Artificial Intelligence in Finance and Quantitative Analysis

Event Studies in Finance

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https://web.ntpu.edu.tw/~myday

1111AIFQA04
MBA, IM, NTPU (M6132) (Fall 2022)
Tue 2, 3, 4 (9:10-12:00) (B8F40)

https://meet.google.com/paj-zhhj-mya
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<th>Date</th>
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<td>18</td>
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Event Studies in Finance
Outline

• Event Studies in Finance
• Event Studies for Financial Research
• Event Study Methodology
• Efficient Market Hypothesis (EMH)
  • Efficient Markets
  • Inefficient Markets
Doron Kliger and Gregory Gurevich (2014),
Event Studies for Financial Research:
A Comprehensive Guide,
Palgrave Macmillan

Event Studies in Finance

• Event studies are widely used in finance research to investigate the implications of
  • Announcements of corporate initiatives
    • Mergers and acquisitions, equity and debt issuance, dividends and repurchases, corporate restructuring
  • Regulatory changes
    • Board reform, compensation, changes in taxation, workplace safety
  • Macroeconomic shocks on stock prices
    • The COVID-19 pandemic, Brexit, the Paris Agreement

Firm-level Event Studies

• M&As
• Restructuring
• Equity issuance
• Dividends
• Analyst forecasts and recommendations
• Earnings

## Single- and Cross-county Event Studies

Published in the four major finance and IB journals

### Firm-level events

<table>
<thead>
<tr>
<th>Event/sample</th>
<th>Single-country sample</th>
<th>Cross-country sample</th>
<th>Cross country (%)</th>
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<tbody>
<tr>
<td></td>
<td>JF</td>
<td>JFE</td>
<td>RFS</td>
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<tr>
<td><strong>M&amp;As</strong></td>
<td>35</td>
<td>50</td>
<td>13</td>
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<td><strong>Restructuring</strong></td>
<td>16</td>
<td>18</td>
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<td><strong>Equity issuance</strong></td>
<td>15</td>
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<td>6</td>
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<td><strong>Dividends</strong></td>
<td>9</td>
<td>11</td>
<td>3</td>
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<tr>
<td><strong>Analyst forecasts and recommendations</strong></td>
<td>9</td>
<td>6</td>
<td>3</td>
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<td><strong>Earnings</strong></td>
<td>9</td>
<td>5</td>
<td>4</td>
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<td><strong>Board structure changes</strong></td>
<td>7</td>
<td>9</td>
<td>3</td>
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<td><strong>Debt issuance</strong></td>
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<td>9</td>
<td>3</td>
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<td><strong>Investor activism and voting</strong></td>
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<td><strong>Listing/delisting</strong></td>
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<td>0</td>
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<td>7</td>
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<td><strong>Managerial turnover</strong></td>
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<td>7</td>
<td>2</td>
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<tr>
<td><strong>Bankruptcy and liquidation</strong></td>
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<td>3</td>
<td>2</td>
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<td><strong>Managerial compensation</strong></td>
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<tr>
<td><strong>Credit ratings</strong></td>
<td>5</td>
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<td>1</td>
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<td><strong>Right offerings</strong></td>
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<td><strong>Bank loan</strong></td>
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<td>1</td>
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<td><strong>IPOs, IPO lockups, and quiet period</strong></td>
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<td>2</td>
<td>3</td>
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</table>

