Corporate Cash and Employment

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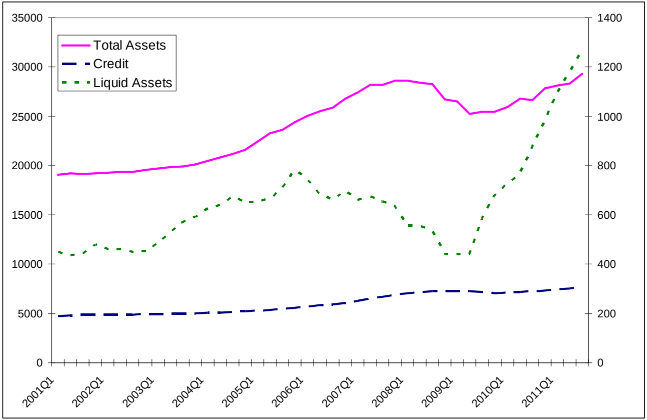
Motivation

Figure: A financial crisis?



Source : Flow of Funds

Motivation

- During the recent financial crisis:
  - decline in employment
  - strong increase in cash in corporate balance sheets
- Raises two questions about the relationship between **corporate employment** and **cash holding:**
  - is the negative relationship specific to the crisis?
  - how to analyze employment and corporate cash decisions in a macro model?
  - what does it tell us about the source of the crisis?

Aim

- The contribution is twofold:
  - Show **systematic negative correlation** between employment and corporate cash ratio in the US
    $\rightsquigarrow$ both at *aggregate* and *firm* level.
  - Build a theoretical framework with **heterogeneous firms** which incorporates employment and corporate cash management.
    $\rightsquigarrow$ Argue that the negative correlation can be explained by **liquidity** shocks and **productivity** shocks (not by **"standard" credit** shocks)

Strategy

1. **Empirical analysis**, US data:
   - Aggregate data (Flow of Funds)
   - Firm-level data (Compustat)

2. **Tractable macro model**:
   - Continuum of heterogenous firms
   - Liquidity needs to pay wage bills
   - Hit by aggregate and idiosyncratic shocks

3. Simple **parametrization** procedure to assess model's ability to generate empirical stylized facts

Related literature

- **Liquidity needs** have been analyzed in the literature:
  - In the spirit of Woodford (1990) and Holmstrom and Tirole (2011): Aghion et al. (2010), Kyiotaki and Moore (2012), Bacchetta and Benhima (2013)
    ⇝ No link with employment fluctuations
  - Christiano and Eichenbaum (1995), model with working capital but full access to external liquidity

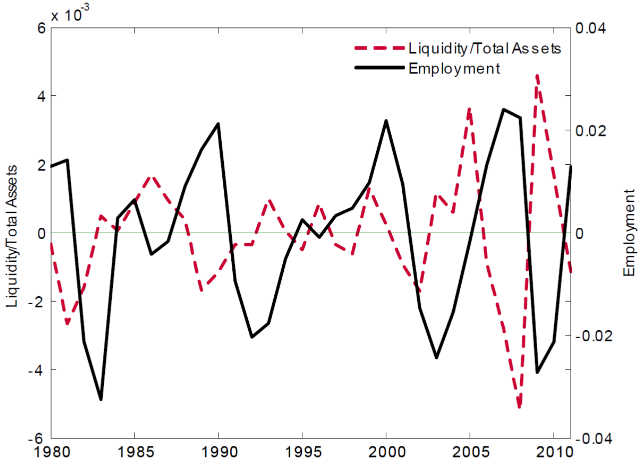
- Role of **financial frictions on labor market**:
  - Benchmelech et al. (2011): focus on firm's cash flow; Chodorow-Reich (2012): banking sector frictions; Pagano and Pica (2012): financial frictions and labor reallocation; Boeri et al. (2012): focus on leveraged sectors; Monacelli et al. (2011): credit frictions and unemployment
    ⇝ No clear focus on corporate cash holding

