Event Study

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Event Study Analysis

- <u>Definition</u>: An event study attempts to measure the valuation effects of an economic event, such as a merger or earnings announcement, by examining the response of the stock price or market value of firms.

- <u>Underlying assumption</u>: the market processes information about the event in an efficient and unbiased manner.

Event Study Analysis

- The event that affects a firm's valuation may be:

1) within the firm's control, such as the announcement of a stock split, bonus dividend distribution, bonus share, etc.

2) outside the firm's control, such as macroeconomic announcement that will affect the firm's future operations in some way.

Event Study Analysis

Various events can be examined:

- M&A

- earnings announcements, dividend announcements.

- issues of new debt or equity

- announcements of macroeconomic variables

- IPO

- Etc.

Classic References

- Brown and Warner (1980, 1985): Short-term performance studies
- Loughran and Ritter (1995): Long-term performance study.
- Barber and Lyon (1997) and Lyon, Barber and Tsai (1999): Long-term performance studies.
- Eckbo, Masulis and Norli (2000) and Mitchell and Stafford (2000): Potential problems with the existing long-term performance studies.
- Ahern (2008), WP: Sample selection and event study estimation.

Updated Reviews:

- M.J. Seiler (2004), Performing Financial Studies: A Methodological Cookbook. Chapter 13.
- Kothari and Warner (2006), Econometrics of event studies, Chapter 1 in Handbook of Corporate Finance: Empirical Corporate Finance

