Testing for efficient markets, Part II

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Recap:

- Market efficiency: all information is captured in current price.
- Operationalised by: no-arbitrage principle.
- Three types of tests of efficient markets based on information assumed: weak, semi-strong and strong form.
- Weak: Tests of independence of returns.
- Core idea of variance ratio: Uncertainty goes up as $\sqrt{T}$ • Approximation of VR using ACF • Test statistic and inference based on overlapping samples • Nelson-Kim-Startz strategy of scrambling • Tests which address heteroscedasticity • Standard explanations for serial correlations in returns data – nonsynchronous trading and indexes, and bid-ask bounce.

Semi-strong form tests of EMH: The event study framework

What are event studies?

- Typical event studies analyse the impact of a specific event on returns behaviour.
- Typically, "events" are types of corporate actions.
  Example: dividend announcements, sale of new shares, issuance of new debt, etc.
- Sometimes it is a macro-economic or institutional event at fixed periods, or at a given point in time. For example, the start of electronic trading in India, or the depository; the abolition of long term capital gains tax; the implementation of Clause 49, etc.
- Sometimes, the events can be spread over different points in time. For example, the announcement of an SEO; the start of futures trading on a stock; the impact of the budget, etc.

Quantifying EMH questions

- We seek to understand the behaviour of stock returns around the event.
  1. This can be measured as statistics of the returns like the mean or median.
  2. It can be time series characteristics of the returns such as the value of the AR(k) coefficient.
- Other variables that have been studied more recently are:
  - Volatility of returns.
  - Liquidity of stocks.

The "event study" approach involves:

1. Identify the event (say, bonus issues).
2. Identify the variable to be studied (say, returns).
3. Identify an "event horizon".
   The event horizon is a set of days N before the event, and an equal number of days after over which we expect that the event could have had the major, if not the sole, impact on price.
4. Identify a set of firms K that have undergone this event.
5. Line up the event dates for each firm in such a manner that we are able to calculate the "average" return on a portfolio of firms that have undergone this event.
   Each firm will have undergone the event at different points in time; for each firm, set $T = 0$ as the date on which the event took place and calculate daily returns for a set of days $T - N$ and $T + N$.

The event study approach

- For K firms, for the same day, t, we calculate the average returns for t.

$$\bar{r}_t = \sum_{j=1}^{j=K} r_{j,t}, \forall t = -N, -N+1, \ldots, -1, 0, 1, 2, \ldots N-1, N$$

- This gives us a time series of length $(2N+1)$.

The event study approach, contd.

- We calculate the average to remove any stock-specific biases in the results.
- Typically, event study analysis is done on **Cumulated Average Returns** or CAR, as follows:

$$CAR_{(t<0)} = \sum_{t=-N}^{t=-1} \bar{r}_t, \qquad CAR_{(t>=0)} = \sum_{t=0}^{t=N} \bar{r}_t$$

- $CAR_{(t<0)}$ gives us the returns to investing in a portfolio of the K stocks at the start of the event horizon till the event. Similarly, $CAR_{(t>=0)}$ gives us the returns to investing in a portfolio of the K stocks from the event date to the end of the event horizon.
- The null is that the event has no impact:

$$H_0 : CAR_{(t>=0)} = CAR_{(t>0)}$$

The event study premise

- **EMH** H_0 :**car**$_{(t<0)}$ = **car**$_{(t>0)}$
- For example, we expect that when a firm announces a bonus issue/stock split, there should be no difference in the behaviour of returns.
- H_1 can be dependent on the event itself.
- For example, we expect that an increase in transparency of the trading process will improve the liquidity of stocks.
  To test this, we structure the following event study:
  - Calculate the average liquidity of a set of K stocks **before** the start of NSE, $\bar{\text{IC}}_{(t<NSE)}$
  - Calculate the average liquidity of a set of K stocks **six months after** the start of NSE, $\bar{\text{IC}}_{(t>NSE)}$
- Then,

$$
\begin{aligned}
H_0: &\quad \bar{\text{IC}}_{(t<NSE)} = \bar{\text{IC}}_{(t>=NSE)}; \\
H_1: &\quad \bar{\text{IC}}_{(t<NSE)} > \bar{\text{IC}}_{(t>=NSE)}
\end{aligned}
$$

Inference in an event study

Inference

- Testing H_0 often involves knowing a "expected" CAR/excess returns, E(CAR), and the standard deviation of the CAR, σ.
- For EMH, the E(CAR) $= 0$.
- σ for the CAR is calculated assuming independence. Then $\sigma_{car} = N\sigma_{ear}$, assuming that the CAR is calculated using N excess average returns.
- The event *horizon* becomes an important variable affecting robustness: the longer the horizon, the more noisy the inference.