### Single- and Cross-county Event Studies

*published in the four major finance and IB journals*

<table>
<thead>
<tr>
<th>Event/sample</th>
<th>Single-country sample</th>
<th>Cross-country sample</th>
<th>Cross country (%)</th>
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<tbody>
<tr>
<td><strong>Country-level events</strong></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Governance reform/legislative change</td>
<td>8 JF, 15 JFE, 6 RFS, 0 JIBS, Total 29</td>
<td>2 JF, 1 JFE, 0 RFS, 0 JIBS, Total 3</td>
<td>9.38</td>
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<td>Elections/Political risk events</td>
<td>0 JF, 8 JFE, 5 RFS, 0 JIBS, Total 13</td>
<td>1 JF, 0 JFE, 1 RFS, 2 JIBS, Total 4</td>
<td>23.53</td>
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<td>Monetary policy</td>
<td>5 JF, 4 JFE, 1 RFS, 0 JIBS, Total 10</td>
<td>0 JF, 0 JFE, 2 RFS, 0 JIBS, Total 2</td>
<td>16.67</td>
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<td>Market trading mechanism changes</td>
<td>3 JF, 6 JFE, 1 RFS, 0 JIBS, Total 10</td>
<td>1 JF, 0 JFE, 0 RFS, 0 JIBS, Total 1</td>
<td>9.09</td>
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<td>Government intervention</td>
<td>2 JF, 0 JFE, 1 RFS, 0 JIBS, Total 3</td>
<td>3 JF, 0 JFE, 1 RFS, 0 JIBS, Total 4</td>
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<td>News</td>
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<td>0 JF, 1 JFE, 0 RFS, 2 JIBS, Total 3</td>
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<td>Natural disasters</td>
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<td>0 JF, 0 JFE, 0 RFS, 1 JIBS, Total 1</td>
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# Single- and Cross-county Event Studies

*published in the four major finance and IB journals*

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<th>Event/sample</th>
<th>Single-country sample</th>
<th></th>
<th>Cross-country sample</th>
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<th>Cross country (%)</th>
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<td>JFE</td>
<td>RFS</td>
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<td>Distress in bank–borrower relationship</td>
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<td>1</td>
<td>0</td>
<td>0</td>
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<td>Bankruptcy</td>
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<td>3</td>
<td>0</td>
<td>0</td>
<td>3</td>
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<td>M&amp;As</td>
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<td>Proxy contests</td>
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<td>Others</td>
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Event Studies for Financial Research
state-of-the-art event study software

**event studies**

**Short- and Long-Term Event Studies**
- Cumulative Abnormal Returns
- Buy-and-hold Abnormal Returns
- Fama-French Calander Time Portfolios

**Parametric and Non-Parametric Tests**
- Time-Series t-Test
- Cross-Sectional t-Test
- Standardized Residual Test
- Standardized Cross-Sectional Test
- Corrado Rank Test
- Generalized Sign Test
- Skewness-Adjusted t-Test

**Return Models**
- Constant-Mean
- Market Adjusted
- Market Model
- Factor Model
- Matching Models
- Stocks and Bonds

https://eventstudymetrics.com/
Event Studies in Economics and Finance

Event Study

Source: Rajesh Mudholkar (2014), "Event studies: Confirms Market Efficiency or Behavioral Anomalies?", https://www.youtube.com/watch?v=VErwDaQNB74
Event Study
Time line for an event study

Source: https://eventstudymetrics.com/index.php/event-study-methodology/
Event Study Methodology

Source: https://eventstudymetrics.com/index.php/event-study-methodology/
Event Study Methodology

- **Estimation window**
  - $T_0$ to $T_1$
  - $L_1$

- **Event window**
  - $T_1$ to $T_2$
  - $L_2$

- **Post event window**
  - $T_2$ to $T_3$

Source: https://eventstudymetrics.com/index.php/event-study-methodology/
Event Study Methodology

Source: https://eventstudymetrics.com/index.php/event-study-methodology/
Efficient Markets
Behavioral Economics
Behavioral Finance
Rational Behavior

Irrational Behavior
Emotion

Sentiment
Modern Financial Research

• Theoretical Finance
  • study of logical relationships among assets.

• Empirical Finance
  • study of data in order to infer relationships.

• Behavioral Finance
  • integrates psychology into the investment process.

Source: Robert A. Strong (2004), Practical Investment Management, South-Western
Behavioral Finance Themes

• Heuristic-Driven Bias
• Framing Dependence
• Inefficient Markets

Efficient Market Hypothesis (EMH)

Efficient Market Hypothesis (EMH) (Fama, 1970)

Efficient capital markets: A review of theory and empirical work
EF Fama - The Journal of Finance, 1970

This paper reviews the theoretical and empirical literature on the efficient markets model. After a discussion of the theory, empirical work concerned with the adjustment of security prices to three relevant information subsets is considered. First, weak form tests, in which the information set is just historical prices, are discussed. Then semi-strong form tests, in which the concern is whether prices efficiently adjust to other information that is obviously ...

