Lecture 5

Event studies: methodology and applications

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Key methodological references

- Campbell, J., A. Lo, and C. MacKinlay(1997), *The econometrics of financial markets, Princeton University Press, ch. 4*
- Mac Kinlay, C. (1997), “Event studies in economics and finance”, *Journal of EconomicLiterature.*

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Event Studies

What is an Event Study?

- An event study attempts to measure the valuation effects of an event, (in corporate finance it is typically a corporate event, such as a merger or earnings announcement), by examining the response of the stock price around the announcement of the event.
- In the rational interpretation:

  → Given the rationality in the market place, the effects of an event will be reflected immediately in security prices.
- In the "non-rational" context:

  → One could look at market reaction to infer preferences. However, this model leads to inconsistencies.

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Event Studies

- Loosely speaking, an event study is a t-test of a change in the price of some asset

  → One measures an unexpectedly large increase or decrease relative to the standard deviation of typical change

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Some examples of events are:

- Mergers and acquisitions
- Stock splits
- Earnings announcements
- Issues of new debt or equity
- Announcements of macroeconomic variables such as the trade deficit
- Announcements of new regulations or legislations:
  - Recent U.S. banking legislation allowing commercial banks to have investment banking operations
  - Introduction of pollution regulations

The majority of applications focus on the effect of an event on

→ the price of securities, most commonly equity

→ but also debt

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A bit of history:

The first published event study is by James Dolley (1933) who

→ studies nominal price changes at the time of stock splits

→ he finds that prices increased in 57 out of 95 splits, and the prices declined in 26 cases.

Other studies later on improved the methodology by removing general stock market price movements and separating out confounding events.

→ Seminal studies are by Ball and Brown (1968), and Fama et al. (1969) who introduced the methodology that is essentially the same as that which is in use today.

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Event Studies

The steps for an event study are as follows:

1. Define the event of interest
2. Define the event window, i.e. a period over which the event occurs
3. Define an estimation window – a period over which parameters are estimated
   → the event window should be short relative to the estimation window
4. Measure Normal and Abnormal Returns
5. Proceed to estimations
6. Testing of null hypothesis: e.g. the event has no effect stock prices
7. Empirical results
8. Interpretation

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Example:

Suppose one is looking at the information content of an earnings announcement with daily data,

- the event will be the earnings announcement
- the event window is the total period of time over which all statistically significant effects of the event on the stock price are presumed to take place.
  - The event window will include the one day of the announcement, but may also contain additional days. The additional days may be arranged either symmetrically or asymmetrically around the event date.
  - E.g. the day after the announcement should be included when the announcement was made after markets had closed

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Example (cont.):

- the estimation window (also called the comparison period) is the period which is used as the basis for estimating what the values of the observed time series during the announcement period would have been if the announcement had not occurred.
  - It excludes the event window, and can be symmetrical or asymmetrical around the event window.
  - Examples:
    - Kiger (1972) used a five-day period beginning eight days prior to the earnings announcement.
    - Eades, Hess, and Kim (1984) used 30 days on each side of the announcement period.
    - Zeghal (1983, 1984) used all of those days of the calendar year which did not fall within an announcement period.

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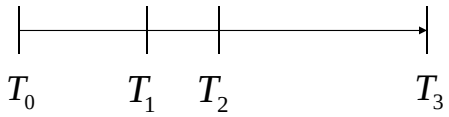
Event Studies

Formal definition of an event window:



$(T_0 \ldots T_1]$ is the estimation window

$(T_1 \ldots T_2]$ is the event window

$(T_2 \ldots T_3]$ is the post-event window

It is typical for the estimation window and the event window not to overlap.

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How to estimate the return due to the event?

- The return due to the event is called the

  "Abnormal Return"

- The Abnormal Return is:

  the actual ex-post return of the security over the event window minus the normal return of the firm over the event window

- The Normal return is:

  the expected return without conditioning on the event taking place, i.e. the return that would be expected if the event did not take place.

