EVENT STUDIES IN ECONOMICS AND FINANCE: A REPLICATION

Vincent Yang

June 2023

Abstract. This study examines changes in a firm's equity value in response to annual earnings announcements, both 20 days before and after the announcement dates, for publicly traded companies listed on the S&P 500 Stock Exchange during the period 2013 - 2014. An event study methodology is employed, encompassing a total of 3638 events. The findings of the replication, which is also reflected through evidence of significant abnormal returns and post-earnings announcement drift around earnings announcement dates, indicate that earnings announcements possess significant information content. Higher-than-expected earnings are correlated with increases in the equity value, while lower-than-expected earnings are associated with decreases in the equity value.

1 Introduction

Financial information about any company is crucial when assessing the value of stock prices. Investors do consider this publicly available financial information to evaluate the potential future prospects of a company. Earnings serve as a measure of the company's profit or loss from business activities and events over a defined period. Earnings announcements is the most significant financial pieces of information used by investors to make decisions regarding the purchase and sale of a firm's shares (Lonie et al., 1996). The capital market generates expectations and speculation about announcements before they are made. If a company announces earnings that deviate from market expectations, the market will react unexpectedly. If the earnings announcement surpasses expected earnings (generally considered good news), the stock price will surge. Conversely, if the earnings announcement falls short of expected earnings (typically seen as bad news), the stock price will decline.

This paper aims to replicate the classic event study methodology paper published in the Journal of Economic Literature by A. Craig MacKinlay. Unlike the earlier paper's example, which focused on the 30 firms in the Dow Jones Industrial Index, this replication concentrates on the quarterly earnings announcements for 488 firms in the S&P 500. The expanded dataset of these more recent announcements yields 3638 events, as opposed to the 600 in the original study.

The rest of this study is organized as follows: Section 2 outlines the methodology, Section 3 elaborates on the data, Section 4 presents the empirical findings, and Section 5 concludes the article.

2 Methodology

Event study measures the impact of a specific event on the value of a firm(MacKinlay, 1997). Each announcement is assignment to one of three categories: good news, no news, or bad news. Each announcement is categorized using the deviation of the actual earnings form the expected earnings. Good news: if the actual earnings exceed the expected earnings by more than 2.5 percent. Bad news: if the actual earnings are more than 2.5 percent lower than the expected earnings. No news: announcements where the absolute value of the difference between actual and expected returns is less than 5 percent.

With the announcement categorized, it is necessary to specify a length of observation interval, an event window, and an estimation window. This study focuses on the quarter earnings announcement for the listed companies in S&P 500 from 2013 to 2014. Listed companies in S&P 500 which have announced their earnings per share (EPS) on a quarterly basis were used for estimation window. The announcement day (day 0) is designated as the day when any firm makes a quarterly EPS announcement and its shares are traded. If stocks are not traded on the day of announcements due to a stock market holiday, the following trading day will be considered as the announcement day.

The interval is set to one day, thus daily stock returns are used. In this paper, 41-day event window is used to calculate the abnormal returns of the security and 41 days' event window consists of 20 trading days before, the announcement day and 20 trading days after the event. Estimation window consisting of 250 days prior to the event window consists of 270 trading days before the announcement date and 21 trading days before the announcement date, has been used which is considered to be large enough to have an assumption that expected disturbance term will be zero.

2.1 Measurement for Abnormal Return

Abnormal returns or excess returns were computed by subtracting the normal return of the security from actual return of any security over the event window. The abnormal returns are computed as per

$$AR_{it} = R_{it} - E(R_{it}) \tag{1}$$

where,

R_{it} : Actual returns of security i at time t;

$E(R_{it})$: Expected returns of security i at time t.

The assumption for the statistical models that asset returns are jointly multi-variate normal and independently and identically distributed through time is imposed. This distributional assumption is sufficient for the constant mean return model and the market model to be correctly specified. Also one can easily modify the statistical framework so that the analysis of the abnormal returns is autocorrelation and heteroscedasticity consistent by using a generalized method -of-moments approach.

