

Portfolio Choice

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Session 7

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 *Variances*

 A!A!ADVISORS!

 ABN-AMRO



Part 7. The Efficient Market Hypothesis

7.1 The EMH

7.2 EMH, martingale, fair game and no free lunch

7.3 Three forms (quality information)

7.4 Evidence of anomalies and mispricing

7.5 Limits of arbitrage

7.1 The EMH

Efficiency concepts

- Allocation Efficiency
 - Does capital flow to the projects with the highest risk-adjusted returns?
- Operational Efficiency
 - Are transactions completed on a timely basis, accurately and at low cost?
- Informational Efficiency
 - Does the observed market price of a security reflect all information relevant to pricing the security?

Informational efficiency

- Financial economics focuses on informational efficiency
 - An efficient market is a market that is efficient in processing information
 - Prices of securities observed at any point in time are based on a correct evaluation all information available at the time, i.e. prices “fully reflect” all available information
 - Also called “Efficient Markets Hypothesis (EMH)”



The Efficient Market Hypothesis (EMH)

- Price = Fundamental value
- Price captures all relevant information
- “No Arbitrage” assumption
- Implications
 - Only new information affects prices
 - Known information has no value
 - Investors should “index”
 - Allocation efficiency

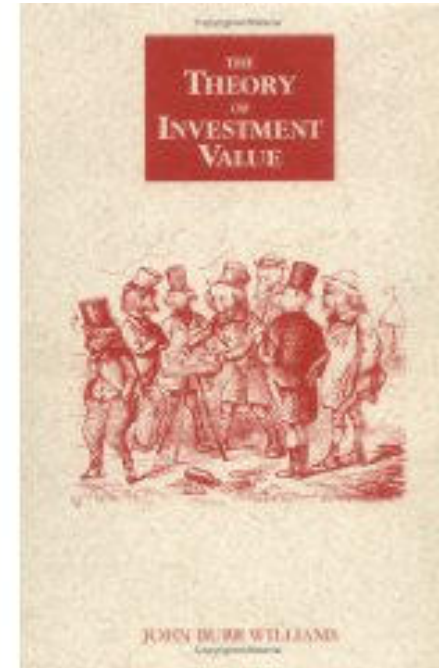
- General Asset Pricing Model (Cochrane, 2001)

$$P_{it} = E_t \left[M_{t+1} X_{i,t+1} \right]$$

- M_t : “pricing kernel” or “Stochastic Discount Factor” (SDF)
- Simple formula
- unobservable
- \cong (radical) uncertainty for some assets

Fundamental value of a stock

A cow for her milk,
A hen for her eggs,
And a stock, by heck,
For her dividends.
An orchard for fruit,
Bees for their honey,
And stocks, besides,
For their dividends



« Therefore we must say that a stock derives its value from its dividends, not its earnings. In short, a stock is worth only what you can get out of it »
(Williams, 1938; p.57)

Fundamental value or intrinsic value

- Stocks:

$$P_t = E_t \left[\frac{P_{t+1} + D_{t+1}}{1 + R} \right]$$

$$P_t = E_t \left[\sum_{i=1}^k (1 + R)^{-i} D_{t+i} \right] + E_t \left[(1 + R)^{-k} P_{t+k} \right]$$

- Transversality condition: $\lim_{k \rightarrow \infty} (1 + R)^{-k} E_t P_{t+k} = 0$

$$P_t^f = E_t \sum_{i=1}^{+\infty} \left[D_{t+i} (1 + R)^{-i} \right]$$

The joint-hypothesis problem

- EMH: price = fundamental value
- Becomes "security prices reflect all available information"
- BUT How determine R
- The joint-hypothesis problem:
 - We can never know whether the market is inefficient or the model is wrong.
 - The choice of model may influence the findings (CAPM, 3-4-5 CAPM, APT, etc)

7.2 EMH, martingale and fair game

Random Walk and the EMH

- Random Walk - stock prices are random
 - Randomly evolving stock prices are the consequence of intelligent investors competing to discover relevant information
 - Expected price is positive over time
 - Positive trend and random about the trend

Random Price Changes

- Why are price changes random
 - Prices react to information
 - Flow of information is random
 - Therefore, price changes are random

Does randomness = irrationality?

- Suppose researchers found that security prices are predictable and then developed a model to predict the prices.
- Following this model, investors would reap unending profits simply by purchasing stocks that would appreciate in price and selling stocks that would decrease in price!

Ramifications of Predictability

- Suppose a model predicts that XYZ stock price (currently \$100) would rise dramatically in three days to \$110.
- Obviously, everybody will want to BUY it; no one would want to SELL it.
- The prediction of underpricing of a security would lead to an immediate price increase!



Ramifications of Predictability

- As soon as there is any information predicting that stock XYZ is underpriced, investors will flock to buy the stock and immediately bid up its price to a fair level.
- However, if prices are bid immediately to fair levels, given all available information, it must be that these prices increase or decrease only in response to new information.
- New information (by definition) must be unpredictable, which means that stock prices should follow a “random walk.”

Random Walk Hypothesis

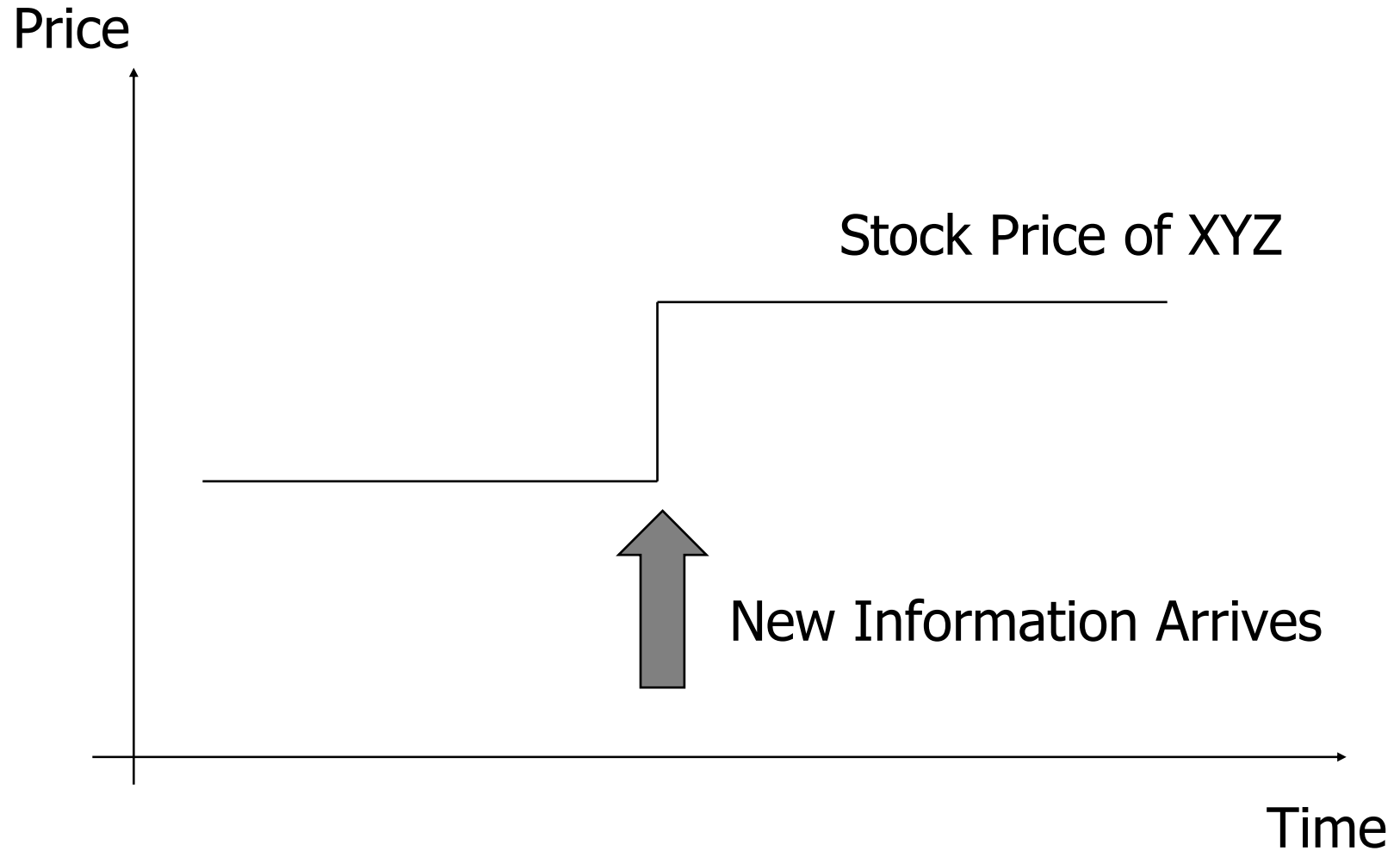
If stock prices follow a random walk (with a trend), then future stock prices **cannot** be predicted based on past stock prices.

