Firm selection and corporate cash holdings

JFE 2021.03

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2022.03.23

secular increase trend in cash holdings
1979-2003
among US public firms

other literatures for drivers
ie.riskier cash flows
lower opportunity cost of holding cash
taxes, agency frictions
a change in production technologies

this paper for drivers from three stylized facts

1. Positive selection effect at entry
2. Negative within-firm effect for incumbents
3. The importance of R&D-intensive firms

Model:
standard neoclassical investment dynamics & selection

SMM:
4 types of moments & 13 parameters

Analysis & Counterfactuals & Dicussions

Contributions:
use **dynamic corporate finance model** other than reduced-form approach to **quantify and isolate** the role of firm selection mechanism.

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6 counterfactuals

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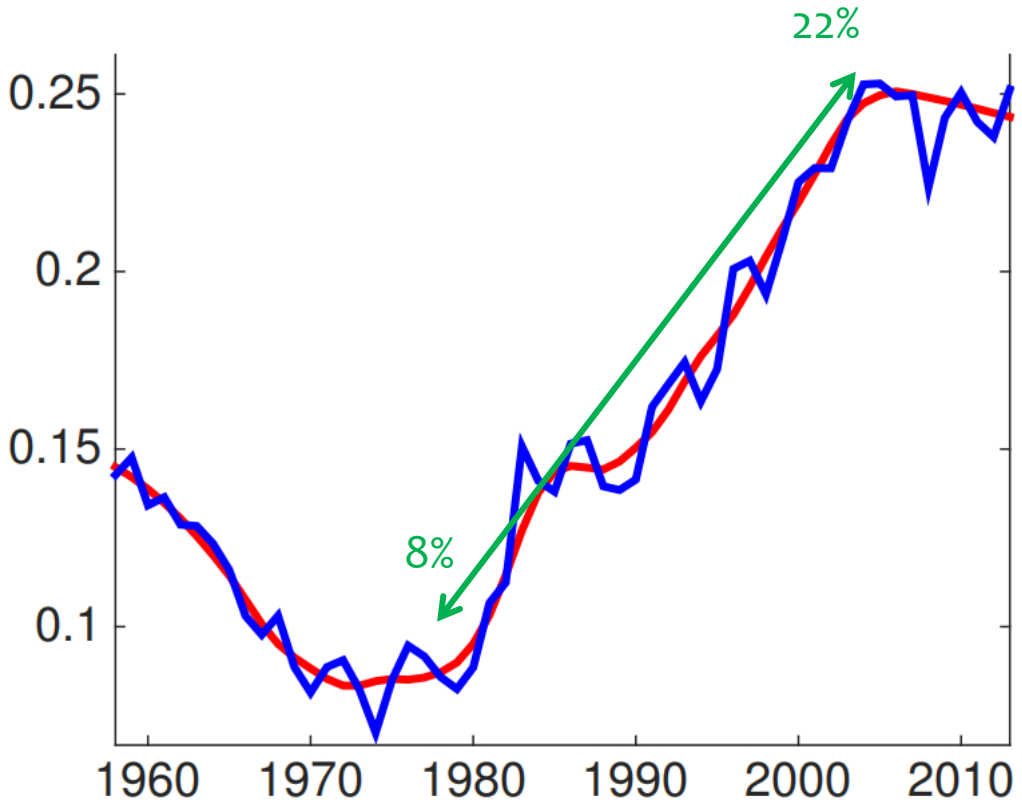
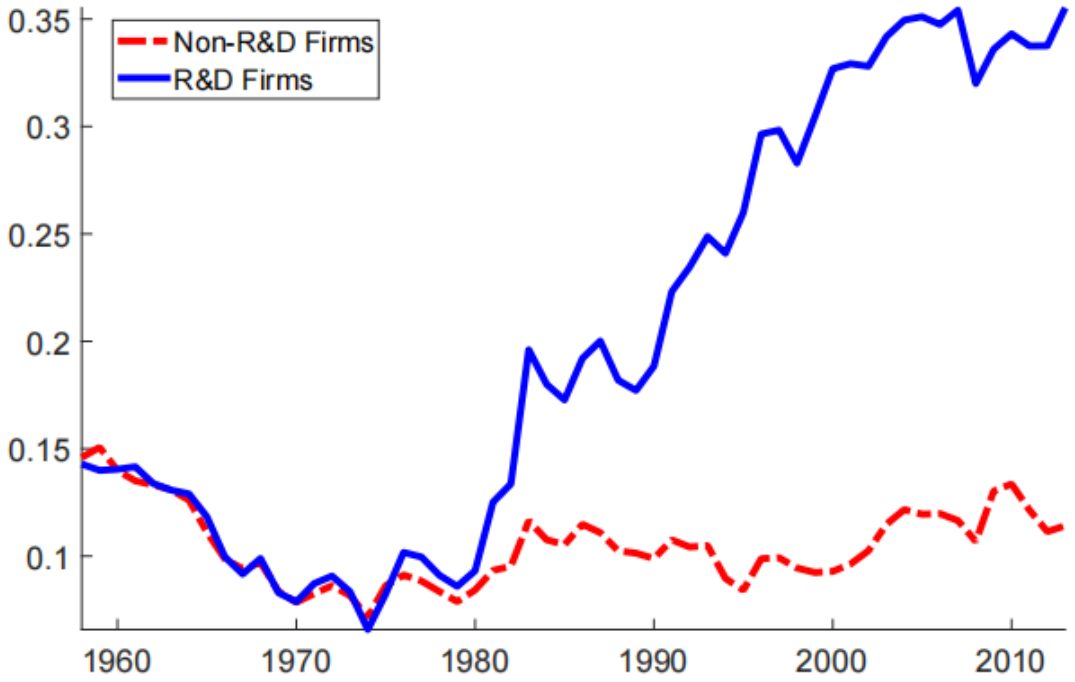
一、three stylized facts