Related literature

- The **corporate finance literature** is vast.... Some papers looking at corporate cash holding:
  - Bolton et al. (2013); Hugonnier et al. (2013): worsening external funding conditions increase cash holding and depresses investment
  - Eisfeld and Muir (2013): focus on cash accumulation (and external finance)
  - Boileau and Moyen (2012): funding risk on liquidity
  - Falato et al. (2013); Gao (2013): explain upward trend in corporate cash

Stylized Facts

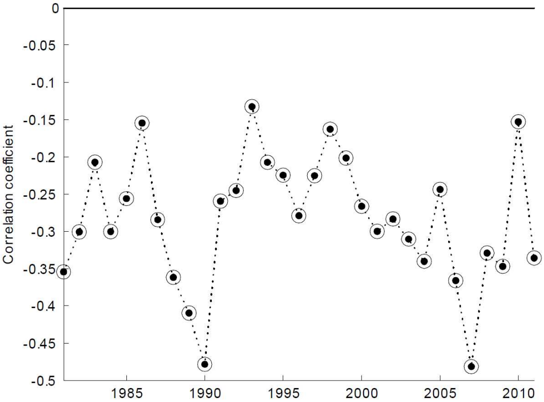
Aggregate evidence (Flow of Funds and BLS)



$\Rightarrow$ Negative correlation of -0.52, significant at 1%

▸ data ▸ robust ▸ level

Firm-level evidence (Compustat)



⇒ On average, cross section correlation is -0.29

Note: individual linear trend has been removed. robust to OLS with year-fixed effects and standard control variables ▸ data

Potential puzzle

- Cash is used, at least in part, to pay for wages.
  - Firms with higher labor share hold more cash on average.
    ▸ more
- More cash should allow for a higher wage bill and more employment. Not the case!

Model

Modeling cash and employment

- **Employment decisions** modelled in a very simple way: labor demand from standard production function
- But we introduce a **demand for cash**
  - We consider a model with two subperiods, as in Christiano and Eichenbaum (1995)
  - Need for short-term liquidity in the second sub-period: wage bill
  - Internal source of liquidity
    - e.g., could come from early payment by customers, credit lines, late wage payment
  - But constraint on internal liquidity may create demand for external liquidity (cash)

Model overview

- Single good economy, infinitively-lived heterogenous entrepreneurs and a representative household
- Entrepreneurs are credit-constrained
- Shocks to productivity, credit, and liquidity, revealed at the beginning-of-period
- In partial equilibrium, model can be solved analytically
- In general equilibrium wages adjust, but interest rate is constant

Entrepreneurs

- Continuum of **entrepreneurs** indexed by $i \in [0,1]$. Entrepreneur i maximizes

$$E_t \sum_{s=0}^{\infty} \beta^s u(c_{it+s})$$

- Produces Y_{it} using **capital** and **labor**

$$Y_{it} = F(K_{it}, A_{it} l_{it})$$

where A_{it} is the TFP shock

$$A_{it} = A_t + \epsilon_{it}^A \quad A_t = \rho A_{t-1} + \varepsilon_{A,t}, \quad \epsilon_{it}^A \sim \text{Markov process.}$$

Entrepreneurs

- At **beginning-of-period** ('bop'), the budget constraint is

$$\underbrace{Y_{it-1} + \widetilde{M}_{it-1} - r_{t-1} D_{it-1} - \psi L_{it-1}}_{\Omega_{it}} + D_{it} \geq c_{it} + K_{it} + M_{it}$$

D_{it}: one-period illiquid bonds with a gross return r_t
L_{it-1}: *external liquid funds* with cost ψ
M_{it}: cash or *internal liquid funds*, bearing no interest
$\widetilde{M}_{it-1}$: unused cash, typically $\widetilde{M}_{it} = 0$

- The entrepreneur faces the borrowing constraint

$$r_t D_{it} \leq \phi_{it} Y_{it}$$

where $\phi_{it} = \phi_t + \epsilon_i^{\phi}$ and $\phi_t = \rho \phi_{t-1} + \varepsilon_{\phi,t}$

