

Exploring Arbitrage Opportunity toward Natural Disaster Based on Indonesia Capital Market Observation

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Abstract

Revisiting the EMH that the market price should reflect the true state efficiently, we have found some delay effect that can represent arbitrage opportunity to in Indonesia capital market during period 2009 – 2014. We believe to filter this effect from some popular effect which are January Effect and Holiday Effect in sampling process and we obtain the pattern that can give direction for future investment purpose in the future. The exciting classification stocks to be probed are the ones which give direct impact to the natural disaster emergency handling. They are: consumer goods (food & beverage), medicine which are for first aid in natural disaster, and cement for first temporary construction aftermath. We also interest to see the effect on media sector since they have active role in proliferating the news about. Most of the observation gives non normality data. Hence, instead utilize usual standard of classical statistical analysis, we employ non parametric approach.

Keywords: arbitrage opportunity, investment, capital market, natural disaster effect, abnormal return, event study

1. Introduction

The main objective of investor is to generate return from their investment. In capital market, especially in stock market, all investors try to get return by having dividend or capital gain. The most common form of generating stock market return is by doing trading in secondary market. Every country has its own stock exchange. For example, America has New York Stock Exchange (NYSE), Japan has Tokyo Exchange Group (TSE), and Hong Kong has Hong Kong Stock Exchange (HKEx). In Indonesia, people trade in Indonesia Stock Exchange (IDX), previously known as Jakarta Stock Exchange (JSX).

Related with stock, there is theory about Efficient Market Hypothesis (EMH) by Fama (1970) who said that a market can be called efficient if stock prices fully reflect all available information. It means, investor cannot beat the market and obtain abnormal return. However, when people talk about the existence of efficient market, there is also a thing called market anomaly. Market anomaly is the opposite of efficient market since in market anomaly, it is found things which should not happen or exist in efficient market. In market anomaly, investor can make use of specific event to generate abnormal return. Previous research found that there is market anomaly in United States. A day before national holiday, stock market index in United States increase significantly above average. It is one of the examples of market anomaly which called holiday effect. Holiday effect stated that there is tendency for stock market to generate higher return compare to non-holiday season. Other example is January effect which said that stock prices tend to increase during the month of January. Both of those market anomalies have violated Efficient Market Hypothesis which means that stock market is inefficient. A lot of researches have been conducted to test the existence of market anomaly and there are also different results. For instance, Hendrawan (2012) could not capture the existence of holiday effect in Indonesia Stock Exchange (IDX), but result from Ashri and Deddy (2014) found that holiday effect is exist in IDX.

When market is inefficient, it has been already said before that it means investor can generate abnormal return. It also means that investor had arbitrage opportunity. Arbitrage opportunity happens when investor can take advantage or benefit from simultaneously buying and selling financial asset by exploiting price differences. For example, when holiday effect exists, investor knows that return will be higher. Holiday effect can give 30 up to 50% return compared with non-holiday season, as mentioned by Lakonishok and Smidt (1988). Because of that, investor can get arbitrage opportunity by buying the stock before holiday and selling it after and generate abnormal return.

There are already a lot of researches regarding market anomaly in Indonesia. There are even researches about Jokowi effect which said that the election of Jokowi as Indonesia's president has boosted stock market and Indonesia currency. However, there are still not many researches about the impact of natural disaster toward stock prices in Indonesia. This topic is interesting since Indonesia is a country that prone to natural disaster. Being located on the Pacific Ring of Fire, area where large number of earthquakes and volcanic eruptions occur in the basin of Pacific Ocean,

Indonesia has to cope with constant risk of volcanic eruptions, earthquake, floods, and tsunamis. It is also said that stock market is quite sensitive to specific event which means that there is probability that occurrence of natural disaster has impact on market price.

This paper analyzes the impact of natural disaster toward stock prices in Indonesia Stock Exchange (IDX), whether there is significant difference in stock prices after the occurrence of natural disaster. The analysis uses event study method. Event study is a method to analyze whether a given type of event is statistically significant affecting public firm's market values. The stocks which are used in this research are companies in consumer goods sector (except of cigarettes, cosmetic, and housewares), cement, and media. This research also only analyzes natural disasters which happened from 2009 until 2014 and have high economic damage (at least 1 trillion IDR).