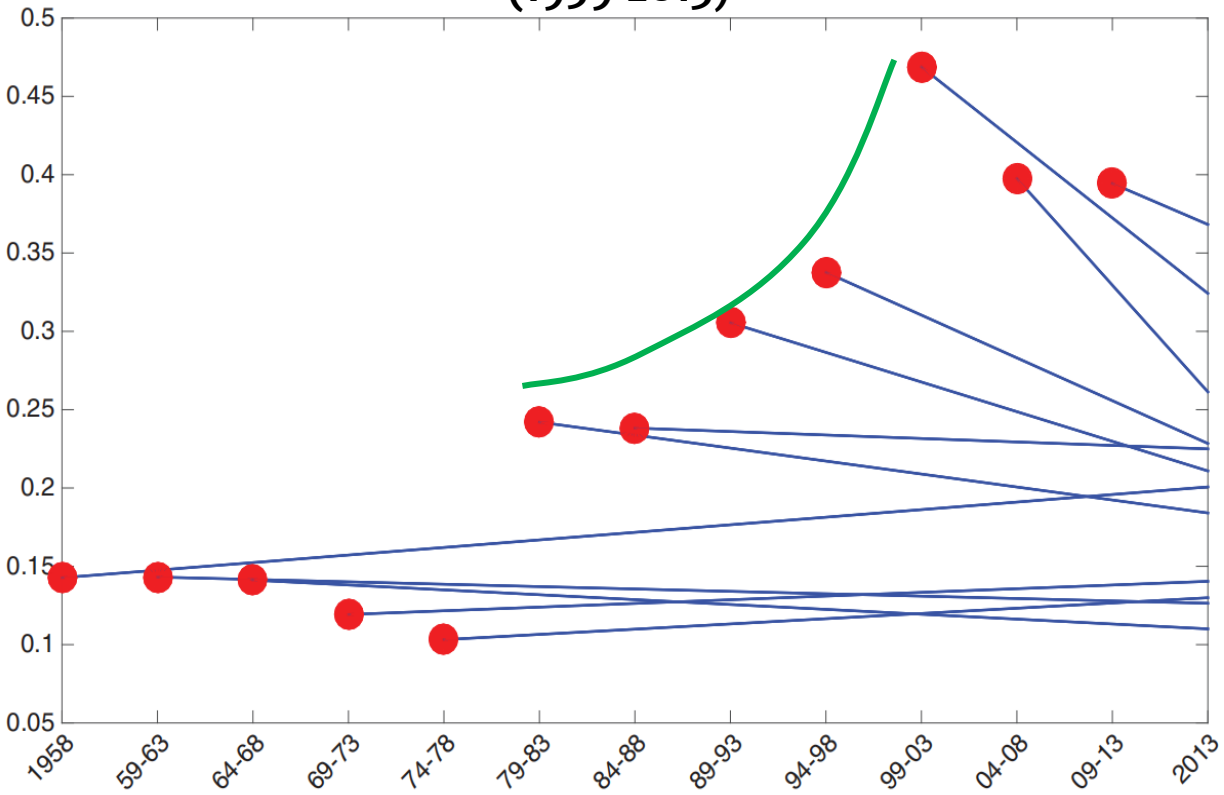
the average cash-to-asset ratio of US public firms

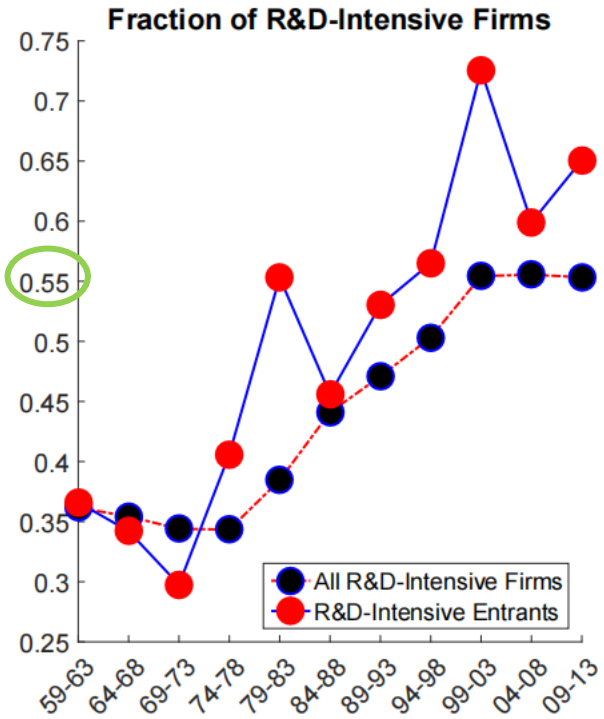


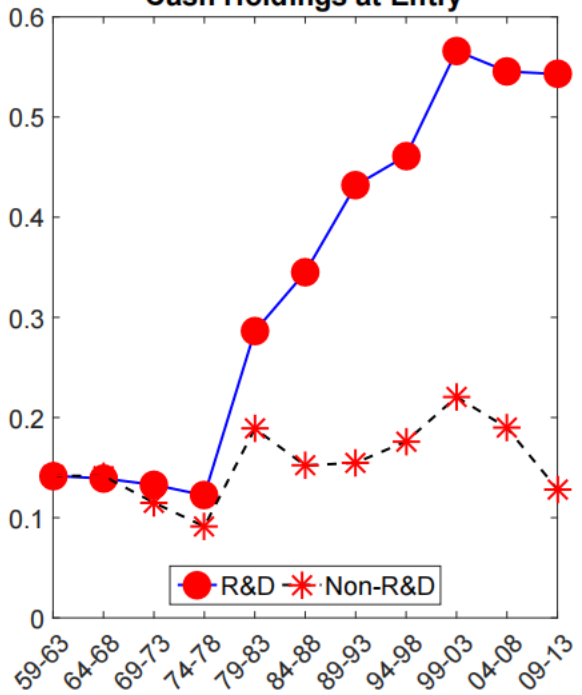
Average cash-to-assets ratio by sector



Average cash holdings at entry (1959-2013)







一、three stylized facts

$$CH_{i,t} = \alpha + \beta t + \sum_{k\in\{K\}} \gamma_k \times I_{i\in k} + \varepsilon_{i,t},$$

During the first half of the 2000s, two events had a significant impact on corporate cash holdings: the Sarbanes-Oxley Act and the 2003 dividend tax cut