Entrepreneurs

- At **end-of-period** ('eop'), pay wages using **internal** and **external** liquid funds

$$M_{it} + L_{it} \geq w_t l_{it}$$

  where w_t is the wage rate

- External liquid funds, L_{it}, are assumed to be a proportion κ_{it} of current output:

$$L_{it} = \kappa_{it} Y_{it}$$

- External liquid funds can be provided by:
  - Customers: early sales or early payment
  - Financial intermediaries: credit lines with binding constraint
  - Workers: some wages paid later

Liquidity shocks

- Shocks to κ_{it} are liquidity shocks
- E.g., credit line shocks or early sale shock

- We assume that

$$\kappa_{it} = \kappa_t + \epsilon_{it}^{\kappa} \quad \kappa_t = \rho\kappa_{t-1} + \varepsilon_{\kappa,t} \quad \epsilon_{it}^{\kappa} \sim \text{Markov process.}$$

$\Rightarrow$ The demand for cash holdings is directly affected by liquidity shock

Entrepreneurs

- The optimization program of the type-i entrepreneur is given by

$$\max_{c_{it},K_{it},l_{it},D_{it},M_{it}} \qquad E_t \sum_{s=0}^{\infty} \beta^s u(c_{it+s})$$

$$\text{st} \quad Y_{it-1} + \widetilde{M}_{it-1} - r_{t-1}D_{it-1} - \psi L_{it-1} + D_{it} \geq c_{it} + K_{it} + M_{it}$$

$$M_{it} + L_{it} \geq w_t l_{it}$$

$$r_t D_{it} \leq \phi_{it} Y_{it} \qquad L_{it} \leq \kappa_{it} Y_{it}$$

- We consider the case with:
  - Binding credit constraint: return of labor ($w_{it}^* \equiv w(A_{it}, \kappa_{it})$) larger than the wage paid by firms (w_t)
  - log utility $\Rightarrow$ consumption is $c_{it} = (1-\beta)\Omega_{it}$.

Partial equilibrium analysis

- Focus on **cash ratio** $m_t \equiv M_t/(M_t + K_t)$ and **employment**:
- The **liquidity constraint** can be rewritten as

$$\frac{M_{it}}{K_{it}} = \frac{1}{k_t}\left[w_t - \kappa_{it} A_{it} f(k_t)\right]$$

  - $\Rightarrow$ Lower κ_{it} and A_{it} increase cash intensity in production (*portfolio effect*) and therefore the cash ratio
- **Labor demand** is characterized by

$$l_{it} = Z_{it}\Omega_{it} \quad \text{where } Z_{it} = \frac{\beta r_t}{r_t[k_t + w_t] - (\kappa_{it} r_t + \phi_{it})A_{it} f(k_t)}$$

  - $\Rightarrow$ Lower κ_{it} and A_{it} reduce the scale of production through the financial multiplier (*size effect*)

Other policy functions

Relationship cash ratio-employment

- Ceteris paribus, firms with lower liquidity κ_{it} or lower productivity A_{it} have lower employment l_{it} and a higher cash ratio m_{it}. Moreover, ϕ_{it} affects negatively employment l_{it} but has no effect on the cash ratio m_{it}
- Intuition:
  - Smaller κ_{it} = less available external liquid funds at 'eop' $t \Rightarrow$ more internal liquidity
  - Smaller κ_{it} = smaller financial multiplier$\Rightarrow$ less labor demand
  - Same intuition for a reduction in A_{it}
  - Negative credit shock (ϕ_{it}) affects long-term credit (D_{it}) but not the liquidity needs

▸ cash level

Households

- Identical households with linear utility function in consumption and in cash
- Receive wages at 'eop' t and consume at 'bop' $t+1$