Indonesia is a country that prone to natural disaster. Every year, Indonesia gets many natural disasters such as flood, earthquake, landslide, *puting beliung*, and volcanic eruptions. There are researches that prove that several market anomalies exist in Indonesia, for example holiday effect, which means capital market in Indonesia is not efficient. In research by Indonesian Capital Market and Global Economic Volatility Study Team (*Tim Studi Volatilitas Pasar Modal Indonesia dan Perekonomian Dunia*), it is said that research by Manurung (1994), Jasmina (1999), and Suha (2004) have proven empirical study which show inefficiency in Indonesian capital market. Since stock market is sensitive to events or news and Indonesian market is said to be inefficient, then there is probability that occurrence of natural disaster has impact toward stock prices.

The purpose of this research is to find out whether there is significant difference of stock return after the occurrence of natural disasters on specific sectors of companies which are listed in Indonesia Stock Exchange (IDX). If there is significant difference, then investor can utilize it to get abnormal return.

Based on the background and problem identification, the writer formulates research questions as the following:

1. Is there any significant difference of stock return in consumer goods sector after the occurrence of natural disaster?
2. Is there any significant difference of stock return in medicine sector after the occurrence of natural disaster?

3. Is there any significant difference of stock return in cement sectors after the occurrence of natural disaster?
4. Is there any significant difference of stock return in media sectors after the occurrence of natural disasters?

The rest of the paper is organized as follows. Section 2 covers the literature review, section 3 highlights the research method, section 4 presents the empirical results,

2. Literature Review

Moles *et al.* (2011) said that price of financial instrument in capital market, as well as stock, is an equilibrium price which is formed by supply and demand mechanism in market. Security is priced based on its intrinsic value which represents present value that will be received in the future. Present value represents volume, time, and risk of the cash flow at a certain time period. Therefore, when there is new information, present value of security will reflect that information because investor will adjust it by buying or selling stock. This theory is represented in Efficient Market Hypothesis (EMH).

The origins of Efficient Market Hypothesis (EMH) can be traced back to the past where the pioneer of theoretical contribution came from Bachelier (1900) and empirical research from Cowles (1933). Fama (1970) summarized the idea of Efficient Market Hypothesis by saying “A market in which prices always „fully reflect“ available information is called „efficient“. More recent definition of EMH was stated by Malkiel (1992). The first sentence by Malkiel (1992) is consistent with definition by Fama (1970).

“A capital market is said to be efficient if it fully and correctly reflects all relevant information in determining security prices. Formally, the market is said to be efficient with respect to some information set...if security prices would be unaffected by revealing that information to all market participants. Moreover, efficiency with respect to an information set...implies that it is impossible to make economic profits by trading on the basis of that information set.”

In Efficient Market Hypothesis (EMH), it is said that market prices fully reflect all available information. It means that no one can beat the market by generating abnormal returns. When investors manage to have abnormal return, it means that there is anomaly and market is inefficient. Literary, anomaly means a strange of unusual occurrence. George and Elton (2001)

defined anomaly as “Anomaly is a term that is generic in nature and it applies to any fundamental novelty of fact, new and unexpected phenomenon or a surprise with regard to any theory, model or hypothesis”. There are anomalies which only happen once then disappear, while others happen frequently or continuously. In term of finance, market anomaly happens when there is a deviation of stock’s or group stock’s performance from the assumption of Efficient Market Hypothesis. Jones (1996) defined market anomaly as a technique and strategy which contradict efficient market.

Arbitrage is very closely related to the concept of Efficient Market Hypothesis. Arbitrage is a simultaneous purchase and sale of an asset in order to profit from a different in price. When market is anomaly (inefficient), investor can generate abnormal return. It means that investor has arbitrage opportunity.

3. Methodology

3.1 Research Design

In order to examine the occurrence of Natural Disaster Effect in Indonesia, this research utilizes event study. Natural disasters which are used in this empirical study are only those with material loss at least 1 Trillion IDR in 2009 – 2014 and the period of analysis (window) was not overlapped with IdulFitri (Lebaran), Christmas, and early January in order to avoid Holiday Effect and January Effect. The observed chosen disaster are Mount Merapi eruption (2010), flood in Pidie, Aceh (2011), earthquake in Aceh (2013), and Mount Kelud eruption (2014). This study also includes Mount Sinabung eruption (2013) even though it’s material loss less than 1 Trillion IDR due to its high frequency moments. The first time Sinabung erupted in 2010 was overlapped with IdulFitri, therefore, the researcher choose the second time it was erupted which was in 2013.