Relationship between event study and EMH

Stock Price

Overreaction

Efficient reaction →

Underreaction

-t

0

+t

Announcement Date
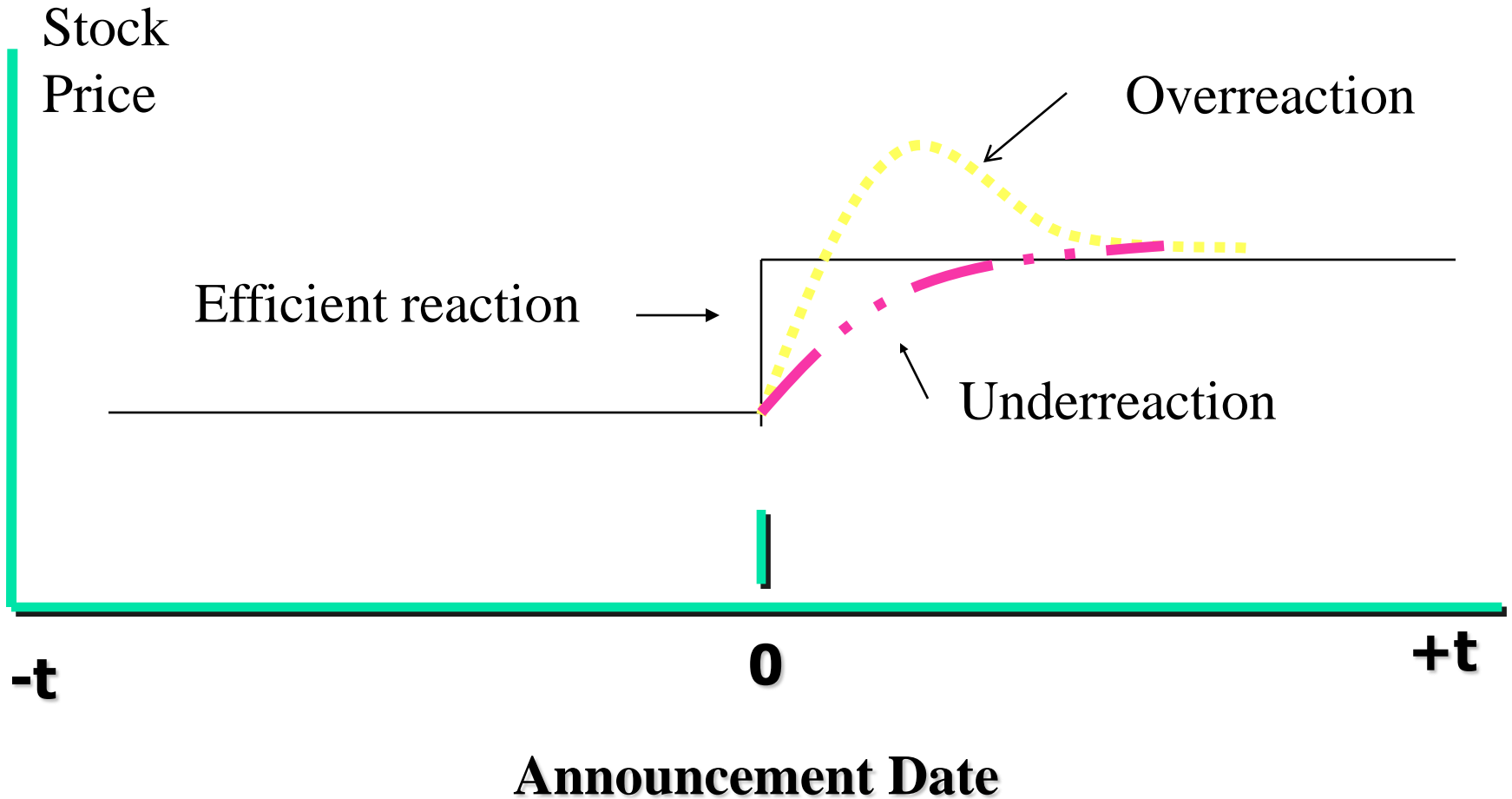
Event Study Design

- Goal: to measure the effect of an economic event on firm value
- Conventional steps for an event study (Fama, Fisher, Jensen and Roll, 1969; Campell, Lo and Mackinlay, 1977) :
  - Define the event and the event window
  - Selection Criteria
  - Calculate normal and abnormal returns for securities
  - Estimate model parameters with data
  - Conduct Test
  - Present results and diagnostics
  - Interpret results and draw inferences and conclusions

Time-line

- The time-line for a typical event study is shown below in event time:
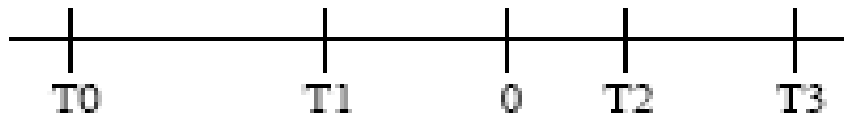
- The interval T0-T1 is the estimation period
- The interval T1-T2 is the event window
- Time 0 is the event date in calendar time
- The interval T2-T3 is the post-event window
- There is often a gap between the estimation and event periods

Time-line

- Issues with the Time-line:

- Definition of an event: We have to define what an event is. It must be unexpected. Also, we must know the exact date of the event. Dating is always a problem (WSJ is not a good source - leakage).

- Frequency of the event study: We have to decide how fast the information is incorporated into prices. We cannot look at yearly returns. We can't look at 10-seconds returns. People usually look at daily, weekly or monthly returns.

- Sample Selection: We have to decide what is the universe of companies in the sample.

Time-line

- Horizon of the event study: If markets are efficient, we should consider short horizons –i.e., a few days. However, people have looked at long-horizons. Event studies can be categorized by horizon:

➢ Short horizon (from 1-month before to 1-month after the event)

➢ Long horizon (up to 5 years after the event).

- Short and long horizon studies have different goals:

➢ Short horizon studies: how fast information gets into prices.

➢ Long horizon studies: Argument for inefficiency or for different expected returns (or a confusing combination of both)

Normal and Abnormal Return

- We can always decompose a return as:

$$R_{i;t} = E[R_{i;t} \mid X_t] + \xi_{i,t},$$

where X_t is the conditioning information at time t:

- In event studies, $\xi_{i;t}$ is called the "abnormal" return; while $E[R_{i;t} \mid X_t]$ is called expected return or "normal return".

Normal and Abnormal Return

- Definition of "Normal" Returns: We need a benchmark (control group) against which to judge the impact of returns.

- Normal return might be "ex-post" return that exist in the absence of significant event.

Normal and Abnormal Return

- **Mean adjusted model**

$$R_{i,t} = E[R_i; t \,|X_t] + \xi_{i,t} \,,$$

$$\text{where} \quad E[R_i; t \,|X_t] = \mu,$$

$$E[\xi_{i,t}] = 0 \text{ and } Var[\xi_{i,t}] = \sigma\xi, i2$$

The expected return for one security is assumed to be constant over time over estimation period.

Normal and Abnormal Return

- **Market Adjusted model** (the most popular in practice)
- For each asset i, the MM assumes that asset returns are given by:

$$R_{i,t} = E[R_{i;t} \,|X_t] + \xi_{i,t} \,,$$

$$\text{where } E[R_{i;t} \,|X_t] = \alpha_i + \beta_i \, R_{m,t} \,,$$

$$E[\xi_{i,t}] = 0 \text{ and } Var[\xi_{i,t}] = \sigma_{\xi,i}^2$$

In this model $R_{m,t}$ is the return on the market portfolio, and the model's linear specification follows from an assumed joint normality of returns.

