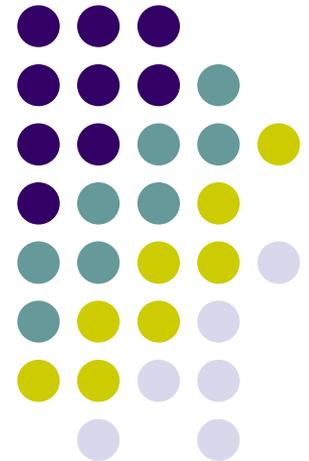
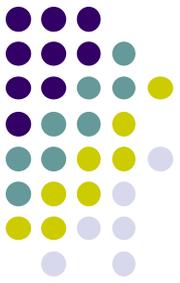


# Stock Return Predictability

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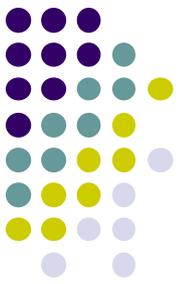
Sheridan Titman  
University of Texas





# Outline

1. The Market Efficiency Debate
2. Macro-finance example
  - Uncertainty about recession duration
3. Cross-sectional return anomalies
  - Value, profitability and asset growth
  - A parsimonious model of creative destruction



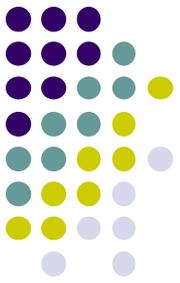
# The 2013 Nobel Prize Debate

- Return differences reflect risk differences (Fama)
  - Risk varies over the time series and cross-sectionally
  - Risk preferences change over time
- Behavioral biases distort prices (Shiller)
  - People are overconfident about their information
  - People sometimes panic or get overly enthusiastic



# Examples

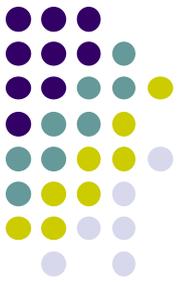
- Time Series Evidence: Market returns are higher following recessions
  - Fama: The market is riskier coming out of recessions
  - Shiller: The market overreacts to macro news
- Cross-sectional Evidence: Value Stocks outperform Growth Stocks
  - Fama: Value/distressed stocks are riskier
  - Shiller: Growth/glamour stocks are subject to “irrational exuberance”



## Third Possibility

- The economic environment generating returns is complicated
  - Requires investors to have beliefs
  - Historical data challenges
- Even rational people make mistakes
  - Price patterns may reflect beliefs that turned out to be wrong
  - What are the sources of those mistakes?

# Interpreting Semi-strong Form Efficiency



- Definition: Prices *fully* reflect all public information
- Interpretation
  - Send my coauthors (e.g. Kent and Jegadeesh) back to 1965 with modern computers and detailed databases (up to 1965)
  - If markets were semi strong efficient, Kent and Jegadeesh would not outperform investors with primitive computers and incomplete data (and no training in modern finance)
- Of course market prices were “wrong,” but not necessarily “irrational”



# Macro Time-Series Example

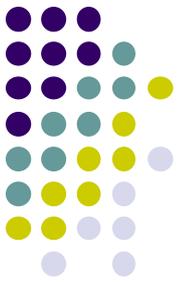
- Why are returns higher following recessions?
  - The market is riskier coming out of recessions (Fama)
  - The market overreacts to macro news (Shiller)
  - The economy recovered from past recessions faster than anticipated (i.e., investors happened to be wrong)

# Business Cycle Expectations



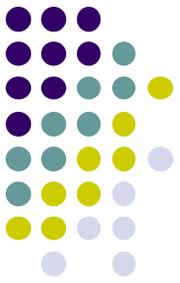
- Minor recession or prolonged downturn?
  - Did the great depression influence post-war investors' beliefs?
  - Did the 90s Japanese financial crisis influence investors in the 2008 financial crisis?
- Are US post war return patterns consistent with “wrong” prior beliefs arising rationally?

# Cross-sectional Example



- Corporate opportunities tend to be mean-reverting
  - (e.g., Apple cannot mint money forever)
- The amount by which opportunities mean-revert determines how much prices react to information
  - e.g., how much should Apple stock increase with a 30% increase in iPad sales
- If the market is systematically “wrong” about mean-reversion, market prices will either over or under-react
  - creating momentum and/or value effects, etc.

