Lecture Notes

Li, Livdan, and Zhang (2009, Review of Financial Studies): Anomalies

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Outline

Outline

What

How much can the standard, neoclassical framework quantitatively explain the relations between stock returns and financing decisions?

Why

Return-related evidence on behavioral underreaction to market timing

- Equity issuance waves
- Stock market predictability associated with the new equity share
- Negative drift following SEOs
- Deteriorating profitability of issuers
- Positive drift following cash distribution, higher in value firms
- Mean-reverting profitability of cash-distributing firms
- Negative investment-return correlation, increasing in cash flow

Ritter (2003): managers time the market and investors underreact to financing decisions

Why

Related literature

Empirical asset pricing and corporate finance:

- Ritter (1991, 2003); Loughran and Ritter (1995, 1997); Spiess and Affleck-Graves (1995, 1999); Ikenberry, Lakonishok, and Vermaelen (1995); Baker and Wurgler (2000, 2002); Titman, Wei, and Xie (2004)

Capital structure theory:

- Hennessy and Whited (2005, 2007); Strebulaev (2005)

Asset pricing theory:

- Stein (1996); Pastor and Veronesi (2005); Carlson, Fisher, and Giammarino (2006)

Outline

Model

Partial equilibrium, neoclassical investment framework as in Zhang (2005)

Technology:

$$\underbrace{y_{it}}_{\textbf{Operating profits}} = \overbrace{e^{x_t + z_{jt}}}^{\textbf{Productivity}} \underbrace{k_{jt}^{\alpha}}_{\textbf{Capital stock}} - \overbrace{f}^{\textbf{Fixed costs of production}}$$

$$\underbrace{x_{t+1}}_{\textbf{Aggregate productivity}} = \overline{x}(1 - \rho_x) + \rho_x x_t + \sigma_x \epsilon^x_{t+1}$$

$$\underbrace{z_{jt+1}}_{\textbf{Firm-specific productivity}} = \rho_z z_{jt} + \sigma_z \epsilon^z_{jt+1}$$

Model

Corporate investment, costly external equity

$$\underbrace{c_{jt}}_{\textbf{Adjustment costs}} = \frac{a}{2}\left(\frac{i_{jt}}{k_{jt}}\right)^2 k_{jt}, \qquad a > 0$$

$$\underbrace{e_{jt}}_{\textbf{External equity}} = \max\left\{0, \underbrace{(i_{jt} + c_{jt})}_{\textbf{The uses of funds}} - \underbrace{y_{jt}}_{\textbf{Internal funds}}\right\}$$

$$\underbrace{\lambda(e_{jt})}_{\textbf{Equity floatation costs}} = \underbrace{\lambda_0 \mathbf{1}_{\{e_{jt}>0\}}}_{\textbf{Fixed costs}} + \underbrace{\lambda_1 e_{jt}}_{\textbf{Proportional flow costs}}$$

Model

Payout, stochastic discount factor, and firm value

$$\underbrace{v(k_{jt}, x_t, z_{jt})}_{\textbf{Firm value}} = \max_{\{i_{jt}\}} \underbrace{d_{jt} - e_{jt} - \lambda(e_{jt})}_{\textbf{Effective cash flow}} + \mathrm{E}_t[m_{t+1} v(k_{jt+1}, x_{t+1}, z_{jt+1})]$$

- $$\underbrace{d_{jt}}_{\textbf{Payout}} = \max\left\{0, \underbrace{y_{jt}}_{\textbf{Internal funds}} - \underbrace{(i_{jt} + c_{jt})}_{\textbf{The uses of funds}}\right\}$$

- $$\underbrace{m_{t+1}}_{\textbf{Stochastic discount factor}} = \eta e^{\gamma_t(x_t - x_{t+1})}$$
$$\gamma_t = \gamma_0 + \gamma_1(x_t - \overline{x}) \quad \text{where} \quad \gamma_1 < 0$$

Model

Risk and expected return

Evaluating the value function at the optimum yields:

$$v_{jt} = \widetilde{d}_{jt} + \mathrm{E}_t[m_{t+1} v_{jt+1}] \quad \Leftrightarrow \quad 1 = \mathrm{E}_t[m_{t+1} r_{jt+1}]$$

where $r_{jt+1} \equiv v_{jt+1}/(v_{jt} - \widetilde{d}_{jt})$

$$\mathrm{E}_t[r_{jt+1}] = \underbrace{r_{ft}}_{\textbf{real interest rate}} + \beta_{jt}\lambda_{mt}$$

where $\beta_{jt} \equiv \frac{-\mathrm{Cov}_t[r_{jt+1}, m_{t+1}]}{\mathrm{Var}_t[m_{t+1}]}$ and $\lambda_{mt} \equiv \frac{\mathrm{Var}_t[m_{t+1}]}{\mathrm{E}_t[m_{t+1}]}$

