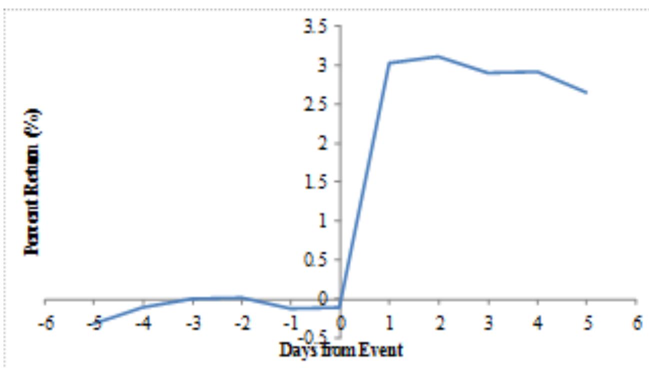
9 The Event Study Method

Text: pp. 571-585.

9.1 What are Event Studies Good For?

- Study impact of news on asset prices.
  - Mergers and acquisitions
  - New debt or equity issues
  - Macroeconomic announcements (surprises)
  - Dividend announcements
  - Stock splits
  - Trump's tweets



- Why not use regression with dummy variables for events? Say you are looking at stock splits. Any one firm will only split maybe once or twice in 30 years, so you don't have many instances. But with the event study method, you pool across many firms that split their stocks and can work with many observations on splits.

  Then again, what if you have 500 firms that have split but at different times. The dummy variable method needs you to pool the firms so you have 500 cross-sections. And you have to specify across firms–do you constrain the coefficients on the dummy variables or allow variation across firms? If you allow variation, then there are 500 parameters to estimate.

  Event study method simplifies things.

9.2 Assumptions

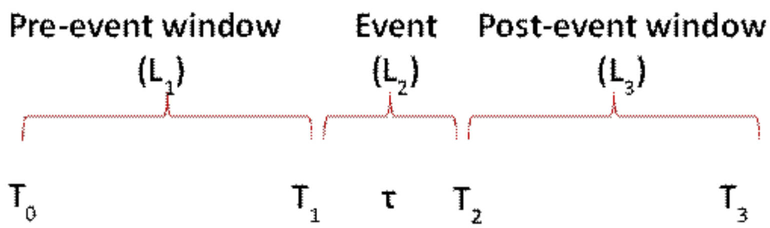
- Market is efficient.

- Event is unanticipated (and exogenous).

  If this is not true, returns will have already fully or partially adjusted before the event, and you won't find anything.

- No confounding effects during the event window (because you want to measure the effect of what you define as the event, not something else).

9.3 Procedure



- We transform calendar time to event time.
- L_1 is estimation window. Use to estimate what 'normal' returns look like. Any parameters that we estimate is done with these observations.
- L_2 is event window. Ask if you see 'abnormal' returns during this time.
- L_3 is Post-event window. Use to verify that returns go back to 'normal.'
- Choose the event and data sampling frequency
  - Higher frequency of observations means more statistical power. Daily better than weekly better than monthly better than quarterly.
- Length of event window
  - Decide the time required for market to digest information.
  - Long-run or short run effects? Short run: 10 pre-event trading days and 10 post-event trading days. Long run: a month or a year after the event.
- Which firms to include in sample
- How to measure normal and abnormal returns
- Decide on estimation window. (e.g., with daily data, use 120 days before the event)

- The key to approach is to isolate the event. We don't want the event window to be confounded with other causal factors. e.g., looking at effect on firm from being included in S&P index. What if announcement was on 9/11?

- Let $r_{t,i}$ be the rate of return on day t for firm i .

- Object of interest is **abnormal** return, $AR_{t,i}$, (this is the textbook's notation)

$$AR_{t,i} = r_{t,i} - \underbrace{E\left(r_{t,i}|X_t\right)}_{\text{Normal Returns}}$$

  where X_t is the relevant conditioning information for the normal performance period.

- Need a model for $E(r_{t,i}|X_t)$. Keep it simple or the sampling error from estimation of many parameters will mess you up. Candidates can be purely statistical or economic We going to estimate the model for normal returns $E(r_{t,i}|X_t)$ using pre-event data.

  - Constant return model: $E(r_{t,i}|X_t) = \mu_i$, $AR_{t,i} = r_{t,i} - \mu_i$
  - Market model: $AR_{t,i} = r_{t,i} - \alpha_i - \beta_i r_{t,m}$ (TBD)
  - CAPM: $AR_{t,i} = r^e_{t,i} - \alpha_i - \beta_i r^e_{t,m}$ (TBD)
  - Fama-French 3-factor model. (TBD)

- Length of pre-event window (for estimation)

  - Daily returns: 100 to 300 observations.
  - Monthly returns: 24 to 60 item.
  - Market model is a most common approach. People argue about whether to include α_i in normal return. Anticipatory effects (of the event) may bleed into estimate of α_i. If so, assume $\alpha_i = 0$.

