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EVENT STUDY METHDOLOGY: A CRITICAL REVIEW

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Abstract

In this study, we examine the event study methodology critically. In simple terms, event study examines the behavior of firms' equity and bond prices around corporate events. Event Studies are useful in business research to assess the intensity of unusual returns during the occurrence of an event. This assists the researchers' to ascertain precisely the shock of an event on the assets of the firms' claim holders. Outlining the evolution and growth of event study methodology over a period of hundred years, steps involved in event study methodology and its appropriateness in meeting the objectives of the study, a critical comparison of mean adjusted model, market adjusted model and conditional risk adjusted model, we expose the robustness of event study methodology in determining the influence of an event on equity and bond returns. We consider this critical evaluation is highly relevant and suitable especially in Ocobter 2013 when Professor Eugene F. Fama, Professor, University of Chicago who got the Sveriges Riksbank Prize in Economic Sciences in Memory of Alfred Nobel. Prof. Eugene Fama is recognized as the "father of modern finance". The Royal Swedish Academy of Sciences commented on Prof. Eugene Fama's contributions to modern finance through event study methodology, "as a ground breaking research on the empirical analysis of asset prices." From the review, we concludes that though there are few econometric issues which are very trivial, event study methodology is one of the effective methods to assess the impact of certain event on the returns of equities and bonds.

Keywords: Mean Adjusted Model, Market Adjusted Model, Conditional Risk Adjusted Model, Event Study Methodology

1. Introduction

Computing the economic impact of an event is a rigid task before the economists and finance professionals. Though, this seems a daunting assignment event study methodology emerged as a tool to assist them. With the emergence of capitalistic thoughts, the impact of an economic, political or social incident will be incorporated into the security prices in the due course of time. This paved way for the advent of event study methodology as a popular statistical solution in business research to ascertain the impact of an event. As per McWilliams and Siegel (1997) an event study methodology, *"determines whether there is an 'abnormal' stock price effect associated with an unanticipated event. From this analysis the researcher can infer the*

significance of the event". As Mitchell and Netter, (1994) stated, "*an event study methodology is a statistical technique that estimates the stock price impact of occurrences such as mergers, earnings announcements, and so forth. The basic notion is to disentangle the effects of two types of information on stock prices –information that is specific to the firm under question (e.g., dividend announcement) and information that is likely to affect stock prices market wide (e.g., change in interest rates)."* In simple terms, event study methodology examines the performance of firms' stock prices just about business news.

Broadly event studies are classified into three. Market efficiency studies assess the speed and accuracy of market's reaction and incorporation of original news. Information impact researches evaluate the extent to which firms returns response to an event. Apart from these two, a few event studies examine the abnormal return after segregating securities into various sub sections. They analyze the variation of abnormal return among different subsections. Event study methodology looks into the impact in both short and long horizon.

2. Brief History of Event Study Methodologies

Tracing the history of the event study method, we came across the work of James Dolley (1933) who used event study method to examine the returns effect of stock splits. As per the records this is the first event study employed research. John H. Myers and Archie Bakay (1948), C. Austin Barker (1957, 1958), and John Ashley (1962) were the subsequent users of the event study methodology. The Event study methodology evolved accommodating the new requirements of research. Modifications like removing the general stock market price variations and extricating the effects of confounding events are the later modifications to meet the emerging requirements of research. However, it is the paper by Eugene Fama et al., (1969), which brought the primary presentation of event study methodology. Eugene Fama et al., (1969) analyzed how the stock splits influence after eliminating the confounding events. That research paper was cited more than 750 times according to records of Social Sciences Citation Index till 2005. Briefly we can conclude that the work of Eugene Fama et al., (1969) were the beginning of a new era of methodology in accounting, finance and economics. There after event study methodology has emerged as a technique for analyzing the impact of economic or business incidents on the security prices.

