Empirical Methods in Corporate Finance

Event Study Methods in Finance

Outline

- Introduction
  - Market efficiency
  - Value event studies
  - Fama et al. (1969)
- Standard event study methods
  - Normal return computation
  - Statistical significance tests
- Event Studies with a contaminated estimation period
  - Aktas, de Bodt and Cousin (2007), *Journal of Corporate Finance*

Introduction (1)

- Price-based event studies originally designed to test the efficient market hypothesis (EMH)
  - Efficient market = market in which resource allocation is socially optimal
    - **Allocational efficiency:** The effectiveness with which a market channels capital toward its most productive uses.
  - Efficient market = market in which security prices adjust rapidly to the arrival of new information and, therefore, the current prices of securities reflect all information about the security
    - **Informational efficiency:** The speed and accuracy with which prices reflect new information
- In the mid-1970s a new type of price-based approach emerged called « **Value Event Studies** »
  - Aim is to examine the impact of events on the market value of specific companies, considering that the market is efficient (**valorization tool**)

Introduction (2)

- Implicit hypothesis of « **Value Event Studies** »
  - Financial markets are efficient
  - Financial markets are *anticipation markets*
    - Investors form rational expectation about future cash flows
    - In an efficient market prices are on average equal to the value of the exchanged asset
    - Recall: The **value** in finance corresponds to the sum of discounted cash flows (Fisher's capital-value theorem, 1930)

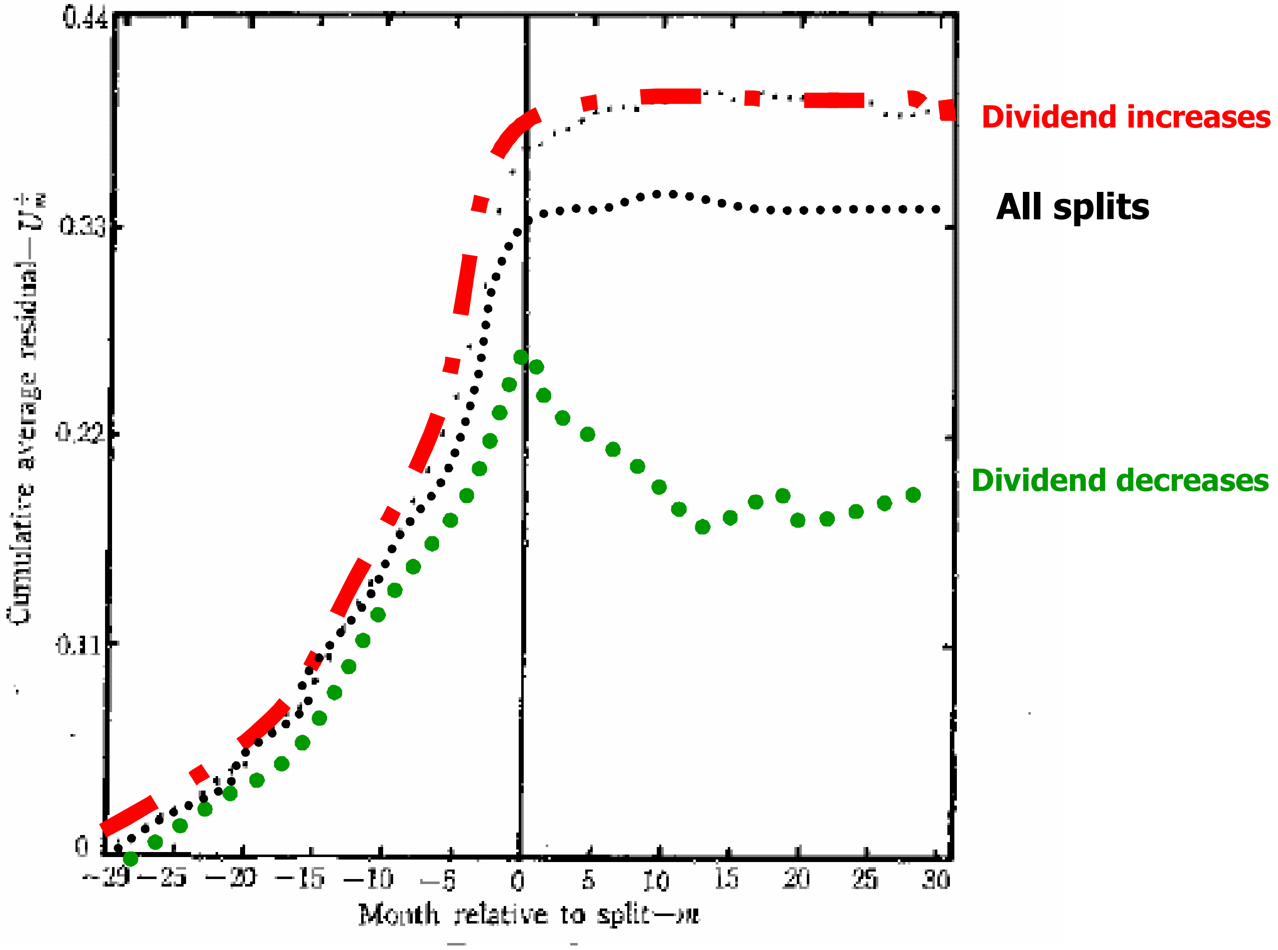
$$V_0 = \sum_{t=1}^{\infty} \frac{CF_t}{(1+R)^t}$$

    - The studied event impacts either future CFs or the discount rate
- Considered event types
    - firm-specific event, sector-based event, market wide event, …

Introduction (3)

- Seminal contribution in the field is Fama, Fisher, Jensen and Roll (1969)
  - They examine the process by which stock prices adjust to the information (if any) that is implicit in a *stock split*
  - *Stock Split* consists in multiplying the number of shares available for investors without changing the total equity value of the firm
    - As a natural consequence price per share decreases
      - Allows small investors to enter the market and buy stocks at a lower transaction costs
  - Why *stock split* should convey valuable information?
    - *Stock splits* are *usually* preceded by a period of *unusual* high earnings (high *ex post* returns and stock prices);
    - Companies like to keep the dividend per share stable through time
    - *Stock split* COULD signal that *unusual* high earnings will persist in the future

