Institutional Finance

Financial Crises, Risk Management and Liquidity

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Overview

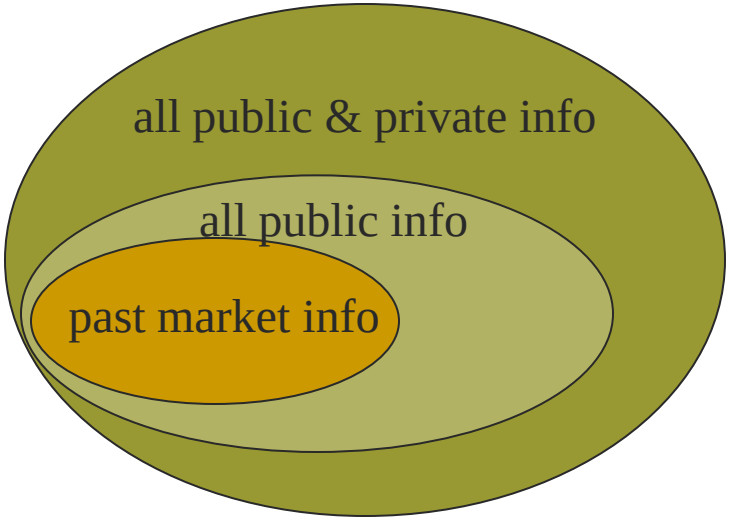
- Efficiency concepts
- EMH implies Martingale Property
- *Evidence I:* Return Predictability
- Mispricing versus Risk-factor
- Informational (market) efficiency concepts
- Asymmetric Information and Price Signal
- Grossman-Stiglitz Paradox
- *Evidence II:* Event Study Methodology
- *Evidence III:* Fund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

Allocative vs. Informational Efficiency

- Allocative Efficiency
  - An allocation is Pareto efficient if there does not exists 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

Versions of EMH/Info-Efficiency

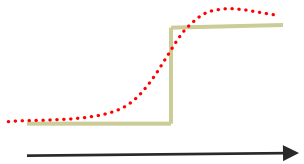
- Weak-form efficiency:
  - Prices reflect all information contained in past prices
- Semi-strong-form efficiency:
  - Prices reflect all publicly available information
- Strong-form efficiency:
  - Prices reflect all relevant information, including private (insider) information



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

EMH $\Rightarrow$ Martingale Property

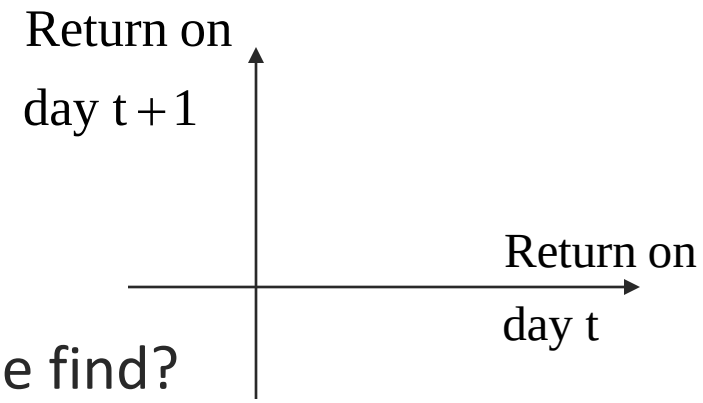
- A stock price is always at the "fair" level (fundamental value)
- What will eventually happen to repeated price pattern?
  - The predictability in prices creates a profit opportunity (not completely riskfree like last week, but fairly low risk)
  - If the price must go up tomorrow – what would happen today?
  - The *risk-adjusted* likelihood of up- and down-movements of the discounted process are equal.
  - Competition for low risk profit opportunities eliminates the predictability
    - A stock price reacts to news without delay.
- Naïve "technical" analysis is not going to generate ***risk-adjusted*** profits



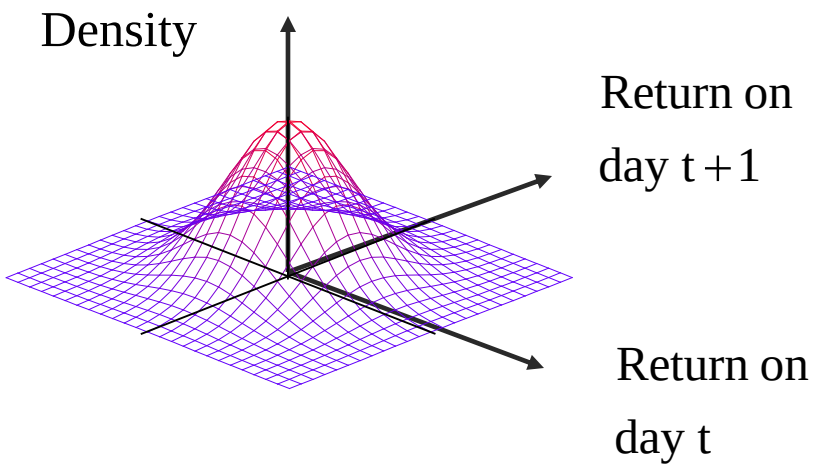
- $\Rightarrow$ ***discounted*** stock price/gain process is a Martingale process
  [using the equivalent martingale measure $E^*[.]$]
  - Hence, any predictable component is due to changes in the risk premium.
  - Weak-form, semistrong-form and strong-form of EMH differ in underlying filtrations (dynamics of martingale measure)

Return Predictability…

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

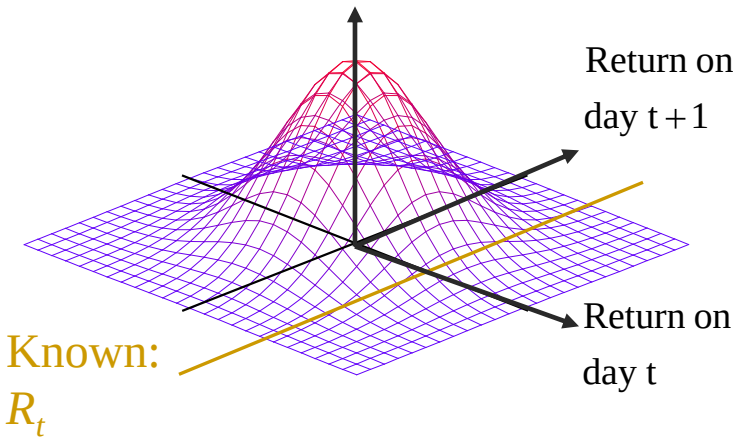


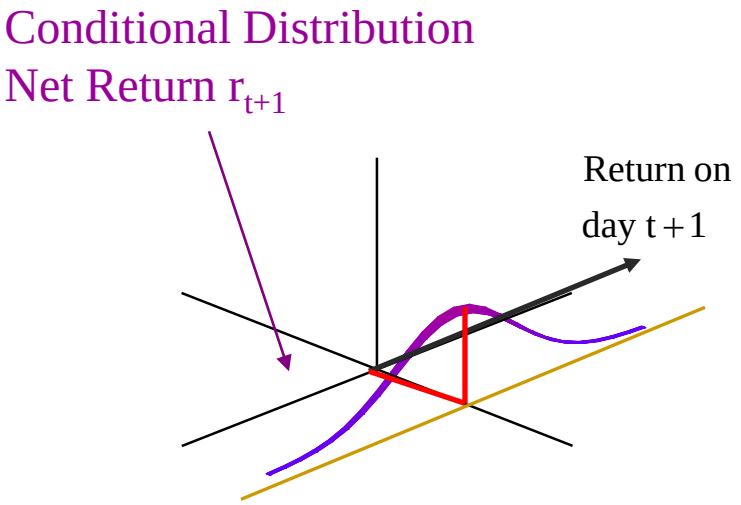
What "should" he find?