After 1970, different researchers started modifying the event study methodology to resolve the statistical issues so as to make event study methodology statistically valid. Among those modifications, the recommendations by Stephen Brown and Jerold Warner (1980 and 1985) were the most significant. The paper in 1980 mulled over performance problems in monthly data, while the paper in 1985 describes the problems in using daily data. Subsequently, Kothari and Warner (2005) suggested few recommendations to resolve econometric issues in the event study methodology.

From the period of 1970 to 2010 there are more than 600 researchers reported event study results. This paper is not an attempt to survey the entire 600 research papers.
However, we will highlight certain important contributions. Subramani.M. and E.Walden (2001) analyzed the effect of e-commerce events influence on the market price of firms, Das, Sen and Sengupta (1998) evaluated the effects of Strategic alliances on firm valuation, Horsky and Swyngedouw (1985) assessed the effects of firm's name change, Lane and Jacobson (1985),

studied the announcement effects of branch leveraging, Chaney et.al., (1991) examined the effects of new product announcements on stock prices of the firms. Apart from these studies other notable studies like Peterson (1989), MacKinlay (1997), Serra (2002), Kothari and Warner (2005), Cichello and Lamdin (2006) and Johnston (2007).
In this paper we discuss the event study methodology design or the steps involved in event study methodology, event study problems (problems in defining event date, issues in estimating normal returns, issues in calculating excess returns, issues in aggregating and measuring excess returns, issues in using parametric and non-parametric test for testing the significance of abnormal returns).

Event Study involves certain steps. These steps are outlined by Mac Kinlay (1997)
(1) Choosing an interested event
(2) Finalize the event window
(3) Choosing the sample set of firms to be incorporated in the analysis
(4) Elimination of confounding events during the event window
(5) Issues of time in event studies
(6) Forecasting of a "normal" return throughout the event window in the nonexistence of the incident;
(7) Calculate the parameter in the inference period;
(8) Compute the estimate errors (and find variance/covariance details) for the event window; total across firms and infer about the average impact;
(9) Test the abnormal returns for significance.
(10) After conducting cross-sectional regressions the excess returns on appropriate or unique firm characteristics

3. Literature on Issues of Event Dates and Event Windows

"Time is the father of truth; its mother is our mind".

Giordano Bruno

"Even if a researcher doing an event study has a strong comparative advantage at improving existing methods, a good use of his time is still in reading old issues of the Wall Street Journal to more accurately determine event dates"

Stephen Brown and Jeralad Warner

As emphasized by Brown and Warner (1985) the need for determining the event dates is a necessity. This is mainly due to the poor outcome when applied to uncertain events. Brown and Warner (1985) asserted the increased statistical power of event studies, while using daily and exact dates of the events. However, Glascock (1987) warned about the leakage of information well ahead of actual event dates. Even though Glascock (1987) warned the studies with event dates, the predictions made with precise event dates are much more accurate than the studies with vague event occurring time.

There can be difference in short-horizon and long-horizon event window results (Pinches and Singleton, 1978, Glascock et.al. (1987). Pinches and Singleton (1978) selected an event period of 30 days before the credit rating announcements and 12 days after the announcement. Griffin and Sanvincente (1982) selected an event window of 11 days prior to the rating announcements and one day after the rating announcement. Meanwhile, Houlthausen and Leftwich (1986) selected a

relatively long window to analyze the abnormal returns. They selected 300 days before the rating announcements and 60 days after the announcements to find out the abnormal performance. Glascock et al. (1987) studied on abnormal performance by selecting a window of 90 days before and after the credit rating change announcement date. Goh and Ederington (1993) selected an event window of 30 days) before and after the credit rating changes. Vassalou and Xing (2003) selected an event window of 36 days before and after the event.

Katz (1974) selected an event window of 12 days before the credit rating changes and 5 days after the credit rating changes. Grier and Katz (1976) selected an event window of 4 days before the credit ratings and 3 days after the credit ratings. Weinstein (1977) selected an event of 6 days before the rating changes and 7 days after the rating changes. Hite and Warga (1997) analyzed the excess bond returns before and after 12 days of rating changes. Steiner and Heinke (2001) analyzed the abnormal bond returns for an event window of 180 days before and after the incident of interest. Barber and Lyon (1997) Lyon and Barber (1999) and Kothari and Warner (1997) revealed the restrictions of long established event study in getting accurate results of the event. .