Introduction (4)



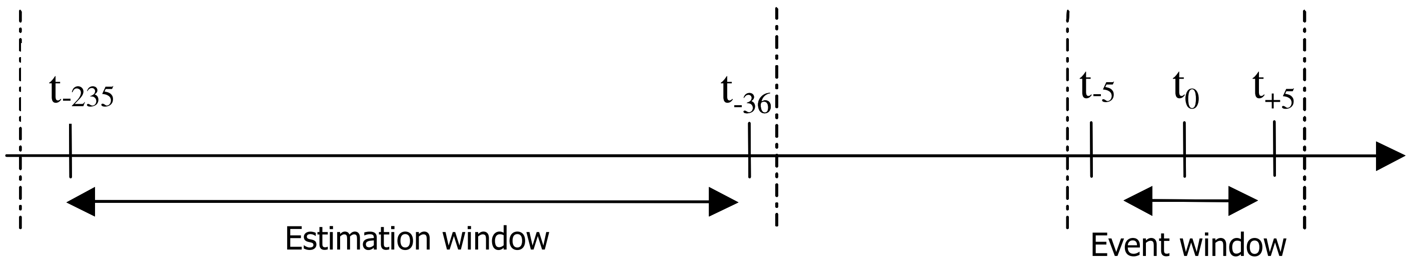
Source: Fama *et al.* (1969)

Standard Event Study methods (1)

- Goal: To measure the effect of an economic event on firm value
- Steps
  - Identification of the events (nature, announcement date, …)
  - Identification of the estimation and event windows
  - Estimation of the normal return generating process (RGP) parameters
  - Computation of the abnormal returns
    - $AR_{i,t} = R_{i,t} - E(R_{i,t}|X_t)$
    - $CAR_i(k,l)$=Firm i AR cumulated between day K (event window 1st day) and day L (event window last day)
  - Significance test
    - Case study. H_0: $CAR_i=0$; H_1: $CAR_i \neq 0$
    - Sample study. H_0: $CAAR=0$; H_1: $CAAR \neq 0$

Standard Event Study methods (2)

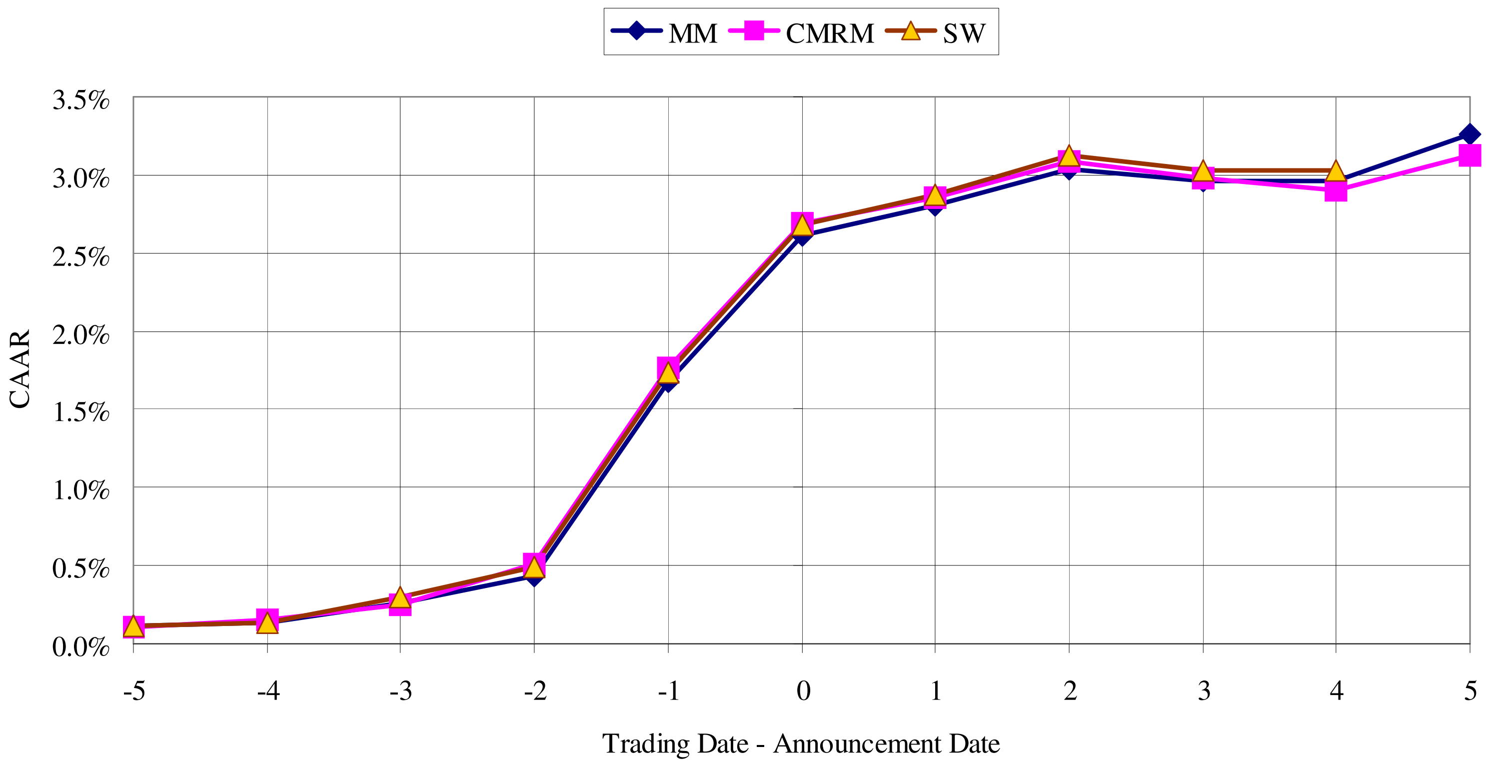
- Computation of **Normal Return**: $E(R_{i,t}|X_t)$
  - Statistical models
    - **CMRM** $R_{i,t} = \mu_i + \varepsilon_{i,t}$, where $\varepsilon_{i,t} \sim N(0;\sigma^2_{\varepsilon_i})$
    - **MM** $R_{i,t} = \alpha_i + \beta_i R_{m,t} + \varepsilon_{i,t}$, where $\varepsilon_{i,t} \sim N(0;\sigma^2_{\varepsilon_i})$
  - Economic models (CAPM, APT, …)
- Significance test
  - Are observed ARs significantly different from zero?
    - Parametrical tests Vs Non-parametrical tests