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For firm *i* and event date *t* the abnormal return is:

$$AR_{it} = R_{it} - E(R_{it} \mid X_t)$$

Where:

AR_{it} is the abnormal return

R_{it} is the actual return

$E(R_{it} \mid X_t)$ is the normal return

X_t is the conditional information for the normal return model.

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How to estimate the normal return?

There are two common models (statistical models):

- **The Constant Mean Return Model**

  -- where X_t is a constant and μ is the mean return for asset i

  $$R_{it} = \mu_i + \xi_{it}$$

  $$with \quad E(\xi_{it}) = 0 \quad Var(\xi_{it}) = \sigma^2_{\xi_i}$$

- **The Market model (most commonly used)**

  -- where X_t is the market return

  -- this model assumes a stable linear relation between the market return and the security return

  $$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}$$

  $$with \quad E(\varepsilon_{it}) = 0 \quad Var(\varepsilon_{it}) = \sigma^2_{\varepsilon_i} \quad E(\varepsilon_{it}\varepsilon_{it-j}) = 0$$

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- R_{it} *and* R_{mt} are the period-t returns on security i and the market portfolio respectively.
- Popular choices for the market portfolio include broad based stock indexes such as: the S&P 500 index, the CRSP Value Weighted Index, and the CRSP Equal Weighted Index.

- The market model improves over the constant mean return model:
  - by removing the portion of the return that is related to variation in the market's return, the variance of the abnormal return is reduced
  - This can increase the ability to detect event effects
- The benefit of each model will depend upon the R-squared of each model

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Measuring and analyzing abnormal returns:

Take the *market model* as the normal performance return model:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}$$

$$with \;\; E(\varepsilon_{it}) = 0 \;\; Var(\varepsilon_{it}) = \sigma^2_{\varepsilon_i} \;\; E(\varepsilon_{it}\varepsilon_{it-j}) = 0$$

Procedure:

1. Estimate the market model equation by OLS using data from the *estimation* window
2. Use the parameter estimates of the market model from the estimation window to calculate the possible abnormal return over the *event* window

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1) Estimated equation of the market model:

$$R_{it} = \hat{\alpha}_i + \hat{\beta}_i R_{mt} + \hat{\varepsilon}_{it}$$

--- t is for the estimation window and ranges from

$$T_0 + 1 \;\; to \;\; T_1$$

Under general conditions,

-- OLS is a consistent estimation procedure for the market model parameters

Given the assumptions on the market-model,

-- OLS is efficient

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2) Abnormal returns:

$$AR_{it} = \hat{\varepsilon}_{it} = R_{it} - \hat{\alpha}_i - \hat{\beta}_i R_{mt}$$

---t is for the event window and ranges from $T_1 + 1 \ to \ T_2$

- → The abnormal return is the actual return in the event window minus the return predicted by the market model (a benchmark) over the event window
- → The abnormal returns are simply the prediction errors of the model over the event window.

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Properties:

- Under the null hypothesis, conditional on the event window, the abnormal returns will be jointly normally distributed with:
  - a zero conditional mean $E(\varepsilon_{it}) = 0$
  - conditional variance

$$\sigma^2(AR_{it}) = \sigma^2_{\varepsilon_i} + \frac{1}{(T_1 - T_0)}\left[1 + \frac{(R_{mt} - \hat{\mu}_m)^2}{\hat{\sigma}^2_m}\right] \quad with \quad \hat{\mu}_m = \frac{1}{(T_1 - T_0)} \sum_{t=T_0+1}^{T_1} R_{mt}$$

- Under the null hypothesis H_0, that the event has no impact on the behavior of returns, the distribution of the sample abnormal return of a given observation in the event window is:

$$AR_{it} \sim \mathrm{N}\left(0, \sigma^2(AR_{it})\right)$$

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The Aggregation of Abnormal Returns:

We have to aggregate returns both over time and across firms:

