



Lecture 10: Market Efficiency

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Overview

- Efficiency concepts
- EMH implies Martingale Property
- *Evidence I*: Return Predictability
- Mispricing versus Risk-factor
- Informational (market) efficiency concepts
- Asymmetric Information and Price Signal
- *Evidence II*: Event Study Methodology
- Grossman-Stiglitz Paradox
- *Evidence III*: Fund Managers' Out/underperformance



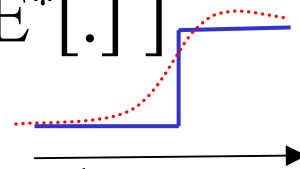
Allocative vs. Informational Efficiency

- Allocative Efficiency
 - An allocation is Pareto efficient if there does not exist a possible redistribution which would make at least one person better off without harming another person.
 - In finance: \Rightarrow optimal risk sharing
- Informational (Market) Efficiency
 - Price reflects all (xxxxx) information
 - Efficient Market Hypothesis = “Price is right”-Hypothesis



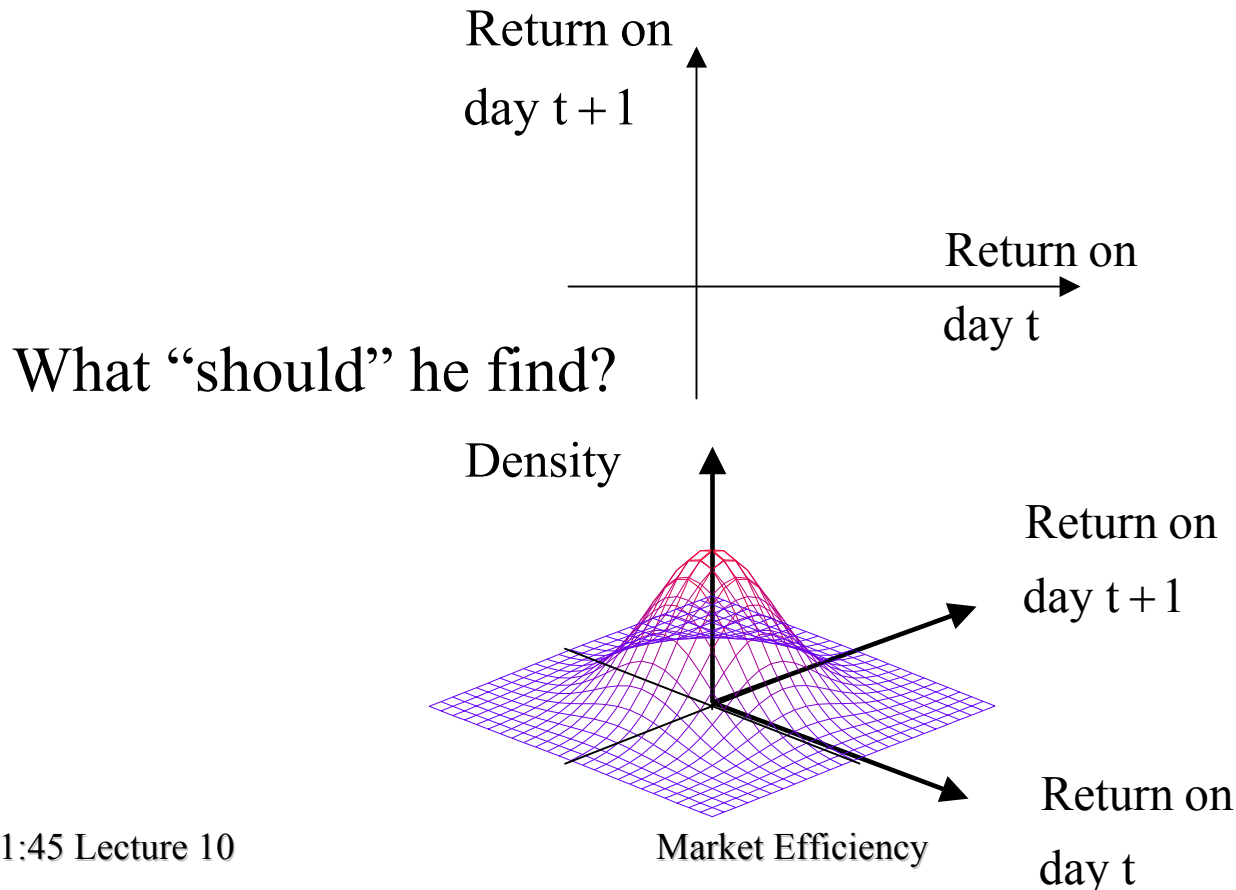
EMH \Rightarrow Martingale Property

- A stock price is always at the “fair” level (fundamental value)
- \Rightarrow *discounted* stock price/gain process is a Martingale process [using the equivalent martingale measure $E^*[\cdot]$]
 - A stock price reacts to news without delay.
 - If the price must go up tomorrow – what would happen today?
 - The *risk-adjusted* likelihood of up- and down-movements of the discounted process are equal.
- Any predictable component is due to changes in the risk premium.
- Weak-form, semistrong-form and strong-form of EMH differ in underlying filtrations (dynamics of martingale measure)



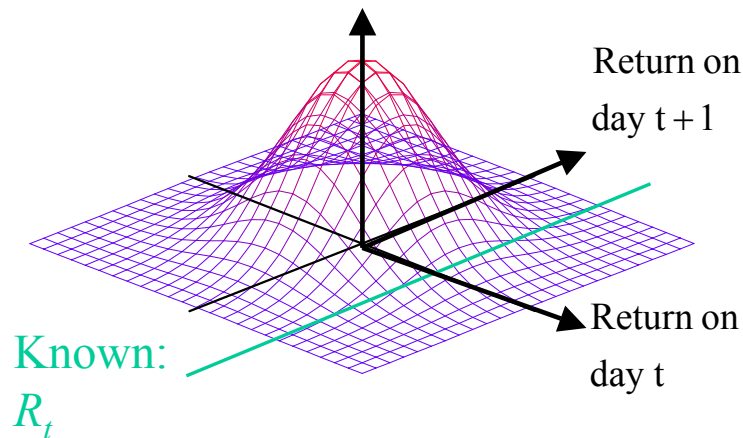
Return Predictability...