	Pooled OLS	All Firms	Non-R&D Intensive	R&D Intensive
	I	II	III	IV
t	0.415***	-0.000	-0.033*	0.017
	(0.019)	(0.019)	(0.019)	(0.032)
1959-1963		-1.521*	-0.931	-1.811
		(0.916)	(1.103)	(1.499)
1964-1968		-1.335	-0.322	-2.274
		(0.921)	(1.148)	(1.407)
1969-1973		-0.932	-1.130	0.705
		(0.840)	(0.952)	(1.473)
1979-1983		6.288***	2.445**	8.547***
		(0.980)	(1.113)	(1.519)
1984-1988		7.970***	1.263	13.711***
		(1.000)	(0.993)	(1.602)
1989-1993		10.739***	0.527	19.177***
		(1.053)	(1.004)	(1.608)
1994-1998		13.513***	2.183**	22.126***
		(1.043)	(1.074)	(1.560)
1999-2003		23.835***	7.186***	29.465***
		(1.299)	(1.562)	(1.705)
2004-2008		16.569***	2.678**	28.328***
		(1.513)	(1.326)	(2.222)
2008-2013		14.255***	3.667	22.919***
		(3.805)	(2.606)	(5.731)
Constant	11.678***	11.349***	10.270***	13.022***
	(0.342)	(0.719)	(0.817)	(1.210)
Observations	76,872	76,872	38,553	38,319
R-squared	0.031	0.108	0.016	0.163

一、three stylized facts

persistent issue

$$CH_{i,t} = \alpha + \beta t + \varepsilon_{i,t}.$$

	Pooled OLS		Firm-by-Firm							
	All	All	All	All	Young	Young	Mature	Mature	Old	Old
	I	II	III	IV	V	VI	VII	VIII	IX	X
Trend	0.418***	0.055***	-0.497***	-0.267***	-0.461***	-0.239***	-0.226***	-0.115***	0.005	0.001
	0.007	0.006	0.034	0.048	0.037	0.053	0.026	0.037	0.239	0.033
Trend X R&D		0.605***		-0.463***		-0.447***		-0.224***		0.007
		0.013		0.068		0.075		0.052		0.048
R&D Dummy		4.579***		20.711***		20.760***		0.180***		11.100***
		0.253		0.587		0.642		0.000		0.910
Constant	10.661***	9.371***	21.920***	11.640***	21.581***	11.276***	20.234***	11.446***	14.648***	9.510***
	0.123	0.122	0.325	0.413	0.350	0.453	0.387	0.505	0.474	0.619
Observations	85,947	85,947	(5,496; 16)		(5,496; 5)		(3,614; 9)		(1607; 13)	
Adjusted R^2	0.035	0.185	0.295		0.418		0.312		0.291	

一、three stylized facts

The importance of R&D-intensive firms
—— an industry whose average R&D investment amounts to at least 2% of assets over the sample period.

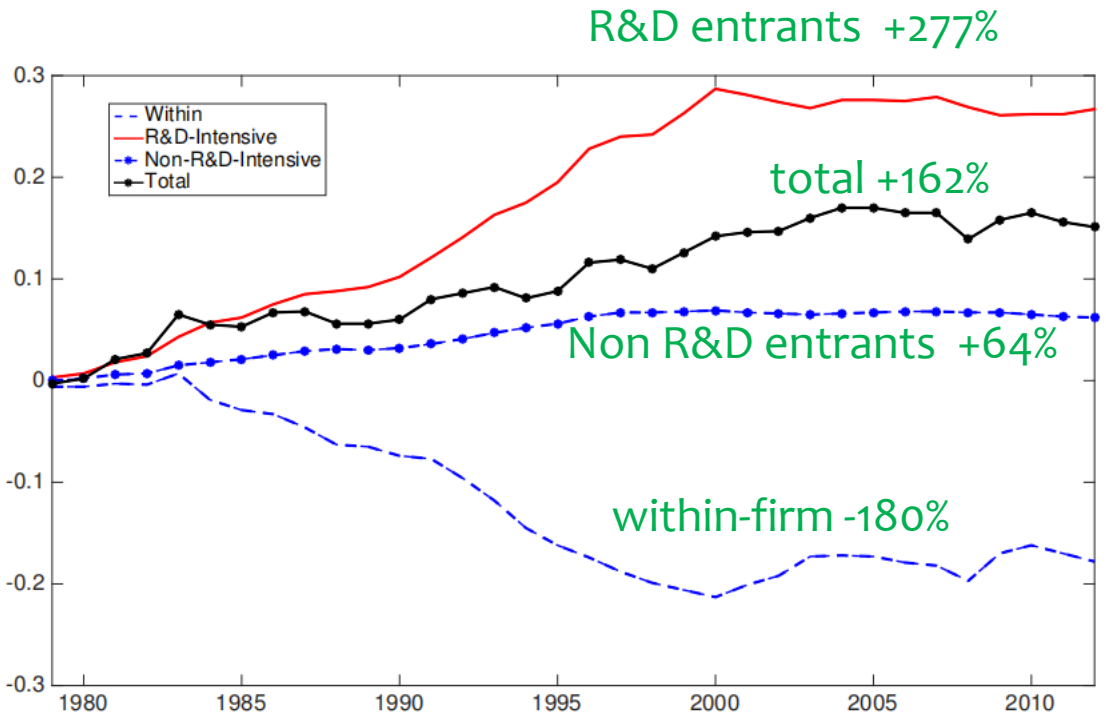
$$\Delta CH_t=(CH_t - CH_{t-1})$$

$$= \left(\frac{N_t^I}{N_t} CH_t^I + \frac{N_t^E}{N_t} CH_t^E\right) - \left(\frac{N_t^I}{N_{t-1}} CH_{t-1}^I + \frac{N_{t-1}^X}{N_{t-1}} CH_{t-1}^X\right)$$

$$= \underbrace{\left(\frac{N_t^I}{N_t} CH_t^I - \frac{N_t^I}{N_{t-1}} CH_{t-1}^I\right)}_{\text{within-firm change}} + \underbrace{\left(\frac{N_t^E}{N_t} CH_t^E - \frac{N_{t-1}^X}{N_{t-1}} CH_{t-1}^X\right)}_{\text{selection change}}$$

$$\Delta CH_t = \left(\frac{N_t^I}{N_t} CH_t^I - \frac{N_t^I}{N_{t-1}} CH_{t-1}^I\right) + \sum_{i=\{R\&D;nonR\&D\}} \left(\frac{N_t^{E_i}}{N_t} CH_t^{E_i} - \frac{N_{t-1}^{X_i}}{N_{t-1}} CH_{t-1}^{X_i}\right).$$

cumulative change in average cash holdings



This result not only reemphasizes the importance of a **selection mechanism** but also shows that most of the selection mechanism is driven by **R&D intensive firms**.

