# Impact of Environmental Policy Announcements on Investment Performance of Equity Mutual Funds

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Previous research has shown that stock prices will also respond to environmental policy announcements because of the impact on firms' value. As equity mutual funds are primarily invested in stocks, this study aims to examine whether these announcements also impact the investment performance of equity mutual firms. Some studies also prove that it is still debatable whether green mutual funds or polluting mutual funds perform better in terms of investment returns. Based on this, this study will also further extend to analyze investment performance between green and polluting equity mutual funds under stringent and loosened environmental policy announcements. This study utilized the polluting and green mutual funds data from Morningstar as well as US SIF website. For the announcements, the major environmental policy announcements were selected from several US government websites as well as news sources. The event study methodology along with regression analysis was used in this study to capture the cumulative abnormal returns (CAR) generated from green and polluting mutual funds under stringent and loosened environmental policy announcements. The findings indicate that significant impacts were observed on cumulative abnormal returns (CAR) in both stringent and loosened announcements for event periods of 5 days, 10 days and 20 days. To account for fund and fund managers' characteristics, control variables were added, and expense ratio and fund size have material effect on fund returns except portfolio turnover ratio which appears to have weak influence on mutual funds' returns under the announcements. Furthermore, when comparing investment performance of green and polluting mutual funds' performance under stringent and loosened environmental policy announcements, it was found that green mutual funds outperform most of the time.

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# 1. Introduction

## 1.1. Background, Significance of the Problem

The effects of global warming have become increasingly evident in recent years, with rising temperatures, extreme weather events, and declining biodiversity. The emphasis on sustainability and environmental consciousness has grown significantly over time and governments worldwide have recognized the urgent need to address these issues, beginning to implement various environmental policies to mitigate the effects of climate change which started with the launch of the Kyoto Protocol on February 16, 2005.

Adherence to environmental regulations can have unintended detrimental effects on firms' financial performance, and competitiveness within the market as compliance to these regulations often necessitates changes to corporate operations and business models, incurring increased expenses. (Palmer et al., 1995; Walley & Whitehead, 1994). Another viewpoint is that regulations aimed at promoting a cleaner environment may lead to positive outcomes, such as innovation externalities, which can potentially increase value (Porter, 1995). This firm performance, as measured by financial metrics such as earnings per share, quick ratio, return on assets, return on equity, and net profit margin has been found to have a significant impact on stock prices (Anwaar, 2016; Sukesti et al., 2021).

A company's stock prices are contingent upon its financial performance, and it was proved that financial performance, in turn, is affected by environmental policy announcements. This has prompted researchers to investigate how policy announcements about environmental measures affect stock performance. The findings conclude that predominantly positive abnormal returns and volatility changes around environmental regulations announcements are detected (Pham, Nguyen, Ramiah, Mudalige, et al., 2019; Ramiah et al., 2013).

Along with the trend of green policies, there has also been a rise in the popularity of green investment options, such as green mutual funds. Mutual funds are a popular investment vehicle and are widely used by individual investors and financial professionals, which can reflect the investment behavior and preferences of a large population segment. The investment performance of equity mutual funds is closely

tied to the performance of the stock market and the individual stocks within the fund's portfolio.

Both green and traditional mutual funds aim to achieve financial returns for their investors, but they differ in their approach to investing. Green mutual funds focus on investing in companies that prioritize environmental sustainability and clean energy. Besides, traditional mutual funds invest in a wide variety of companies across different sectors without a specific focus on environmental sustainability and may invest in companies that can harm the environment.

The two divergent perspectives regarding which type of mutual fund, either green or traditional, has superior investment performance have been the subject of ongoing debate and have yet to be resolved. Green mutual funds have produced lower returns and comparable levels of risk compared to traditional mutual funds. Also, on a risk-adjusted basis, it has been shown that green mutual funds have performed below too (Chang et al., 2012). In addition, although the magnitude of underperformance is small compared to the non-socially responsible component, the socially responsible portion exhibits a lower raw return, risk-adjusted return (alpha) and sharpe ratio (El Ghoul et al., 2023).

But on the flip side, one literature also revealed that green mutual funds generated returns that were not statistically dissimilar to those of other socially responsible investment (SRI) and traditional mutual funds during an examination of a more recent time frame (2001-2009)(Climent & Soriano, 2011). Besides, a more recent study proved that green mutual funds outperform with more returns than conventional mutual funds (Ji et al., 2021).

In general, exploring the connections between all these pieces of literature, it has been demonstrated that announcements related to environmental policy can affect stock returns. As equity mutual funds are primarily invested in stocks, it is crucial to examine whether these announcements also impact the investment performance of equity mutual firms. When exploring this, in addition, as investment performance between green and polluting mutual funds is still debated, investigating both polluting and green equity mutual funds provides valuable insight for examining the effects of environmental policy announcements. This study employs the event study methodology as used by Hamilton (1995); Klassen and McLaughlin (1996); White

(1995) to obtain abnormal returns to access the investment performance of green and polluting mutual funds and compare them to determine which type of mutual fund performed better after the environmental policy announcements. Recent financial research frequently uses this event study methodology to assess the effects of particular events, such as the influence of stock price announcements regarding environmental policies.

## 1.2. Objectives

The main objective of this study is to the effects of environmental policy announcements on equity mutual funds. The study aims to gain insights into two key aspects (1) whether environmental policy announcements significantly impact equity mutual funds and (2) to determine the relative investment performance between green and polluting equity mutual funds under the influence of environmental policy announcements.

## 2. Literature review

### 2.1 Environmental regulations, firms value and stock market

As stated by Ramiah et al. (2015a), the implementation of the Kyoto Protocol on Climate Change has resulted in a notable increase in focus on environmental regulations. This can be observed through the substantial growth of literature dedicated to studying the effects of these policies and events on firm values and stock returns since the protocol's introduction in 2005. This particular area of research has attracted considerable attention.

*2.1.1 Environmental Regulations and firms' performance*

The underlying assumption is that companies that adhere to higher environmental standards tend to have higher market values and better performance than those with lower standards. Ramiah et al. (2013) assumed that firms that engage in polluting activities would incur additional costs due to the implementation of strict regulations, leading to a decline in their financial performance compared to less polluting firms. This was also proved by other studies as well.

However, on the positive side, Dowell et al. (2000) find that companies that implement strict environmental standards tend to have higher market values compared to those that have weaker standards. Accordingly, there are several arguments in support of environmental regulation. These include the potential for cost savings, the possibility of lower costs associated with new investments, the ability to reduce pollution through production process changes, and the potential for additional benefits such as increased employee morale and productivity. Additionally, according to Hart and Ahuja (1996), implementing emission-reduction strategies has a beneficial effect on the return on sales and return on assets in the year that follows.

Additionally, policies may have ambiguous effects. More specifically, legislation might not affect environmentally friendly businesses in a positive or bad way. This theory is supported by Veith et al. (2009) who demonstrate that when strict environmental regulations are implemented, polluting businesses tend to pass on increased environmental costs to consumers and receive non-negative anomalous returns.

*2.1.2 Environmental regulation announcements and stock market returns*

Hamilton (1995), found that after the initial release of pollution figures reported in the Toxics Release Inventory (TRI), shareholders in firms that reported such figures experienced abnormal returns that were negative and statistically significant. The study examined stock market reactions to the TRI data. This conclusion was also supported by Klassen and McLaughlin (1996) event study methodological investigation on the financial impact coming from high level of toxicity discharges by American businesses. Companies that received public recognition for their exceptional environmental practices were studied and found that these firms saw a rise in their market value as a result of their investments in reducing negative environmental impacts and enhancing environmental safety. They concluded that announcements of these emissions resulted in abnormal returns for the polluting companies' stock that were statistically significant and negative.

In an event study investigation, Anderson-Weir (2010) explored the connection between abnormal stock returns for companies and the release of the "Green Rankings." These rankings assess the environmental performance of corporations. This paper found that the stock market reacts negatively to news about the environmental behavior of firms. Ramiah et al. (2016) utilized event studies to analyze the effects of environmental news on stock markets in the United Kingdom (U.K.). The study found that the U.K. market is highly responsive to announcements related to the environment, both domestically and internationally, as well as those related to nuclear events. Some sectors of the market saw cumulative abnormal returns reaching 30-40%.

Konar and Cohen (1997) analyzed the stock market reaction to the public announcement of toxic chemical emissions by firms. The firms with the largest negative stock price effects were found to be among the top 3 polluting firms based on revenue. The report also suggests that businesses that aggressively lower their emissions typically see a gain in market value. This discovery explains why big businesses willingly contribute more to environmental improvements than what is required by environmental legislation. Deak and Karali (2014) conducted a study focused on analyzing the stock returns of food processing business, a sector known

for its substantial greenhouse gas emissions. The study's results revealed that the returns exhibited an upward trend in response to environmental enhancements, while they experienced a decline in response to environmental violations.