- **Labor supply** $l^s(w_t)$ depends positively on the wage rate

$$l^s(w_t) = (w_t/\bar{w})^\eta$$

- Wage, w_t, is determined such that $l^s(w_t) = \int_0^1 l_{it} di$

▸ asset supply

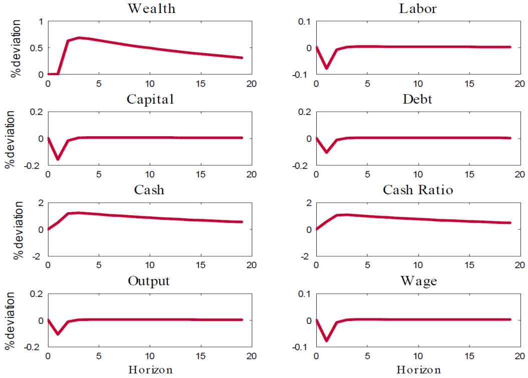
Aggregate Shocks

Shocks

- Assume that firms only face aggregate shocks:
  - liquidity shock (κ_t)
  - TFP shock (A_t)
  - credit shock (ϕ_t)

calibration

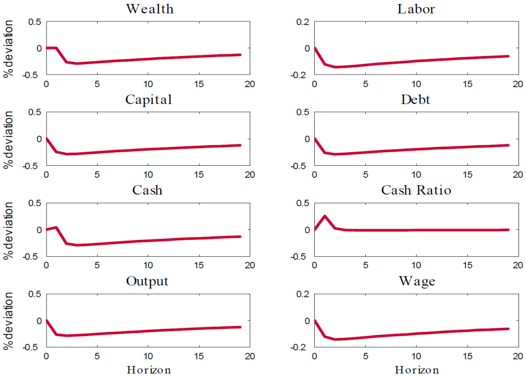
Liquidity shock



- **Negative liquidity shock**:
  - $\searrow$ external liquid funds to pay $w_t l_t$ at 'eop' $\Rightarrow$ $\nearrow$ M_t and m_t
  - Financing conditions deteriorate $\Rightarrow$ $\searrow$ demand for labor $\Rightarrow$ $\searrow$ l_t and w_t

$\Rightarrow$ negative co-movement between m_t and l_t

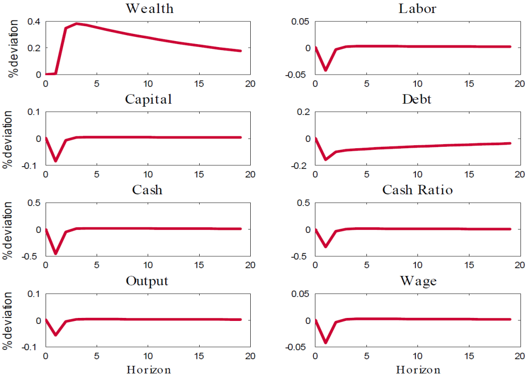
Technology shock



- **Negative technology shock**:
  - ↘ external liquid funds to pay $w_t l_t$ at 'eop' ⇒ ↗ M_t and m_t
  - ↘ production ⇒ ↘ demand for labor ⇒ ↘ l_t and w_t

⇒ negative co-movement between m_t and l_t

Credit shock



- **Negative credit shock**:
  - ↘ borrowing ⇒ ↘ capital and labor demand
  - ↘ wage to finance ⇒ ↘ M_t and m_t

⇒ *Positive* co-movement between m_t and l_t

Summary

- Negative co-movement between employment and cash ratio can be driven by liquidity shocks and technology shocks
- This result goes in favor of a liquidity supply tightening during the Great Recession
- A credit shock generates a positive co-movement between cash ratio and employment: its recessionary effect reduces liquidity needs

Cross-firms correlation

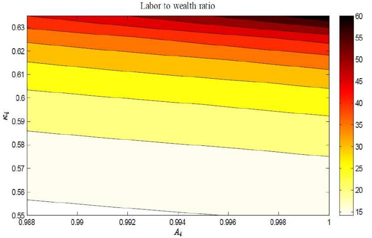
Calibration strategy

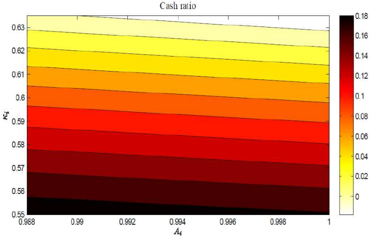
- Heterogenous firms that are hit by idiosyncratic ϵ_{it}^{A} and ϵ_{it}^{κ}:
  - 10 equidistant possible realizations, independent first-order Markov process with transition probability of $\frac{0.25}{9}$
  - $\kappa_i \in [0.55; 0.635]$ and $A_i \in [0.988; 1]$
- **Targeted moments**