二、Model：heterogeneous firm model

1.incumbent problem : within-firm effect

1）Techonology : input/output(sales)/costs

Assumption:In both sectors, firms use a **decreasing returns-to-scale** technology with **capital** as the only input.

$$y_t = pe^{z_t}k_t^{\alpha}$$

p: scale parameter

α: decreasing returns-to-scale

$$z_{t+1} = \rho z_t + \sigma\epsilon_{t+1}$$

ρ: persistent of TFPR(productivity)

σ: volatility of TFPR

$$k_{t+1} = (1-\delta)k_t + x_{t+1}$$

δ: depreciation rate

$$\varphi(k_{t+1}, k_t) = \eta\left(\frac{k_{t+1} - (1-\delta)k_t}{k_t}\right)^2 k_t$$

η: adjustment cost parameter

2）Financing : issue equity/internal cash(R.E)

Assumption:both **costly**

- internally transferring cash from one period to the next at an accumulation rate $1 + \hat{r}$ lower than the (gross) risk-free rate $1 + r$.
  assume $\hat{r} = \nu r$, where $\nu \in (0, 1)$.

- raise external resources by issuing equity.raising equity (i.e., having a negative dividend $d_t < 0$) requires the payment of $H(d_t)$.
  where $H(d_t) = -f_e - \kappa|d_t|$.

二、 Model：heterogeneous firm model

1.incumbent problem : within-firm effect

3） Incumbent problems :

$$V_t \equiv \max_{c_{t+1}\geq 0, x_{t+1}} d_t + H(d_t)\mathbf{1}_{[d_t \leq 0]} + \frac{1-\lambda}{R}E_t[V_{t+1}] + \frac{\lambda}{R}E_t[w_{t+1} + (1-\delta)k_{t+1}],$$

subject to:

$$z_{t+1} = \rho z_t + \sigma \epsilon_{t+1},$$

$$d_t = w_t - \frac{c_{t+1}}{\widehat{R}} - x_{t+1} - \phi(k_{t+1}, k_t),$$

$$k_{t+1} = (1-\delta_j)k_t + x_{t+1},$$

$$w_{t+1} = pe^{z_{t+1}}k_{t+1}^{\alpha} + c_{t+1}.$$

二、Model：heterogeneous firm model

different initial productivity——>
different initial capital stock & cash balances

2.Entry : selection effect

——While the decision to enter is itself not endogenous,
firms can **choose their initial capital stock and cash holdings at entry**

- each potential entrant receives a **signal q about its future productivity**.
- This signal follows a Pareto distribution q ~ Q(q) over the interval [$\underline{q}$, +∞], whose shape is governed by the parameter ξ .
- Conditional on q, an entrant chooses capital and cash balances to maximize the value function below:

$$V^E(q_t) = \max_{c_{t+1}, k_{t+1}} \left\{ -k_{t+1} - \frac{c_{t+1}}{\widehat{R}} + \frac{1}{R} E[V(k_{t+1}, c_{t+1}, z_{t+1}) | q_t] \right\},$$

where the next-period idiosyncratic shock depends on q in the following fashion

$$z_{t+1} = \rho \log q_t + \sigma \epsilon_{t+1}.$$

二、Model：heterogeneous firm model

3.model implications for cash holdings

——a firm's investment and financing policies are the result of a standard firm- optimization model.
given the parameters, both entrants and incumbents maximize firm value by **choosing cash balances and capital stock.**

1）Incumbents

- Large incumbent firms (high productivity and large installed capital)——>low precautionary savings motive
  <——in expectation, they can generate large cash flows and have low investment needs.

Given the mean-reverting nature of the firm-level productivity process, these firms expect to disinvest in the near future, so the benefit of holding cash is very low.

- small firms(low productivity and low installed capital)——>keep large cash balances relative to their capital<——
  expect to grow fast in the near future.

the benefit of holding cash is large given the high probability of financing investment with costly external equity.

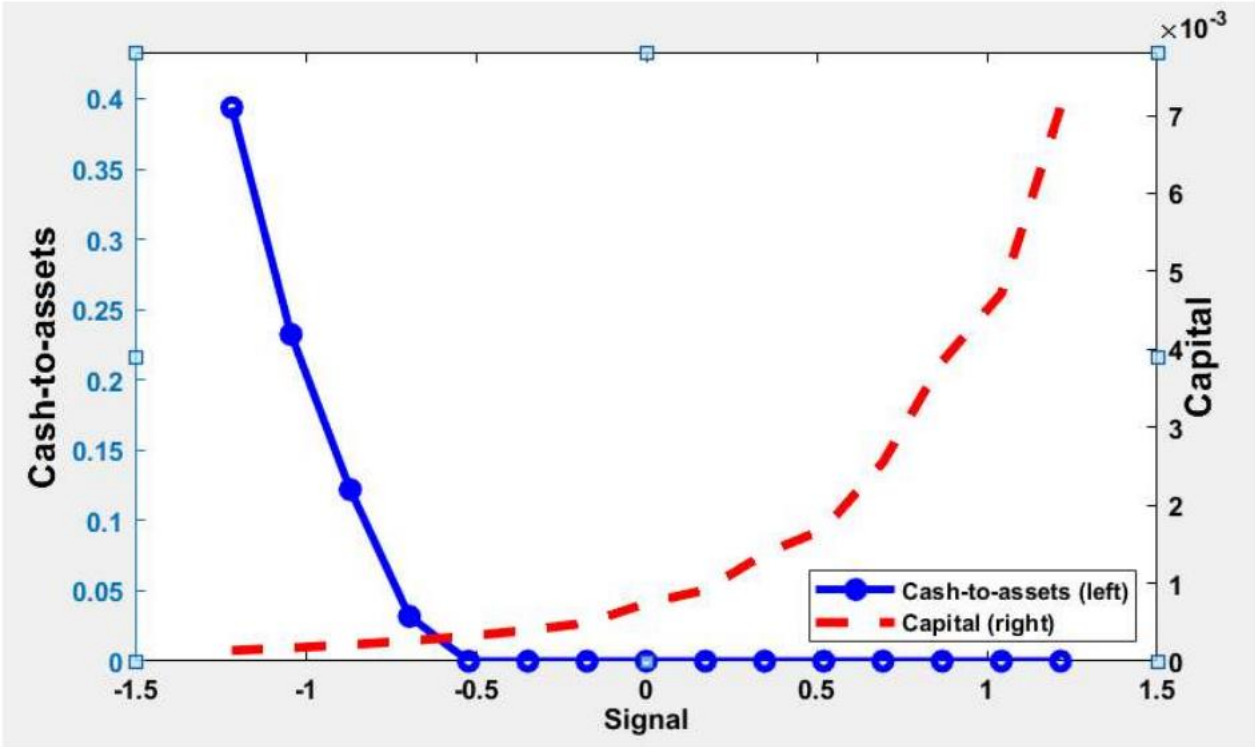
二、 Model：heterogeneous firm model

3.model implications for cash holdings

2） Entering firms

- receives a large signal q——>invest a lot in productive capital and to carry no cash balances<—— expects low growth and large cash flows in the future.

