AI in Finance
Big Data Analytics

Event Studies in Finance

1081AIFBDA05
TLVXM2A (M2449) (8497) (Fall 2019)
(MBA, DBETKU) (3 Credits, Required) [Full English Course]
(Master’s Program in Digital Business and Economics)
Tue, 2, 3, 4, (9:10-12:00) (B1012)

Min-Yuh Day, Ph.D.
Associate Professor
Department of Information Management
Tamkang University

http://mail.tku.edu.tw/myday

2019-10-08
<table>
<thead>
<tr>
<th>Week</th>
<th>Date</th>
<th>Subject/Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2019/09/10</td>
<td>Course Orientation on AI in Finance Big Data Analytics</td>
</tr>
<tr>
<td>2</td>
<td>2019/09/17</td>
<td>AI in FinTech: Financial Services Innovation and Application</td>
</tr>
<tr>
<td>3</td>
<td>2019/09/24</td>
<td>ABC: AI, Big Data, Cloud Computing</td>
</tr>
<tr>
<td>4</td>
<td>2019/10/01</td>
<td>Business Models of Fintech</td>
</tr>
<tr>
<td>5</td>
<td>2019/10/08</td>
<td>Event Studies in Finance</td>
</tr>
<tr>
<td>6</td>
<td>2019/10/15</td>
<td>Case Study on AI in Finance Big Data Analytics I</td>
</tr>
<tr>
<td>7</td>
<td>2019/10/22</td>
<td>Foundations of AI in Finance Big Data Analytics with Python</td>
</tr>
<tr>
<td>8</td>
<td>2019/10/29</td>
<td>Case Study on Financial Industry Practice I</td>
</tr>
<tr>
<td>9</td>
<td>2019/11/05</td>
<td>Quantitative Investing with Pandas in Python</td>
</tr>
<tr>
<td>Week</td>
<td>Date</td>
<td>Subject/Topics</td>
</tr>
<tr>
<td>------</td>
<td>------------</td>
<td>--------------------------------------------------------------------</td>
</tr>
<tr>
<td>10</td>
<td>2019/11/12</td>
<td>Midterm Project Report</td>
</tr>
<tr>
<td>11</td>
<td>2019/11/19</td>
<td>Machine Learning in Finance Application with Scikit-Learn In Python</td>
</tr>
<tr>
<td>13</td>
<td>2019/12/03</td>
<td>Case Study on AI in Finance Big Data Analytics II</td>
</tr>
<tr>
<td>14</td>
<td>2019/12/10</td>
<td>Deep Learning for Financial Time Series Forecasting with TensorFlow II</td>
</tr>
<tr>
<td>15</td>
<td>2019/12/17</td>
<td>Case Study on Financial Industry Practice II</td>
</tr>
<tr>
<td>17</td>
<td>2019/12/31</td>
<td>Final Project Presentation I</td>
</tr>
<tr>
<td>18</td>
<td>2020/01/07</td>
<td>Final Project Presentation II</td>
</tr>
</tbody>
</table>
Event Studies in Finance
Doron Kliger and Gregory Gurevich (2014),
Event Studies for Financial Research:
A Comprehensive Guide,
Palgrave Macmillan

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 Calendar 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/](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

- **estimation window**: $T_0$ to $T_1$
- **event window**: $T_1$ to $T_2$
- **post event window**: $T_2$ to $T_3$

$L_1$: -30 to $T_1$
$L_2$: -1 to +5

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

Source: https://www.amazon.com/Beyond-Greed-Fear-Understanding-Association/dp/0195304217
Andrei Shleifer (2000),
Inefficient Markets: An Introduction to Behavioral Finance,
Oxford University Press
Lucy Ackert and Richard Deaves (2009), Behavioral Finance: Psychology, Decision-Making, and Markets, South-Western College Pub
Edwin Burton and Sunit N. Shah (2013)
Behavioral Finance: Understanding the Social, Cognitive, and Economic Debates, Wiley

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 capital markets: A review of theory and empirical work

BG Malkiel, EF Fama - The Journal of Finance, 1970 - Wiley Online Library

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 20928 Related articles All 28 versions