A chartist tries to predict the return of a stock from past returns; using the following diagram

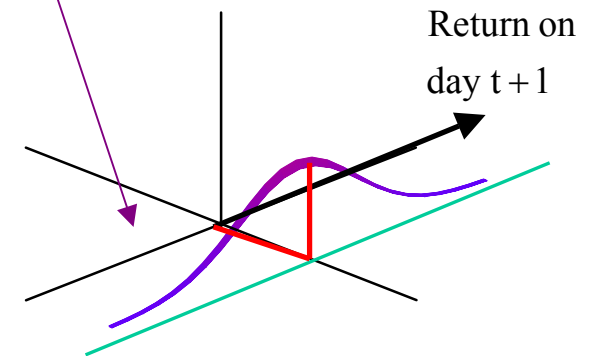


Non-Predictability of Returns

- No correlation case: Knowing return on day t gives you no information about the return on day $t+1$



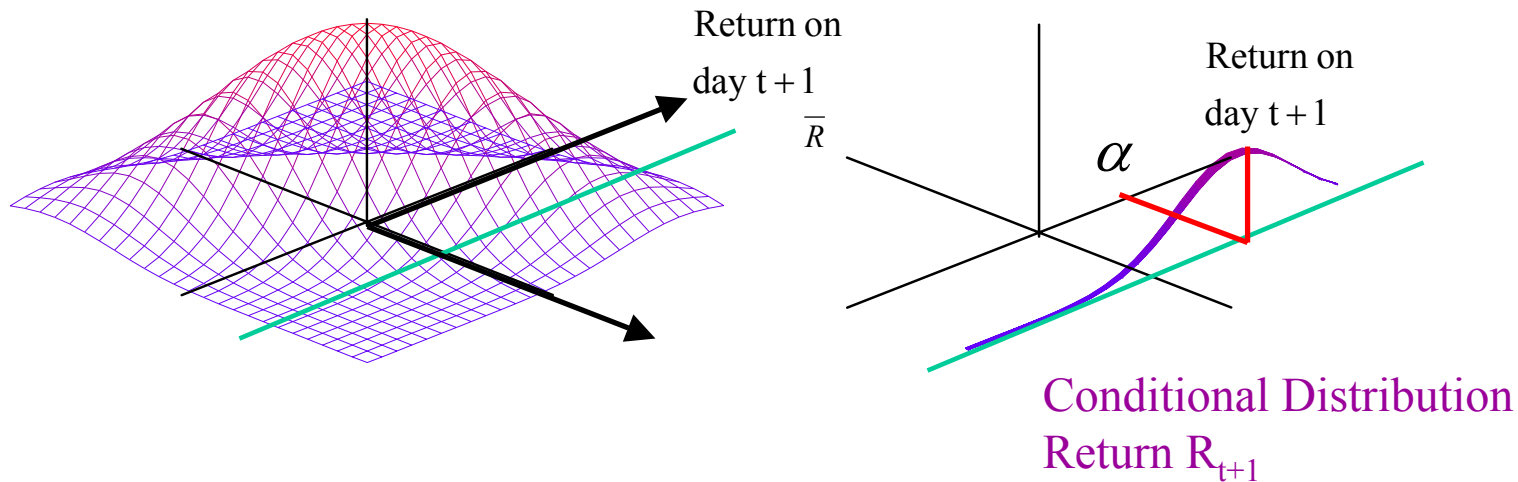
Conditional Distribution
Return R_{t+1}



- The expected (excess) return conditional on the date t return R_t is zero:
$$E^*(R_{t+1} | R_t) = 0$$

Predictability of Returns

- Correlation case: Density with correlation between period t return and period $t+1$ return



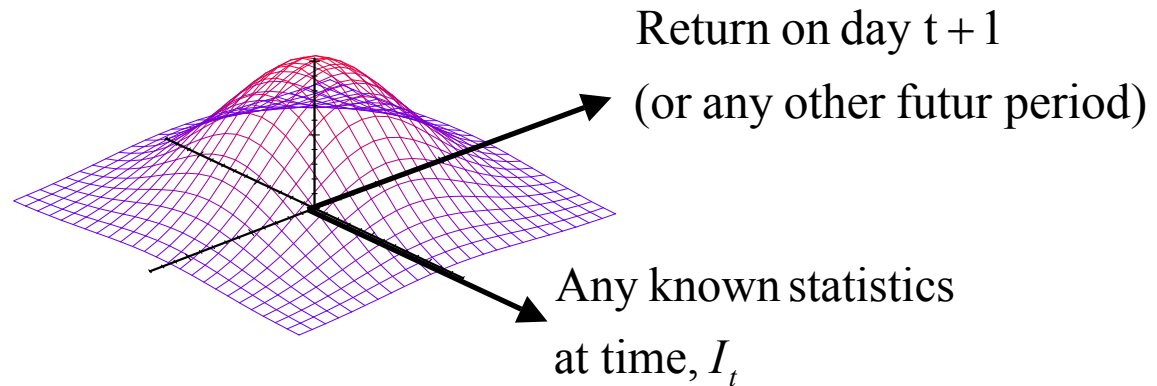
- The expected (excess) return conditional on the date t return R_t is α :

$$E^*(R_{t+1} | R_t) = \alpha$$



Non-Predictability of any current Information

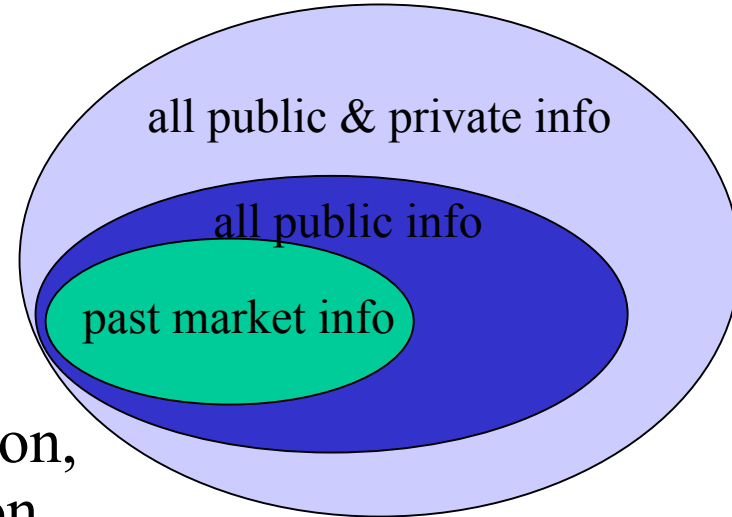
$$E(R_{t+1} | I_t) = 0$$



- Non-predictability of excess returns – beyond a risk-premium – is the equilibrium condition of a financial market
- All available information is already reflected in the price
- Prices change only under new information arrival
- Let's be more precise about information I_t .

Versions of EMH/Info-Efficiency

- **Weak-form efficiency:**
 - Prices reflect all information contained in **past prices**
- **Semi-strong-form efficiency:**
 - Prices reflect **all publicly** available information
- **Strong-form efficiency:**
 - Prices reflect **all** relevant information, **include private** (insider) information

