Lecture Topic 8 week 8 (821L1) 2022

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Lecture 8: Event Study Analysis

821L1: Financial and Time Series Econometrics

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Lecture outline

- Examples of the relationship between breaking news and share prices.
- Overview of event study analysis
- The Constant Mean Return Model and the Market Model
- Estimation
- Aggregating over time and across securities
- Sensitivity
- Example
- Conclusions.

March 16: News breaks that Cambridge Analytica harvested facebook user data to help Trump win.

March 15: Rihanna retorts at snapchat's 'who would you rather slap…'

Credit: NYSE

Feb 21: Kylie Jenner tweets asks “does anyone else not open snapchat anymore?”

Snap stock price. For reference, Kylie Jenner tweeted at 4:50PM ET on February 21st. | Image: Google

Motivation

- Unanticipated events affect stock prices, and other economic time series.
- These graphs are suggestive, but as trained econometricians you may have a whole host of other concerns.
  - Are these differences statistically significant?
  - How did other, similar shares do in the mean-time?
  - Could some unobserved process be driving this?
  - In other words, what is the appropriate counterfactual?
- The formal econometric methodology that addresses these concerns is called ‘Event Study Analysis’.

Overview of an event study

1. Event definition
   - **What is the event?**
   - Examples: Earnings announcement, oil spill, CEOs health.
   - **What is the window of time this event will affect the stock price in?**
   - Theory says instantaneous. Usually we take 1-2 days after the event.
   - Sometimes it can be longer. Train crash investigation shows negligence, then prolonged effect.

2. Selection criteria
   - We rarely cover all firms. Usually only data on publicly traded firms are available.
   - Sometimes we focus on largest firms, by say market capitalization.
   - Important to be explicit and to think through the potential for bias sample selection may introduce
   - Internal vs. external validity

Overview (Cont'd)

3. Normal and abnormal returns
   - Abnormal return = actual return – expected return.
   - $\varepsilon_{it}^{*} = R_{it} - E[R_{it}|X_t]$ (1)
   - Two usual suspects for $\mathrm{E}[R_{it}]$
   - Constant mean return model
   - Market model.
4. Estimation procedure
   - Parameters estimated during 'estimation window'; usually the period immediately prior to the event.
   - In some cases this is not appropriate (information leakage)

Overview (Cont'd)

5. Testing procedure
   - Determine technique of aggregating abnormal returns across firms and over time.
   - Design testing framework.
6. Empirical results
   - Present results
   - include diagnostic tests and sensitivity analysis
7. Interpretation and conclusions
   - Shed insight on interesting economic phenomena.
   - ….or the power of celebrities/ the demise of liberal democracy

Timeline

- T0-T1: Pre-event, or estimation window
- T1-T2: Event window. Contains the date of the event 0.
- T2-T3: Post-event Window.

The Constant Mean Return Model

- The CMRM can be expressed simply as:
  - $R_{it} = \mu_i + \epsilon_{it}$ (2)
  - Where E[ϵ_{it}]=0, and Var[ϵ_{it}] = $\sigma^2_{\epsilon_i}$
- The simplest model for measuring normal performance.
- Often yields results similar to those of more complicated models (Brown and Warner, 1980, 1985).
- With daily data, usually use nominal returns.
- With monthly data use real, excess (over risk free rate) returns, or nominal returns.

The Market Model

- $R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}$ (3)
- $\mathrm{E}[\varepsilon_{it}] = 0, \quad Var[\varepsilon_{it}] = \sigma_{\varepsilon_i}^2$
- Relates the return to any given security to the return on the market.
- Removes variation in returns that is explained by the market.
- Typically reduces the variance of the estimates.
- Potentially enhances the ability to detect abnormal returns.

Estimation

- Observations **in the Estimation window** are fitted to a regression using OLS.
- $R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it}$,
- We can thus retrieve $\hat{\alpha}_i$ and $\widehat{\beta_i}$.
- We apply these parameter estimates **to the event window** to compute normal returns.
- Can then compute abnormal returns:
- $\hat{\varepsilon}_{it} = R_{it} - \hat{\alpha}_i - \hat{\beta}_i R_{mt}$ (4)
- Under general assumptions, we can conduct hypothesis testing.