- Aggregate abnormal returns over time, to get "cumulative abnormal return" in the event window for firm i:

$$CAR_i(t_1, t_2) = \sum_{t=t_1}^{t_2} AR_{it}$$

For $T_1 < t_1 \le t_2 \le T_2$

Its distribution under H_0 is:

$$CAR_i(t_1, t_2) \sim \mathrm{N}\left(0, \sigma_i^2(t_1, t_2)\right) \text{ with } \sigma_i^2(t_1, t_2) = (t_2 - t_1 + 1)\sigma_{\varepsilon_i}^2$$

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- Aggregate abnormal returns across firms too, to get one test statistic for hypothesis:
  - Suppose abnormal returns are independent across firms (i.e. no overlapping over the event windows)
  - Given N events, the sample aggregated abnormal returns across firms and across time is:

$$\overline{CAR} = \frac{1}{N}\sum_{i=1}^{N} CAR_i$$

And for large estimation window, its variance is:

$$\mathrm{var}(\overline{CAR}) = \sigma_{\overline{CAR}}^2 = \frac{1}{N^2}\sum_{i=1}^{N} \hat{\sigma}_{CAR,i}^2$$

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The null hypothesis can be tested using

$$\theta = \overline{CAR} \Big/ \text{var}(\overline{CAR}(t_1, t_2))^{1/2} \sim \text{N}(0,1)$$

Interpretation:

- → a statistical and economically significant result is interpreted as the impossibility of rejecting the null hypothesis
- → the event has a significant effect on stock prices.

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Problems (overlapping event windows):

- When the event windows of different securities overlap, covariances are not zero and thus the variance of the aggregated sample is modified. Two ways out:
  - Aggregate abnormal returns into a portfolio dated using event time
  - To analyze abnormal returns without aggregating by applying a multivariate regression model with dummy variables for the event date. Especially used when the event is at the same time. Drawbacks: poor finite sample properties of the test statistic, and little power of the test.

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Problems (continued):

- New information moves prices (Prabhala 1997)
  - Even if corporate events are not voluntary, only new information should move prices.
  - But suppose events are *voluntary*.
  - The fact that the firm chooses to announce at a particular time conveys information. Presumably, they are going to announce only at a time most favorable. This introduces a truncation bias.
  - When events are modeled accounting for the firm's choice to announce some event, the resulting specifications are typically nonlinear cross-sectional regressions, not the simple linear specifications typically used.
  - Prabhala (1997) details how this works.

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Event Studies

Problems (continued):

→ Prabhala suggests that the choice between traditional and conditional specifications depends on whether one has a sample of nonevent data (firm's that were partially anticipated to announce and event, but did not). With nonevent data, the conditional models provide more powerful tests.

- *Non-normality:* several studies have found that daily returns are non-normal, however, residuals are found to be close to normality

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Event Studies

- *Autocorrelation in the residuals*: one method has consisted on estimating lead, lagged and contemporaneous betas separately and then taking a weighted average of these. This does not eliminate autocorrelation.

A comment on these and other problems can be found at:

Glenn V. Henderson, Jr. (1990), "Problems and Solutions in Conducting Event Studies". *The Journal of Risk and Insurance*, 57 – 2, pp 282-306.

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Event Studies Application: Earning Announcement Underreaction

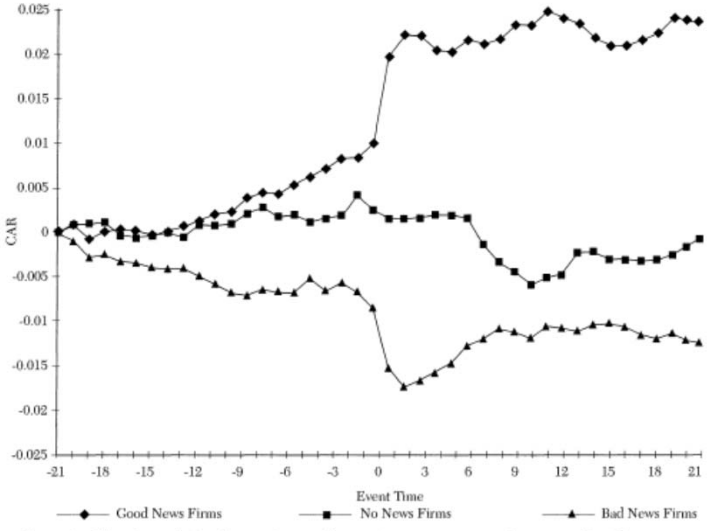

Figure 2a. Plot of cumulative abnormal return for earning announcements from event day -20 to event day 20. The abnormal return is calculated using the market model as the normal return measure.

