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: ⇒ optimal risk sharing

• Informational (Market) Efficiency
  ➢ Price reflects all (xxxxx) information
  ➢ Efficient Market Hypothesis = “Price is right”-Hypothesis
EMH ⇒ Martingale Property

- A stock price is always at the “fair” level (fundamental value)
- ⇒ discounted stock price/gain process is a Martingale process [using the equivalent martingale measure E^*[.] ]
  - 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

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 \( t \) return \( R_t \) is zero:

\[
E \left( R_{t+1} \mid R_t \right) = 0
\]
Predictability of Returns

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

  \[
  \text{Return on day } t + 1 = R_{t+1} \\
  \text{Return on day } t = R_t
  \]

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

  \[
  E^* (R_{t+1}|R_t) = \alpha
  \]
Non-Predictability of any current Information

\[ E(R_{t+1} | I_t) = 0 \]

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 \( I_t \).
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

• All traders know that (e.g. price is too high)
• All traders know that all traders know that…
• All traders know that … that …
• …
• …∞

mutual knowledge
1\text{st} \text{ order}
2\text{nd} \text{ order}
n\text{th} \text{ order}
∞ \text{ th} \text{ 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
    \[(S^1, \ldots, S^i, \ldots, S^I) \mapsto \bar{S} \text{ (sufficient statistic)}\]
  - 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

Returns to previous 5 year’s winner-loser stocks (market adjusted returns)
...Short-run Momentum

Momentum
Monthly Difference Between Winner and Loser Portfolios at Announcement Dates

Months Following 6 Month Performance Period
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”:
   \[ t = -30, -29, \ldots, -1, 0, 1, \ldots, 29, 30 \]
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 → against strong-form

Post-announcement drift → against semi-strong form
Event Study: Earning Announcement

Cumulative abnormal returns around earning announcements

(MacKinlay 1997)
Event Study: Stock Splits

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

Selection bias or Insider trading

No post-announcement drift → for weak form
Event Study: Take-over

Cumulative abnormal return, percent

Days relative to announcement date

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Market Efficiency
Event Study: Death of CEO

Stock Price and CEO Death

Source: Johnson et al.

CEO as Founder

CEO as Non-Founder

Cumulative abnormal returns (in percentage terms)

Days after death

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Market Efficiency
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

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

before expenses

after expenses
...Outperformance (more recent)

\[ R_{\text{fund}}^f - R_f = \alpha + \beta_{\text{fund}} [R_m^f - R_f] + \epsilon \]

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

At best, chances even worse than 1:3!

Source: Carhart (1997)
Summary

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