Majority of the previous research use large event windows, like monthly returns or weekly returns, but both (Brown and Warner, 1985) and (Bessembinder et al., 2009) pointed out the ineffectiveness of larger even windows for small samples. This is due to the impact of confounding factors especially pertaining to the firm specific factors. Furthermore, Brown and Warner (1980, p.225) exposed the poor repeatability in results of long-horizon windows Yaniv Konchitchki and Daniel E. O'Leary (2011) provided an overview of event studies in information system research. Consequently, Rubin and Rubin (2007) defined a narrow event window of 10 days preceding and succeeding the event. Cheng et.al. (2007) further reduced the event window as five days before and five days after the event.

4. Issues in Sample Selection in Event Studies

With the help of simulated event studies, Brown and Warner (1985) demonstrated simple and clear-cut estimation techniques are better to get precise outcome. Brown and Warner (1985) stated that the abnormal return computed based on standard market model with a robust market index will give accurate results of an event. Subsequently, the computed abnormal returns can be tested for its significance using a parametric t-test. The outcomes are exact to capture the impact of an event. However, this is questioned Ahern.R., Kenneth (2009) , who carried out a test comparable to Brown and Warner (1985) but selected samples non randomly. While selecting samples Ahern.R., Kenneth (2009) ensured that the sample was a representative of all firms in NYSE. Type I and Type II errors are visible in grouped samples. According to Fama (1996) the true asset pricing model with risk adjustment can also give error in predictions. The sample specific patterns will augment such prediction errors. The two researches confirm the uniqueness of organizations chosen for an event study sample can give a biased forecast. To avoid these biased predictions, the researchers are expected to use robust forecast technique proper for market average of the firms. So from the discussion above it is evident that the firm characteristics related with security pricing variances is also correlated with corporate events.

5. Elimination of Confounding Events in the event windows

The precise evaluation of impact of an event is the objective of an event study. It is a challenge before the researchers to eliminate the effect of a different event that happening at the same time along with the incident of interest. Due to these simultaneous occurrences of the events, it is difficult to ascertain the impact of one event on stock returns. Hence it is the task of a researcher to eliminate the presence of confounding events around the event date and event window. Joint venture announcements (McConnell and Nantell, 1985), (splitting of stocks and fundamental changes), dividends, Administration Changes (Cannella and Hambrick, 1993), earnings declarations (Brown and Warner, 1985), and merger, acquisition activities (Morck and Yeung, 1992) are typical confounding events. These events can manipulate the market price in relation with particular event's impact assessment.

One method to reduce the effect of confounding events is to reduce the size of event windows. The short-horizon event windows increase the probability to control the confounding events. This is confirmed by Brown and Warner (1985). Following the steps of DeFond et al. (2010), we can decrease the force of confounding events in the data base by collecting and analyzing the news pertaining to the company from the event dates. Thus through this exercise we can identify the news around events dates and event windows and eliminate those other confounding event's impact on stock returns.

6. Issues of "TIME" in Event Studies

Through multiple ways time acts upon a significant role in event studies. The major issues are presence of "meta"events, and issues of stationary..

Issues of "Meta" Events

Some significant events can cause change in stock market reactions. This significant event has nothing to do with a particular firm. These are called "meta" events. Due to these "meta" events the comparison of outcome that happen in various time periods may seriously differ. For example the "9/11" event triggered market circumstances for a year,

Stationarity

At times the stock market reaction data need not be stationary over a period of time. The major factor for lack of stationarity is due to the change in perception of investors over a period of time. The lack of stationarity provides one result for a period and a diverse outcome for another period. Dehning et al. (2004) revealed that e-commerce events had significant influence during 1998 compared to 2000. Meanwhile, a non- stationary state helps in getting an accurate result associated with an event. This condition of stationarity is highly significant in long-horizon event studies.

