

Lecture 2

Predictability of Prices and Market Efficiency

Qianqian DU
duqq@swufe.edu.cn

Reading

- Textbook: chapter 2 & 3

Further reading:

- Malkiel, B. G. (2011) , A Random Walk down Wall Street, Norton, completely revised and updated edition.
- Shiller, R. J. (2006), Irrational Exuberance, Crown, 2nd edition.
- Shleifer, A. (2000), Inefficient Markets: An Introduction to Behavioral Finance, Oxford University Press.

Key Points

- Martingales
- Random walks
- Informational efficiency
- Efficient market hypothesis
- Asset market anomalies

I. Unpredictability: Martingale

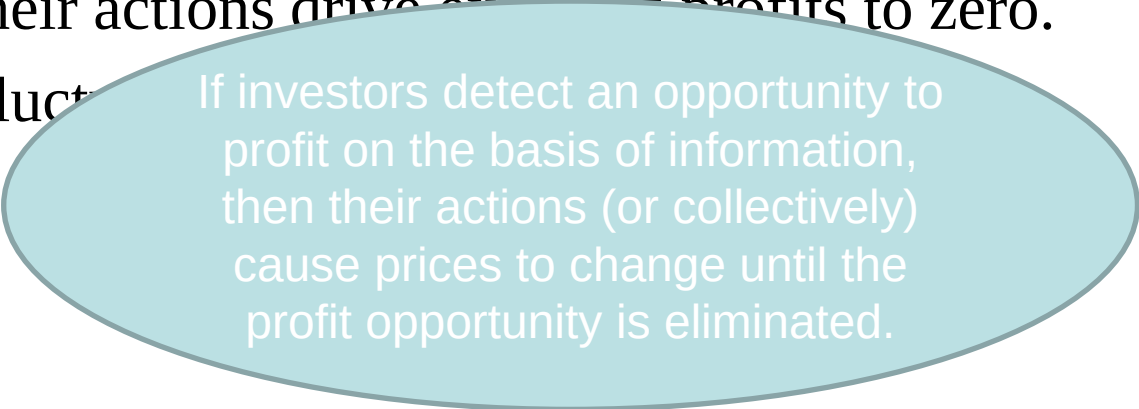
October. This is one of the peculiarly dangerous months to speculate in stocks in. The others are July, January, September, April, November, May, March, June, December, August, and February.

— Mark Twain

I. Unpredictability: Martingale

Objective: understand that asset prices fluctuations are **unpredictable**.

- Why may asset prices be unpredictable?
 - Suppose not, i.e. asset prices are predictable.
 - Investors will seek to profit from the predictions.
 - How? Buy ‘cheap’, sell ‘dear’ assets.
 - Collectively their actions drive expected profits to zero.
 - Hence, price fluctuations are unpredictable.



If investors detect an opportunity to profit on the basis of information, then their actions (or collectively) cause prices to change until the profit opportunity is eliminated.

I.Unpredictability: Martingale

- *Martingale hypothesis* formalizes this process.
- Participating in a fair game, a game which is neither in your favor nor your opponent's:

$$E[P_{t+1}|\Omega_t] = P_t \quad \text{or} \quad E[P_{t+1} - P_t|\Omega_t] = 0$$

where Ω_t is a set of available information available at date t.

- The crucial features of Ω_t are (a) it contains only things that known at date t and (b) it contains at least all current and past pricies of the asset (c) the information once in Ω_t , doen't subsequently disappear.
- As expressed so far, the martingale hypothesis predicts that the expected rate of return on asset equals zero:

$$E[P_{t+1} - P_t | \Omega_t] / P_t = 0$$

- Most assets are assumed to have a **positive** return, on average. Hence, replace the martingale with:

$$E[P_{t+1}|\Omega_t] = (1 + \mu)P_t \quad (a)$$

where μ is a constant. (In probability theory, if $\mu > 0$, (a) is known as a **submartingale**. Typically it is assumed that $\mu > 0$. Rearranging equation (a) gives

$$\mu = \frac{E[P_{t+1}|\Omega_t] - P_t}{P_t}$$

- so that μ can be interpreted as the expected rate of return from holding the asset, conditional upon information set.