$$P_t = \alpha + P_{t-1} + \varepsilon_t$$

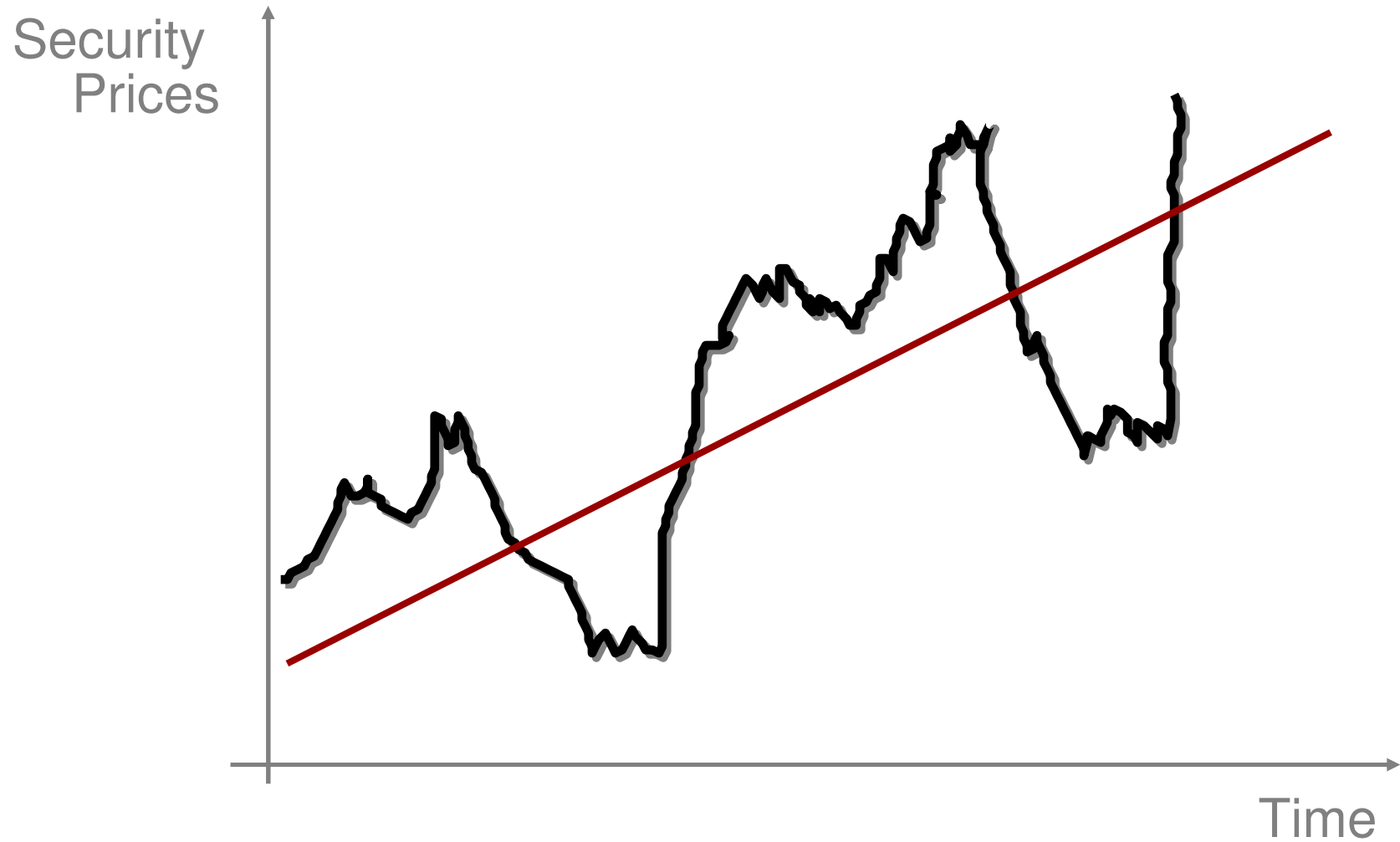
New information is a “surprise”.

When new information arrives, stock prices will adjust immediately.

Example: Positive Surprise



Random Walk with Positive Trend



Martingale and fair game

- Martingale:

$$E_t(x_{t+1} | \Omega_t) = x_t$$

- x_t is the best predictor of x_{t+1}

- Fair game:

$$E_t(z_{t+1} | \Omega_t) = 0$$

$$z_{t+1} = (x_{t+1} - x_t)$$

Martingale and fair game (2)

- Consider a stock's price:

$$(1) \quad P_t = \rho E_t(P_{t+1} + D_{t+1}) \quad \text{with} \quad \rho = (1 + R)^{-1}$$

- Consider the number of stocks in the portfolio: h_t
- Consider the value of the portfolio discounted back to date zero: z_t

$$(2) \quad z_t = \rho^t h_t P_t$$

$$(3) \quad h_{t+1} P_{t+1} = h_t (P_{t+1} + D_{t+1}) \quad \text{since dividends are reinvested}$$

$$\Rightarrow \underbrace{E_t(z_{t+1})}_{(2)} = E_t(\rho^{t+1} h_{t+1} P_{t+1}) \stackrel{(3)}{=} E_t[\rho^{t+1} (P_{t+1} + D_{t+1}) h_t] \stackrel{(1)}{=} \rho^t h_t P_t = \underbrace{z_t}$$

This is a martingale!

New definition of EMH

“In an efficient market at any point in time the actual price of a security will be a good estimate of its intrinsic value”
(Fama, 1965, p.56).



“A market in which prices always « fully reflect » available information is called « efficient »”
(Fama, 1970 ; p.383).



“A market is efficient with respect to information set if it is impossible to make economic profits by trading on the basis of information set”
(Jensen, 1978 ; p. 96).

EMH \Leftrightarrow no free lunch

7.1 Three Forms of EMH

EMH and Competition

- Stock prices fully and accurately reflect publicly available information
- Once information becomes available, market participants analyze it
- Competition assures prices reflect information

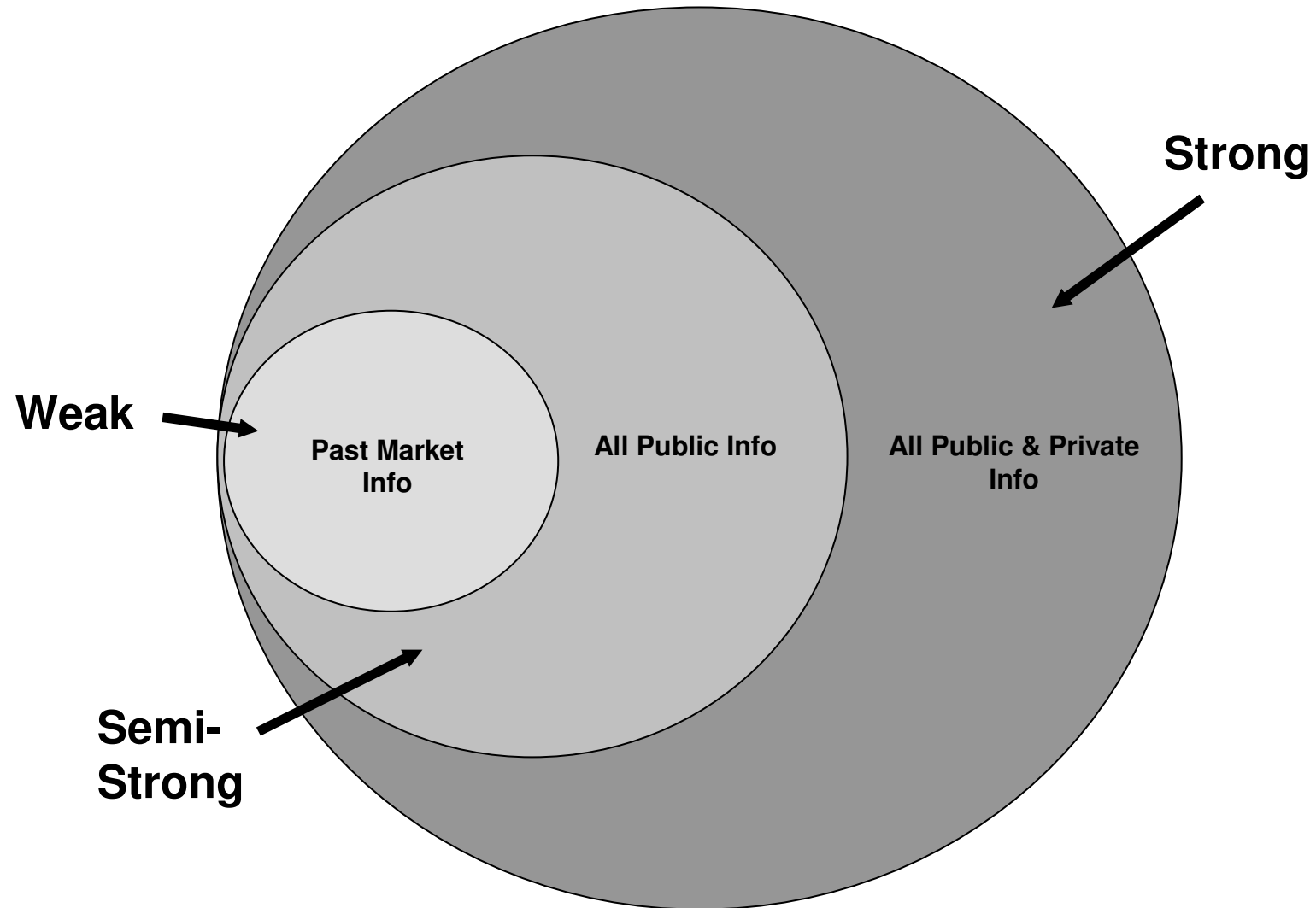
Efficient Market Hypothesis (EMH)