Non-Predictability of Returns

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

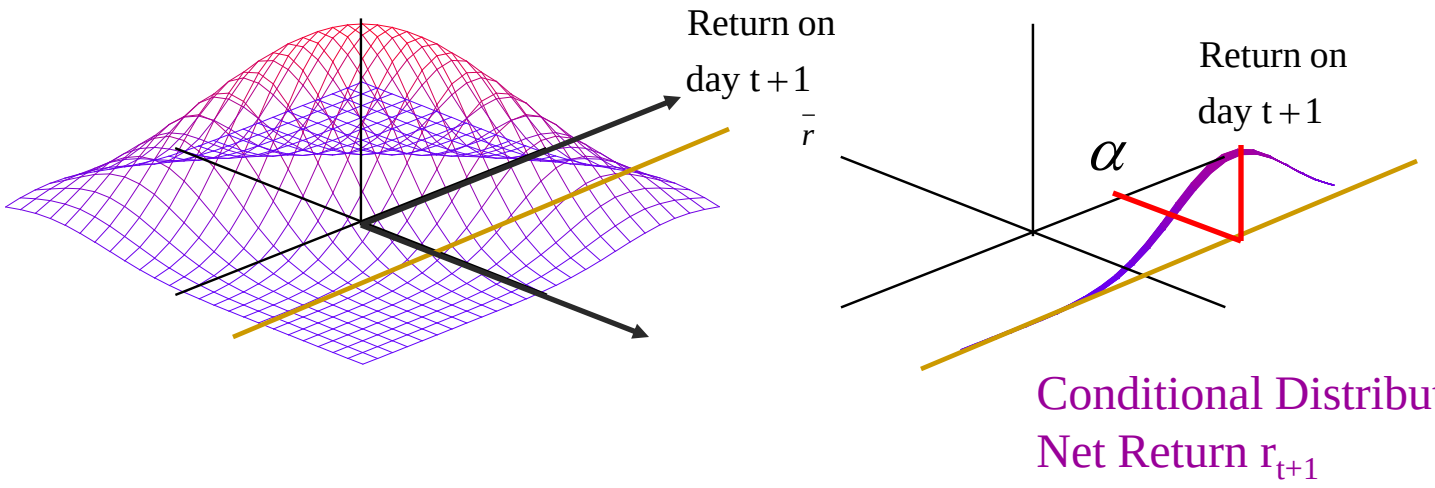




- The expected (excess) return conditional on the date t net return r_t is zero: $E^*(r_{t+1}|r_t) = 0$

Predictability of Returns

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



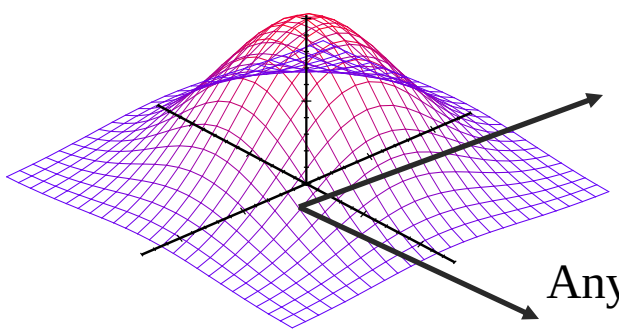
Conditional Distribution
Net Return r_{t+1}

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

$$E^*(r_{t+1}|r_t) = \alpha$$

Non-Predictability

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



Return on day $t+1$

(or any other future period)

Any known statistics

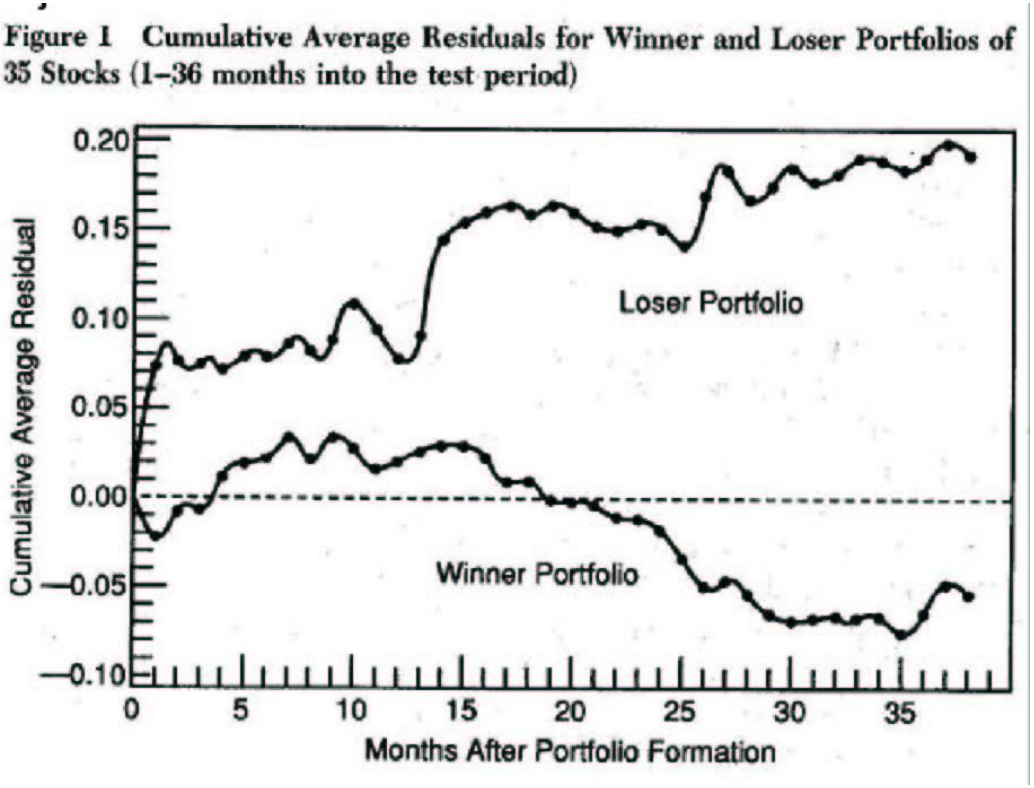
at time, I_t

- 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 .