- Or rewrite as:

$$r_{t+1} = \mu + \varepsilon_{t+1}$$

where

$$E[\varepsilon_{t+1} | \Omega_t] = 0$$

- The rate of return at one point of time provides no information about the rate of return at any later date. Or, less crudely, the rate of return is uncorrelated with any function of the return at any later point of time.

Random walk hypothesis

In empirical tests, assume:

- Random walk 1: IID increments (independently and identically distributed)

$$p_t = \mu + p_{t-1} + \varepsilon_t, \varepsilon_t \sim IID(0, \sigma^2)$$

where $p_t \equiv \ln P_t$.

- Random walk 2: independent increments
- Random walk 3: uncorrelated increments

What's the evidence?

Estimated covariances are often non-zero:

- short term positive correlation from one month to the next, “momentum effect”
- long term (several years) “mean reversion /contrarian”



II. Asset market efficiency

Informational efficiency

- “A capital market is said to be efficient if it **fully and correctly reflects all relevant information** in determining security prices.”
- What is ‘all relevant information’?

EMH suggests that the information should be ‘fundamental’.

What is to be ‘fundamental’?

- What does ‘fully and correctly reflects’ mean?

Implication: a model is always required to provide the benchmark criteria for ‘efficiency’.

Here's how Fama expresses the importance of a model in studying market efficiency

- “The theory [of asset market efficiency] only has empirical content . . . within the context of . . . a specific model of market equilibrium when prices ‘fully reflect’ available information.” (Fama, 1970)
- “. . . market efficiency per se is not testable. It must be tested jointly with some model of market equilibrium, an asset pricing model.” (Fama, 1991)

Beating the market

- Another approach to informational efficiency
- W. Sharpe: “A market is efficient with respect to a particular set of information if it is impossible to make abnormal profits (other than by chance) by using this set of information to formulate buying and selling decisions.”
- Does this imply that a model is unnecessary? No.
- The model provides benchmark criteria for ‘normal profits’
- Which model? – Could be CAPM or APT, or some other model.

III. Pattern of Information

- Weak Form Efficiency: information set: all **current and past** prices.
- Semi-Strong Form Efficiency: information set: all **publicly** available information.
- Strong-Form Efficiency: information set: all information, public or **private**.

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.

IV. Asset market anomalies

- An anomaly violates ‘conventional wisdom’.
- Conventional wisdom = prediction of ‘the’ orthodox model

Some well-known anomalies:

- Calendar effects:
 - January effect: small firms tend to have above average return in January.
 - Week of the month effect: first half of the month return tends to be above average.
 - Monday blues: tend to be negative each Monday

- The small firm effect, or **size effect**.
 - Evidence has been produced that small companies earn higher returns than predicted by models such as the Capital Asset Pricing Model, CAPM.
- The high earnings/price ratio effect. (BV/MV, **value effect**)
 - Companies with a high ratio of earnings to stock price appear to have shares which earn excess returns (again, measured against a common benchmark such as the CAPM).
- The **Closed-End Mutual Fund Paradox**.
 - A closed-end mutual fund is essentially a bundle of other securities that could themselves be purchased and sold individually. The closed-end mutual fund paradox stems from the observation that the market value of the funds often **diverges from** the current market value of their net assets.

- Initial Public Offerings (IPOs) and Seasoned Equity Offerings (SEOs).
- Initial returns on the shares, in the weeks immediately following an IPO, tend to be **high** (though the size of the short-term gain is thought to vary cyclically across time). Over time-spans of several years, the shares of IPOs are observed, on average, to **underperform** relative to conventional market benchmarks.
- The price patterns for SEOs — shares issued to raise additional funds for an existing publicly traded company — are **not dissimilar** though perhaps less pronounced.

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?

V. Event Studies

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

1. Calculate **daily abnormal returns** (ARs) for each firm in the days surrounding the announcement of the event being studied. The daily ARs can be calculated using various benchmarks:
 - 1) Market model
 - 2) Net-of-market returns
 - 3) net-of-characteristic matched portfolio (or matched firm) return
 - 4) an equilibrium asset pricing model, such as the CAPM.

Market model: CAMP or other factor models or very intuitive model, for example:

$$E(R_{i,t}) = b_0 + b_1 E(R_{m,t})$$

- i. Define estimation window: -170 days to -21 days, to estimate b_0 and b_1 .
- ii. Calculate daily ARs as:

$$AR_{i,t} = R_{i,t} - E(R_{i,t})$$

for days -20 to 20 (event window).