# US Cross-Sectional Patterns



## Fundamentals

- Size
- Value
- Profitability
- Asset Growth

## Investment Flows

- Post-earnings announcement drift
- Short-run return reversals
- Momentum



# Fundamental versus flow signals

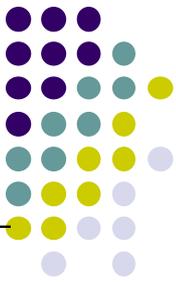
## Fundamental signals

- High Sharpe ratios
- Relatively low turnover
- High potential mispricing (>30%)

## Investor flow signals

- High Sharpe ratios
- High turnover
- Low potential mispricing (<10%)

# Sharpe Ratios of Characteristic-Sorted Portfolios



Market-Neutral Portfolios				
Weight *				
Value minus Growth (Market-to-Book)	High minus Low Profitability	Low minus High Asset Growth	Standard Deviation (Annualized %)	Sharpe Ratio (Annualized) <sup>a</sup>
1.000	0.000	0.000	13.423	<b>0.385</b>
0.000	1.000	0.000	12.428	<b>0.435</b>
0.000	0.000	1.000	10.693	<b>0.515</b>
0.458	0.542	0.000	8.450	<b>0.627</b>
0.000	0.421	0.579	8.079	<b>0.676</b>
0.176	0.420	0.404	7.768	<b>0.696</b>

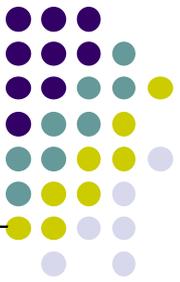
\* Weights are calculated according to mean-variance efficiency

<sup>a</sup> Under the null of zero expected return,  $p < 0.001$  when Sharpe ratio is larger than 0.440

Monthly return correlation between strategies:

value and profitability: -0.142;      value and asset growth: 0.621;      profitability and asset growth: -0.007

# Sharpe Ratios of Characteristic-Sorted Portfolios



Market-Neutral Portfolios				
Weight				
Value minus Growth (Market-to-Book)	High minus Low Profitability	Low minus High Asset Growth	Standard Deviation (Annualized %)	Sharpe Ratio (Annualized)
0.333	0.333	0.333	8.013	<b>0.669</b> <sup>a</sup>
0.208	0.424	0.368	7.760	<b>0.695</b> <sup>b</sup>
0.300	0.324	0.376	7.992	<b>0.673</b> <sup>c</sup>

<sup>a</sup> Equally-weighted portfolio; p-value:  $1.40 \times 10^{-6}$

<sup>b</sup> Minimum-variance portfolio; p-value:  $5.75 \times 10^{-7}$

<sup>c</sup> Risk-parity portfolio; p-value:  $1.22 \times 10^{-6}$

# Sharpe Ratios of Characteristic-Sorted Portfolios

(Half-samples)



Market-Neutral Portfolios				
Weight				
Value minus Growth (Market-to-Book)	High minus Low Profitability	Low minus High Asset Growth	Standard Deviation (Annualized %)	Sharpe Ratio (Annualized)
<i>July 1964 – June 1989</i>				
0.333	0.333	0.333	5.184	<b>0.972<sup>a</sup></b>
0.228	0.516	0.256	4.106	<b>1.009<sup>b</sup></b>
<i>July 1989 – June 2014</i>				
0.333	0.333	0.333	9.789	<b>0.627<sup>c</sup></b>
0.220	0.383	0.397	9.683	<b>0.683<sup>d</sup></b>

<sup>a</sup> Equally-weighted portfolio; p-value:  $7.92 \times 10^{-12}$

<sup>b</sup> Minimum-variance portfolio; p-value:  $1.41 \times 10^{-12}$

<sup>c</sup> Equally-weighted portfolio; p-value:  $5.52 \times 10^{-6}$

<sup>d</sup> Minimum-variance portfolio; p-value:  $8.70 \times 10^{-7}$

# Sharpe Ratios of Characteristic-Sorted Portfolios

(excluding the largest 10% of firms each year)