Evidence I: Predictability Studies…

- Statistical variables have only low forecasting power, 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

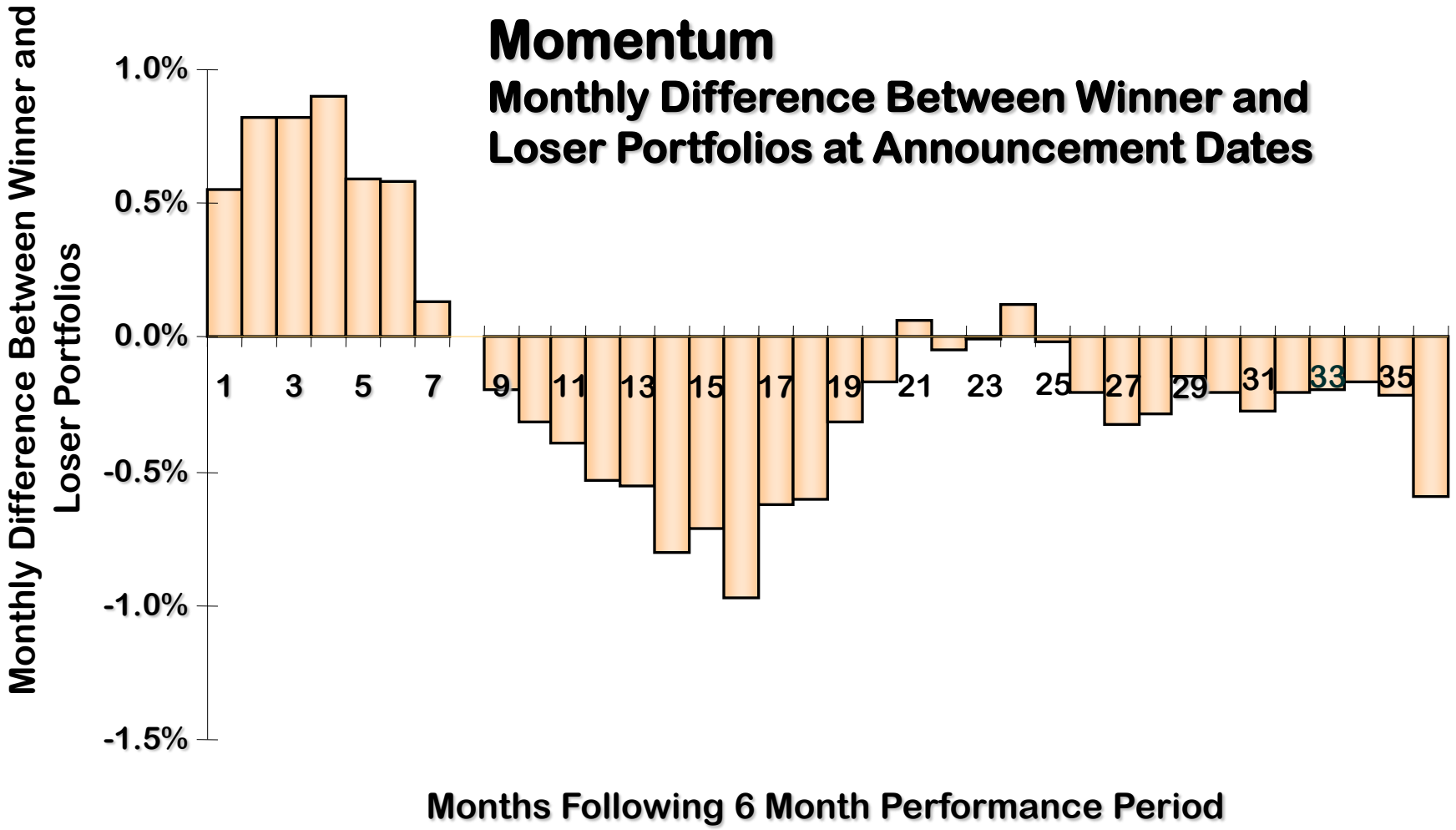
Long-Run Reversals



Long-run Reversals

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

…Short-run Momentum



Size, Book-to-Market, Momentum

	rm-rf	smb	hml	mom
1990	-13.92	-13.97	-9.75	17.56
1991	28.05	16.04	-14.24	14.60
1992	5.56	7.59	23.88	3.22
1993	8.69	6.01	19.03	23.45
1994	-4.67	-1.40	-0.73	3.18
1995	30.07	-7.68	1.39	17.82
1996	15.96	-2.33	3.44	6.39
1997	25.08	-4.87	12.37	11.85
1998	17.43	-25.23	-9.52	23.47
1999	20.57	14.72	-33.16	34.60
2000	-16.93	-2.08	39.96	14.88
2001	-15.13	18.58	18.27	4.38
2002	-22.47	3.37	10.25	25.86
2003	32.12	27.41	4.69	-24.57
2004	11.82	4.86	9.42	-0.41
2005	4.33	-2.20	8.68	14.92
average	**7.91**	**2.43**	**5.25**	**11.95**
stdev	**17.95**	**13.00**	**17.07**	**13.64**

Return of FF-Carhart Portfolios

Very Short-run Reversals

- 1-week/month Reversal
  (stock that have high (low) returns over past 1-week/month tend to have low (high) returns)
  - Seems to produce risk-adjusted profit
  - Effect tends to disappear
    - Except for small stocks,
    - LIQUIDITY for small stocks
    - was anomaly for large stocks

Weekly Reversals - Kaniel et al. (2006)

	All Stocks		Small Stocks		Mid-Cap Stocks		Large Stocks	
	Intercept	Return(t)	Intercept	Return(t)	Intercept	Return(t)	Intercept	Return(t)
1964 – 1967	0.0039**	-0.0765**	0.0054**	-0.0925**	0.0036**	-0.0695**	0.0024*	-0.0561**
	(3.21)	(-11.33)	(3.77)	(-12.32)	(2.95)	(-8.31)	(2.23)	(-7.27)
1968 – 1971	0.0013	-0.0920**	0.0013	-0.1084**	0.0013	-0.0848**	0.0012	-0.0786**
	(0.63)	(-12.63)	(0.58)	(-12.83)	(0.64)	(-9.67)	(0.72)	(-10.05)
1972 – 1975	0.0004	-0.0973**	0.0006	-0.1263**	0.0004	-0.0814**	0.0003	-0.0635**
	(0.16)	(-14.59)	(0.22)	(-17.86)	(0.16)	(-10.24)	(0.13)	(-7.64)
1976 – 1979	0.0046**	-0.0797**	0.0062**	-0.0930**	0.0046**	-0.0804**	0.0023	-0.0658**
	(3.04)	(-12.58)	(3.33)	(-13.98)	(3.06)	(-10.88)	(1.78)	(-9.06)
1980 – 1983	0.0051**	-0.0698**	0.0061**	-0.0765**	0.0050**	-0.0715**	0.0042*	-0.0657**
	(3.04)	(-13.34)	(3.38)	(-13.49)	(2.99)	(-10.67)	(2.52)	(-7.85)
1984 – 1987	0.0023	-0.0688**	0.0013	-0.0758**	0.0026	-0.0720**	0.0035	-0.0710**
	(1.10)	(-10.84)	(0.58)	(-10.50)	(1.26)	(-9.16)	(1.83)	(-7.80)
1988 – 1991	0.0036*	-0.0909**	0.0033	-0.1114**	0.0033*	-0.0358**	0.0036*	-0.0471**
	(2.16)	(-7.83)	(1.64)	(-7.06)	(2.19)	(-4.37)	(2.51)	(-5.31)
1992 – 1995	0.0031**	-0.0730**	0.0035**	-0.0936**	0.0026**	-0.0331**	0.0029**	-0.0446**
	(3.37)	(-12.63)	(3.14)	(-11.59)	(2.92)	(-4.50)	(3.57)	(-6.42)
1996 – 1999	0.0028	-0.0376**	0.0022	-0.0448**	0.0029	-0.0182	0.0033*	-0.0302**
	(1.74)	(-5.69)	(1.27)	(-6.75)	(1.72)	(-1.48)	(2.22)	(-3.52)
2000 – 2003	0.0031	-0.0229**	0.0038*	-0.0383**	0.0033	0.0099	0.0023	-0.0126
	(1.78)	(-3.27)	(1.98)	(-4.94)	(1.86)	(1.09)	(1.30)	(-0.99)

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?