Cited by 34710 Related articles All 27 versions

Efficient capital markets: A review of theory and empirical work.
Efficient Market Hypothesis (EMH) (Fama, 1970)

SESSION TOPIC: STOCK MARKET PRICE BEHAVIOR

SESSION CHAIRMAN: BURTON G. MALKIEL

EFFICIENT CAPITAL MARKETS: A REVIEW OF THEORY AND EMPIRICAL WORK*

EUGENE F. FAMA**

I. INTRODUCTION

The primary role of the capital market is allocation of ownership of the economy's capital stock. In general terms, the ideal is a market in which prices provide accurate signals for resource allocation: that is, a market in which firms can make production-investment decisions, and investors can choose among the securities that represent ownership of firms' activities under the assumption that security prices at any time "fully reflect" all available information. A market in which prices always "fully reflect" available information is called "efficient."

This paper reviews the theoretical and empirical literature on the efficient markets model. After a discussion of the theory, empirical work concerned with the adjustment of security prices to three relevant information subsets is considered. First, weak form tests, in which the information set is just historical prices, are discussed. Then semi-strong form tests, in which the concern is whether prices efficiently adjust to other information that is obviously publicly available (e.g., announcements of annual earnings, stock splits, etc.) are considered. Finally, strong form tests concerned with whether given investors or groups have monopolistic access to any information relevant for price formation are reviewed. We shall conclude that, with but a few exceptions, the efficient markets model stands up well.

TABLE 1 (from [10])
First-order Serial Correlation Coefficients for One-, Four-, Nine-, and Sixteen-Day
Changes in Log, Price

<table>
<thead>
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<th>Stock</th>
<th>One</th>
<th>Four</th>
<th>Nine</th>
<th>Sixteen</th>
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<tr>
<td>Allied Chemical</td>
<td>.017</td>
<td>.029</td>
<td>-.091</td>
<td>-.118</td>
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<td>Alcoa</td>
<td>.118*</td>
<td>.095</td>
<td>-.112</td>
<td>-.044</td>
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<td>American Can</td>
<td>-.087*</td>
<td>-.124*</td>
<td>-.060</td>
<td>.031</td>
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<tr>
<td>A. T. &amp; T.</td>
<td>-.039</td>
<td>-.010</td>
<td>-.009</td>
<td>-.003</td>
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<tr>
<td>American Tobacco</td>
<td>.111*</td>
<td>-.175*</td>
<td>.033</td>
<td>.007</td>
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<tr>
<td>Anaconda</td>
<td>.057*</td>
<td>-.068</td>
<td>-.125</td>
<td>.202</td>
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<tr>
<td>Bethlehem Steel</td>
<td>.013</td>
<td>-.122</td>
<td>-.148</td>
<td>.112</td>
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<tr>
<td>Chrysler</td>
<td>.012</td>
<td>.060</td>
<td>-.026</td>
<td>.040</td>
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<tr>
<td>Du Pont</td>
<td>.013</td>
<td>.069</td>
<td>-.043</td>
<td>-.055</td>
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<tr>
<td>Eastman Kodak</td>
<td>.025</td>
<td>-.006</td>
<td>-.053</td>
<td>-.023</td>
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<tr>
<td>General Electric</td>
<td>.011</td>
<td>.020</td>
<td>-.004</td>
<td>.000</td>
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<tr>
<td>General Foods</td>
<td>.051*</td>
<td>-.005</td>
<td>-.140</td>
<td>-.098</td>
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<tr>
<td>General Motors</td>
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<td>-.128*</td>
<td>.009</td>
<td>-.028</td>
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<td>Goodyear</td>
<td>-.123*</td>
<td>.001</td>
<td>-.037</td>
<td>.033</td>
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<td>-.068</td>
<td>-.244*</td>
<td>.116</td>
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<td>International Nickel</td>
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<td>.038</td>
<td>.124</td>
<td>.041</td>
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<td>International Paper</td>
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<td>.060</td>
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<td>-.002</td>
<td>.002</td>
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<tr>
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<td>.003</td>
<td>-.022</td>
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<td>Procter &amp; Gamble</td>
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<td>.098</td>
<td>.076</td>
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<td>Sears</td>
<td>.007*</td>
<td>-.070</td>
<td>-.113</td>
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<td>Standard Oil (Calif.)</td>
<td>.025</td>
<td>-.143*</td>
<td>-.046</td>
<td>.040</td>
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<td>Standard Oil (N.J.)</td>
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<td>-.082</td>
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<tr>
<td>Swift &amp; Co.</td>
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<td>-.072</td>
<td>.118</td>
<td>-.197</td>
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<td>Texaco</td>
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<td>-.053</td>
<td>-.047</td>
<td>-.178</td>
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<td>Union Carbide</td>
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<td>.049</td>
<td>-.101</td>
<td>.124</td>
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<td>United Aircraft</td>
<td>.014</td>
<td>-.190*</td>
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<td>U.S. Steel</td>
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<td>-.006</td>
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<td>Westinghouse</td>
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<td>-.097</td>
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<td>Woolworth</td>
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<td>-.033</td>
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<td>.040</td>
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</table>