- In 1970 Eugene Fama (Roberts, 1967) defined the efficient market hypothesis and divided it into 3 levels.
 - Weak Form Efficient
 - Semi-Strong Form Efficient
 - Strong Form Efficient
- Each differs with respect to the information that is reflected in the stock prices.

3 forms

- Weak Form:
 - Stock Prices reflect all past market price and volume information.
- Semi-strong Form:
 - Stock Prices reflect all publicly available information about a firm.
- Strong Form:
 - Stock Prices reflect all information (public and private) about a firm.

Relation of 3 Forms of EMH



EMH: Weak Form

- Stock Prices reflect all past market price and volume information
 - It is impossible to make abnormal risk adjusted returns by using past prices or volume data to predict future stock prices.

Technical Analysts

- Do not think the stock market is weak form efficient.
- Believe that investors are emotionally driven and predictable. Therefore, you can exploit this predictability, as it shows up in past prices and volume.
- Find patterns.



EMH: Semi-Strong Form

- Stock Prices reflect all publicly available information about a firm.
- It is impossible to make abnormal risk-adjusted returns by analyzing any public information to predict future stock prices.

Fundamental Analysts

- Do not think the stock market is semi-strong form efficient.
- They use publicly available information to identify firms that are **worth more** (or worth less) than everyone else's estimate of their values.



EMH: Strong Form

- Stock Prices reflect all information (public)
- It is impossible to make abnormal risk adjusted returns by analyzing publicly available information or trading based on private or “inside” information.

Trading On Inside Information

- Not legal to trade on inside information
- SEC prosecutes offenders
- Rules protect the small investor

Question...

- What is the meaning of the Efficient Markets Hypothesis to the Investment Industry?
 - debate between active and passive portfolio management.



Active or Passive Management

- Active Management
 - Security analysis
 - Timing
- Passive Management
 - Buy and Hold
 - Index Funds

Ironic Situation

- If the stock market is efficient, you may be better off buying index funds.
- However, if everyone buys index funds, market would not be as efficient, because no one is willing to search for information.

ASSUMPTIONS:

Two types of investors:

- **Uninformed:** Liquidity or noise traders
- **Informed:** Spend serious amounts of money to dig up information

Grossman/Stiglitz Theorem

- Informed: Do research until marginal benefit = marginal cost.
- Uninformed: Do NO research.
- Some of the informed have marginal benefits $>$ marginal costs, some have marginal benefits $<$ marginal costs. On average, marginal benefit = marginal cost.

Grossman/Stiglitz Theorem

- So, the informed make the market efficient for the uninformed!
Justification for professionals!!
- If active managers fail to use information properly or have excessive transaction costs, they will do worse than a passive portfolio.
- In equilibrium, investors should earn the same return investing in a passive index fund as in an actively managed fund after research & transaction costs.

7.4 Evidence of anomalies and mispricing



Difficult to Determine If Market is Efficient

If we can find people who beat the market based on skill, this would imply abnormal returns are possible and the market is not efficient.

Problem #1:

Difficult to distinguish luck from skill!



Newsletter Example

Send out 8 newsletters for three years. Predict whether the stock market will rise or fall. How many will have a perfect record?

There are 2 outcomes each year, or a total of eight possible outcomes for 3 years. So if each newsletter has different prediction, one will turn out to predict the movement exactly!!!!

Newsletter Example

8 newsletters sent out for three years. Predict whether the stock market will rise or fall. (R=Rise; F=Fall)

Yr	1	2	3	4	5	6	7	8
1	R	R	R	R	F	F	F	F
2	R	R	F	F	R	R	F	F
3	R	F	R	F	R	F	R	F



Applied to Professional Investors

- Record whether or not an investor beats the market each year for 10 years.
- By pure chance there is a 50% probability an investor will beat the market in any given year (ignoring fees and expenses).
- If there are 10,000 professional money managers, how many will have a perfect record of beating the market every year due to chance?

Solution

Possible Permutations (outcomes) over 10 years

$$= 2^{10} = 1024$$

Probability of being correct each year for 10 years

$$= 1 / 1024 = 0.00097$$

Expected number of “gurus”

$$= 10,000 \times 0.00097 = 9.7$$

Monkeys beat the market?

Burton Malkiel's book: "A Random Walk Down Wall Street":

"a blindfolded monkey throwing darts at a newspaper's financial pages could select a portfolio that would do just as well as one carefully selected by experts."

"Unfortunately for investors, Wall Street professionals pay themselves a lot more than monkeys"

In 1988 the Wall Street Journal began a contest that was inspired by Burton Malkiel

Wall Street Journal staff members typically play the role of the monkeys vs professional analysts



Problem #2: Selection Bias

- If you had a scheme that worked would you announce it?
- There may be hidden investors that do earn abnormal risk-adjusted returns.

Problem #3: Difficult to measure risk-adjusted returns

A. Dual test of the CAPM along with market efficiency! (Joint Hypothesis Problem)

B. Benchmark Error

Abnormal Returns

Define Excess Return: (Asset Return – r_f)

Suppose, last year, an investor's portfolio had an excess return of 15% and the market had an excess return of 10%. Did the investor beat the market?

Non-Risk Adjusted Abnormal Return:

$$\text{Abnormal Return}_{i,t} = (r_{i,t} - r_{f,t}) - (r_{m,t} - r_{f,t})$$

$$\begin{aligned}\text{Abnormal Return}_{i,t} &= 15\% - 10\% \\ &= 5\%\end{aligned}$$

Risk-Adjusted Ab. Return $\equiv \alpha_i$

Recall Example:

Investor earned 15%

Market earned 10%

Assume the beta of the investor's portfolio was 1.80. Determine the abnormal risk-adjusted return using the CAPM:

$$\alpha_i = (r_{i,t} - rf_t) - \beta_i(r_{m,t} - rf_t)$$

$$\alpha_i = 15\% - 1.80 * 10\%$$

$$\alpha_i = -3\%$$

Measurement Concerns!

- Is the CAPM the “right” model to use?
 - (Model or Specification Error)
- Did we use the “right” market proxy as our benchmark?
 - (Measurement Error)

Bottom Line: Market Efficiency Verification is Tough!

If you found investors that beat the market on a risk-adjusted basis it could be because:

- a. The market is inefficient
- b. The CAPM is not correct (model error)
- c. Benchmark problem (measurement error)
- d. LUCK!!!!

How to test for Market Efficiency?

- Try testing each form of the EMH:
 - Weak
see if there are patterns in past prices
 - Semi-strong
see if new public information rapidly synthesized in market prices; can you profit from public information?
 - Strong
see if private information can lead to profits

Weak Form EMH Tests: Method #1

Positive (+) Serial Correlation:

- (+) returns follow (+) returns for a given stock or (-) returns follow (-) returns for a given stock
- Called “momentum”

Negative (-) Serial Correlation:

- (+) returns follow (-) returns for a given stock or (-) returns follow (+) returns for a given stock.
- Called “reversals”

Weak Form EMH Tests: Method #1

- If we find (+) or (-) serial correlation, this is evidence against the weak-form EMH as it implies that past prices can be used to predict future prices.
- Technical analysis looks for such patterns to exploit and earn abnormal returns.