Problems of inference in event studies

- What happens when the event affects the volatility of returns?
  For example, US studies showed that the returns volatility increased in the post-bonus issue period.
- This is an even bigger issue for event studies over a longer term horizon.
  This is because multiple other events can impact upon returns behaviour over the event horizon.
- If this is not corrected, the results are biased in favour of rejecting H_0.

Improving robustness of the event study

1. Calculate average returns *across firms*.
   This reduces the idiosyncracies of a single firms characteristics and focuses on reaction only to the event.
2. Calculate excess returns.
   This reduces the impact of systematic/macro-economic events on returns behaviour.
3. Create a *matched sample* of firms that are not vulnerable to the event.
   Ideally, for every firm sensitive to the event, find a firm that has similar characteristics for that period of time, that is not effected by the event.
4. Calculate returns variance on the day of the event, and the variance in the post-event period.
5. Use MonteCarlo or Bootstrap simulations to draw the distribution of the variable under the event study.

Impact of the budget on Indian stock markets

Event study of the budget and the market index

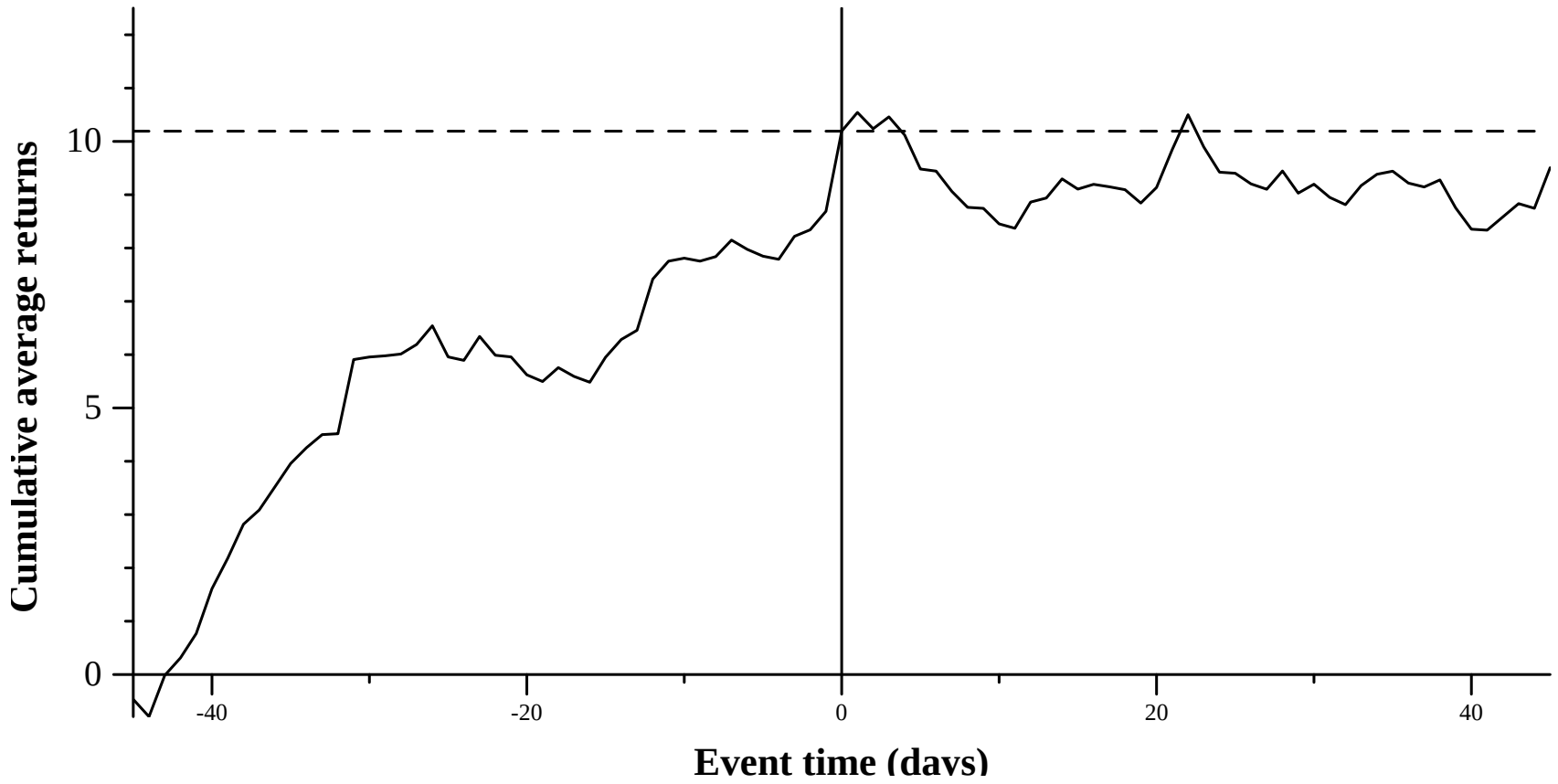
- Event: The Union Budget of the GoI.
- Event variable: Cumulated returns for the stock market index.
- Event horizon: 45 days before and after the event, which is around two months before and two months after the bonus issue.
- Question: Do stock market prices fully react to all information announced in the budget on the date of budget itself, or does it adjust to it over a period after?