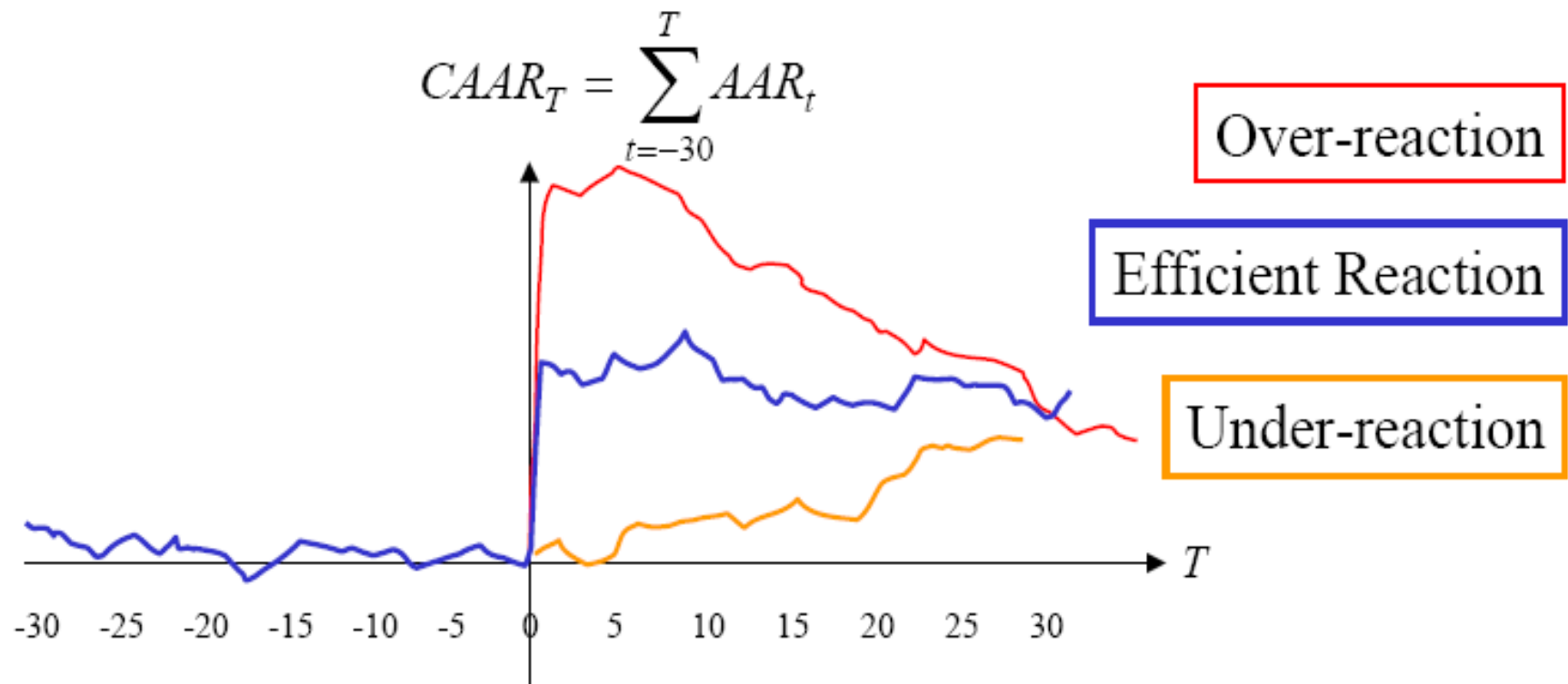
2. Calculate average abnormal return (AAR) over all N stocks in the sample for each reference day