Standard Event Study methods (2')

- Normal RGP is not an issue for short horizon event studies

Panel A. Initial Announcement of Combination, All Firms, US$, Local Indexes



Source: Aktas, de Bodt, and Roll (2004, JFQA)

Standard Event Study methods (3)

- Parametrical test - Case Study
  - Student test: $CAR_i/\sigma(CAR_i)$
    - For a T-day event window $\sigma(CAR_i)=[T\sigma^2(AR_i)]^{1/2}$
      - $\sigma^2(AR_i)$ estimated using estimation window information
  - Ruback's (1982) adjusted-student test: $CAR_i/\sigma(CAR_i)$
    - Take into account serial autocorrelation in AR
      - $\sigma(CAR_i)=[T\sigma^2(AR_i)+2(T-1)cov(AR_{i,t},AR_{i,t-1})]^{1/2}$
      - CAR_i= Firm i AR cumulated between day K and day L
      - $T=L-K+1$
      - Autocovariance computed over the estimation window!

Standard Event Study methods (4)

- Parametrical test - Sample Study
  - Student test: CAAR/σ(CAAR)
    - First studies use information from estimation window to compute σ(CAAR)

$$t\text{-}student = \frac{CAAR}{\sigma(CAAR)}, \text{ where } \sigma(CAAR) = \sqrt{\frac{1}{N^2}\sum_{i=1}^{N} T\sigma_{\varepsilon_i}^2}$$

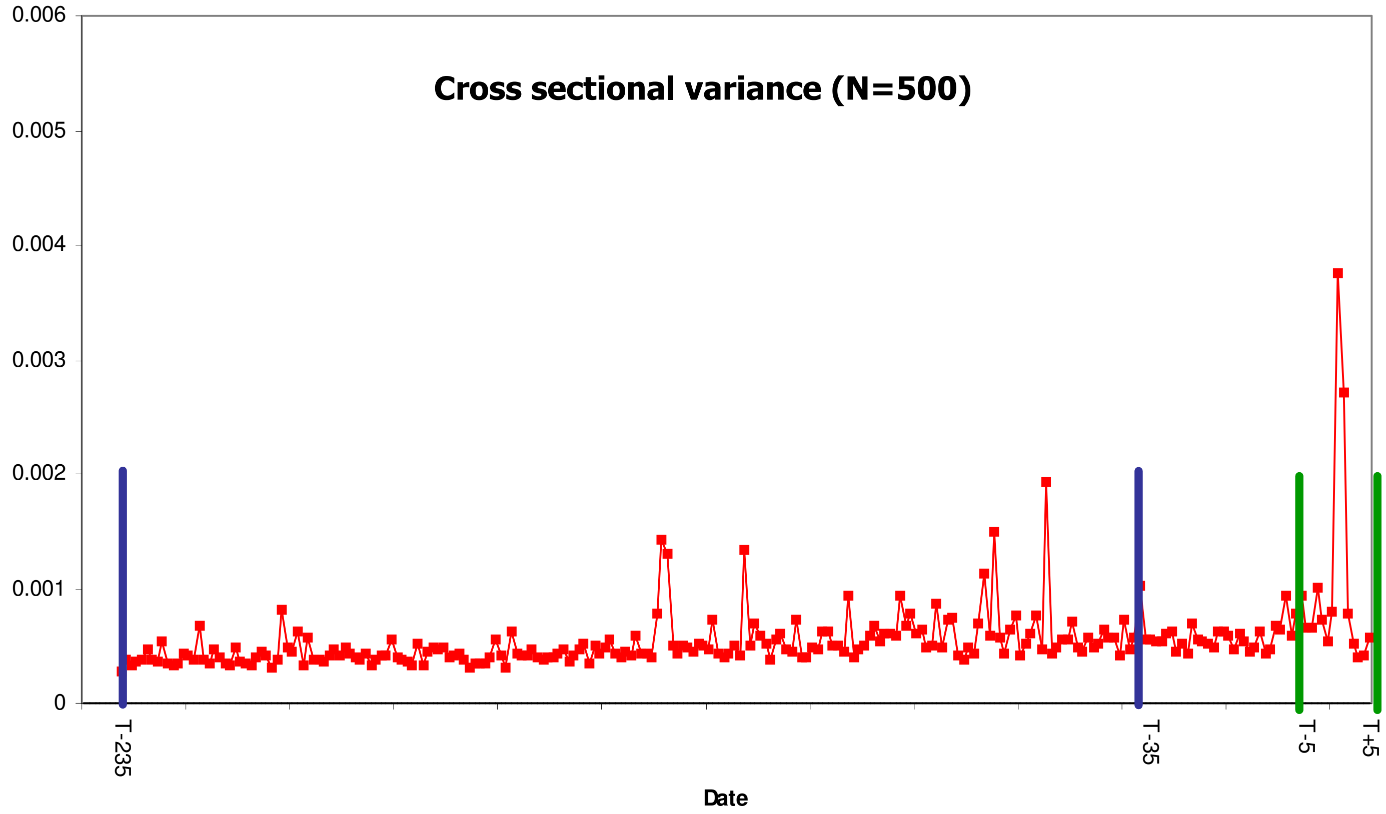
    - Patell (1979) proposes **first** to standardize each CAR_i using estimation window σ_i and, **then** to realize the test using standardized CAR_i

$$t\text{-}student = \frac{ASCAR}{\sigma(ASCAR)}, \text{ where } \sigma(ASCAR) = \frac{1}{\sqrt{N}}$$