Event study setup

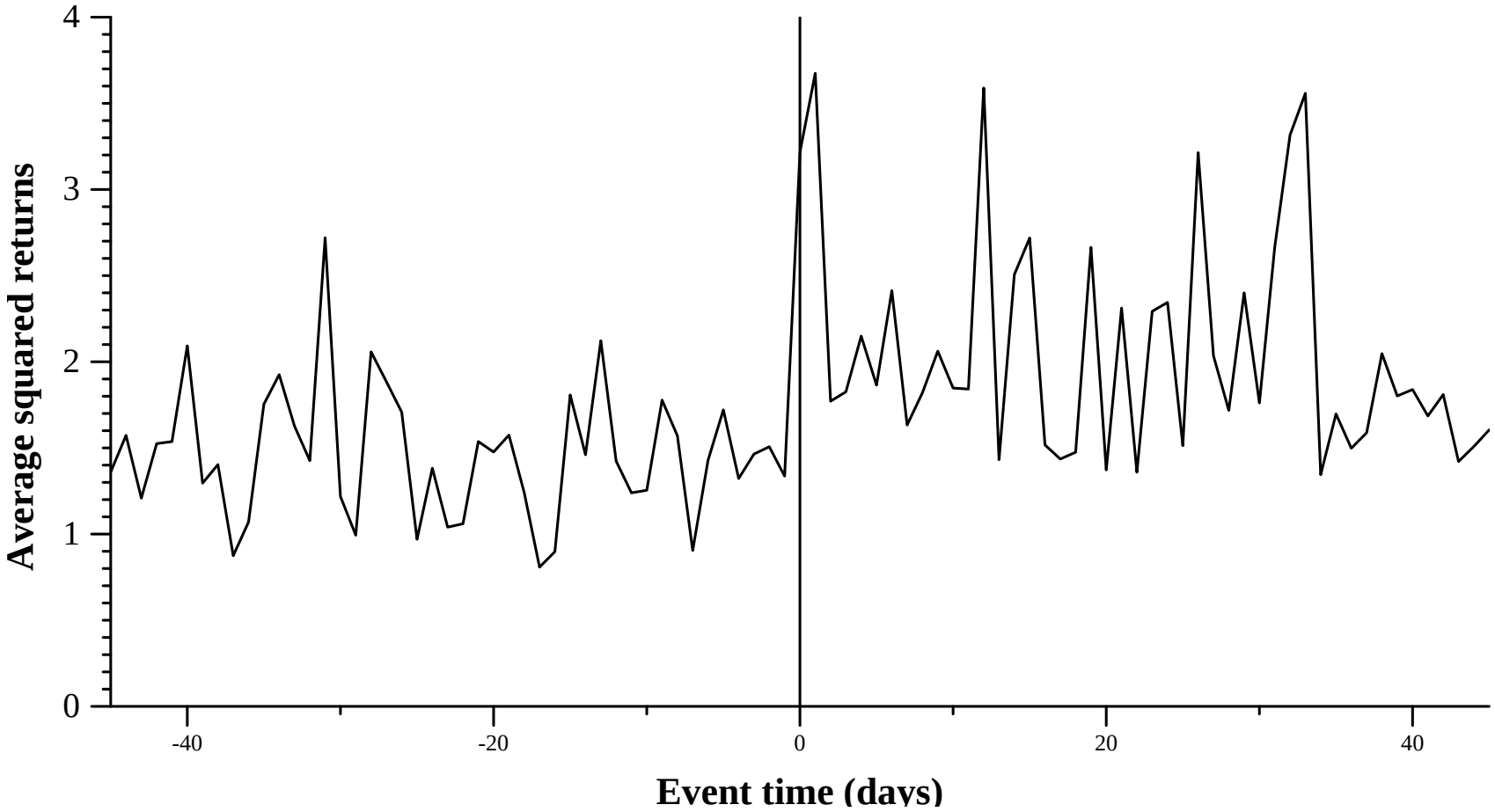
- There had been 26 Union Budgets between April 1979 and June 2001.
- We have a time series of the market index put together by using a series of different indexes.
  The length of the time series is important because our study is on the impact of the Budget: the more the number of Budgets, the better the inference.
- The summary statistics for the returns on the index is:

	All days	45 days		Non–Budget days
		before Budget	after Budget	
$\bar{r}_t$	0.084	0.193	-0.015	0.070
$\bar{r}_t^2$	2.943	2.447	4.681	2.445
Obs	4673	945	945	2762

CAR around the event



The volatility of returns around the event



Results

- On average, there is a build up of returns before the budget.
- On average, there is a minor drop in returns after the budget.
- There is a significant rise in volatility after the budget.
- This is relatively consistent with what we would expect from an efficient market: in fact, most of the information appears to have been impounded into prices even **before** the budget date itself!