Aggregation over time for one security

- Depending on the research question aggregation may be across time and across securities.
- Define the Cumulative Abnormal Return as follows:
- $\widehat{CAR_i}(T_1, T_2) \equiv \sum_{T_1}^{T_2} \hat{\varepsilon}_{it}$ (5)
- This aggregates the effect of the news over all the observations in the event window.
- That is, for a given security, we have used the market model to predict a ”normal return” in the event window, and are now adding up the difference between this and the observed returns over time.
- This provides the magnitude of the cumulative abnormal returns, but we can also conduct statistical inference.

Hypothesis testing aggregating over time

- The CAR is effectively a point estimate, and we can divide by the standard error to get the usual t-statistic.
- Dividing something by it's variance or standard error is known as 'standardizing'.
- We can use OLS estimates of the standard error to conduct hypothesis tests using the Standardized CAR:
- $\widehat{SCAR}_i(T_1, T_2) \equiv \frac{\widehat{CAR}_i(T_1,T_2)}{\widehat{\sigma_i}(T_1,T_2)}$ (6)
- This is distributed as a *t*-statistic with [(T_1-T_0)-2] degrees of freedom.

Aggregating CAR and SCAR over multiple securities

- In general we may be interested in aggregating over many different securities.
- Statistically, this is very straightforward as the event study methodology is fairly flexible.
- We define time relative to the event date for each security and define the estimation and event windows for each security (NB: not calendar time).
- We then compute the CAR for each security and can take averages.
- An important distributional assumption is that the event windows do not overlap (where they do overlap, additional steps need to be taken, see CLM textbook)

Aggregating over securities (cont'd)

- $\overline{CAR} = \frac{1}{N}\sum_{i=1}^{N} \widehat{CAR_i}$ (7)
- We can conduct inference by observing that:
- $\text{Var}[\overline{CAR}] = \bar{\sigma}^2(T_1, T_2) = \frac{1}{N^2}\sum_{i=1}^{N} \sigma_i^2(T_1, T_2)$. (8)
- We can therefore undertake hypothesis testing using:
- $J_1 = \frac{\overline{CAR}(T_1,T_2)}{\widehat{[\sigma^2}\,(T_1,T_2)]^{\frac{1}{2}}} \sim N(0,1)$ (9)

Sensitivity: Normal Returns Model

- Using a different model to specify normal returns can affect the point estimates and the variance.
- The Market Model described here has lower variance than the Constant Mean Return Model, as it explains the part of the share price that is driven by movements in the market.
- In principle, further reductions in variance could be generated by accounting for additional factors.
- However, the MM and CMRM remain the workhorse models.

Sensitivity: Clustering

- We have assumed that events do not overlap in calendar time.
- This may be a strong assumption as company earnings announcements may coincide, implying positive covariance across different stocks.
- There are two common ways to deal with this problem.
  1. We may construct an equally (market capitalization) weighted portfolio of the two stocks and compute abnormal returns for this portfolio.
  2. We may circumvent aggregation by analyzing the abnormal returns for the two stocks separately, rather than aggregating them up.

Further issues

- Sampling interval: If we are sure that the market internalizes all new information quickly, a smaller event window can enhance our power to detect abnormal returns.
- Event date uncertainty: Newspapers may only report earnings announcements the next day, but the market may have received this information the day before the report. So we should bring the event window a day forward form the report.

Example:

- The FASB and the SEC regulations necessitate that firms report earnings announcements periodically.
- Event studies can analyze the information content of these announcements.
- CLM analyze the quarterly earnings announcements of 30 firms from the Dow Jones from 1989-1993.
- Total sample of 600 announcements.

Example (cont'd):

- Use Institutional Brokers Estimate System to proxy for market expectations.
- Classify announcements into 'good news', 'no news' and 'bad news':
  - Good news (189 obs): Earnings exceed expectations by >2.5%.
  - No news (173): Earnings within 5% of expected value (-2.5% to + 2.5%).
  - Bad news (238): Earnings below expectations by >2.5%.
- 1 day sampling interval.
- Event window: 41 day event window (20 before, 20 after).
- Estimation window: 250 trading days prior to event window.

