Lecture 4
Event Studies
Review Fama-French 1992
Factors and More Factors

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Outline

- Event Studies
- Review Fama-French 1992
- What is a Factor?
- Factor Creation
- Factors (or Anomalies?)
- Classic Factors
  - Value-Growth
  - Size
  - Momentum
- Multi-Factors
- Summary

Event Studies

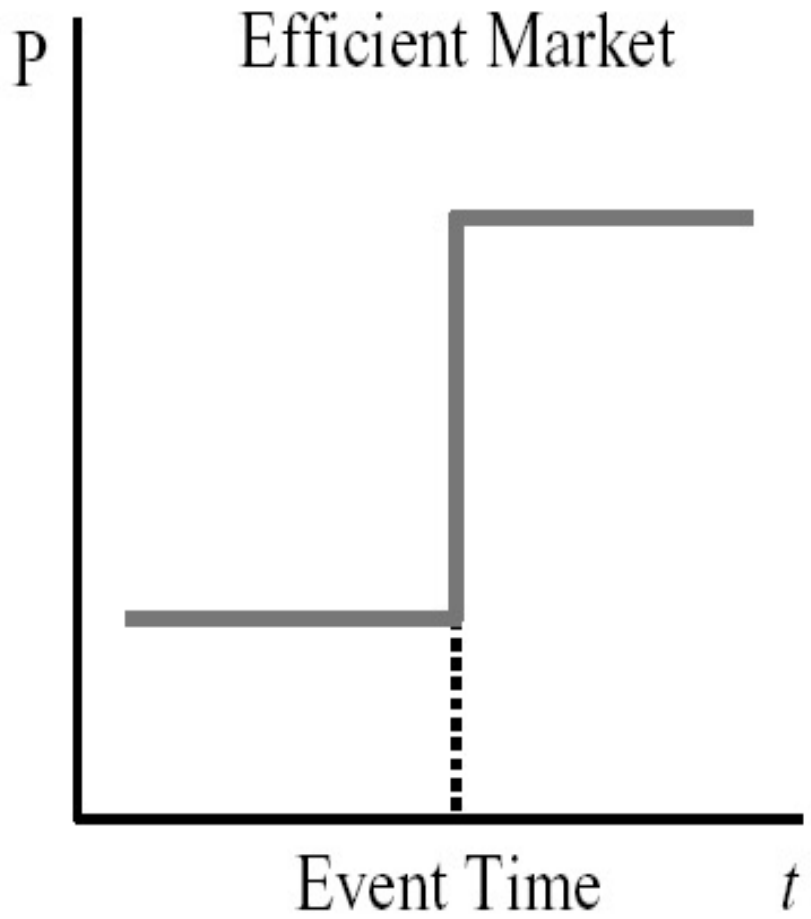
Event Study Analysis

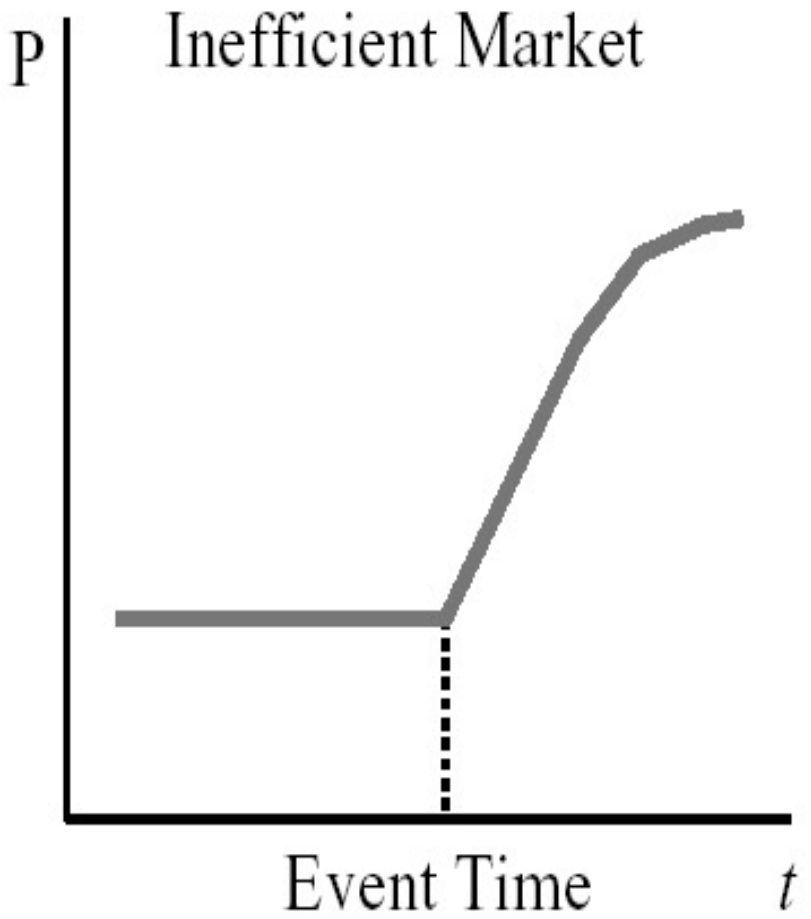
- Definition: An event study attempts to measure the valuation effects of a corporate event, such as a merger or earnings announcement, by examining the response of the stock price around the announcement of the event.

- One underlying assumption is that the market processes information about the event in an efficient and unbiased manner.

- Thus, we should be able to see the effect of the event on prices.

Event Study Analysis





Models for Measuring Performance

- We can always decompose a return as:

$$R_{i;t} = E[R_{i;t} | X_t] + \xi_{i,t},$$

where X_t is the conditioning information at time t:

- In event studies, $\xi_{i;t}$ is called the "abnormal" return.
- Question: Why abnormal?
- It is assumed that the unexplained part is due to some "abnormal" event that is not captured by the model.
- In a sense, we want to get close to a natural experiment.
  - There is an exogenous (unanticipated) shock that affects some stocks.
  - We want to compare the returns of those stocks around the announcement to others that are not affected.

Models for Measuring Performance

- **Constant mean return model**

- For each asset i, the constant mean return model assumes that asset returns are given by:

$$R_{i,t} = E[R_{i;t} \mid X_t] + \xi_{i,t},$$

$$\text{where } E[R_{i;t} \mid X_t] = \mu,$$

$$E[\xi_{i,t}] = 0 \text{ and } Var[\xi_{i,t}] = \sigma_{\xi,i2}$$

- **Market Model**

- For each asset i, the MM assumes that asset returns are given by:

$$R_{i,t} = E[R_{i;t} \mid X_t] + \xi_{i,t},$$

$$\text{where } E[R_{i;t} \mid X_t] = \alpha_i + \beta_i R_{m,t},$$

$$E[\xi_{i,t}] = 0 \text{ and } Var[\xi_{i,t}] = \sigma_{\xi,i}^2$$

- In this model $R_{m,t}$ is the return on the market portfolio, and the model's linear specification follows from an assumed joint normality of returns.

- Usually a broad-based stock index is used as the market portfolio (S&P 500 or the CRSP EW or CRSP VW).

  - Note when $\beta_i = 0$, we have the constant mean return model.

- The MM improves over the constant mean return model: we remove from $\xi_{i,t}$ changes related to the return on the market portfolio.

Estimation of Abnormal Returns

- **Cumulated Abnormal Returns (CARs)**

$$AR_{i,t} = R_{i,t} - E[R_{i;t} | X_t]$$

$$CAR^{i}_{t,;t+K} = \Sigma_k \, AR_{i,,t+k}$$

If we fix K; we can compute the variance of the CAR. Then, under certain conditions:

$$CAR^{i}_{t,;t+K} \sim N(0,\sigma^2_{i,,t+k})$$

Sometimes we are looking at only several categories (j = 1,..,J) (IPO and non-IPO firms). Suppose there are $N_1,\ldots,N_J$ firms in each category.

