An Event Study on Cash Dividend Declaration

—— The Case of Apple Inc.

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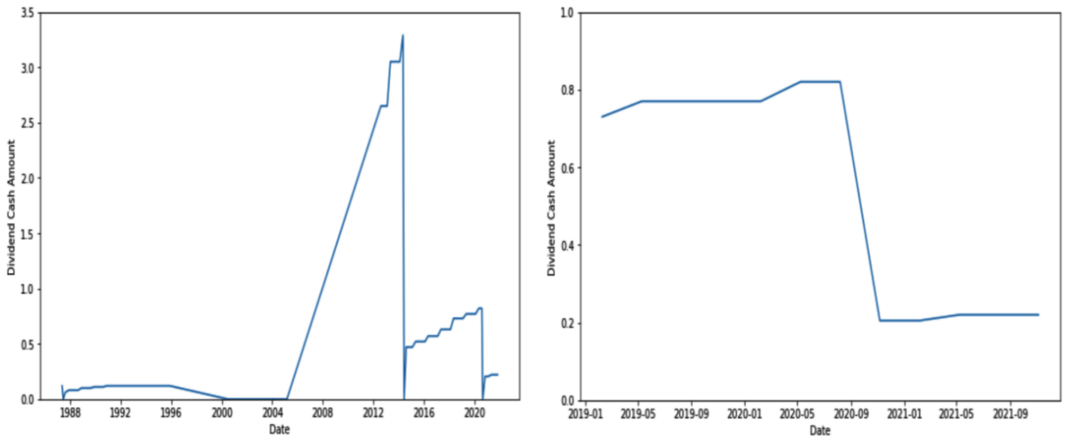
1 Dividend Fluctuation

In Figure 1, the left graph shows the changes in Apple's dividends from December 12, 1980 to December 31, 2021, with quarterly dividends. The right graph shows that in the last three years (2019 to 2021), Apple's dividends plunged from 0.82 per share to 0.205 per share on November 6, 2020, which corresponds to the declaration date of October 29, 2020, so this date is chosen as the event date (Day 0) for the estimation.



(a) 1980 to 2021 (b) 2019 to 2021

Figure 1: Dividend Cash Amount of Apple

2 Estimation Window and Estimation Results

The period from the first six calendar months (April 14, 2020 to October 14, 2020) prior to Day -11 (October 14, 2020) to Day -11 is chosen as the estimation window with the number of observations L = 129. The market model and CAPM equation model are applied to estimate the parameters from this period.

2.1 Market Model

Perform OLS regression on the market model during the estimation period

$$r_{it} = \alpha_i + \beta_i r_{mt} + e_{it}$$

The OLS regression gives the $\hat{\alpha}_i$ and $\hat{\beta}_i$:

OLS Regression Results

Dep. Variable:	RET	R-squared:	0.405
Model:	OLS	Adj. R-squared:	0.401
Method:	Least Squares	F-statistic:	86.54
Date:	Sun, 13 Mar 2022	Prob (F-statistic):	5.12e-16
Time:	19:00:08	Log-Likelihood:	329.99
No. Observations:	129	AIC:	-656.0
Df Residuals:	127	BIC:	-650.3
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
const	0.0024	0.002	1.420	0.158	-0.001	0.006
vwretd	1.1255	0.121	9.303	0.000	0.886	1.365

Omnibus:	42.379	Durbin-Watson:	1.828
Prob(Omnibus):	0.000	Jarque-Bera (JB):	164.524
Skew:	1.094	Prob(JB):	1.88e-36
Kurtosis:	8.081	Cond. No.	72.8

Figure 2: OLS Regression Results for Market Model

Thus

$$\hat{r}_{it} = 0.0024 + 1.1255 \times r_{mt}$$

α is not significant at 90% confidence level, but β is significantly different from 0 at 99% confidence level.

2.2 CAPM Equation Model

Perform OLS regression on the CAPM model during the estimation period

$$r_{it} = r_{ft} + \beta_i(r_{mt} - r_{ft}) + u_{it}$$

The OLS regression result gives the $\hat{\alpha}_i$ and $\hat{\beta}_i$:

OLS Regression Results

Dep. Variable:	stock_exc	R-squared (uncentered):	0.408
Model:	OLS	Adj. R-squared (uncentered):	0.404
Method:	Least Squares	F-statistic:	88.38
Date:	Sun, 13 Mar 2022	Prob (F-statistic):	2.78e-16
Time:	19:00:09	Log-Likelihood:	328.84
No. Observations:	129	AIC:	-655.7
Df Residuals:	128	BIC:	-652.8
Df Model:	1		
Covariance Type:	nonrobust		

	coef	std err	t	P>|t|	[0.025	0.975]
mkt_exc	1.1401	0.121	9.401	0.000	0.900	1.380

Omnibus:	42.427	Durbin-Watson:	1.793
Prob(Omnibus):	0.000	Jarque-Bera (JB):	163.728
Skew:	1.098	Prob(JB):	2.80e-36
Kurtosis:	8.063	Cond. No.	1.00

Figure 3: OLS Regression Results for CAPM

Thus

$$\hat{r}_{it} = r_{ft} + 1.1401 \times r_{mt}$$

β is significantly different from 0 at 99% confidence level.

3 Event Window and Hypothests Test

This section analyzes the movement of Apple's stock price before and after the event anouncement and investors' reaction to the new information, which somehow implies the information efficiency. 10 days before and after event day (October 29, 2020) are selected as the event window, i.e., October 15, 2020 to November 12, 2020, with 21 observations. The abnormal return (AR) and cumulative abnormal return (CAR) during this period and the corresponding statistics are calculated based on 4 different benchmark models, and t-test is used for the hypothesis test.

In the statistic test results, '**' means the AR statistic or the CAR statistic is significantly different from 0 at 1% two-tailed significance level; '*' means the AR statistic or the CAR statistic is significantly different from 0 at 5% two-tailed significance level.

3.1 Benchmark Models and Test Statistics

3.1.1 Market Model

The AR and CAR are given by

$$\begin{aligned} AR_{i\tau} &= r_{i\tau} - (\hat{\alpha}_i + \hat{\beta}_i r_{m\tau}) \\ &= r_{i\tau} - (0.0024 + 1.1255 \times r_{m\tau}) \end{aligned}$$

$$\begin{aligned} CAR_i(\tau_1, \tau_k) &= \sum_{\tau=\tau_1}^{\tau_k} AR_{i\tau} \\ &= \sum_{\tau=\tau_1}^{\tau_k} (r_{i\tau} - (0.0024 + 1.1255 \times r_{m\tau})) \end{aligned}$$

3.1.2 CAPM Equation Model

The AR and CAR are given by

$$\begin{aligned} AR_{i\tau} &= r_{i\tau} - (r_{f\tau} + \hat{\beta}_i (r_{m\tau} - r_{f\tau})) \\ &= r_{i\tau} - (r_{f\tau} + 1.1401 \times (r_{m\tau} - r_{f\tau})) \end{aligned}$$

$$CAR_i(\tau_1, \tau_k) = \sum_{\tau=\tau_1}^{\tau_k} [r_{i\tau} - (r_{f\tau} + 1.1401 \times (r_{m\tau} - r_{f\tau}))]$$

3.1.3 Market Adjusted Excess Return

The AR and CAR are given by

$$AR_{i\tau} = r_{i\tau} - r_{m\tau}$$

$$CAR_i(\tau_1, \tau_k) = \sum_{\tau=\tau_1}^{\tau_k} (r_{i\tau} - r_{m\tau})$$

3.1.4 Mean Adjusted Excess Return

The AR and CAR are given by

$$AR_{i\tau} = r_{i\tau} - \overline{r}_i$$

$$CAR_i(\tau_1, \tau_k) = \sum_{\tau=\tau_1}^{\tau_k} (r_{i\tau} - \overline{r}_i)$$

where

$$\overline{r}_i = \frac{1}{L} \sum_{t=-L-10}^{-11} r_{it}$$

3.2 Hypothesis Test Results

The test statistic for AR and CAR is given by

$$\frac{AR_{i\tau}}{\hat{\sigma_i}} \cong t_{L-2}$$

$$\frac{CAR_i(\tau_1, \tau_k)}{\sqrt{(\tau_k - \tau_1 + 1)\hat{\sigma_i}^2}} \approx N(0,1)$$

where

$$\hat{\sigma_i} = \sqrt{\frac{1}{L-2} \sum_{t=-L-10}^{-11} AR_{it}^2}$$

3.2.1 Market Model

Date	AR-Stat	Date	AR-Stat
2020-10-15	-0.2899	2020-10-29	1.2109
2020-10-16	-0.8256	2020-10-30	-2.3109*
2020-10-19	-0.6346	2020-11-02	-0.8905
2020-10-20	0.3443	2020-11-03	-0.4353
2020-10-21	-0.2099	2020-11-04	0.8683
2020-10-22	-0.9991	2020-11-05	0.4969
2020-10-23	-0.6787	2020-11-06	-0.1839
2020-10-26	0.9557	2020-11-09	-1.8174
2020-10-27	0.7670	2020-11-10	-0.2526
2020-10-28	-0.6234	2020-11-11	1.0012
		2020-11-12	0.3256