Numerous studies have explored a wide range of regions, including France, the U.K., China, Singapore, Argentina, the U.S., and Australia, in their investigations. These studies primarily look at how stock market responses in various industries are affected by environmental laws and regulations. However, there is a lot of diversity and heterogeneity in the results of these research.

Pham, Nguyen, Ramiah, Saleem, et al. (2019) conducted a study in France to examine the impact of environmental regulations on various industries. According to their findings, the building and materials industries showed favorable reactions, whereas the chemical, oil, and gas sectors showed negative reactions. Similar results were found in the analysis of Ramiah et al. (2015a), which found sluggish policy responses and limited market effects of environmental policies. However, another study conducted by Pham, Nguyen, Ramiah, Mudalige, et al. (2019) focusing on the Singaporean stock market suggested that environmental regulations and policies were effective in achieving their goals. This study revealed that major polluting industries experienced negative impacts following the announcement of regulations and policies, while environmentally friendly sectors displayed a positive reaction.

Ramiah et al. (2013) looked into how news and announcements of environmental policies affected the perceptions of the financial sector in their research. Their conclusions showed that the Australian market responds to declarations of economic policies. However, when it comes to environmental policy announcements, polluting industries such as energy exhibited no significant changes in returns. This suggests that these companies tend to transfer the increased costs resulting from environmental policies to consumers. Grand and DElia (2005) conducted a study investigating the influence of environmental news on stock market performance in Argentina. Their findings indicated that positive environmental news did not have a significant effect on stock returns. However, negative news, especially regarding citizen complaints and government rulings, had a detrimental impact on stock market performance.

Ramiah et al. (2015b) utilized asset pricing and event studies to investigate the connection between political leadership, financial markets, and environmental policy. The study concentrated on Barack Obama's administration and the environmental legislation he supported while in his tenure. The findings showed that companies with significant polluting activities experienced negative abnormal returns after implementing green policies. On the other hand, firms with a positive track record of environmental performance were less negatively impacted, although the reactions were not substantial. This suggests that these policies were ineffective in achieving their intended goals.

Nerger et al. (2021) also analyze the effects of environmental news announcements in the U.S. during the Trump administration. The findings demonstrate that the Trump administration's recently announced environmental regulations and policies had an impact on stock market performance and corporate results as reflected in stock returns, but they had no positive impact on the U.S. economy given that the administration had already loosened environmental regulations and policies to stimulate the economy.

## 2.2 Green investment Vs traditional investment

In the context of real estate investment trusts (REITs), the relationship between financial success and environmental sustainability has been investigated. Research by Eichholtz et al. (2012) and Sah et al. (2013) have found a positive association between environmental-friendly practices and firm value as measured by Tobin's Q. The findings indicate that green real estate investment trusts (REITs) outperform non-green counterparts regarding return on assets and annual returns. Levi and Newton (2016) utilized a six-dimensional framework of "greenness" to compare the risk-adjusted long-term returns of environmental-friendly stocks versus less green stocks. Their study identified a green stock outperformance of up to 3.7% annually. They further proposed that the consistent presence of these positive returns over time might signify the gradual incorporation of environmental sustainability considerations into stock pricing by investors. A study in BRICS countries disclosed that green funds outperform with higher returns their counterparts for the entire sample and within-country assessment Ji et al. (2021).

In contrast to the earlier studies, other research has discovered that there is, at best, a tenuous connection between being environmentally friendly and economic worth. For example, Climent and Soriano (2011) noted that when compared to other funds, green funds do not offer any additional benefits to investing performance. This result became especially obvious in the latter part of their study period (2001-2009). Similar findings were made by Chang et al. (2012), who found that 131 green mutual funds on average had poorer returns than traditional mutual funds. Puopolo et al. (2015) looked over 500 US businesses that have adopted environmental standards and discovered a connection between achieving financial success and going green. They assumed that the recent approval and implementation of environmental rules by management was the cause of this. In examining whether green fund investors are socially responsible, Chung et al. (2012) 's investigation of the social responsibility of green fund investors showed no appreciable differences between the performance of the two types of funds.

## 2.3. Efficient Market Hypothesis

According to Hayek (1945), markets are a means of processing new information as it becomes available. The combination of newly generated information with market participants' preferences results in fluctuating returns that exhibit unpredictable patterns and outcomes (Fama, 1970). A capital market is considered efficient if it accurately and completely incorporates all relevant information in determining security prices. This can be formalized as stating that security prices would not be affected if all market participants were privy to a specific information set. Additionally, if a market is considered efficient concerning a particular information set, it is deemed impossible for any individual to earn economic profits by engaging in trading activities. Roberts (1967) expanded upon the Efficient Market Hypothesis (EMH) concept by identifying three market efficiency levels, which he categorized as weak form, semi-strong form, and strong form. The semi-strong variant of EMH asserts that all publicly available information related to a company's securities is included in current stock prices, in addition to past price information. If markets are efficient in this regard, then performing fundamental analysis on balance sheets, income statements, dividend change announcements, stock split

announcements, or any other publicly available information about a firm won't lead to atypical economic profits.

In the context of this discussion, the concept of semi-strong form efficiency refers to the adjustment of security prices to new information. Fama et al. (1969) conducted a study on the concept of semi-strong form efficiency by examining the impact of new information, particularly stock splits, on security prices. This principle can be applied to other forms of information, such as environmental policy announcements, to assess its impact on the market and determine if the information it provides has any value. Environmental policy announcements shouldn't affect stock prices if markets are efficient because the information should already be represented in the price. However, if the event study, which is used to test if a capital market is efficient, shows that an event does influence the stock price, this suggests that markets are not fully efficient and that investors can take advantage of new information to earn abnormal returns. In this paper, semi strong form test of efficient market hypothesis (EMH) will be conducted regarding impact on environmental policy announcements on investment performance of equity mutual funds.

## 2.4. Literature gap and contribution

Overall, there is evidence to suggest that environmental policy announcements can impact stock returns, and as equity mutual funds invest predominantly in stocks, it is worth investigating whether these announcements have a corresponding effect on investment performance of equity mutual firms. Most studies in this area specifically examined the impact of environmental policy announcements on stock markets from various countries (Pham et al., 2020; Ramiah et al., 2013; Ramiah et al., 2016), but research papers have yet to be founded regarding the impact on mutual funds, which hold stocks as a portfolio. Additionally, most papers specialized in the comparison of firm performance between green and traditional mutual funds (Chang et al., 2012; El Ghoul et al., 2023) but have not been conducted findings regarding how the investment performance of these firms react when external shock such as government announces certain types of policies. This paper intends to fill this gap.

Thereafter, this study provides an addition to the growing body of literature on green investing by providing evidence on the impact of environmental policy

announcements on green and polluting mutual fund returns. It sheds light on the debate over the trade-off between financial performance and environmental responsibility by providing evidence of the relationship between environmental policy announcements and investment performance in the case of the mutual fund.

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### 3. Hypothesis development

Previous research has shown that the announcements of environmental policies can impact a firm's value, affecting various factors such as costs, revenues, growth, and productivity. Given the efficient market theory and prior studies, stock prices will also respond to these announcements because of the impact on firms' value (Pham, Nguyen, Ramiah, Mudalige, et al., 2019; Ramiah et al., 2013). This gives rise to the first hypothesis concerning the influence of environmental policy announcements on the investment performance of equity mutual funds. As equity mutual funds are primarily invested in stocks, it is crucial to examine whether these announcements also impact the investment performance of equity mutual firms. This is because mutual funds may or may not be influenced by environmental policy announcements in the way stock returns are. Stock returns are proved to be being influenced by those announcements. Green stocks are positively affected while polluting stocks suffer from these announcements (Deak & Karali, 2014; Pham, Nguyen, Ramiah, Saleem, et al., 2019). Thereafter, hypothetically it appears to be that it is possible to assume as mutual funds which hold stocks will also have an impact from those announcements too. However, there is also probability that no abnormal returns from those announcements are being captured due to either specific investment styles or characteristics like fund size and fees of mutual funds. It is also likely that fund managers of mutual funds are bad to capture positive reactions or skillful to avoid negative reactions from stock prices fluctuation that their investment performance may not be as much influenced. This is why this paper will focus on mutual fund level impact from environmental policy announcements.