Outline

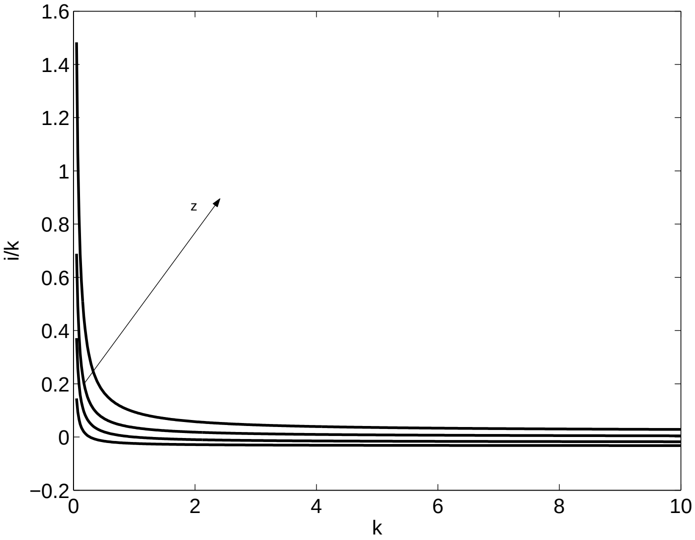
Calibrate the model in monthly frequency:

α	$\bar{x}$	ρ_x	σ_x	ρ_z	σ_z	η
0.70	-3.751	$\sqrt[3]{0.95}$	0.007/3	0.965	0.100	0.994
γ_0	γ_1	f	δ	a	λ_0	λ_1
50	-1000	0.005	0.01	15	0.08	0.025

Similar to previous studies such as Gomes (2001) and Zhang (2005)

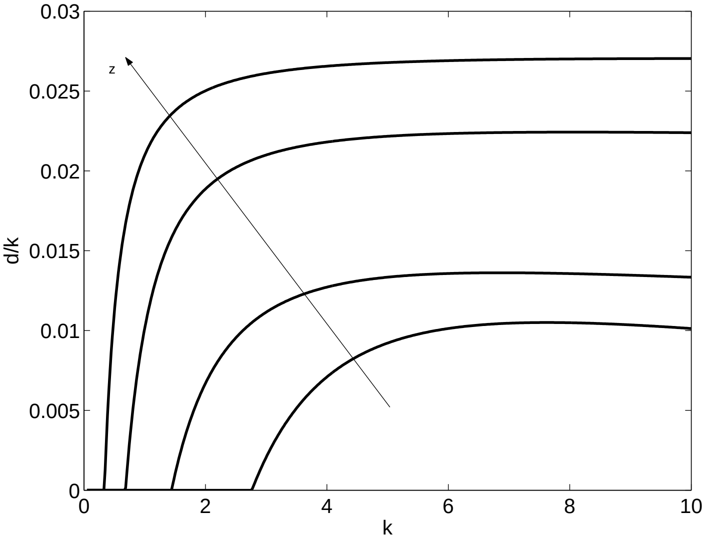
Quantitative Results

Optimal investment-to-capital, similar to optimal new equity-to-capital



Quantitative Results

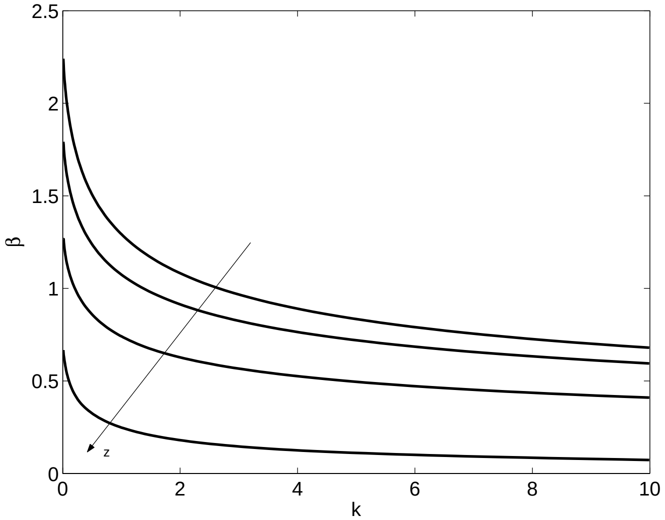
Optimal payout-to-capital



Outline

Quantitative Results

Beta decreases with the capital stock



Quantitative Results

Intuition for the physical-size effect

A two-period example: dates 1 and 2. Production is k_t^α. Capital: $k_2 = i + (1-\delta)k_1$. No adjustment costs. A gross discount rate r

The firm's objective function is:

$$\max_{k_2} \; k_1^\alpha - k_2 + (1-\delta)k_1 + \frac{1}{r}(k_2^\alpha + (1-\delta)k_2)$$

The first-order condition says:

$$r = \alpha k_2^{\alpha-1} + 1 - \delta \quad \Rightarrow \quad \frac{\partial r}{\partial k_2} = \alpha(\alpha-1)k_2^{\alpha-2} < 0$$

due to decreasing returns to scale

Quantitative Results

Intuition for the negative investment-return relation

Add quadratic capital adjustment costs, $(a/2)(i/k_1)^2 k_1$, into the setup. Now the firm maximizes:

$$\max_{k_2}\ k_1^\alpha - k_2 + (1-\delta)k_1 - \frac{a}{2}\left(\frac{k_2}{k_1} - (1-\delta)\right)^2 k_1 + \frac{1}{r}(k_2^\alpha + (1-\delta)k_2)$$