- Then, the CAR for each category is:

$$\overline{CAR}^{j}_{t,t+K} = \frac{1}{N_j} \sum^{N_j} CAR^{n}_{t,t+k}$$

- The advantage of aggregating across assets is immediately clear

$$\overline{CAR}^{j}_{t,t+K} \sim N\left(0, \frac{1}{N_j^2} \sum \sigma^2_{i,t,t+K}\right)$$

Testing

- Null Hypothesis: Event has no impact on returns –i.e., no abnormal mean returns, unusual return volatility, etc.
- The focus is usually on mean returns.

- **Parametric Test**.
- Traditional t-statistics (or variations of them) are used:

$$t_{CAR} = \overline{CAR}_{i\tau} / \left(\sigma(CAR_{i\tau}) / \sqrt{n}\right)$$

or

$$t_{BHAR} = \overline{BHAR}_{i\tau} / \left(\sigma(BHAR_{i\tau}) / \sqrt{n}\right)$$

Appealing to the CLT, a standard normal is used for both tests

Testing

Non-Parametric Test.

- Advantage: Free of specific assumptions about return distribution.

Intuition: Let $p = P(CAR_i \geq 0)$, then under the usual event studies hypothesis, we have H_0: $p \leq 0.5$ against H1 : $p > 0.5$.

(Note if distribution of CAR_i is not symmetric, we need to adjust the formulation of p.)

- Popular Tests: Sign Test (assumes symmetry in returns) and Rank Test (allows for non-symmetry in returns). See Corrado (1989).

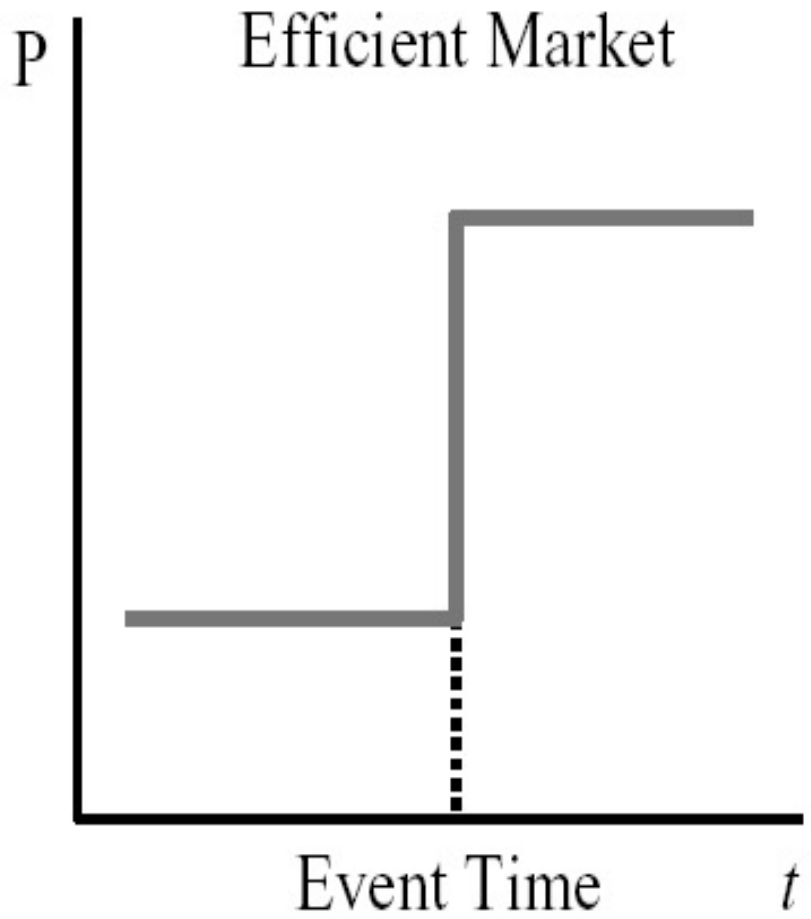
Example: Sign Test

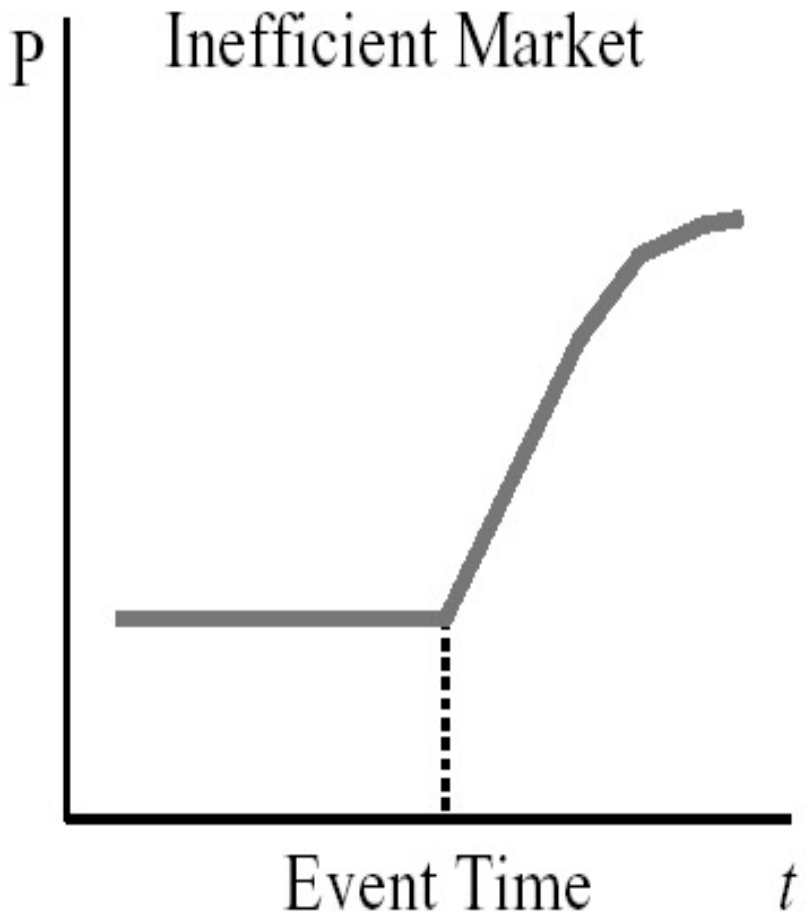
Let N+ be the number of firms with CAR>0, and N the total number of firms in the sample. Then, H_0 can be tested using

$$= [(N+/N) - 0.5]/\ 2 \quad N \sim N(0,1)$$

- Usually, non-parametric tests are used as a check of the parametric tests.

Event Study Analysis





Fama-French (1992)

Fama French (1992)

What are the Fama-McBeth regressions that they run in Table 3?

At time t, for all stocks j=1,…..,*n*, we run the following regression

$$R_{j,t} - r_{f,t} = \gamma_o + \gamma_1 X_{j,t-1}$$

How do we interpret the coefficient $\widehat{\gamma_1}$? What is the economic interpretation?

Well, let's think of it this way:

First, we run a series of time-series regressions, from, say t-60,……t-2, to get estimates of a stocks $\hat{\beta}$. In other words, we just estimate a stock's β in a traditional way.

Now let's re-look at the regression above:

$$R_{j,t} = \gamma_o + \gamma_1 \beta_{j,t-1}$$

Now, how would you interpret the coefficient $\widehat{\gamma_1}$?

Answer: It is the estimate of that month's market premium $(R_m - r_f)$

Fama French (1992)

What is being reported in Table 3 are average $\hat{\gamma}$ coming from a series of cross-sectional regressions.