When investigating the investment performance of mutual funds, Ji et al. (2021) classified mutual funds as green, brown, and black, in which green represents mutual funds investing in green stocks, black with polluting stocks and brown with a mixed portfolio. But in this study, conventional equity mutual firms, which are not either green or polluting mutual firms, might not have any significant impact from environmental policy announcements because their portfolios consist of a mixed proportion of stocks between green, normal, and polluters. When external shocks, environmental policy announcements in this case, come in, the effects on those stocks

in one portfolio will be cancelled out. Thereafter, this paper will mainly highlight investment performance between green mutual funds and polluting mutual funds under environmental policy announcements.

Therefore, the first hypothesis of this study will be:

*H1: Environmental policy announcements have significant impact on investment performance of equity mutual funds.*

While discussing about the mutual funds, unlike stocks, mutual funds can react differently to the impact from environmental policy announcements due to their nature of diversification, fund managers' skills, fund size etc., as mentioned above. Taking into account for these factors, this study will also test whether mutual fund characteristics can be accountable for the better or worse investment performance under environmental policy announcements. To do so, the control variables which are expense ratio, portfolio turnover ratio and fund size will be added. A higher expense ratio means that a larger portion of the fund's returns is consumed by operating expenses. And funds with higher expense ratios may face a competitive disadvantage compared to funds with lower expense ratios. This is consistent with other studies by Dellva and Olson (1998), Blake et al. (1993) and Golec (1996). According to previous studies by Friend and Blume (1970), Grinblatt and Titman (1994), and Wermers (2000), high levels of trading actively can produce better returns as managers always seeking opportunities to achieve market timing for excess returns and acting on new information. Larger fund size has a downside of being hard to adjust and implement new strategies for the whole fund within a short period of time or may have an advantage of being easier to diversify the portfolio to adapt new trends.

Therefore, the second hypothesis of this study considering for mutual funds characteristics will be:

*H2: Mutual funds' characteristics have contribution to investment performance of equity mutual funds under environmental policy announcements.*

Regarding green and polluting mutual funds, some literature indicates that polluting firms underperform compared to green funds (Ji et al., 2021; Ramiah et al., 2013). Some studies also prove that green funds and polluting firms do not significantly differ in terms of performance. Sometimes polluting firms outperform because green funds must comply with regulations to select environmentally friendly

stocks for their portfolio (Chang et al., 2012; Chung et al., 2012). The first hypothesis above will be further extended to study investment performance between green and polluting equity mutual funds.

*H3.a: Under stringent environmental policy announcements, investment performance of green equity mutual funds is better than polluting equity mutual funds.*

*H3.b: Under loosened environmental policy announcements, investment performance of polluting equity mutual funds is better than green equity mutual funds.*

## 4. Data and sample

The region of focus for this paper will be the United States (U.S.), as a large number of funds and a high level of regulation characterizes its mutual fund market. As of 2020, according to the Statista database website, the highest mutual fund assets were in the United States, which was around 30.16 trillion U.S. dollars, more than five times the value in Luxembourg, the country with the second-highest value of mutual fund assets. It is also worth mentioning that one of the top seven emitters accounted for about half of global greenhouse gas emissions in 2020, according to the United Nations. Furthermore, the United States government has been a leader in climate change policy and has significantly invested in renewable energy, carbon reduction and energy efficiency. For all those reasons, studying the impact of environmental policy on United States mutual funds would be of significant value.

The period of environmental policy announcements will be from 2015 to 2022. These announcements are collected from the Environmental Protection Agency (EPA), the U.S. Department of State website, the White House, the Federal Register, and other news websites. They are selected as a consideration for firms to engage in environmental issues like carbon emission and climate change because climate change, which is caused by the buildup of greenhouse gases, primarily carbon dioxide, in the atmosphere, is recognized as the most pressing environmental concern nowadays. Only significant announcements like those made at the Conference of the Parties (COP), the supreme decision-making body of the United Nations Framework Convention on Climate Change (UNFCCC), are considered, and smaller announcements about slight changes in regulations, punishments, and incentives are excluded. Moreover, announcements of proposed rules and plans to revise the policies are not included. There are a total of 7 announcements, as listed in Table 1.

Table 1. Selected major announcements on environmental policy.

| Event | Announcement Date | Description | Nature |
|-------|-------------------|-------------|--------|
| 1 | August 3rd, 2015 | President Obama announced the Clean Power Plan | Stringent |
| 2 | September 3rd, 2016 | The United States Formally Entered the Paris Agreement from COP21 | Stringent |
| 3 | June 1st, 2017 | President Donald Trump announced that the U.S. is withdrawing from the Paris Agreement but will attend COP23. | Loosen |
| 4 | June 19th, 2019 | EPA issued the final Affordable Clean Energy rule, which replaces Clean Power Plan | Loosen |
| 5 | July 15th, 2020 | The Trump administration's repeal of the National Environmental Policy Act (NEPA) regulations | Loosen |
| 6 | February 19th, 2021 | The United States Officially Rejoins the Paris Agreement | Stringent |
| 7 | November 7th, 2022 | U.S. Announcements Under the Green Shipping Challenge at COP27 | Stringent |

Active mutual funds data are sourced from Morningstar's Principal database and website as of December 31st, 2022. As it was assumed that the environmental policy announcements impact stock returns, open-ended equity mutual funds, predominantly investing in stocks, will be researched. Equity mutual funds are filtered to be U.S. domicile with inception date before January 1st, 2016, to have at least eight years of data available as of December 31st, 2022, to be a fair analysis as Howell (2001); Karoui and Meier (2009); Kaur (2018) identified that fund age can have influences on performance. Accordingly, equity mutual funds that invest in specific polluting industries such as energy, materials, and utilities are selected. These funds were chosen to specifically focus on polluting equity mutual funds. Here, a total of 205 polluting equity mutual funds are identified.

The green mutual funds to be examined in the present study were identified as prescribed by US SIF as of December 31$^{st}$, 2022. US SIF, formerly the Social Investment Forum (SIF), is the U.S. membership association for professionals, firms, institutions, and organizations engaged in socially responsible and sustainable investing. Total of 100 green funds are identified.

The daily Net Asset Value (NAV), expense ratio, portfolio turnover and fund size of all these polluting and green mutual funds are downloaded from the Morningstar database. Monthly data of market returns ($R_m$), SMB, HML and MOM factors on the U.S. market are downloaded from the public data library of Kenneth R French.

## 5. Methodology

The study will employ the event study methodology developed by Brown and Warner (1985) to examine the hypothesis of investigating how environmental policy announcements affect the investment performance of equity mutual funds. As equity mutual funds mainly invest in stocks, stock returns play a crucial role in the returns of these funds. This methodology was selected as it allows for the examination of abnormal returns from stock price reactions of equity mutual funds to new information, in this case, the environmental policy announcements. Furthermore, this approach has been widely utilized in several environmental event studies (Pham, Nguyen, Ramiah, Mudalige, et al., 2019; Ramiah et al., 2013; Ramiah et al., 2016).

The event day is the day when new information becomes available to the market and is considered the starting point for all time divisions. This day is designated as t = 0, and days before it is labelled as t = -1, while days after it are labelled as t = +1. If an announcement is made after the market closes, the event day is considered to be the following day. This concept was introduced by Campbell and Wesley (1993) and further explained by Ott (2011).

According to the efficient market hypothesis (EMH), market players act promptly in response to new information, which results in stock prices reflecting all available information and abnormal returns on the first transaction day. However, some critiques of the EMH, including those who support behavioral finance, assert that because of insider information, market participants may change more slowly or respond before the announcement. This study calculates cumulative abnormal returns before and after the event day to capture the potential delayed reactions, such as overreactions and underreactions or predictions of environmental announcements (when the EMH may not hold), and fully understand the impact. This period is referred to as the "announcement window (or) event window". According to Holler (2016), there is no universally accepted definition for the length of the event window. Armitage (1995) also highlights that a shorter event window makes it easier to identify abnormal returns. Accurate identification of the event date and using daily data, when available, is important. In the present case, an event window of 21 days, with 10 days prior to and 10 days after the event date will be used. In the purpose of

acquiring more reliable results and to distinguish between long-term and short-term investment performance rather than just immediate market reaction, cumulative abnormal returns (CAR) over calculation will also be employed to get for the trading day windows of 5 days and 20 utilizing the same procedures mentioned.
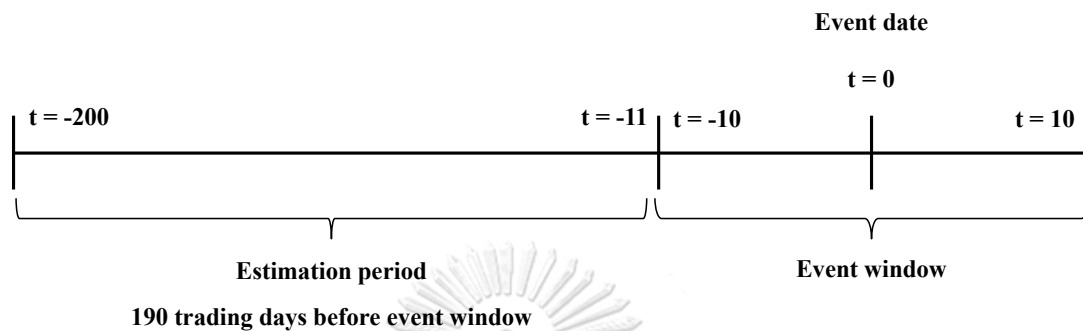