The first-order condition implies that:

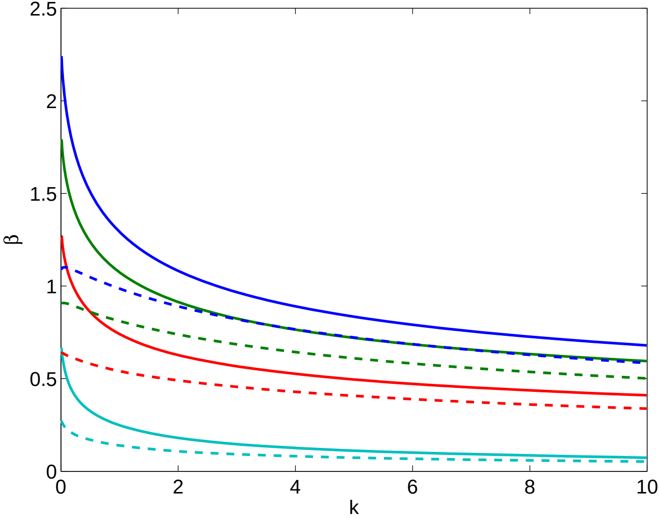
$$r = \frac{\alpha[i + (1-\delta)k_1]^{\alpha-1} + 1 - \delta}{1 + a(i/k_1)} \quad \Rightarrow$$

$$\frac{\partial r}{\partial i} = \frac{\alpha(\alpha-1)k_2^{\alpha-2}}{1 + a(i/k_1)} - \frac{\alpha k_2^{\alpha-1} a}{(1 + a(i/k_1))^2 k_1} < 0$$

Intuition: cash flow channel versus discount rate channel

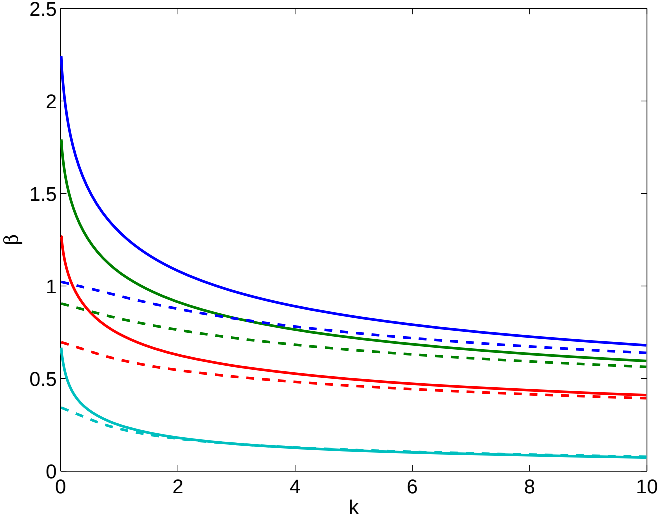
Quantitative Results

More curvature in production, lower risk (intuition? no clue)



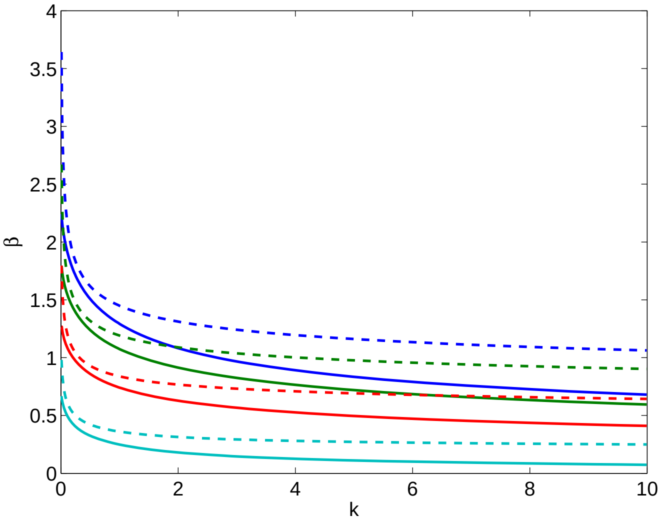
Quantitative Results

Lower fixed costs of production, lower risk (intuition: operating leverage)