Table 1: AR Statistic from τ=-10 to τ = +10 (Market Model)

Date	CAR-Stat	Date	CAR-Stat
2020-10-15	-0.2899	2020-10-29	-0.2965
2020-10-16	-0.7888	2020-10-30	-0.9510
2020-10-19	-1.0105	2020-11-02	-1.1606
2020-10-20	-0.7029	2020-11-03	-1.2348
2020-10-21	-0.7226	2020-11-04	-0.9687
2020-10-22	-1.0675	2020-11-05	-0.8137
2020-10-23	-1.2449	2020-11-06	-0.8340
2020-10-26	-0.8266	2020-11-09	-1.2389
2020-10-27	-0.5236	2020-11-10	-1.2638
2020-10-28	-0.6939	2020-11-11	-1.0079
		2020-11-12	-0.9126

Table 2: CAR Statistic from τ=-10 to τ = +10 (Market Model)

On Day 1, the AR is significantly different from 0 on 5% two-tailed significance level, rejecting the null hypothesis H_0: the event has no impact on stock abnormal returns. This indicates that the news of the

dividend reduction significantly affects the stock price performance on the next trading day, and investors have a relatively big reaction to this news.

CAR statistic does not reject the null hypothesis at both 1% and 5% two-tailed significant level, cannot reject the null hypothesis, meaning that this news did not cause a significant increase or decrease in cumulative abnormal returns.

3.2.2 CAPM

Date	AR-Stat	Date	AR-Stat
2020-10-15	-0.1540	2020-10-29	1.3235
2020-10-16	-0.6858	2020-10-30	-2.1491*
2020-10-19	-0.4861	2020-11-02	-0.7598
2020-10-20	0.4696	2020-11-03	-0.3139
2020-10-21	-0.0741	2020-11-04	0.9769
2020-10-22	-0.8630	2020-11-05	0.6083
2020-10-23	-0.5443	2020-11-06	-0.0495
2020-10-26	1.0924	2020-11-09	-1.6767
2020-10-27	0.8938	2020-11-10	-0.118
2020-10-28	-0.4622	2020-11-11	1.1182
		2020-11-12	0.4629

Table 3: AR Statistic from τ=-10 to τ = +10 (CAPM)

Date	CAR-Stat	Date	CAR-Stat
2020-10-15	-0.1540	2020-10-29	0.1537
2020-10-16	-0.5938	2020-10-30	-0.4733
2020-10-19	-0.7655	2020-11-02	-0.6654
2020-10-20	-0.4282	2020-11-03	-0.7251
2020-10-21	-0.4161	2020-11-04	-0.4483
2020-10-22	-0.7321	2020-11-05	-0.2820
2020-10-23	-0.8836	2020-11-06	-0.2856
2020-10-26	-0.4403	2020-11-09	-0.6727
2020-10-27	-0.1172	2020-11-10	-0.6818
2020-10-28	-0.2573	2020-11-11	-0.4145
		2020-11-12	-0.3035

Table 4: CAR Statistic from τ=-10 to τ = +10 (CAPM)

The hypothesis test based on CAPM parameters gives a similar result to the market model. On Day 1 the AR statistic significantly rejects the null hypothesis H_0: the event has no impact on stock abnormal returns at 5% two-tailed significance level, indicating that the event significantly affects the stock price performance on the next trading day, and investors have a relatively big reaction to this news. Thus AR is different from 0. But it cannot reject the null hypothesis at 1% two-tailed significance level.

CAR statistic does not reject the null hypothesis at both 1% and 5% two-tailed significance level, meaning that this news did not cause a significant increase or decrease in cumulative abnormal returns.

