# Real Anomalies

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# Motivation

Sharpe's arithmetic:

- Sharpe divided all investors into two sets:
  - "passive" investors: people who hold the market portfolio
  - "active" investors: the rest

- Market clearing $\Rightarrow$ the sum of active and passive investors' portfolios is the market portfolio $\Rightarrow$ the sum of just active investors' portfolios must also be the market portfolio.

- This observation is used to imply that the abnormal return of the average active investor must be zero, what has become known as Sharpe's critique.

**Suppose** we take this argument as given and assume that the arithmetic is correct, does this imply that active managers cannot add value to the economy?

No! Price discovery can create real value, part of which we quantify in this paper!

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- Our criterion: PV(real output losses) if $\hat{\alpha}$ = mispricing
  - Method to provide mapping:

    Informationally inefficient market $\xrightarrow{?}$ Real inefficiency

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> If firms maximize value as measured by market prices, what are the real implications of asset pricing anomalies?

1. Classic view: market prices aggregate information, yielding signals to decision makers Hayek (1945) & literature on feedback effects

   - Risk prices given current macro state
   - Firm's exposures priced factors (betas)
   - A firm's percentile of the BtM distribution ...

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2. Compensation contracts tie managers to going market prices

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- What is the total market cap of firms affected?

- How much is investment distorted and how much surplus is lost?

# Investment-$\alpha$ Relation in the Cross-section
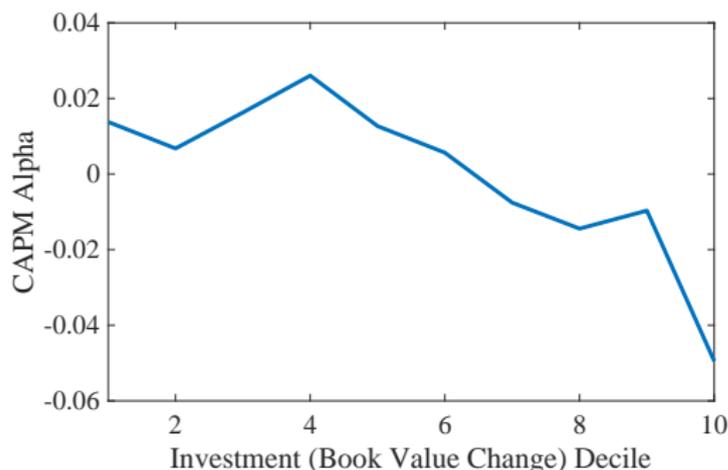


CAPM alphas of decile portfolios (both series are demeaned)

Empirical Observations:
- Investment is related to abnormal components of discount rates
- Robust: true for CAPM, FF 3 factor, Carhart, Pastor-Stambaugh
- Holds with and without cash $\Rightarrow$ suggests firms do adjust investment in response to distorted market prices

How large could the efficiency losses from this possibly be?

# Outline

Framework ingredients:

Investment model
Cross-sec. distr. in closed-form

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~~Exogenous $\alpha$ process~~
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**Counterfactual analysis:**
What would happen to firm outcomes (CFs) absent anomaly ($\alpha = 0$)?

# Literature

- Literatures in macro & corporate finance on financing frictions:
  - Wedges between internal and external funds
    (issuance cost, leverage constraints, info asymmetries)
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- Literature on real feedback effects of financial markets
  - Hayek (1945), Morck, Shleifer, and Vishny (1990), Barro (1990),
    Leland (1992), Dow and Gorton (1997), Baker, Stein, and
    Wurgler (2003), Chen, Goldstein, and Jiang (2007), Edmans,
    Goldstein, Jiang (2012), ...

# Model Overview

Continuous time investment model

- Continuum of heterogenous firms with DRS technologies $AK^\eta$
- Asymmetric cost when searching for opportunities to (dis)invest
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   - Firms search for opportunities for lumpy (dis)investment
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   $\Rightarrow$ Conditional on firm controls distributions available in closed-form
   $\Rightarrow$ Allows side-stepping time-consuming, imprecise simulations

# Market Valuations

The market values a stream of firm after-tax net-payouts $\{\pi_\tau\}$ as follows:

$$\mathbb{E}_t \int_t^\infty \frac{m(Z_\tau)}{m(Z_t)} e^{-\int_t^\tau \alpha(s_k)dk} \pi(s_\tau)d\tau$$