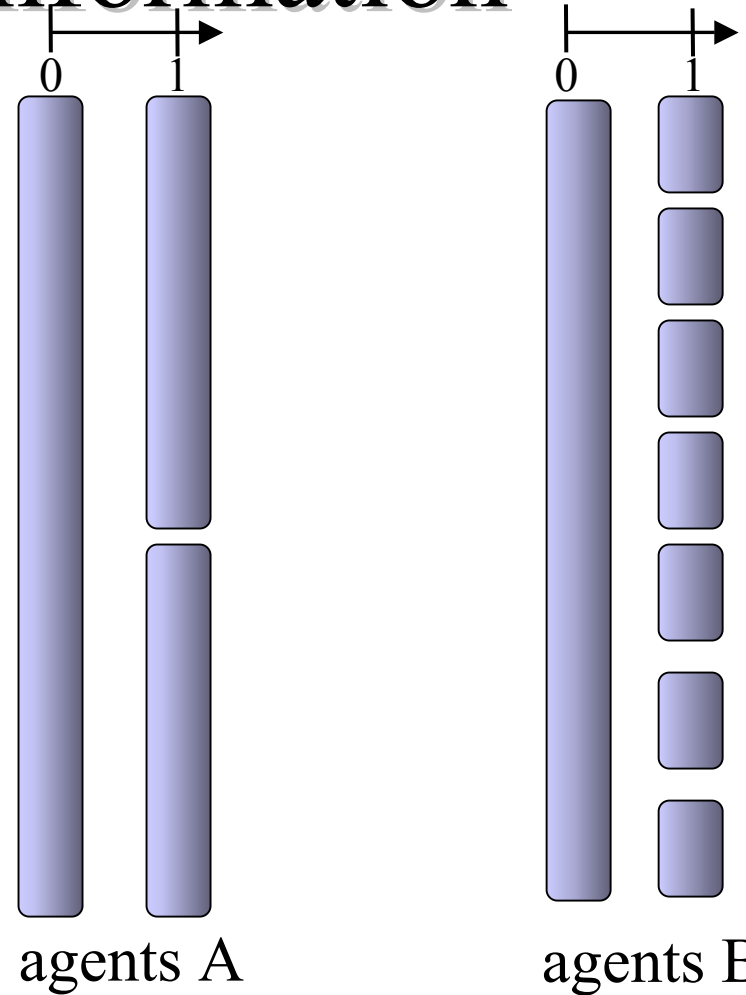


According to each of these theories, which kind of information **cannot** be used to trade profitably?



Asymmetric Information

- So far we focused on models where all market participants had the same information at each point in time.
(same filtration + distribution)
- To analyze strong-form market efficiency different agents must have different information at some points in time.



Whose filtration is more informative?



Asym. Info – Higher Order Uncertainty

mutual knowledge

- All traders know that (e.g. price is too high) 1st order
 - All traders know that all traders know that... 2nd order
 - All traders know that ... that ... nth order
 - ... ∞ th order
 - ... ∞ =Common knowledge
-
- What's a bubble?
 - Even though all traders know that price is too high, the price is too high.
(since e.g. they don't know that others know it as well.)



Price as a Signal

- If information is dispersed among many agents
- Price reveals info about many individuals' signals

- Information aggregation

$$(S^1, \dots, S^i, \dots, S^I) \mapsto \bar{S} \quad (\text{sufficient statistic})$$

- Information revelation

Price is a signal of \bar{S}

The better the price signal the more info-efficient is the market

Price affects agents filtration and distributions!



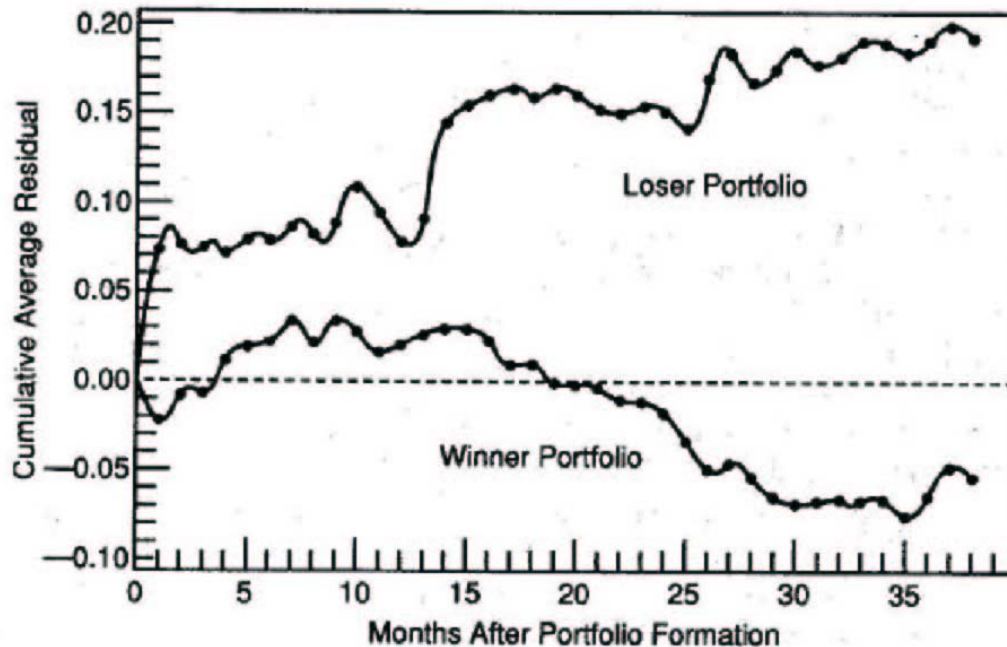
Evidence I: Predictabilities Studies...

- Statistical variables have only low forecasting power, but
 - But some forecasting power for P/E or B/M
 - Long-run reversals and short-run momentum
- Calendar specific abnormal returns due to Monday effect, January effect etc.
- CAVEAT: Data mining: Find variables with spurious forecasting power if we search enough