In other words: at time t, for all stocks j=1,…..,*n*, we run the following regression

$$R_{j,t} - r_{f,t} = \gamma_o + \gamma_1 X_{j,t-1}$$

This is done T times for t=1,…..*T* and then the coefficients reported are:

$$\bar{\gamma} = \sum_{t=1}^{T} \gamma_t \text{ and the } t-stats \text{ are calculated as } \frac{\bar{\gamma}}{stderr(\gamma_t)}$$

So the coefficients reported in Table 3 come from what we call Fama-McBeth regressions and should be interpreted as the “risk-premium” on a “factor”.

Fama French (1992)

Table 3

β	ln(ME)	ln(BE/ME)	ln(A/ME)	ln(A/BE)	E/P Dummy	E(+)/P
0.15 (0.46)						
	−0.15 (−2 58)					
−0.37 (−1.21)	−0.17 (−3.41)					
		0.50 (5.71)				
			0.50 (5 69)	−0.57 (−5.34)		
					0.57 (2.28)	4.72 (4.57)
	−0.11 (−1.99)	0.35 (4.44)				
	−0 11 (−2 06)		0.35 (4.32)	−0 50 (−4.56)		
	−0.16 (−3.06)				0.06 (0 38)	2.99 (3.04)
	−0.13 (−2.47)	0.33 (4.46)			−0.14 (−0.90)	0.87 (1.23)
	−0.13 (−2.47)		0.32 (4.28)	−0.46 (−4.45)	−0.08 (−0.56)	1.15 (1.57)

What is a Factor?

What is a Factor?

- A *systematic factor* is a variable that affects the returns of all assets—it is only a question of degree as to how a particular asset is affected
- Factors can be
  - Fundamental or macro, which are usually non-tradable (at least not in scale)
  - They proxy for a risk that are non diversifiable
- Exposure to factor risk earns a risk premium, on average. Because of general risk aversion in the economy, investors require a positive risk premium to be exposed to assets which lose, on average, when factor realizations are high.

  For example, assets which tend to have low returns when inflation is high are risky, and so over the long run earn an inflation risk premium.

What is an anomaly?

- A *systematic mispricing* that affects the returns of assets — it is only a question of degree as to how a particular asset is affected
- Anomalies can be
  - Thought of “trading” strategies that can be put on in large scale
  - That are pervasive, stable, and have economic intuition
- Exposure to an anomaly earns a positive return on average.

How do you distinguish between factors that proxy for a risk that investors should be compensated for an anomaly?

What Macro Environments Might Matter?

Hypothesis: Even different assets within the same asset class (e.g. different stocks within equities) will respond differently to these different macro environments.

For example, some stocks might be perform better than others when there is a negative shock to oil prices.

So if you have a view (forecast) on oil prices there is a group of stocks you might want to go long and a group you might want to go short.

Your job is simply to:

1. Forecast oil prices movements correctly (and better than the market).
2. Come up with a measure (a proxy or a sensitivity) for which stocks will do best and worst in such an oil price regime.

Empirically test your predictions / measures to see if they work!

Do you **reliably** "make money" with your process (strategy)? Statistical tests!

How Do You Create A Factor?

How Do You Create a Factor?

Remember a factor is represented by an asset's exposure to a risk premium.

There are two ways to envision that exposure:

1. The asset's covariance (or "loading" or "senstivity" or "beta") with that risk premium.
   - The easiest example to think about here is a stock's "beta" (or covariance) with the market.
   - This represents a stock's exposure (or sensitivity) to the market risk premium.
2. The asset's "characteristic" can also be thought of as its exposure to that risk premium.
   - The easiest example to think of here are the Fama-French factors of Book-to-Price or Size
   - These are fundamental characteristics of the stock that we think capture an element of risk (mispricing) associated with the stock.

How Do You Create a Factor?

For tradable risk-premium that are observable in the market, it is relatively easy to envision how to create a “sensitivity” (or “loading”) to the factor.

- Just run a regression of the asset’s return against the factor return.

What are examples of observable or tradable risk premium?

To a certain extent, loadings are “proxies”. Why?

We want current loadings. These regression are historical and simply our best (noisy?) estimate of the current loadings.

How Do You Create a Factor?

For non-tradable or unobservable risk premium, there really is no way to estimate an asset's loading on the return. There is no observable return stream!

Where do you find value? Or quality? It doesn't actually exist. We just have measures that we think proxy for it.

- Book-to-Price, Sales-to-Price, Earnings-to-Price just are proxies for what we believe represents "Value". There is no observable actual Value return.
- This is also why we have so many different definitions of "Quality"

These loadings are also "proxies". Why?

Do these also capture the current value of cheapness? Or are these proxies also for cheapness measures?

How Do You Create a Factor?

Why do some people make such a big deal out of using coefficients (or “betas”) with a return stream or “characteristics” such as BE/ME?

Betas are a measure of “risk” in that the capture the covariances.

They capture how much an asset covaries, or diversifies, with the underlying risk you are care about. If you are concerned with “unexpected housing shocks” you care about how much an asset covaries with unexpected housing shocks.

Characteristics are not covariances. Rather, by definition, they are a measure of the “exposure” or “degree of exposure” that the asset gives you to an underlying non-tradeable factor.

In other words, a company’s ME is how Big (or Small) it is. It is not how much it actually varies with the return stream of a size factor. These are different beasts.

What are the pro’s and con’s of using either of this metrics?

How Do You Create a Factor?

Simple Version: The Process

1. Search for stock characteristics derive with an economic or behavioral justification for predicting which stocks will outperform and which stocks will underperform.

2. Calculate factor score for each asset
   - May be a simple ratio using accounting information (e.g. price / book) or may require sophisticated statistical analysis
   - May be an actual sensitivity to some estimated factor premium

3. Rank stocks by factor score over selected universe (large cap vs. small cap vs. sectors) with information known at a given date *t*

4. Create long/short factor portfolios (for that specific month t)
   - Long the highest ranked quintile of stocks
   - Short the lowest ranked quintile of stocks

5. Calculate the *forward* returns for the quintiles from t ➔ t+1

6. Repeat steps 2 to 5, typically monthly, re-ranking the stocks with any new information you now know.

7. Determine factor efficacy using appropriate statistical tests

How Do You Create and Test a Factor?

More Complex: The Process

1. Search for stock characteristics with an economic or behavioral justification for predicting which stocks will outperform and which stocks will underperform.

2. Calculate factor score for each asset
   - May be a simple ratio using accounting information (e.g. price / book) or may require sophisticated statistical analysis
   - May be an actual sensitivity to some estimated factor premium

3. Create a z-score for each stock based upon its characteristic, where the stock is demeaned by the average characteristic value (for the appropriate universe) and then divided by the standard deviation of the characteristic for that same universe. Why z-score?

4. Run a regression where the LHS variable (dependent variable) is the *forward* returns for ➔ t+1 and the RHS variable (independent variable) is the z-scored characteristic know at time t.

5. Repeat steps 2 to 5, typically monthly, re-scoring the stocks, re-running the regressions and getting the co-efficient.

6. Determine whether or not that coefficient is different from zero

How Do You Test a Factor?

How Do You Test the Efficacy Factor?

1. Quintile (or Tertiles? Or Deciles) Spread Returns
    - » You get a time-series of returns from the process we just described.
    - » Do a simple t-test to see if the returns are statistically different from zero.

2. Run a Cross-Sectional Regression
    - » Remember how Fama-French (1992) did this! (Lecture 2, Slide 24)
    - » Test whether the coefficients are statistically different from zero

t-stats are not enough to test whether a factor works. Don't let your quantitative research shop / testing procedure become a maximizing t-stat factory!!!

There is no one sufficient measure that tells you whether to believe or not believe in a factor. And don't let there be one. People will game it.

How Do You Test a Factor?

What Else Should You Look At?

