy and No Policy]

- **Investment**
  - 2: 0.9
  - 4: 0.97
  - 6: 1.03

- **Capital**
  - 2: 1.07
  - 4: 1.06
  - 6: 1.05

- **Default rate**
  - 2: 0.07
  - 4: 0.08
  - 6: 0.09

- **\( r \)**
  - 2: 1.03
  - 4: 1.05
  - 6: 1.07

**Policy** vs **No Policy**
Corporate debt holdings

Log corporate debt securities

St Dev Log corporate debt securities

Log Total Assets

Log Total Assets
Log total assets histogram
Log investment histogram
Log cash histogram
Leverage histogram
Investment during Great Recession

<table>
<thead>
<tr>
<th>Year</th>
<th>2008</th>
<th>2009</th>
<th>2010</th>
<th>2011</th>
<th>2012</th>
<th>2013</th>
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<tbody>
<tr>
<td>% Change</td>
<td>-0.2</td>
<td>-0.15</td>
<td>-0.1</td>
<td>-0.05</td>
<td>0</td>
<td>0.05</td>
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</tbody>
</table>

High risk
Low risk

Investment % change

Miguel H. Ferreira
Corporate Lending by Nonfinancial Firms
# Aggregate corporate bond holdings by industry

<table>
<thead>
<tr>
<th>Fama-French Industry</th>
<th>Amount (M$)</th>
<th>% Total Assets</th>
<th>% Cash and Cash Equivalents</th>
<th>% Cash</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total</td>
<td>254,273.8</td>
<td>5.0</td>
<td>31.9</td>
<td>63.7</td>
</tr>
<tr>
<td>Consumer</td>
<td>17,669.82</td>
<td>1.5</td>
<td>12.6</td>
<td>19.2</td>
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<tr>
<td>Manufacturing</td>
<td>15,423.42</td>
<td>0.9</td>
<td>13.4</td>
<td>16.5</td>
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<tr>
<td>High Tech</td>
<td>172,265.10</td>
<td>9.8</td>
<td>37.5</td>
<td>95.4</td>
</tr>
<tr>
<td>Health</td>
<td>83,491.78</td>
<td>9.5</td>
<td>46.5</td>
<td>94.1</td>
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<tr>
<td>Others</td>
<td>32,903.31</td>
<td>2.7</td>
<td>24.0</td>
<td>31.0</td>
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</table>

Miguel H. Ferreira  
Corporate Lending by Nonfinancial Firms  
ESEM  36 / 63
### Firm corporate bond holdings by industry

| Fama-French Industry | Amount (M$) | % Total Assets | % Cash and Cash Equivalents | % Cash |%
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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</thead>
<tbody>
<tr>
<td>Total</td>
<td>704.20</td>
<td>7.9</td>
<td>94.0</td>
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<td>Consumer</td>
<td>253.32</td>
<td>2.2</td>
<td>123.3</td>
<td>148.1</td>
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<tr>
<td>Manufacturing</td>
<td>221.06</td>
<td>2.0</td>
<td>18.0</td>
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<td>High Tech</td>
<td>1,059.12</td>
<td>9.1</td>
<td>28.9</td>
<td>72.7</td>
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<td>Health</td>
<td>847.30</td>
<td>17.6</td>
<td>269.8</td>
<td>885.8</td>
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<tr>
<td>Others</td>
<td>772.18</td>
<td>2.7</td>
<td>48.6</td>
<td>167.5</td>
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</table>
### Top 20 firms corporate bond holdings