Long-Run Reversals

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

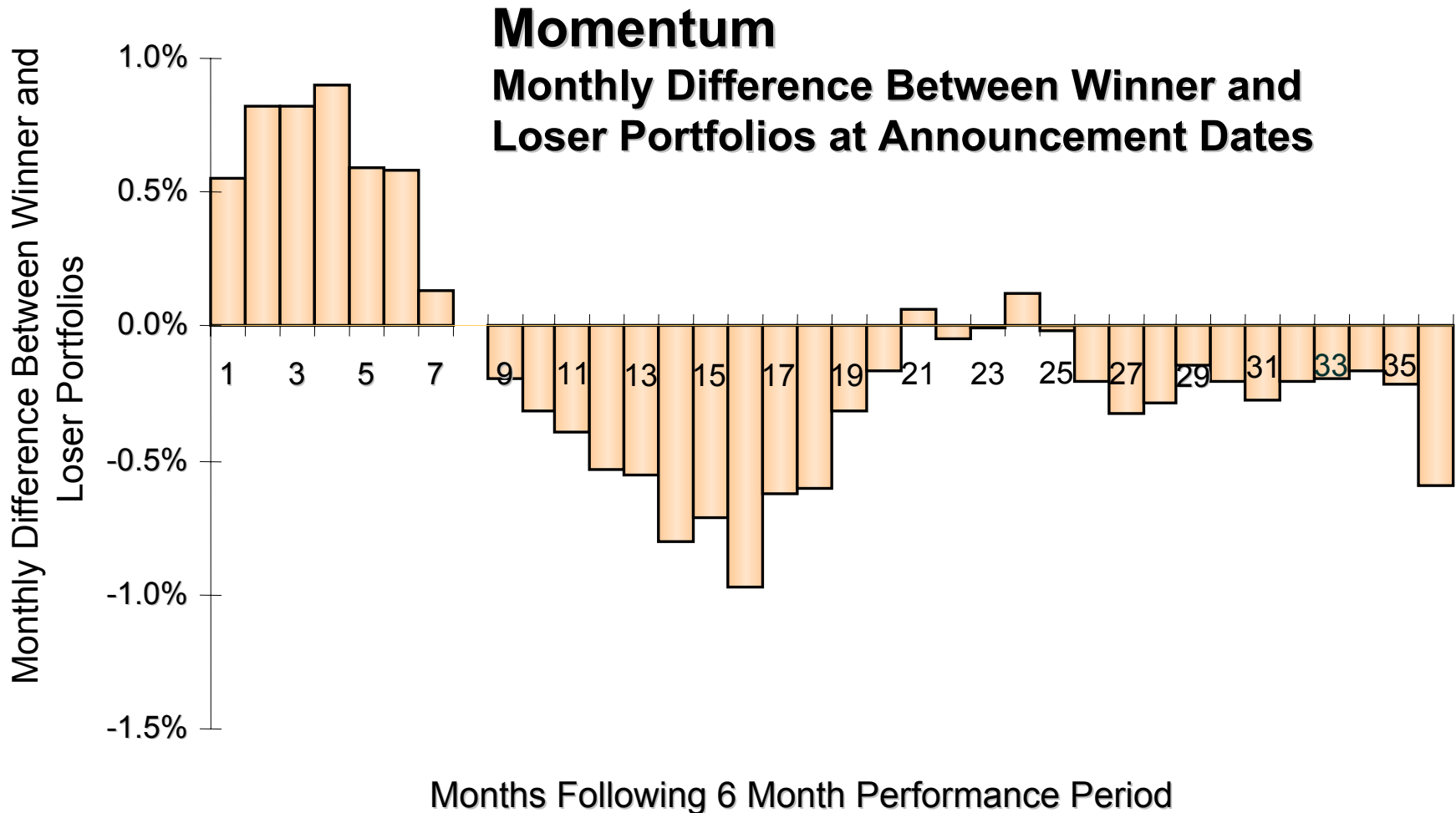


Long-run Reversals

Returns to previous 5 year's winner-loser stocks (market adjusted returns)



...Short-run Momentum





Clash of two Religions

- Size, Book/Market, Momentum effects ... are
 - evidence against market efficiency *versus*
 - just risk-factors and markets are efficient.
- Joint-hypothesis issue (of testing)
 - Is the market inefficient or did your model adjust for risk incorrectly?



Evidence II: Event Studies

Objective: Examine if new (company specific) information is incorporated into the stock price in one single price jump upon public release?

1. Define as day “zero” the day the information is released
2. Calculate the daily returns R_{it} the 30 days around day “zero”:
 $t = -30, -29, \dots, -1, 0, 1, \dots, 29, 30$
3. Calculate the daily returns R_{mt} for the same days on the market (or a comparison group of firms of similar industry and risk)
4. Define abnormal returns as the difference $AR_{it} = R_{it} - R_{mt}$
5. Calculate average abnormal returns over all N events in the sample for all 60 reference days

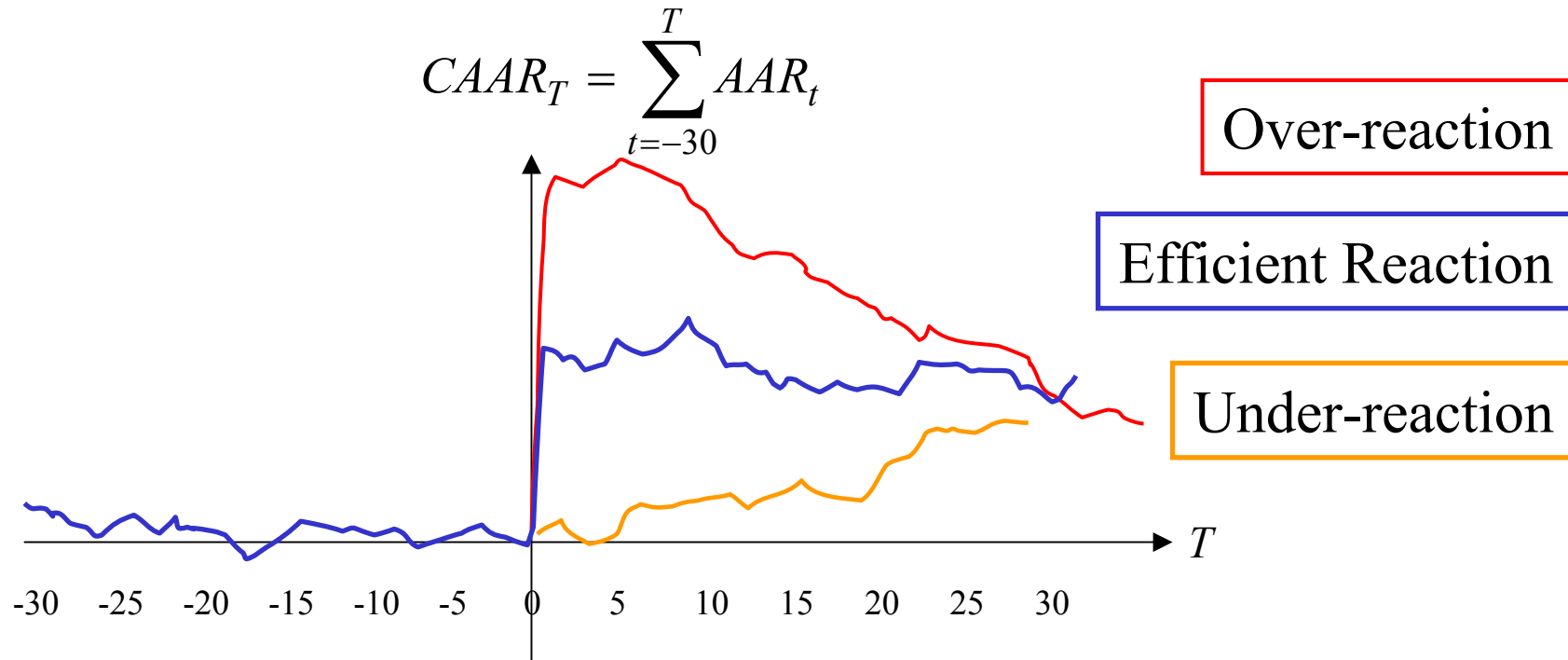
$$AAR_t = \frac{1}{N} \sum_{i=1}^N AR_{it}$$