Weak Form EMH Tests: Findings

In the '50s and '60s it was shown that in general:

1. No evidence of serial correlation. The price of a stock is just as likely to rise after a previous day's increase as after a previous day's decline.
2. Therefore, stock prices follow a random walk.

Weak-Form Tests: Patterns in Stock Returns

- Returns over short horizons
 - Very short time horizons small magnitude of positive trends
 - 3-12 month some evidence of positive momentum
- Returns over long horizons – pronounced negative correlation
- Evidence on Reversals

Weak Form EMH Tests: Method #2

- Use historical price information to analyze “abnormal returns” over various time horizons.
- In general, this method involves investing in stocks that have performed in a certain manner in the past to see if these stocks will provide abnormal returns in the future.

CAR: Cumulative Abnormal Return

- Methodology:
 - Addition of a series of abnormal returns.
 - For example, a “3-day CAR” would use a pricing model like the CAPM to calculate alpha each of the three days. Then, the three calculated alphas would be summed to get the “3-day CAR.”

Example: Calculating CAR

Month	Return	S&P500
1	18%	15%
2	21%	12%
3	21%	20%

Use the CAPM as the relevant risk-adjustment model to calculate the 3-month CAR for the above fund. Assume the fund's Beta is 1.2 and the r_f is 2%.

Example: Calculating CAR

Month	Return	S&P500
1	18%	15%
2	21%	12%
3	21%	20%

$$\text{Alpha}_i = \text{Actual } r_{i,t} - (r_{f,t} + B_i * [\text{Actual } r_{m,t} - r_{f,t}])$$

$$\text{Alpha}_{i,1} = .18 - (.02 + 1.2 * [.15 - .02]) = .18 - .176 = \mathbf{.004}$$

$$\text{Alpha}_{i,2} = .21 - (.02 + 1.2 * [.12 - .02]) = .21 - .14 = \mathbf{.07}$$

$$\text{Alpha}_{i,3} = .21 - (.02 + 1.2 * [.20 - .02]) = .21 - .236 = \mathbf{-.026}$$

3 month CAR = ...

Tests of Weak Form EMH Short Horizons

Jegadeesh and Titman (1993)

- Investigate whether buying winners (stocks that have done well in the past) and selling losers (stocks that have done poorly in the past) can generate significant positive returns over future holding periods.
 1. Measure stock rates of return over the past 3 – 12 months.
 2. Rank the stocks from highest to lowest and then divide the sample into deciles. “Losers” are the bottom decile and “winners” are the top decile.
 3. Follow the returns for the next 3 – 12 months.

Evidence: Jegadeesh and Titman

- Winners outperforms losers over the short run. Most significance is found over the next 6 months based upon the past 12 months.
- Abnormal profit opportunities.

Short Run: Momentum



Test of Weak-Form EMH Long-Term Horizons

DeBondt and Thaler (1985):

- Create “Loser” and “Winner” portfolios based on past 36 months of CARs. Top decile are Winners, bottom decile are Losers.
- Examine CAR’s for next 36 months.
- “Losers” outperforming “winners”,
 - Consistent with an overreaction followed by a correction.

Tests of Weak-Form EMH – De Bondt

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The Journal of Finance

Average of 16 Three-Year Test Periods
Between January 1933 and December 1980
Length of Formation Period: Three Years

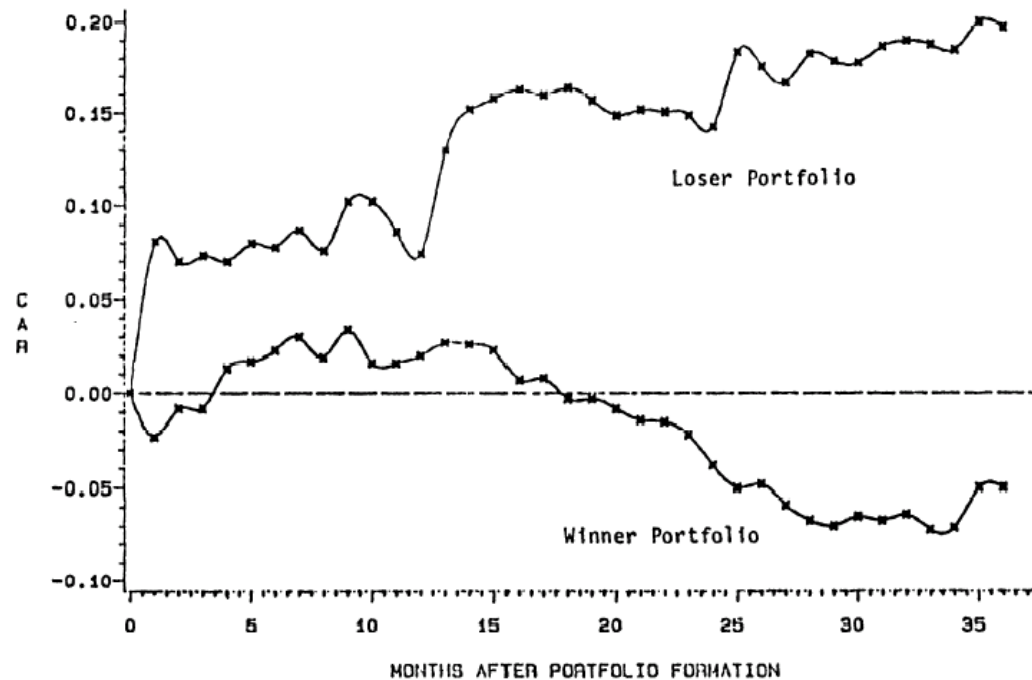


Figure 1. Cumulative Average Residuals for Winner and Loser Portfolios of 35 Stocks (1–36 months into the test period)



Tests of Semi-Strong EMH

- Predictors
- Event study
- Anomalies/rational factors

Semi-Strong form: Predictors of Broad Market Returns

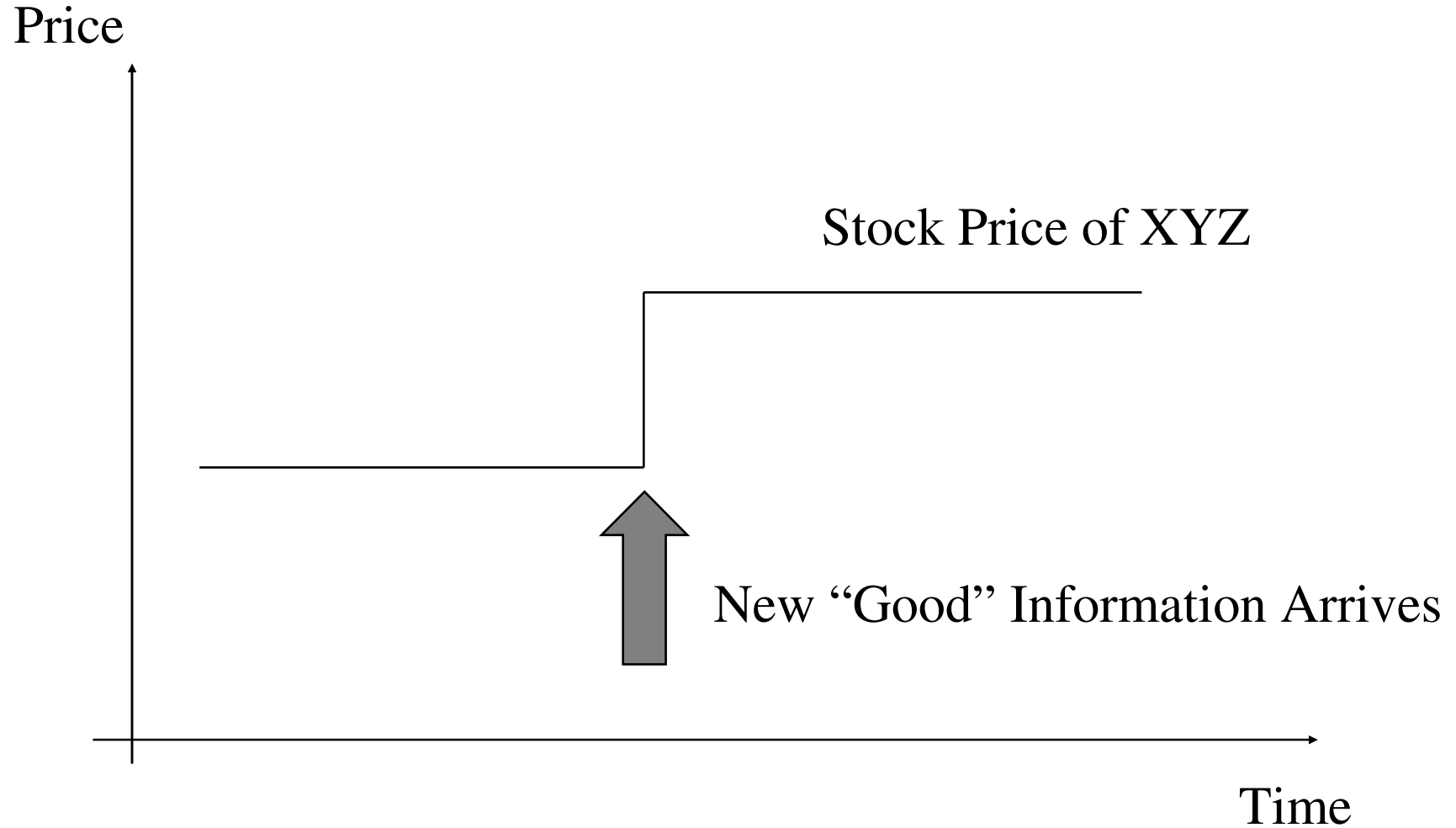
- Fama and French
 - Aggregate returns are higher with higher dividend ratios
 - Campbell and Shiller
 - Earnings yield can predict market returns
 - Keim and Stambaugh
 - Bond spreads can predict market returns
- ⇒ Inefficiency or evidence of time-varying risk premium?



