A Markov Switching Re-evaluation of Event-Study Methodology

R. Castellano and L. Scaccia

Dipartimento di Istituzioni Economiche e Finanziarie

Università di Macerata

Outline

- Event-study methodology and its drawbacks
- A possible solution based on Markov Switching models
- An application to Credit Default Swap market

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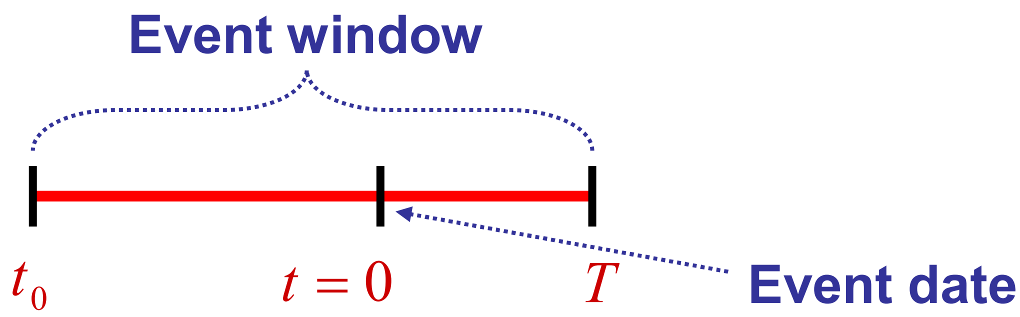

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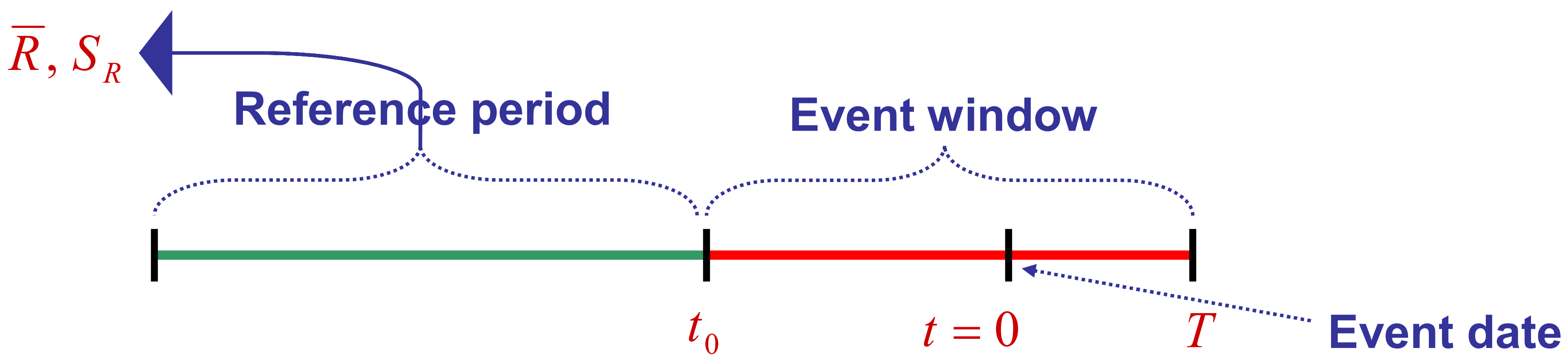