- receives a low signal q——> expects to grow in the near future ——> carry some cash to minimize the cost of future external financing.



受到initial firm-level TFPR（signal)的影响，新进入企业在capital和cash balances 进行权衡
前者代表现在的资本投资，后者代表未来的资本投资

三、Model Estimation

1.estimation strategy——key structural parameters

1)fixed 5 parameters

- depreciation rate δ = 0.15
- the interest rate r = 4%
- proportional equity issuance cost κ = 0.07
- scaling parameter p = 0.07

(pins down the average/optimal firm size)

- exit rate λ =8%

(generate an age and industry distributions close to the ones observed in our sample over the period 1979–2003)

2)use SMM to estimate 7+1 parameters

- govern production technology:

The returns-to-scale parameter α
the convex adjustment cost parameter η
the persistence of the TFPR process ρ
the volatility of the TFPR process σ

- the financing cost parameters: ν and f_e
- drive the selection of average productivity at entry:

the lower bound and the shape parameter of the Pareto distribution, $\underline{q}$ and ξ

ξ using the estimated value entrants over baseline 1974-1978

三、Model Estimation——simulated method of moments

2.identification strategy——4 types moments

	model	data
cash-to-asset	$c_t/(c_t+k_t)$	che_t/at_t
sales growth	$\frac{y_t-y_{t-1}}{0.5y_t+0.5y_{t-1}}$	$\frac{rsale_t-rsale_{t-1}}{0.5rsale_t+0.5rsale_{t-1}}$
investment-to-asset	$x_{t+1}/(c_t+k_t)$	$(ppent_{t+1}-ppent_t)/at_t$
equity-to-assets	$\frac{d_t\mathbf{1}_{[d_t\leq 0]}}{(c_t+k_t)}$	$\frac{sstk_t}{a_t}$

- We calculate the moments at the industry(1/0) and cohort level(1974-1978,1979-2003).
- To capture the dynamics of the cash-to-asset ratio both in the cross-section (i.e., secular increase) and within the firm (i.e., negative average trend), we calculate moments both at the time of entry into the sample and at age ten, when a firm has matured.

- **real sales growth** by netting out nominal GDP growth from nominal sales growth. In this way we remove the effect of inflation and aggregate economic growth, two forces not present in our stationary setup.
- To focus only on **equity issuances for financing purposes** (as opposed e.g., to for compensation purpose), only consider equity issues with proceeds exceeding 3% of the firm's market equity value.

三、Model Estimation

2.identification strategy ：four production technology parameters

1).the average firm-level sales growth volatility → volatility (σ) of the idiosyncratic productivity shock process

2).the average firm-level sales growth autocorrelation → autocorrelation (ρ) of TFPR process

- ρ → 0, no persistence in the productivity process, sales growth rate reverts quickly to its L/T average.
- ρ → 1, the productivity process is highly persistent, a mature firm's sales growth rate is close to its 10 years ago.

$$z_{t+1} = \boldsymbol{\rho} z_t + \boldsymbol{\sigma} \epsilon_{t+1}$$

3). the average change in the sales growth rate (within-firm 2-10 year) → returns-to-scale parameter α

- For α < 1, the marginal productivity declines over the firm's lifetime when its capital stock grows.

$$y_t = \boldsymbol{p} e^{z_t} k_t^{\boldsymbol{\alpha}}$$

4)the average firm-level investment-to-asset ratio volatility → the adjustment cost parameter η

- firms with higher adjustment costs → adjust their investments less in response to productivity shocks → have a lower investment rate volatility

$$\varphi(k_{t+1}, k_t) = \boldsymbol{\eta}\left(\frac{k_{t+1} - (1 - \boldsymbol{\delta})k_t}{k_t}\right)^2 k_t$$

三、Model Estimation

2.identification strategy ：

2 financing cost parameters:

- the average size of equity issuances → the fixed equity issuance cost f_e
- average cash-to-asset ratio at entry → the cost of carrying cash ν
- Higher costs→ lower amount of equity or internal financing.

average signal is $\frac{\underline{q}\xi}{\xi-1}$

signal's variance is $\frac{\underline{q}^2\xi}{(\xi-1)^2(\xi-2)}$

2 firm selection parameters:

- average and volatility of the sales growth at entry → $\underline{q}$ and ξ
- larger average expected signal (higher $\underline{q}$ or lower ξ) → lower average growth rate in sales at entry
- larger signal dispersion (higher $\underline{q}$ or lower ξ) → larger dispersion in sales growth rates among entrants

other 5 moments

- firms' investment rates both at entry and ten years after

—— the average investment rate at entry and the within-firm change in this variable over ten years.

- a negative within-firm trend in cash holdings

——the within-firm change in the cash-to-asset ratio during the first ten years after entry.

- the volatility and autocorrelation of cash holdings

三、Model Estimation

3.Baseline cohorts estimation : 1974-1978

Panel B: Parameter estimates

Parameter	Point Estimate	S.E.
σ	0.156	0.002
ρ	0.649	0.009
α	0.694	0.011
η	0.092	0.009
ξ	11.804	14.640
$\log(\underline{q})$	-0.774	0.156
ν	0.851	0.034
f_e	0.093	0.057