Versions of EMH/Info-Efficiency

- Weak-form efficiency:
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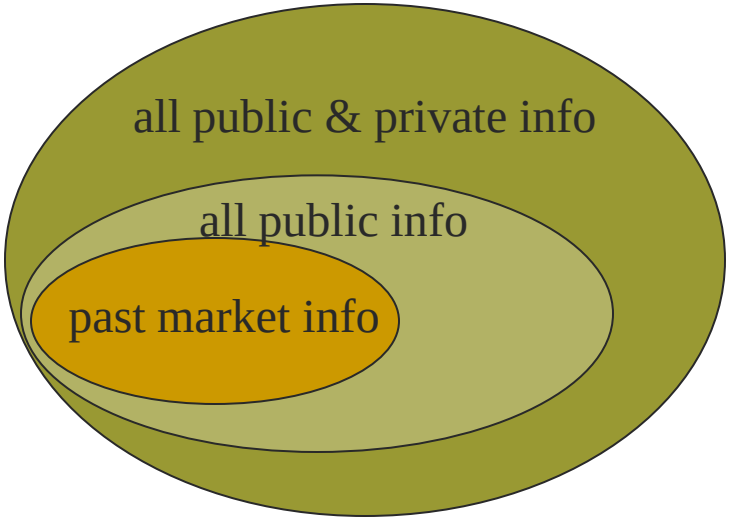
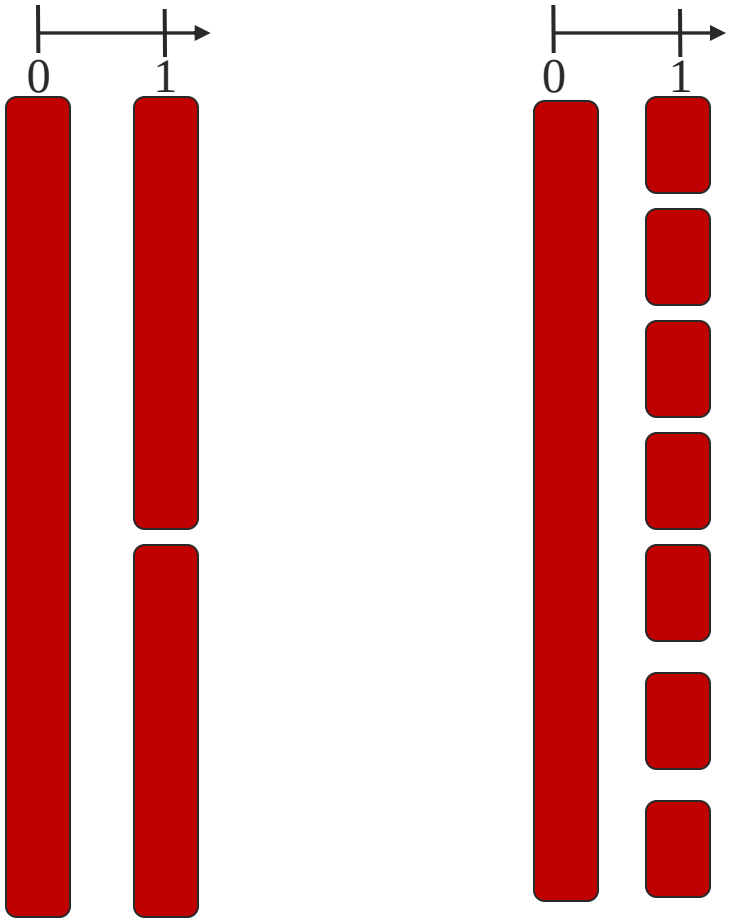


According to each of these theories, which kind of information **cannot** be used to trade profitably?

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 the price is too high, the price is too high.
    (since e.g. they don't know that others know it as well.)

Asymmetric Information & REE

- Agents learn from the market price (more generally, from the demand and supply of other agents) in a setting with differential information e.g. insider trades

- If a stock price falls sharply for no visible reason you would not simply think it's a bargain & buy more of it. You would, more likely, think there is something wrong with it that others know about but you do not.
- Other people's information is relevant to you, because you are not perfectly well informed about the value of the stock.

- Dual role of price system
  - Index of scarcity
  - Conveyor of information
- An equilibrium where a price system plays these two roles is called a **Rational Expectations Equilibrium** (competitive)

Hayek's big idea

- Idea commonly attributed to F.A. Hayek, The Use of Knowledge in Society, *The American Economic Review*, XXXV, September 1945, 519-530:

- *"We must look at the price system as (such) a mechanism for communicating information if we want to understand its real function... The most significant fact about this system is the economy of knowledge with which it operates, or how little the individual participants need to know in order to be able to take the right action. In abbreviated form, by a kind of symbol, only the most essential information is passed on ..."* (pp. 526-527).

More formally – some tools first

- CARA utility + Gaussian distribution
  - $E[u(W)|\cdot] = E[-\exp\{-\rho W\}|\cdot]$
  - Certainty equivalent =

$$E[W|\cdot] - \frac{\rho}{2} Var[W|\cdot]$$

    - (maximize certainty equivalent)
  - Projection theorem (Bayes' Rule)

$$E[x|S] = E[x] + \frac{Cov[x,S]}{Var[S]}(S - E[S])$$

$$Var[x|S] = Var[x] - \frac{Cov[x,S]^2}{Var[S]}$$

independent of realization of S

Demand for risky asset

- 2 assets

asset	payoff	endowment
bond (numeraire)	R	e_0^i
stock	$v \sim \mathcal{N}(\mu, \sigma^2)$	z^i

- $Px^i + b^i = Pz^i + e_0^i$

- final wealth is
  $W^i = b^i R + x^i v = (e_0^i + P(z^i - x^i))R + x^i v$
  - mean: $(e_0^i + P(z^i - x^i))R + xE[v|\cdot]$,
  - variance: $(x^i)^2 Var[v|\cdot]$

Demand for risky asset

$$(e_0^i + Pz^i)R + x^i(E[v|\cdot] - PR) - \frac{1}{2}\rho Var[v|\cdot](x^i)^2$$

- First order condition

$$E[v|\cdot] - PR - \rho Var[v|\cdot]x^i = 0$$

$$x^i(P,\cdot) = \frac{E[v|\cdot] - PR}{\rho Var[v|\cdot]}$$

- Remarks: Let R=1 (i.e. r=0)

A first step…

- Risky payoff v
- S^i signal of trader *i* $S^i = v + \varepsilon^i$ means=zero; i.i.d. (normal)
- N… equilibrium
  - Updating

$$E[v|S^i] = E[v] + \overbrace{\frac{Cov[S,v]}{Var[S]}}^{=:\beta}(S^i - E[v])$$

$$Var[v|S^i] = (1-\beta)Var[v]$$

  - Demand

$$x^i = \frac{E[v|S^i] - P}{\rho Var[v|S^i]}$$

NB: Var[v|S^i] is The same for all realizations of S^i

  - Market Clearing

$$\sum_i \frac{(1-\beta)E[v] + \beta S^i - P}{\rho(1-\beta)Var[v]} = \sum_i z^i$$

"risk premium"

Role of prices

- Price

$$P = (1-\beta)E[v] + \beta \underbrace{\frac{1}{I}\sum_i S^i}_{\text{Sufficient statistic}} - \underbrace{\rho(1-\beta)Var[v]\frac{1}{I}\sum_i z^i}_{\text{Risk premium}}$$

  - Perfectly aggregates all information
  - Perfectly reveals sufficient statistic (informationally efficient)
- What's wrong with this analysis?