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Example:

- Information processing cost $\to$ not all public information processed. Empirical evidence consistent with trend in info. cost (Bai et al., 2016)

# Firm Behavior

Firms maximize their market value at all times

$$\max_{\{i_\tau^+, i_\tau^-\}} \mathbb{E}_t \int_t^\infty \frac{m(Z_\tau)}{m(Z_t)} e^{-\int_t^\tau \alpha(s_k)dk} \pi(s_\tau) d\tau$$

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Asset pricing anomalies are measured w.r.t. public information

- Firm interpret public information as reflected in market valuations
  E.g., Hayek's view that prices signal information to decision makers

- Or managers are contractually incentivized to max going market values

# Model Estimation

Estimation approach:

- Calibrate aggregate trend growth/vol, SDF
- Estimate 23 parameters minimizing distance between model & data
- 42 empirical moments targeted
  - Cross-sectional distribution of Market/Book
  - Cross-sectional distribution of Book size
  - Cross-sectional distribution of asset growth
  - Empirical alphas associated with Market/Book deciles
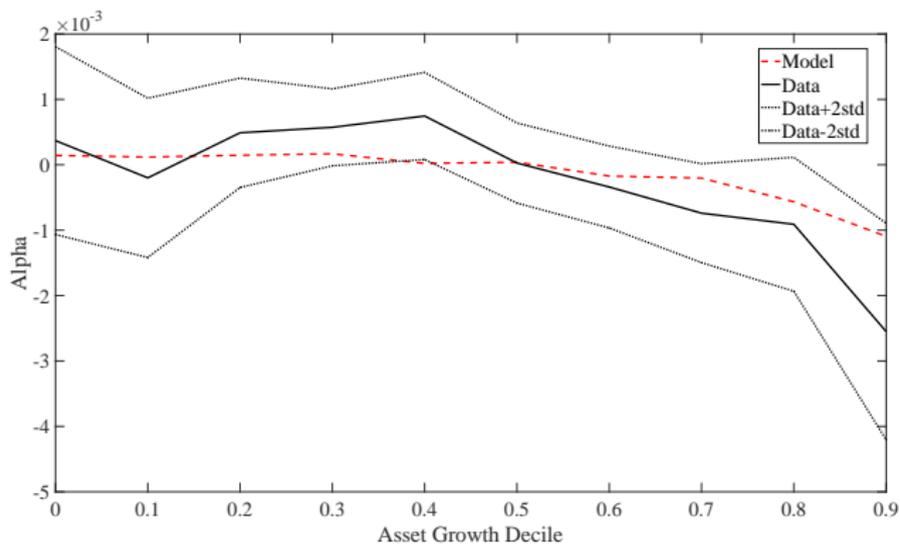  - Market value weights of Market/Book deciles

Stochastic firm parameters:

- Firm-specific alpha process (3 alpha states)
- Firm-specific process jointly governing depreciation & operating cost
- No dependence between technology shocks and mispricing shocks