Strong form tests of market efficiency

Testing for the existence of insider trading

- Isolate a set of financial market entities who can have access to non–public information.
- *Professional fund managers* such as mutual funds, insurance companies, pension fund management companies.
- Test whether they demonstrate access to better information in the form of *enhanced returns*.
  If fund managers are able to systematically produce better returns, then his would be evidence of deviations from market efficiency.

Mutual fund performance evaluation

- Daily NAV (Net Asset Value) of mutual funds are observable.
- Performance evaluation focus: *Are the returns on the mutual fund higher than some benchmark portfolio?*
- Hypothesis: $r_{mf_t} - r_{f_t} = \alpha + \beta_{mf}(r_{M_t} - r_{f_t})$
  1. If the fund manager has systematically better performance, α will be positive and significant. (Jensen's measure)
  2. If the fund manager has systematically better performance, the risk-adjusted return $((r_{mf_t} - r_{f_t})/\beta_{mf} r_{M_t})$ will be better than the benchmark portfolio. (Sharpe's measure)
- Tests:

$$H_0 : \alpha > 0$$

$$H_0 : \frac{r_{mf_t} - r_{f_t}}{\beta_{mf} r_{M_t}} > \frac{r_{M_t} - r_{f_t}}{\sigma_{r_{M_t}}}$$

Analysing mutual fund performance for Indian MFs

- Mutual funds in Indian began developing as an industry in the late eighties.
- We analysed the performance of 13 MF schemes in April 1994, with around Rs.69 billion of assets under management.

Summary statistics for the fund schemes

Summary Statistics						
	Scheme	Weeks	$r_j - r_f$		$r_M - r_f$	
			$E()$	Var()	$E()$	Var()
1	Canbonus	71	-1.159	104	0.073	25
2	Canshare	206	0.107	88	0.589	28
3	Candouble	139	-0.096	90	0.535	31
4	Cangrowth	201	-0.320	105	0.605	29
5	Cantriple	60	-0.977	107	0.555	25
6	Canstar-cap	102	-0.195	137	0.293	37
7	Ind Ratna	140	0.376	134	0.600	29
8	Mastershare	215	0.511	75	0.514	28
9	Masterplus 91	81	-0.873	52	0.056	23
10	UGS 2000	87	0.260	48	0.228	23
11	UGS 5000	87	0.128	87	0.228	23

Measures of Jensen's α

		α	β	R^2	σ_ϵ
1	Canbonus	-1.216	0.779	0.147	9.479
		(1.13)	(0.23)		
2	Canshare	-0.373	0.815	0.213	8.345
		(0.58)	(0.11)		
4	Cangrowth	-0.966	1.068	0.316	8.489
		(0.60)	(0.11)		
6	Canstar-cap	-0.447	0.862	0.202	10.494
		(1.04)	(0.17)		
7	Ind Ratna	-0.360	1.227	0.327	9.535
		(0.81)	(0.15)		
8	Mastershare	-0.119	1.226	0.566	5.710
		(0.39)	(0.07)		
9	Masterplus 91	-0.927	0.953	0.402	5.632
		(0.63)	(0.13)		
10	UGS 2000	0.110	0.659	0.212	6.197
		(0.67)	(0.14)		
11	UGS 5000	-0.060	0.822	0.190	8.268
		(0.89)	(0.18)		

Performance evaluation inference

- These mutual funds appear to have more unsystematic risk than the market.
- They give lower returns than the market index.
- Therefore, their Sharpe's ratio is not as good as that of the market index.
- The Jensen's α is not significant for any of the schemes analysed.
- Conclusion: Mutual fund managers (circa 1994) were not out-performing the market index.
  This leads us to infer that the hypothesis of strong-form of market efficiency cannot be rejected.

Concerns in performance evaluation

- The benchmark portfolio might be misspecified
  1. Problems with the market index construction.
  2. Practitioners claim: The benchmark chosen ought to be compatible with the objective of the investment. E.g., sectoral funds must be benchmarked against sectoral indices.
- Tradeoff between long time series (and high power of the tests) and short maturity of fund managers (and low power of the tests).

In conclusion

- EMH is a function of the economic environment. When market institutions change,