國立交通大學

管理科學系碩士班

碩士論文

社會責任投資:

綠能基金投資人是否真的具有社會企業責任?

Are Green Fund Investors Really Socially Responsible?

研究生: 蔡佩君

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摘要

此篇論文分別對綠能基金與傳統基金的績效，基金特性，基金流量與次貸危機造成的影響進行研究。在基金績效方面，結果顯示綠能基金與傳統基金的績效並沒有顯著的差異；而基金特性方面，綠能基金相較於傳統基金對市場風險較為敏感;基金流量與基金年齡也有反向關係,越成熟的基金,其基金流量也會較小。此外，綠能基金的基金流量也都小於傳統基金。

而此篇論文最重要的結果，為綠能基金的績效與前期正報酬有顯著關係，但對前期負報酬卻沒有顯著關係，顯示出綠能基金投資人重視前期正報酬。然而當前期報酬為負時，他們卻不會積極拋售手中的部位。

關鍵字: 綠能基金, 傳統基金; 基金績效; 基金流量

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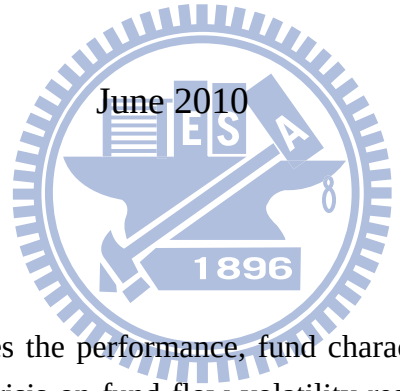

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Abstract

This paper investigates the performance, fund characteristic, fund flow and the impact of subprime loan crisis on fund flow volatility respectively. In terms of fund performance, the result shows that there is no significant difference in performance between green funds and conventional funds. As for fund characteristics, CAPM Model reveals that green funds are more sensitive to market risk than conventional funds with the 25th and 50th percentile. Four-factor model exhibits that green funds are more sensitive to size factor compared to conventional funds. In the other hand, green funds are less sensitive to the momentum factors than conventional funds.

In consideration of age, fund flow volatility is much lighter when mutual funds are mature. When conducting the OLS regression which is described in Bollen (2007), there exist asymmetric phenomenon for green funds in the "All", "Young", and "Mature" category. That is, fund flows of green funds are significant related to the lagged positive return but not significant associated with lagged negative returns.

Key words: Green Funds; Conventional Funds; Performance; Fund Flows

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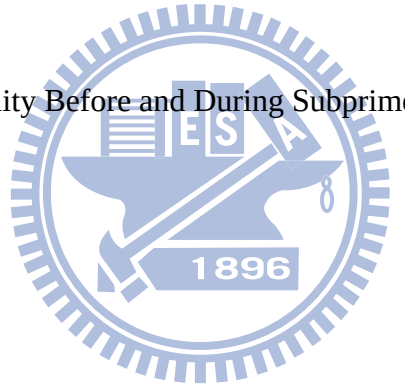

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I. Introduction

Climate change and energy shortage have raised people's attention on green investments during recent years all over the world. Kyoto Protocol [1]in 1997 and Copenhagen climate change conference[2] in 2009 were held to alleviate more serious damage to the ecosystem.

Green investors concern not only for the abnormal returns of their portfolios but also for the eco-friendly effects on the environment. Fund Managers of green mutual funds screen investments from other investments according to the green objectives and environmental regulations settled by companies. So what is the difference between green investments and social responsible investments (SRI)? In fact, there is little difference between the two groups. SRI includes wider category for screen, such as environment, community, human right, labor relations, alcohol, animal testing, and the tobacco. In the other hand, green investments only consider environmental issues such as the reduction of toxic gas and the development of alternative energy.

Some shareholders and investors see environmental performance as an important

[1] Kyoto Protocol is a protocol to the United Nations Framework Convention on Climate Change (FCCC). The goal is to reach stabilization of greenhouse gas concentration in the atmosphere by restricting the level of green house gas emission for nationals which have signed and ratified the protocol.

[2] This summit contains the 15th Conference of the Parties (COP15) to the United Nations Framework Convention on Climate Change as well as the 5th Meeting of the Parties (COP/MOP 5) to the Kyoto Protocol.

index of firms. As the statement in Cohen (2001), poor environmental performance has a significant negative effect on the intangible-asset value of publicly traded firms included in the S&P 500. In addition, pollution index called Toxics Release Inventory (TRI) provides news to investors (Hamilton, 1993). As a result, companies have to scrutinize their regulations to improve the environment and avoid the proliferation of pollution. Figure 1 shows total quarterly financial investment in billion dollars in clean energy 2004 to 2009 from World Economic Forum [3](WEF). The substantial improvement in the second season in 2009 is involved with the investments of wind industry in China, wind farms in the UK, and solar thermal electricity generation plants in Spain.