Rational Expectations Equilibrium

- Demand

$$x^i = \frac{E[v|S^i,P]-P}{\rho Var[v|S^i,P]} = \frac{E[v|P]-P}{\rho Var[v|P]}$$

- Updating

$$E[v|P] = E[v|\bar{S} := \tfrac{1}{I}\textstyle\sum_i S^i] = \bar{\beta}E[v] + (1-\bar{\beta})\bar{S}$$

- Price

$$P = \underbrace{(1-\bar{\beta})E[v] + \bar{\beta}\frac{1}{I}\sum_i S^i}_{E[v|S^1,\ldots S^I]} - \underbrace{\rho(1-\bar{\beta})Var[v]\frac{1}{I}\sum_i z^i}_{\text{Risk-premium}}$$

  - Higher price - lower risk (premium) – now $\bar{\beta}$ instead of β

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?

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

Noise trader …

- Total supply = $\sum_i z^i + \tilde{\eta}$

  (uninformed trading, noise/liquidity trading, ….)
- Hence,

$$P = \underbrace{(1-\bar{\beta})E[v] + \bar{\beta}\frac{1}{I}\sum_i S^i}_{E[v|S^1,\ldots S^I]} - \underbrace{\rho(1-\bar{\beta})Var[v](\frac{1}{I}\sum_i z^i + \tilde{\eta})}$$

  - {S^i,P} is better than price signal, P, alone to predict v
  - Price still aggregates, but is not fully info-efficient

Price as a Signal – more abstract

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

    $(S^1,\ldots,S^i,\ldots,S^I) \mapsto \bar{S}$ (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!

Debriefing of Simulation A

- Weak-form (informational) efficiency
  - Pioneer stock: Price is cycling
  - Demo at home:
    - Monopolistic arbitrageur does not want to fully eliminate inefficiency
  - Simulation in class:
    - Competition with others makes traders more aggressive
    - Inefficiency is *partially* traded away
- Market efficiency measure reported in table
  prob. of upward movement if the last movement was an upward move.

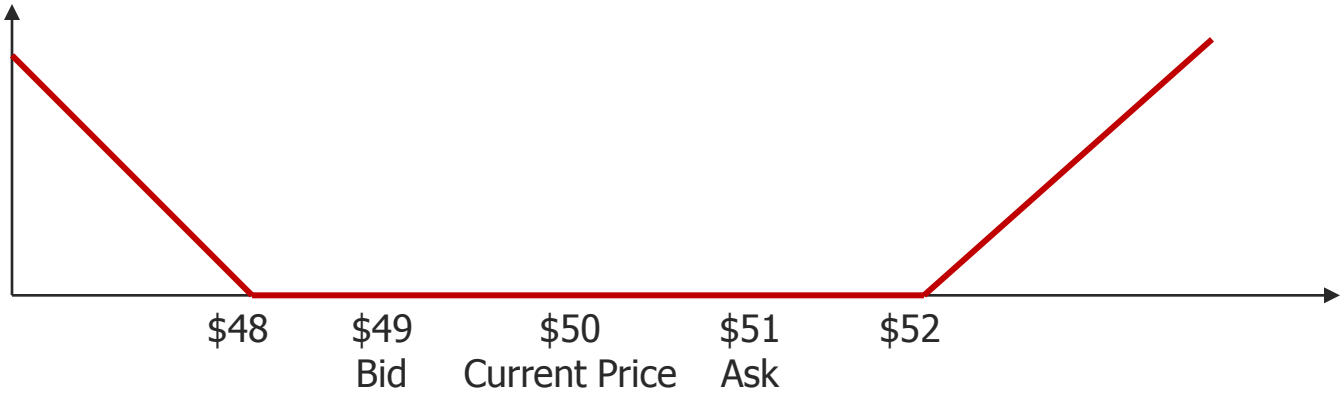
Debriefing of Simulation B

- Strong-form (informational) efficiency
  - 6 students could acquire privilege to obtain historical price signals 1 month in advance
  - the more informed students
    - the worse, since they compete against each other
    - the better, since price in 1 month will be closer to historical price
- price of privilege = expected trading benefit (in equilibrium) [$80K was very cheap!]

How to Value Information

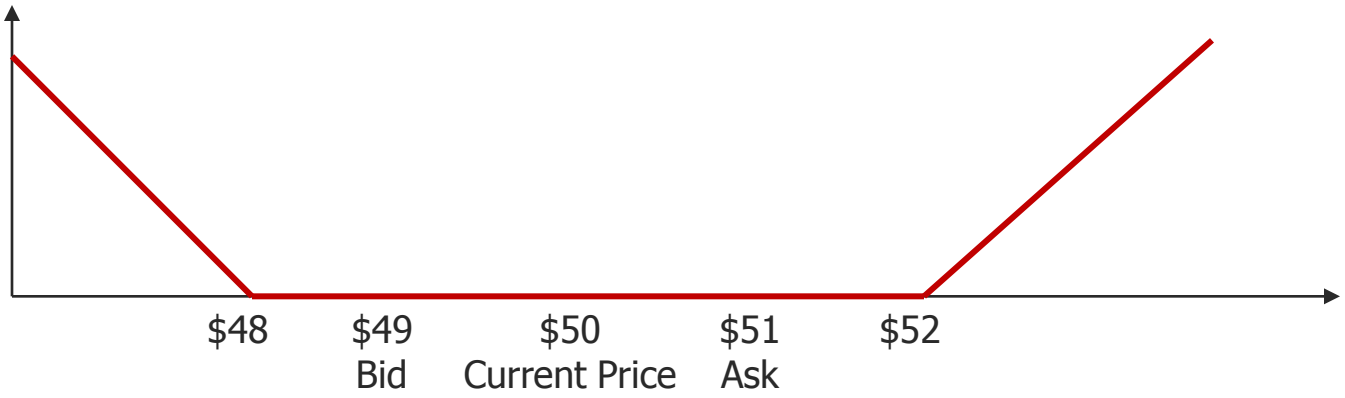
- Assumptions
  - Trader may acquire a signal of the fair price for the security in one month's time.
  - Suppose the current price is $50, a trader can trade 10,000 shares, and effective spread (D) they face is $2, the stock has an annual volatility of 40% (~11.5% per month), and that the risk free rate is 5%.
  - How large does the signal have to be for a trader to break even?
  - How much should the individual be willing to pay for a signal? (monopolistic vs. competitive seller of information)
  - The future price has to be either above $52 or below $48.
  - How do payoffs look for various realizations of the signal?

The Value of Information



- How can we value this set of payoffs?
- What type of equity position does this resemble?
- A “Strangle”: A $52 Call Option and a $48 Put Option.