Semi-Strong Form: Event Study Results

- Most (but not all) studies support the Semi-Strong Form of the EMH.
- Those that support it include analyses of stock splits, mergers and most corporate reorganizations.
- One study that doesn't offer support is the event of a security being listed on an exchange (shows positive abnormal returns after the listing announcement).

Example: Event Study



Example of event study

- Post-Earnings Announcement Drift
 - There is a large abnormal return on the earnings announcement day



Bernard and Thomas, 1989

Event: Quarterly Earnings Surprises

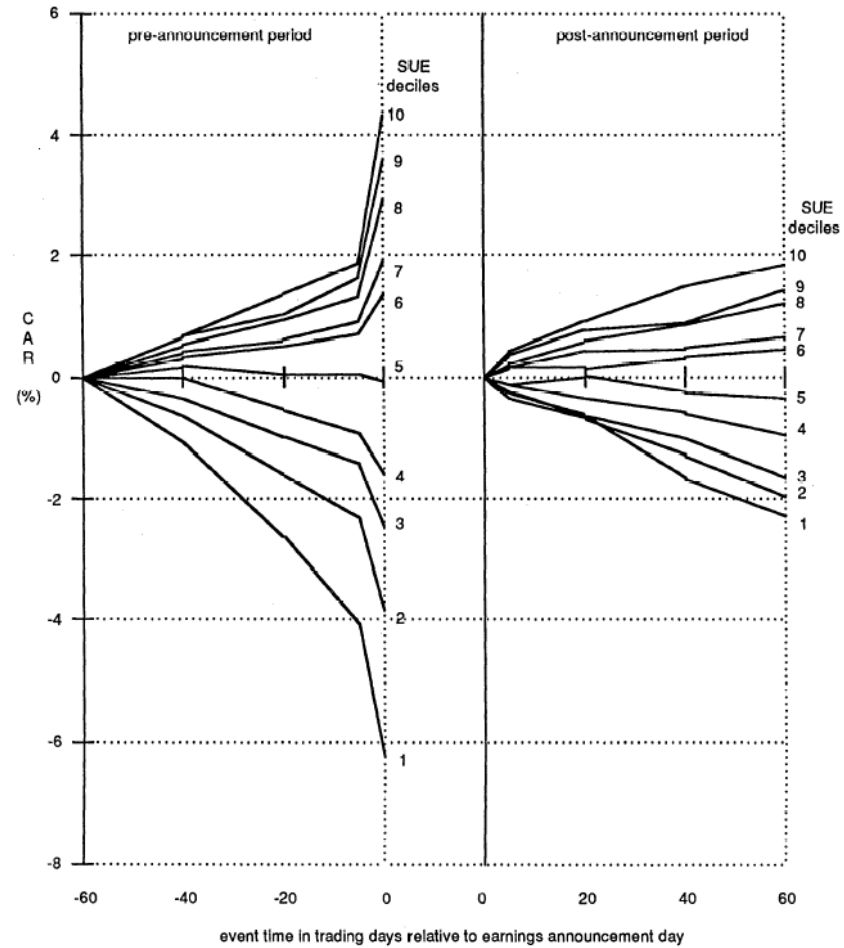
- Measure the abnormal risk-adjusted return after an earnings surprise.
- Earnings Surprise =
Actual Quarterly EPS – Forecasted Earnings
- If the stock market is efficient, any surprise when earnings are announced should be reflected rapidly in the stock price and (+) or (–) alphas should not be possible trading on the information after it is released.

Evidence: Bernard and Thomas

- Rank from highest to lowest by magnitude of earnings surprises and place stocks into decile portfolios.
- See if trading on earnings surprises results in subsequent abnormal returns.
 - Remember: Cumulative Abnormal Returns (CARs) are the daily alphas summed up over time.
 - Find “drift” in returns after announcements – inconsistent with market efficiency

Evidence: Bernard and Thomas

10 VICTOR L. BERNARD AND JACOB K. THOMAS





Evidence: Bernard and Thomas

For positive earnings surprises:

- Larger earnings surprises lead to higher positive abnormal returns.
- The upward drift in the stock price continues a couple of months after the earning announcement!

For negative earnings surprises:

- Larger negative earnings surprises lead to larger losses as measured by the abnormal return.
- The downward drift in the stock price continues a couple of months after the earning announcement!



Evidence of Long-Run Abnormal Risk-Adjusted Returns

- After IPOs and after seasoned equity offerings (-) (Loughran and Ritter 1995)
- After share repurchase announcements (+) (Ikenberry, Lakonishok, Vermaelen, 1995)
- After dividend initiations (+) and omissions (-) (Michaely, Thaler, Womack, 1995)

Further Semi-Strong EMH Tests: “Anomalies”

- Challenges to the EMH
 - In the 1980’s and 1990’s, empirical evidence accumulated that provided evidence against the semi-strong and weak form EMH. Evidence is labeled as “anomalies.”
- Two of the best-known anomalies:
 - The Size Effect
 - $\text{Size} = \text{Price} * \text{Shares Outstanding}$
 - The BV/MV Effect
 - $\text{BV} / \text{MV} = \text{Book Value} / \text{Market Value}$
 - Ratio that compares how the market is pricing the book value of assets.

The Size Anomaly

- First explored by Banz (1981)
- Portfolios of small cap stocks earn positive abnormal risk-adjusted returns (+ alphas).

Can Size be a measure of risk?

Possible sources of risk for small caps

- **Neglected** by analysts and institutional investors, so there is less information, which implies higher risk.
- **Less Liquidity**: Higher trading costs. Bid-ask spreads are wider, and broker commissions are larger.

Further findings regarding anomalies

- Fama and French (1992) also find that:
 - Portfolios of smaller firms have higher CAPM adjusted returns than portfolios of larger stocks
 - Portfolios of stocks with high BV/MV ratios (value stocks) have higher CAPM adjusted returns than portfolios of low BV/MV ratios (growth stocks).



Can BV/MV be a measure of risk? “Value Puzzle...”