	Data	Model
$m_{25\%}$	0.02	0.04
$m_{75\%}$	0.15	0.15
$\frac{Y_{75\%}}{Y_{25\%}}$	17	17

▸ Simulation

Results





- low $\kappa_{it} \Rightarrow$ large m_{it} and low l_{it}, for a given Ω_{it}

- low $A_{it} \Rightarrow$ large m_{it} and low l_{it}, for a given Ω_{it}

Results

- Simulated moments

Benchmark Calibration			Data	Model
$(m)_{average}$			0.11	0.10
$(m)_{std}$			0.13	0.23
$\frac{\ell_{75\%}}{\ell_{25\%}}$			15.75	17.36
$corr(m, \ell)$			-0.29	-0.18
Credit-Constrained Firms			Data	Model
	$\frac{D}{Y}$			
$corr(m, \ell)$	bottom 25%	$\mathrm{Corr}(m; l)_{\phi_{low}}$	-0.24	-0.08
	top 25%	$\mathrm{Corr}(m; l)_{\phi_{high}}$	-0.35	-0.20

Results

- What are the effects of **credit constraints** on the cross-firms correlation?
  - Financially constrained firms (low value of ϕ_i) exhibit a correlation closer to zero.
  - Larger financial multiplier for less financially-constrained firms (more resources through their level of borrowing)
    $\Rightarrow$ more sensitive labor to shocks, while m_t not affected by ϕ_i

▸ Table

Extensions

Extensions

- Consider various extensions:
  - **Partial capital depreciation and CES production function**: imperfect substitutability between capital and labor $\Rightarrow$ labor is less volatile $\Rightarrow$ cross-firms correlation by -0.10
  - **Unconstrained firms**: Cash and labor are more disconnected than in the benchmark constrained case
  - **Liquidity uncertainty**: Higher uncertainty increases cash demand. But impact of shocks is similar to benchmark if labor is predetermined: firms choose to hold amount of cash for the worse state (low κ) to ensure that their revenue is sufficient
  - **Unanticipated productivity shocks**: on impact, unused cash is an adjustment variable ($\tilde{M}_t \geq 0$), but if the shock is persistent then the dynamics becomes similar to an anticipated shock.

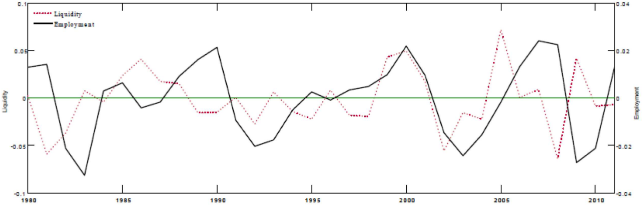
Conclusion

Conclusion

- **Contribution**:
  - Highlight stylized fact: negative correlation between cash ratio and employment
  - Build a tractable model to explain this correlation. Based on cash holding decisions which depend on external liquidity needs
- **Results**:
  - Liquidity and technology shocks can generate negative co-movement
  - "Standard" credit supply shock cannot
  - Model is able to reproduce a sizeable negative cross-firms correlation
- **Potential extensions**:
  - upward trend in corporate cash holding
  - introduce financial intermediaries
  - policy analysis

additional slides

Cash level and employment



⇒ correlation of 0.02 and insignificant

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Aggregate evidence

- Data source: Flow of Funds & BLS. Annual data, non-farm non-financial corporate sector, 1980-2011
- Data construction:
  - Cash ratio: share of corporate liquidity to total assets. Liquidity: private foreign deposits + checkable deposits and currency + total time and savings deposits + money market mutual fund shares
  - Employment: log of total number of employees
- Data transformation: both cash ratio and employment are HP filtered.