3.2.3 Market Adjusted Excess Return

Date	AR-Stat	Date	AR-Stat
2020-10-15	-0.1662	2020-10-29	1.3874
2020-10-16	-0.6940	2020-10-30	-2.2398*
2020-10-19	-0.5938	2020-11-02	-0.6741
2020-10-20	0.4892	2020-11-03	-0.1811
2020-10-21	-0.1047	2020-11-04	1.1092
2020-10-22	-0.8203	2020-11-05	0.7528
2020-10-23	-0.5195	2020-11-06	-0.0568
2020-10-26	0.9486	2020-11-09	-1.5975
2020-10-27	0.8612	2020-11-10	-0.128
2020-10-28	-0.7049	2020-11-11	1.1647
		2020-11-12	0.3824

Table 5: AR Statistic from τ=-10 to τ = +10 (Market Adjusted Excess Return)

Date	CAR-Stat	Date	CAR-Stat
2020-10-15	-0.1662	2020-10-29	0.0250
2020-10-16	-0.6082	2020-10-30	-0.6226
2020-10-19	-0.8395	2020-11-02	-0.7851
2020-10-20	-0.4824	2020-11-03	-0.8050
2020-10-21	-0.4783	2020-11-04	-0.4913
2020-10-22	-0.7715	2020-11-05	-0.2875
2020-10-23	-0.9106	2020-11-06	-0.2927
2020-10-26	-0.5164	2020-11-09	-0.6610
2020-10-27	-0.1998	2020-11-10	-0.6727
2020-10-28	-0.4125	2020-11-11	-0.3953
		2020-11-12	-0.3023

Table 6: CAR Statistic from τ=-10 to τ = +10 (Market Adjusted Excess Return)

The hypothesis test result shows that on Day 1, the AR statistic significantly rejects the null hypothesis H_0: the event has no impact on stock abnormal returns at 5% two-tailed significance level, indicating that the event significantly affects the stock price performance on the next trading day, and investors have a relatively big reaction to this news. Thus AR is different from 0. But it cannot reject the null hypothesis at 1% two-tailed significance level.

CAR statistic does not reject the null hypothesis at both 1% and 5% two-tailed significance level, meaning that this news did not cause a significant increase or decrease in cumulative abnormal returns.

3.2.4 Mean Adjusted Excess Return

Date	AR-Stat	Date	AR-Stat
2020-10-15	-0.357	2020-10-29	1.3174
2020-10-16	-0.7669	2020-10-30	-2.4824*
2020-10-19	-1.2381	2020-11-02	-0.2291
2020-10-20	0.3433	2020-11-03	0.4316
2020-10-21	-0.4176	2020-11-04	1.472
2020-10-22	-0.5865	2020-11-05	1.2539
2020-10-23	-0.4457	2020-11-06	-0.2416
2020-10-26	-0.1917	2020-11-09	-1.0106
2020-10-27	0.3547	2020-11-10	-0.3181
2020-10-28	-2.0861*	2020-11-11	1.0440
		2020-11-12	-0.291

Table 7: AR Statistic from τ=-10 to τ = +10 (Mean Adjusted Excess Return)

Date	AR-Stat	Date	AR-Stat
2020-10-15	-0.3570	2020-10-29	-1.2285
2020-10-16	-0.7947	2020-10-30	-1.8928
2020-10-19	-1.3637	2020-11-02	-1.8821
2020-10-20	-1.0094	2020-11-03	-1.6983
2020-10-21	-1.0896	2020-11-04	-1.2606
2020-10-22	-1.2341	2020-11-05	-0.9071
2020-10-23	-1.3110	2020-11-06	-0.9386
2020-10-26	-1.2942	2020-11-09	-1.1504
2020-10-27	-1.1019	2020-11-10	-1.1927
2020-10-28	-1.7050	2020-11-11	-0.9290
		2020-11-12	-0.9701

Table 8: CAR Statistic from τ=-10 to τ = +10 (Mean Adjusted Excess Retur)

The hypothesis test result based on mean adjusted excess return also shows that on Day 1, the AR statistic significantly rejects the null hypothesis H_0: the event has no impact on stock abnormal returns at 5% two-tailed significance level, indicating that the event significantly affects the stock price performance on the next trading day. Additionally, it also reject the null at 5% two-tailed significance level on Day -1, implying that there could be a information leakage, so that the market react before the event announcement.

CAR statistic does not reject the null hypothesis at both 1% and 5% two-tailed significance level, meaning that this news did not cause a significant increase or decrease in cumulative abnormal returns.