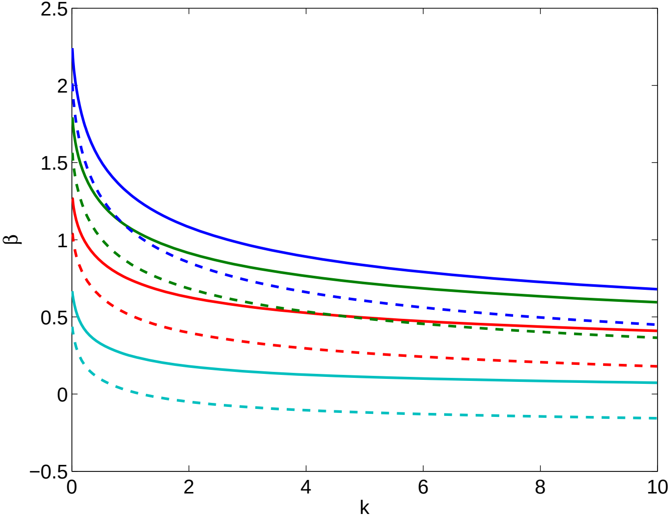
Quantitative Results

Higher adjustment costs of capital, higher risk (intuition: real flexibility)



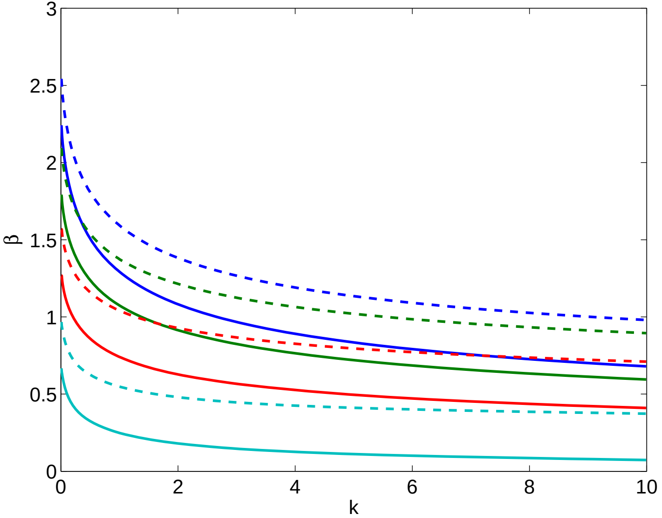
Quantitative Results

Lower fixed costs of financing, lower risk (intuition: real flexibility)



Quantitative Results

Higher variable costs of financing, higher risk (intuition: real flexibility)



Outline

Quantitative Results

Applying the Kydland-Prescott (1982) quantitative-theory approach

1. Simulate 100 artificial samples of 5000 firms and 480 months
2. Replicate empirical studies on the artificial samples
3. Report the cross-simulation averaged statistics
4. Compare the model-implied moments with data moments

Overidentification: 14 parameters vs. 424 moments!

Quantitative Results

Unconditional moments

Table 1
Unconditional moments from the simulated and real data

	Data	Model
The average annual risk-free rate	0.018	0.021
The annual volatility of risk-free rate	0.030	0.029
The average annual Sharpe ratio	0.430	0.405
The average annual investment-to-assets ratio	0.130	0.119
The volatility of investment-to-assets ratio	0.006	0.013
The frequency of equity issuance	0.099	0.285
The average new equity-to-asset ratio	0.042	0.043
The average market-to-book ratio	1.493	1.879
The volatility of market-to-book	0.230	0.242

Quantitative Results

The relation between investment and average returns

Table 2
Excess returns of capital investment (*CI*) portfolios

Panel A: Excess return distribution of capital investment portfolios

CI portfolio	Mean		Std Dev		Max		Median		Min	
	Data	Model	Data	Model	Data	Model	Data	Model	Data	Model
Low	0.042	0.064	0.010	0.050	3.38	0.16	0.06	0.07	−3.11	−0.07
2	0.083	0.010	0.007	0.031	2.26	0.08	0.10	0.01	−2.76	−0.06
3	0.055	−0.007	0.006	0.023	1.84	0.05	0.03	−0.01	−2.07	−0.06
4	−0.083	−0.021	0.005	0.027	1.38	0.04	−0.06	−0.02	−1.88	−0.08
High	−0.127	−0.038	0.010	0.046	2.61	0.06	−0.08	−0.04	−4.08	−0.13
CI spread	0.169	0.101	0.009	0.004	3.30	0.07	0.12	0.07	−2.63	0.04

Panel B: $r^a_{jt+1} = l_{0t} + l_{1t}\,CI_{jt} + l_{2t}\,CI_{jt} \times DCF_{jt} + \epsilon_{jt+1}$

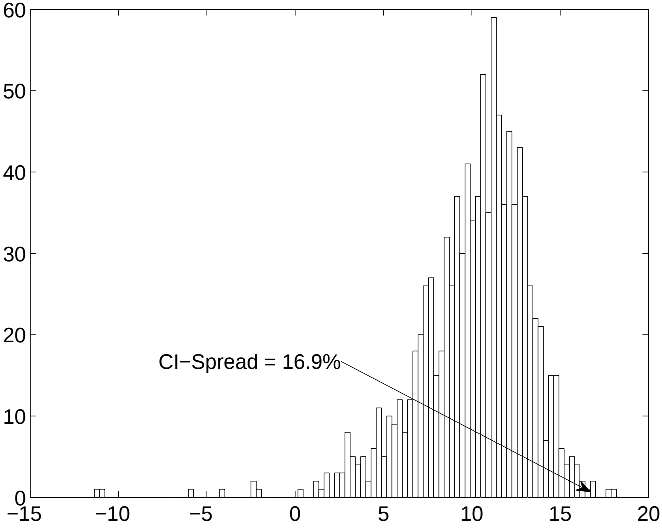
	CI		$CI \times DCF$	
	Data	Model	Data	Model
Slopes	−0.79	−0.56	−0.76	−0.47
(t)	(−2.80)	(−3.14)	(−2.19)	(−3.44)