1. Hit Rates: Separating Big Returns from Consistency
   - How often do your quintiles outperform?
   - What percent of stocks in your quintiles outperform?
2. Look for monotonicity across all your quintiles
   - Does Q1 outperform Q2 which outperforms Q3 which outperforms Q4 which outperforms Q5? Or are you U or L or “reverse” J shaped?
   - Are you monotonic in hit-rates too?
3. Does your factor perform better in certain market environments? Or macro environments?
   - High Vol vs Low Vol? High inflation vs low inflation? High interest rate regimes vs low interest regimes?
   - How time-sensitive is the performance? Did it do very poorly or well in recessions? In the Financial Crisis? Or the rebound from the crisis?
4. Does it do better (or worse) in certain sectors / industries or in certain countries (if a global model)?
5. How big are the drawdowns? Could you withstand them?

How Do You Test a Factor?

Your job is to figure out very carefully and thoughtfully when your factor will work …

And when your factor will fail …

And when your factor will blow-up spectacularly.

Because your factor will fail and will not work for a prolonged period of time.

It is not Truth.

It is a model and all models are false. By definition. It is a model, not reality, and so it will fail.

Your job is to understand why it fails. What doesn't it understand. When will it fail.

If you don't understand this, if you can't articulate this, you should NOT be investing with it.

How Do You Test a Factor?

Every researcher on my team better know:

- What causes your factor to produce an erroneous signal?
- When does your model underperform?

Examples:

- When does Book / Price fail? What might cause a stock to look very cheap when it really isn't?
- When might your Beta estimates be really inaccurate?
- When might Momentum fail?
- What can your NLP algorithm not handle? When will it be get something wrong? Remember Anne Hathaway vs. Berkshire Hathaway

If you don't understand this backwards and forwards, you should not be using that investment strategy. At best, you are just gambling. You are being reckless.

Factors (or Anomalies?)

Factors (or Anomalies?)

Classics

- Value = Value stocks minus Growth stocks
- Size = Small stocks minus Large stocks
- Momentum = Winning stocks minus Losing stocks

Others

- Illiquidity = Illiquid securities minus Liquid securities
- Quality = High Quality stocks minus Low Quality stocks
- Low Volatility = Stocks with low volatility minus stocks with high volatility

See Rothman, “Launch of Lehman Large Cap Stock Selection Model” for a list of well known stock anomalies

Forecasting Returns – Three Classic Themes

- Valuation
- Quality of Management / Capital Deployment
- Market Dynamics & Temperament

Forecasting Returns – Three Classic Themes

- **Valuation**
  - EBITDA to EV
  - Trailing Earnings to Price
  - Book to Price
  - Sales to Price
  - Total Yield
  - Net Free Cash Flow to Price
  - Net Income to Operating Cash Flow
  - Gross Free Cash Flow to Price
  - Sharpened Forecast Earnings to Price
- Quality of Management / Capital Deployment
- Market Dynamics & Temperament

Forecasting Returns – Three Classic Themes

- Valuation
- **Quality of Management / Capital Deployment**
  - ROE
  - Change in Shares Outstanding
  - Taxes Paid to Pre-tax Income
  - Incremental Net Margins
  - Intangibles to Assets
  - Sales Growth
  - ROIC
  - Change in Employees
  - Net Income Growth
  - Change in Debt to Assets
  - Asset Turnover
  - Managerial Discretionary Accruals
- Market Dynamics & Temperament

Forecasting Returns – Three Classic Themes

- Valuation
- Quality of Management / Capital Deployment
- **Market Dynamics & Temperament**
  - Residualized Price Momentum
  - Sharpened Analyst Recommendations
  - Sharpened Earnings Revisions Model
  - Earnings Revision Ratio
  - Abnormal Trading Volume
  - Market Estimated Earnings Surprise Signal

Value-Growth

Value vs Growth: Why Might They Perform Differently?

- Value Stocks: “Stocks that are out of favor with the investment community selling at relatively low prices in relation to their earnings or book value. These stocks typically produce above-average dividend income, have low prices relative to earnings or book value.”

- Growth Stocks: “Stocks of companies with above-average prospects for growth based on measures like revenue, earnings and book value. These stocks generally produce little dividend income and tend to trade at high prices relative to earnings or book value.”

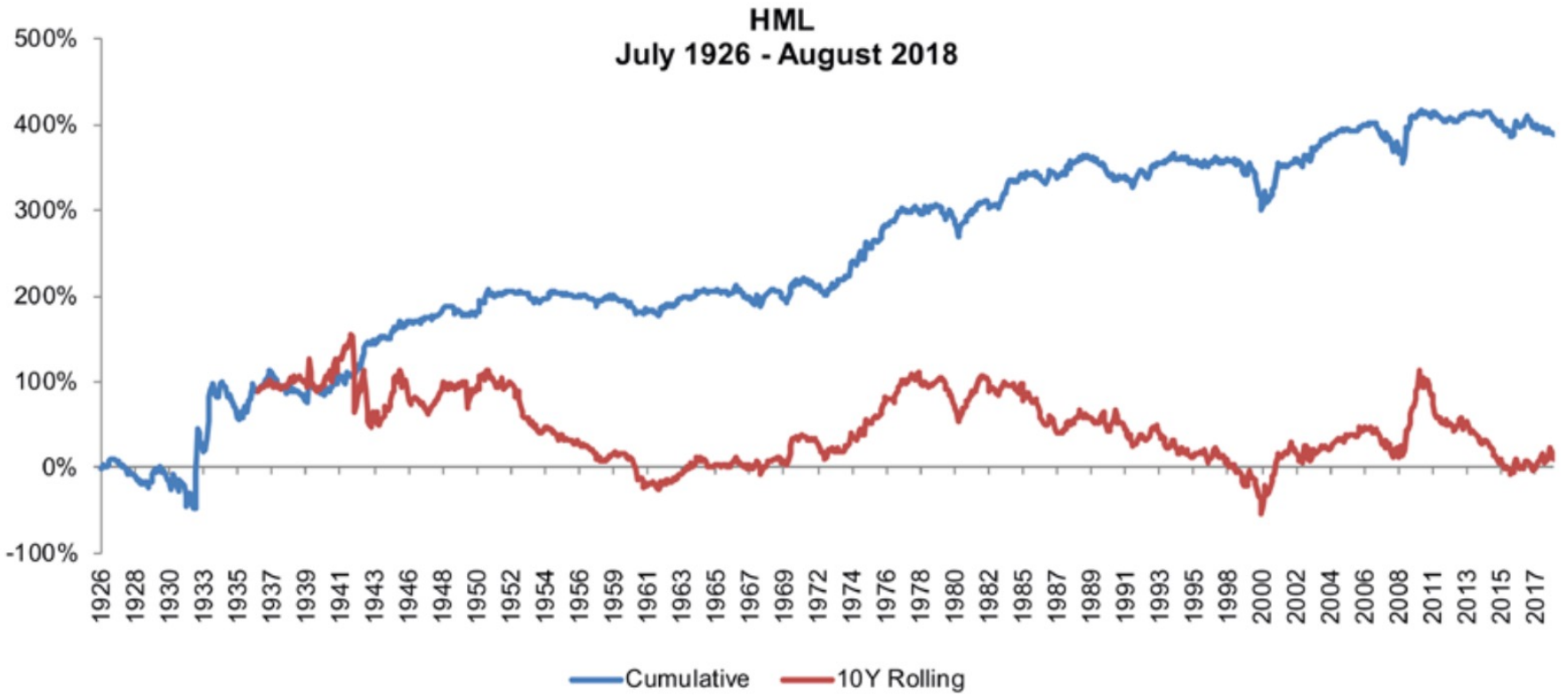
Behavioral Theories: Over-Extrapolation

- Most behavioral explanations of value center around over-reaction/over-extrapolation
  - Investors over-extrapolate past growth rates into the future.
  - Growth firms have had high past growth rates. Prices of these firms are bid up too high reflecting excessive optimism.
  - When growth does not materialize, prices fall so returns are low relative to value firms
  - Value stocks here are NOT fundamentally riskier but investors don't understand mean-reversion and over-extrapolate the recent past

- Crucial assumption: naïve investors over-extrapolate and prices reflect the over-reaction. Contrarian (value) investors outperform by taking the opposite side.
  - Why don't more value investors enter the market and bid up the prices of value stocks removing the value premium?
  - This should be easy to arbitrage away, why hasn't it been?