Figure 5.1. Event period

The initial step in the procedure involves determining daily returns through the logarithmic difference of the stock price in question.

$$DR_{i,t} = \ln(\frac{P_{i,t}}{P_{i,t-1}}) \tag{1}$$

where $DR_{i,t}$ is the daily return for mutual fund i at time t, $P_{i,t}$ is the price for mutual fund i at time t and $P_{i,t-1}$ is the price for mutual fund i at time t-1.

The adjustment on the daily returns, $AR_{i,t}$, is computed to obtain the ex-post abnormal returns for each mutual fund following the methodology presented by Brown and Warner (1985). The calculation of abnormal returns is derived as follows:

$$AR_{i,t} = DR_{i,t} - E(R_{i,t,q}) \tag{2}$$

where $E(R_{i,t,q})$ is the daily expected return for mutual fund i which is calculated from the announcement window of q.

In order to get $E(R_{i,t,q})$, several models were found to be used across various literature of event studies. The Capital Asset Pricing Model (CAPM) by Sharpe (1964) is a widely used financial model that aims to understand the relationship between risk and expected return in financial markets. While a study by Fama and MacBeth (1973) found support for the CAPM, subsequent research such as that by Jensen et al. (1972) and Jagannathan and Wang (1996) indicated that the CAPM was inadequate in fully explaining the cross-section of stock returns. The model has been criticized for its limited explanation of stock returns with only one factor (market risk)

and not accounting for other important factors such as size and value. In later studies, the CAPM was replaced with the Fama-French 3-factor model with the addition of a momentum factor to address its limitations and accurately determine the expected return.

The Fama-French three-factor model by Fama and French (1992) is a widely used financial model for explaining stock returns. It argues that small firms and firms with high book-to-market ratios (value stocks) are likely to outperform the market, while larger firms and firms with low book-to-market ratios (growth stocks) are likely to underperform. The model consists of three factors: market risk, size, and value, and has received strong empirical support (Carhart, 1997; Fama & French, 1993). The size effect, which shows that small-cap stocks have higher returns than large-cap stocks, has been widely confirmed in multiple studies and markets (Banz, 1981; Fama & French, 2015). The value effect, which refers to the outperformance of value stocks, has also been well-documented in multiple studies and markets (Hou et al., 2012). The addition of a momentum factor has provided further insights into stock returns.

The momentum factor evaluates the performance of stocks with strong returns in the recent past compared to those with weak returns. This factor representing the difference between stocks with upward momentum and those with downward momentum was introduced by Jegadeesh and Titman (1993) and has been confirmed by various studies in both the U.S. and international markets. Incorporating momentum into the Fama-French three-factor model has significantly improved its explanatory power for stock returns (Moskowitz et al., 2012). Carhart (1997) conducted a study that demonstrated the persistence of excess returns in the U.S. stock market through momentum. Further research by Lewellen (2002) showed that the momentum phenomenon is not just restricted to the U.S. market but is a persistent and strong occurrence in international markets as well. Due to these factors, Carhart (1997)'s four-factor model , which combines the momentum factor with the Fama-French three-factor model of Fama and French (1992).

Firstly, $\alpha$ and $\beta$ are necessary to obtain by conducting a regression analysis over the estimation period (normal period). This period is critical to the event study methodology as it provides a baseline against which the abnormal returns surrounding the event can be compared. Although it is common to use estimation periods of 200-

300 days, periods of 100 days or more are considered adequate for accurate calculation of alpha and beta. In this case, this period is defined as 190 trading days before the announcement window with 10 days prior to and 10 days after event q, as shown in Figure 1. For other announcement windows (5 days and 20 days), estimation period will be 195 days and 180 days respectively. Then, the next step is to use the estimated $\alpha$ and $\beta$ values obtained previously to calculate the expected returns during the announcement window of event q, with the data from before and after the event date. Here is the formula for four-factor model:

$$E[R_t^{i,q}] = \hat{\alpha}^{i,q} + \hat{\beta}_1^{i,q} * R_t^m + \hat{\beta}_2^{i,q} * SMB_t + \hat{\beta}_3^{i,q} * HML_t + \hat{\beta}_4^{i,q} * MOM_t \qquad (3)$$

where $\alpha$ is the intercept (constant) term, SMB (Small Minus Big) represents the return spread between small-cap and large-cap stocks, HML (High Minus Low) represents the return spread between high book-to-market and low book-to-market stocks, and MOM represents the return spread between past winners (high momentum) and past losers (low momentum).

The next step is to compute the cumulative abnormal return (CAR) for each individual mutual fund, over the designated announcement window surrounding the event. This approach provides a comprehensive measure of the event's overall impact on the mutual fund's investment performance.

$$CAR_i^q = \sum_{t=-10}^{t=10} AR_{i,t} \qquad (4)$$

To assess the statistical significance of the impact of an environmental poicy announcement on mutual fund returns, we will utilize t-statistic method to obtain cumulative average abnormal return (CAAR). This t statistic calculation for CAAR is to analyze the abnormal returns and whether there is impact from environmental policy announcements on investment performance of green and polluting mutual funds by identifying if significantly different from zero, indicating whether wealth is being created or destroyed, or remains unchanged. A positive CAAR indicates an increase in wealth, while a negative CAAR represents a decrease in wealth. If CAAR equals zero, there has been no change in the wealth.

In the purpose of considering for the potential influence of mutual fund characteristics on the comparison of investment performance between green and polluting mutual fund status using cumulative abnormal returns, expense ratio, portfolio turnover ratio and fund size will be added to the regression. Here, expense

ratio is the annual fee that all mutual funds charge investors. Expense ratio is expressed as the percentage of assets deducted each fiscal year for fund expenses, including 12b-1 fees, management fees, administrative fees, operating costs, and all other asset-based costs incurred by the fund. Higher expense ratios generally mean lower returns for investors, as more of the fund's assets are being used to cover expenses. This is important because it is possible that green mutual funds may have different expense ratios than non-green funds, which could affect their investment performance. The turnover ratio serves as a measure for the trading activity of the fund. This ratio also gauges the level of trading activity within a mutual fund, as well as the tendency of the fund's manager to engage in trades. This is measured by dividing the lower of the total value of purchases or sales of long-term securities made by the average monthly net assets. A higher turnover ratio typically indicates that the fund's manager is executing a greater number of trades within the fund, which can result in higher transaction costs. High levels of trading activity may also be a sign that the manager is actively seeking out and acting on new information. An aggressive investment strategy including significant buying and selling of assets would be suggested by high turnover. A buy-and-hold strategy would ostensibly be indicated by a low turnover rate. Here this paper will assume that higher turnover ratio will indicate better returns as active investment strategy can generate greater returns which can offset to high transaction cost. Fund size is the sum of a fund's assets. A larger fund may have difficulty implementing a specific investment strategy like being green, which could negatively impact its performance. Incorporation of these control variables to regression can provide a more accurate estimate of the impact of green mutual fund status on investment performance and can help to avoid potential biases that might arise from these variables while comparing between green and non-green funds under environmental policy announcements.