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Event Studies and Capital structure: Asquith and Mullins (1985)

Asquith and Mullins: "Equity issues and offering dilution" (1985)

- This paper studies the effect on stock prices of seasoned equity offerings
- The paper demonstrates that the announcement of equity offerings reduces stock prices significantly
- The findings are consistent with both the hypothesis that equity issues are perceived by investors as negative signals (asymmetric information) and with the hypothesis that there is a downward sloping demand for a firm's shares.

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Event Studies Application: Asquith and Mullins (1985)

Data:

- Data comes from 531 registered common stock offerings (both primary and secondary offerings) by utilities and industrial firms
- Source: Moody's Industrial Manual and Moody's Public Utility Manual
- Stock offerings that took place in the period January 1963 to December 1981.
- The offering was public, registered with the SEC and it was for common stock only.
- The offering announcement was published in the Wall Street Journal.
- Daily stock return data is from the CRSP database.

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Event Studies Application: Asquith and Mullins (1985)

Empirical strategy:

- An event study is performed.
- The stock market reaction to equity offerings announcements is measured using daily excess stock returns.
- The daily excess return for any security is estimated by:

$$XR_{it} = R_{it} - E(\tilde{R}_{it})$$

  - The expected rate of return E(R(i,t)) is estimated by grouping annually all securities listed on NYSE and AMEX using the correction of estimators by Scholes and Williams (1977) for daily data.
  - The actual daily returns are obtained from CRSP.
  - Excess returns are the difference between the two, over the event window.

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Event Studies Application: Asquith and Mullins (1985)

Empirical strategy:

- The event window is taken to be the day of the announcement and the day after in which the announcement is reported in the Wall Street Journal (i.e. [-1,0]). But it is also calculated as 21 days around announcement (-10,+10).
- Cumulative excess returns are calculated as:

$$CER_{i,K,L} = \sum_{t=K}^{L} XR_{it}$$

- And average returns are:

$$\overline{CER} = \frac{1}{N} \sum_{i=1}^{N} CER_i$$

- T-statistic is calculated as usual:

$$t(CER) = \frac{\overline{CER}}{\sqrt{Var(\overline{CER})}}$$

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Table 2

Average excess returns (*XRET*) and cumulative excess returns (*CER*) from 10 days before until 10 days after the announcement day of industrial equity offerings by type of offering in the period 1963–1981.

	Type of offering							
	All		Primary		Secondary		Combination	
Day	*XRET*	*CER*	*XRET*	*CER*	*XRET*	*CER*	*XRET*	*CER*
	(%)		(%)		(%)		(%)	
−10	−0.1	−0.1	−0.0	0.0	0.2	0.2	−0.6	−0.6
−9	0.0	−0.1	−0.1	−0.1	−0.1	0.3	0.1	−0.5
−8	0.1	0.0	0.1	0.0	0.1	0.4	0.2	0.3
−7	0.1	0.1	0.3	0.3	0.0	0.4	−0.4	−0.7
−6	−0.3	−0.2	−0.3	0.0	−0.3	0.1	−0.5	−1.2
−5	−0.0	−0.2	−0.4	−0.4	0.3	0.4	0.4	−0.8
−4	0.0	−0.2	−0.0	−0.4	0.0	0.4	0.1	−0.7
−3	0.1	−0.1	−0.2	−0.6	0.5	0.9	0.1	−0.6
−2	−0.4	−0.5	−0.3	−0.9	−0.1	0.8	−1.1	−1.7
−1	−1.8	−2.3	−2.3	−3.3	−1.0	−0.2	−1.8	−3.5
AD[a]	−0.9	−3.2	−0.7	−3.9	−1.0	−1.2	−1.4	−5.9
+1	−0.0	−3.2	−0.1	−4.0	−0.0	−1.2	0.0	−5.9
+2	0.1	−3.1	0.0	−4.0	−0.0	−1.2	0.2	−5.7
+3	0.2	−2.9	0.3	−3.7	0.2	−1.0	0.1	−5.6
+4	0.2	−2.7	0.1	−3.6	0.3	−0.7	−0.1	−5.7
+5	0.0	−2.7	0.1	−3.5	0.1	−0.6	−0.4	−6.1
+6	0.0	−2.7	−0.1	−3.6	0.3	−0.3	0.1	−6.0
+7	0.3	−2.4	0.1	−3.5	0.2	−0.1	1.2	−4.8
+8	0.0	−2.4	−0.1	−3.6	0.0	−0.1	0.2	−4.6
+9	0.1	−2.3	−0.1	−3.7	0.1	0.0	0.6	−4.0
+10	0.0	−2.3	0.2	−3.5	0.0	0.0	−0.3	−4.3
Two-day announcement return	−2.7		−3.0		−7.0		−3.2	
t-statistic	14.8		12.5		9.1		5.9	
N	266		128		85		53	