7. Issues in measurement of Returns and Normal Returns in the absence of the event

Before discussing the issues with respect to the prediction of normal return calculations, we need to discuss the issues pertaining to return calculations. Fama (1976, pp. 17-20) recommends

continuously compounded returns are the best suited for meeting the requirements of normality assumptions in regression. Brown and Warner (1985) point out the similarity in the results of both simple and continuously compounded returns. However, Thompson, Rex (1988, p.81) ignores the form of returns in event studies. Even though Thompson, Rex (1988, p.81) ignores the form of returns in event studies, most of the event studies use continuously compounded returns.

$R_{it} = \ln\{(P_t)/P_{t-1}\}$ Natural log of continuosly compounded rate of return on the stock of firm i on event day t defined as

P_t = Adjusted Closing price on day 't'.

P_{t-1} = Adjusted Closing price on day '(t-1)'

$R_{mt} = \ln\{(I_t)/I_{t-1}\}$ Natural log of Continuously compounded rate of return on the BSE 100 index on event day t given as ln (It/It-1)

I_t = Market Index on day t

I_{t-1} = Market Index 100 Index on day t-1

After the return it is the turn of normal expected returns. It is significant to differentiate two periods in any event study. They are the estimation period and event period. Anthony et al. (2006) uses one day before and two days after the event as event window and 240 days before the event window and six days before the event window as the normal return window (estimation period). Meanwhile, Acquisti et al. (2006) used 100 days before the event window and 8 days before the event window as estimation period. Thus, based on the estimates derived in the estimation period, the researchers predict the normal expected returns for each firm in the duration of the event. The normal anticipated return is the "normal" return for the duration of the testing period in the nonexistence of the incident. As stated previously, the testing period is plus and/or minus a selected time frame which is defined by the researcher to test the influence of an event on the sample firms' returns. There are three popular methods of normal return computation. The methods are as follows:

1. Mean Adjusted Returns
2. Market Adjusted Returns
3. Conditional Risk Adjusted Returns

Mean Adjusted Returns

In this method, the firm is anticipated to produce the return similar to its average during the estimation period. Mean adjusted returns are the difference between the event period return and the estimation period's average return Even though Dyckman, Philbrick and Stephan (1984) did not suggest both mean adjusted and market model for calculating excess returns, Brown and Warner (1980, 1985) recommended mean adjusted return method as robust like other methods for both monthly and daily returns. However, Brown and Warner (1985) also pointed out the issues of calendar clustering, a problem of events together occur. Klein and Rosenfield (1987) also pointed out the presence of biased upward (downward) residuals if the period is a bull (bear) period.

Market Adjusted Returns

The difference between the market return for the event period and the actual stock return for the same period is the abnormal return. However, the researchers are differing in their opinion on the powerfulness of the test. Brown and Warner (1980) concludes the market adjusted method at par with the regression model.

Conditional Risk Adjusted Models

In this methodology a regular market model regression is employed to estimate the link between the R_{jt} (stock returns) and R_{mt} (bench mark stock market index) for the entire estimation period. The primary step is to regress R_{jt} on R_{mt} throughout the estimation period to estimate a_j and b_j. Subsequently, we need to predict throughout the event window the normal expected return for the security had this event did not occur. That is known as normal expected returns. The variation between the actual stock returns during the testing window and normal expected returns during the event window is the abnormal returns. We can infer theexcess return is the impact of the event.

However, there are modifications for this single index market model. Running a cross sectional regressions, Fama (1973) attempted to calculate the estimates of time varying betas between January 1935 and June 1968. After the Fama-MacBeth (1973) approach, an investigator got a freedom to compute the time varying beta. In addition, F.de.Jong et al (1992) concluded that beta might be calculable with a time series method. Meanwhile, Brenner (1979) evaluated these four approaches and concluded that Single Index Market Model (Standard Market Model) is the simple and effective among the four methods of normal return calculators. This is confirmed by Brown and Warner (1985). It is very convenient to use due to its single independent variable – R_{mt} Roll (1981) and Ohlson and Rosenberg (1982) opinioned that an overall value weighted index captures the entire market performance accurately.