Panel A: Moments

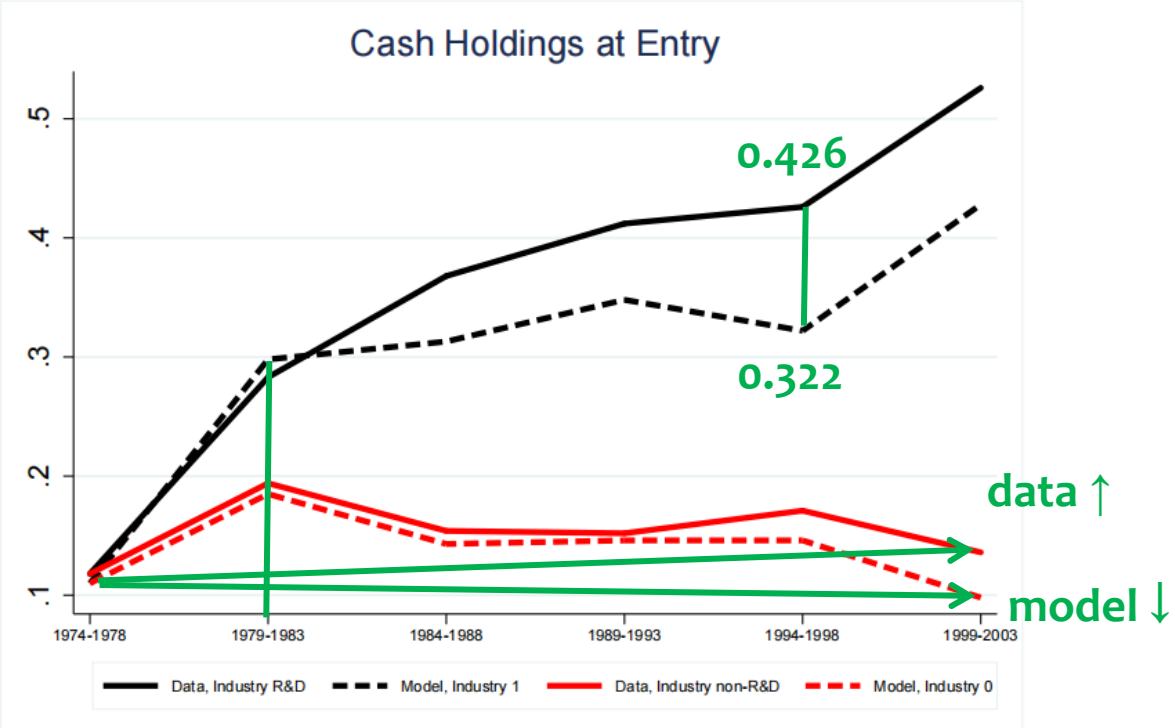
Moments	Data	Model	*t-stat*
		N=532	
Average cash holdings at entry	0.118	0.110	1.486
Average change in cash holdings	-0.018	-0.061	7.264
Volatility cash holdings	0.057	0.053	2.093
Autocorrelation cash holdings	0.276	0.282	-0.368
Average issue size at year 10	0.022	0.022	-0.067
Mean sales growth at 2	0.152	0.167	-1.152
Volatility sales growth at entry	0.086	0.054	3.426
Average change in sales growth	-0.136	-0.141	0.292
Volatility sales growth	0.191	0.175	2.941
Autocorrelation sales growth	0.053	-0.002	3.530
Average investment rate at entry	0.108	0.082	4.003
Average change in investment rate	-0.050	-0.056	0.746
Volatility investment rate	0.088	0.104	-5.972

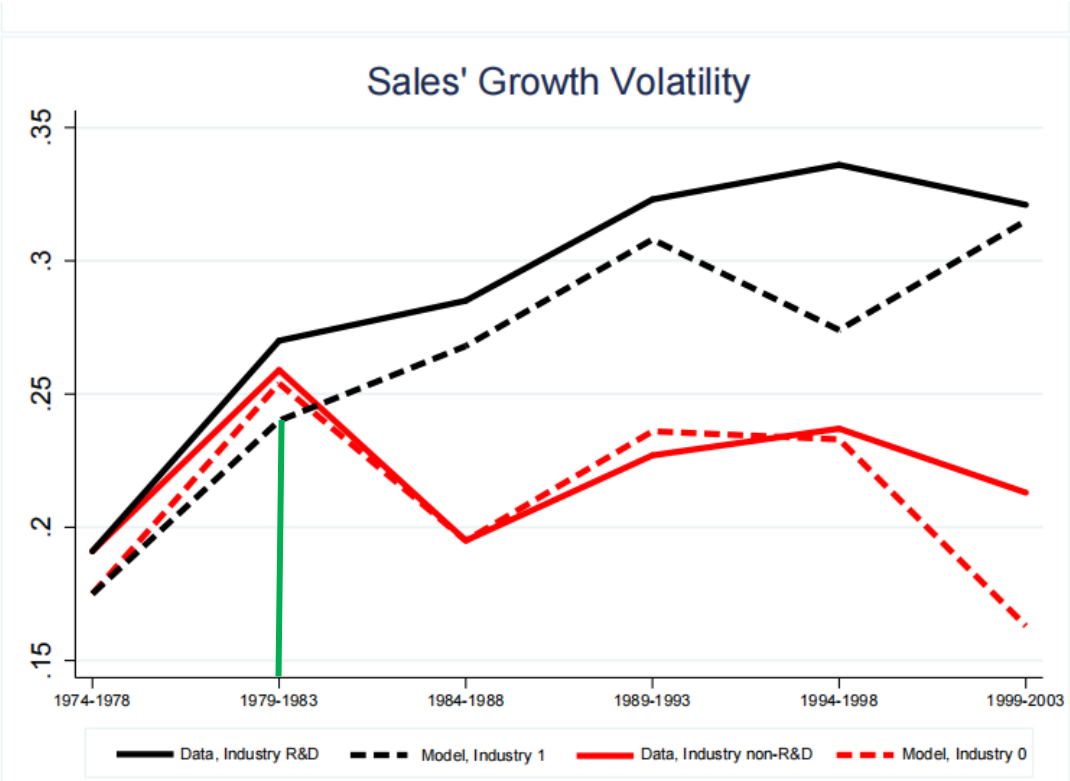
The estimated value for the cost of carrying cash ν = 0.851.

This means that cash carried on the firm's balance sheet delivers a return of **3.4%** instead of **4%** the risk-free rate.

三、Model Estimation

4.Industry-cohort estimation : 1979-2003





三、 Model Estimation

4.Industry-cohort estimation : 1979-2003 industry 1 （R&D-intensive firms)