These equations will be regressed to find out. Here ER, PT and FS each denotes expense ratio, portfolio turnover and fund size respectively.

$$CAR_i^q = \beta_0 + \varepsilon \tag{5}$$

$$CAR_i^q = \beta_0 + \beta_1\, ER_i + \beta_2\, PT_i + \beta_3\, FS_i + \varepsilon \tag{6}$$

where $H_0 : \beta_0 = 0$ vs $H_1 : \beta_0 \neq 0$ ;

Additionally, in the way of extending to analyze the cumulative average abnormal returns (CAAR) resulting from the impact of environmental policy announcements on mutual funds, investment performance comparison between green and polluting mutual funds will be conducted to determine which type of mutual fund performed better after announcements. The lack of significant abnormal returns following the announcement of environmental regulations may be an indication of ineffective policy implementation or may result from offsetting changes in both revenues and costs or having the ability to pass on costs to consumers.

$$CAR_i^q = \beta_0 + \beta_1\ GREEN_i \tag{7}$$

$$CAR_i^q = \beta_0 + \beta_1\ GREEN_i + \beta_2\ ER_i + \beta_3\ PT_i + \beta_4\ FS_i + \varepsilon \tag{8}$$

where $H_0 : \beta_1 = 0$ vs $H_1 : \beta_1 > 0$ under stringent environmental policy announcements;

$H_0 : \beta_1 = 0$ vs $H_1 : \beta_1 < 0$ under loosened environmental policy announcements; Here ER, PT and FS each denotes expense ratio, portfolio turnover and fund size respectively.

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## 6. Empirical result and discussion

### 6.1. Event study results

In accordance with the Efficient Market Hypothesis (EMH), to account for possible reactions from mutual funds before or after the announcements, we calculated the cumulative abnormal return (CAR) for a period of 10 days prior to the event date and 10 days following the event date. This allows us to capture any pre-announcement or delayed reactions that may occur, which is important in case the Efficient Market Hypothesis (EMH) fails to hold true.

In order to enhance the accuracy of results and distinguish between of long-term and short-term investment performance beyond just immediate market reactions, we will again utilize the same concept of event study methodology to identify cumulative abnormal returns (CAR) of mutual funds. This involves calculating the cumulative abnormal returns (CAR) over two different trading day windows: 5 days and 20 days.

The response of mutual funds' returns to environmental policy announcements were classified into two categories: under stringent and under loosen type of environmental policy announcements. Cumulative abnormal returns (CAR) were used to evaluate how these announcements affected equities mutual funds.

Table 2. Overall Mutual funds' returns reaction (CAR) to stringent and loosened environmental policy announcements under 5 days, 10 days, 20 days of event window

|  | 5 days | | 10 days | | 20 days | |
|---|---|---|---|---|---|---|
|  | Stringent | Loosened | Stringent | Loosened | Stringent | Loosened |
| VARIABLES | CAR | CAR | CAR | CAR | CAR | CAR |
|  |  |  |  |  |  |  |
| Constant | 0.00768*** | 0.0105*** | -0.00744*** | -0.00359** | -0.0259*** | 0.000222 |
|  | (0.00136) | (0.000751) | (0.00207) | (0.00143) | (0.00191) | (0.00160) |
|  |  |  |  |  |  |  |
| Observations | 1,220 | 915 | 1,220 | 915 | 1,220 | 915 |
| R-squared | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 | 0.000 |

In Table 2, we generally examined the cumulative abnormal return (CAR) produced from the mutual funds under stringent and loosened environmental policy announcements resulting from the event study. Under 5 days of event window, we

documented significant positive abnormal returns from the mutual funds for both stringent and loosened environmental policy announcements. In the case of 10 days of event period, there was significant negative abnormal returns for both categories of announcements. And lastly, the results identified a significant negative return from mutual funds affected from stringent announcements but found no impact from loosened announcements under 20 days event window.

Overall, we can conclude that investment performance of mutual funds measured in terms of the cumulative abnormal returns (CAR) were significantly impact from environmental policy announcements, categorized into stringent and loosened. However, it can be misleading to determine whether it was favorable positive effect or unfavorable negative effect judging from these the cumulative abnormal returns. The reason behind is that the result in Table 2 is a mixture of the cumulative abnormal returns (CAR) generated from both green and polluting types of mutual funds under stringent and loosened environmental policy announcements. We hypothesize the impact on mutual funds to be negative when stringent environmental policies are released under assumption that stocks will be loosed out as business have to suffer to comply with new regulations and mutual funds holding stocks will also react negatively. Verse versa, for loosened environmental policies, we expect the mutual funds returns to be positive as business stocks gain as they achieve more flexibility and profitability. Under these assumptions, the result in Table 2 would be inaccurate in terms of direction of impact whether it was positive or negative because the opposite impacts on green and polluting mutual funds from stringent and loosened announcements will be cancelled out. This could also be a reason why loosened announcements under 20 days result insignificant or it can be just faded market reaction due to longer time horizon with 20 days event period.

### 6.1.1. Mutual fund characteristics' contribution to the investment performance of mutual funds

In previous studies of Pham, Nguyen, Ramiah, Mudalige, et al. (2019), Nerger et al. (2021) and Ramiah et al. (2015b) when they tested the environmental policy announcements' impact on stock returns, evidences were found to have negative

reaction on stock market coming from the announcements while environmental friendly sectors showing positive returns. As equity mutual funds are predominantly holding stocks, we expected the mutual funds returns to have impact from these announcements. However, the impact can be differed from stock market returns as mutual funds can gain diversification benefits and make profits as much as the fund managers are capable in stock selection and market timing skills.

This is why we included control variables which are mutual fund characteristics in the purpose to improve precision as well as to account for factors that could affect mutual funds' returns other than the environmental policy announcements. We will examine here whether the mutual fund characteristics can help to explain variable in the cumulative abnormal returns (CAR). The Table 3 presents the results including the control variable while regressing the cumulative abnormal returns (CAR).

Table 3. Overall Mutual funds' returns reaction (CAR) to stringent and loosened environmental policy announcements under 5 days, 10 days, 20 days of event window with control variables

| | 5 days | | 10 days | | 20 days | |
|---|---|---|---|---|---|---|
| | Stringent | Loosened | Stringent | Loosened | Stringent | Loosened |
| VARIABLES | CAR | CAR | CAR | CAR | CAR | CAR |
| | | | | | | |
| Expense Ratio | 0.000440 | -0.00481*** | -0.0139*** | -0.0178*** | 0.000689 | -0.0220*** |
| | (0.000417) | (0.00141) | (0.00385) | (0.00259) | (0.000592) | (0.00303) |
| Portfolio Turnover | 5.89e-06 | 2.84e-06 | -4.28e-05*** | -1.21e-05 | -1.34e-06 | 1.22e-05 |
| Ratio | (1.17e-05) | (4.38e-06) | (1.59e-05) | (8.02e-06) | (1.66e-05) | (9.38e-06) |
| Fund Size | -0.0130*** | -0.00349*** | -0.0189*** | -0.0162*** | 0.000117 | -0.0165*** |
| | (0.00219) | (0.00129) | (0.00358) | (0.00235) | (0.00311) | (0.00275) |
| Constant | 0.120*** | 0.0463*** | 0.179*** | 0.162*** | -0.0296 | 0.171*** |
| | (0.0195) | (0.0121) | (0.0337) | (0.0222) | (0.0277) | (0.0259) |
| | | | | | | |
| Observations | 1,134 | 847 | 1,134 | 847 | 1,134 | 847 |
| R-squared | 0.042 | 0.021 | 0.030 | 0.102 | 0.032 | 0.144 |

In Table 3, as we discussed above, we tried to identify the cumulative abnormal returns accounted from mutual funds characteristics and from the stringent and loosened environmental policy announcements separately.

*Expense ratio* – This control variable is negatively significant in the cumulative abnormal returns regression under loosened environmental policy announcements with event window of 5 days, under both stringent and loosened environmental policy announcements with event window of 10 days and under loosened environmental policy announcements with event window of 20 days. This explains the cumulative abnormal returns in the way that a negative coefficient for the expense ratio control variable could suggest that higher expenses are negatively impacting the fund's performance during environmental policy announcements. This finding might indicate that the fund's management fees, or other costs are not being effectively utilized to generate higher returns in the context of environmental policy changes.

*Portfolio turnover ratio* – This control variable is positively significant only in the cumulative abnormal returns regression under stringent environmental policy announcements with event window of 10 days. A positive coefficient for the portfolio turnover ratio control variable could suggest that higher portfolio turnover, or more active trading within the fund, is associated with higher returns during environmental policy announcements. This might indicate that the fund's active management and ability to exploit market opportunities related to environmental policies are contributing positively to its performance. And other scenarios under which this portfolio turnover ratio were not significant implies that the turnover ratio is not influencing the fund's performance during environmental policy announcements.

*Fund size* - This control variable is negatively significant all the scenarios except for the cumulative abnormal returns regression under stringent environmental policy announcements with event window of 20 days. A negative coefficient for the fund size control variable could suggest that larger mutual funds experience lower CAR during environmental policy announcements. There could be several reasons for this finding. Larger funds may face challenges in reallocating their portfolios quickly or efficiently, or they may be limited in the number of investment opportunities they can pursue. Additionally, larger funds may attract more attention from investors, leading to a potential reduction in the abnormal returns that can be generated.