    - Limit: the first tests overestimate CAAR's significance because they do not take into account *event-induced variance*

Standard Event Study methods (5)

Event-induced variance phenomenon



Standard Event Study methods (5)

- Boehmer, Musumeci and Poulsen (1991)
  - Boehmer *et al.* (1991) propose the *standardized cross-sectional method* which is robust to the *event-induced variance* phenomenon
    - Standardization like Patell (1979)
    - σ(ASCAR) estimated only with event window information (cross-sectional estimate)

n	CAR_T	$SCAR_T$
1	2%	
2	3%	
3	0%	
500	-2%	

Average	CAAR	ASCAR
Variance of Average	σ²(CAAR)	σ²(ASCAR)

⇨ T Boehmer = ASCAR/σ(ASCAR)

Standard Event Study methods (6)

$$\mathrm{Var}[\mathrm{CAR}_T] = T\sigma^2\left[1 + \frac{T}{U} + T\left(\frac{r_{m0}^T}{T} - \bar{r}_m\right)^2 / U\,\mathrm{Var}(r_m)\right]$$

Where,

- T is the number daily abnormal returns accumulated in CAR
- σ^2 is the estimated residual variance
- U is the estimation period length in days
- $\bar{r}_m$ is the estimation period mean of the market return
- $Var(r_m)$ is the estimation period variance of the market return
- $r_{m_0}^T$ is the cumulated market return from the beginning of the event window up to time T

Step 1. Standardization: Var(CAR) is used to standardize each individual firm CAR ➔ SCAR

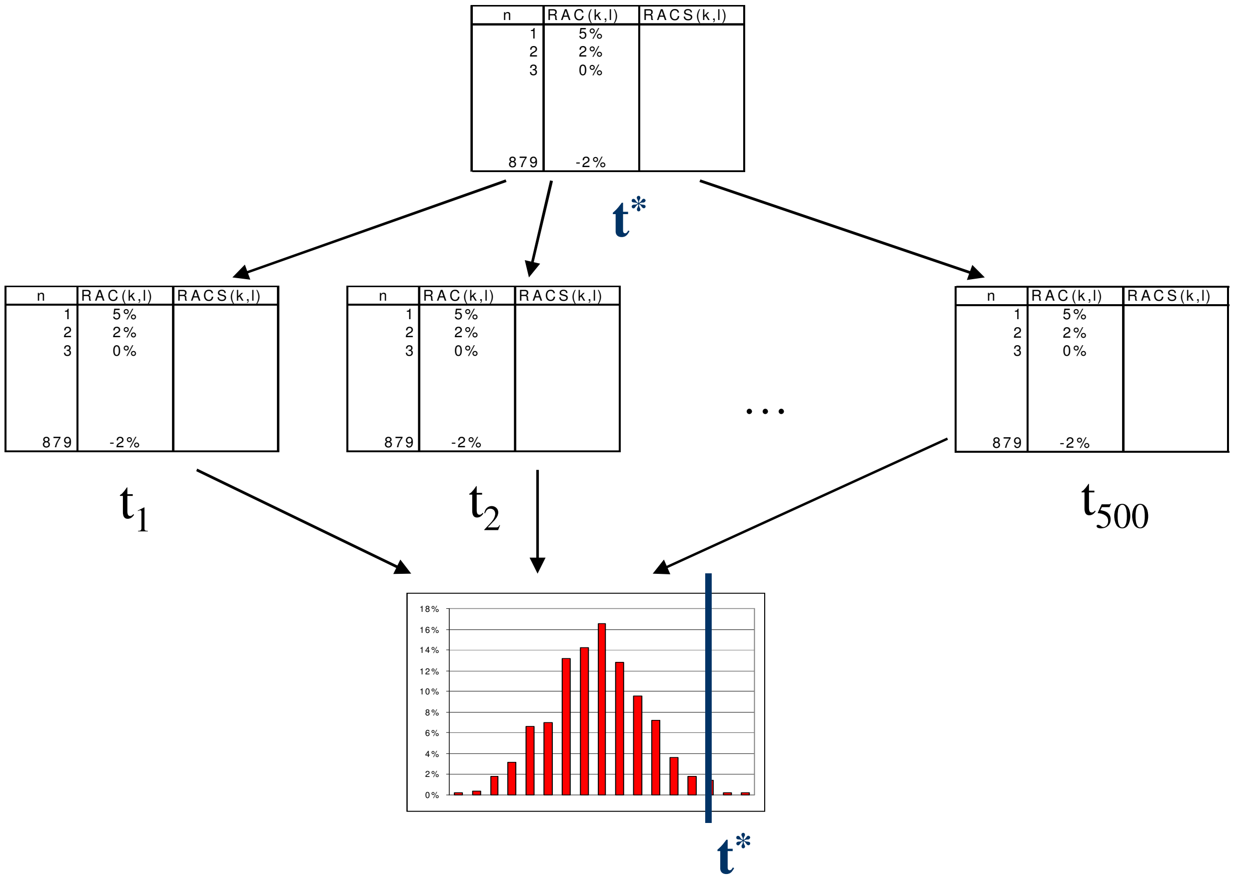
Step 2. Computation of the cross-sectional average ➔ ASCAR

Step 3. Computation of the cross-sectional variance ➔ σ^2(ASCAR)

Step 4. Computation of student t-statistic ➔ t=ASCAR/σ(ASCAR)

Standard Event Study methods (7)

