Lecture Notes

Belo, Xue, and Zhang (2013, Review of Financial Studies): A Supply Approach to Valuation

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Theme

A supply approach to valuation

Motivation

Cochrane (2011, "Presidential address: Discount rate")

"[W]e have to answer the central question, what is the source of price variation? When did our field stop being 'asset pricing' and become 'asset expected returning'? Why are betas exogenous? A lot of price variation comes from discount-factor news. What sense does it make to 'explain' expected returns by the covariation of expected return shocks with market market return shocks? Market-to-book ratios should be our left-hand variable, the thing we are trying to explain, not a sorting characteristic for expected returns (p. 1063, our emphasis)."

The standard demand approach to valuation:

$$P_{it} = E_t \sum_{\triangle t=1}^{\infty} \frac{D_{it+\triangle t}}{1 + R_{it+\triangle t}} \Leftrightarrow P_{it} = E_t \sum_{\triangle t=1}^{\infty} \frac{Y_{it+\triangle t} - dB_{it+\triangle t}}{1 + R_{it+\triangle t}}$$

- Accounting-based valuation, standard b-school curriculum: Ohlson (1995), Lundholm and Sloan (2007), Penman (2010)

We explore the supply approach to valuation:

$$P_{it} = Q_{it} K_{it+1} - B_{it+1} \qquad \text{in which} \qquad Q_{it} = f\left(\frac{I_{it}}{K_{it}}, \theta\right)$$

Parsimony:

- Investment-to-capital as the only input
- No need to estimate the discount rate
- No terminal valuation assumptions

Reliability:

- "Structural" parameters are likely more stable than nonstructural parameters

Weakness: Only portfolio-level estimation, firm-level analysis upcoming

Penman (2010, p. 666):

> *"Compound the error in beta and the error in the risk premium and you have a considerable problem. The CAPM, even if true, is quite imprecise when applied. Let's be honest with ourselves: No one knows what the market risk premium is. And adopting multifactor pricing models adds more risk premiums and betas to estimate. These models contain a strong element of smoke and mirrors."*

Outline

1 The Model

2 Econometric Methodology

3 Empirical Results

4 Summary, Interpretation, and Future Work

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Operating profits, $\Pi(K_{it}, X_{it})$, constant returns to scale

Convex adjustment costs:

$$\Phi(I_{it}, K_{it}) = \frac{1}{\nu}\left(\eta \frac{I_{it}}{K_{it}}\right)^{\nu} K_{it}$$

One-period debt, B_{it+1}, with pretax corporate bond return r^{B}_{it+1} and after-tax corporate bond return: $r^{Ba}_{it+1} = r^{B}_{it+1} - (r^{B}_{it+1} - 1)\tau_{t+1}$

M_{t+1}: the pricing kernel, correlated with X_{it+1}

Firms maximize the cum-dividend market value of the equity

$$P_{it} + B_{it+1} = \left[1 + (1 - \tau_t)\eta^{\nu} \left(\frac{I_{it}}{K_{it}}\right)^{\nu-1}\right] K_{it+1}$$

- P_{it}: ex-dividend market equity
- B_{it+1}: market value of debt
- K_{it+1}: capital

$$1 + (1-\tau_t)\eta^{\nu}\left(\frac{I_{it}}{K_{it}}\right)^{\nu-1} =$$

$$E_t\left[M_{t+1}\left[\begin{array}{c} (1-\tau_{t+1})\left[\kappa\frac{Y_{it+1}}{K_{it+1}} + \frac{\nu-1}{\nu}\left(\eta\frac{I_{it+1}}{K_{it+1}}\right)^{\nu}\right] + \delta_{it+1}\tau_{t+1} \\ +(1-\delta_{it+1})\left[1 + (1-\tau_{t+1})\eta^{\nu}\left(\frac{I_{it+1}}{K_{it+1}}\right)^{\nu-1}\right] \end{array}\right]\right]$$

The Model

The investment return = the WACC:

$r^I_{it+1} = w_{it} r^{Ba}_{it+1} + (1 - w_{it}) r^S_{it+1}$

$$r^I_{it+1} \equiv \frac{\overbrace{\left[\underbrace{(1-\tau_{t+1}) \left[\kappa \frac{Y_{it+1}}{K_{it+1}} + \frac{\nu - 1}{\nu} \left(\eta \frac{I_{it+1}}{K_{it+1}} \right)^{\nu} \right]}_{\textbf{Marginal product plus economy of scale (net of taxes)}} + \tau_{t+1}\delta_{it+1} + \underbrace{(1-\delta_{it+1}) \left[1 + (1-\tau_{t+1})\eta^{\nu} \left(\frac{I_{it+1}}{K_{it+1}} \right)^{\nu-1} \right]}_{\textbf{Expected continuation value}} \right]}^{\textbf{Marginal benefits of investment at time } t+1}}{\underbrace{1 + (1-\tau_t)\eta^{\nu} \left(\frac{I_{it}}{K_{it}} \right)^{\nu-1}}_{\textbf{Marginal costs of investment at time } t}}$$

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Test if the average Tobin's q observed in the data equals the average q predicted in the model:

$$E\left[q_{it} - \left(1 + (1-\tau_t)\eta^{\nu}\left(\frac{I_{it}}{K_{it}}\right)^{\nu-1}\right)\frac{K_{it+1}}{A_{it}}\right] = 0$$

in which $q_{it} \equiv (P_{it} + B_{it+1})/A_{it}$

Matching average Tobin's q differs critically from investment regressions:

- Portfolio level estimation mitigates the impact of measurement errors in q
- Average q moments alleviate the impact of temporal misalignment between investment and q
- Flexible adjustment costs allow nonlinear marginal costs of investment

Test whether the average stock return equals the average levered investment return:

$$E\left[r_{it+1}^{S} - r_{it+1}^{Iw}\right] = 0$$

in which

$$r_{it+1}^{Iw} \equiv \frac{r_{it+1}^{I} - w_{it} r_{it+1}^{Ba}}{1 - w_{it}}$$

$$E\left[\left(\frac{\begin{matrix} 1+(1-\tau_t)\eta^\nu\left(\frac{I_{it}}{K_{it}}\right)^{\nu-1} - \\ \left[\begin{matrix}(1-\tau_{t+1})\left[\kappa\frac{Y_{it+1}}{K_{it+1}}+\frac{\nu-1}{\nu}\left(\eta\frac{I_{it+1}}{K_{it+1}}\right)^\nu\right]+\delta_{it+1}\tau_{t+1} \\ +(1-\delta_{it+1})\left[1+(1-\tau_{t+1})\eta^\nu\left(\frac{I_{it+1}}{K_{it+1}}\right)^{\nu-1}\right]\end{matrix}\right]\end{matrix}}{w_{it}r^{Ba}_{it+1}+(1-w_{it})r^{S}_{it+1}}\right)\frac{K_{it+1}}{A_{it}}\right]=0.$$

- A_{it}: Total assets
- K_{it}: Net property, plant, and equipment
- I_{it}: Capital expenditure minus sales of property, plant, and equipment
- Y_{it}: Sales
- B_{it}: Long-term debt and short-term debt
- P_{it}: Market value of common equity
- δ_{it}: Depreciation divided by capital
- r^B_{it+1}: Impute bond ratings, assign corporate bond returns of a given rating to all firms with the same rating

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Empirical Results

Descriptive statistics

	Mean	Low	2	3	4	5	6	7	8	9	High	H−L	[t]
q_{it}	1.56	0.44	0.65	0.77	0.89	1.02	1.19	1.43	1.80	2.52	4.94	4.50	12.11
$\frac{I_{it}}{K_{it}}$	0.22	0.15	0.16	0.16	0.17	0.18	0.20	0.22	0.25	0.29	0.39	0.24	14.70
$\frac{K_{it+1}}{A_{it}}$	0.43	0.30	0.40	0.44	0.46	0.48	0.49	0.49	0.47	0.41	0.40	0.10	3.44