# Moments Fit
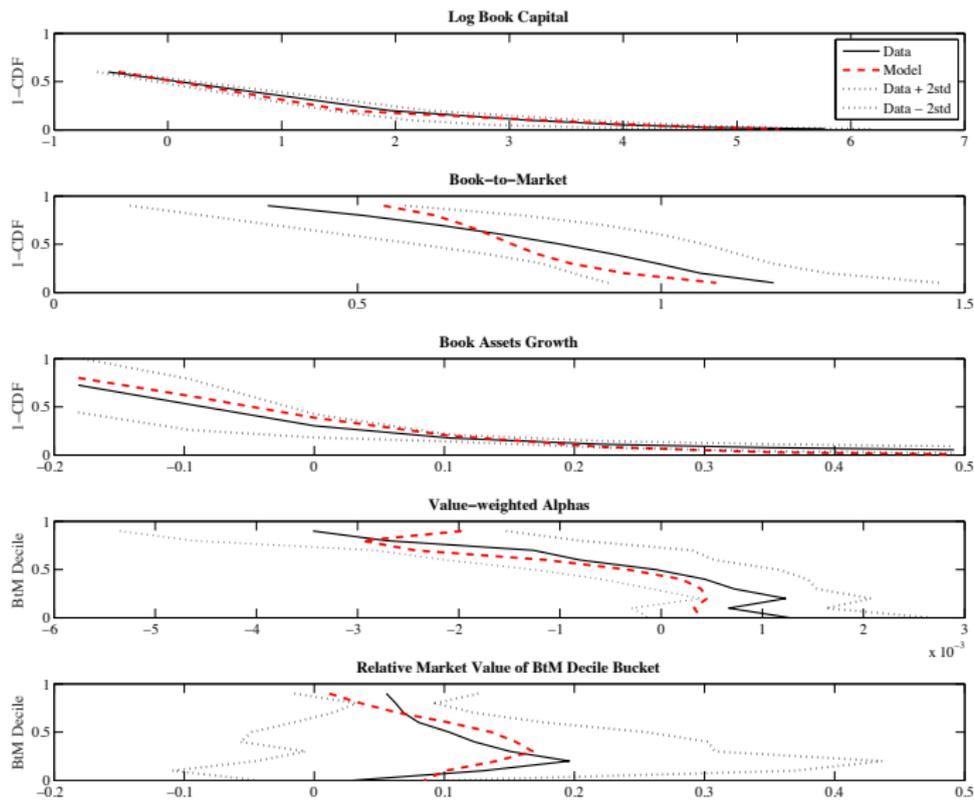


- Market/Book becomes noisy measure of alphas

# Investment-$\alpha$ Relation
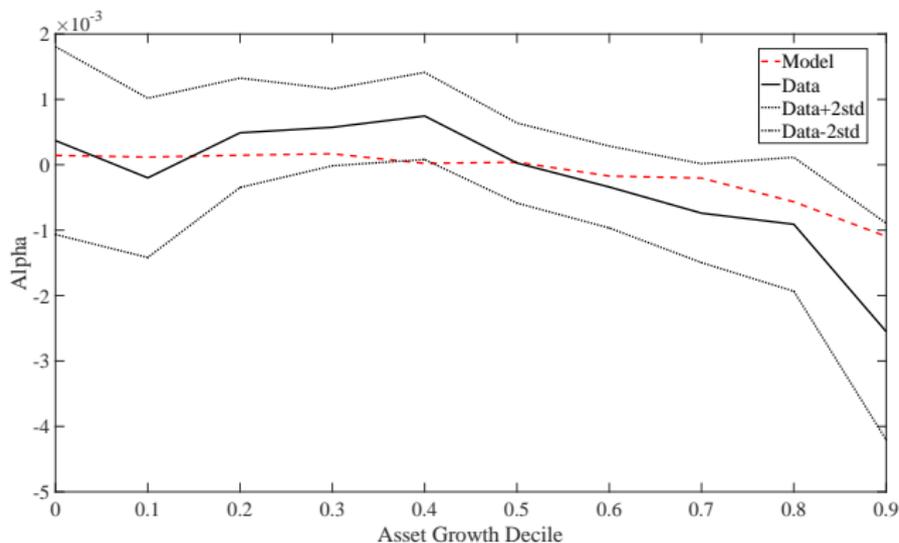


CAPM alphas of decile portfolios (both series are demeaned)

1. Empirical Observations:
   ○ Investment is related to abnormal components of discount rates

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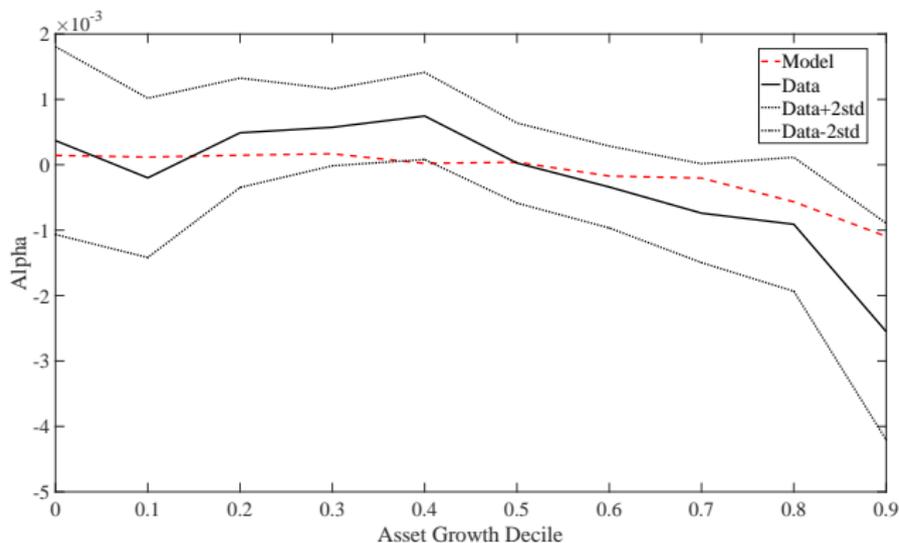