Moments	1979-1983			1984-1988			1989-1993			1994-1998			1999-2003		
	Data	Model	*t-stat*	Data	Model	*t-stat*	Data	Model	*t-stat*	Data	Model	*t-stat*	Data	Model	*t-stat*
	N=172			N=227			N=213			N=306			N=199		
Average cash holdings at entry	0.283	0.298	(-0.75)	0.368	0.313	(2.98)	0.412	0.348	(3.14)	0.426	0.322	(6.30)	0.526	0.428	(4.67)
Average change in cash holdings	-0.093	-0.201	(5.22)	-0.114	-0.210	(6.27)	-0.110	-0.224	(5.92)	-0.097	-0.230	(9.09)	-0.172	-0.264	(4.42)
Volatility cash holdings	0.122	0.094	(5.26)	0.120	0.099	(4.74)	0.131	0.105	(5.30)	0.132	0.103	(7.64)	0.142	0.127	(3.00)
Autocorrelation cash holdings	0.333	0.380	(-1.70)	0.333	0.467	(-5.61)	0.337	0.455	(-4.89)	0.327	0.500	(-8.25)	0.322	0.552	(-9.38)
Average issue size at year 10	0.015	0.015	(0.07)	0.069	0.069	(0.04)	0.061	0.061	(-0.02)	0.063	0.062	(0.09)	0.055	0.055	(-0.03)
Mean sales growth at 2	0.263	0.254	(0.27)	0.319	0.328	(0.38)	0.279	0.293	(-0.47)	0.297	0.309	(-0.46)	0.346	0.325	(0.51)
Volatility sales growth at entry	0.187	0.109	(2.233)	0.206	0.164	(2.228)	0.181	0.164	(0.955)	0.209	0.155	(3.152)	0.329	0.188	(5.469)
Average change in sales growth	-0.195	-0.227	(0.88)	-0.205	-0.279	(1.99)	-0.243	-0.261	(0.47)	-0.186	-0.271	(2.59)	-0.325	-0.289	(-0.84)
Volatility sales growth	0.270	0.24	(2.35)	0.286	0.268	(1.34)	0.323	0.308	(1.11)	0.336	0.274	(5.14)	0.321	0.315	(0.48)
Autocorrelation sales growth	0.061	-0.047	(4.32)	0.095	-0.071	(6.68)	0.084	-0.156	(9.05)	0.077	-0.094	(8.59)	0.07	-0.089	(6.85)
I1 Average investment rate at entry	0.117	0.114	(0.27)	0.081	0.081	(-0.02)	0.068	0.062	(0.76)	0.078	0.085	(-1.02)	0.048	0.057	(-1.30)
I0 Average investment rate at entry	0.157	0.147	(0.46)	0.116	0.102	(1.10)	0.149	0.124	(1.54)	0.142	0.140	(0.12)	0.132	0.119	(0.50)
Volatility investment rate	0.093	0.111	(-4.20)	0.073	0.093	(-6.07)	0.07	0.089	(-5.36)	0.061	0.092	(-11.41)	0.048	0.097	(-15.22)

- I0>I1 均呈下降趋势
进入时选择越来越多的现金在以后投资

- 所有时间和行业，刚进入的公司都比上市十年后快
  - low TFPR, grow faster now
  - mean reversion in the future,grow larger but at slower pace.

- 消耗太快
方向相反但强度不大

- 太低
太高

三、 Model Estimation

4.Industry-cohort estimation : 1979-2003

● 现金持有收益没有明显时间趋势，但I1比I0高

I0

	σ	ρ	α	η	$\log(q)$	ν	f_e
1979-1983	0.246	0.795	0.493	0.051	-1.087	0.869	0.246
	0.007	0.014	0.010	0.000	0.077	0.014	0.033
1984-1988	0.186	0.774	0.606	0.072	-1.015	0.767	0.044
	0.003	0.013	0.001	0.004	0.050	0.050	0.005
1989-1993	0.221	0.721	0.592	0.044	-0.865	0.732	0.048
	0.005	0.012	0.018	0.006	0.029	0.065	0.017
1994-1998	0.215	0.717	0.564	0.071	-1.224	0.701	0.098
	0.004	0.018	0.000	0.005	0.227	0.057	0.026
1999-2003	0.126	0.494	0.716	0.057	-0.883	0.774	0.092
	0.005	0.016	0.024	0.002	0.161	0.160	6.924

I1

	σ	ρ	α	η	$\log(q)$	ν	f_e
1979-1983	0.209	0.513	0.823	0.062	-0.830	0.876	0.032
	0.004	0.009	0.013	0.002	0.024	0.015	0.670
1984-1988	0.229	0.511	0.850	0.179	-1.340	0.862	0.039
	0.003	0.011	0.011	0.005	0.086	0.029	0.133
1989-1993	0.263	0.461	0.888	0.165	-1.219	0.892	0.000
	0.008	0.013	0.003	0.005	0.076	0.016	0.001
1994-1998	0.236	0.494	0.851	0.159	-1.216	0.869	0.026
	0.091	0.019	0.012	0.005	0.021	0.027	215.220
1999-2003	0.275	0.505	0.872	0.192	-1.361	0.900	0.001
	0.005	0.006	0.004	0.033	0.088	0.150	0.001

● 只有这两个参数在 I1 有明显的时间变化趋势

$\log q$ 均比基组(-0.774)小，尤其 I1 近年来特别低，考虑到均值回归以及股权融资的成本，会因此在进入时持有大量现金

● relative to large firms, smaller firms have a larger volatility parameter , a smaller persistence parameter , and a larger return-to-scale parameter .
模型中，I1是I0公司规模的四分之一

三、Analysis：two trends between 1974-1978 and 1999-2003

1.secular increase in cash

Year5	Sample Composition		Cash-to-asset		Cash-to-asset (Ind. 0)		Cash-to-asset (Ind. 1)		Sales growth vol	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Data	Model	Data	Model	Data	Model	Data	Model	Data	Model
Difference	0.218	0.213	0.136	0.056	0.012	-0.027	0.237	0.116	0.152	0.078
% Change	65%	65%	160%	78%	14%	-38%	278%	163%	88%	44%

+40% +50% +50% +60% +50%

	1994-1998			1999-2003		
	Data	Model N=236	*t*-stat	Data	Model N=86	*t*-stat
	0.171	0.146	(2.06)	0.136	0.098	(1.99)

不能完全拟合的原因：
1.消耗速度是实际的两倍
2.Io 后两时间组生成了较低的进入现金持有量，总体趋势也有所不同

Cohort	1974-1978	1979-1983	1984-1988	1989-1993	1994-1998	1999-2003
Industry 1 (ω)	0.33	0.55	0.45	0.52	0.55	0.74
Industry 0 (1-ω)	0.67	0.45	0.55	0.48	0.45	0.26

Note: our choice of an exogeneous exit rate 8%

2.secular increase in sales growth rate volatility

- This result is not merely an artifact of our estimates for the volatility of the productivity process σ.
- There is no trend in industry 0 estimates of σ.
- We estimate that the 1999-2003 cohort has only a **30%** higher volatility parameter than the 1974- 1978 cohort in industry 1 (0.275 versus 0.209).
- Moreover, **46%** of firms during 1999-2003 period do not operate in industry 1（54%）, nor are all firms in industry 1 of the 1999- 2003 cohort.