6. Cumulate the returns on the first T days to $CAAR$

$$CAAR_T = \sum_{t=-30}^T AAR_t$$



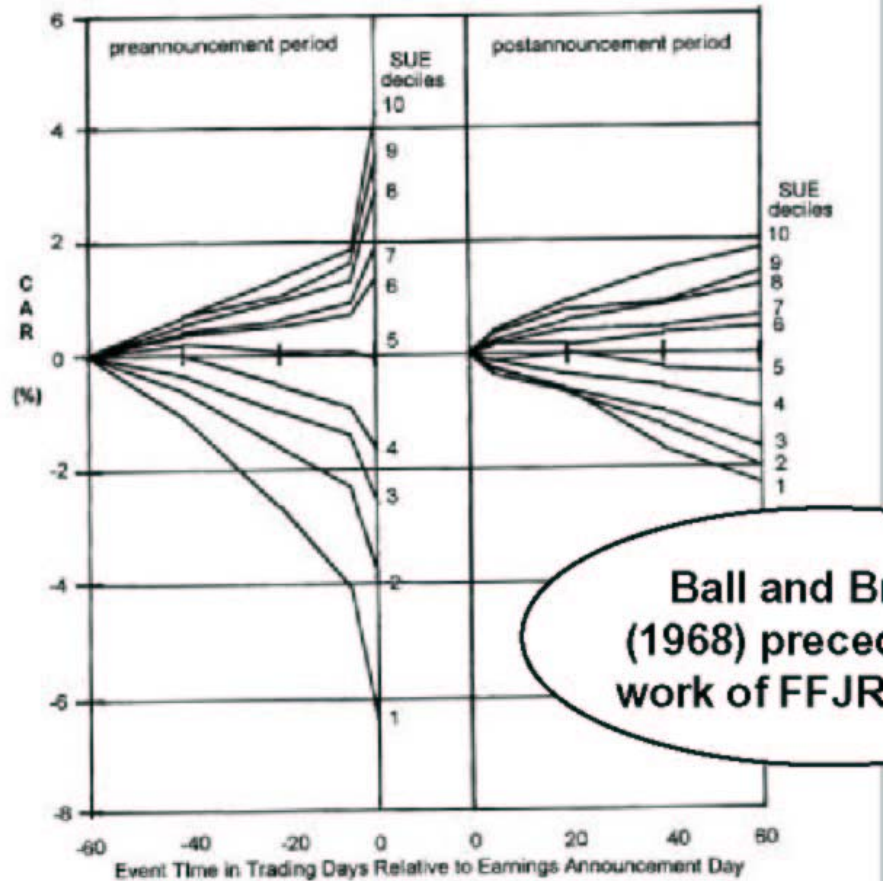
Market Efficiency in Event Studies



Important: Information has to become public at a single moment

Event Study: Earning Announcements

Figure 1 Cumulative Abnormal Returns (CAR) for SUE Portfolios (84,792 earnings announcements, 1974–1996)

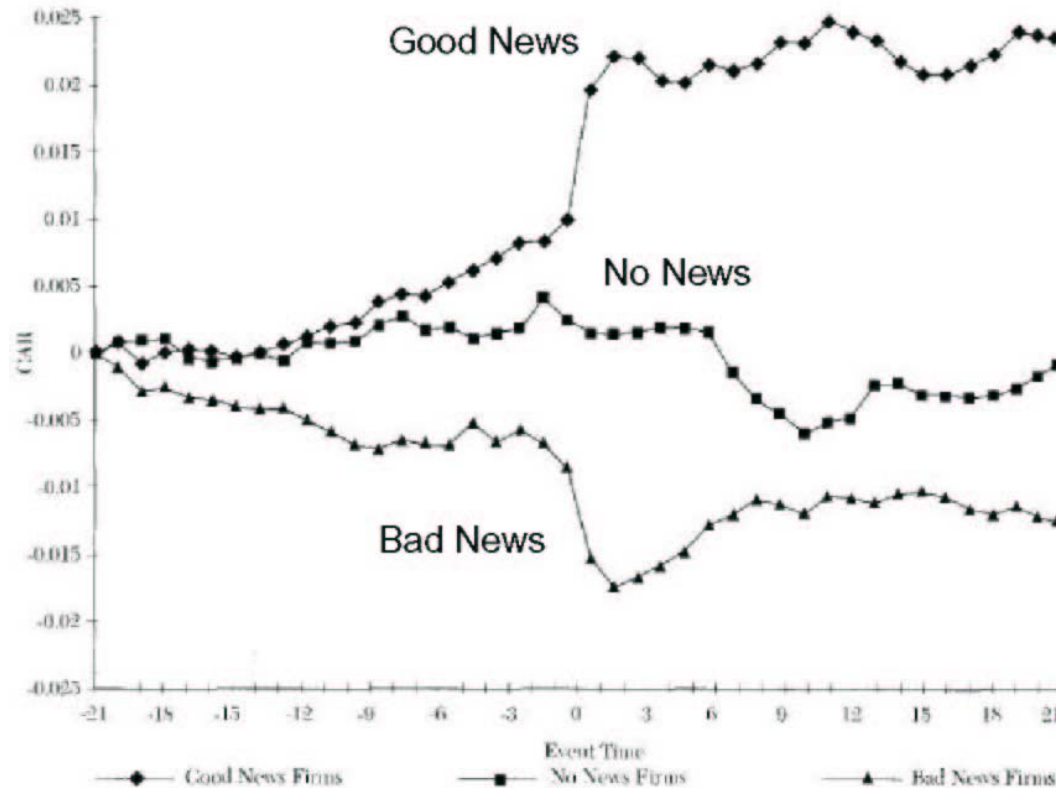


Event Study by
Ball and Brown (1968)
Pre-announcement drift prior to
earnings due to insider trading
→ against strong-form

Post-announcement drift
→ against semi-strong form



Event Study: Earning Announcement

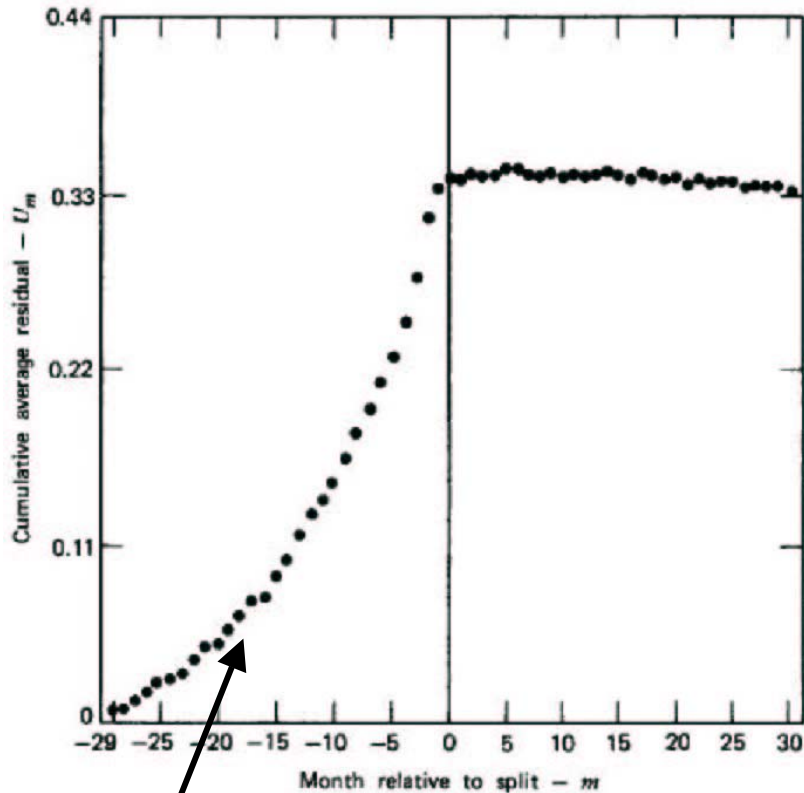


Cumulative abnormal returns around earning announcements

Figure 2a. Plot of cumulative abnormal return for earning announcements from event day -20 to event day 20. The abnormal return is calculated using the market model as the normal return measure.

