# 1 The Event Study Method. (Text pp. 571-585)

Do returns go up when a stock splits
Mergers/acquisitions
Dividend announcements
New debt or equity issues
Added or dropped from an index
Trump's tweets

In constructing the experiment:

Assume the market is efficient (in the sense that the event is properly assessed by investors and quickly), is unanticipated and exogenous.

Let $r_{t,i}$ be rate of return at $t$ on firm $i = 1, ..., N$.

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

Normal return is fitted value from a regression, $AR$ is the regression residual.

Candidate models:

- Constant mean return model $E\left(r_{t,i}|X_{t,i}\right) = \mu_i$. so $AR_{t,i} = r_{t,i} - \mu_i$
- Market model: Run regression

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

- CAPM: run on excess returns

$$r^e_{t,i} = \alpha_i + \beta_i r^e_{t,m} + AR_{t,i}$$

- Can get fancier say with Fama-French 3 factor model. Usually is better to stick with a simpler less parameterized model (so sampling or estimation variability doesn't mess you up).

Goal: test the null hypothesis that abnormal returns during the event window is not significantly different from 0. In what follows, we will ignore the estimation uncertainty in $\hat{\alpha}$ and $\hat{\beta}$.

1. For an individual firm $i$,Compute sample variance of abnormal return. Sample variance

$$\text{Var}\left(AR_{t,i}\right) = \hat{\sigma}^2_{ar(T_1,i)} = \frac{1}{T_1 - 1}\sum_{t=1}^{T_1} AR^2_{t,i}$$

Hence,

$$\text{SAR}_{t,i} = \frac{AR_{t,i}}{\sigma_{ar(T_1,i)}} \sim N\left(0,1\right)$$

Can check if $\text{SAR}_{t,i}$ during the event window is significantly different from zero. Say you've estimated the market model. $\hat{\alpha}_i$ and $\hat{\beta}_i$ estimated over $L_1$.During $L_2$, and $L_3$,then use the returns over the entire event sample to construct.

$$AR_{t,i} = r_{t,i} - \hat{\alpha}_i - \hat{\beta}_i r_{t,m}$$

This is for a single firm at a single point in time.

2. Cumulate abnormal returns (CAR) over the event window.

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

The variance is

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

Sample variance

$$\hat{\sigma}^2_{car(T_1,T_2,,i)} = \left(T_2 - T_1 + 1\right)\underbrace{\hat{\sigma}^2_{ar(T_1,i)}}_{\text{computed}}$$

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

3. Average across firms to increase sample size.

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

We are assuming the AR's are independent across firms. Then

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

Sample variance is

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

Now standardize

$$\text{SAR}_t = \frac{AR_t}{\hat{\sigma}_{ar(T_1)}} \sim N\left(0,1\right)$$

4. Cumulate these average returns

$$\mathrm{CAR}_{\mathrm{T}_1,T_2} = \frac{1}{N}\sum_{i=1}^{N} CAR_{T_1,T_2,i}$$

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

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

$$SCAR_{T_1,T_2} = \frac{\mathrm{CAR}_{\mathrm{T}_1,T_2}}{\hat{\sigma}_{car(T_1,T_2)}} \sim N\left(0,1\right)$$