Panel C: Cross-sectional regressions of r^a_{jt+1} on *CI*, $CI \times DCF$, and rolling market betas ($\hat{\beta}_{jt}$); and on *CI*, $CI \times DCF$, and true betas (β_{jt})

	CI	$CI \times DCF$	$\hat{\beta}_{jt}$	CI	$CI \times DCF$	β_{jt}
Slopes	−0.32	−0.16	−0.04	−0.38	−0.41	0.43
(t)	(−2.31)	(−3.67)	(−3.37)	(−1.85)	(−1.65)	(4.83)

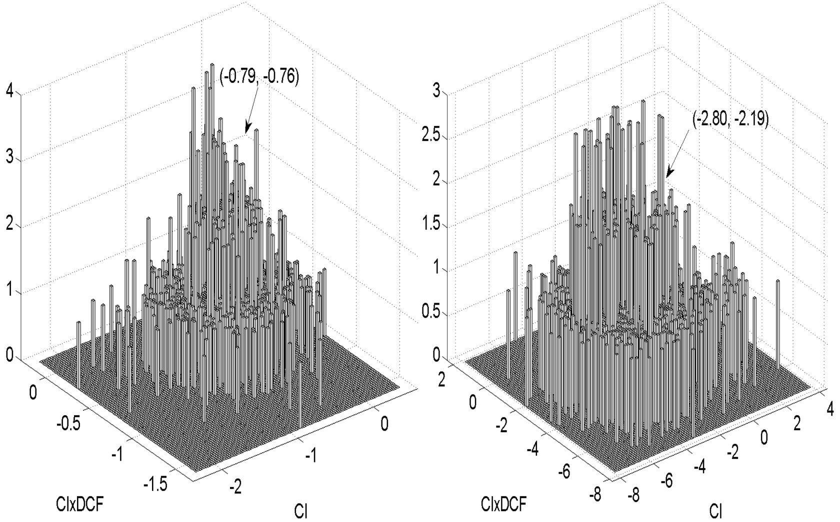
Quantitative Results

Empirical distribution of the mean *CI* spread



Quantitative Results

Empirical distributions of the slopes of *CI* and $CI \times DCF$ and their *t*-statistics in Fama-MacBeth cross-sectional regressions



Quantitative Results

Monthly cross-sectional regressions of percentage stock returns

Table 3

Fama-MacBeth (1973) monthly cross-sectional regressions of percentage stock returns on size, book-to-market, and the new issues dummy

Panel A: Replicating Loughran and Ritter (1995, Table VIII)

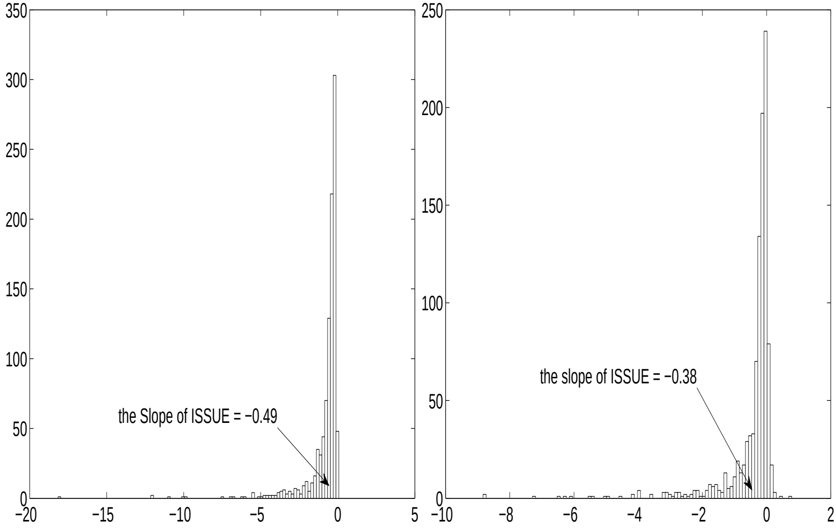
	$\log(ME)$		$\log(BM)$		*ISSUE*	
Sample	Data	Model	Data	Model	Data	Model
All months					−0.49	−0.81
					(−3.98)	(−4.76)
	−0.05	0.63	0.30	0.89	−0.38	−0.44
	(−0.91)	(4.22)	(4.57)	(8.18)	(−2.32)	(−2.87)
Periods following light volume	−0.26	0.88	0.20	1.00	−0.17	0.06
	(−3.12)	(5.21)	(1.80)	(7.62)	(−1.19)	(0.31)
Periods following heavy volume	0.16	0.39	0.39	0.79	−0.60	−0.90
	(2.11)	(1.39)	(6.30)	(4.49)	(−3.98)	(−3.75)