<table>
<thead>
<tr>
<th>Name</th>
<th>Amount (M$)</th>
<th>Name</th>
<th>% Total Assets</th>
</tr>
</thead>
<tbody>
<tr>
<td>APPLE INC</td>
<td>60998</td>
<td>INTERCEPT PHARMA INC</td>
<td>69.8</td>
</tr>
<tr>
<td>AMERICAN SCIENCE ENGINEERING</td>
<td>42229</td>
<td>TONIX PHARMACEUTICALS HLDG</td>
<td>66.2</td>
</tr>
<tr>
<td>GENERAL ELECTRIC CO</td>
<td>27686</td>
<td>ALPINE IMMUNE SCIENCES INC</td>
<td>62.6</td>
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<tr>
<td>ALPHABET INC</td>
<td>15555</td>
<td>XENOPORT INC</td>
<td>60.1</td>
</tr>
<tr>
<td>CISCO SYSTEMS INC</td>
<td>14318</td>
<td>ACHAOGEN INC</td>
<td>57.6</td>
</tr>
<tr>
<td>SPECTRUM BRND HLDG INC</td>
<td>10933</td>
<td>PTC THERAPEUTICS INC</td>
<td>55.6</td>
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<tr>
<td>AMGEN INC</td>
<td>9390</td>
<td>ENANTA PHARMACEUTICALS INC</td>
<td>53.4</td>
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<tr>
<td>QUALCOMM INC</td>
<td>9108</td>
<td>OVASCENCE INC</td>
<td>51.0</td>
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<tr>
<td>AUTOMATIC DATA PROCESSING</td>
<td>7558</td>
<td>REGULUS THERAPEUTICS INC</td>
<td>48.8</td>
</tr>
<tr>
<td>PFIZER INC</td>
<td>6775</td>
<td>KYTHERA BIOPHARMA INC</td>
<td>48.5</td>
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<tr>
<td>GENERAL MOTORS CO</td>
<td>6699</td>
<td>CHIASMA INC</td>
<td>47.7</td>
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<tr>
<td>MICROSOFT CORP</td>
<td>6643</td>
<td>ZAFGEN INC</td>
<td>47.4</td>
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<tr>
<td>MERCK &amp; CO</td>
<td>6249</td>
<td>SYNDAX PHARMACEUTICALS INC</td>
<td>45.8</td>
</tr>
<tr>
<td>BOEING CO</td>
<td>5344</td>
<td>PULSE BIOSCIENCES INC</td>
<td>44.8</td>
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<tr>
<td>MEDTRONIC PLC</td>
<td>5150</td>
<td>ADAPTIMMUNE THERAPEUTICS</td>
<td>44.8</td>
</tr>
<tr>
<td>FACEBOOK INC</td>
<td>5141</td>
<td>MITEK SYSTEMS INC</td>
<td>44.2</td>
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<tr>
<td>EBAY INC</td>
<td>4514</td>
<td>DYNAVAX TECHNOLOGIES CORP</td>
<td>43.7</td>
</tr>
<tr>
<td>GILEAD SCIENCES INC</td>
<td>4504</td>
<td>CERES INC</td>
<td>43.5</td>
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<tr>
<td>PAYPAL HOLDINGS INC</td>
<td>4168</td>
<td>XENCOR INC</td>
<td>43.2</td>
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<tr>
<td>INTEL CORP</td>
<td>3834</td>
<td>NEKTAR THERAPEUTICS</td>
<td>43.0</td>
</tr>
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</table>
Corporate bonds represented more than 60% of risky assets in 2017

Different risk profile. Risk-weight of 100% vs 50% of municipal bonds (second most held asset - Darmouni and Mota 2020)
Small firms save more than large firms, despite saving mainly in the risk-free securities.
Empirical Analysis: Great Recession
## Stylized fact 3

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
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</thead>
<tbody>
<tr>
<td>$\beta$</td>
<td>-0.071***</td>
<td>-0.055***</td>
<td>-0.089***</td>
</tr>
<tr>
<td></td>
<td>(0.023)</td>
<td>(0.023)</td>
<td>(0.027)</td>
</tr>
<tr>
<td>Firm FE</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Sector-Time FE</td>
<td>Yes</td>
<td>No</td>
<td>Yes</td>
</tr>
<tr>
<td>Sector-Crisis dummy</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>Time FE</td>
<td>No</td>
<td>Yes</td>
<td>No</td>
</tr>
<tr>
<td>$\ln(\text{asset})_{ijt-1}$</td>
<td>-</td>
<td>-</td>
<td>(+)</td>
</tr>
<tr>
<td>$\ln(\text{revenues})_{ijt-1}$</td>
<td>-</td>
<td>-</td>
<td>(+)</td>
</tr>
<tr>
<td>$\ln(\text{cash})_{ijt-1}$</td>
<td>-</td>
<td>-</td>
<td>(+)</td>
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<tr>
<td>leverage$_{ijt-1}$</td>
<td>-</td>
<td>-</td>
<td>(-)</td>
</tr>
</tbody>
</table>

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1
Empirical Analysis: Web scraping data

\[
\ln(\text{Inv})_{ijt+h} = \gamma S&P_{\text{vol}_{t-1}} + \alpha \text{risky}_{ijt-1} + \beta S&P_{\text{vol}_{t-1}} \times \text{risky}_{ijt-1} + \lambda_i + \theta_j + \epsilon_{ijt}
\]
Empirical Analysis: Web scraping data