Panel A: Point estimates and the χ^2 tests

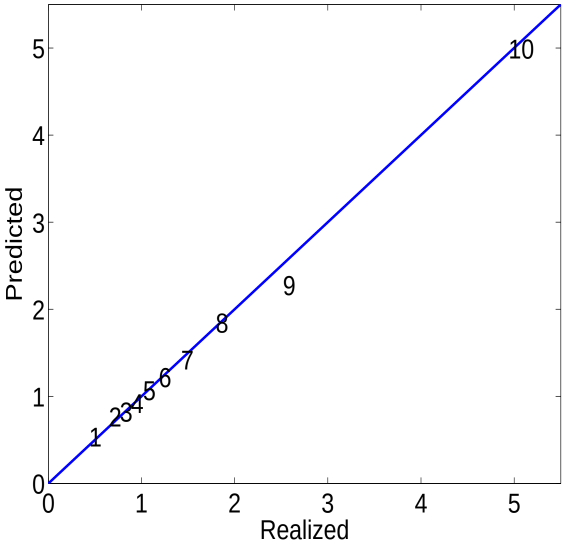
η	$[t]$	ν	$[t]$	$p_{\nu=2}$	Φ/Y	$\overline{\lvert e_i^q \rvert}$	χ^2	d.f.	p_{χ^2}
4.15	18.64	3.75	18.62	0.00	4.78	0.07	7.63	8	0.47

Panel B: Valuation errors for individual deciles

	Low	2	3	4	5	6	7	8	9	High	H−L
e_i^q	−0.10	−0.11	−0.06	−0.03	−0.05	−0.03	0.01	−0.05	0.24	−0.05	0.05
$[t]$	−1.77	−2.18	−1.49	−0.90	−1.20	−0.93	0.23	−0.80	1.83	−1.88	1.21