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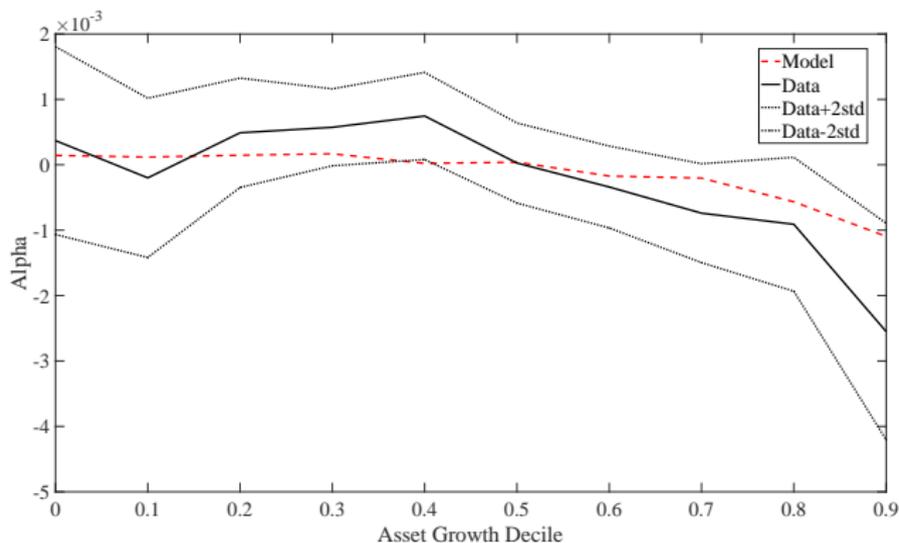
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   - Holds with and without cash $\Rightarrow$ suggests firms do adjust investment in response to distorted market prices
2. Very good model fit (not targeted in estimation!)

# Outline

Framework ingredients:

Fit empirical distributions:

| |
|---|
| Investment model<br>Cross-sec. distr. in closed-form |

| |
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| Exogenous $\alpha$ process<br>Distorted $r$ and/or $g$ |

$\Longrightarrow$

- Book values
- Asset growth
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# Investment Distortions
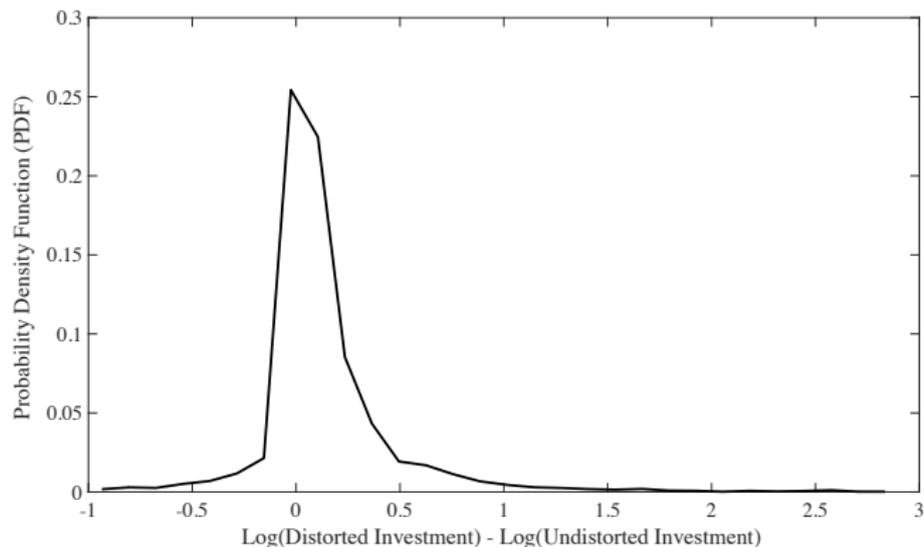


The graph plots the probability distribution function (PDF) of the log difference between distorted and undistorted expected investment rates, where defined. Under the estimated parameterization there are substantial inaction regions where $(i_+ - i_-) = 0$, implying that $\log(i_+ - i_-)$ is not defined in a subset of states.