* Coefficient is twice its computed standard error.
Cumulative Average Residuals

Figure 1a
Cumulative average residuals—all splits.

Cumulative Average Residuals

**Figure 1b**
Cumulative average residuals for dividend "increases."

**Figure 1c**
Cumulative average residuals for dividend "decreases."

Market Efficiency

The empirical work itself can be divided into three categories depending on the nature of the information subset of interest. *Strong-form* tests are concerned with whether individual investors or groups have monopolistic access to any information relevant for price formation. One would not expect such an extreme model to be an exact description of the world, and it is probably best viewed as a benchmark against which the importance of deviations from market efficiency can be judged. In the less restrictive *semi-strong-form* tests the information subset of interest includes all obviously publicly available information, while in the *weak form* tests the information subset is just historical price or return sequences.

Types of Efficiency Market

• Weak Form
  • Security prices reflect all information found in past prices and volume.

• Semi-Strong Form
  • Security prices reflect all publicly available information.

• Strong Form
  • Security prices reflect all information—public and private.

Can Financing Decisions Create Value?

What Sort of Financing Decisions?

• Typical financing decisions include:
  • How much debt and equity to sell
  • When (or if) to pay dividends
  • When to sell debt and equity
• Just as we can use NPV criteria to evaluate investment decisions, we can use NPV to evaluate financing decisions.

How to Create Value through Financing

• Fool Investors
  • Empirical evidence suggests that it is hard to fool investors consistently.

• Reduce Costs or Increase Subsidies
  • Certain forms of financing have tax advantages or carry other subsidies.

• Create a New Security
  • Sometimes a firm can find a previously-unsatisfied clientele and issue new securities at favorable prices.
  • In the long-run, this value creation is relatively small, however.

Efficient Capital Markets

• An efficient capital market is one in which stock prices fully reflect available information.

• The EMH has implications for investors and firms.
  • Since information is reflected in security prices quickly, knowing information when it is released does an investor no good.
  • Firms should expect to receive the fair value for securities that they sell. Firms cannot profit from fooling investors in an efficient market.

Reaction of Stock Price to New Information in Efficient and Inefficient Markets

Efficient market response to “good news”

Overreaction to “good news” with reversion

Delayed response to “good news”

Reaction of Stock Price to New Information in Efficient and Inefficient Markets

Efficient market response to “bad news”

Overreaction to “bad news” with reversion

Delayed response to “bad news”

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

Relationship among Three Different Information Sets

- All information relevant to a stock
- Information set of publicly available information
- Information set of past prices

Efficient Market

• An efficient market incorporates information in security prices.

• There are three forms of the EMH:
  
  • **Weak-Form EMH**
    
    Security prices reflect past price data.
  
  • **Semistrong-Form EMH**
    
    Security prices reflect publicly available information.
  
  • **Strong-Form EMH**
    
    Security prices reflect all information.

• There is abundant evidence for the first two forms of the EMH.

Investor behavior tends to eliminate any profit opportunity associated with stock price patterns. If it were possible to make big money simply by finding “the pattern” in the stock price movements, everyone would do it and the profits would be competed away.