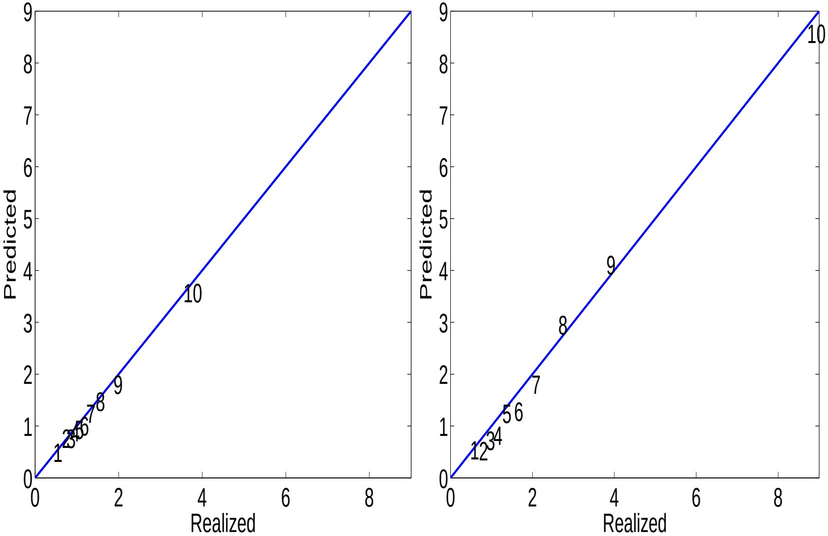
Empirical Results

Predicted Tobin's q versus realized Tobin's q



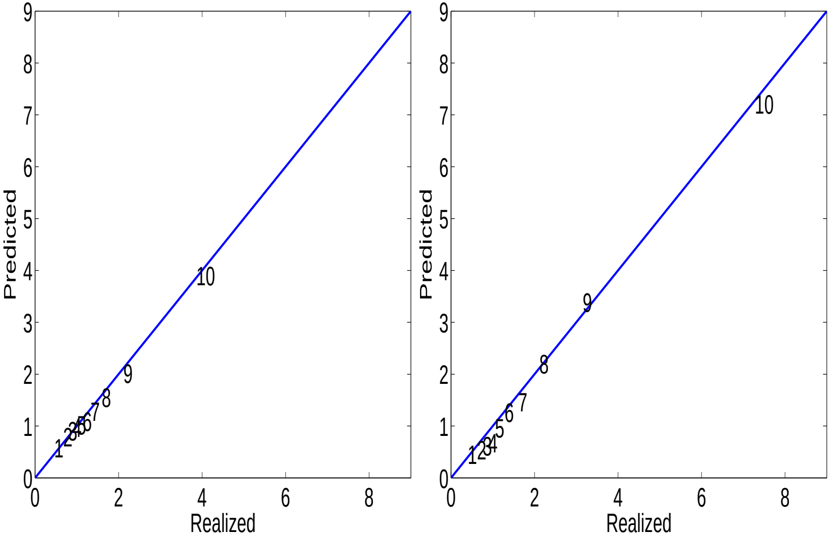
Empirical Results

Predicted q versus realized q, Tobin's q deciles within the low and the high terciles split by the Size-age index



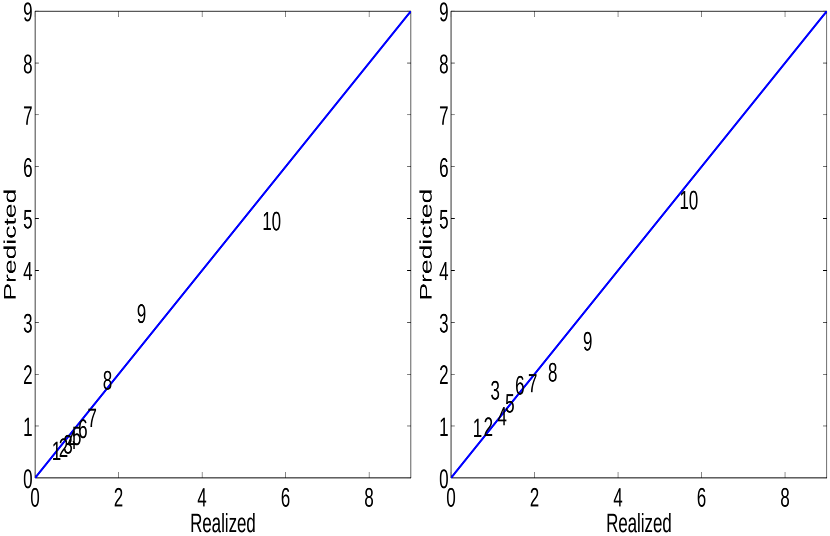
Empirical Results

Predicted q versus realized q, Tobin's q deciles within the low and the high terciles split by idiosyncratic volatility



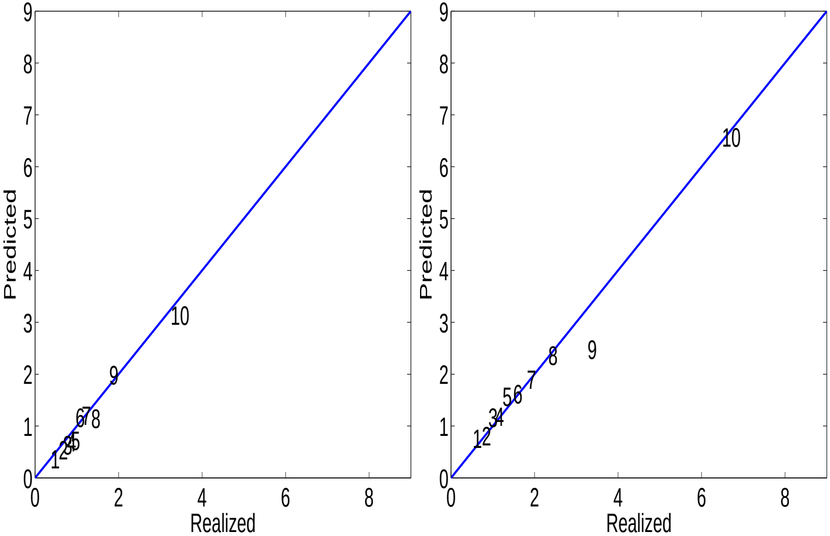
Empirical Results

Predicted q versus realized q, Tobin's q deciles within the low and the high terciles split by cash flows