- We test the **null hypothesis** that event has **no effect** on abnormal returns.

- For now, we are going to ignore the sampling variation in $\hat{\alpha}_i$ and $\hat{\beta}_i$, as done in the **Brooks text.** I can show you how to account for that uncertainty if you need it, say for your senior thesis. Also, Brooks (your text) puts hats over the abnormal returns to indicate that they are estimated and not raw data. I'm not going to hat the abnormal returns.

- **Standardized abnormal returns** for an individual firm at t, ($\text{SAR}_{t,i}$). Compute the sample variance of firm $i's$ abnormal returns

$$\hat{\sigma}^2_{ar(T_1,i)} = \frac{1}{T-1}\sum_{t=1}^{T_1} AR^2_{t,i}$$

then standardize the abnormal returns,

$$SAR_{t,i} = \frac{AR_{t,i}}{\hat{\sigma}_{ar(T_1,i)}} \sim N(0,1) \tag{23}$$

We use $SAR_{t,i}$ as the test statistic for each firm i for each event date t.

- **Cumulating Abnormal Returns (CAR)** over Event Window for Firm i. Because returns can be **noisy**, we might want to cumulate the abnormal returns over the **event window**.

$$CAR_{T_1,T_2,i} = \sum_{t=T_1}^{T_2} AR_{t,i} \tag{24}$$

Since

$$\mathrm{Var}\left(\sum_{t=T_1}^{T_2} AR_{t,i}\right) = (T_2 - T_1 + 1)\,\mathrm{Var}\left(AR_{t,i}\right)$$

under the null, use

$$\hat{\sigma}^2_{car(T_1,T_2,i)} = (T_2 - T_1 + 1)\hat{\sigma}^2_{ar(T_1,i)} \tag{25}$$

Standardize to get test statistic for firm i

$$SCAR_{T_1,T_2,i} = \frac{CAR_{T_1,T_2,i}}{\hat{\sigma}_{car(T_1,T_2,i)}} \sim N(0,1) \tag{26}$$

This is what we do for a single firm.

- **Average the Abnormal Returns** across Firms. Say there are N firms. For each t,form the cross-sectional average.

$$AR_t = \frac{1}{N}\sum_{i=1}^{N} AR_{t,i} \tag{27}$$

Theoretically, abnormal returns should be independent across firms.

$$\mathrm{Var}\left(AR_t\right) = \frac{1}{N^2}\sum_{i=1}^{N} \mathrm{Var}\left(AR_{t,i}\right)$$

Estimate time t averaged abnormal returns with the sample variance.

$$\hat{\sigma}^2_{ar(T_1)} = \frac{1}{N^2}\sum_{i=1}^{N} \hat{\sigma}^2_{ar(T_1,i)} \tag{28}$$

Test statistic for the firm average at date t

$$SAR_t = \frac{AR_t}{\hat{\sigma}_{ar(T_1,i)}} \sim N(0,1) \tag{29}$$

- **Cumulate the Firm Averaged Abnormal Returns**. Use the cumulated abnormal returns for each firm i in (24), average across firms.

$$CAR_{T_1,T_2} = \frac{1}{N}\sum_{i=1}^{N} CAR_{T_1,T_2,i} \tag{30}$$

The theoretical variance is

$$\text{Var}\left(\sum_{i=1}^{N} CAR_{T_1,T_2,i}\right) = \frac{1}{N^2}\sum_{i=1}^{N} \text{Var}\left(CAR_{T_1,T_2,i}\right)$$

Estimate this thing with the sample variance, :

$$\hat{\sigma}^2_{car(T_1,T_2)} = \frac{1}{N^2}\sum_{i=1}^{N} \hat{\sigma}^2_{car(T_1,T_2,i)} \tag{31}$$

where $\hat{\sigma}^2_{car(T_1,T_2,i)}$ was computed in (25) above. Now standardize

$$SCAR_{T_1,T_2} = \frac{CAR_{T_1,T_2}}{\hat{\sigma}_{car(T_1,T_2)}} \sim N(0,1) \tag{32}$$

9.4 More Advanced Material

Below, is the procedure that takes into account the sampling variation in estimating the market model. It requires knowledge of matrix algebra, which I will cover in a future class.

Procedure

- Estimate normal return, using market model, for each event $i = 1, ..., n$, using L_1 sample. These are returns (not excess returns).

$$r_{t,i} = \alpha_i + \beta_i r_{t,m} + \epsilon_{t,i}$$

- In matrix form,