Market-Neutral Portfolios				
Weight *				
Value minus Growth (Market-to-Book)	High minus Low Profitability	Low minus High Asset Growth	Standard Deviation (Annualized %)	Sharpe Ratio (Annualized) <sup>a</sup>
1.000	0.000	0.000	15.392	<b>0.520</b>
0.000	1.000	0.000	13.399	<b>0.554</b>
0.000	0.000	1.000	9.231	<b>0.734</b>
0.433	0.567	0.000	11.744	<b>0.654</b>
0.000	0.343	0.657	7.574	<b>0.924</b>
-0.146	0.380	0.766	7.230	<b>0.946</b>

\* Weights are calculated according to mean-variance efficiency

<sup>a</sup> Under the null of zero expected return,  $p < 0.001$  when Sharpe ratio is larger than 0.440

Monthly return correlation between strategies:

value and profitability: 0.353;      value and asset growth: 0.626;      profitability and asset growth: -0.010

# Sharpe Ratios of Characteristic-Sorted Portfolios

(excluding the largest 10% of firms each year)



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## Market-Neutral Portfolios

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Weight

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Value minus Growth (Market-to-Book)	High minus Low Profitability	Low minus High Asset Growth	Standard Deviation (Annualized %)	Sharpe Ratio (Annualized)
0.333	0.333	0.333	9.563	<b>0.774</b> <sup>a</sup>
-0.211	0.379	0.832	7.188	<b>0.941</b> <sup>b</sup>

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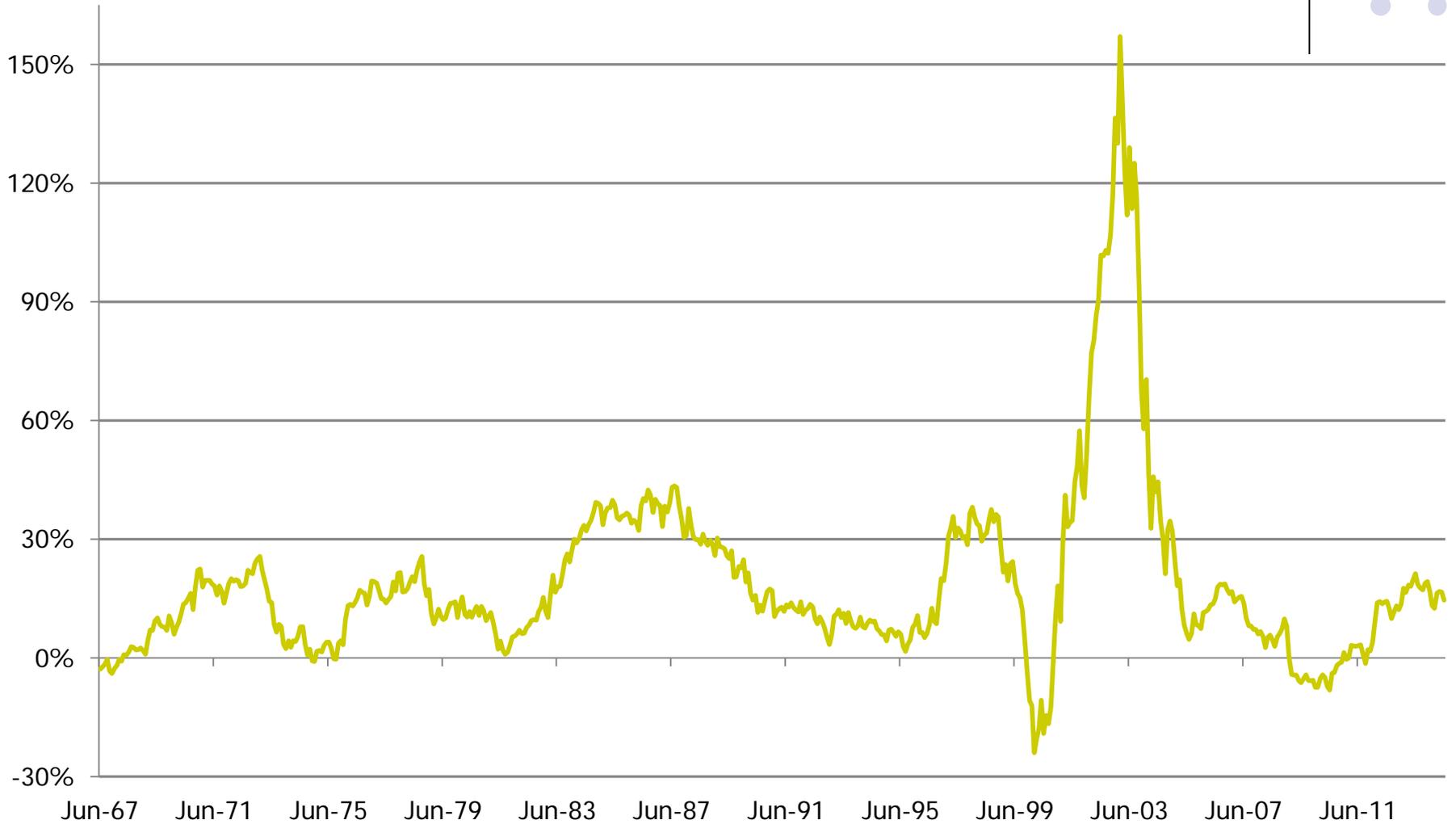
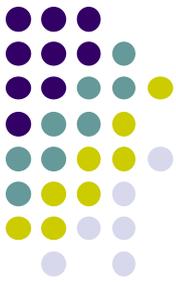
<sup>a</sup> Equally-weighted portfolio; p-value:  $3.25 \times 10^{-8}$