Historical Performance of Value

What's Happened to Value?

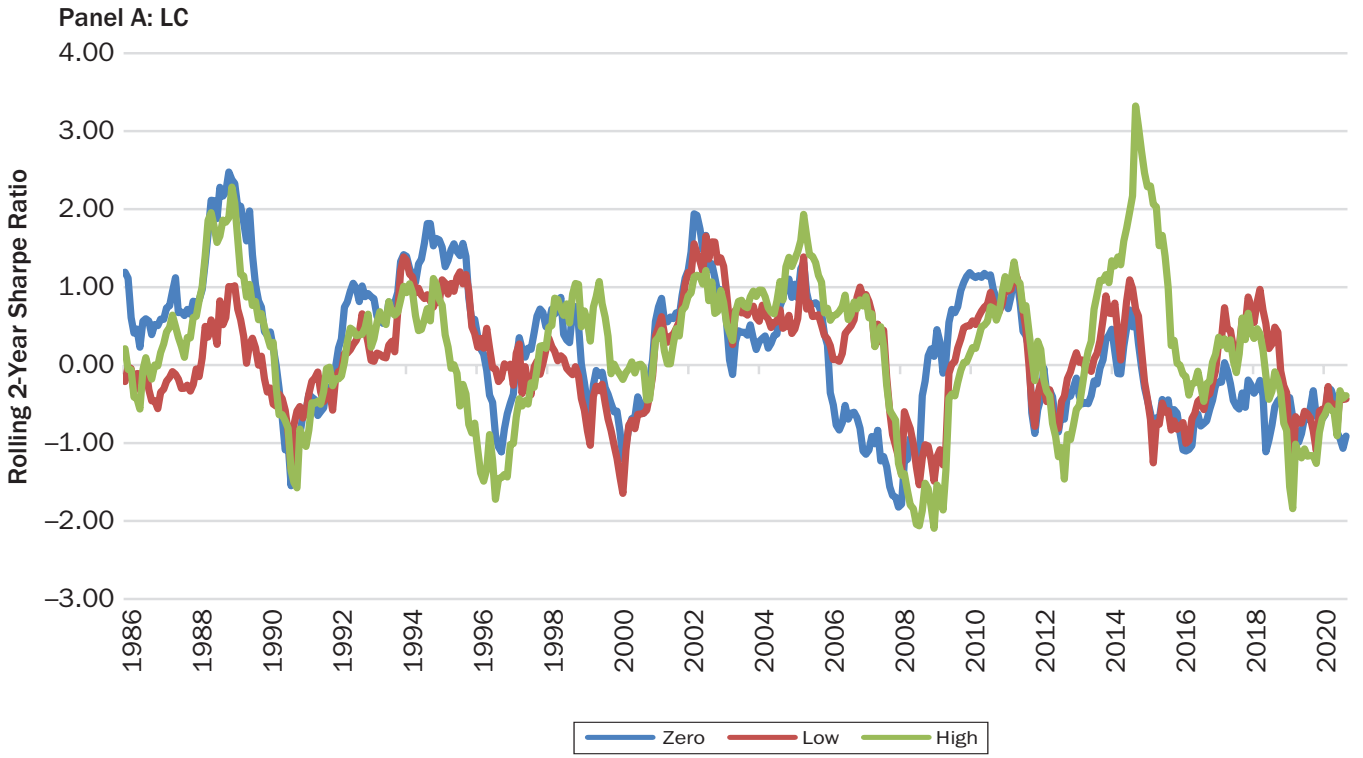


Source: AQR. Returns are from a long high Book-to-Market, short low Book-to-Market factor using the adjusted definition (HML Devil) of Asness and Frazzini (2013), "The Devil in HML's Details." *Journal of Portfolio Management*. For Illustrative purposes only.

What's Happened to Value?

EXHIBIT 4

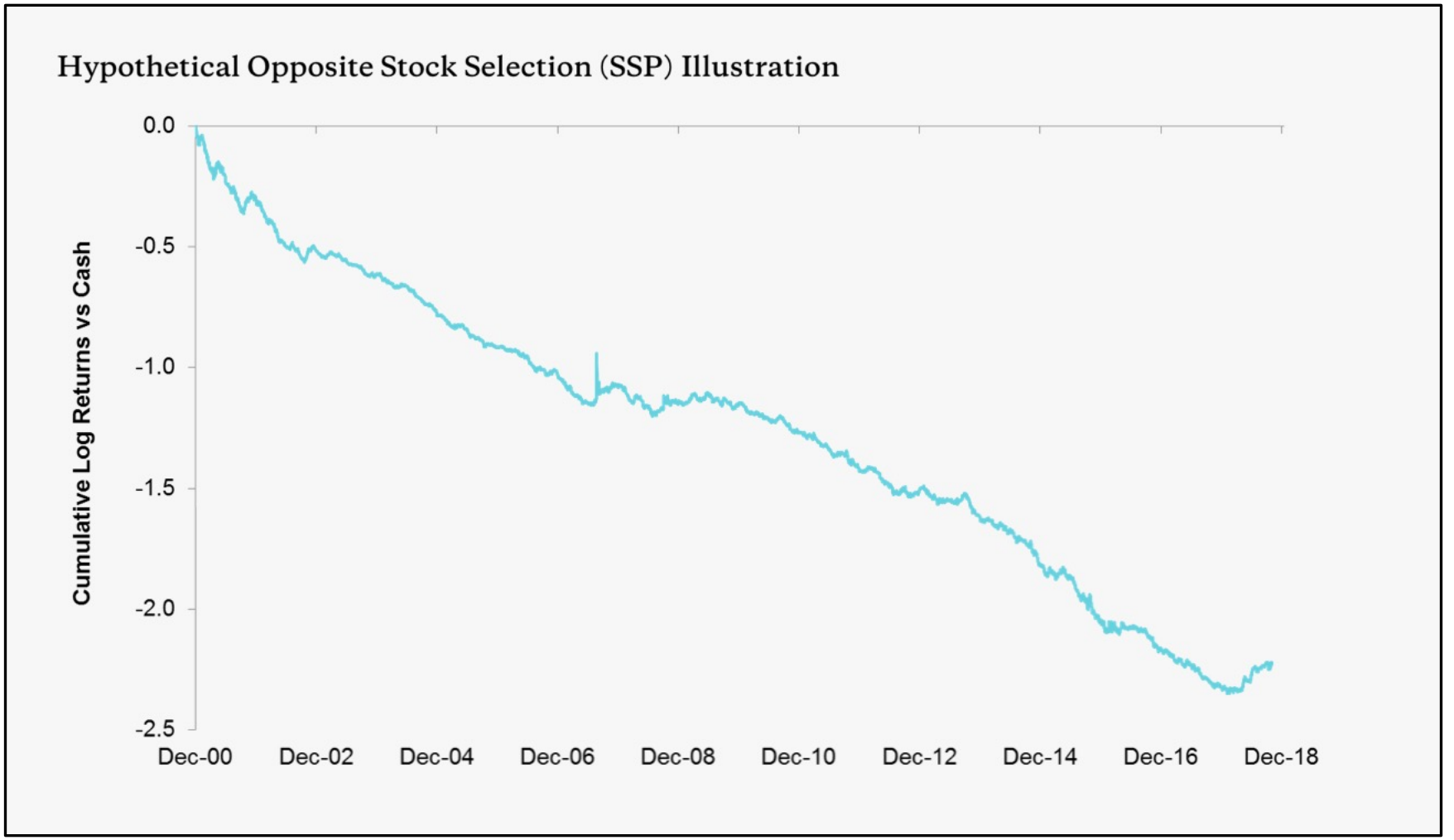
Two-Year Rolling Sharpe Ratios for the B/P Value Strategy for the US