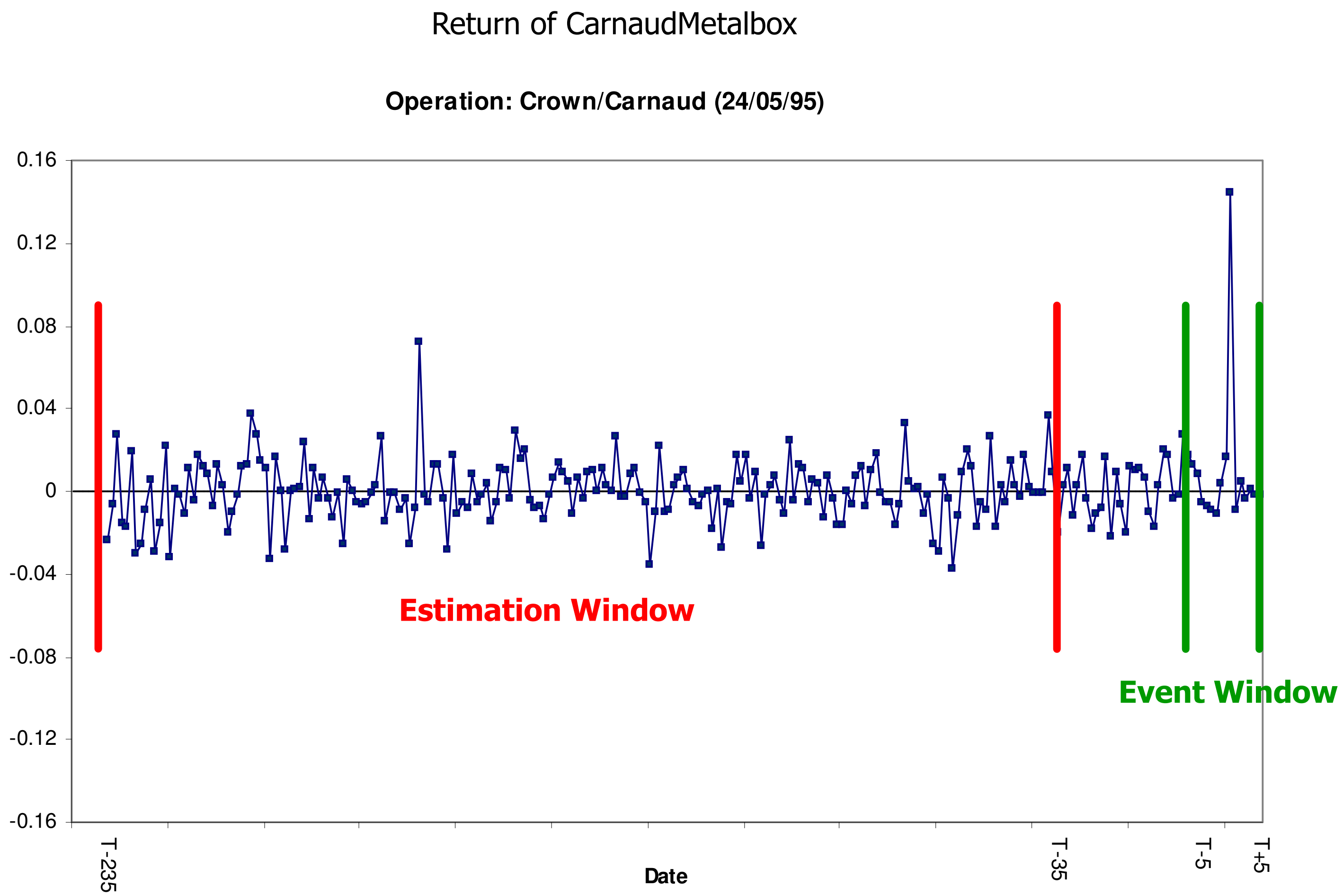
⇨ To tackle the normality problem and to improve the power of the test, we could use a **percentile t** bootstrap approach, instead of relying only on an asymptotic *p*-value



Standard Event Study methods (8)

- Corrado (1989)
  - Non-parametric test
  - RANK test merges the estimation and event windows in a unique time series
  - Abnormal returns are sorted and a rank is assigned to each day
    - $K_{i,t}$=rank($AR_{i,t}$)
    - $AR_{i,t1}$>$AR_{i,t2}$ ➔ rank($AR_{i,t1}$) >rank($AR_{i,t2}$)
  - The test compares the average rank of event period Ars to the expected rank under the null hypothesis of no AR (H_0: AR=0).
  - The use of ranks neutralizes the impact of the form of the abnormal returns distribution (skewness, kurtosis, outliers,…)

Contaminated estimation period? (1)



Contaminated estimation period? (2)

- To conduct an event study we need to define an **estimation window**
  - It has to correspond to a normal period without any other significant firm specific perturbing events
- How to be sure that the estimation window correspond to a normal period?
  - In practice estimation windows are contaminated
    - Malatesta and Thompson (1985) put forward that bidders frequently follow a strategy of acquisition programs
    - Fuller et al. (2002) emphasize the importance of this phenomenon
  - It is impractical to analyze the estimation period on a **case-by-case** basis
    - Nowadays, real sample encompasses thousands of observations
  - The likely existence of such perturbing events will definitely affect the parameters of the RGP

Our solution (1)

- We propose the use of a two-state **Market Model**:

$$R_{i,t} = \alpha_i + \beta_i R_{m,t} + \varepsilon_{1i,t} \qquad \varepsilon_{1i,t} \sim N(0;\sigma_1^2) \quad \text{si} \quad \mathrm{S_t} = 1$$
$$R_{i,t} = \alpha_i + \beta_i R_{m,t} + \varepsilon_{2i,t} \qquad \varepsilon_{2i,t} \sim N(0;\sigma_2^2) \quad \text{si} \quad \mathrm{S_t} = 2$$

- The regime switching is governed by a state variable not directly observable (St)
  - We assume that it is described by a first-order Markov process