Abnormal returns: MM and CMRM

(Source: CLM)

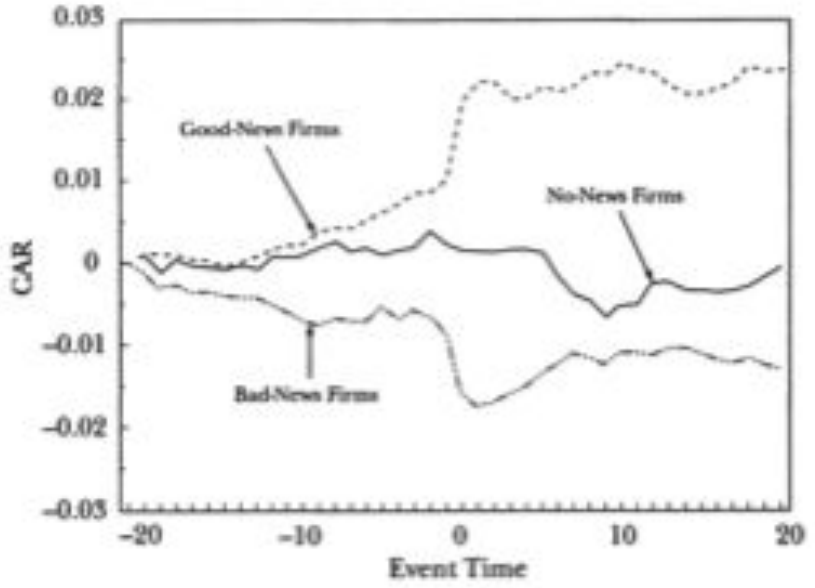

Figure 4.2a. Plot of Cumulative Market-Model Abnormal Return for Earning Announcements

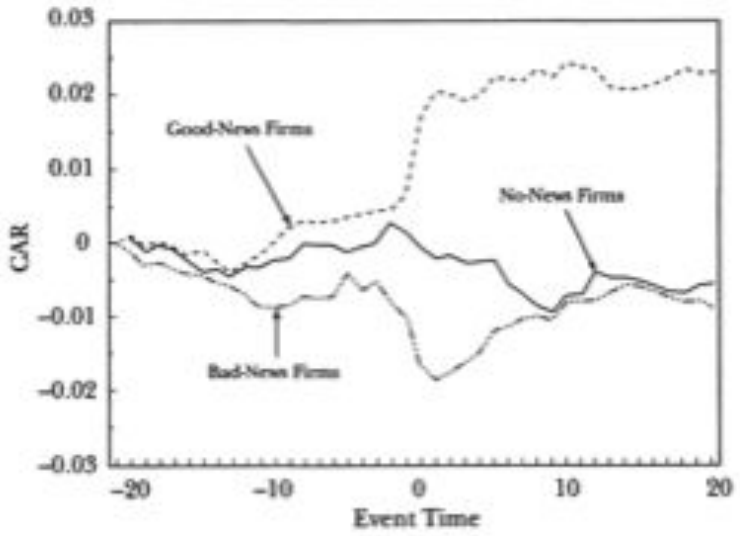

Figure 4.2b. Plot of Cumulative Constant-Mean-Return-Model Abnormal Return for Earning Announcements

Discussion

- The information content of earnings announcements do indeed appear to drive abnormal returns in these stocks.
- There is some evidence of both
  - under-reaction (markets do not react instantaneously) and
  - over-reaction (bad news stocks partially recover in value after initial losses)
- There is some evidence of information leakage / insider trading.
- Both the Market Model and the Constant Mean Return Model yield qualitatively similar results.

Summary

- Event study analysis is an important tool that we can use to understand the economic determinants of stock prices.
- Event studies are characterized by a pre-event estimation period and an event period.
- There are many choices for the normal return model, here we have discussed the constant mean return and the market model.
- The results may be sensitive to model choice, clustering of events, sampling intervals and event date uncertainty.
- Analyzing earnings announcements shows that new information does indeed generate abnormal returns.