Share corporate securities > 0.1

β coefficient
Empirical Analysis: Web scraping data

Share corporate securities > 0.2

$\beta$ coefficient

-0.2
-0.1
0
0.1

0 1 2 3 4
Empirical Analysis: Web scraping data

Share corporate securities > 0.3

β coefficient

0 1 2 3 4
-0.2 -0.1 0 0.1
Mechanism validation: Bond and cash holdings

\[ Y_{ijt} = \beta_1 Revt_{ijt-1} + \beta_2 Debt_{ijt-1} + X_{ijt-1} + \alpha_i + \lambda_{jt} + \epsilon \]

<table>
<thead>
<tr>
<th>VARIABLES</th>
<th>Bond holdings</th>
<th>Cash</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \beta_1 )</td>
<td>0.141***</td>
<td>-0.029**</td>
</tr>
<tr>
<td>(0.020)</td>
<td>(0.012)</td>
<td></td>
</tr>
<tr>
<td>( \beta_2 )</td>
<td>0.054***</td>
<td>0.072***</td>
</tr>
<tr>
<td>(0.011)</td>
<td>(0.007)</td>
<td></td>
</tr>
</tbody>
</table>

Observations: 4,769 4,730
R-squared: 0.955 0.910

Standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

- Debt associated with cash savings - precautionary savings
- Increase in revenues associated with accumulations of corporate bonds
Real frictions important determinant of portfolio composition

- Firms in inaction region save to finance future investment

<table>
<thead>
<tr>
<th>Moment</th>
<th>Inaction</th>
<th>Action</th>
</tr>
</thead>
<tbody>
<tr>
<td>% of firms</td>
<td>35.3%</td>
<td>64.7%</td>
</tr>
<tr>
<td>Savings to capital ratio</td>
<td>29.2%</td>
<td>4.89%</td>
</tr>
<tr>
<td>Share of risky savings</td>
<td>38.2%</td>
<td>16.3%</td>
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</tbody>
</table>
1 - Portfolio determinants: Production and financial link

- Real frictions important determinant of portfolio composition
  - Firms in inaction region save to finance future investment

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Real frictions important determinant of portfolio composition

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1 - Portfolio determinants: Production and financial link

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1 - Portfolio determinants: Production and financial link

- Real frictions important determinant of portfolio composition
  - Firms in inaction region save to finance future investment

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- I compare the same firms while holding different shares of risky assets to scenario where firms only hold risk-free securities

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The larger the share of risky assets, the more firms’ investment and default react to $r^r$.

- $r^r < 0$
- $r^r > r^{rf}$
3 - Macro outcomes

- Aggregating the micro effects generates large macro non-linearities

- Small and large shocks produce qualitatively and quantitatively different results

- Small shock is a 1% drop in aggregate productivity

- Large shock is calibrated to match the decrease in investment during the Great Recession in the U.S.
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- For small shocks, return on risky assets is still above the risk-free rate.
- Identified micro mechanism is only triggered in large recessions.
Policy Implications

Two different policies:

- **Market liquidity provision policy:**
  - In the spirit of Secondary Market Corporate Credit Facility by the Fed
  - Limit losses on risky savings in large recessions: \( r^r \geq r^{rf} \)
  - Limits propagation of the negative shock from defaulting borrowers to lending firms
  - Smaller decrease of investment and capital

- **Financial sector regulations:**
  - Capital requirements - share of risky savings lower than 94%
  - Counter-cyclical buffers - during downturns the maximum share of risky savings is 2.5 p.p. lower
  - No significant aggregate differences, as constraints are only binding for large firms
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Effect stronger when considering periods with $r^r < 0$
Default and risky holdings

- Default rates also change with the exposure to corporate bonds
To focus exclusively on the size effect, I simplify some model assumptions:

- **Static**: Firms start with a given endowment and choose capital to produce at the end of the period.
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1 - Portfolio determinants: Size

- Small firms invest in capital and save in the risk free asset
  - Precautionary savings
- As firms grow, probability of default decreases and share of risky asset holdings increase
Mechanisms: Distribution

Size Distribution

- More firms at the top of the distribution
Determinants of increase in risky assets

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**Mechanism:** \( r \downarrow \rightarrow \) Share defaulted debt \( \downarrow \rightarrow \) Risky asset excess returns \( \uparrow \)
(Model: 0.32p.p. vs Observed: 0.44p.p.) \( \rightarrow \) Risky savings \( \uparrow \) Interest rate
IRF: Productivity and Financial shock

![Graphs showing the impact of productivity and financial shocks on Investment, Capital, Default rate, and \( r^r \) for No Risky Assets and Risky Assets.](image-url)