(MacKinlay 1997)

Event Study: Stock Splits



Selection bias or
Insider trading

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Event Study on Stock Splits by
Fama-French-Fischer-Jensen-Roll
(1969)

Split is a signal of good profit

Pre-announcement drift can be due
to selection bias (only good firms
split) or insider trading.
→ inconclusive

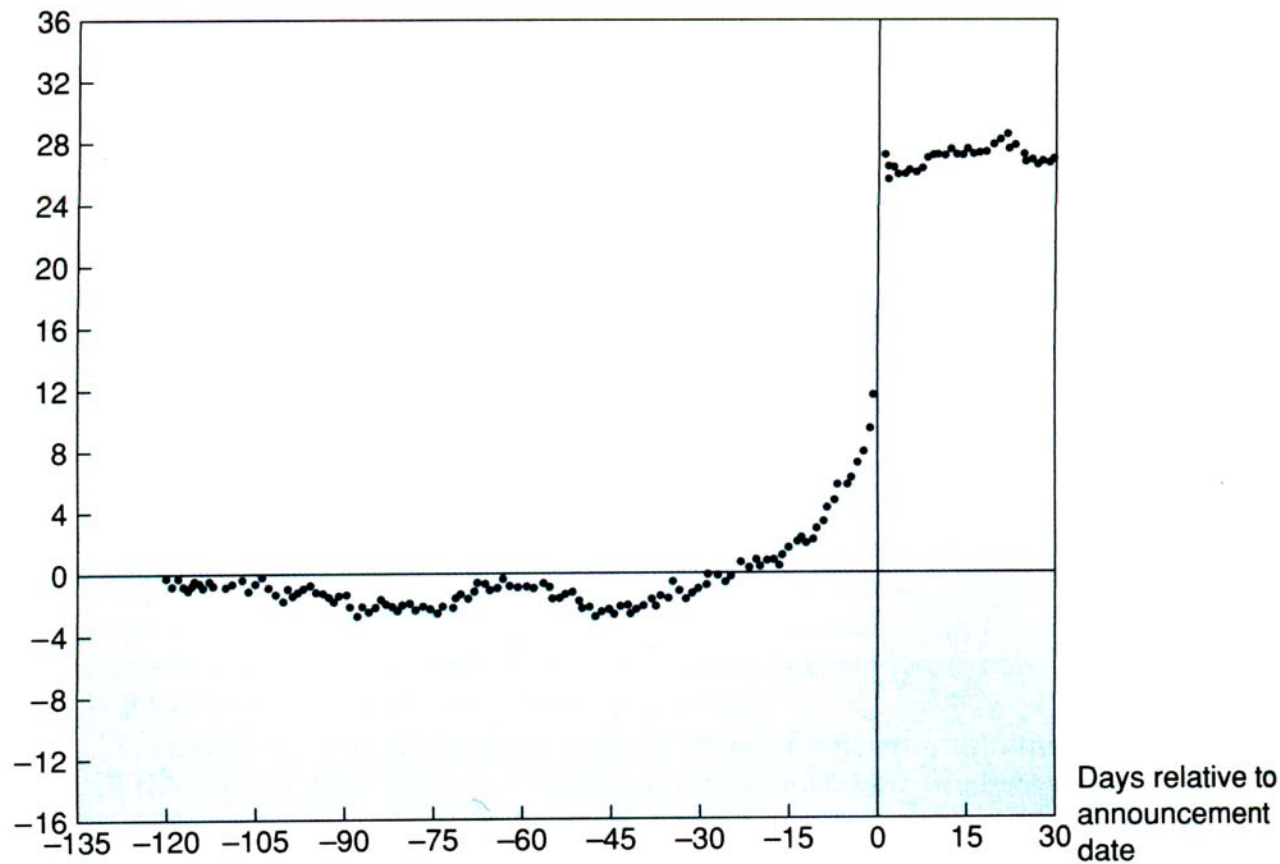
No post-announcement drift
→ for weak form

Market Efficiency



Event Study: Take-over

Cumulative
abnormal
return,
percent

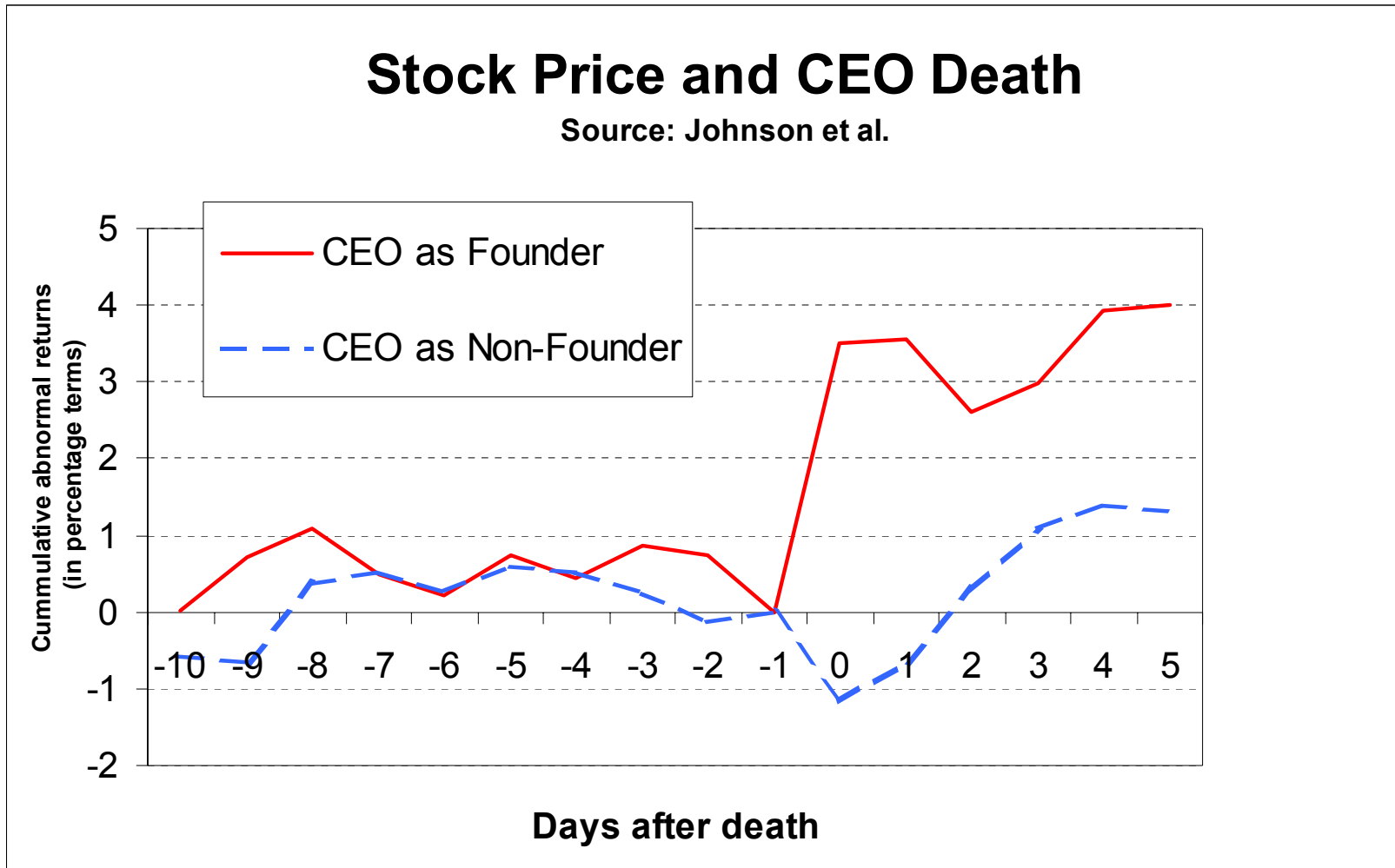




Event Study: Death of CEO

Stock Price and CEO Death

Source: Johnson et al.