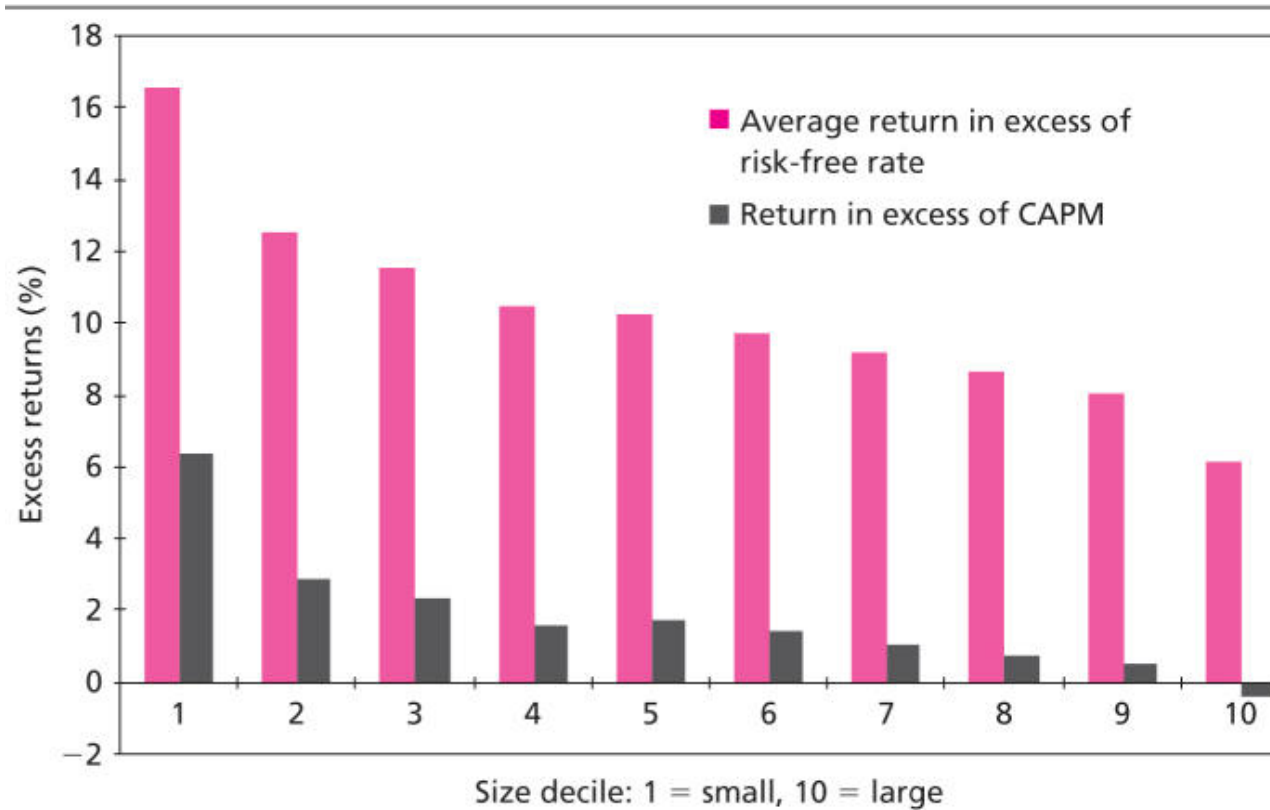
It is not evident why value stocks should be riskier than growth stocks. Value stocks have lower standard deviations than growth stocks after controlling for size!

Explanation for Size and BV/MV Results

It could be that the Market is Semi-Strong Efficient, but...

- There are measurement errors
 - Benchmark Error (wrong Market proxy)
 - CAPM is a forward looking model while we are testing it with historic (or ex-post) data.
- CAPM may not be the proper risk adjustment model.
 - ***[Joint Hypothesis Problem!]***
 - If the CAPM is wrong, then abnormal risk-adjusted returns using this model are wrong.

Returns in Excess of Risk-Free Rate and in Excess of the SML (1926-2005)



Source: BKM (2007)

Average Annual Return as a Function of Book-to-Market (1963-2005)

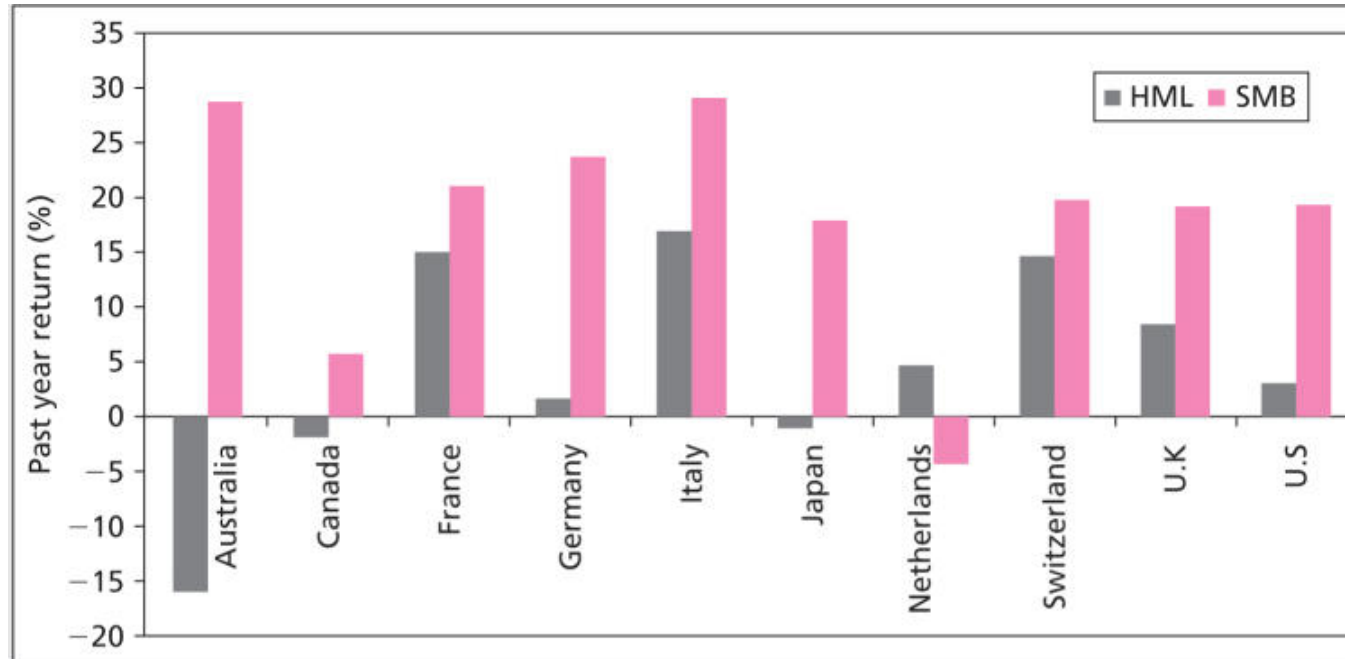


Source: BKM (2007)

Interpreting the Evidence

- Risk Premiums or market inefficiencies—disagreement here
 - Fama and French argue that these effects can be explained as manifestations of risk stocks with higher betas
 - Lakonishok, Shleifer, and Vishney argue that these effects are evidence of inefficient markets

Return to Style Portfolio as a Predictor of GDP Growth



Return to style portfolio as a predictor of GDP growth. Average difference in the return on the style portfolio in years before good GDP growth versus in years before bad GDP growth. Positive value means the style portfolio does better in years prior to good macroeconomic performance. HML = high minus low portfolio, sorted on ratio of book-to-market value. SMB = small minus big portfolio, sorted on firm size.

Source: Reprinted from J. Liew and M. Vassalou, "Can Book-to-Market, Size, and Momentum Be Risk Factors That Predict Economic Growth?" *Journal of Financial Economics* 57 (2000), pp. 221–45. Copyright 2000 with permission from Elsevier Science.

Source: BKM (2007)

Interpreting the Evidence (Con't)

- Anomalies or Data Mining
 - Rerun the computer database of past returns over and over and examine stock returns along enough dimensions:
 - Simple chance may cause some criteria to appear to predict returns

Strong Form of EMH Test

- Are abnormal risk-adjusted returns possible if you trade using private information?



Strong-Form Tests: Inside Information

- The ability of insiders to trade profitably in their own stock has been documented in studies by Jaffe, Seyhun, Givoly, and Palmon
- SEC requires all insiders to register their trading activity

Evidence on Insiders

- Corporate insiders are required to report their transactions to the SEC.
- They are not supposed to trade when in the possession of “material” information.
- Even with regulation, they achieve positive risk-adjusted abnormal returns.

7.5 Limits of arbitrage

Behavioral Finance

- Investors do not always process information correctly
- Investors often make inconsistent or systematically suboptimal decisions
- Study of investor market behavior that derives from psychological principles of decision making

Information? (contd..)

- *What's in a name?* Cooper, Dimitrov, and Rau (2001), “A Rose.com by Any Other Name”
- Investors revalued companies upward by about 53% in a 11-day window around the announcement of the name change when they simply changed their name to include “dot-com” in 1998-1999
 - Even for firms whose business is unrelated to internet, 23% abnormal return!