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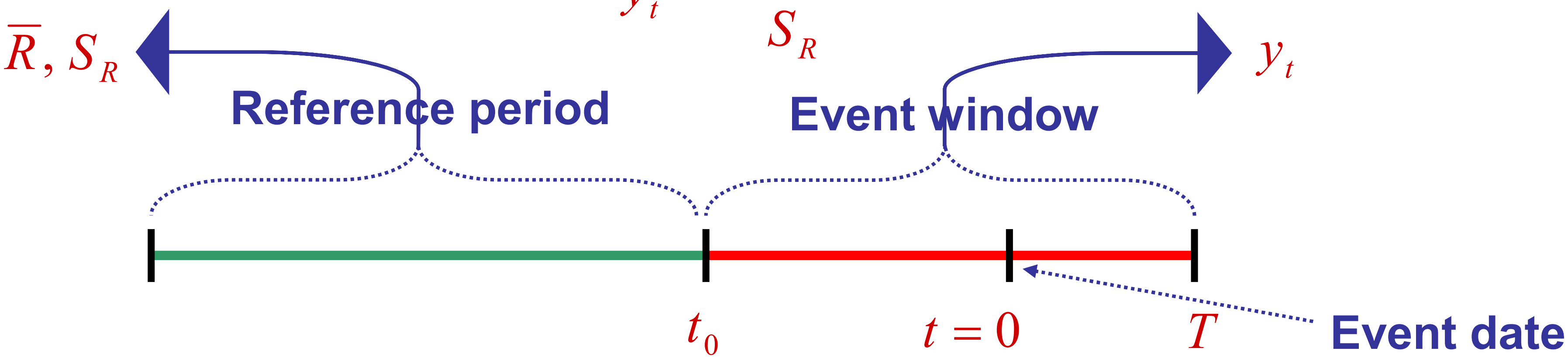

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  4) use of parametric or non parametric test statistics to **test hypotheses** on the mean or variance of ARs

Event-study methodology pitfalls

- T-test or other non parametric tests are used to test the null hypothesis of no abnormal returns at the time of the event

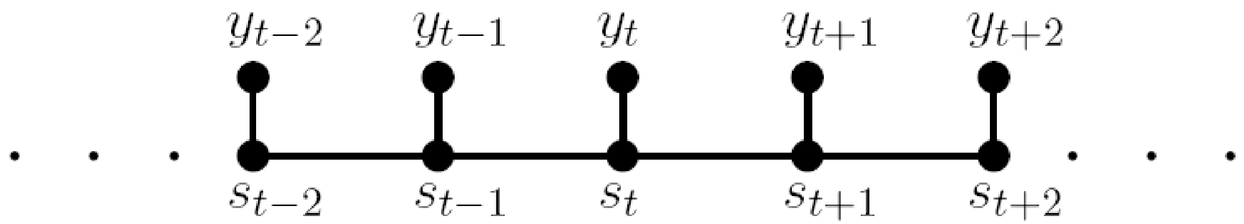
  - Misleading results may be obtained because of the kurtosis and volatility clustering characterizing financial time series

- We propose to model abnormal returns in the event window through a Markov Switching model with two regimes:

  - regime 1 : normal market conditions
  - regime 2 : abnormal market conditions

Markov Switching models

- Let $\mathbf{y} = (y_t)_{t=t_0}^{T}$ be the observed data
- A MSM assumes that the distribution of an observed data point y_t depends on an unobserved (hidden) “state" or “regime" $s_t \in \{1, \ldots, k\}$
- The elements of $\mathbf{s} = (s_t)_{t=t_0}^{T}$ follow a Markov chain with transition matrix $\mathbf{\Lambda} = (\lambda_{ij})$, i.e. $p(s_t = j \mid s_{t-1} = i) = \lambda_{ij}$, and stationary distribution $\boldsymbol{\pi} = (\pi_i)_{i=1}^{k}$



- The full conditional distribution of y_t is $P_{s_t}(y_t \mid \boldsymbol{\theta})$