Panel B: Cross-sectional regressions controlling for rolling betas ($\hat{\beta}_{jt}$), true betas (β_{jt}), or true expected returns ($E_t[r_{jt+1}]$)

	$\log(ME)$	$\log(BM)$	*ISSUE*	$\hat{\beta}_{jt}$	$\log(ME)$	$\log(BM)$	*ISSUE*	β_{jt}	$\log(ME)$	$\log(BM)$	*ISSUE*	$E_t[r_{jt+1}]$
All months			−0.30	−0.95			−0.31	0.67			−0.31	0.96
			(−2.64)	(−3.09)			(−3.37)	(15.45)			(−1.52)	(9.99)
	0.63	0.55	−0.27	−0.20	−0.79	−0.70	−0.27	0.70	−0.07	0.58	−0.23	0.87
	(6.74)	(8.29)	(−2.25)	(−4.04)	(−1.12)	(−1.53)	(−2.96)	(9.15)	(−1.67)	(0.90)	(−1.28)	(9.39)
Periods following light volume	0.19	0.45	−0.07	−0.16	−0.91	−0.61	−0.16	0.82	−0.08	0.29	−0.15	0.89
	(4.63)	(3.15)	(−1.03)	(−2.02)	(−1.65)	(−1.03)	(−2.43)	(8.09)	(−1.67)	(0.92)	(−1.52)	(8.93)
Periods following heavy volume	1.08	0.66	−0.47	−0.24	−0.55	−0.79	−0.39	0.59	−0.06	0.86	−0.32	0.86
	(8.89)	(9.30)	(−3.73)	(−4.57)	(−1.41)	(−1.58)	(−3.19)	(7.18)	(−1.33)	(0.85)	(−1.06)	(9.79)

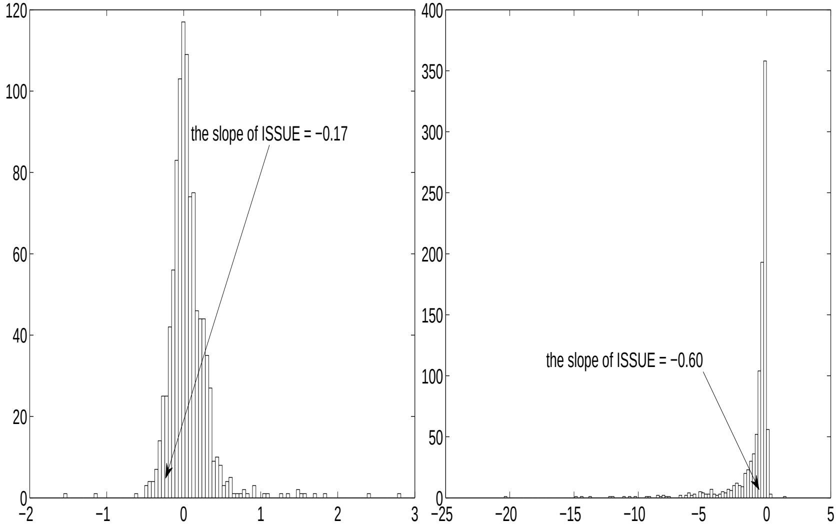
Quantitative Results

Empirical distributions of the slopes of the *ISSUE* dummy in cross-sectional regressions, univariate and multiple



Quantitative Results

Empirical distributions of the slopes of the *ISSUE* dummy in cross-sectional regressions (multiple), light and heavy volume periods



Quantitative Results

Positive long-term stock price drift following open market share repurchases

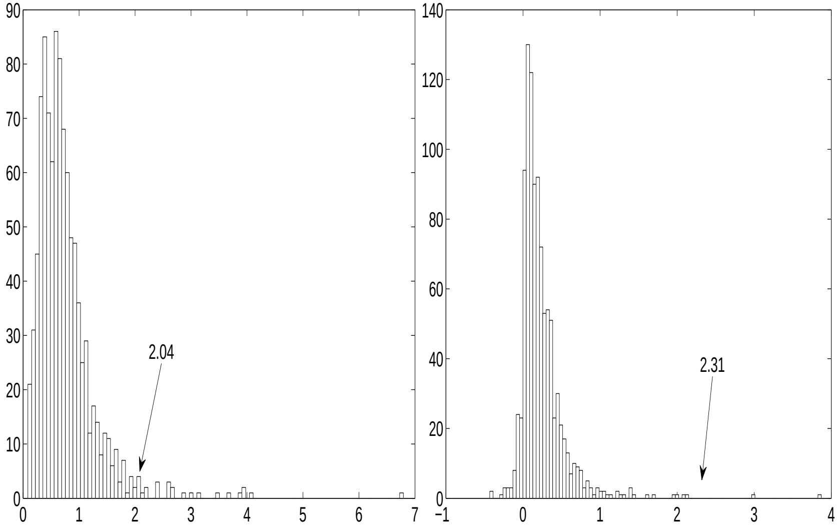
Data: Ikenberry, Lakonishok, and Vermaelen (1995)

	Annual buy-and-hold returns					
	Repurchase		Reference		Difference	
Year	Data	Model	Data	Model	Data	Model
1	20.8	10.6	18.8	9.8	2.04	0.74
2	18.1	8.9	15.8	8.7	2.31	0.22
3	21.8	8.3	17.2	8.1	4.59	0.14
4	8.6	7.9	9.5	7.8	−0.96	0.10

Larger difference in compounded holding period returns. . .