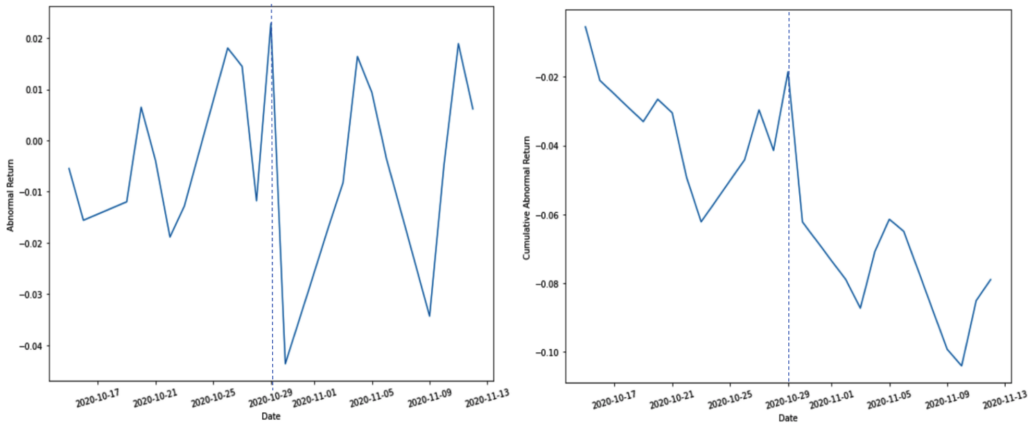
4 Conclusion

The results of the hypothesis tests based on the Market model, CAPM, and market-adjusted excess return model show that the AR and CAR are not significantly different from 0 before the event day (Day -11 to Day -1) and after Day 1 (Day 2 to Day 10). Therefore, there is no information leakage. However, the results of the hypothesis test based on the mean adjusted excess return model show that there is information leakage on the day before the event, and the AR of the four models (Figure 4(a)-7(a)) show that there is a drop in AR, which shows that the market reacts in advance.

The four models all agree that market reacted significantly to the new information on Day 1, and the AR (Figure 4(a)-7(a)) and holding period returns (Figure 8) manifest that this information exert negative effect on investors' confidence in Apple, causing positive abnormal returns to drop to negative abnormal returns. However, the market reacts afterward and reflects this information in the stock price,

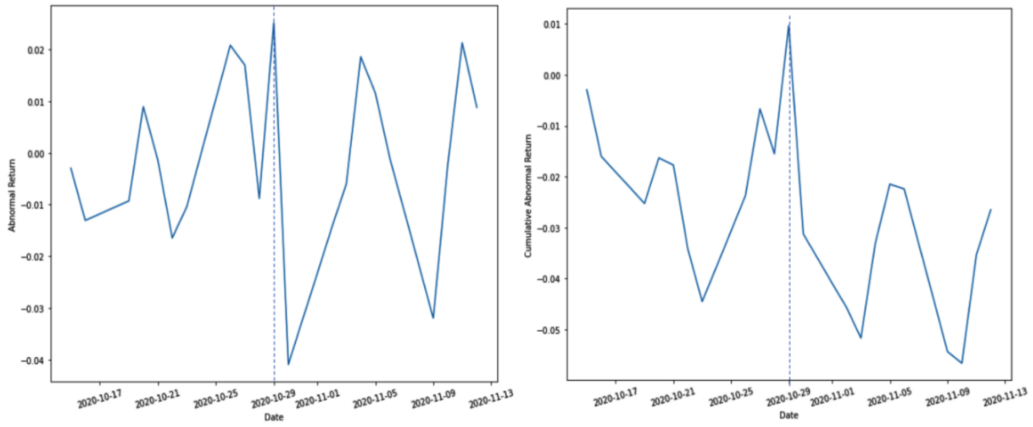
so AR and CAR are insignificantly different from zero after Day 1.

As seen in Figure 4(b)-7(b), CAR generally shows a downward trend after Day 1, which means that AR is actually not zero after the event, indicating that the market has a lag and does not adjust quickly enough, and the negative impact of Apple lower its dividends continues during the event period. Thus proving the information inefficiency.



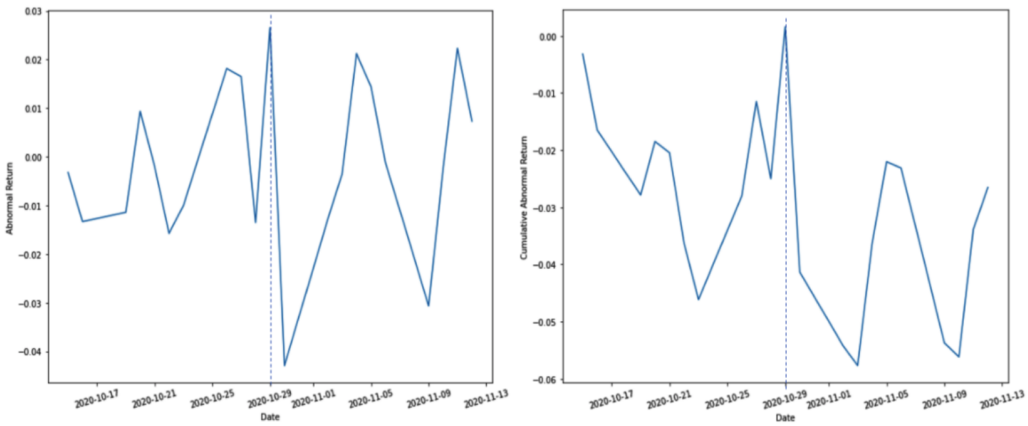
(a) Abnormal Return (b) Cumulative Abnormal Return