The model proposed

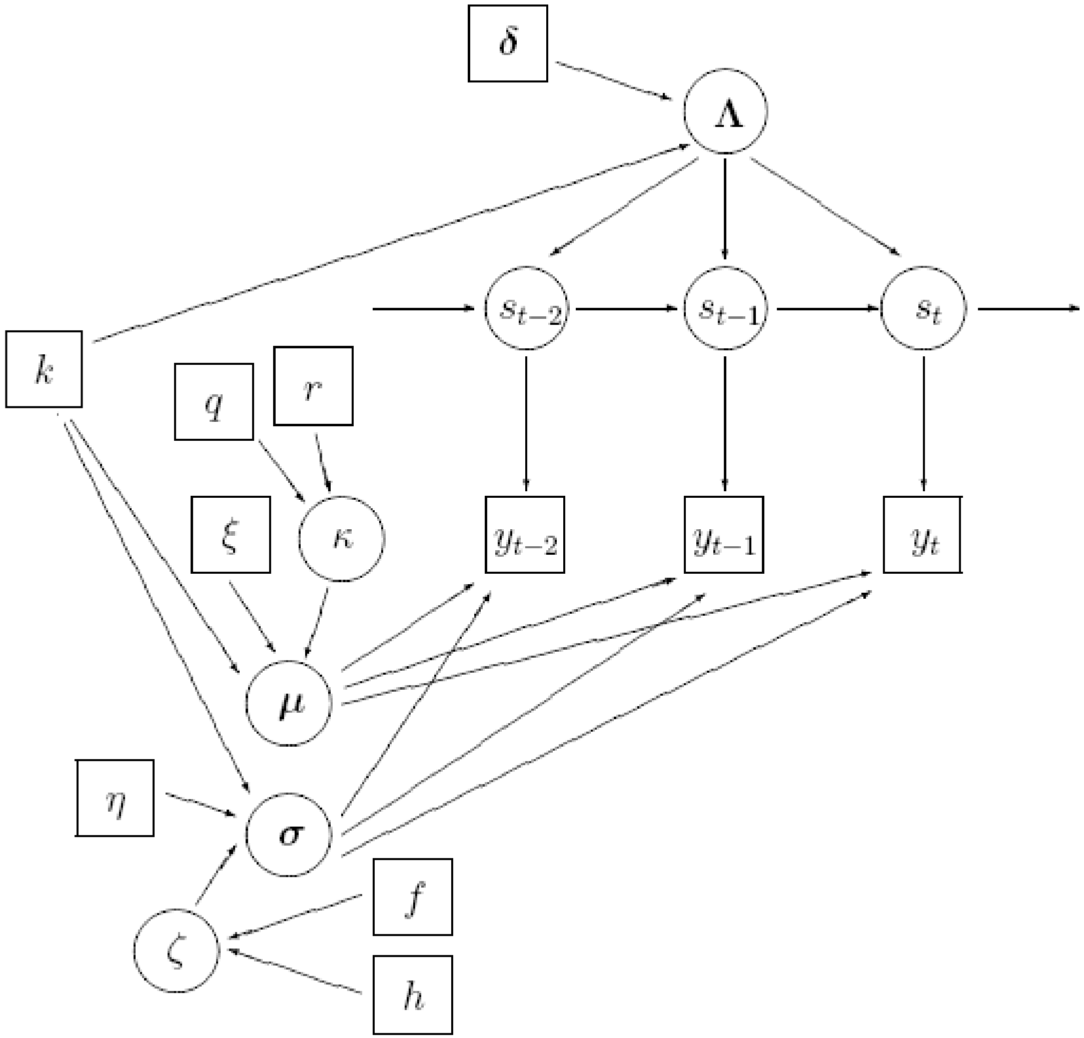
- When $s_t = i$, we assume that y_t is drawn from a $N\left(\mu_i, \sigma_i^2\right)$
  - μ_i is the mean of the *i*-th regime
  - σ_i^2 is the variance of the *i*-th regime
- Thus the marginal distribution of y_t is a mixture of Normal distributions:

$$y_t \sim \sum_{i=1}^{k} \pi_i N\left(\mu_i, \sigma_i^2\right)$$

  - π_i's are the components of the stationary vector of the transition matrix

Prior distributions on the parameters

- $k = 2$
- $\boldsymbol{\lambda}_i \sim D(\delta, \ldots, \delta)$
- $\mu_i \mid \sigma_i^2 \sim N(\xi, \kappa\sigma_i^2)$
- $\kappa \sim IG(q, r)$
- $\sigma_i^2 \sim IG(\eta, \varsigma)$
- $\varsigma \sim G(f, h)$



Bayesian Inference

- We use MCMC to sample from the posterior joint distribution of the parameters

  - update $\mathbf{\Lambda}$, $\mathbf{s}$, $\boldsymbol{\mu}$, $\boldsymbol{\sigma}^2$, κ and ς through Gibbs steps