Psychological biases

- Optimism and overconfidence
- Ambiguity aversion
- Anchoring
- Representativeness
 - Sample size neglect
- Mental accounting
- Loss aversion
- Sunk cost fallacy
- Others

Optimism

- *How good a driver are you? Compared to the drivers you encounter on the road, are you above-average, average, or below-average?*

Overconfidence

- (Barber and Odean 2000) Individuals who trade the most frequently post exceptionally poor investment results
 - 20% of households that traded the most earned an average annual return of 10% versus the overall average return of 17.6%
- Trading is hazardous to your wealth!

Overconfidence (contd..)

- (Barber and Odean 2001) Performance of stocks picked by men and women was about the same
- Men traded 45% more than women
 - And chose stocks in smaller companies, higher price-to-book, and higher betas
 - Earned 1.4% less on risk adjusted basis
- Single men traded 67% more and earned 3.5% less on a risk-adjusted basis

Ambiguity aversion

Familiarity breeds contempt

- US stocks account for only 45% of global market value of equity. US investors hold less than 7% of their portfolios in foreign securities (French and Poterba 1993)
- Mutual fund managers tend to hold more stocks of companies in states closer to them (home bias at home, Coval and Sumway 1999)

Isn't familiarity good?

- Invest in what you know
- Employees typically allocate more than a third of their retirement account to the stock of company that they work for
 - Should perhaps be shorting the stock given that a significant fraction of their human capital is tied to the company

Representativeness

- *Linda is 31, single, outspoken, and very bright. She majored in philosophy. As a student she was deeply concerned with issues surrounding equality and discrimination.*
- *Is it more likely that Linda is: A bank clerk?*
- *Or A bank clerk and active in feminist movement.*

Representativeness (contd..)

- May explain reversal evidence of DeBondt and Thaler (1985):

Stocks that have been extreme losers in the preceding three years do much better than extreme past winners over the subsequent three years

- Investors become unduly pessimistic about the prospects of the past losers, driving down their prices. Prices revert back giving exceptional returns.

Sample size neglect

- *Hot hands: Imagine that you're the coach of a basketball team. There's 10 sec left and your team is down by a basket. Your star player (5-year career average of 55% shots made) is only 2 for 10 today. Another veteran player (5-year career average of 45% shots made) is 10 for 10 today. Whom do you give the ball to?*

Sample size neglect (contd..)

Mutual fund managers

- New evidence suggests that managers do tend to have hot hands (Carhart 1997)
 - May be driven by momentum
- Mutual fund manager's track record is critical
 - During Lynch's tenure, Magellan became the largest mutual fund in the world, growing from \$20million to \$14billion
 - Investors tend to misread this record or other evidence of hot hands
 - Attribute too much to skill rather to luck

- Gambler's Fallacy
 - This refers to an overemphasis on mean-reverting behavior
 - If I flip a coin and get heads 3 times in a row, what is the probability that the next flip will result in heads?
 - “Financial Gravity and the comeback”
 - May be a partial explanation to why investors are more willing to sell stocks that have increased in value rather than stocks that have declined in value
- Overconfidence
 - Most people tend to be overconfident.
 - A recent survey had over 70% of people classify themselves as “better than average” drivers.
 - Overconfidence is most likely after a series of “successes” and can lead to excessive risk taking.
 - May explain excessive trading
 - Combined with restrictions on short-selling can lead to overvaluation

- Anchoring
 - Anchoring refers to the tendency to place too much emphasis on information (even irrelevant information) that we are exposed to
 - Many people can be slow to adjust to new information.
 - One study asked subjects to (a) estimate whether the % of UN countries that are in Africa is greater or less than a randomly selected number and then (b) what the correct % is. The answer to b is highly correlated to the random number.

- Risk/Return inversion
 - Many investors expect to earn higher returns on stocks that are less risky. For example, which stock do you feel will have a higher return over the next 5 years -- Ford, Crocs or Exxon? Now, which stock do you feel is riskier?
- Mental Accounts
 - Many investors place profits into a separate category than their initial principal. This “house money” can be lost with much less mental pain than the original capital.
 - Dividends, as income, are easier to spend than original capital.

- Problems with Numbers

- Stock A is currently trading for \$4.95. Stock B is currently trading for \$96.90. Which one has the potential for a greater % profit over the next year?
- Stock C has a market cap of \$8.75 Billion. Stock D has a market cap of \$888 Million. Which one has the potential for a greater % profit over the next year?
- Many investors think greater percentage increases are possible with low priced stocks and greater percentage decreases are possible with high priced stocks.
- Possible reason why stock splits are attractive.

Limits to Arbitrage

- Fundamental risk
- Implementation costs
- Noise traders risk
- Synchronization risk

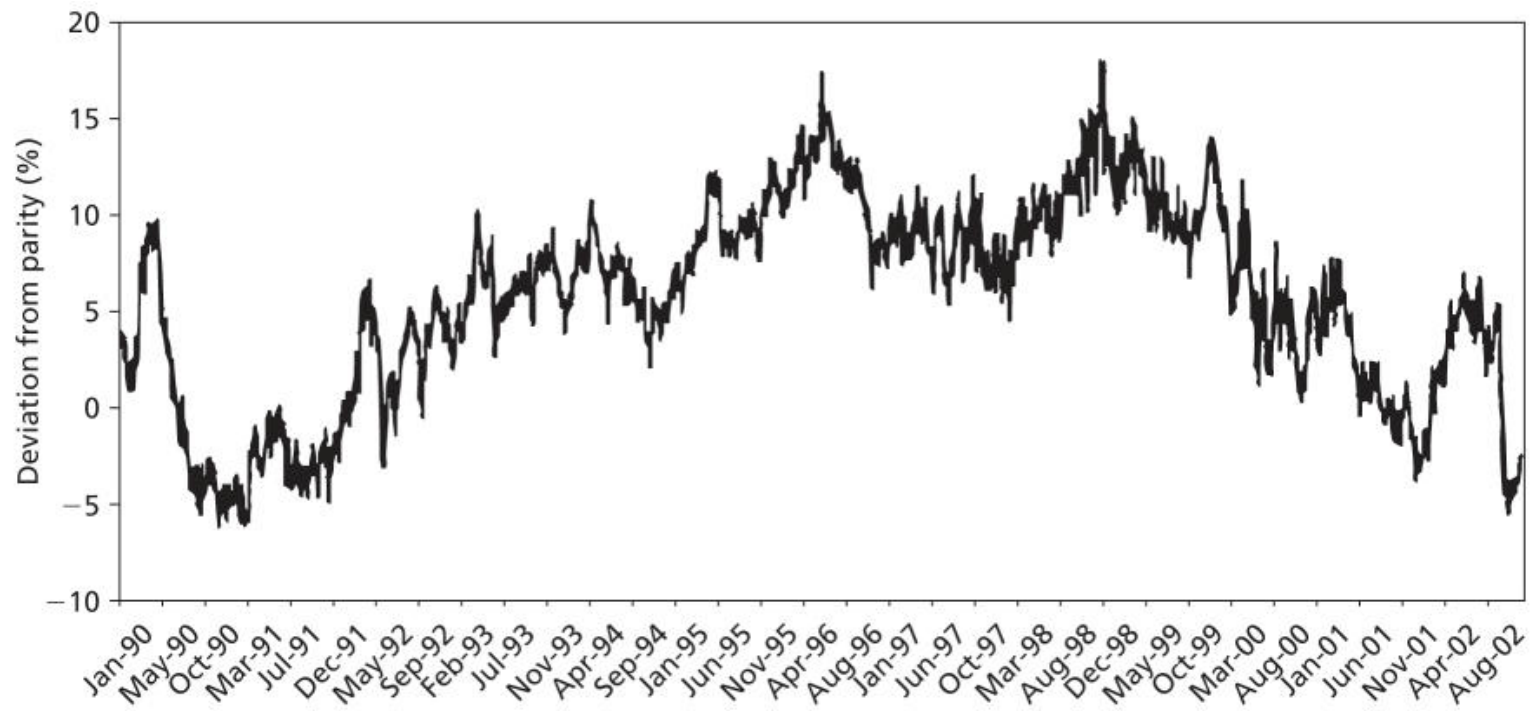
Limits to arbitrage

- Say that the fundamental value of a Ford is \$20. Imagine that a group of irrational traders becomes excessively pessimistic about Ford's future prospects and through its selling, pushes the price to \$15. What would rational traders do?
- Buy Ford at its bargain price and, perhaps, at the same time, hedge their bet by shorting a “substitute” security, such as GM
- What are the risks of this strategy?