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$_e$ Price

<table>
<thead>
<tr>
<th>Stock</th>
<th>One</th>
<th>Four</th>
<th>Nine</th>
<th>Sixteen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allied Chemical</td>
<td>.017</td>
<td>.029</td>
<td>-.091</td>
<td>-.118</td>
</tr>
<tr>
<td>Alcoa</td>
<td>.118*</td>
<td>.095</td>
<td>-.112</td>
<td>-.044</td>
</tr>
<tr>
<td>American Can</td>
<td>-.087*</td>
<td>-.124*</td>
<td>-.060</td>
<td>.031</td>
</tr>
<tr>
<td>A. T. &amp; T.</td>
<td>-.039</td>
<td>-.010</td>
<td>-.009</td>
<td>-.003</td>
</tr>
<tr>
<td>American Tobacco</td>
<td>.111*</td>
<td>-.175*</td>
<td>.033</td>
<td>.007</td>
</tr>
<tr>
<td>Anaconda</td>
<td>.067*</td>
<td>-.068</td>
<td>-.125</td>
<td>.202</td>
</tr>
<tr>
<td>Bethlehem Steel</td>
<td>.013</td>
<td>-.122</td>
<td>-.148</td>
<td>.112</td>
</tr>
<tr>
<td>Chrysler</td>
<td>.012</td>
<td>.060</td>
<td>-.026</td>
<td>.040</td>
</tr>
<tr>
<td>Du Pont</td>
<td>.013</td>
<td>.069</td>
<td>-.043</td>
<td>-.055</td>
</tr>
<tr>
<td>Eastman Kodak</td>
<td>.025</td>
<td>-.006</td>
<td>-.053</td>
<td>-.023</td>
</tr>
<tr>
<td>General Electric</td>
<td>.011</td>
<td>.020</td>
<td>-.004</td>
<td>.000</td>
</tr>
<tr>
<td>General Foods</td>
<td>.061*</td>
<td>-.005</td>
<td>-.140</td>
<td>-.098</td>
</tr>
<tr>
<td>General Motors</td>
<td>-.004</td>
<td>-.128*</td>
<td>.009</td>
<td>-.028</td>
</tr>
<tr>
<td>Goodyear</td>
<td>-.123*</td>
<td>.001</td>
<td>-.037</td>
<td>.033</td>
</tr>
<tr>
<td>International Harvester</td>
<td>-.017</td>
<td>-.068</td>
<td>-.244*</td>
<td>.116</td>
</tr>
<tr>
<td>International Nickel</td>
<td>.096*</td>
<td>.038</td>
<td>.124</td>
<td>.041</td>
</tr>
<tr>
<td>International Paper</td>
<td>.046</td>
<td>.060</td>
<td>-.004</td>
<td>-.010</td>
</tr>
<tr>
<td>Johns Manville</td>
<td>.006</td>
<td>-.068</td>
<td>-.002</td>
<td>.002</td>
</tr>
<tr>
<td>Owens Illinois</td>
<td>-.021</td>
<td>-.006</td>
<td>.003</td>
<td>-.022</td>
</tr>
<tr>
<td>Procter &amp; Gamble</td>
<td>.099*</td>
<td>-.006</td>
<td>.098</td>
<td>.076</td>
</tr>
<tr>
<td>Sears</td>
<td>.097*</td>
<td>-.070</td>
<td>-.113</td>
<td>.041</td>
</tr>
<tr>
<td>Standard Oil (Calif.)</td>
<td>.025</td>
<td>-.143*</td>
<td>-.046</td>
<td>.040</td>
</tr>
<tr>
<td>Standard Oil (N.J.)</td>
<td>.008</td>
<td>-.109</td>
<td>-.082</td>
<td>-.121</td>
</tr>
<tr>
<td>Swift &amp; Co.</td>
<td>-.004</td>
<td>-.072</td>
<td>.118</td>
<td>-.197</td>
</tr>
<tr>
<td>Texaco</td>
<td>.094*</td>
<td>-.053</td>
<td>-.047</td>
<td>-.178</td>
</tr>
<tr>
<td>Union Carbide</td>
<td>.107*</td>
<td>.049</td>
<td>-.101</td>
<td>.124</td>
</tr>
<tr>
<td>United Aircraft</td>
<td>.014</td>
<td>-.190*</td>
<td>-.192*</td>
<td>-.040</td>
</tr>
<tr>
<td>U.S. Steel</td>
<td>.040</td>
<td>-.006</td>
<td>-.056</td>
<td>.236*</td>
</tr>
<tr>
<td>Westinghouse</td>
<td>-.027</td>
<td>-.097</td>
<td>-.137</td>
<td>.067</td>
</tr>
<tr>
<td>Woolworth</td>
<td>.028</td>
<td>-.033</td>
<td>-.112</td>
<td>.040</td>
</tr>
</tbody>
</table>

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

\[ U_m \]

\[ 0.44 \]

\[ 0.33 \]

\[ 0.22 \]

\[ 0.11 \]

\[ 0 \]

\[ -29 \]

\[ -25 \]

\[ -20 \]

\[ -15 \]

\[ -10 \]

\[ -5 \]

\[ 0 \]

\[ 5 \]

\[ 10 \]

\[ 15 \]

\[ 20 \]

\[ 25 \]

\[ 30 \]

Month relative to split—m

**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."

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

Stock Price

Overreaction to “good news” with reversion

Efficient market response to “good news”

Delayed response to “good news”

Days before (-) and after (+) announcement

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.

Why Technical Analysis Fails

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”: $t = -30, -29, \ldots, -1, 0, 1, \ldots, 29, 30$
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
   \[ CAAR_T = \sum_{t=-30}^{T} AAR_t \]

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

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

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

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

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

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

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

Selection bias or Insider trading

Event Study: Take-over

Cumulative abnormal return, percent

Days relative to announcement date

Event Study: Death of CEO

Stock Price and CEO Death
Source: Johnson et al.

- Cumulative abnormal returns (in percentage terms)

CEO as Founder
CEO as Non-Founder

Days after death

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

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

Getting Technical
Barron’s March 5, 2003

STANDARD & POOR’S 500

($SPX,D) Dynamic, 0:00-24:00

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

Efficient market response to “bad news”

Days relative to announcement of dividend omission


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

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

• 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
References