Overall, the expense ratio and fund size can be accounted for the cumulative abnormal returns of mutual funds under both stringent and loosened environmental policy announcements. However, the portfolio turnover ratio can be concluded to have weak correlation to the cumulative abnormal returns of mutual funds under the environmental policy announcements.

Under regression with control variables, the cumulative abnormal returns (CAR) of mutual funds were still significantly affected from environmental policy announcements except for scenario under stringent announcement with 20 days of event window. The rationale behind this event being insignificant could be cancelled out effect from opposition of positive returns from green mutual funds and negative returns from polluting mutual funds. Another reason could be that the cumulative abnormal returns (CAR) disappeared due to longer time horizon of 20 days event window.

## 6.2. Comparison of Green and Polluting mutual funds' investment performance

*6.2.1. Comparison of Green and Polluting mutual funds' investment performance without control variables*

We separated the green and polluting mutual funds, examined whether environmental policy announcements have impact on each of them and compared their investment performance under those announcements. We regressed the cumulative average returns (CAR) of 5 days, 10 days, and 20 days for both stringent and loosened announcements with dummy variable "GREEN" which will help to identify the difference between green and polluting mutual funds.

In compliance with hypothesis 2, green mutual funds may gain better investment performance than polluting mutual funds under stringent environmental policy announcements as they are investing in stocks of business that have already complied with new mandatory regulations and incurred no additional compliance costs or restriction. On the other hand, polluting mutual funds may perform better than green mutual funds under loosened environmental policy announcements as they

are investing in company stocks that gain more flexibility and incur less cost for greenness in their businesses for profitability.

Therefore, we expected the dummy variable "GREEN" which identify the difference between green and polluting mutual funds to be positive under stringent environmental policy announcement and negative under loosened environmental policy announcements.

Table 4. Overall Green Vs Polluting mutual funds' returns reaction (CAR) to environmental policy announcements under event window of 5, 10 and 20 days without control variables

|  | 5 days | | 10 days | | 20 days | |
| --- | --- | --- | --- | --- | --- | --- |
|  | Stringent | Loosened | Stringent | Loosened | Stringent | Loosened |
| VARIABLES | CAR | CAR | CAR | CAR | CAR | CAR |
|  |  |  |  |  |  |  |
| GREEN | 0.000284 | 0.00161 | 0.0212*** | 0.0206*** | 0.0330*** | 0.0288*** |
|  | (0.00291) | (0.00160) | (0.00437) | (0.00297) | (0.00397) | (0.00328) |
| Constant | 0.00759*** | 0.0100*** | -0.0144*** | -0.0103*** | -0.0367*** | -0.00923*** |
|  | (0.00166) | (0.000916) | (0.00250) | (0.00170) | (0.00227) | (0.00188) |
|  |  |  |  |  |  |  |
| Observations | 1,134 | 847 | 1,134 | 847 | 1,134 | 847 |
| R-squared | 0.042 | 0.021 | 0.030 | 0.102 | 0.032 | 0.144 |

Judging from the dummy variable "GREEN" in the Table 4, it is apparent that all the dummy variables for both stringent and loosened announcements with event windows of 10 days and 20 days are positively significant. Conversely with our assumption, the results from the study indicate that the green mutual funds return always perform better than polluting mutual funds returns under both stringent and loosened types of announcements. One reason to justify this is that investors may concern with stricter future regulations and afraid of investing in polluting stocks again.

However, it is not the same case of 5 days of event window as the dummy variable is not statistically significant. We interpret that we cannot identify any material performance difference between green and polluting mutual funds for 5 days of event window. This could because there is no short-term performance difference

between the two types of mutual funds or just the short-term delayed reactions from the market for the green mutual funds.

### 6.2.2. *Comparison of Green and Polluting mutual funds' investment performance with control variables*

Taking into account for potential factors that may affect the comparison of investment performance between green and polluting mutual funds using cumulative abnormal returns, we will incorporate control variables into the regression analysis similar to what we did in above. These variables include expense ratio, portfolio turnover ratio, and fund size. By including these factors, we aim to consider their potential influence on the investment performance assessment between the two types of funds.

We examined the dummy variable capturing the difference in investment performance between polluting and green equity mutual fund from the impact of stringent and loosened environmental policy announcements while controlling for the mutual fund characteristics for event period of 5 days, 10 days, and 20 days.

Table 5. Overall Mutual funds' returns reaction (CAR) to stringent and loosened environmental policy announcements under 5 days, 10 days, 20 days of event window with control variables

| | 5 days | | 10 days | | 20 days | |
|---|---|---|---|---|---|---|
| | Stringent | Loosened | Stringent | Loosened | Stringent | Loosened |
| VARIABLES | CAR | CAR | CAR | CAR | CAR | CAR |
| | | | | | | |
| Expense Ratio | 0.000465 | -0.00560*** | -0.0120*** | -0.0133*** | 0.000546 | -0.0138*** |
| | (0.000417) | (0.00150) | (0.00407) | (0.00270) | (0.000583) | (0.00310) |
| Portfolio Turnover Ratio | 2.93e-06 | 2.09e-06 | -3.89e-05** | -7.75e-06 | 1.61e-05 | 2.00e-05** |
| | (1.18e-05) | (4.41e-06) | (1.61e-05) | (7.96e-06) | (1.66e-05) | (9.12e-06) |
| Fund Size | -0.0130*** | -0.00361*** | -0.0181*** | -0.0155*** | 0.000576 | -0.0152*** |
| | (0.00219) | (0.00129) | (0.00362) | (0.00232) | (0.00307) | (0.00266) |
| GREEN | -0.00426 | -0.00283 | 0.00716 | 0.0163*** | 0.0252*** | 0.0293*** |
| | (0.00299) | (0.00180) | (0.00483) | (0.00325) | (0.00419) | (0.00372) |
| Constant | 0.122*** | 0.0494*** | 0.167*** | 0.145*** | -0.0428 | 0.139*** |
| | (0.0196) | (0.0123) | (0.0347) | (0.0221) | (0.0274) | (0.0253) |
| Observations | 1,134 | 847 | 1,134 | 847 | 1,134 | 847 |
| R-squared | 0.042 | 0.021 | 0.030 | 0.102 | 0.032 | 0.144 |

In table 5, in align with the results from the regression analysis for the cumulative abnormal returns (CAR) of green and polluting mutual funds without control variables, the difference in the investment performance of green and polluting mutual fund, judging from the dummy variable "GREEN", is only obvious under loosened environmental policy announcements with event window of 10 days and under 20 days of announcement window for both stringent and loosened environmental policy announcements.

Here also, contrary to our expectations, the findings of the study indicate that green mutual funds consistently outperform polluting mutual funds in both stringent and loosened announcement scenarios. This suggests that the returns of green funds are consistently better than those of polluting funds. One possible explanation for this trend is that investors may be concerned about potential future regulations and are hesitant to invest in polluting stocks. As a result, they show a preference for green investments, leading to better performance for green mutual funds.

### 6.2.3. Event by event analysis for Comparison of Green and Polluting mutual funds' investment performance

Following the investigation of overall performance comparison between green and polluting mutual funds' investment performance with and without control variables under stringent and loosened environmental policy announcements, the in-depth analysis for each event under stringent and loosened environmental policy announcements are provided in this section for a more concise and clear view on the impact from announcements on green and polluting mutual funds.

### (i)	Without control variables

In the first section from Table 6a to 6f, we discussed about event-by-event analysis for polluting and green mutual funds investment performance under stringent and loosened environmental policy announcements without control variables.