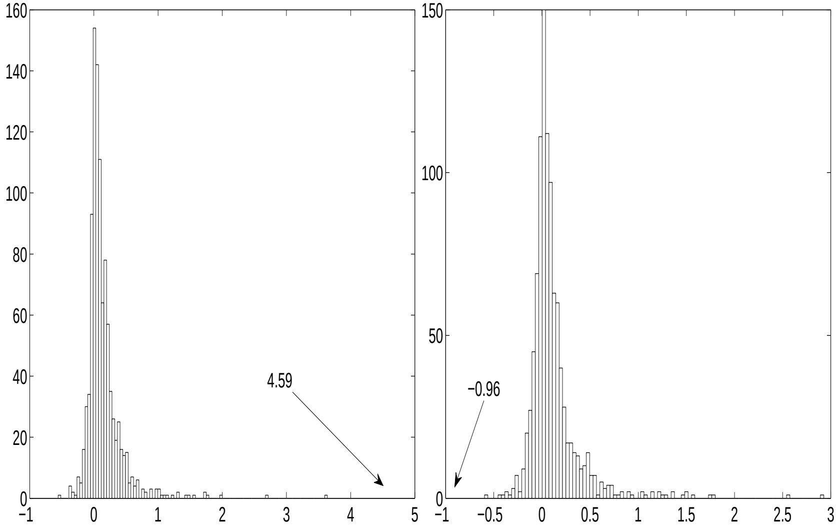
Quantitative Results

Empirical distributions for the differences in annual buy-and-hold returns between the repurchase portfolio and the reference portfolio: Years 1 and 2



Quantitative Results

Empirical distributions for the differences in annual buy-and-hold returns between the repurchase portfolio and the reference portfolio: Years 3 and 4



Quantitative Results

Mechanism: investment policy and expected returns

Assume a two-period structure:

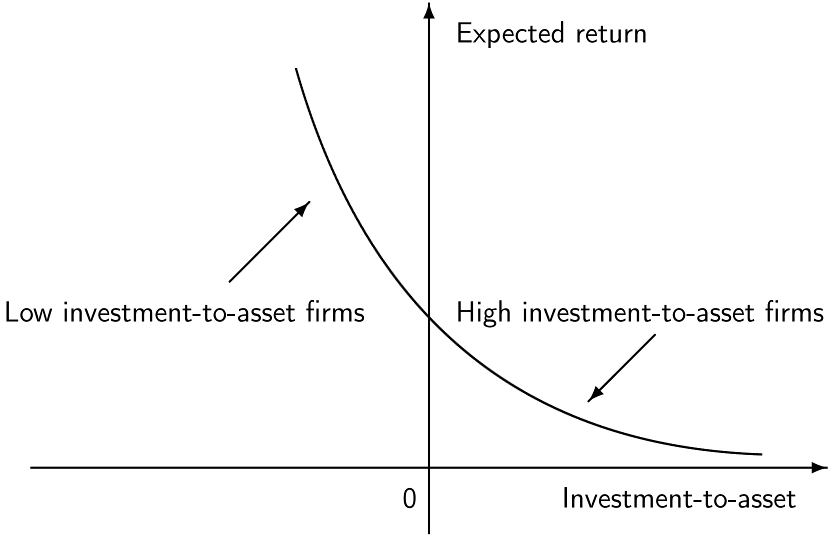
$$\underbrace{1 + a\left(\frac{i_{jt}}{k_{jt}}\right)}_{\textbf{Marginal Cost of Investment}} = \underbrace{\frac{\text{Expected cash flow}}{\text{Expected return}}}_{\textbf{Marginal } q}$$

Consider two firms, A and B, with similar expected cash flows, then

$$\frac{i_{At}}{k_{At}} > \frac{i_{Bt}}{k_{Bt}} \quad \Leftrightarrow \quad E_t[r_{At}] < E_t[r_{Bt}]$$