# Measuring Efficiency Losses

**Efficiency gain from eliminating anomalies ($\alpha \to 0$):**

$$gain = \frac{\mathbb{E}[\int \frac{m_\tau}{m_t} \text{Optimal CF}_\tau d\tau]}{\mathbb{E}[\int \frac{m_\tau}{m_t} \text{Actual CF}_\tau d\tau]} - 1$$

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- Eliminating the value spread yields only a fraction of this gain
  - Value-sorts are noisy measures of underlying alphas
  - Additional sorts (investment & profitability) yield additional info
  - Active mutual funds & hedge funds processing public information
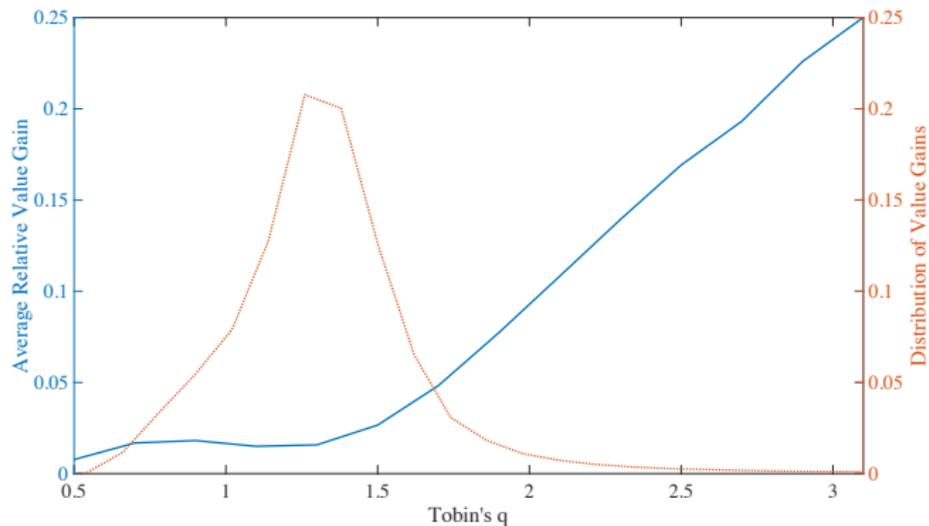
# Gains and Value Spread
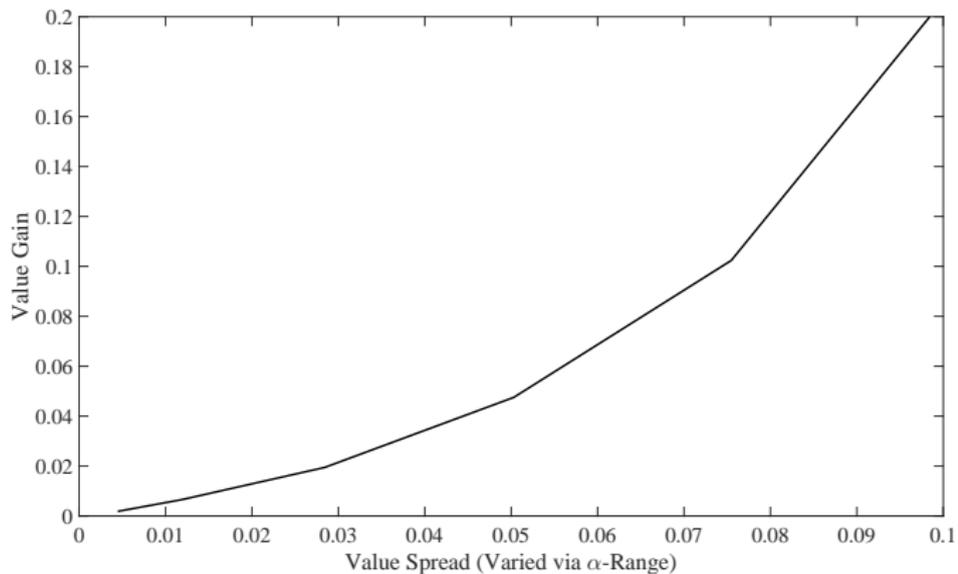