Limits to arbitrage theory

- **Fundamental risk:** Bad news about Ford's fundamental value causes the stock to fall further, leading to losses
 - Substitute securities are rarely perfect
- **Noise trader risk:** Even if General Motors is a perfect substitute security for Ford, the arbitrageur still faces the risk that the pessimistic investors causing Ford to be undervalued in the first place become even more pessimistic, lowering its price even further
- **Implementation costs:** Commissions, bid–ask spreads, price impact, short-sale constraints

Pricing of Royal Dutch Relative to Shell (Deviation from Parity)



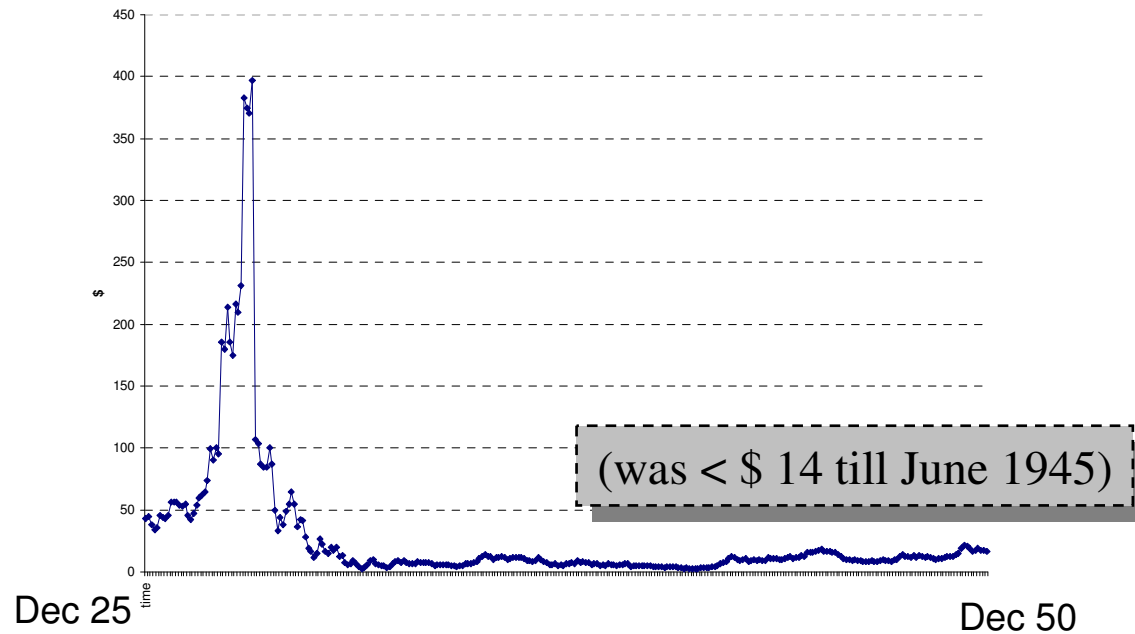
Story of a typical technology stock

- Company X introduced a revolutionary wireless communication technology.
- It not only provided support for such a technology but also provided the informational content itself.
- It's IPO price was \$1.50 per share. Six years later it was traded at \$ 85.50 and in the seventh year it hit \$ 114.00.
- The P/E ratio got as high as 73.
- The company never paid dividends.

About RCA: READ Bernheim et al. (1935) "The Security Market" Findings and Recommendations of a special staff of the 20th century fund - p. 475 and following

Story of RCA - 1920's

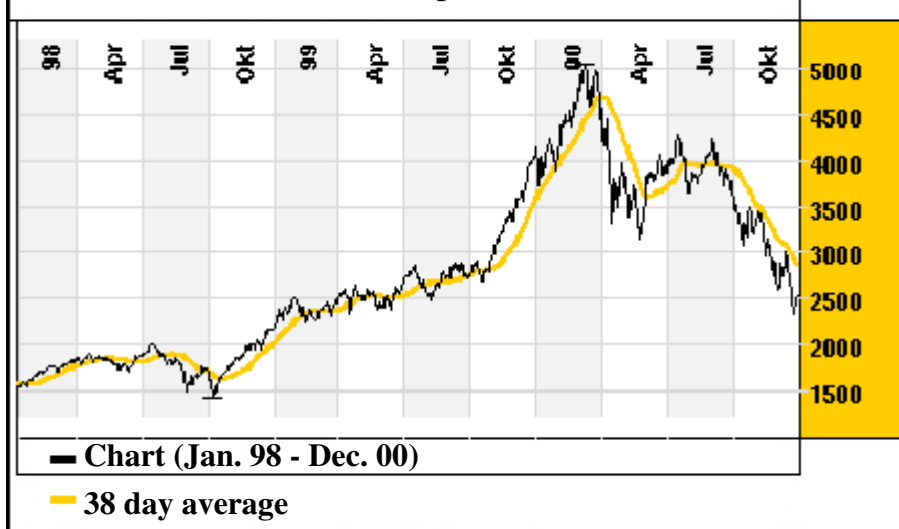
- Company: *Radio Corporation of America (RCA)*
- Technology: *Radio*
- Year: *1920's*



– It peaked at \$ 397 in Feb. 1929, down to \$ 2.62 in May 1932

Internet bubble? - 1990's

NASDAQ Combined Composite Index



Loss of ca. **60 %**
from high of \$ 5,132

NEMAX All Share Index (German Neuer Markt)



Loss of ca. **85 %**
from high of Euro 8,583

- **Why do bubbles persist?**
- **Do professional traders ride the bubble or attack the bubble (go short)?**
- **What happened in March 2000?**

Do (rational) professional ride the bubble?

- South Sea Bubble (1710 - 1720)
 - *Isaac Newton*
 - 04/20/1720 sold shares at £7,000 profiting £3,500
 - re-entered the market later - ended up losing £20,000
 - “I can calculate the motions of the heavenly bodies, but not the madness of people”
- Internet Bubble (1992 - 2000)
 - *Druckenmiller* of Soros’ Quantum Fund didn’t think that the party would end so quickly.
 - “We thought it was the eighth inning, and it was the ninth.”
 - *Julian Robertson* of Tiger Fund refused to invest in internet stocks

Pros' dilemma

- “The moral of this story is that irrational market can kill you ...
- Julian said ‘This is irrational and I won’t play’ and they carried him out feet first.
- Druckenmiller said ‘This is irrational and I will play’ and they carried him out feet first.”

Quote of a financial analyst, *New York Times*

April, 29 2000

Classical Question

- Suppose behavioral trading leads to mispricing.
- **Can mispricings or bubbles persist in the presence of rational arbitrageurs?**
- What type of information can lead to the bursting of bubbles?

Timing Game - Synchronization

- (When) will behavioral traders be overwhelmed by rational arbitrageurs?
- *Collective* selling pressure of arbitrageurs *more than suffices* to burst the bubble.
- Rational arbitrageurs understand that an *eventual* collapse is inevitable. But when?
- Delicate, difficult, dangerous *TIMING GAME* !

Bubbles and Rational Speculative Activity

- **Efficient markets view**

“If there are many sophisticated traders in the market, they may cause these “bubbles” to burst before they really get under way”

(Fama 1965)

- **Limits to “arbitrage”?**

“Had I followed my own advice, I would have lost my shirt ... everybody knew that it could not go on like this. The start and end of a bubble just cannot be explained rationally.”

(Milton Friedman, 2001)

“So, you think that investors are irrational—but then you expect them to become rational just when you have gone short?”

(A hedge fund manager’s wife, 1999)

- **How did sophisticated investors react to the bubble?**

Why Did Rational Speculation Fail to Prevent the Bubble ?

(1) Unawareness of the bubble?

- **Implication:** Rational speculators would perform as badly as other investors when prices collapse

(2) Limits to arbitrage?

- Reluctance to trade against mispricing: limits of arbitrage
- **Implication:** Rational speculators may be reluctant to go short in overpriced Tech stocks

Why Did Rational Speculation Fail to Prevent the Bubble ?

(3) Predictable investor sentiment

- Incentives for rational arbitrageurs to ride a bubble
 - Predictable bubble growth (Abreu-Brunnermeier 2003)
 - Anticipation of positive-feedback trader demand (DSSW 1990b)

- **Implication:** Rational speculators may want to hold Tech stocks and try to go short before prices collapse

Main Lesson

« prices are right » \Rightarrow « no free lunch »

« no free lunch » $\not\Rightarrow$ « prices are right »

Thank you for your attention...

See you next week