NOTES: This exhibit shows the two-year rolling Sharpe ratios for the B/P value strategy for the US across three subsamples based on share repurchase intensity. US firms are split into three groups separately for LC and SC categories as follows: (1) firms with no share repurchase activity over the last 12 months (labeled Zero), (2) firms with low levels of share repurchase activity over the last 12 months, defined as below the median of share repurchase activity over the last 12 months (labeled Low), and (3) firms with high levels of share repurchase activity over the last 12 months, defined as above the median of share repurchase activity over the last 12 months (labeled as High). Within each share repurchase partition, we adjust B/P by subtracting the median of the respective sector (GICS level 2) group and then rank and standardize across all stocks belonging to that partition. Portfolio weights are directly proportional to the rank-standardized B/P score. Portfolios are dollar neutral.

Historical Performance of Value

The Costanza Portfolio



Momentum

Origins of Momentum Matter

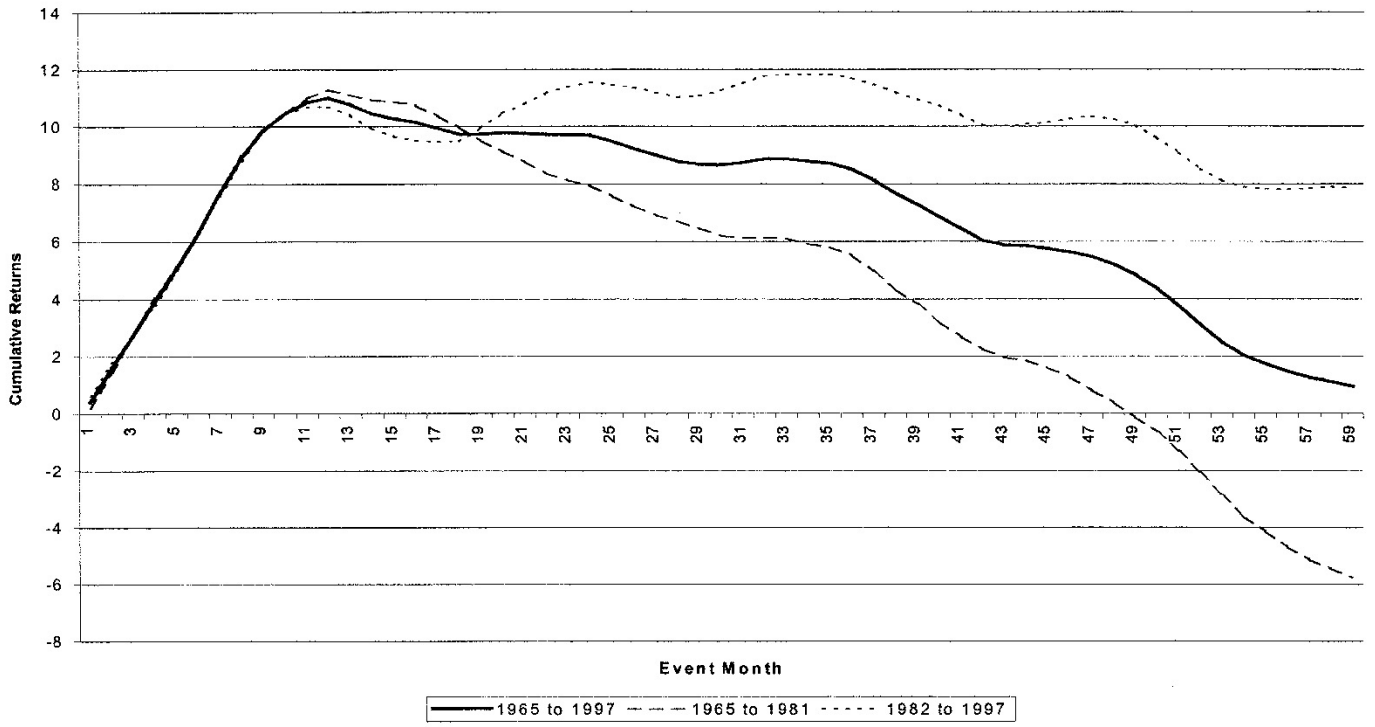
- Rational Theories
  - The payoff to momentum is a payoff for bearing systematic risk
    Implication: Eventually the risk will materialize
  - Momentum contains information generated by hard-working investors that is not yet fully discounted by market prices
    Implication: If the information is correct, momentum investing will yield positive returns
- Behavioral Theories
  - Investors make systematically irrational decisions by over-extrapolating price movements
    Implication: Invest in momentum, but jump off at the right time
  - They under-react to important information
    Implication: If so, buy past winners and sell past losers. As investors adjust to the information, you will profit

Risk Theories

- Momentum is hard to explain with a risk story. But, there seem to be some risk components of momentum profits
  - Momentum profitability varies over the business cycle
  - Momentum strongest during bull markets (this is also consistent with over-reaction)
  - There are downside risk components to momentum profits
  - Links to liquidity risk

Momentum Reversals

- Jegadeesh and Titman (2001) track the returns of momentum portfolios up to 5 years post-formation
- Momentum profits reverse in years 2-5.



Behavioral Theories

- Behavioral explanations of momentum come in two main flavors:
  - Under-reaction: good news comes out but investors under-react. Then, prices slowly drift upwards to the rational price.
  - Over-reaction: irrational investors over-react to positive news. This over-reaction is gradual, so stock prices display momentum for a period of time but then eventually reverse and return to fundamental value.
  - Most combine elements of under- and over-reaction
- The under-reaction captures momentum, while the over-reaction captures long-term mean reversion

Behavioral Theories

Barberis, Shleifer and Vishny (1998): Under-reaction

- Uses two psychological biases
  - Conservatism: Investors underreact to information because they stick to their prior beliefs. This causes momentum.
  - Representative heuristic: investors mistakenly conclude that firms with high earnings growth in the past continue to experience high earnings growth in the future. Representativeness causes investors to assume commonality between similar objects (here past and future growth rates). Representativeness leads to long-term mean reversion.
- No role for any rational investors