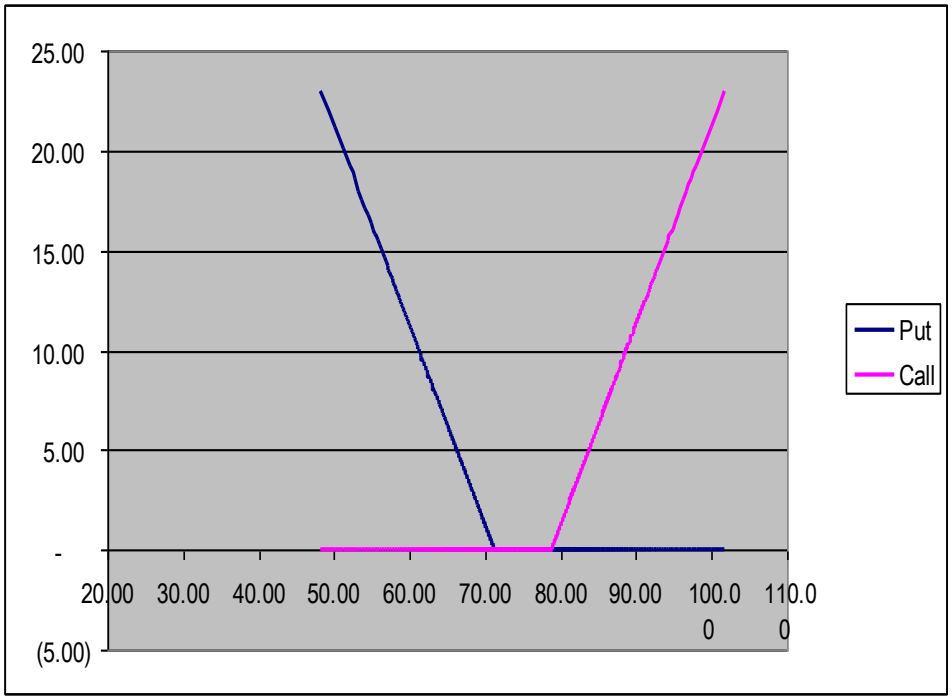
The Value of Information



- A Strangle: A $52 Call Option and a $48 Put Option.
- We can use Black-Scholes to value these options
  - V=C(S=$50, X=$52, σ=40%, T=1/12, r=5%) + P(S=$50, X=$48, σ=40%, T=1/12, r=5%)
  - V=$3.09 + $3.11 = $6.20
- If the trader can trade 10,000 shares at this effective spread:
  - 10,000 shares => $6.20*10,000 = $62,000 = Value of signal

Endogenous info acquisition

- Value of signal (conditional on knowing realization)
  - Intermediate signals are worthless
  - Very high (go long) and very low (go short) are worth the most.
- Take expectations before knowing signal
- Payoff is very **skewed only extreme signal realizations are valuable**



- Value of strangle (put + call) use Black-Scholes
  - More valuable for higher vol.

(see Excel file)

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 60 days around day "zero":
   t = -30, -29,…-1, 0, 1,…, 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

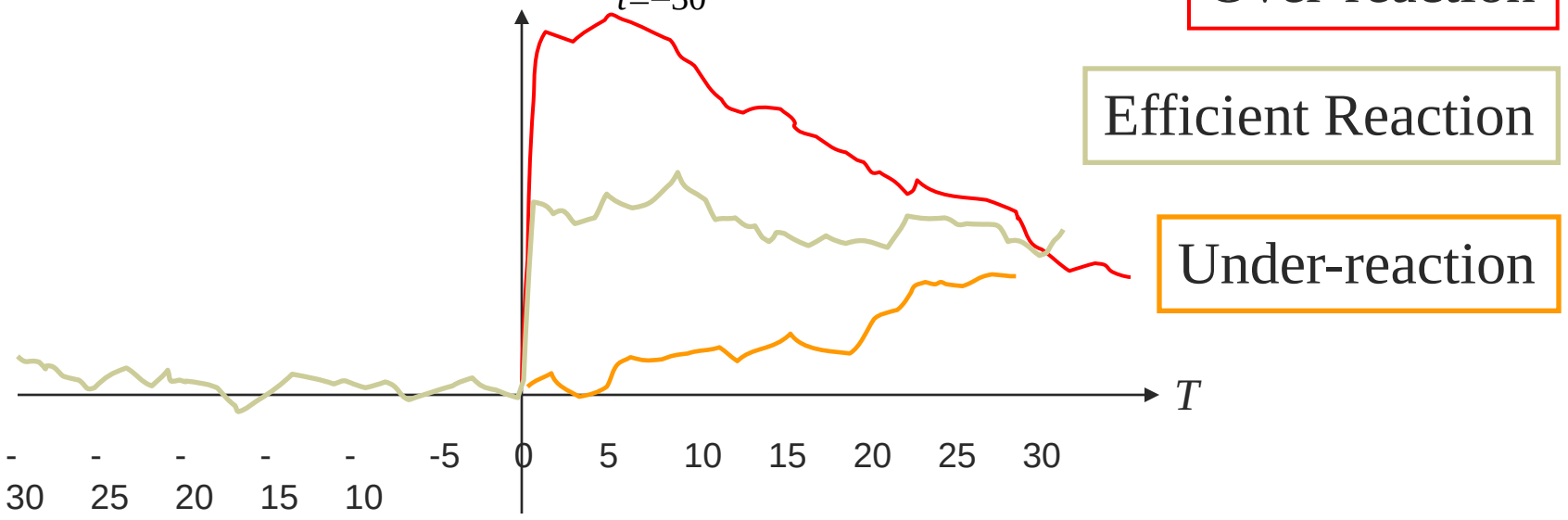
$$AAR_t = \frac{1}{N}\sum_{i=1}^{N} AR_{it}$$