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

3. Cumulate the AAR over the T days in the event window to form the cumulative average abnormal return ($CAAR$)

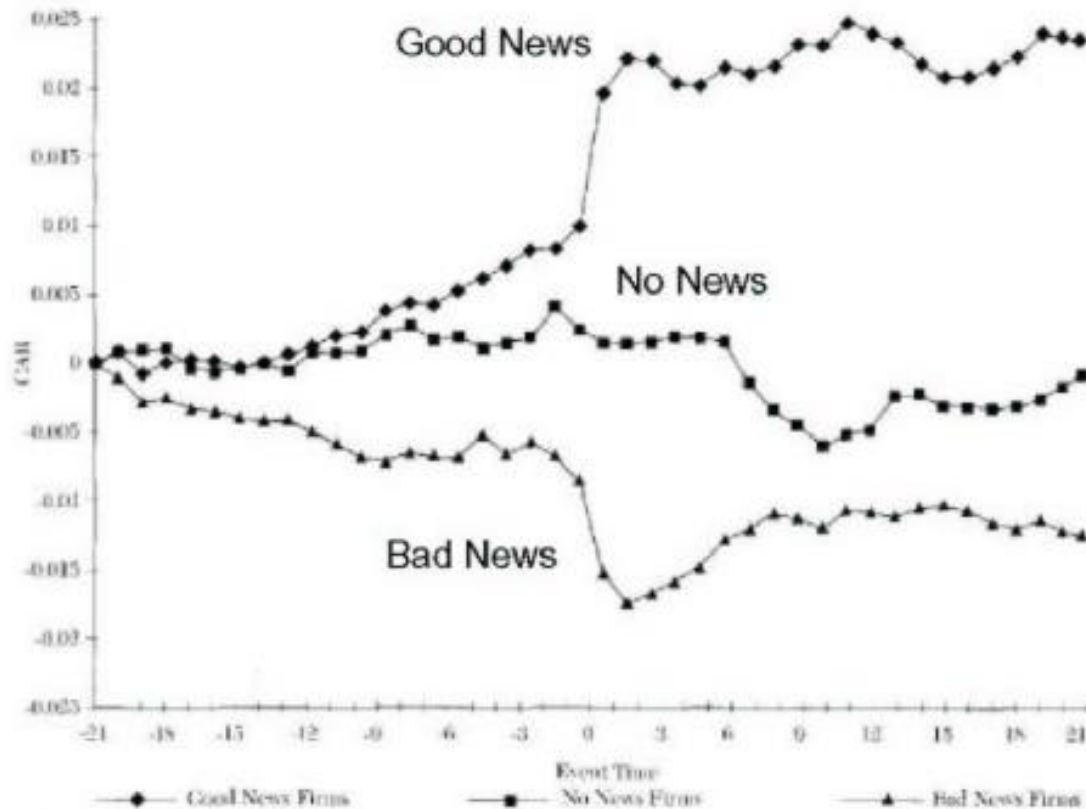
$$CAAR_T = \sum_{t=1}^T AAR_t$$

Market efficiency in event studies



Important: Information has to become public at a single moment

Event study: earnings announcement

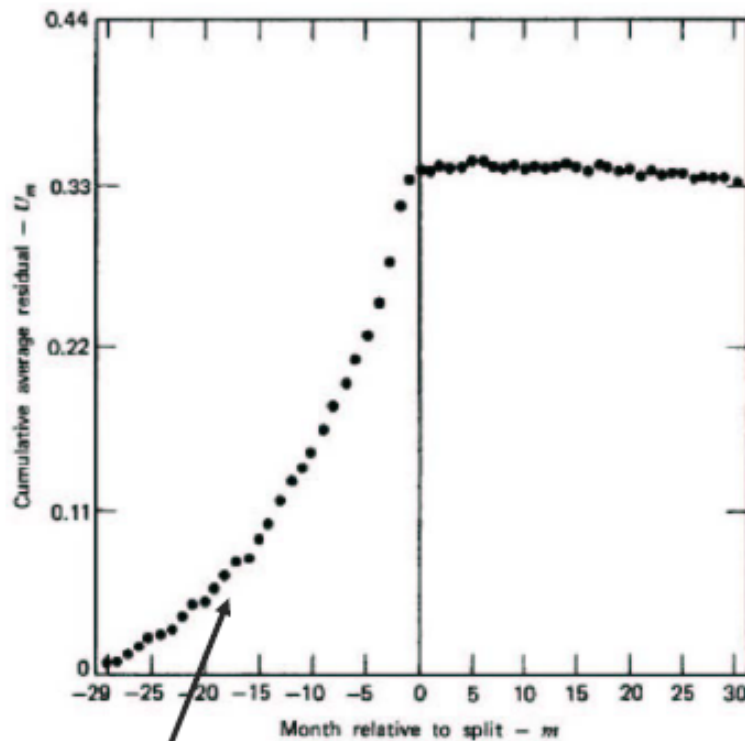


Cumulative abnormal returns around earning announcements

Figure 2a. Plot of cumulative abnormal return for earnings 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