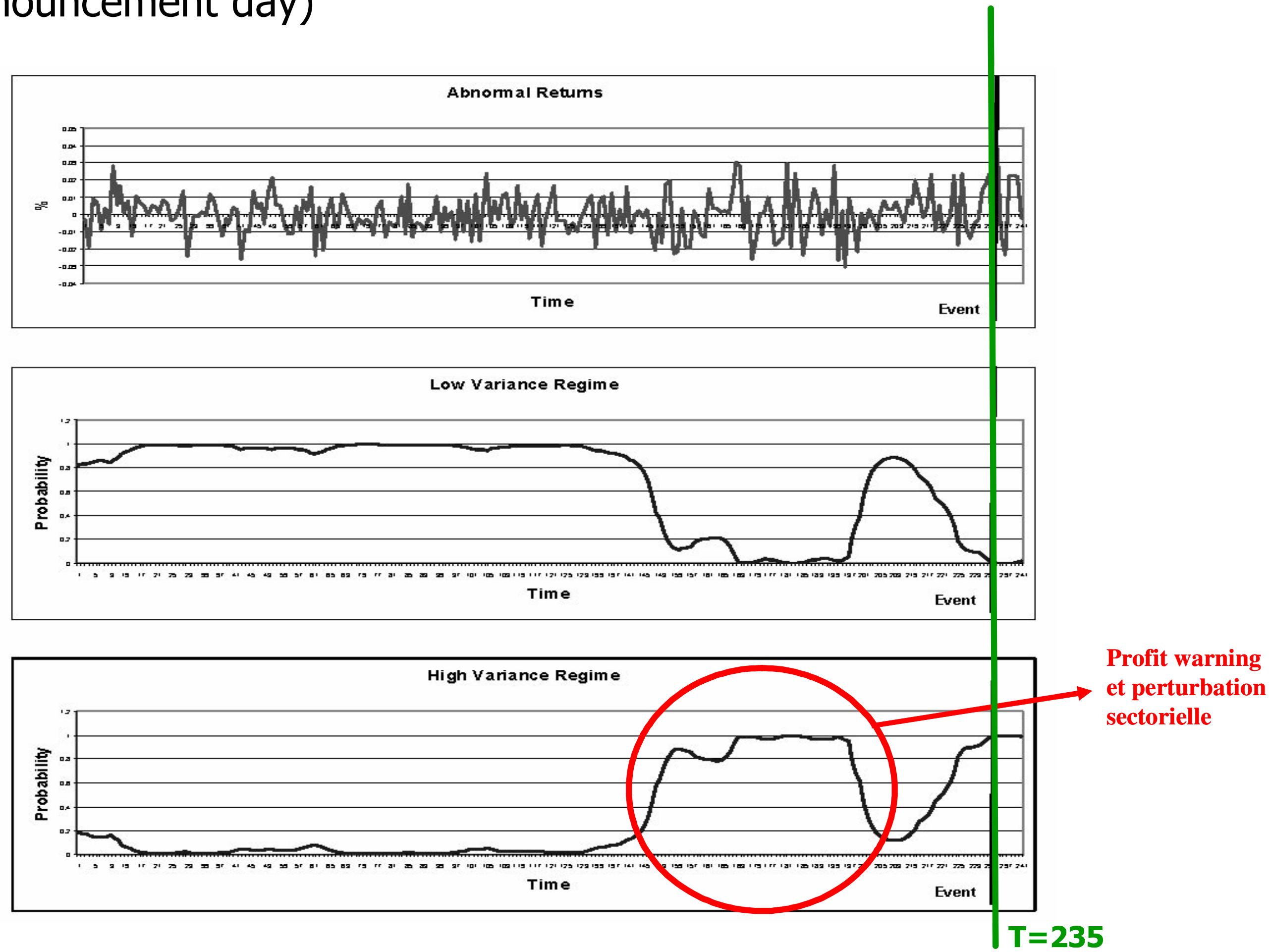
$$p_{ij} = P(S_t = i \mid S_{t\text{-}1} = j)$$

Our solution (2)

- The way we propose to model the return is in line with Roll (1987) intuition
  - The true generating process is better described by a mixture of two distributions
    - One corresponding to a state of information arrival
    - Another to the normal behavior
- The Markov-Switching Regression test (MSR)
  - The AR are obtained with the Two-State Market Model
  - Then for the significance test, we adapt the Boehmer et al. (1991) approach
    - The standardization procedure is done with the estimated standard deviation of the low variance regime
  - The MSR test does not lead to an automatic power increase (see proof in Appendix 1 of the paper)
- Advantages of the method
  - Inference on the regime for a specific day
  - Capture both the skewness and kurtosis observed in the unconditional distribution of returns

Our solution (3)

Example: Acquisition of ICI Nylon activities by DuPont (T=235, Announcement day)



Specification and power analysis (1)

- Aim: to study the **power** and the **specification** of the MSR test when the estimation window is contaminated
  - Power=ability to detect ARs when there are ARs
  - Specification=ability to detect ARs when there is no AR
- A well-defined test is a test that simultaneously maximise the **power** and minimize the **specification**
- The considered benchmarks are the following approaches
  - Cross-sectional method of Boehmer et al. (1991)
  - Rank test of Corrado (1989)
  - Beta-1 (see Brown and Warner, 1985)
- The considered sample for the simulation analysis
  - Stocks of the S&P 1500 index
  - Daily stock price from 01/01/1990 to 01/03/02
- Sample generation
  - Companies and event dates are determined by random drawing with replacement
  - For each simulation we construct 250 samples of 50 firms
  - The estimation period encompasses 200 days, and the event day is situated at day T=250

Specification and power analysis (2)