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

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

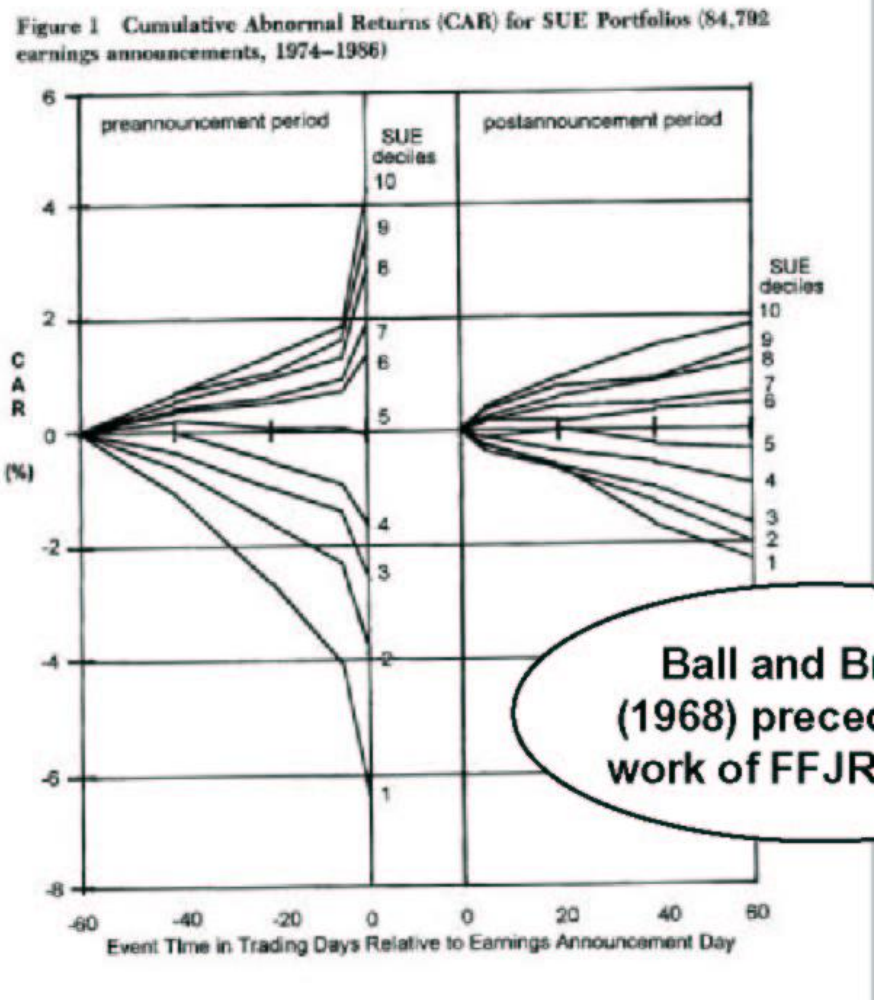
Market Efficiency in Event Studies

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



Important: Information has to become public at a single moment

Event Study: Earning Announcements



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

$\rightarrow$ against strong-form

Post-announcement drift

$\rightarrow$ against semi-strong form

Event Study: Earning Announcement

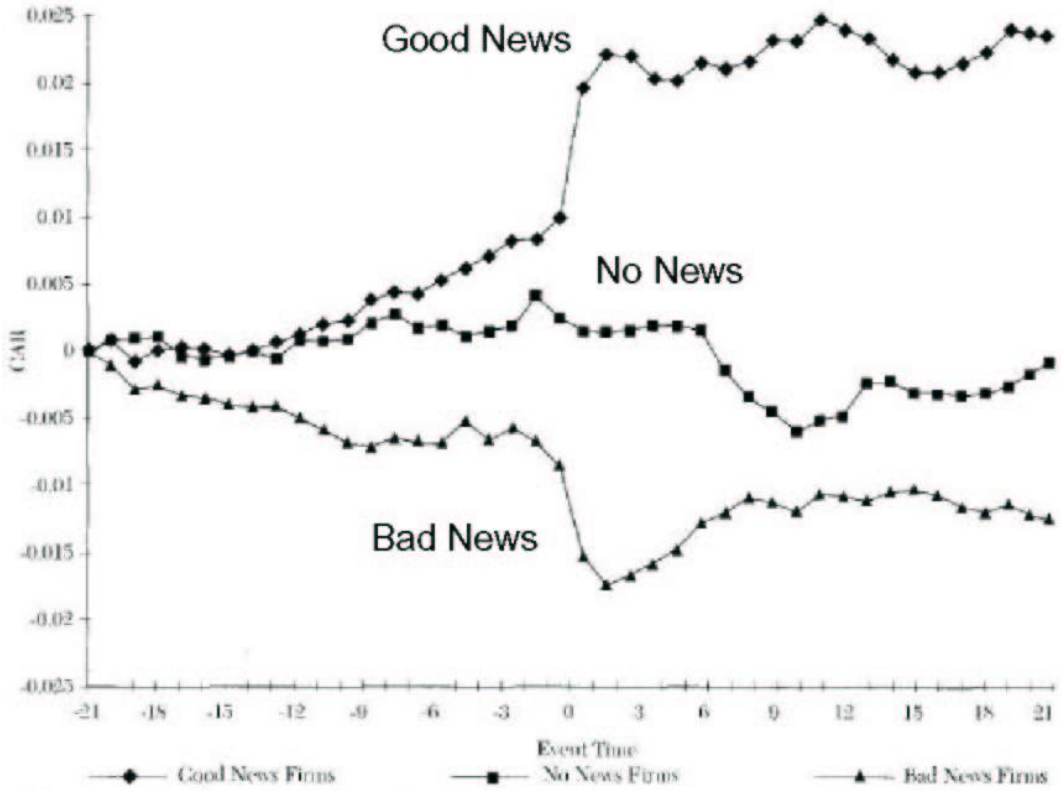
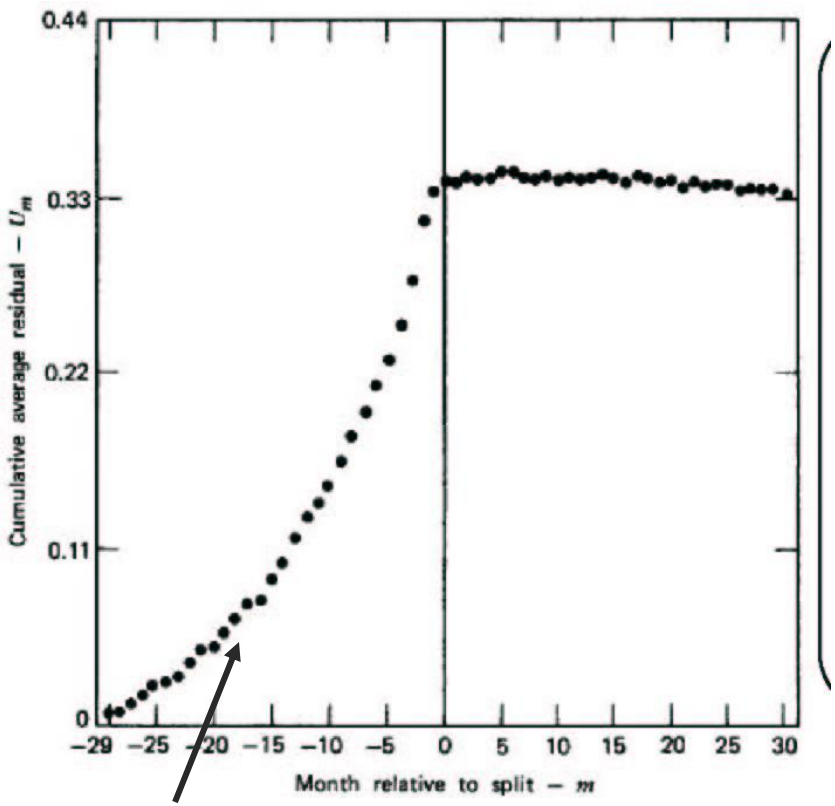


Figure 2a. Plot of cumulative abnormal return for earning announcements from event day -20 to event day 20. The abnormal return is calculated using the market model as the normal return measure.