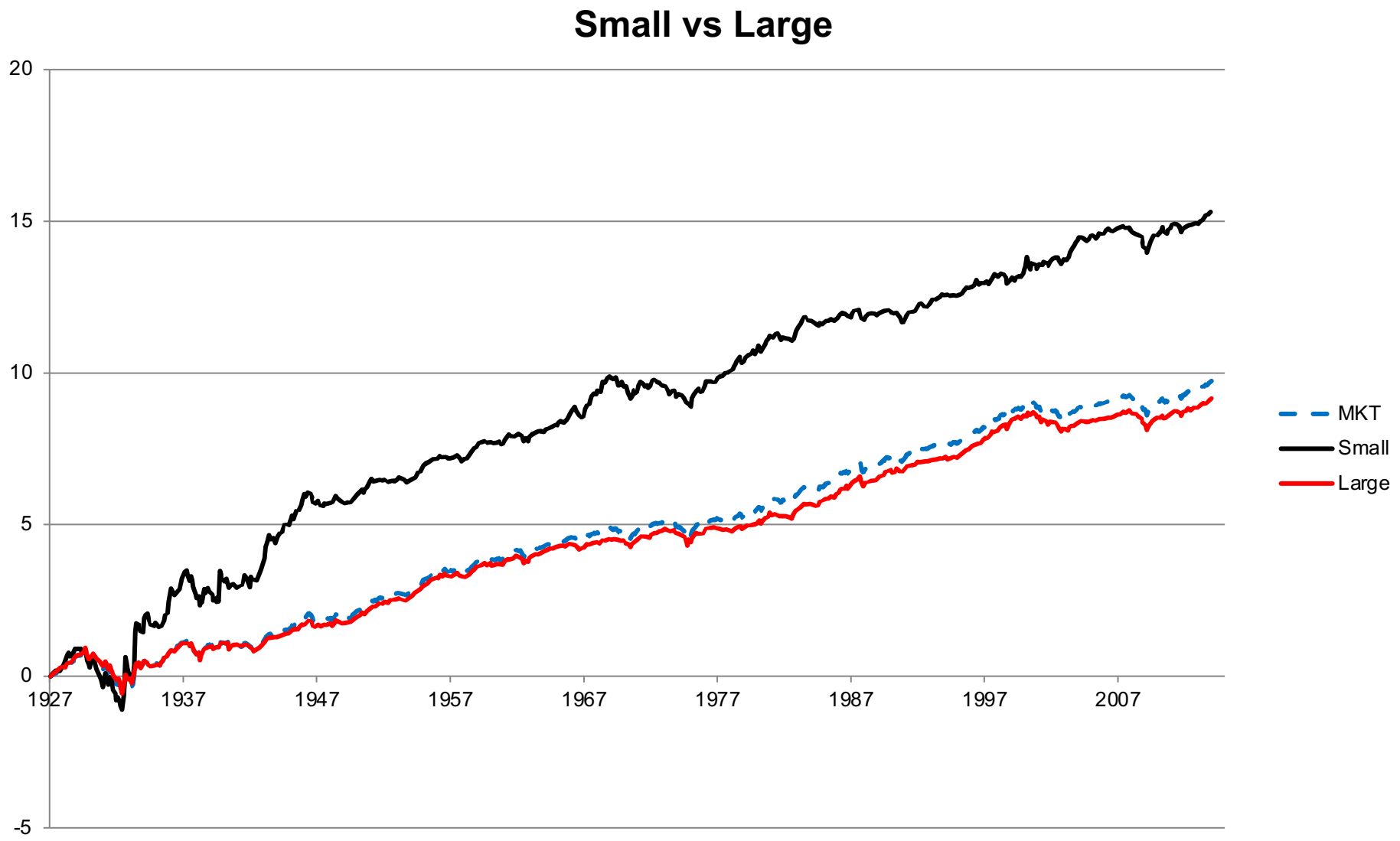
Behavioral Theories

Hong and Stein (1999): Under-reaction

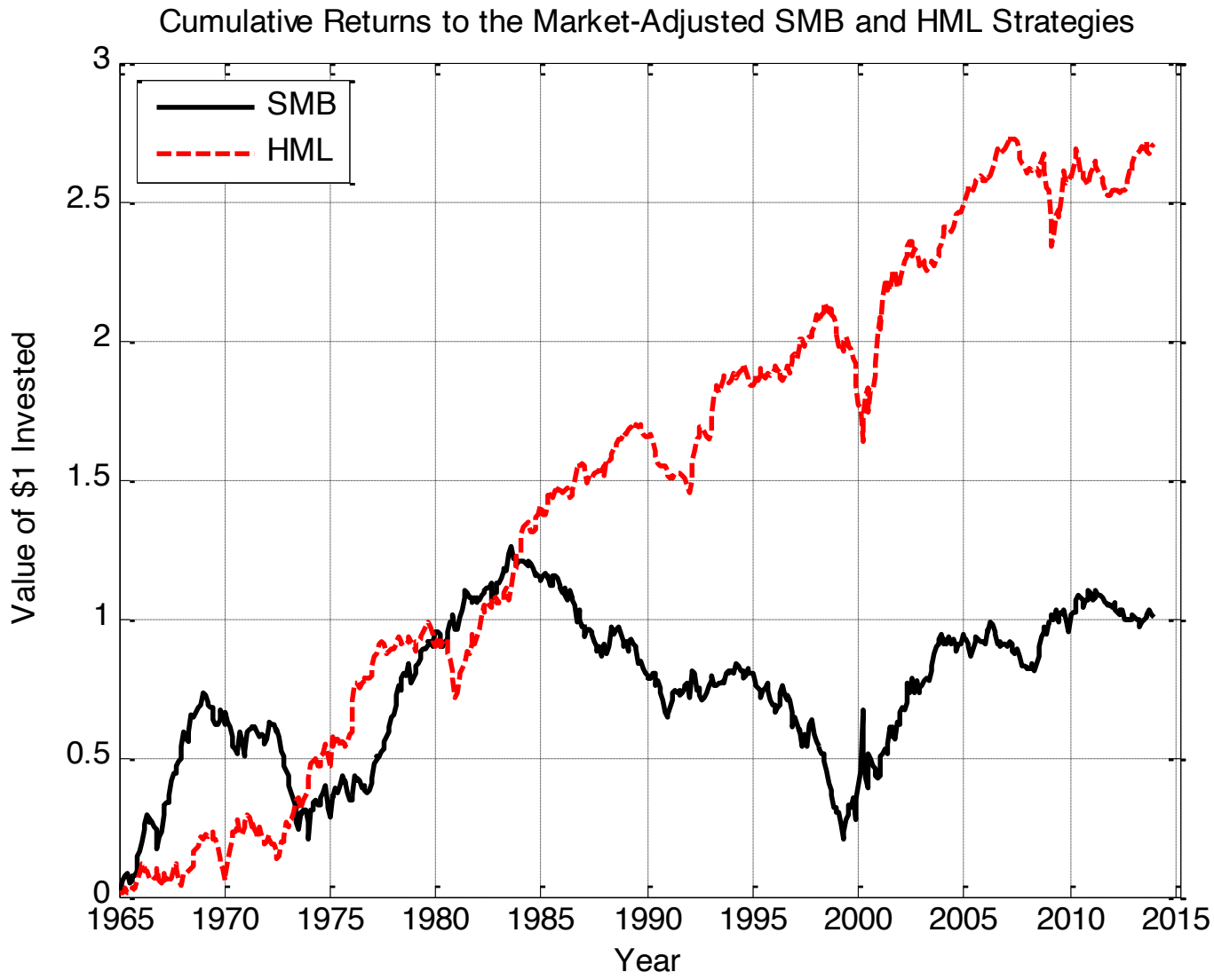
- No behavioral biases
- Two groups of investors, both rational but have limited information sets ("bounded rationality")
  - Informed investors ("news watchers") receive signals of firm value but ignore information in the past history of prices
  - Uninformed investors ("momentum traders") do not receive signals but trade based only on past prices
- Information received by informed investors is transmitted with a delay and is only partially incorporated in prices when first revealed to the market. Momentum traders jump on the train. This leads to under-reaction and momentum.
- Momentum traders push prices past fundamental values. Reversals obtain when prices eventually revert to fundamentals.

Size

Small vs Large



Fama-French


Cumulative Returns to the Market-Adjusted SMB and HML Strategies
SMB
HML
Value of $1 Invested
Year
0
0.5
1
1.5
2
2.5
3
1965
1970
1975
1980
1985
1990
1995
2000
2005
2010
2015

Small-Large

- Is it spurious?
- What might an economic story be for why small stocks should earn higher returns than large stocks? What risk does it proxy for?
- What behavioral story might it be consistent with a size effect?
- What role do you think information asymmetry places in the size effect? Can you tell the story? What variables might you use to control for information asymmetry and see if there is still a size effect?
- What other phenomena might be being picked up in the size effect? Hint: are the transaction costs associated with investing each cohorts?
- How might size be positively correlated with momentum? Or negatively with value?