The CAR_k is the sample cumulative abnormal return (CAR) for the event time.

$$CAR_k = \sum AR_{it}. \tag{2}$$

Given N events, the sample aggregated abnormal returns for period t is

$$\overline{AR_t} = \frac{1}{N} \sum_{i=1}^{N} AR_{it}. \tag{3}$$

The average abnormal return is calculated by taking the averages cross-sectionally. These ARs can be summed over the event window and CAR is calculated:

$$\overline{CAR_k} = \sum_{k} \overline{AR_t}. \tag{4}$$

2.2 Measurement for Normal Return

2.2.1 Constant Mean Return Model

The constant mean return model is perhaps the simplest model, it is calculated by

$$\begin{aligned} &E(R_{it}) = \alpha_i + \varepsilon_{it}, \\ &E(\varepsilon_{it}) = 0; Var(\varepsilon_{it}) = \sigma^2 \varepsilon \end{aligned} \tag{5}$$

where

$E(R_{it})$: Expected returns of security i during time period t;

α_i : Constant mean for security i;

ε_{it} : Disturbance/error term of security i at time t.

The Ordinary Least Squares (OLS) method is employed to compute the constant mean model in this study. Within the OLS framework, for the i^{th} firm during the event period, the OLS estimators of the constant mean model utilize an observation window in the estimation time to determine α_i.

2.2.2 Market Model

The estimated market model is used

$$\begin{aligned} &E(R_{it}) = \alpha_i + \beta_i R_{Index} + \varepsilon_{it}, \\ &E(\varepsilon_{it}) = 0; Var(\varepsilon_{it}) = \sigma^2 \varepsilon \end{aligned} \tag{6}$$

The daily closing price of the value-weighted S&P 500 return index (VWRETD) is employed to ascertain the market return. The parameters of the market model encompass α_i, β_i and ε_{it}.

2.3 The Hypothesis Test

For large estimation window, its variance is

$$var(\overline{AR_t}) = \frac{1}{N^2}\sum_{i=1}^{N}\sigma_{\varepsilon}^2. \tag{7}$$

Therefore, the variance of CAR is

$$var(\overline{CAR_k}) = \sum_{k} var(\overline{AR_t}). \tag{8}$$

Using these estimates, the ARs and CARs for each day in event window can be analyzed.

The null hypothesis, H_0, is the abnormal returns are not significantly different from zero. Assuming the normal distribution of CARs, the inferences can be drawn by standardizing CAR to test whether CARs equals to zero. The test statistic θ can be written as

$$\theta = \frac{\overline{CAR_k}}{\sqrt{var(\overline{CAR_k})}} \sim N(0,1). \tag{9}$$

3 Sample and data description

This study focuses on the quarter earnings announcement for the listed companies in S&P 500 from 2013 to 2014. For each firm and quarter, three pieces of information are compiled: the date of announcement, the actual EPS and the average EPS forecast. The surprise element of any earnings announcement can be calculated by measuring actual EPS and average EPS forecast. The companies, having insufficient data of earnings announcements, were excluded from the sample. This excluded several listed firms, and our final data consist of 488 firms, and the total number of events used for analysis is 3,638. Table 1 presents number of each three earnings news categories across the 3,638 event observations. Number of earnings announcements of good news, no news and bad news is 1867, 1032, 739 respectively.

TABLE 1

Event classification for the period 2013- 2014

Event category	No. of events
Good News	1867
No News	1032
Bad News	739
Total	3638

The example from the earlier paper assessed the influence of quarterly earnings announcements on the 30 firms in the Dow Jones Industrial Index. This evaluation spanned a five-year period from January 1989 to December 1993, encompassing a total sample of 600 events.

4 Analysis and results

Two models were replicated: the market model and the constant mean return model. Plots illustrating the cumulative abnormal returns (CAR) are presented, with Figure 1 depicting CAR from the market model and Figure 2 showcasing CAR from the constant mean return model.

Figure 1 illustrates the CARs using the market model. For firms delivering bad news, there's a progressive decline from Day -20 to Day -1. On the other hand, the CAR for the good news firms stays positive range from the start of the event window and shows stable rise over this period.

The CAR for earnings announcements reporting bad news starts from negative, then onward stays in the negative range, shows a steep dip from Day 0. The CAR for the good news firms begins to visibly rise from the announcement day and continues this trend until Day 2. Later on, it begins to get stable.

The CAR for no news firms in this case shows less significantly decrease from Day 0 to Day 2 than bad news firms. Its onward shows slightly negative but stable behavior.