[a]AD = announcement day.

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Event Studies Application: Asquith and Mullins (1985)

Results:

- The previous results show that equity issues have a negative and significant impact on stock prices, i.e. the market reacts negatively to external equity financing
- This is true for both primary and secondary issues
- This effect is pervasive in that 80% of the sample industrial issues are associated with negative announcement day excess returns

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Empirical results from Event Studies in Capital Structure

More generally, in their survey of empirical results of event studies in finance,

Harris and Raviv (1991) document that, in general,

- Leverage increasing financing decisions almost always receive a positive reaction from the stock market → perceived as good news: by the market.
- Leverage decreasing financing decisions almost always receive a negative reaction from the stock market → perceived as bad news.
- Leverage neutral financing decisions (issue new debt for cash) have neutral reaction.

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Empirical results from Event Studies in Capital Structure

More specifically, with regard to security issues (in HR 91):

- Abnormal returns associated with announcements of common stocks are the most negative (about -3% according to Smith, 1986)
- Abnormal returns associated with convertible bonds or convertible preferred stock are more negative than those associated with the respective nonconvertible security
- Abnormal returns associated with straight debt or preferred stock are not statistically significantly different from zero
- Abnormal returns associated with securities issued by utilities are less negative than those associated with the same securities issued by industrial firms.

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Empirical results from Event Studies in Capital Structure

In particular, with regard to exchange offers, Masulis (1983) reports that:

- Debt issued in exchange for common stock results in a 14% abnormal stock return
- Preferred stock issued in exchange for common stock results in a 8.3% abnormal stock return,
- Debt issued in exchange for preferred stock results in a 2.2% abnormal stock return
- Common stock issued in exchange for preferred stock results in a -2.6% abnormal stock return
- Common stock issued in exchange for debt results in a -9.9% abnormal stock return
- Preferred stock issued in exchange for debt results in a -7.7% abnormal stock return.

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Event studies: Empirics meets theory

Explanations:

- Consistent with signaling stories / pecking order:
  - Issue equity ➔ bad news regarding company prospects.
  - Reduce equity ➔ good news regarding company prospects.
- Consistent with tax theories (and new information):
  - Increased leverage ➔ reduced taxes.
- Consistent with agency stories (and new information):
  - More equity ➔ less pressure on management.
    - (Management more likely to overinvest.)
  - Less equity ➔ more pressure on management.

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Criticism of event study literature

- Unanticipated events:
  - Is the event really unexpected?Information leakage in press?
- Exogenous events
  - Who chooses the event to occur?
- Confounding events
  - The longer the event window, the more difficult it is for researchers to claim that they have controlled for confounding effects
- Control group
  - Depending on the event, which observations are on the control group?
- Test statistics
  - Based on normality assumptions-> Non parametric test statistics (eg. Binomial Z statistic, Wilcoxon signed rank test)

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Conclusions on event studies

Event study methodology can be useful, but apply and interpret with care

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