After getting the α_j and β_j, the normal expected return during the event window is estimated. The estimated anticipated normal return during the event window period is R* it. The difference between the normal anticipated returns (R*it) and actual returns (R_{it}) is the abnormal (excess) returns. The standard regression equation is

R_{it} = Return on security I on day t
R_{mt} = Return on the market I on day t
$\sim R_{it}$ = Estimated return on security I on day t
AR_{it} = $R_{it} - \sim R_{it}$
α, β = Estimated from the regression
$Y = x + BR_{mt} + e_{it}$

.

8. Measurement and Statistical Analysis of abnormal returns modeled as regression coefficients

A method where the excess returns are represented as coefficients of a regression model with a set of equations where the each organization is characterized by a single equation. Here the dummy variables are also used in the regression framework to capture the effect of the event in the event period. Scholes (1972), used another method where the abnormal return is estimated in the standard market model regression equation.

9. Aggregating Excess Returns

Even studies involve two types of aggregation of excess returns. S.P. Kothari and Jerold B. Warner (2005) compared both the mean abnormal returns for the testing period with the cross sectional distribution of returns at the time of testing period. According to the event study, the mean abnormal returns are expected to be equal to zero in the normal conditions. In some studies, the cross sectional abnormal returns at the time of the event is aggregated and check whether the mean value is zero. This is known as the cross sectional aggregation. On the contrary, there is also a time series aggregation over a period of time to know the anticipation effects of the event as well as to test the speed at which the new information is incorporated. Subsequently, Cumulative Abnormal Returns are calculated. Before the cumulative abnormal returns, the mean abnormal returns (Average Prediction Errors) were calculated by taking the mean of abnormal returns of all firms on day t. A_{rt} is the mean of abnormal return on day t. After that, cumulative abnormal returns are calculated by cumulating the sum of excess returns from t to T.

10. Issues of econometrics

Statistical assumptions are the key basis for regression models. It is assumed in normal analysis that

1. the prediction errors form a normal distribution with zero mean
2. residuals are free from autocorrelation,
3. have a same variance,
4. zero correlation between dependent and independent variables
5. Besides zero correlation between the prediction errors of different firms.

However, in real economics research, these assumptions do not hold good. In reality security returns are:

a. Distributed non-normally
b. serial correlation in security returns is a fact,
c. Presence of non-synchronous trading,
d. Shift in the variance
e. Event clustering,
f. Correlation between residuals and R_{mt}.

Non-normality Problems: Brown and Warner (1985) pointed out the non-normality issue while collecting and analyzing the daily data. Henderons et.al., (1990) pointed out that the daily returns

are non-normal. However, the residuals are distributed normally. Consequently, the null hypothesis cannot be rejected.

Serial Correlation and Non-synchronous Trading: In the case of non relationship between the values of R_{mt} (Independent Varibale) and R_{it} (Depedent Variable), Brown and Warner (1985) pointed out a beta bias. Though there are number of correction models like Scholes and Williams (1977), Dimson (1979) etc. still the problem persists.

Variance Shift or changes in the variance: Patell and Wolfson (1979) provided proof of variance shifts concurrent by means of economic events. However, Collins and Dent (1984) examined the impact of variance shift by using generalized least squares (GLS) model.

Correlation between residuals and R_{mt} Collins and Dent (1984) also evaluated techniques to adjust the cross-correlations among different firms' residuals and correlation between prediction error and the market index (independent variable) in the event studies. Standardized Residual Patell Test (1976), Brown and Warner (1985) and Boehmer's Standardized Cross-Sectional Test (1991) were the primary methods to solve the misspecification and inaccurate estimation.

Event Clustering:

Brown and Warner (1985) pointed out that the event clustering will be biased, if it is conducted in a bull market. This is because the estimation of normal expected returns will be abnormal,and So the excess return will not be accurate. Mainly two approaches are employed to solve the issue of event clustering. They are

1. Modification of the Test Statistics (Brown and Warner 1985)
2. Using regressing models which accommodates the regression coefficients.