Multivariate (Model) Factor Creation

How Do We Do It? Multivariate Factor Selection

- Multivariate (joint) Factor Selection
  - We seek Nirvana: two or more factors that each work on an individual basis but have small correlation with each other.
  - Combing low correlation signals increases returns and reduces return volatility
- Process:

1. Calculate factor score for each factor separately
2. Calculate combined score for each stock: sum of each factor score x factor weight
3. Rank stocks by combined factor score
4. Create long/short factor portfolios (each month)
   - Long the highest ranked quintile of stocks
   - Short the lowest ranked quintile of stocks
5. Calculate forward returns for the quintiles
6. Determine efficacy

Forecasting Returns – Quantitative Research

Performance Statistics for Univariate and Multivariate Examples

	Book/ Price (B/P)	Momentum (MOM)	ROIC	B/P + MOM	**B/P + MOM + ROIC**
Return	3.5%	6.1%	2.5%	7.5%	**9.2%**
Volatility	12.2%	15.6%	8.4%	11.1%	**9.9%**
Information Ratio	0.29	0.39	0.30	0.68	**0.92**

– Combining independent signals enhances performance

- Higher expected returns
- Lower return volatility
- Higher information ratios

How Do We Do It? Multivariate Factor Selection

How Do You Test a Multivariate Factor Model?

1. Do all the same tests you did for a univariate factor.
2. When you run cross-sectional regressions, watch out for multi-collinearity!
   - My favorite (and should be easiest) interview question is:

     "When you are running a regression and your two independent variables, X1 and X2 are correlated, how does this impact the coefficients and t-stats?"

   - Why do I ask this? This is multivariate Fama-McBeth regressions when your factors are not independent. Happens all the time. What should you do?
   - Econometrics 101 and most people don't know it. It is shameful!
3. When does your model fail?
4. What are the biases in your model performance? Break it down and understand it!

We will talk more about this next week. Again. This the difference between being an investor and computer geek betting in the market.

Multivariate Factor Testing

Things to consider in testing the efficacy of a factor in multivariate setting

1. What is the correlation of signals?
2. What is the correlation of your factor returns?
3. If your signals are highly correlated but there is incremental return should you have a 'composite' factor?
4. What is the "Jensen's Alpha" of your factors? Test it both ways!

$$R_{Y,t} = \alpha + R_{X,t} + e_t$$

5. What is the incremental R^2 of your model?
6. Is your factor diversifying your positioning or is exacerbating your biases?
7. Are you getting "exposure" to your new alpha source? Is the exposure appropriate?

Univariate Factor Testing

Things to consider in testing the efficacy of a univariate factor

1. Do you want to have any out-of-sample period?
2. What is the absolute return that the factor is able to produce?
3. What the Sharpe Ratio, and the Information Ratio (IR) of the factor? What is its Alpha-to-Margin ratio? Sortino Ratio?
4. What is its risk adjusted return? Is it long (or short) market beta? Is it loading up on factor exposures? Does it have it systematic sector or country exposures?
5. What are its hit-rates, both for stock selection and in terms of its performance rate?
6. What is turnover? The autocorrelation of the signal itself? What are the transaction costs associated with trading it?
7. What are its drawdowns? Given its Sharpe Ratio and IR what should you expect its drawdown and underperformance to look like? (see pp. 33-34 of Pedersen!)
8. What does it payoff profile look like? How quickly does its payoff efficacy decay?
9. How robust is the signal's performance to minor variation in its definition?
10. Are there certain universes (large cap, small cap, EM, DM, U.S., Japan) that it performs better or worse? Certain sectors? Do these make sense to you?
11. What is the time series behavior of the factor? Does the time series behavior align with macro regimes? Market regimes?

Open Questions in Factor Construction

What do you need to consider in creating your factors? What do you want to make sure you get right?

1. Make sure your sample is free of survivorship bias. How might you test this?
2. Is your dataset backfilled? How might you look for this?
3. Is your dataset point-in-time? Does it have the revision history?
4. Make sure your identifier “mapping table” is functioning and free of survivorship issues and consistent across vendors
5. Make sure you are only using information known at time t-1 (time lag is appropriate)
6. Make sure your returns are from time t to $t+\tau$
7. Make sure your LHS is demeaned (by what?).
8. Make darn sure you UNDERSTAND your data. Plot it!
9. What universe do you want to use? And how do you want “standardize” your variable (industry neutral, sector neutral, country neutral)? How does this compare to your answer in (7)?
10. How do you want to handle outliers? Do you “normalize” your variables? Is there information, or noise, in the shape of the distribution and outliers?
11. Do you understand your data?!? Did you look at it??

Summary

Summary

- What is the difference between a factor and an anomaly? How do you know which one you discovered? Why might you care?
- What distinguishes a macro factor from some of the other factors?
- How does one create a “factor” or a “signal”?
- How might one test whether a factor has efficacy? What type of measures might one want to look at?
- Why might one include factors in a model with a relatively low IR?
- What are the behavioral and economic rationales behind Value? Size? Momentum? And the other factors listed in the presentation? How do these tie back to the psychological biases we discussed last class?
- Which are more appealing to you the behavioral stories or the rational / risk stories for the anomalies above?
- When might Book/Price be a really bad signal to invest on? Give some real life-examples of when you might get “blown up”?
- What are the advantages and disadvantages of testing a factor’s efficacy using quintile spreads vs using a Fama-McBeth regression? What does one tell you that the other does not?
- If you want to understand when your model might work and when it might fail what measures might you want to look at? What kind of scenario analysis should you perform?

Summary

- What robustness tests might you want to perform to see if your factor performance is likely to repeat?
- Why is important to asses the historical drawdowns associated with a factor?
- Why is sector neutralization important for factor testing?
- When might sector neutralization not be granular enough and one should do industry neutralization? When might industry neutralization be a bad idea?
- Imagine you were aggregating factors and coming up with Value Factors at the Secto rLevel. That is coming up with a sector book-to-price value for each sector. Then you went long the cheapest sectors and short the most expensive sectors. Would kind of errors and biases might you expect there? How might you correct for them?
- Imagine you did the same exercise as above but now aggregated the book-to-price factor at the country level. What might be some of the issues you encountered? What biases might your factors have? Hint: Think doing this for Russia vs Taiwan.
- Should you winsorize your LHS variable (returns)?
- You are doing an analysis on the efficacy of a factor over time. The universe you are using is the current S&P 500 and you back populate the factor value for this current set of stocks and then test how the factors performed over time. What could go wrong here?

Summary

- What are the advantages and disadvantages to normalizing your data? That it is making sure it is transformed to be on a normal distribution?
- If one has demeaned and standardized a factor does it have N(0,1) distribution?
- You have a factor model that you are applying to stocks. It has five factors linear model with each weighted 20%. Each factor has a N(0,1) distribution.
  - What is the distribution of the total alpha score, assuming the stock has values for each of the five factors? Why?
  - Now assume that for a subset of stocks two of the factors are systemically missing – that is there values are “null”. What is the distribution of the total alpha score for these set of stock?
  - What problems and biases could this create for your model?
  - Where might you see this type of problem described here occur in the real world? What kind of problems might that result in? Hint: Think Financial Stocks vs other stocks? What about IPO stocks versus older stocks?
- How might you distinguish whether your outliers in your data are noise or signal?
- Why do you need to use data to known at time t to predict return from t to t+1? What goes wrong when you use information known at time t+1 in the above prediction? What if you use information only known at time t-2? Please give an example of an analysis where someone might make this mistake? What warning signs might you look for in an analysis to see if someone has not used information known at time t but at time t+1?