What Makes Market Efficient?

- Public information (including past price data)
 - Trade on it to take advantage of inefficiencies
 - Demand/supply pressure will correct the mispricing
 - Is this a risk-free arbitrage?
- Private information
 - Collect private information (do research)
 - Exploit this private information
 - ...but efficient markets lead to a Paradox!



Grossman-Stiglitz Paradox

- If the market is (strong-form) efficient and all information (including insider information) is reflected in the price
- No one has an incentive to expend resources to gather information and trade on it.
- How, then can all information be reflected in the price?

⇒ markets cannot be strong-form informationally efficient, since agents who collect costly information have to be compensated with trading profits.



For Whom is it Worthwhile to Collect Information?

- Economies of scale – information costs are essentially fixed cost
 - Investors with a lot of money
 - Agents who manage a lot of money
- Do fund managers outperform the market?
 - On average, they don't.
 - Almost no one beats the market consistently
 - Evidence for EMH?



Evidence III: Outperformance

$$\text{Jensen's (1968) } \alpha : R^{\text{fund}} - R^f = \alpha + \beta^{\text{fund}}[R^m - R^f] + \epsilon$$

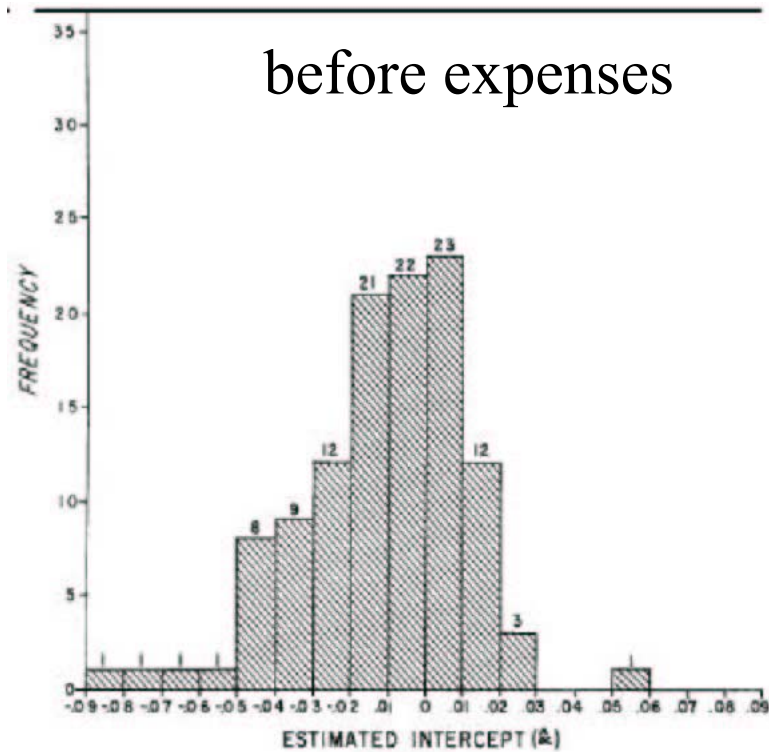


FIGURE 1

Frequency distribution (from col. (1), Table 4) of estimated intercepts ($\hat{\alpha}$) for eq. (8) for 115 mutual funds for all years available for each fund. Fund returns calculated net of all expenses.

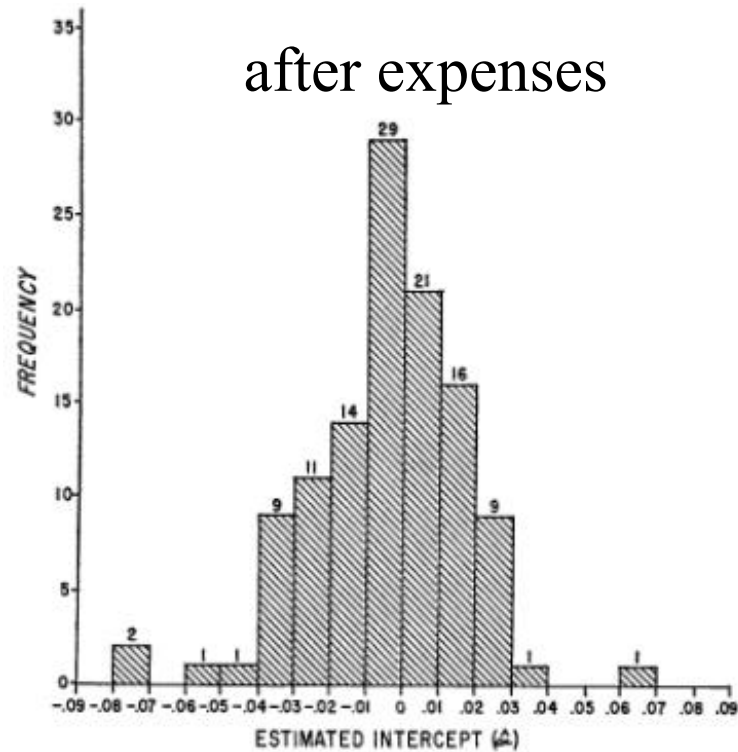


FIGURE 2

Frequency distribution (from col. (2), Table 4) of estimated intercepts ($\hat{\alpha}$) for eq. (8) for 115 mutual funds for all years available for each fund. Fund returns calculated gross of all management expenses.



...Outperformance (more recent)