Evidence on Market Efficiency

• Return Predictability Studies
• Event Studies
• Performance Studies

Event Studies

• Objective

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

Event Studies Methodology

1. Define as day “zero” the day the information is released
2. Calculate the daily returns $R_{it}$ the 30 days around day “zero”: $t = -30, -29, ..., -1, 0, 1, ..., 29, 30$
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 (AR) as the difference $AR_{it} = R_{it} - R_{mt}$
5. Calculate Average Abnormal Returns (AAR) 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
   \[
   CAAR_T = \sum_{t=-30}^{T} AAR_t
   \]

Event Studies Methodology

Step 1.
Define as day “zero” the day the information is released

Step 2.
Calculate the daily returns $R_{it}$ the 30 days around day “zero”: $t = -30, -29, \ldots, -1, 0, 1, \ldots, 29, 30$

Event Studies Methodology

Step 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)

Event Studies Methodology

Step 4.
Define
Abnormal Returns (AR) as the difference

\[ AR_{it} = R_{it} - R_{mt} \]

Step 5.
Calculate
Average Abnormal Returns (AAR)
over all N events in the sample for
all 60 reference days

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

Event Studies Methodology

Step 6.
Cumulate the returns on the first T days to Cumulative Average Abnormal Returns (CAAR)

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

Event Studies Methodology

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 (AR) as the difference
   \[ AR_{it} = R_{it} - R_{mt} \]

5. Calculate Average Abnormal Returns (AAR) 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

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

Over-reaction

Efficient Reaction

Under-reaction

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

No post-announcement drift ! for weak form

Event Study: Take-over

Event Study: Death of CEO

Stock Price and CEO Death

Source: Johnson et al.

Days after death

Cumulative abnormal returns (in percentage terms)

CEO as Founder

CEO as Non-Founder

Evidence I: Predictabilities Studies

• Statistical variables have only low forecasting power, but
  • But some forecasting power for P/E or B/M
  • Short-run momentum and long-run reversals
• Calendar specific abnormal returns due to Monay 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

Corrective wedge pattern or the start of a new trading range?

Getting Technical

Back to Buy Low, Sell High  

Barron’s March 12, 2003

What Pattern Do You See?

With different patterns, you may believe that you can predict the next value in the series—even though you know it is random.

Event Studies: Dividend Omissions

Cumulative Abnormal Returns for Companies Announcing Dividend Omissions

The Record of Mutual Funds

Annual Return Performance of Different Types of U.S. Mutual Funds Relative to a Broad-Based Market Index (1963-1998)

Taken from Lubos Pastor and Robert F. Stambaugh, “Evaluating and Investing in Equity Mutual Funds,” unpublished paper, Graduate School of Business, University of Chicago (March 2000).

Weak Form Market Efficiency

• Security prices reflect all information found in past prices and volume.

• If the weak form of market efficiency holds, then technical analysis is of no value.

• Often weak-form efficiency is represented as

\[ P_t = P_{t-1} + \text{Expected return} + \text{random error}_t \]

• Since stock prices only respond to new information, which by definition arrives randomly, stock prices are said to follow a random walk.

Market Efficiency

• One group of studies of strong-form market efficiency investigates insider trading.

• A number of studies support the view that insider trading is abnormally profitable.

• Thus, strong-form efficiency does not seem to be substantiated by the evidence

Why Doesn’t Everybody Believe the EMH?

- There are optical illusions, mirages, and apparent patterns in charts of stock market returns.
- The truth is less interesting.
- There is some evidence against market efficiency:
  - Seasonality
  - Small versus Large stocks
  - Value versus growth stocks
- The tests of market efficiency are weak.

Efficient Markets
Inefficient Markets
Behavioral Finance
Python in Google Colab (Python101)

https://colab.research.google.com/drive/1FEG6DnGvwfUbeo4zJ1zTunjMqf2RkCrT

```python
# Future Value
pv = 100
r = 0.1
n = 7
fv = pv * ((1 + (r)) ** n)
print(round(fv, 2))
```

```
amount = 100
interest = 10 #10% = 0.01 * 10
years = 7
future_value = amount * ((1 + (0.01 * interest)) ** years)
print(round(future_value, 2))
```

```
# Python Function def
def getFV(pv, r, n):
fv = pv * ((1 + (r)) ** n)
return fv
fv = getFV(100, 0.1, 7)
print(round(fv, 2))
```

```
# Python if else
score = 80
if score >=60 :
  print("Pass")
else:
  print("Fail")
```

https://tinyurl.com/aintpupython101
Summary

• Event Studies in Finance
• Event Studies for Financial Research
• Event Study Methodology
• Efficient Market Hypothesis (EMH)
  • Efficient Markets
  • Inefficient Markets
References

• Ross et al. (2005), Corporate Finance, 7th Edition, McGraw–Hill
References