Table 6a. Green Vs Polluting mutual funds' returns reaction (CAR) to stringent announcements under event window of 5 days

| | Stringent Announcements | | | |
|---|---|---|---|---|
| | Event window of 5 days | | | |
| Announcement Date Announcement No. | (1) 3-Aug-2015 | (2) 3-Sept-2016 | (6) 19-Feb-2021 | (7) 7-Nov-2022 |
| | CAR | CAR | CAR | CAR |
| GREEN | -0.0147*** | 0.0470*** | -0.0375*** | 0.00635* |
| | (0.00295) | (0.00297) | (0.00631) | (0.00337) |
| Constant | 0.0329*** | -0.0598*** | 0.0343*** | 0.0230*** |
| | (0.00169) | (0.00170) | (0.00361) | (0.00193) |
| Observations | 305 | 305 | 305 | 305 |
| R-squared | 0.076 | 0.453 | 0.104 | 0.012 |

Table 6b. Green Vs Polluting mutual funds' returns reaction (CAR) to loosened announcements under event window of 5 days

| | Loosened Announcements | | |
|---|---|---|---|
| | Event window of 5 days | | |
| Announcement Date Announcement No. | (3) 1-Jun-2017 | (4) 19-Jun-2019 | (5) 15-Jun-2020 |
| | CAR | CAR | CAR |
| GREEN | 0.0156*** | -0.0161*** | 0.00530** |
| | (0.00252) | (0.00257) | (0.00264) |
| Constant | 0.0121*** | 0.0165*** | 0.00149 |
| | (0.00144) | (0.00147) | (0.00151) |
| Observations | 305 | 305 | 305 |
| R-squared | 0.113 | 0.115 | 0.013 |

Table 6c. Green Vs Polluting mutual funds' returns reaction (CAR) to stringent announcements under event window of 10 days

| | Stringent Announcements | | | |
|---|---|---|---|---|
| | Event window of 10 days | | | |
| Announcement Date Announcement No. | (1) 3-Aug-2015 | (2) 3-Sept-2016 | (6) 19-Feb-2021 | (7) 7-Nov-2022 |
| | CAR | CAR | CAR | CAR |
| GREEN | 0.00881** | 0.0775*** | -0.0701*** | 0.0685*** |
| | (0.00443) | (0.00451) | (0.00863) | (0.00567) |
| Constant | 0.0108*** | -0.104*** | 0.0607*** | -0.0246*** |
| | (0.00254) | (0.00258) | (0.00494) | (0.00325) |
| Observations | 305 | 305 | 305 | 305 |
| R-squared | 0.013 | 0.494 | 0.179 | 0.325 |

Table 6d. Green Vs Polluting mutual funds' returns reaction (CAR) to loosened announcements under event window of 10 days

| | Loosened Announcements | | |
|---|---|---|---|
| | Event window of 10 days | | |
| Announcement Date Announcement No. | (3) 1-Jun-2017 | (4) 19-Jun-2019 | (5) 15-Jun-2020 |
| | CAR | CAR | CAR |
| GREEN | 0.0561*** | 0.0129*** | -0.00728* |
| | (0.00524) | (0.00268) | (0.00383) |
| Constant | -0.0521*** | -0.00300* | 0.0241*** |
| | (0.00300) | (0.00153) | (0.00219) |
| Observations | 305 | 305 | 305 |
| R-squared | 0.275 | 0.071 | 0.012 |

Table 6e. Green Vs Polluting mutual funds' returns reaction (CAR) to stringent announcements under event window of 20 days

| | Stringent Announcements | | | |
|---|---|---|---|---|
| | Event window of 20 days | | | |
| Announcement Date | (1) | (2) | (6) | (7) |
| Announcement No. | 3-Aug-2015 | 3-Sept-2016 | 19-Feb-2021 | 7-Nov-2022 |
| | CAR | CAR | CAR | CAR |
| GREEN | 0.0104** | 0.0543*** | -0.0417*** | 0.109*** |
| | (0.00411) | (0.00443) | (0.00772) | (0.00841) |
| Constant | -0.0268*** | -0.0873*** | 0.0207*** | -0.0536*** |
| | (0.00236) | (0.00253) | (0.00442) | (0.00482) |
| Observations | 305 | 305 | 305 | 305 |
| R-squared | 0.021 | 0.332 | 0.088 | 0.357 |

Table 6f. Green Vs Polluting mutual funds' returns reaction (CAR) to loosened announcements under event window of 20 days

| | Loosened Announcements | | |
|---|---|---|---|
| | Event window of 20 days | | |
| Announcement Date | (3) | (4) | (5) |
| Announcement No. | 1-Jun-2017 | 19-Jun-2019 | 15-Jun-2020 |
| | CAR | CAR | CAR |
| GREEN | 0.0249*** | 0.0379*** | 0.0237*** |
| | (0.00483) | (0.00455) | (0.00718) |
| Constant | -0.0148*** | -0.0122*** | -0.000732 |
| | (0.00277) | (0.00261) | (0.00411) |
| Observations | 305 | 305 | 305 |
| R-squared | 0.081 | 0.186 | 0.035 |

Judging from the dummy variable "GREEN" which captures the difference of the cumulative average returns (CAR) between green and polluting mutual funds from the table 6(a) to 6(f), it is apparent that all the dummy variables for both stringent and loosened announcements in all of the event windows of 5 days, 10 days and 20 days are significant.

Under 20 days of event window, the dummy variable "GREEN" was positive for all the stringent and loosened announcements except announcement no. 6. We can

conclude that the green mutual funds perform better when judging from the long-term abnormal returns whether the announcement type is stringent or loosened. Although we expect the polluting mutual funds to win under loosened announcements, investors prefer not to put their money into polluting stocks under environmental policy announcements.

Under 5 days and 10 days of event window, we documented the mix results between positive and negative when looking at each event, but most of the events generate the dummy variable "GREEN" to be positive. The rationale behind negative dummy variables could be that some of the investors were confused about the information given from the environmental policy announcements in the short run so they make irrational decision and the market self-corrected in the long run as we can see from 20 days event period. Another possible explanation can also because of small number of observations for each event and the results were noisy. Lastly, we can also conclude that the results were inconsistent because there were no control variables consideration of mutual funds characteristics. Thereafter, in the next section, we will explore deeper into each event with control variables in the regression.

*(ii)    With control variables*

Here in this section, we discussed about event-by-event analysis for polluting and green mutual funds investment performance under stringent and loosened environmental policy announcements with control variables.

Table 7a. Green Vs Polluting mutual funds' returns reaction (CAR) to stringent announcements under event window of 5 days

| | Stringent Announcements | | | |
|---|---|---|---|---|
| | Event window of 5 days | | | |
| Announcement Date | (1) | (2) | (6) | (7) |
| Announcement No. | 3-Aug-2015 | 3-Sept-2016 | 19-Feb-2021 | 7-Nov-2022 |
| | CAR | CAR | CAR | CAR |
| Expense Ratio | -0.00485* | -0.00493* | 0.00493 | 0.000124 |
| | (0.00248) | (0.00280) | (0.00542) | (0.000236) |
| Portfolio Turnover Ratio | 6.85e-05*** | -2.43e-05** | 0.000103*** | 8.80e-05*** |
| | (1.61e-05) | (9.76e-06) | (2.07e-05) | (2.66e-05) |
| Fund Size | -0.00454** | -0.00223 | -0.0139*** | -0.00593** |
| | (0.00224) | (0.00271) | (0.00478) | (0.00268) |
| GREEN | 0.00561 | 0.0428*** | -0.0230*** | 0.00567 |
| | (0.00470) | (0.00348) | (0.00625) | (0.00387) |
| Constant | 0.0736*** | -0.0296 | 0.137*** | 0.0681*** |
| | (0.0215) | (0.0261) | (0.0456) | (0.0242) |
| Observations | 304 | 275 | 305 | 250 |
| R-squared | 0.140 | 0.132 | 0.054 | 0.063 |

Table 7b. Green Vs Polluting mutual funds' returns reaction (CAR) to loosened announcements under event window of 5 days

| | Loosened Announcements | | |
|---|---|---|---|
| | Event window of 5 days | | |
| Announcement Date | (3) | (4) | (5) |
| Announcement No. | 1-Jun-2017 | 19-Jun-2019 | 15-Jun-2020 |
| | CAR | CAR | CAR |
| Expense Ratio | 0.000265 | -0.00695*** | -0.00889*** |
| | (0.00270) | (0.00206) | (0.00238) |
| Portfolio Turnover Ratio | -9.40e-06 | 2.19e-05*** | 3.13e-06 |
| | (5.81e-06) | (6.84e-06) | (1.01e-05) |
| Fund Size | 0.00192 | -0.0115*** | -0.00164 |
| | (0.00230) | (0.00185) | (0.00208) |
| GREEN | 0.0127*** | -0.0160*** | 0.00210 |
| | (0.00346) | (0.00245) | (0.00279) |
| Constant | -0.00199 | 0.124*** | 0.0280 |
| | (0.0222) | (0.0175) | (0.0196) |
| Observations | 237 | 305 | 305 |
| R-squared | 0.181 | 0.058 | 0.095 |