<sup>b</sup> Minimum-variance portfolio; p-value:  $3.23 \times 10^{-11}$

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# Rolling 3-year CAR of the Mean-variance Efficient Portfolio

(three strategies; market-neutral; Sharpe ratio 0.696)



# Rolling 3-year CAR of the Mean-variance Efficient Portfolio

(excluding the largest 10% of firms; three strategies; market neutral; Sharpe ratio 0.924)



# Observations



- Historical cross-sectional return patterns are inconsistent with “rational expectations”
  - Extreme Sharpe ratios for market neutral portfolios
    - Probability of observing by chance  $< .1\%$
  - Not a return for risk
    - Investors would have acted differently if they had anticipated these return patterns
    - The “strategy” lost significant amounts only during the internet bubble period
    - Extremely volatile in the late 1990s and early 2000s
    - Looks like an innovation factor?



# Research Agenda

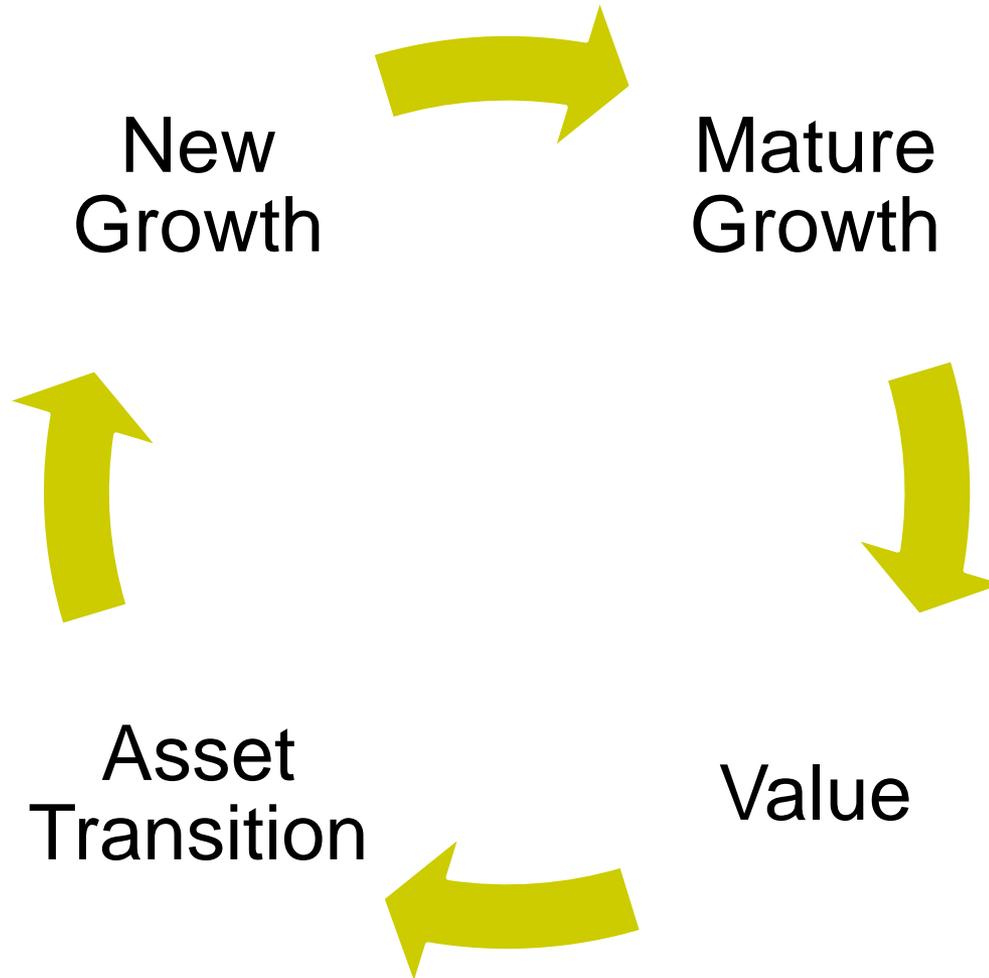
- Develop a plausible model with simulated sample paths that exhibit asset growth, value and profitability effects
- Consider conditions under which these sample paths arise “too often”
  - That is, are there plausible mistakes that can generate these return patterns?
  - What is the cause of these mistakes?
    - Computational limitations, overconfidence, optimism