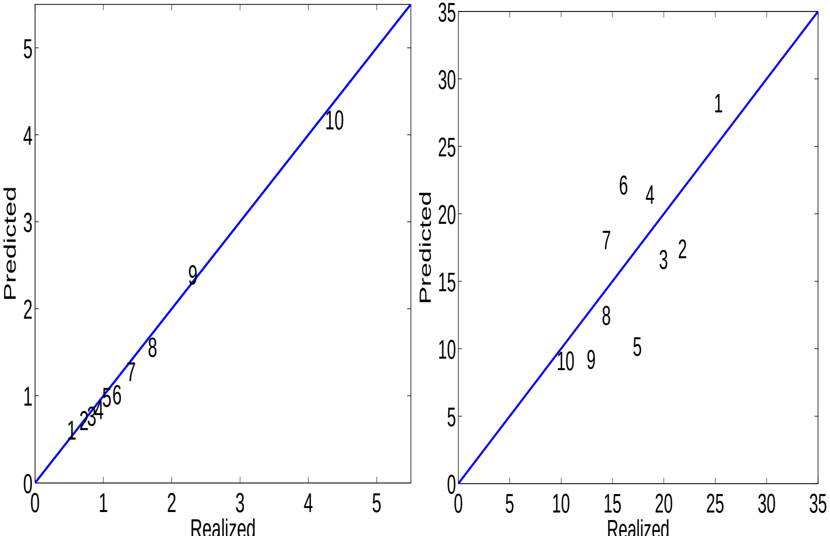
Empirical Results

Predicted q versus realized q, Tobin's q deciles within the low and the high terciles split by lagged investment



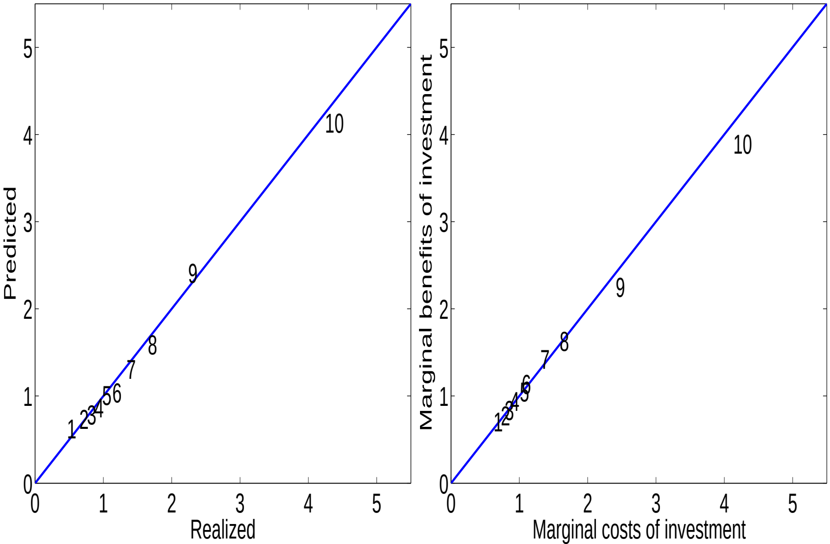
Empirical Results

Predicted q versus realized q, Tobin's q deciles, joint estimation of valuation moments and expected return moments



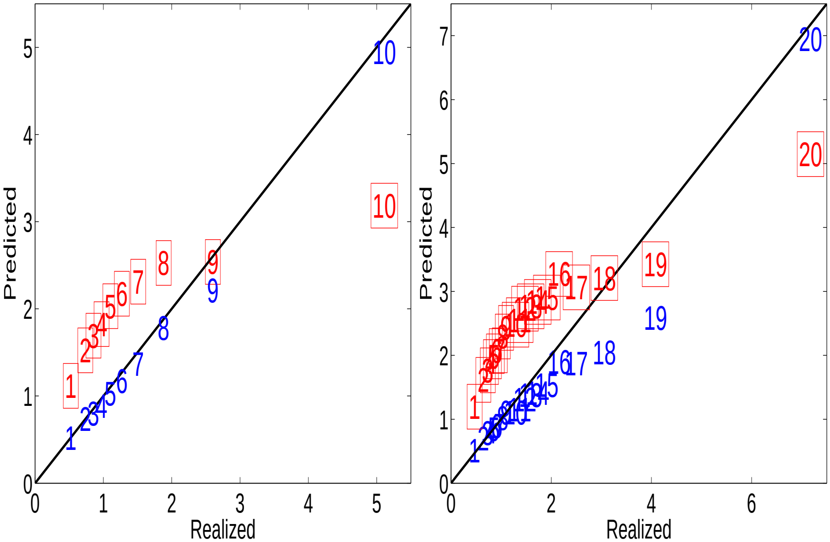
Empirical Results

Predicted q versus realized q, Tobin's q deciles, joint estimation of valuation moments and investment Euler equation moments