Table 7c. Green Vs Polluting mutual funds' returns reaction (CAR) to stringent announcements under event window of 10 days

| | Stringent Announcements | | | |
|---|---|---|---|---|
| | Event window of 10 days | | | |
| Announcement Date | (1) | (2) | (6) | (7) |
| Announcement No. | 3-Aug-2015 | 3-Sept-2016 | 19-Feb-2021 | 7-Nov-2022 |
| | CAR | CAR | CAR | CAR |
| Expense Ratio | -0.000791 | -0.0113*** | 0.0114 | -0.0225*** |
| | (0.00395) | (0.00401) | (0.00765) | (0.00601) |
| Portfolio Turnover Ratio | -4.41e-05* | -5.54e-05*** | 0.000118*** | -4.12e-05** |
| | (2.57e-05) | (1.40e-05) | (2.92e-05) | (2.02e-05) |
| Fund Size | -0.00866** | -0.00245 | -0.0129* | -0.00640 |
| | (0.00357) | (0.00388) | (0.00675) | (0.00531) |
| GREEN | 0.00599 | 0.0683*** | -0.0521*** | 0.0487*** |
| | (0.00472) | (0.00498) | (0.00882) | (0.00752) |
| Constant | 0.0905*** | -0.0585 | 0.143** | 0.0648 |
| | (0.0342) | (0.0373) | (0.0643) | (0.0511) |
| Observations | 304 | 275 | 305 | 250 |
| R-squared | 0.034 | 0.543 | 0.280 | 0.316 |

Table 7d. Green Vs Polluting mutual funds' returns reaction (CAR) to loosened announcements under event window of 10 days

| | Loosened Announcements | | |
|---|---|---|---|
| | Event window of 10 days | | |
| Announcement Date | (3) | (4) | (5) |
| Announcement No. | 1-Jun-2017 | 19-Jun-2019 | 15-Jun-2020 |
| | CAR | CAR | CAR |
| Expense Ratio | -0.0278*** | -0.00902*** | 0.000865 |
| | (0.00552) | (0.00221) | (0.00340) |
| Portfolio Turnover Ratio | -1.28e-05 | 3.15e-05*** | 4.26e-05*** |
| | (1.19e-05) | (7.34e-06) | (1.44e-05) |
| Fund Size | -0.0128*** | -0.00703*** | -0.00540* |
| | (0.00470) | (0.00198) | (0.00297) |
| GREEN | 0.0424*** | 0.0119*** | -0.00240 |
| | (0.00707) | (0.00263) | (0.00400) |
| Constant | 0.102** | 0.0676*** | 0.0646** |
| | (0.0453) | (0.0188) | (0.0281) |
| Observations | 237 | 305 | 305 |
| R-squared | 0.326 | 0.217 | 0.083 |

Table 7e. Green Vs Polluting mutual funds' returns reaction (CAR) to stringent announcements under event window of 20 days

| Announcement Date Announcement No. | Stringent Announcements | | | |
|---|---|---|---|---|
| | Event window of 20 days | | | |
| | (1) 3-Aug-2015 | (2) 3-Sept-2016 | (6) 19-Feb-2021 | (7) 7-Nov-2022 |
| | CAR | CAR | CAR | CAR |
| Expense Ratio | -0.0174*** | -0.0124*** | -0.00205 | -0.000324 |
| | (0.00344) | (0.00418) | (0.00721) | (0.000676) |
| Portfolio Turnover Ratio | 0.000101*** | 2.07e-06 | 7.16e-05*** | -0.000103 |
| | (2.23e-05) | (1.46e-05) | (2.75e-05) | (7.61e-05) |
| Fund Size | 0.00656** | -0.00193 | -0.00178 | -0.000165 |
| | (0.00311) | (0.00405) | (0.00636) | (0.00768) |
| GREEN | 0.0103** | 0.0499*** | -0.0374*** | 0.102*** |
| | (0.00411) | (0.00520) | (0.00831) | (0.0111) |
| Constant | -0.0670** | -0.0526 | 0.0321 | -0.0486 |
| | (0.0298) | (0.0389) | (0.0606) | (0.0692) |
| Observations | 304 | 275 | 305 | 250 |
| R-squared | 0.158 | 0.353 | 0.114 | 0.305 |

Table 7f. Green Vs Polluting mutual funds' returns reaction (CAR) to loosened announcements under event window of 20 days

| Announcement Date Announcement No. | Loosened Announcements | | |
|---|---|---|---|
| | Event window of 20 days | | |
| | (3) 1-Jun-2017 | (4) 19-Jun-2019 | (5) 15-Jun-2020 |
| | CAR | CAR | CAR |
| Expense Ratio | -0.0219*** | -0.00814** | -0.0132** |
| | (0.00527) | (0.00406) | (0.00624) |
| Portfolio Turnover Ratio | 2.39e-05** | -4.78e-06 | 6.98e-05*** |
| | (1.14e-05) | (1.35e-05) | (2.64e-05) |
| Fund Size | -0.0164*** | -0.00356 | -0.0215*** |
| | (0.00449) | (0.00364) | (0.00545) |
| GREEN | 0.0208*** | 0.0348*** | 0.0303*** |
| | (0.00676) | (0.00483) | (0.00734) |
| Constant | 0.155*** | 0.0306 | 0.194*** |
| | (0.0433) | (0.0346) | (0.0515) |
| Observations | 237 | 305 | 305 |
| R-squared | 0.213 | 0.197 | 0.143 |

Firstly, discussing in regards with the results with the 20 days of event window, the dummy variable "GREEN" that captures the difference in performance of green and polluting mutual funds is found to be significant for all the announcements under both stringent and loosened types. Green mutual funds return under all the announcements, except announcement no. 6, are shown to have positive sign which means that green mutual funds outperform the polluting mutual funds in terms of the cumulative abnormal returns (CAR) under 20 days of event window.

In the case of analysis for the 10 days of event window, the dummy variable "GREEN" is found to be significant for 3 out of 4 announcements under stringent and 2 out of 3 announcements under loosened. On the other hand, for the 5 days of event window, the dummy variable "GREEN" is found to be significant only for 2 announcements each for both stringent and loosened types.

Although the dummy variable "GREEN" was significant for all the announcements in the regression result for 20 days of event period, the number of announcements with significant dummy variable of "GREEN" becomes lesser as the event period becomes shorter eventually. This explains that the performance of green and polluting mutual funds are not significantly difference in the short term under both stringent and loosened environmental policy announcements. This could also be the delay market reaction from green mutual funds. Another possible explanation for the insignificance of dummy variable "GREEN" could also be due to high noise rooting from small observations. And the next conclusion we can make is that green mutual funds outperform polluting ones in terms of the cumulative abnormal returns (CAR) when investigating for the long term which is 20 days.

## 7. Conclusion

The objective of this study is classified into two main sections. The first objective aims to determine if there is a notable influence resulting from announcements related to environmental policies on the investment performance of equity mutual funds. We conducted the analysis of it by capturing the cumulative abnormal returns (CAR) of mutual funds' returns using the event study methodology under two categories of stringent and loosened environmental policy announcements. Here, we also examined the mutual funds characteristics' contributions to the cumulative abnormal returns (CAR) of mutual funds under these environmental policy announcements. The second objective targets to perform separate analysis of green and polluting mutual funds in terms of the investment performance to identify which one will have better performance under stringent and loosened environmental policy announcements.

Regarding the first hypothesis, we tested the cumulative abnormal returns (CAR) of mutual funds' returns generated by environmental policy announcements using event window of 5 days, 10 days and 20 days. Overall, we observed the significant impact on cumulative abnormal returns (CAR) in both stringent and loosened announcements for event periods of 5 days, 10 days and 20 days. It can be concluded as the investor behavior suggested that they are aware of the potential consequences which are increment or deterioration in the value of their businesses from environmental policy announcements and they tried to capture the abnormal returns as soon as these policies were announced. Furthermore, we included expense ratio, portfolio turnover ratio and fund size as external control variables to account for mutual fund characteristics that could possibly have certain impact on mutual funds' returns under the announcements while regressing for the cumulative abnormal returns (CAR). Except portfolio turnover ratio which appears to have weak influence on mutual funds' returns under the announcements, expense ratio and fund size have material effect on fund returns.

In second hypothesis, we discovered that green mutual funds' investments perform better than polluting ones under stringent environmental policy announcements. This result is in align with our expectation as we assumed polluting mutual funds' investment would lose out due to unfavorable impact on the polluting

businesses. In case of loosened environmental policy announcements, although we expected polluting mutual funds to perform better in terms of returns, it was reported that green mutual funds still produce better abnormal returns. The rationale behind this could because of investors' sentiment who are afraid of restrictions might imposed again in the future and reputational damage of polluting businesses. This finding is generated from the cumulative abnormal returns (CAR) analysis under 10 days and 20 days of event period.

In the case of 5 days event window, it is observed that there is no significant performance difference between green and polluting mutual funds as the results show insignificant. This could be due to either there is no short-term performance difference, or it could be delayed reactions from the market affecting the performance.

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