Normal and Abnormal Return

- **Market and Risk Adjusted Model:**

➢ **CAPM**

$E[R_{i;t}|X_t] - r_{f,t} = \beta_i (E[R_{m,t} |X_t] - r_{f,t})$,

➢ **Fama and French (1993) (FF) 3 factor model**

$$E[R_{i;t}|X_t] - r_{f},t = a_i + b_{1i}(E[R_m|X_t] - r_f)_t + b_{2i}SML_t + b_{3i}HML_t$$

SML: returns on small (Size) portfolio minus returns on big portfolio

HML: returns on high (B/M) portfolio minus returns on low portfolio

- **More factors can be easily added to this ad-hoc model**, for example, a momentum factor –see, Carhart (1997) .

Testing procedure

- One might test the significance of an event by averaging the abnormal performance for the sampling of securities during the event period. If abnormal performance rapidly disappear, we have evidence of market efficiency.

- If, on the other hand, the market does not react efficiently, abnormal returns might be aggregated.

Testing procedure

- $AR_{i,t} = R_{i,t} - E[R_{i;t} \mid X_t]$

- CAR for each category is:

$$\overline{CAR}^{j}_{t,t+K} = \frac{1}{N_j} \sum_{n=1}^{N_j} CAR^{n}_{t,t+k}$$

- BHAR (Buy and Hold Abnormal Returns)

$$BHAR^{i}_{t,;t+K} = \Pi_k (1 + AR_{i,,t+k})$$

- Difference between CAR and BHAR: arithmetic versus geometric sums

Testing procedure

- Barber and Lyons (1997) relate BHAR and CAR in a regression:

$$BHAR_t = -0.013 + 1.041\ CAR_t + e_t$$

CARs are a biased predictor of long-run BHAR. (There is a measurement bias.)

- Question: Which method to use: BHAR or CAR?

  - For short horizons, both are very similar.

  - For long horizons, BHAR seems conceptually better.

Testing procedure

- Null Hypothesis: Event has no impact on returns – i.e., no abnormal mean returns, unusual return volatility, etc.

- **Parametric Test.**

- Traditional t-statistics (or variations of them) are used:

$$t_{CAR} = \overline{CAR_{i\tau}} / \left(\sigma(CAR_{i\tau}) / \sqrt{n} \right)$$

or

$$t_{BHAR} = \overline{BHAR_{i\tau}} / \left(\sigma(BHAR_{i\tau}) / \sqrt{n} \right)$$

Testing procedure

- **Non-Parametric Tests**

- Advantage: Free of specific assumptions about return distribution.

- <u>Intuition</u>: Let $p = P(CAR_i \geq 0)$, then under the usual event studies hypothesis, we have H_0: $p \leq 0.5$ against $H1$: $p > 0.5$. (Note if distribution of CAR_i is not symmetric, we need to adjust the formulation of p.)

- Popular Tests: Sign Test (assumes symmetry in returns) and Rank Test (allows for non-symmetry in returns). See Corrado (1989).

Testing procedure

- - Example: Sign Test

- Let N+ be the number of firms with CAR>0, and N the total number of firms in the sample. Then, H_0 can be tested using

$$J = [(N+/N) - 0.5] \, 2 \, N^{1/2} \sim^A N(0,1)$$

- Usually, non-parametric tests are used as a check of the parametric tests

Testing procedure

Econometric Problems

There are many econometric problems in event studies. The problems can be divided into two categories:

(i) Misspecifications of expected returns (wrong inference due to bias in the estimates of abnormal returns).

(ii) Non-random sample, leading to non-normal distributions (wrong inference due to standard error calculations).

Bootstrap

• **Basic Bootstrap Setup**

The bootstrap method consists of five basic steps:

(1) Get a sample of data size n from a population.

(2) Take a random sample of size n with replacement from the sample.

(3) Calculate the statistic of interest W under H_0 for the random sample.

(4) Repeat steps (2) and (3) a large number B times (say, 10,000).

(5) Create a relative frequency histogram of the B statistics of interest W under H_0 (all estimated W have the same probability.)

As B approaches infinity the bootstrap estimate of the statistic of interest will approach the population statistic.

Explaining CARs

- Once "abnormal" returns are found, it is common to try to explain CAR, or find whether CAR are correlated with some economic variables. That is, we want to run the regression:

$$CAR_{i,t} = \alpha + \delta X_{i,t} + \upsilon_{i,t}$$

usually, $X_{i,t}$ are firm characteristics.

Explaining CARs

- We can run this regression in the cross-section.

- Main problem with this regression. The OLS assumption $E[X_{i,t} \upsilon_{i,t}]=0$ might be violated. => Inconsistent estimates!

  (Endogeneity is the usual suspect in the cases where the event is within the firm's control.)