- From the sample $\left(\mathbf{\Lambda}^{(m)}, \mathbf{s}^{(m)}, \boldsymbol{\mu}^{(m)}, \boldsymbol{\sigma}^{(m)}, \kappa^{(m)}, \varsigma^{(m)}\right)$, for $m = 1, \ldots M$, we estimate quantities of interest, i.e.:

  - posterior probabilities of being in a certain regime at each time *t*

$$\hat{p}(s_t = i \mid \mathbf{y}) = \frac{1}{M} \sum_{m=1}^{M} I\left\{s_t^{(m)} = i\right\}$$

An application to CDS market

- Data set: 45 historical series of CDS and related reviews for downgrading, leading to 57 non-overlapping event windows

- Event windows: starting 60 business days before a review for downgrading and ending 20 business days after the announcement, i.e.:

$$t \in [-60 \quad ; \quad 20]$$

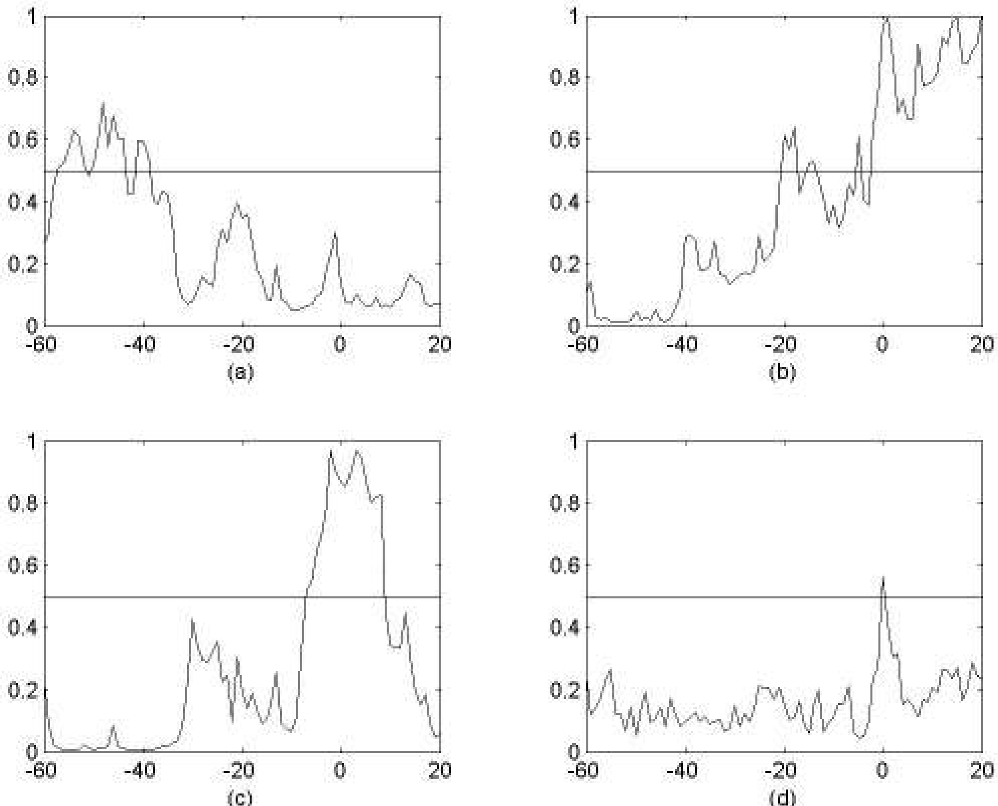
- Number of regimes: 2 regimes for the CDS returns generating process in the event window, i.e.:

  - regime 1 : normal market conditions (low volatilities)
  - regime 2 : abnormal market conditions (high volatilities)

Results

- Different patterns observed for the probability of being in the high volatility regime, within each event window

- Cluster analysis to enucleate typical patterns



Estimated mean posterior probabilities of being in the high volatility regime for series belonging to four different clusters.

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