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

Split is a signal of good profit

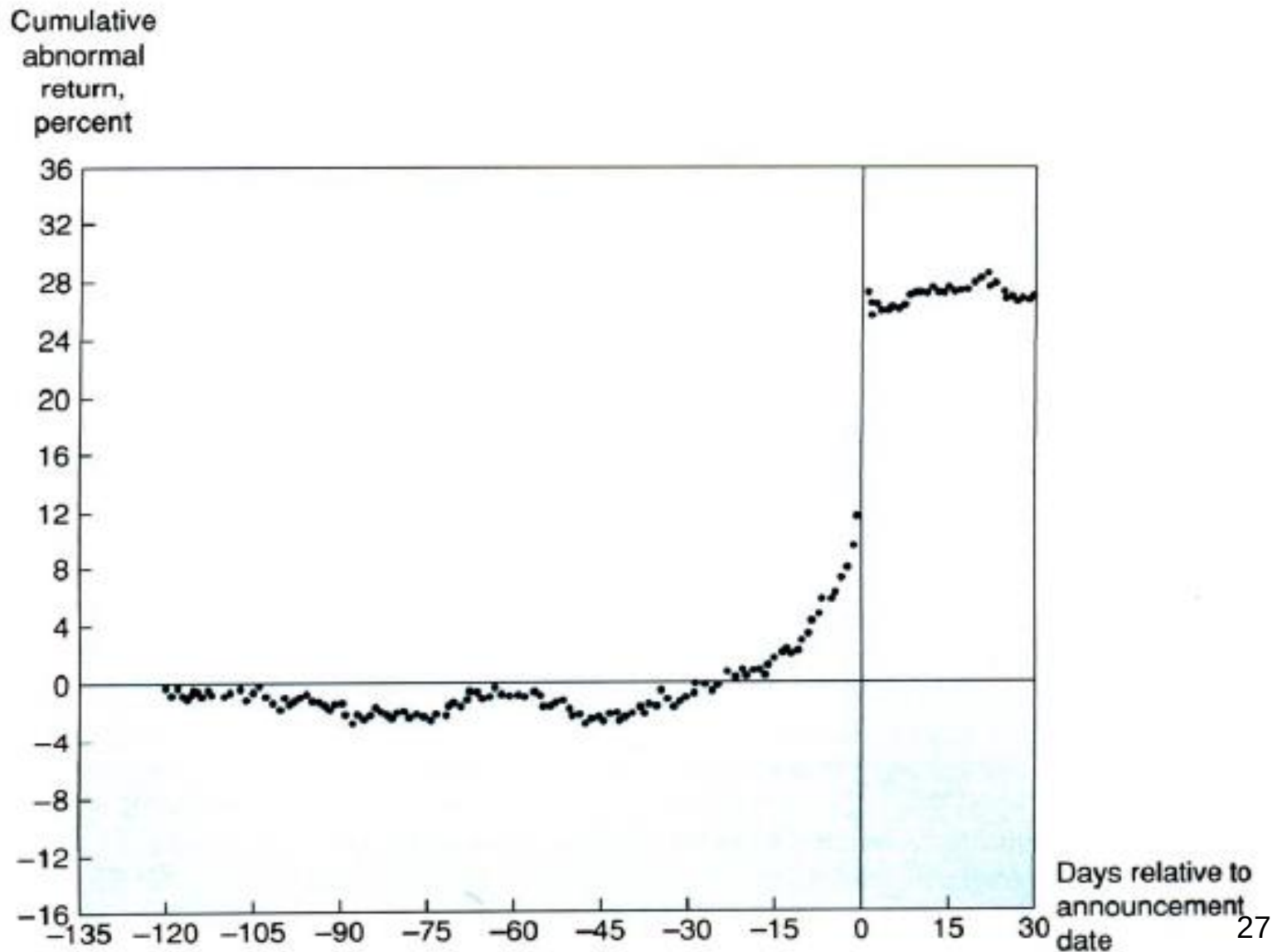
Pre-announcement drift can be due
to selection bias (only firms whose
price rose) or insider trading.

→ inconclusive

No post-announcement drift

→ for weak form

Event study: take over announcement



Event study: death of CEO

Stock Price and CEO Death

Source: Johnson et al.