The exciting classification stocks to be probed are the ones which give direct impact to the natural disaster emergency handling. Those stocks are divided into four sectors which are consumer goods (except cigarettes, alcoholic beverages, confectionary, cosmetics, and house wares), medicine, cement, and media. Stocks which are used also are the one with market capitalization at least 2.5 Trillion IDR (small capital firms) in order to avoid stocks which have high probability of volatility. In total, there are 14 firms in Mount Merapi eruption, 15 firms in Pidie flood, 18 firms in Aceh earthquake and Sinabung eruption, and 20 firms in Kelud eruption.

Since most of the observation gives non normality data, this Event Study analysis use Non-Parametric Test of Wilcoxon Sign Rank for examining statistical difference between pre and post natural disaster return with significance level of 5%. In order to examine whether there are any statistically significant movement of natural disaster effect due to market reaction, the observation of return will be conducted in windows one until windows ten (10-Days before and after the occurrence of natural disasters). This research only analyzes significances until window ten because for event studies, the observed days cannot be too long since it will reduce the sensitiveness (Lakonishok, 1992) and (Fama, 1998). This analysis provides Cumulative NonParametric Paired Test. Cumulative means that this test evaluates reaction from W1 until W-nth and it is interpreted that the investor reaction is accumulated.

Table 1: Sample Stocks

No	Merapi Eruption (2010)	Flood in Pidie (2011)	Earthquake in Aceh (2013)	SinabungEruption (2013)	Kelud Eruption (2014)
1	ICBP	ICBP	AISA	AISA	AISA
2	INDF	INDF	ICBP	ICBP	ICBP
3	ULTJ	ULTJ	INDF	INDF	INDF
4	UNVR	UNVR	ULTJ	ULTJ	ULTJ
5	MYOR	MYOR	UNVR	UNVR	UNVR
6	KLBF	ROTI	MYOR	MYOR	MYOR
7	TSPC	MERK	ROTI	ROTI	ROTI
8	SMCB	KLBF	KAEF	KAEF	STTP
9	SMGR	TSPC	MERK	MERK	KAEF
10	INTP	SMCB	KLBF	KLBF	MERK
11	MNCN	SMGR	TSPC	TSPC	KLBF
12	SCMA	INTP	SMCB	SMCB	TSPC
13	EMTK	MNCN	SMGR	SMGR	SMCB
14		SCMA	INTP	INTP	SMGR
15		EMTK	VIVA	VIVA	INTP
16			MNCN	MNCN	SMBR
17			SCMA	SCMA	VIVA
18			EMTK	EMTK	MNCN
19					SCMA

20					EMTK
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3.2 Investigation of Natural Disaster Effect

Null Hypothesis: There is no significant difference of return between pre-natural disaster and post-natural disaster.

$$H_0 = R_{pre} - R_{post} = 0$$

Alternative Hypothesis: There is significant difference of return between pre-natural disaster and post-natural disaster

$$H_1 = R_{pre} - R_{post} \neq 0$$

This study use statistic significant level of 5% or interval confidence level of 95%. If the significance level < 5%, Null Hypothesis will be rejected, then it means that there is significance difference between pre-natural disaster return and post-natural disaster return and Natural Disaster Effect is occurred. The return for each firm will be calculated by following formula

$$R_t = \frac{\ln P_t}{\ln P_{t-1}}$$

3.3 Investigation of Abnormal Return

In order to examine the abnormal return, this research uses market model as suggested by Barber & Lyon (1997) and Bartholdy *et al.* (2007). Furthermore, market model is said to be more powerful than market-adjusted return model (Dyckman, Philbrick, and Stephan, 1984). In market model, return on a given security are regressed against the concurrent returns of market. The abnormal return will be calculated by following formula.

$$AR_{it} = R_{it} - E(R_{it})$$

Where: AR_{it} = Abnormal return for stock i in period t

R_{it} = Actual return for stock i in period t

$E(R_{it})$ = Expected return for stock i in period t

The expected return is calculated as the following.

$$E(R_{it}) = \alpha_i + \beta_i R_{mt}$$

Where: α_i = The intercept

β_i = The regression constant

R_{mt} = Return on market in period t

Alpha and beta are predicted by using ordinary least square (OLS) regression on the estimation period. The estimation period is 126 work days because estimation period with less than 126 observations can indicate false stock price movements of the market model. Since the event period is 20 days (-10 to +10) surrounding the event day (day 0), the estimation period start from day -11 until day -136.