- Events generation during the **estimation window**
  - Average ARs of 0%, +/- 0.5%;+/- 1%; +/- 2%; +/- 4% and +/-5%
  - These shocks are stochastic with variance $k*\sigma^2$ (where k=1 or 2)
  - The number of contaminating event is determined in two steps:
    - First, a random draw from a Poisson distribution with mean 2 (=λ*)
    - Then, a random draw from a Uniform distribution for each day of the estimation window
      - If the obtained probability **is less than** (λ*/200) we generate an AR for that day
- Events generation during the **event window**
  - The event day is situated at day T=250
  - The simulated ARs are 0% (specification); +0.5% and +1% (power)
  - To produce stochastic ARs we add k' times a randomly selected mean adjusted return from the estimation window (k'=1 ou 2)

$$R'_{i,250} = R_{i,250} + AR_{i,250} + k'(R_{i,x} - \overline{R}_i)$$

Example: Event generation during the estimation window

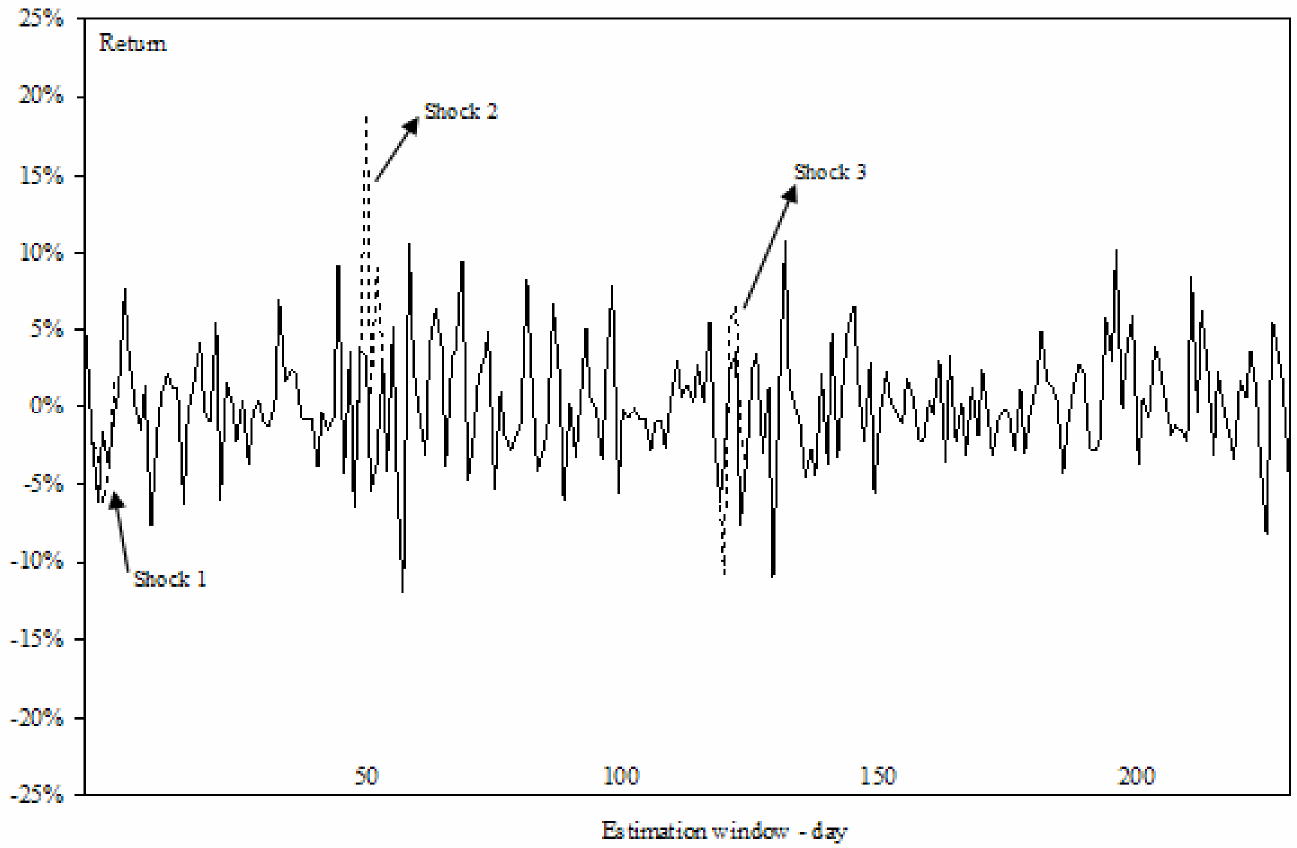
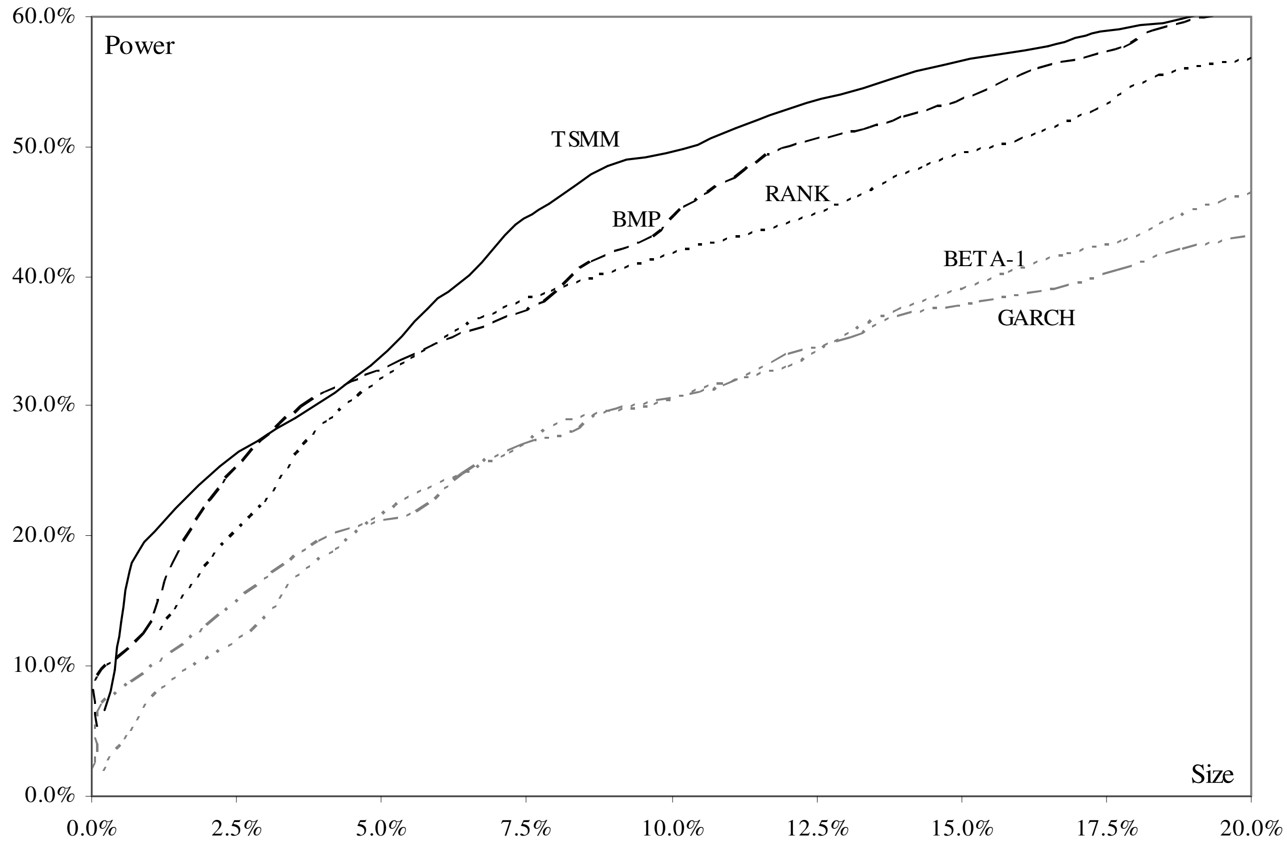