In short we can say the econometric issues can be summarized as

1. Cross sectional correlation of abnormal return estimators Collins and Dent (1984)
2. Difference in variance across firms Jaffe and Madelker (1974)
3. Are not independent across time for a given firm Jeffe and Madelker (1974), Fama (1976)
4. Possesses greater variance during the event period than in the surrounding periods (Beaver 1982)

From the above discussions we can conclude that the problems mentioned above are not major problems. Hence the problems will not affect the results and we can simply ignore these problems. As an example to illustrate, cross-sectional dependence is not a problem when the event periods are randomly dispersed through calendar time Brown and Warner (1985). This is confirmed by Chandra, Moriatry and Willinger, (1990). They explained the insignificance of this problem by citing the methodological reasons.

11. Issues of Cross Sectional Regression Analysis

The cross section tests mainly verify the excess abnormal returns relationship with the firm characteristics. Cross-sectional tests are applicable irrespective of the horizon length. , (Campbell, Lo, and Mackinlay, 1997, p.174) warns us to be very cautious while interpreting the results of cross sectional tests.

The reasons for cross sectional variation in the abnormal returns are numerous. Sefcik and Thompson (1986) conducted a statistical analysis of cross sectional regressions. They brought out the issues of cross sectional correlation of abnormal returns and variance changes (heteroscedastic) in the abnormal returns. They exposed the potential dangers of these issues, and suggested the procedure to deal with the same,. Before using cross sectional tests, we need to understand that the incompleteness of cross sectional test with respect to its many dimensions. In predicting event studies, discrete choice models such as probit or logit model are widely used. Analysis with the help of discrete models reveals the significance of firm's characteristics on the happening of an event. Precisely the researchers will get an intuitive idea as to what factors of the firm directed the firm to face such an event.

12. Testing the significance of abnormal returns and statistical power of the event studies

Precisely, there are two issues in testing the significance of abnormal returns. They are as follows:-

1. f

The standard parametric statistics is

$$t = \frac{ARt}{S(ARt)}$$

Where AR_t is defined as the average abnormal return on time t
$S(AR_t)$ is the estimate of standard deviation of the average abnormal returns in the estimation period

While conducting the studies it is implied that the residuals of different firms are independent. This means the residuals have cross sectional independence. However, for obtaining a similar variance of one among residuals, we can do equivalence of abnormal returns. Standardization of abnormal returns can be computed by dividing each firm's abnormal residual by its standard deviation (obtained over the estimation period). For checking the difference between abnormal returns for the estimation period and event period "F Test" is used.

Other than the parametric test there are few non-parametric test which are good when the variance of abnormal returns are different. They are generalized sign test and Wilcoxin Sign Test.

For checking the difference between abnormal returns for the estimation period and event period "F Test" is used. Non Parametric Rank Tests are also used to test the variance of two population. By computing and adding the absolute value of the abnormal returns for the event period and estimation period, the absolute values are ranked Corrado, C.J. (1989),. At the end the test statistic for the event period is defined as:

$Q_i = \sum(r_{il})_2$
Here r_i refers to the absolute value of abnormal returns.
L refers to the event weeks

In conclusion we can use parametric test to test the significance of prediction errors and among parametric tests "student t-tests work well (Berry, 1990) in variety of conditions.

13. Summary and Conclusion

From the review we conclude that event study methodology is one of the powerful techniques to ascertain the impact of an event. Besides, it is also an accurate measure if analyzed using daily returns data. However, from the study it is evident that the correctly specified event dates will give the event studies precise results. From the review it is clear that among the three methods of normal expected returns estimators, the standard market model is the highly precise and simple to use estimator of normal expected returns. The potential econometric problems raised against event study methodology are not sufficient to alter the end results of the analysis. Besides, the econometric problems can be resolved easily using daily returns data instead of monthly returns data. Finally, the parametric t test is the best test to measure the significance of abnormal returns. In addition, over the years the researchers are perfecting the event study methodology this methodology will emerge as a perfect one.

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