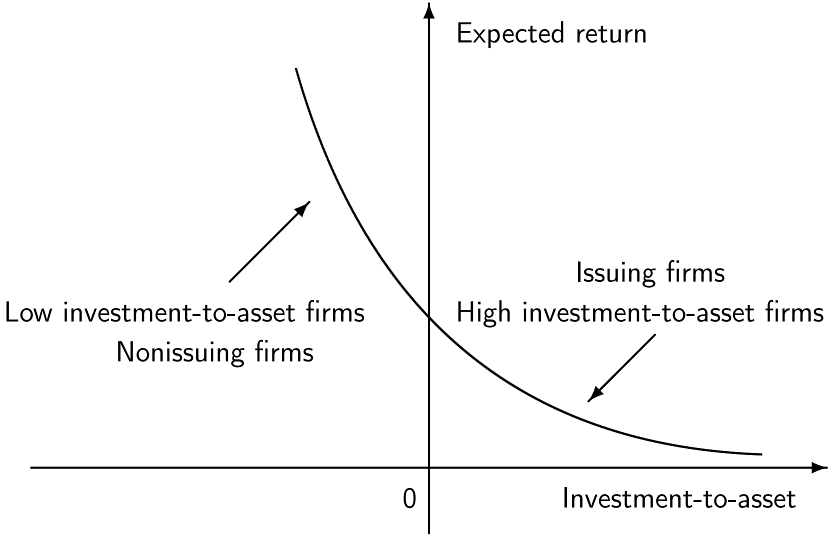
Quantitative Results

Intuition: investment policy and expected return



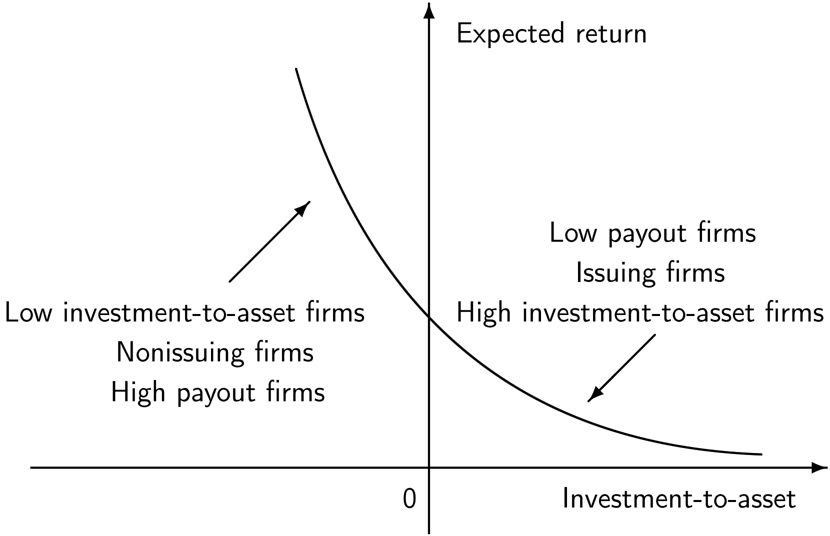
Quantitative Results

Intuition: financing policy and expected return



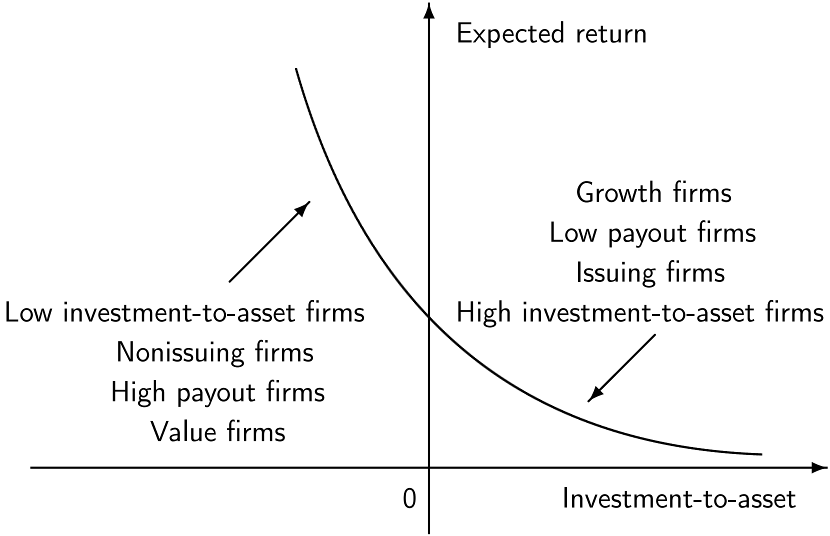
Quantitative Results

Intuition: payout policy and expected return



Quantitative Results

Intuition: book-to-market and expected return



Outline

Conclusion

Summary

The q-theory of investment is a good start to understanding the quantitative relations between stock returns and financing decisions

Conclusion

Future work

Again, go from calibration to estimation to be more rigorous:

- Structural estimation by picking informative Euler equations implemented on real data, instead of simulated data
- Value function iteration combined with SMM

Integrate the framework more deeply with dynamic corporate finance as in Hennessy and Whited's and Neng's work

- Embed the standard trade-off theory of capital structure into the investment-based asset pricing framework. Questions: The impact of time-varying risk premiums on corporate policies
- What determines the forms of payout? An neoclassical approach? The weak quantitative results on payout-related evidence deserve further studies