Gain as a function of the value spread

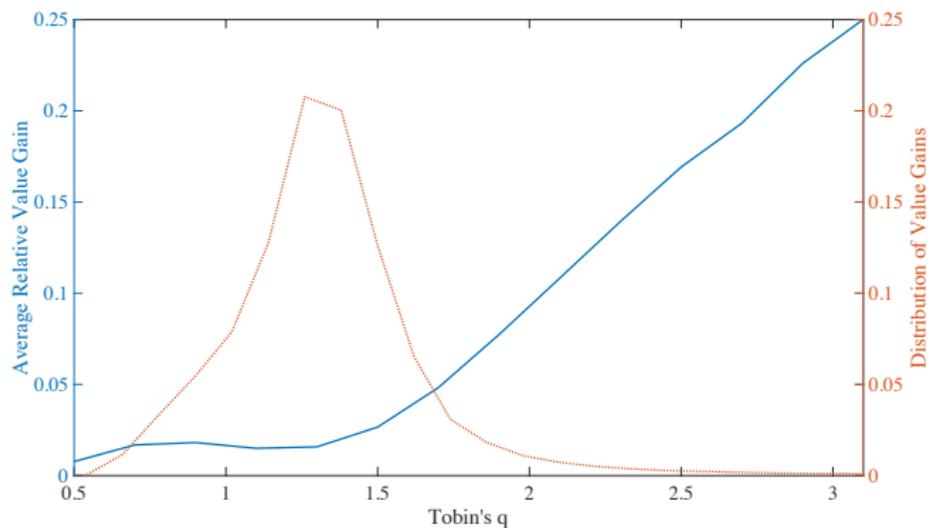# Individual Firms' Value Gain & Tobin's $q$
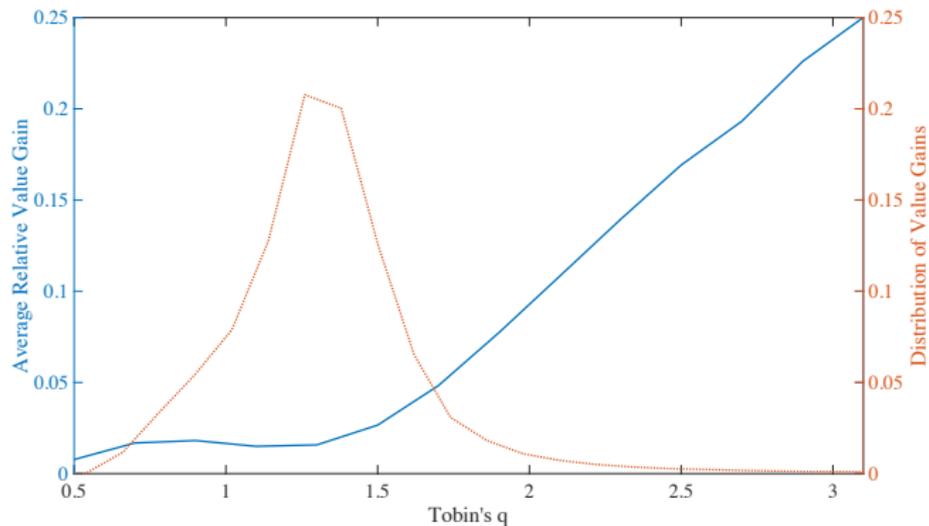