Cumulative abnormal returns around earning announcements

(MacKinlay 1997)

Event Study: Stock Splits



Selection bias or
Insider trading

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

Split is a signal of good profit

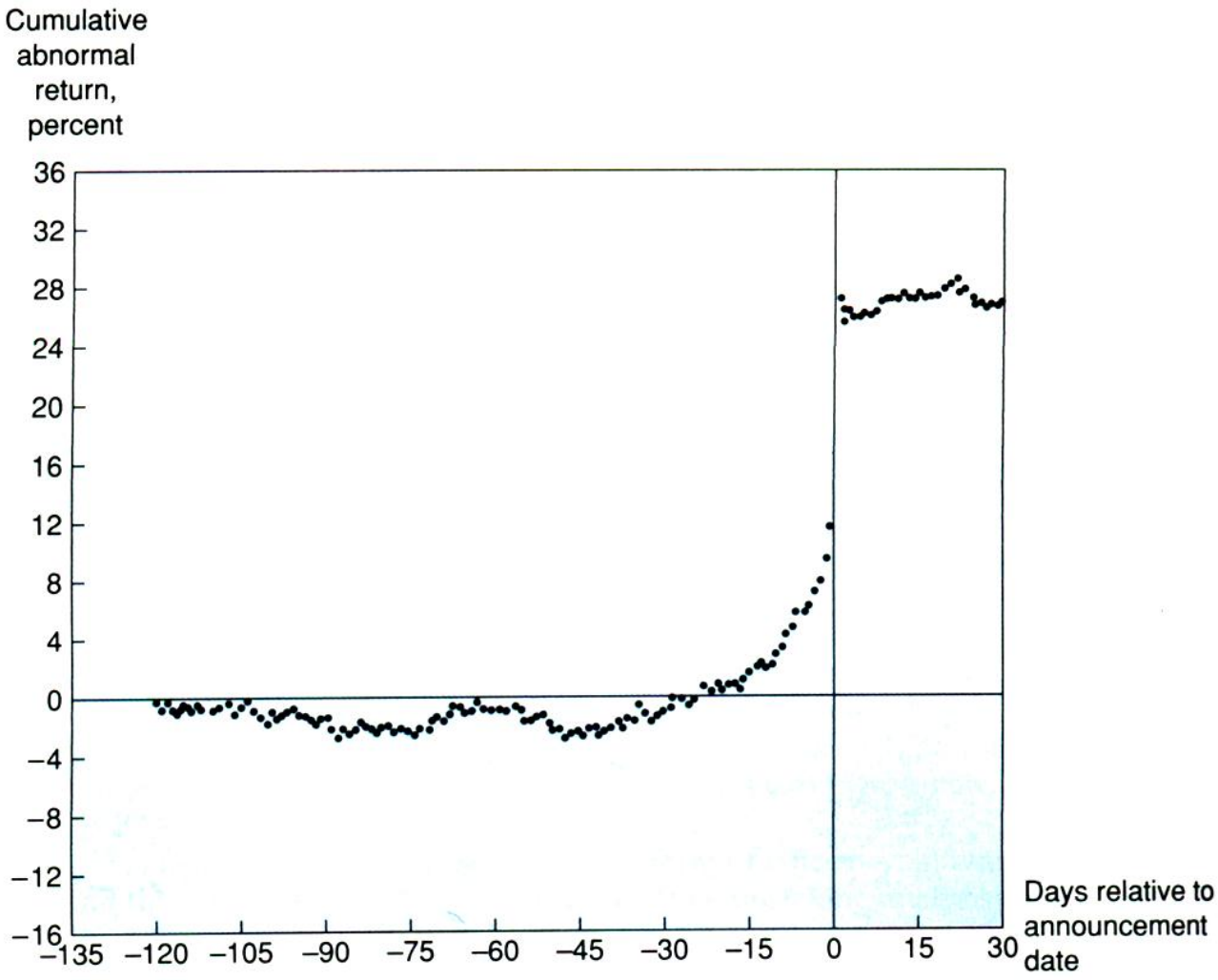
Pre-announcement drift can be due to selection bias (only firms whose price rose) or insider trading.

$\rightarrow$ inconclusive

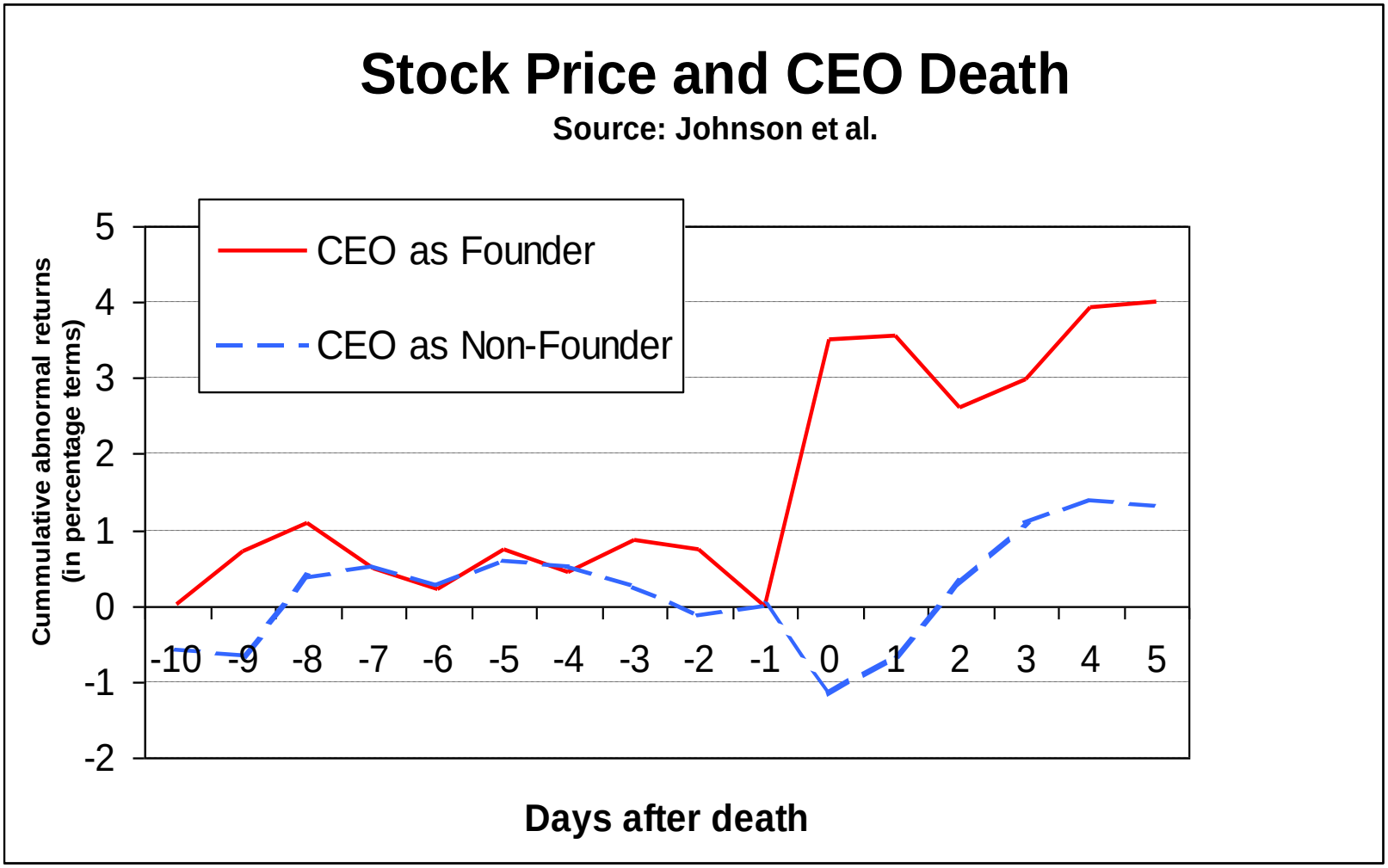
No post-announcement drift

$\rightarrow$ for weak form

Event Study: Take-over Announcement



Event Study: Death of CEO



What makes a 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?

$\Rightarrow$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?

Summary

- Evidence on Market Efficiency
  - Return Predictability Studies
  - Event Studies
  - Performance Studies
    (later more)