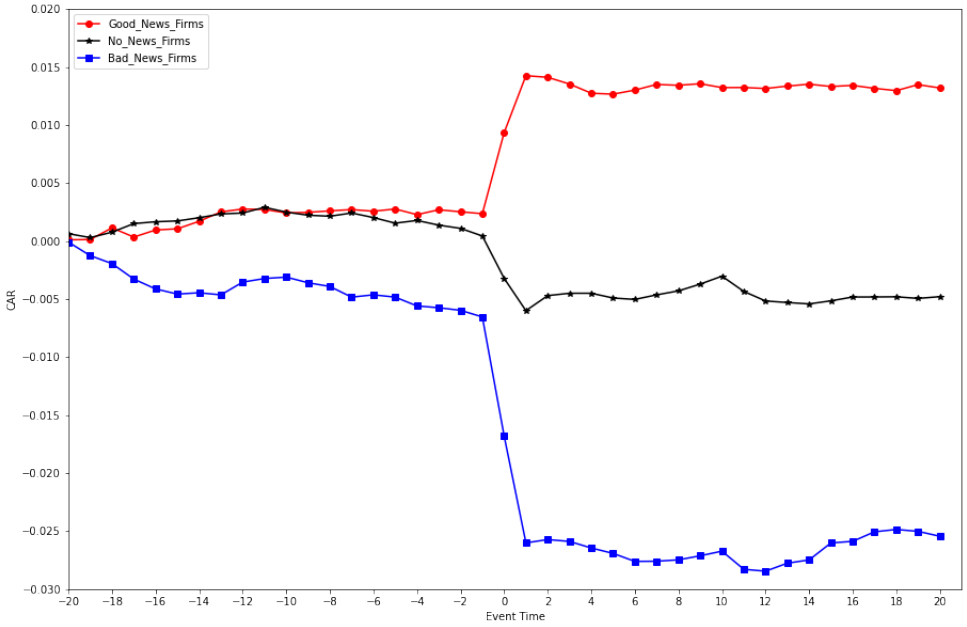

Figure 1: Plot of CARs for earning announcements from event day -20 to event day 20. The abnormal return is calculated using the market model as the normal return measure.

Figure 2 indicates CAR patterns using the constant mean return model. For firms delivering bad news, the CAR demonstrates a downward trajectory beginning Day -20, hitting its lowest point at Day 1. Conversely, the CAR for good news starts positively and exhibits a visible upward trend starting from Day -20, continuing until hitting its

highest point at Day 1.

Notably, the CAR for firms with no news experiences a relatively significant increase compared to the rise observed in firms with good news prior to Day 0. And the CAR for firms with no news witnesses a relatively modest decrease from Day 0 to Day 2, as opposed to the decrease seen in bad news firms.