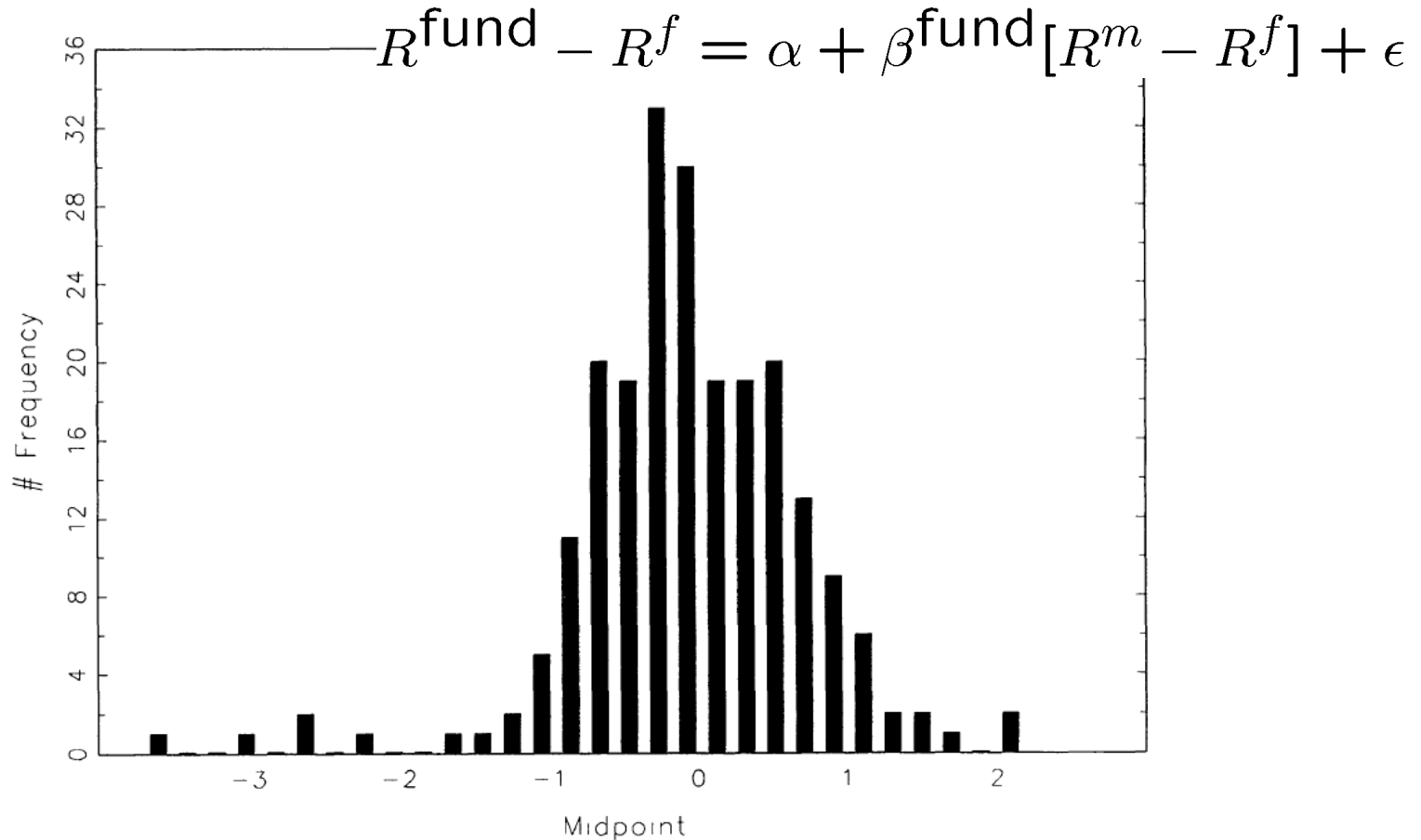


Figure 1. Estimates of Individual Mutual-Fund Alphas 1972 to 1991. The frequency distribution of estimated alphas for all equity mutual funds with 10-year continuous records.



Modern Performance Evaluation

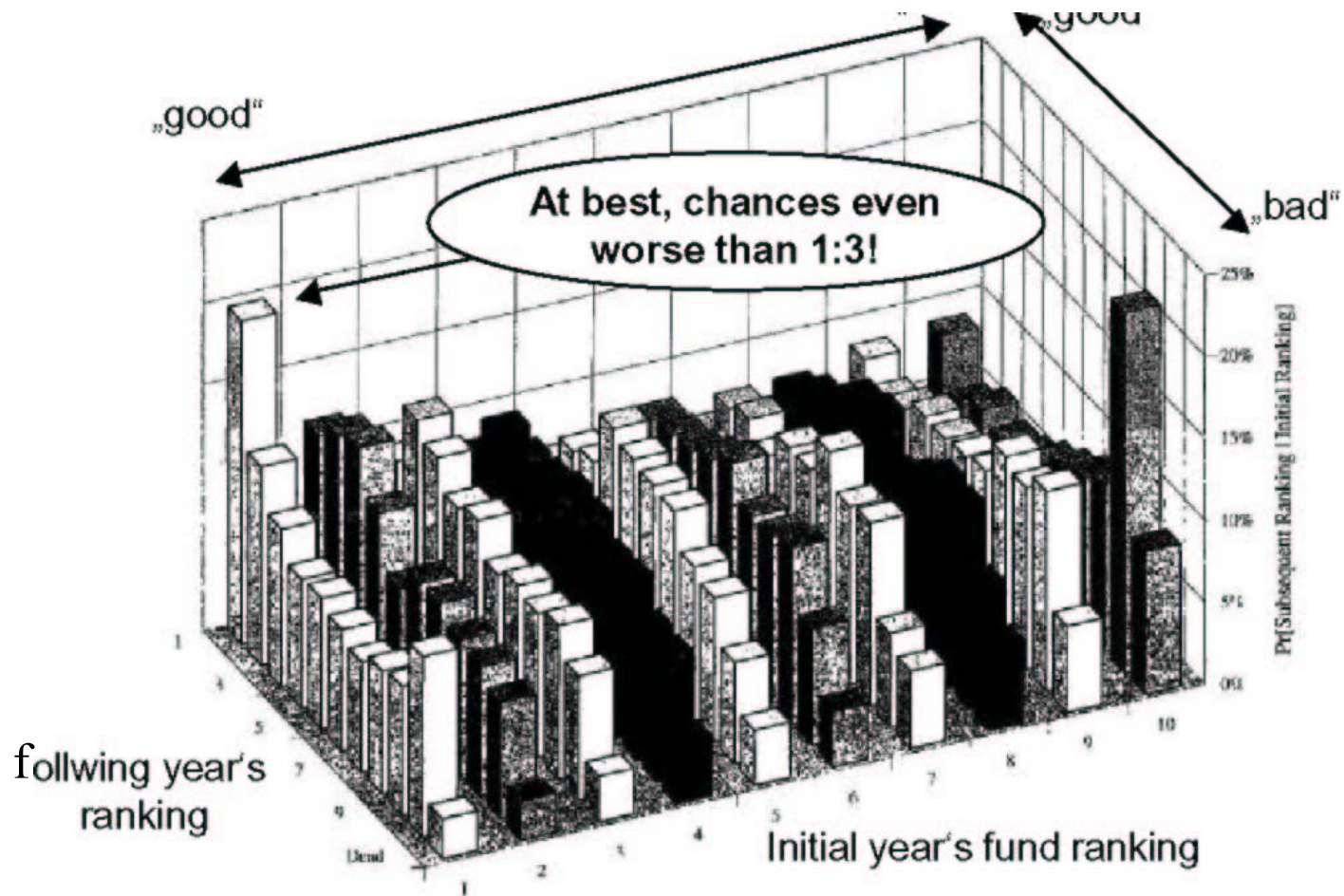
- Characteristic Benchmark Portfolio Approach (Wermers 2000)
 - Form 5x5x5 portfolios
 - Size effect
 - Book to market effect
 - Momentum effect
 - Calculate outperformance of each stock in funds' portfolio w.r.t. to characteristic matched benchmark portfolio



Survivorship Bias

- Window dressing of performance
 - Merging of under- with over-performing funds
 - Incubator funds
- Survivorship bias: Data on fund performance is tainted by overrepresentation of good funds;
 - Lesson: Trust data to the extent you know its design, that is the process by which an observation enters the data set.

Persistence of Managers' Skills





Summary

- Evidence on Market Efficiency
 - Return Predictability Studies
 - Event Studies
 - Performance Studies