After calculating the abnormal return for every stock, the next steps are calculating average abnormal return (AAR) and cumulative average abnormal return (CAAR) using the following formula.

$$AAR_t = \frac{1}{n} \sum_{i=1}^n AR_{it}$$

Where n is the sample size. After that, sum the average abnormal returns over T days in the event window.

$$CAAR_T = \sum_{t=1}^T AAR_t$$

3.4 Data

The stock price daily movement is retrieved from Yahoo Finance website (finance.yahoo.com). There are four sectors which are used in this study. Those sectors are consumer goods (except cigarettes, alcohol beverage, confectionary, house wares, and cosmetic), medicine, cement, and media. Justification of why those sectors are chosen is because those sectors are the one which are needed or play important role when natural disaster occurred. This analysis has observation period starting from 2009 – 2014 because this study want to analyze Indonesia capital market movement pattern after crisis (Global Financial Crisis 2008).

4. Result and Analysis

The observation of natural disaster effect in those four disasters happened during 2009 – 2014 analyzed using Non-Parametric Test of Wilcoxon Sign Rank has been tabulated in tables below. The single asterisk (*) signed the result significant for alpha = 5% while the double asterisk (**) signed the result significant for alpha = 10%.

Natural disaster effect is found on all of those five disasters. For confidence level 95%, effects shown in Merapi eruption, earthquake in Aceh, and Kelud eruption, while for confidence level 90%, effects shown in flood in Pidie and Sinabung eruption.

Table 2: The Observation of Natural Disaster Effect on Consumer Goods Sector

Window	Merapi Eruption	Flood in Pidie	Earthquake in Aceh	Sinabung Eruption	Kelud Eruption
	Sig	Sig	Sig	Sig	Sig
1	(*)0.043	(**)0.075	0.237	(**)0.091	0.401
2	0.799	0.239	(*)0.035	(**)0.064	(*)0.049
3	0.609	1	(*)0.013	0.305	0.253
4	0.145	0.886	(*)0.001	(**)0.084	0.214
5	0.15	0.491	(*)0.001	0.6	0.63
6	0.237	0.528	0.118	0.846	0.939
7	0.461	0.315	0.259	0.877	0.832
8	0.558	0.6	0.802	0.683	0.76
9	0.498	0.929	0.986	0.848	0.752
10	0.327	0.932	0.963	0.282	0.353

Table 3: The Observation of Natural Disaster Effect on Medicine Sector

Window	Merapi Eruption	Flood in Pidie	Earthquake in Aceh	Sinabung Eruption	Kelud Eruption
	Sig	Sig	Sig	Sig	Sig
1	0.18	0.18	0.593	0.18	0.18
2	0.357	0.144	0.345	0.715	0.138
3	0.528	(**)0.08	0.386	0.499	(**)0.069
4	0.944	0.735	(**)0.064	0.959	0.213
5	0.61	0.678	(**)0.088	0.807	0.198

6	0.844	0.374	0.277	0.756	0.588
7	0.851	0.374	0.57	0.601	0.391
8	0.698	0.552	0.675	0.884	0.484
9	0.542	0.925	0.766	0.819	0.657
10	0.457	0.959	0.567	0.439	0.417

There are only less strong reactions (significance level, alpha 10%) that are found in medicine sector. Those effects appear in flood in Pidie, earthquake in Aceh, and Kelud eruption. On the other hand, no effect is found on Merapi eruption and Sinabung eruption.

Table 4: The Observation of Natural Disaster Effect on Cement Sector

Window	Merapi Eruption	Flood in Pidie	Earthquake in Aceh	Sinabung Eruption	Kelud Eruption
	Sig	Sig	Sig	Sig	Sig
1	0.593	0.593	0.285	0.109	0.109
2	0.686	0.917	0.463	(*)0.028	0.398
3	0.484	0.374	0.441	(*)0.011	(**)0.091
4	0.859	(**)0.06	0.136	(*)0.004	(*)0.017
5	0.198	(*)0.017	(**)0.061	0.173	(*)0.03
6	0.163	0.133	0.286	0.286	(**)0.055
7	0.296	0.181	0.931	0.876	(**)0.055
8	0.123	0.407	0.753	0.977	0.183
9	0.158	0.81	0.755	0.517	0.169
10	0.539	0.558	0.91	0.861	0.219

Some cement equity have shown its effect around 4-5 observation window in flood in Pidie and earthquake in Aceh. Meanwhile, stronger effects are reflected in Sinabung and Kelud eruption around the first 7 days.