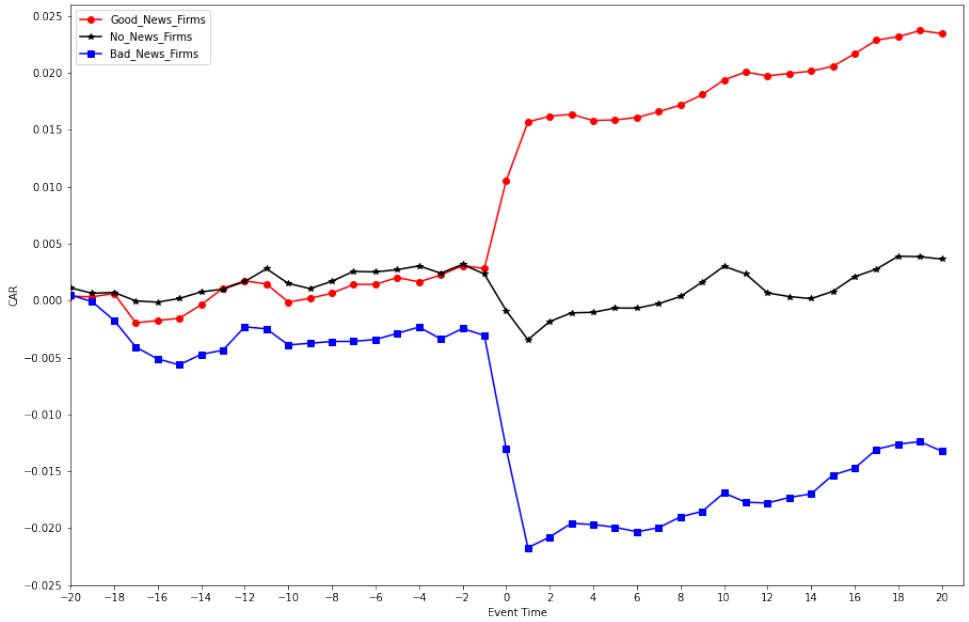

Figure 2: Plot of CAR for earning announcements from event day -20 to event day 20. The abnormal return is calculated using the constant mean model as the normal return measure.

As depicted in both Figure 1 and Figure 2, the visual representation of the six lines vividly highlights a post-earnings-announcement drift (PEAD).

Post-earnings-announcement drift (PEAD) refers to the phenomenon in which stock prices tend to continue moving in the same direction as the earnings surprise even after the initial announcement. This suggests that the market does not fully and immediately incorporate all available information in its valuation of a company's stock following the earnings announcement. Instead, the stock price adjustment occurs gradually over subsequent trading days.

Table 2 presents the AR and CAR for the specified day in a 41-day event window. As discussed in methodology, test statistics θ is applied to all three earnings announcement categories, and the results are presented in Table 3.

Focusing on the market model, the sample AR for the positive news firm at Day 0 is 0.6983 percent, with the variance 0.0014 percent. The value of θ is determined to be 9.6607, leading to a strong rejection of the null hypothesis. This outcome underscores

the impact of earnings announcements on stock prices. The sample AR of bad news firms at Day 0 is -1.0247 percent. Given the standard error of 0.0022 percent, leading to θ equal to -11.6737 and again strong evidence against the null hypothesis. As would be expected, the AR of the no news firms is small at -0.3648 percent and with a standard error 0.0009 percent.

TABLE 3

	Market Model			Constant Mean Return Model		
	Good News	No News	Bad News	Good News	No News	Bad News
Std	0.0014	0.0009	0.0022	0.0016	0.0010	0.0023
θ	9.6670	-5.5926	-11.6737	15.1078	3.6137	-5.8455

There exists some evidence of the announcement effect on returns on Day 1. For positive news firms, the AR is calculated as 0.4908 percent, while for negative news firms, it is -0.9222 percent. The source of these day one effects is likely to be that some of the earnings announcements are made on event day zero after the close of the stock market. In these cases, the effects will be captured in the return on Day 1.

The conclusions using the abnormal returns from the constant mean return model are consistent with those from the market model. However, there is some loss of precision using the constant mean return model, as the variance of the average abnormal return increases for all three categories. When measuring abnormal returns with the constant mean return model the standard errors increase from 0.0014 percent to 0.0016 percent for good news firms, from 0.0009 percent to 0.0010 percent for no news firms, and from 0.0022 percent to 0.0023 percent for bad news firms. These increases are to be expected when considering a sample of large firms such as those in the S&P 500 because these stocks tend to have an important market component whose variability is eliminated using the market model(MacKinlay, 1997) .

In case of market model, the results clearly indicate that the magnitude of CAR is higher in the case of the negative earnings shocks (i.e., bad news) sample compared to the positive earnings shocks (i.e., good news) sample. This pattern holds true for both the pre-announcement, post-announcement, and the day of the announcement. This finding implies that in response to bad news, characterized by negative earnings shocks, the market demonstrates a stronger reaction compared to positive news, aligning with the principle of loss aversion in behavioral finance.

5 Conclusion

In this study, the findings from this analysis align closely with the replicated literature. The presence of significant abnormal returns during and surrounding the event day suggests that the market perceives earnings announcements as valuable sources of information.

To a certain extent, the market gradually absorbs knowledge about the impending announcement. This trend becomes particularly pronounced in the figures for both models'

bad news firms, indicating that investors require a longer period (more than 20 days) to regain confidence following adverse news.

This event study does come with limitations. Firstly, the statistical analysis rests on the assumption of jointly normal returns that are temporally independent and identically distributed. The normality assumption plays a crucial role in ensuring exact finite sample results. Without this assumption, all results would hold asymptotically. Secondly, the sample's time frame is relatively short. Furthermore, nonsynchronous trading can introduce biases, such as the non-trading effect leading to biased moments of returns. Another limitation pertains to the lack of consideration for trading volume within the event window.