Fig. 1. This figure provides an example of estimation window contamination using the procedure described in Section 4.2. The solid line is the time series of initial returns and the dotted line is the time series obtained after event generation. Three events are generated, at dates T=2, 51 and 119. The standard error of the estimation window is 3.73% initially and 4.01% after event generation.

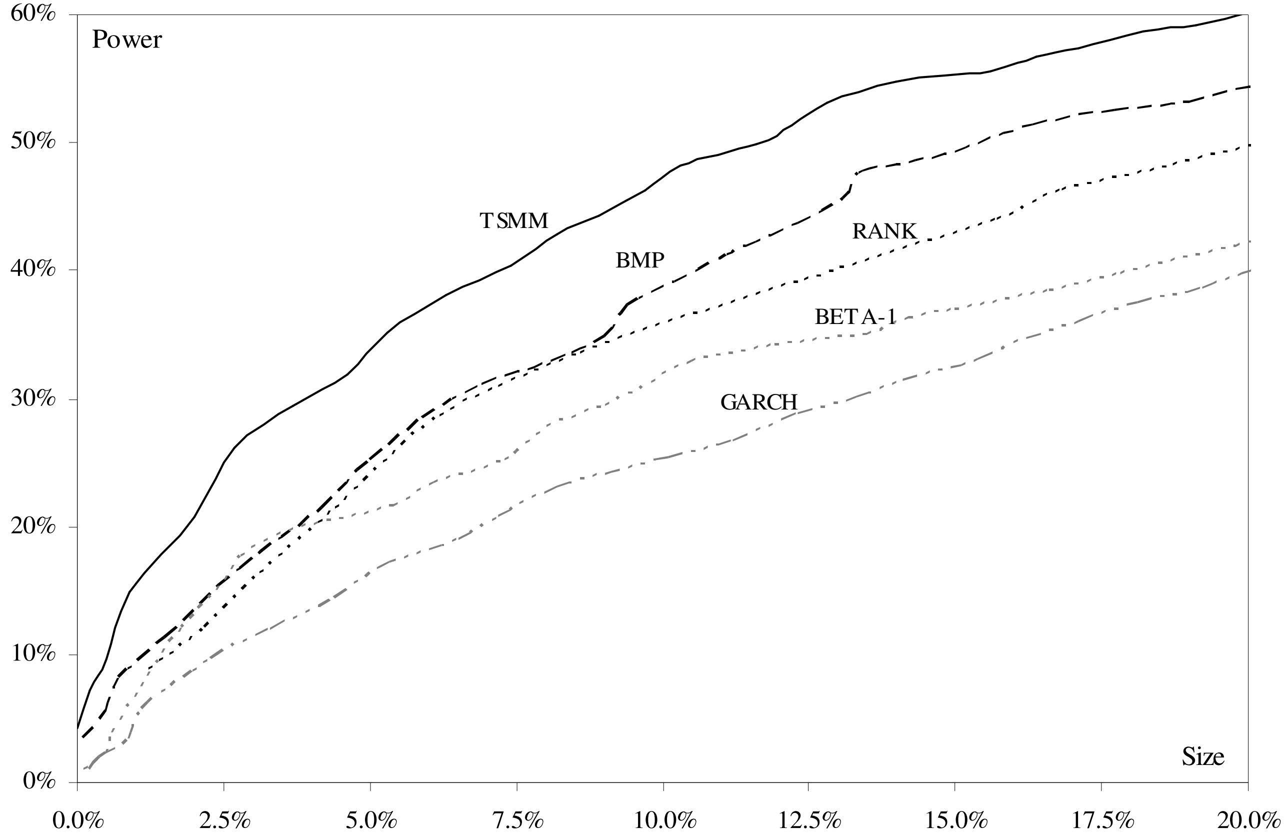
Event-induced return of 1% and an event-induced increase in return volatility

Panel A. Without contaminating events



Event-induced return of 1% and an event-induced increase in return volatility

Panel B. With contaminating events



Conclusion

- Contaminated estimation window is an issue when dealing with thousands of observations
- We propose an event study method robust to this phenomenon
  - The advocated MSR test clearly dominates classical event study methods with respect to specification and power