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Robustness aggregate results

- Divide cash by last period assets: -0.33
- Divide by financial assets: -0.58
- Quarterly data: -0.44
- Use last period cash ratio with quarterly data: -0.30

▸ Back

Relationship cash level-employment

- The policy function of the **level of cash** is:

$$M_{it} = [w_t - \kappa_{it} A_{it} f(k_t)] \, Z_{it} \Omega_{it},$$

$\Rightarrow$ both *size* and *portfolio effects* play a role.

- If $r_t k_t > \phi A_{it} f(k_t)$, then, ceteris paribus, firms with lower liquidity κ_{it} or lower productivity A_{it} have higher cash holdings M_{it}, while firms with lower ϕ_{it} have lower cash holdings.
- Intuition:
  - If ϕ_{it} is small enough (constrained firm), labor less sensitive to shocks (through financial multiplier), portfolio effect dominates in case of κ_{it} or A_{it} shocks.

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Unconstrained Firms

- Baseline framework: firms are always credit-constrained
- Alternative model: firms are not credit-constrained ($r = \frac{1}{\beta}$)
- Result:
  - labor demand is less sensitive to liquidity shock (i.e. decreases by less) since labor productivity is less affected by a reduction in external funding.
  - A technology shock affects (i) directly external liquidity availability, (ii) indirectly the wage. When firms are unconstrained, wages is more sensitive to the shock $\Rightarrow$ wages (and external liquidity needs) decrease by more which offset the positive effect on (i).

Liquidity Uncertainty

- Baseline framework: κ_{it} known at the beginning of the period t.
- Alternative model: firms only know the distribution of κ_{it}.
- Result:
  - Assume that there are only 2 states for κ: low or high.
  - If labor is predetermined, firms choose to hold amount of cash for the worse case (low κ) to ensure that their revenue is sufficient.
    $\Rightarrow$ firms internalize liquidity shocks' distribution and behave exactly as if their anticipated liquidity shock was κ_t^L.

Unanticipated Productivity Shocks

- Baseline framework: productivity shocks are know at the beginning of period t.
- Alternative model: : productivity shocks are unanticipated
- Result:
  - Firms adjust their level of unused cash $\tilde{M}_t$ but if the shock is persistent, then the dynamics becomes similar to an anticipated shock.

▸ Back

Simulation strategy

- We compute the **steady-state distribution**:
  - Set initial distribution of wealth $\Omega_{i0} = \{0, 0.9\}_{1000}$ and make an initial guess on w_0.
  - Obtain the optimal decision rule $\Omega_{it+1}(\Omega_{it}, \epsilon^{\kappa}_{it}, \epsilon^{A}_{it}, w_t)$. Using the policy functions, find the distribution of labor demand l_{it+1}. Aggregate labor demand $l_{t+1} = \sum_i \sum_{\kappa,A} l_{it+1} di$, and if $l_{t+1} > l^s(w_t)$, then we update the equilibrium wage w_{t+1} upward.
  - Repeat the step until the equilibrium wage is reached, i.e. when aggregate labor demand is fully satisfied.

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Numerical Method

- We compute the steady-state distribution:

1. Choose a grid of Ω_{it}, 1000-value, over $[0, 0.9]$. Chebychev nodes to make the grid more concentrated on low values of Ω.
2. Allocate an initial uniform and independent distribution to the values of Ω_{i0}, κ_{i0} and A_{i0}, and make an initial guess on the equilibrium wage w_0.
3. Given the initial distribution on Ω_{it}, κ_{it} and A_{it} and the initial equilibrium wage w_0, we use Proposition and the Markov Chain to compute the new distribution of Ω_{it+1}, κ_{it+1} and A_{it+1}. Compute the corresponding distribution of labor demand l_{it+1}. We aggregate this labor demand $l_{t+1} = \sum_i l_{it+1} di$, and if $l_{t+1} > l^s(w_t)$ (if $l_{t+1} < l^s(w_t)$), then we update the equilibrium wage w_{t+1} upward (downward).
4. We repeat step 3 until the equilibrium wage is reached, i.e. when aggregate labor demand is fully satisfied.