Market practitioners can extract value from this event study by examining specific sectors for potential abnormal return opportunities. Additionally, this study could inform the formulation of trading strategies based on market reactions, potentially capitalizing on instances of under or overreaction to earnings announcement information. The presence of post-earnings announcement drift and the influence of loss aversion are worth considering in these practical applications.

TABLE 2

Event day	Market Model					
	Good News		No News		Bad News	
	AR(%)	CAR(%)	AR(%)	CAR(%)	AR(%)	CAR(%)
-20	0.0107	0.0107	0.0638	0.0638	-0.0092	-0.0092
-19	0.0028	0.0135	-0.0340	0.0297	-0.1164	-0.1256
-18	0.1002	0.1137	0.0468	0.0765	-0.0686	-0.1942
-17	-0.0794	0.0343	0.0739	0.1504	-0.1333	-0.3275
-16	0.0611	0.0954	0.0162	0.1666	-0.0849	-0.4124
-15	0.0102	0.1056	0.0068	0.1734	-0.0445	-0.4569
-14	0.0649	0.1704	0.0277	0.2011	0.0114	-0.4455
-13	0.0809	0.2514	0.0325	0.2337	-0.0181	-0.4636
-12	0.0247	0.2760	0.0078	0.2415	0.1099	-0.3537
-11	-0.0040	0.2720	0.0494	0.2909	0.0309	-0.3228
-10	-0.0297	0.2423	-0.0415	0.2493	0.0121	-0.3107
-9	0.0051	0.2475	-0.0267	0.2226	-0.0486	-0.3593
-8	0.0127	0.2602	-0.0087	0.2139	-0.0319	-0.3912
-7	0.0112	0.2714	0.0279	0.2418	-0.0922	-0.4833
-6	-0.0143	0.2571	-0.0394	0.2024	0.0200	-0.4633
-5	0.0192	0.2763	-0.0480	0.1543	-0.0199	-0.4832
-4	-0.0487	0.2276	0.0233	0.1777	-0.0757	-0.5589
-3	0.0421	0.2697	-0.0403	0.1374	-0.0156	-0.5745
-2	-0.0174	0.2523	-0.0281	0.1093	-0.0224	-0.5969
-1	-0.0166	0.2357	-0.0655	0.0438	-0.0568	-0.6537
0	0.6983	0.9340	-0.3648	-0.3211	-1.0247	-1.6784
1	0.4908	1.4248	-0.2788	-0.5998	-0.9222	-2.6006
2	-0.0136	1.4112	0.1297	-0.4701	0.0285	-2.5721
3	-0.0579	1.3533	0.0203	-0.4498	-0.0158	-2.5879
4	-0.0793	1.2740	0.0001	-0.4497	-0.0568	-2.6448
5	-0.0081	1.2658	-0.0409	-0.4906	-0.0464	-2.6911
6	0.0348	1.3006	-0.0121	-0.5028	-0.0690	-2.7601
7	0.0489	1.3495	0.0392	-0.4636	0.0012	-2.7589
8	-0.0073	1.3422	0.0341	-0.4295	0.0121	-2.7468
9	0.0135	1.3558	0.0586	-0.3709	0.0348	-2.7120
10	-0.0335	1.3223	0.0684	-0.3025	0.0402	-2.6719
11	0.0010	1.3233	-0.1313	-0.4338	-0.1563	-2.8282
12	-0.0088	1.3145	-0.0825	-0.5162	-0.0164	-2.8446
13	0.0209	1.3353	-0.0132	-0.5294	0.0690	-2.7756
14	0.0165	1.3518	-0.0121	-0.5415	0.0280	-2.7476
15	-0.0199	1.3320	0.0265	-0.5150	0.1462	-2.6013
16	0.0093	1.3412	0.0329	-0.4822	0.0140	-2.5873
17	-0.0254	1.3158	0.0005	-0.4817	0.0819	-2.5054
18	-0.0196	1.2963	0.0016	-0.4801	0.0203	-2.4850
19	0.0516	1.3479	-0.0141	-0.4942	-0.0163	-2.5014
20	-0.0287	1.3192	0.0151	-0.4791	-0.0423	-2.5437

TABLE 2 (Cont.)