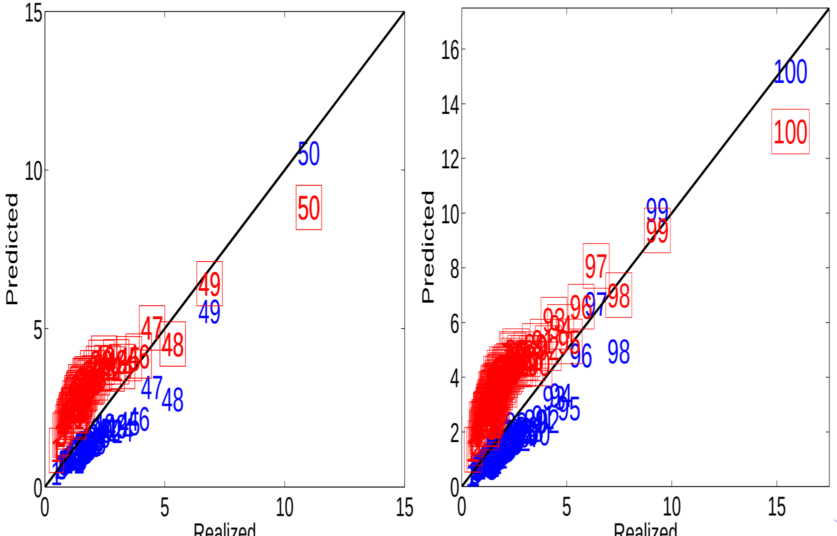
Empirical Results

Predicted q versus realized q, 10 and 20 portfolios formed on Tobin's q, quadratic and nonquadratic adjustment costs



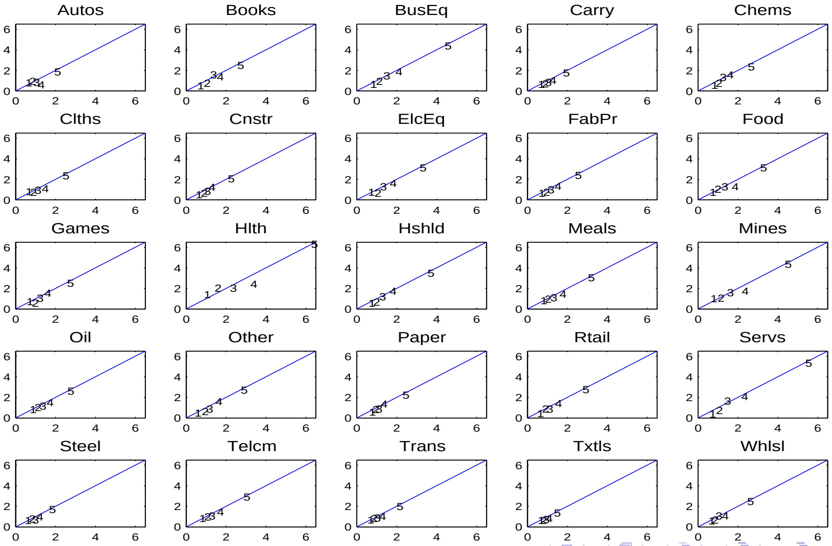
Empirical Results

Predicted q versus realized q, 50 and 100 portfolios formed on Tobin's q, quadratic and nonquadratic adjustment costs



Empirical Results

Tobin's q quintiles, industry-specific estimation



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Conclusion

The market value of equity and investment data are well aligned on average at the portfolio level

Interpretation: A supply approach to valuation

Future work: Firm level estimation, nonconvexity, financial frictions, labor, intangible capital...