Table 5: The Observation of Natural Disaster Effect on Media Sector

Window	Merapi Eruption	Flood in Pidie	Earthquake in Aceh	Sinabung Eruption	Kelud Eruption
	Sig	Sig	Sig	Sig	Sig

1	1	0.109	(**)0.068	0.144	0.715
2	1	0.173	(*)0.012	0.484	0.499
3	0.635	(**)0.066	(*)0.005	0.859	0.203
4	0.844	0.209	(*)0.001	0.798	0.101
5	0.9	0.394	(*)0.000327	0.862	(**)0.084
6	0.449	0.356	(*)0.033	0.649	0.217
7	0.287	0.26	0.258	0.851	0.581
8	0.456	0.205	0.538	0.65	0.838
9	0.509	0.29	0.396	0.592	0.938
10	0.88	0.178	0.604	0.857	0.675

Effects by media equity were shown in window 3 for flood in Pidie and window 5 for Kelud eruption. Stronger effect (significance level, alpha 5%) detected in earthquake in Aceh for window 2 – window 6.

After observing the significance, this study examines the cumulative average abnormal return for each disaster in the event window. However, different from previous research where they calculate abnormal return before the event date, this study only calculates the ex-post return. The reasoning behind this is because investor does not know and cannot predict when natural disaster will happen.

Table 6: Abnormal Returns after the Occurrence of Natural Disaster

Day	Merapi Eruption		Flood in Pidie		Earthquake in Aceh		Sinabung Eruption		Kelud Eruption	
	AAR	CAAR	AAR	CAAR	AAR	CAAR	AAR	CAAR	AAR	CAAR
0	-0.10%	-0.10%	0.78%	0.78%	1.42%	1.42%	–	–	-0.50%	-0.50%
1	0.12%	0.02%	-0.16%	0.62%	0.06%	1.48%	0.28%	0.28%	0.79%	0.29%
2	0.24%	0.25%	-0.38%	0.23%	-1.28%	0.21%	0.02%	0.30%	0.20%	0.49%
3	-0.07%	0.18%	0.35%	0.58%	-1.15%	-0.95%	0.70%	1.00%	-0.36%	0.13%
4	-0.23%	-0.05%	0.09%	0.68%	-0.47%	-1.42%	-0.78%	0.23%	0.01%	0.13%
5	-0.18%	-0.23%	-0.06%	0.62%	-1.00%	-2.41%	1.56%	1.78%	0.38%	0.52%
6	-0.12%	-0.35%	-0.77%	-0.15%	1.58%	-0.84%	-0.12%	1.66%	-0.11%	0.41%

7	-0.13%	-0.47%	-0.36%	-0.51%	-0.32%	-1.16%	0.07%	1.72%	0.47%	0.88%
8	-0.13%	-0.61%	0.74%	0.23%	1.38%	0.22%	-0.16%	1.56%	0.72%	1.60%
9	0.20%	-0.41%	0.55%	0.78%	0.25%	0.47%	0.76%	2.32%	0.24%	1.85%
10	-0.30%	-0.71%	-0.78%	0.0024%	0.64%	1.11%	0.06%	2.38%	-0.32%	1.53%

Note: In Sinabung eruption, the natural disaster happened on Sunday. Therefore, in event day (day 0), there are no AAR and CAAR in Sinabung eruption

From the table the CAAR of each natural disasters in the event period, CAAR in Merapi eruption is -0.71%, Pidie's flood is 0.0024%, Aceh's earthquake is 1.11%, Sinabung eruption is 2.38%, and Kelud eruption is 1.53%. Majority of the natural disasters (4 from 5) have positive CAAR.

5. Conclusion

This research can capture the existence of natural disaster effect in Indonesia. All effects are detected with range from window 1 until window 7 which indicates short term effects pattern. The most significant effects are found in consumer good (found in all natural disasters) and cement sector (found in four from five natural disasters). While the effect only detected in three natural disasters in media sector and only less significant effects in medicine sector (found in three natural disasters). Regarding abnormal return, most of cumulative average abnormal return from day 0 until day 10 of those natural disasters are positive (except of Merapi eruption). It can be concluded that those natural disaster gave positive abnormal return in the event period. This study can be extended by having more natural disaster as the sample since this study only use natural disaster which have material loss at least 1 trillion IDR.

Limitation

Limitation of this research is that this study could not get exact number of natural disaster with material loss at least 1 trillion IDR since it is not stated on National Disaster Management Agency (*Badan Nasional Penanggulangan Bencana*).

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