Event day	Constant Mean Return Model					
	Good News		No News		Bad News	
	AR(%)	CAR(%)	AR(%)	CAR(%)	AR(%)	CAR(%)
-20	0.0378	0.0378	0.1113	0.1113	0.0501	0.0501
-19	-0.0058	0.0321	-0.0481	0.0631	-0.0612	-0.0111
-18	0.0303	0.0624	0.0081	0.0712	-0.1625	-0.1736
-17	-0.2589	-0.1966	-0.0748	-0.0036	-0.2350	-0.4085
-16	0.0208	-0.1758	-0.0109	-0.0145	-0.1047	-0.5132
-15	0.0198	-0.1559	0.0326	0.0181	-0.0511	-0.5644
-14	0.1179	-0.0380	0.0578	0.0759	0.0911	-0.4732
-13	0.1463	0.1082	0.0236	0.0994	0.0365	-0.4367
-12	0.0639	0.1722	0.0666	0.1660	0.2054	-0.2313
-11	-0.0270	0.1452	0.1129	0.2789	-0.0177	-0.2490
-10	-0.1589	-0.0137	-0.1291	0.1498	-0.1410	-0.3900
-9	0.0324	0.0187	-0.0453	0.1045	0.0145	-0.3756
-8	0.0453	0.0640	0.0644	0.1688	0.0154	-0.3602
-7	0.0775	0.1415	0.0876	0.2564	0.0012	-0.3590
-6	-0.0002	0.1413	-0.0057	0.2507	0.0168	-0.3422
-5	0.0605	0.2018	0.0201	0.2708	0.0533	-0.2889
-4	-0.0383	0.1635	0.0331	0.3038	0.0559	-0.2329
-3	0.0598	0.2233	-0.0641	0.2397	-0.1050	-0.3380
-2	0.0825	0.3058	0.0776	0.3173	0.0917	-0.2462
-1	-0.0242	0.2816	-0.0848	0.2325	-0.0605	-0.3067
0	0.7687	1.0504	-0.3206	-0.0880	-0.9931	-1.2998
1	0.5170	1.5674	-0.2564	-0.3444	-0.8711	-2.1709
2	0.0512	1.6185	0.1600	-0.1844	0.0942	-2.0766
3	0.0165	1.6351	0.0762	-0.1082	0.1208	-1.9558
4	-0.0544	1.5806	0.0044	-0.1038	-0.0120	-1.9679
5	0.0049	1.5855	0.0375	-0.0663	-0.0230	-1.9908
6	0.0215	1.6069	-0.0009	-0.0672	-0.0401	-2.0309
7	0.0505	1.6575	0.0390	-0.0282	0.0354	-1.9956
8	0.0585	1.7160	0.0633	0.0351	0.0959	-1.8997
9	0.0912	1.8072	0.1274	0.1624	0.0478	-1.8519
10	0.1295	1.9367	0.1383	0.3007	0.1621	-1.6898
11	0.0694	2.0061	-0.0676	0.2331	-0.0817	-1.7715
12	-0.0343	1.9718	-0.1665	0.0666	-0.0067	-1.7782
13	0.0219	1.9936	-0.0321	0.0345	0.0489	-1.7293
14	0.0203	2.0139	-0.0181	0.0164	0.0312	-1.6981
15	0.0429	2.0568	0.0636	0.0800	0.1661	-1.5319
16	0.1094	2.1662	0.1296	0.2096	0.0587	-1.4732
17	0.1208	2.2870	0.0663	0.2759	0.1669	-1.3063
18	0.0296	2.3166	0.1132	0.3891	0.0457	-1.2606
19	0.0538	2.3704	-0.0046	0.3846	0.0209	-1.2397
20	-0.0270	2.3434	-0.0212	0.3633	-0.0832	-1.3229

References

Lonie, A. A., Abeyratna, G., Power, D. M., and Sinclair, C. D. (1996). The stock market reaction to dividend announcements: A uk study of complex market signals. *Journal of Economic studies*.

MacKinlay, A. C. (1997). Event studies in economics and finance. *Journal of economic literature*, 35(1):13–39.