Figure 4: AR and CAR of APPLE from October 15 to November 11, 2020 (Market Model)



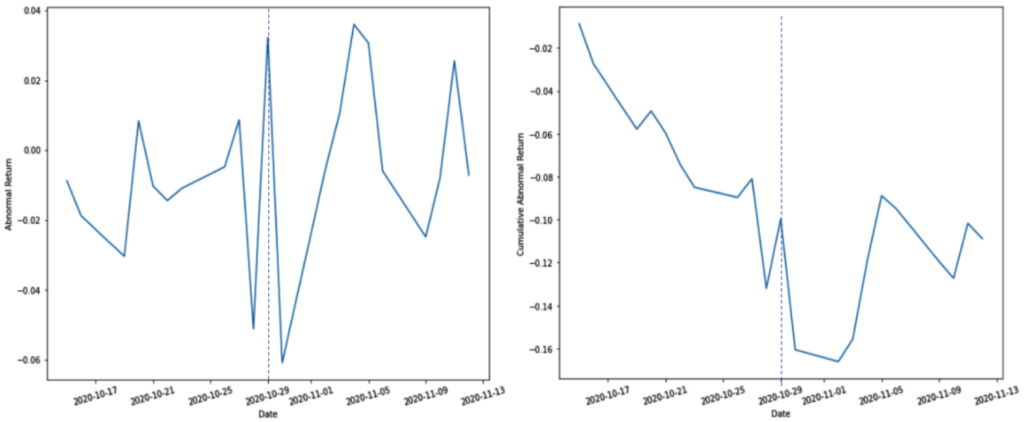
(a) Abnormal Return (b) Cumulative Abnormal Return

Figure 5: AR and CAR of APPLE from October 15 to November 11, 2020 (CAPM Model)



(a) Abnormal Return (b) Cumulative Abnormal Return

Figure 6: AR and CAR of APPLE from October 15 to November 11, 2020 (Market Adjusted Excess Return)



(a) Abnormal Return (b) Cumulative Abnormal Return

Figure 7: AR and CAR of APPLE from October 15 to November 11, 2020 (Mean Adjusted Excess Return)

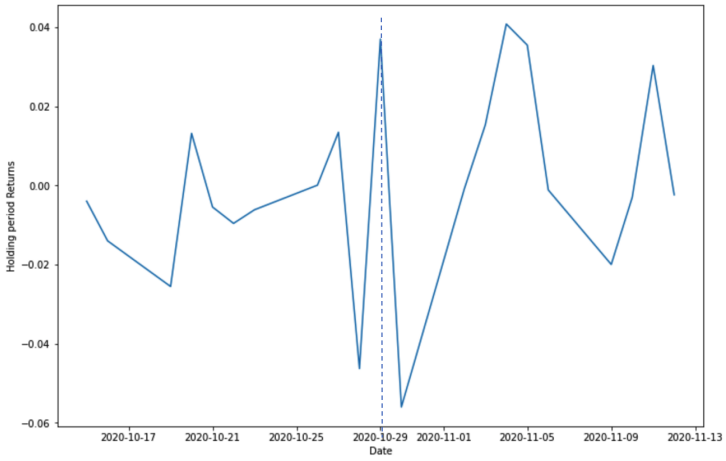


Figure 8: Holding Period Returns of APPLE from October 15 to November 11, 2020

One of the limitations of the research is that it only considers the impact of a single heterogeneous

event on stock performance. Systematic risks such as market risk and political risk may also cause significant declines in Apple's stock abnormal returns. In addition, since the study looks at only one stock, the conclusion of information inefficiency does not necessarily hold. What's more, the estimated results may not be accurate enough due to the existence of market noise and the limitations of the models. Further research would be more meaningful by considering multi-factor models and increasing the number of stocks for research.