Firm-level evidence

- Compustat dataset: US non-financial firms, 1980-2011
- Data construction:
  - Cash ratio: ratio between cash and short term investment and total assets
  - Employment: number of employees
- Data selection:
  - Firms active over the whole sample
  - Drop 10% largest firms (Covas and Den Haan, 2011)
  - exclude: firms not incorporated in US market, engaged in major mergers, negative or missing values for total assets, sales, cash and employees
  - Remove firm-specific linear trend

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Firm-level data

Table 3. Employment and Cash Ratio

Dependant Variable: $\log(EMP_{it})$	(1)	(2)	(3)	(4)
$\left(\frac{CHE}{AT}\right)_{it}$	−1.356**	−1.127**	−1.127**	−0.984**
	(0.181)	(0.147)	(0..149)	(0..138)
$\log(AT)_{it}$		0.656**	0.662**	0.566**
		(0.021)	(0.021)	(0.020)
$CFLOW_{it}$			−0.023*	−0.036
			(0.013)	(0.030)
LEV_{it}				−0.017
				(0.016)
$\log(CAPX)_{it}$				0.088**
				(0.014)
R-squared	0.09	0.48	0.49	0.51
Firm fixed effects	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes
Observations	14 651	14 651	14 627	14 430

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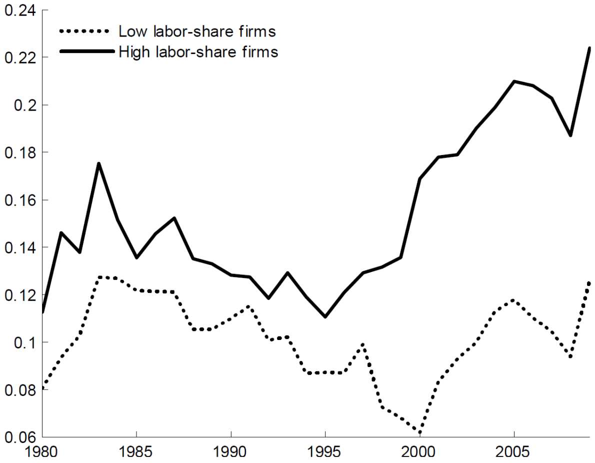
Firm-level data



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Individual policy functions

- For $w_t < w_t^*$, log utility, and Cobb-Douglas production function, the policy functions for K_{it}, M_{it}, l_{it}, D_{it},and Ω_{it+1} satisfy:
  - $l_{it} = Z_{it}\Omega_{it}$
  - $M_{it} = (w_t - \kappa_{it} A_{it} f(k_t)) Z_{it}\Omega_{it}$
  - $D_{it} = \phi_{it} A_{it} f(k_t) Z_{it}\Omega_{it}/r_t$
  - $K_{it} = k_t Z_{it}\Omega_{it}$
  - $\Omega_{it+1} = [(1 - \psi_t\kappa_{it}) - \phi_{it}] A_{it} f(k_t) Z_{it}\Omega_{it}$

  where $Z_{it} = \frac{\beta r_t}{r_t[k_t+w_t]-(\kappa_{it} r_t+\phi_{it}) A_{it} f(k_t)}$ and $k_{it} = k_t = k(w_t)$

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Supply of Assets by Households

- Infinitely elastic supply of illiquid funds D_t at interest rate $r = 1/\beta_h$, where $\beta_h \geq \beta$
- Supply liquid funds L_t at rate ψ at the 'eop'
- Infinitely elastic supply of cash, at rate 1

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Calibration

Table 4. Calibration Strategy

		Value
β	Discount factor	0.97
r	Gross interest rate on bonds	1.02
ψ	Liquidity cost	1.01
η	Frisch parameter	1
α	Elasticity of output wrt capital	0.36
ϕ	Output collateral share for debt	$0.33 \Rightarrow \frac{D}{Y} = 0.32$
κ	s.s output collateral share for liquidity	$0.59 \Rightarrow m = 0.11$
A	Steady-state productivity shock	1.00

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