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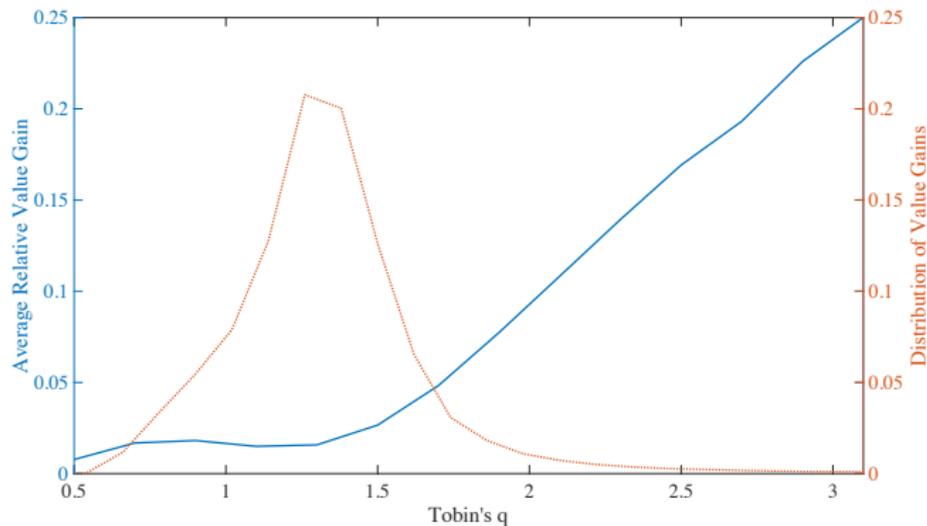
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  - Value firms (MV<BV) are in any case limited in their disinvestment due to frictions in finding buyers of capital
  - Note: growth firms both over- and underinvest!

# Persistence of Alphas
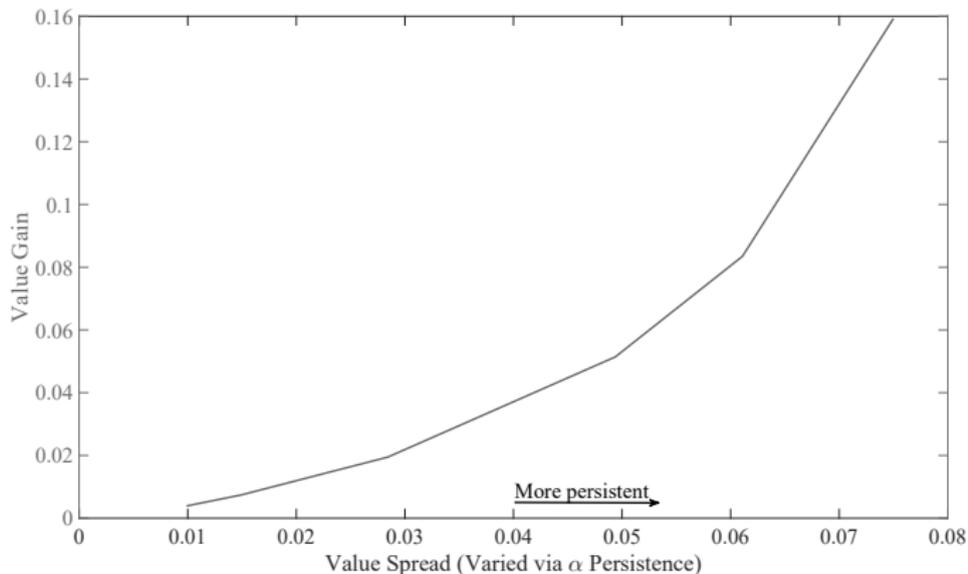


**Changing $\alpha$-process persistence**

- Effects of changing the persistence of the $\alpha$-state by multiplying the $\alpha$ transition rates of the baseline parameterization by a factor $[0.5, 2]$

- Persistence $\uparrow \rightarrow$ longer mispriced & price level is off by more

# Empirical Persistence of Decile Sorts

- How persistent are anomalies? (staying in extreme deciles)

  1. Momentum — $\Pr[Stay] = 0.13$, $\alpha = 0.036$
  2. Investment — $\Pr[Stay] = 0.25$, $\alpha = 0.019$
  3. Value — $\Pr[Stay] = 0.55$, $\alpha = 0.023$
  4. Profitability — $\Pr[Stay] = 0.66$, $\alpha = 0.011$

  [average absolute alphas across deciles]

- Anomalies with small persistent alphas may be more relevant for real efficiency than large short-lived alphas!

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Key contributions relative to existing literature

- Evaluate aggregate real effects of cross-sectional AP anomalies
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Sheds light on value of activities improving informational efficiency

- financial industry (but just chasing highest alphas might be less effective!)
- academia [McLean/Pontiff, 2016]

# Main Takeaways

1. Tractable method with closed-form solutions for distributions
   $\Rightarrow$ makes assessing real effects of anomalies tractable/feasible

2. Sheds light on appropriate compensation of (financial)
   institutions eliminating informational inefficiencies

3. But chasing the highest alphas might be not most productive:
   High alpha $\neq$ most harmful mispricing ($q$, persistence, size, ...)