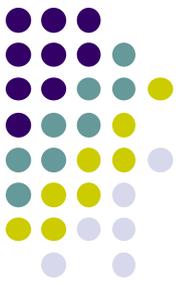


# The Model

- Firms can inhabit three states that capture the arrival of new opportunities
  - New Growth: very profitable opportunities
  - Mature Growth: moderately profitable opportunities
  - Value: harvesting existing businesses

# Firm Migration

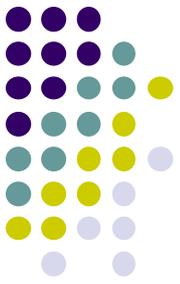




# Systematic Shock

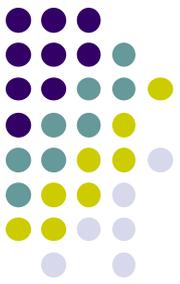
- The macro environment can be characterized by the arrival rate of new growth opportunities
- Creative Destruction: A higher arrival rate implies a higher destruction rate
  - High arrival rate is especially good for unprofitable growth ...
  - but especially bad for profitable value

# Creative Destruction



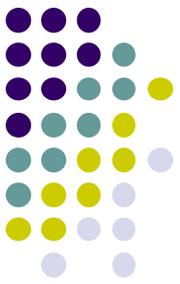
- New projects supplant existing projects





# More details

- Investors observe the recent arrival rate of new investment opportunities
- Soft information that requires judgment
  - The state of technical and regulatory environment
  - May be overconfident about their judgment
- These sources of information are combined to form expectations about future arrival rates
- Investors believe the soft signal is more precise than it really is



# What is our explanation for the historical return pattern?

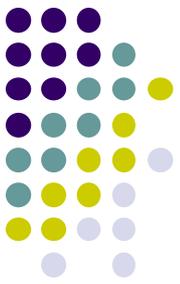
- Investors overreact to the soft innovation signals
  - They think the signal is more precise than it is
- Favorable signals lead to
  - Unprofitable growth firms being overvalued
  - Profitable value firms being undervalued



# Relevant Assumptions

- Level of overconfidence
  - Biased investors' 90% confidence intervals are accurate 34% of the time (compared to 50% in survey evidence)
- Persistence of the innovation process
  - Half life of 10 years

Under these assumptions, we see extreme Sharpe ratios in more than 10% of the sample paths



# Conclusion

- Characteristic-sorted portfolios exhibited extreme Sharpe ratios during the past 50 years
  - Inconsistent with rational pricing models
  - Indicates that investors made mistakes
- What was the mistake?
  - Investors over-reacted to soft information about the innovation climate
  - Our calibrated model suggests that these high Sharpe ratios can occur a bit more than 10% of the time