四、Counterfactuals: isolate and quantify the contribution of mechanism

- volatility of industry 1（σ）
- initial productivity of industry 1（log $\underline{q}$ ）
- cash-to-asset ratio
- sales growth rate volatility

1. role of selection （log $\underline{q}$）

	Cash-to-asset				Sales growth dispersion			
	Model	$\underline{q}$ fixed	$(\omega, \underline{q})$ fixed	only $(\omega, \underline{q})$	Model	$\underline{q}$ fixed	$(\omega, \underline{q})$ fixed	only $(\omega, \underline{q})$
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
1974-1978	0.071	0.071	0.071	0.071	0.176	0.176	0.176	0.176
1979-1983	0.090	0.095	0.080	0.082	0.192	0.196	0.193	0.181
1984-1988	0.096	0.076	0.069	0.097	0.215	0.210	0.208	0.189
1989-1993	0.104	0.079	0.070	0.094	0.228	0.221	0.218	0.189
1994-1998	0.105	0.077	0.064	0.109	0.244	0.236	0.230	0.193
1999-2003	0.127	0.094	0.064	0.107	0.254	0.246	0.231	0.199
Difference	0.056	0.023	-0.008	0.035	0.078	0.070	0.055	0.022
% Change	78%	32%	-11%	50%	44%	40%	31%	13%

1) role of changes in the entry margin
- only 40% of cash
- 90% sales volatility

2) overall effect of firm selection
- negative cash
- 70% sales volatility

3) selection the only force
- 60% cash
- 30% sales volatility

四、Counterfactuals: isolate and quantify the contribution of mechanism

- volatility of industry 1（σ）
- initial productivity of industry 1（log $\underline{q}$ ）
- cash-to-asset ratio
- sales growth rate volatility

2. productivity volatility (σ)

Panel A: Cash flow volatility

	Cash-to-asset			Sales growth dispersion		
	Model	σ fixed	only σ	Model	σ fixed	only σ
	(1)	(2)	(3)	(4)	(5)	(6)
1974-1978	0.071	0.071	0.071	0.176	0.176	0.176
1979-1983	0.090	0.082	0.085	0.192	0.184	0.191
1984-1988	0.096	0.087	0.083	0.215	0.190	0.208
1989-1993	0.104	0.088	0.088	0.228	0.190	0.218
1994-1998	0.105	0.085	0.094	0.244	0.192	0.229
1999-2003	0.127	0.113	0.088	0.254	0.197	0.229
Difference	0.056	0.042	0.017	0.078	0.021	0.053
% Change	78%	59%	24%	44%	12%	30%

1) role of productivity volatility
- 76% of cash
- 27% sales volatility

2) only productivity volatility (industry composition still w=0.33)
- 30% of cash
- 68% sales volatility

四、Counterfactuals: isolate and quantify the contribution of mechanism

3. both: (σ)+(w)+(log $\underline{q}$)

Panel B: Selection and cash flow volatility

	Cash-to-asset			Sales growth dispersion		
	Model	$(\sigma,\omega,\underline{q})$ fixed	only $(\sigma,\omega,\underline{q})$	Model	$(\sigma,\omega,\underline{q})$ fixed	only $(\sigma,\omega,\underline{q})$
	(1)	(2)	(3)	(4)	(5)	(6)
1974-1978	0.071	0.071	0.071	0.176	0.176	0.176
1979-1983	0.090	0.064	0.097	0.192	0.180	0.195
1984-1988	0.096	0.049	0.123	0.215	0.177	0.221
1989-1993	0.104	0.048	0.125	0.228	0.178	0.233
1994-1998	0.105	0.040	0.139	0.244	0.178	0.247
1999-2003	0.127	0.040	0.144	0.254	0.180	0.256
Difference	0.056	-0.031	0.072	0.078	0.004	0.080
% Change	78%	-44%	102%	44%	2%	45%

- Keep the productivity process persistence parameter ρ fixed at (0.649).
- In fact, this parameter decreases over time.
- By keeping it, delivers a lower expected productivity at entry (ρ × log q), which translates in a higher choice of cash balances at entry.

1) except w/σ/log $\underline{q}$
- -44% cash (like industry 0 :-38%)
- no change of sales volatility

2) only w/σ/log $\underline{q}$
- cash: 102% vs. 78%
- sales volatility: 45% vs. 44%

Cash-to-asset (Ind. 0)

(5)	(6)
Data	Model
0.012	-0.027
14%	-38%

五、Discussion: model(78%) vs. data(160%)

Complementary explanations:

1.tax consideration

- large multinational firms hold on to significant cash balances abroad.
- the cash holdings of **technology firms**, i.e., firms with more flexibility to shift profits to low tax locations,are especially **sensitive to tax rates**.

2.the opportunity cost of money (the short-term risk-free rate)

- the risk-free rate has been **falling** over the last 30 years.
- if cash balances are particularly important for R&D-intensive firms to circumvent financing constraints, then, **R&D-intensive firms** might become more **sensitive to changes in the opportunity cost** of holding cash.
- Augmenting our setup to include a **negative time trend in the risk-free rate** in model.
  (now , fixed risk-free rate & no clear time trend of ν of I1)

五、Discussion: model(78%) vs. data(160%)

Complementary explanations:

3.agency friction

- for larger firms, agency frictions (ie. a lower share of managerial firm ownership) are relevant for the upward trend in cash.
- agency frictions are less important for smaller firms that play a prominent role in the selection mechanism.

4.a change in production technologies

- within-firm effect:**new production technologies** are adopted by **existing firms**.
  But unless one controls for cohort effects, the changes could also emerge from **new firms** .
- In addition, we do not allow for **changes in the functional form of the production function or its capital input type**, we find no clear time trend for its parameters over industries and cohorts.
- **Incorporating a capital type choice** in the model.

六、Conclusion

——cash flow volatility and the average TFPR of newcomers into US equity markets as an important forces behind the secular increase in the average cash-to-asset ratio.

selection firms types:1979-2003

- More than a shift in the composition of **R&D-intensive firms**
- a shift toward **smaller, riskier, initially less productive, but higher growth potential** frims

WHY?

- **more favorable IPO conditions** allowed smaller and less profitable firms to go public.
- instigated by relaxing the Employment Retirement Income Security Act's (ERISA) **"Prudent Man" Rule** passed by Congress **in 1979** that **allowed pension funds to invest in riskier ventures** , such as smaller, less profitable firms with higher growth option value.

THANKS FOR YOUR WACTHING