Along with the popularity of climate change, energy shortage and global warming, more and more firms and investors take environmental criteria into account when making investment decisions. For instance, Google claimed in May 2010 that it had invested $38.8 million in two wind farms, and Samsung Group announced in the same month that it planned to invest £14.5 billion in five major new fields of businesses, such as solar cells, rechargeable batteries for hybrid electric vehicles and Light Emitting Diode (LED) technology by 2010. Many countries also take these urgent problems seriously. For example, China invested $34.6 billion in clean energy in 2009, which is larger more than 50 percent in the previous year and makes China

[3]http://www.weforum.org/en/initiatives/gcp/Global%20Competitiveness%20Report/index.htm. World Economic Forum (WEF) which launched in 1971, is a non-profit organization, it holds meeting annually to discuss urgent issues around the world. In addition to meetings, the WEF also provides a series of research reports to public.

the biggest investor in energy-efficient technology around the world in 2009. Furthermore, South Korea plans to provide $84 billion in environment-friendly industries over the next five years since 2010.

However, investors who allocate their money to green investments are really principle-based? Do they really care about the impact of climate change on the earth, or are they just momentum-driven by the popularity of global warming and energy shortage to pursue the abnormal return? This paper will analyze the investors' behavior through observing mutual fund flows to discuss if green fund investors really preserve the environment by investment decisions.

This paper categorizes the samples into two groups to compare the investment style between green funds and conventional funds. The purposes of this paper are: (1) to examine the performance of green funds and conventional funds respectively in order to observe if there is any significant difference in performance between the green funds and conventional funds; (2) to examine the relation between fund flows and performance for green and conventional funds (3) to examine the fund flow volatility of green and conventional funds influenced by Subprime Loan Crisis.

The following is the classification of this paper. Section II states previous research; section III presents relevant hypothesis for the performance and the fund flow of green funds. Section IV enumerates all of the data resources used in this paper and state the definition in detail; Section V shows the formulas and computed

outcomes. Finally, conclusions and possible future research topics are developed in Section VI.

II. Literature Review

Green investments have been a relatively innovative and popular issue in recent years. Therefore, several problems have arisen that multinationals can take advantage of these unsound imperfect environmental standards in developing countries. But Eskelanda and Harrison (2002) depict that there is no evidence to say foreign investments in these developing countries are associated with abatement costs in industrialized countries. Furthermore, they find foreign firms significantly energy-efficient and discover that these companies tend to use cleaner types of resources. They also reveal that foreign companies are less polluting compared to their counterparts in developing countries. Eskelanda and Harrison point out it does not mean "pollution heaven" never exists. Instead the government should pay more attention to policy-making on pollution rather than focus on financial investments or specific investors.

Furthermore, the influence of environmental management on performance may not be immediately, which is proved by Hart and Ahuja (1996) as well as King and Lenox (2002). Nehrt (1996) points out that it takes time and brings diseconomies when continuing to complete the environmental tasks. Especially, an important issue is the causal relationship between environmental variables and financial performance.

Studies about the relation have mainly emphasized on the financial fluctuations caused by environmental variables. Nevertheless, financial performance may also affect the environmental management. (Wagner, 2002)

There are plenty of papers discussing the relation between environmental regulation and financial performance. King, and Lenox (2001) state that there is evidence of relation between pollution reduction and financial gains, but they cannot prove the directional of causality. Cohen, Fenn, and Konar (1997) declare that investors who prefer the environmental leaders in an industry-balanced portfolio to other investments are found to perform as well or better than those who are the environmental laggards in every industry. Dowell, Hart, and Yeung (2000) are also convinced that positive market value is connected to the adoption of more stringent environmental standards all over the world. In spite of the multiple restrictions to be green investments, Stavins, Jaffe, Peterson and Portney(1994) show that there is relatively little evidence to support the assumption that environmental regulation have had substantial adverse effects on competitiveness. Feldman, Soyka and Ameer (1996) also state that companies which enhance their environmental management system as well as their future environmental performance will be capable of boosting shareholder's wealth by possibly as much as five percent. In other words, improving corporate environmental performance pays.

The above literature is associated with the performance of investments instead of addressing on investors' behavior. Bollen (2007) is the first researcher to observe

investors' behavior by analyzing the fund flow volatility of SR funds and conventional funds. Bollen shows that SR funds own significantly lower monthly fund flow volatility than its conventional counterparts. Benson and Humphrey (2007) have the similar conclusion. They reveal that there is sufficient evidence to state that the portfolios and management style of SR funds are different from other investments in the market even though literature shows there is little difference between the two groups. They suggest that, there exists asymmetric relation between fund flows and lagged returns for SR funds, which means fund flow volatility of SR funds is significantly related to the lagged positive returns, but that is not significantly associated with the lagged negative returns.

III. Hypothesis

This section will state the hypothesis of fund performance, fund flow volatility, three testable hypotheses associated with the flow-performance relation for green funds, and the hypothesis for the effect of Subprime Loan Crisis on green funds and conventional funds. Due to the fact that green funds are defined as a subset of SR funds in this paper, the fund flow-performance relation and fund flow volatility just follow the hypotheses presented in Bollen (2007).

1. Fund Performance

According to the efficient market hypothesis, it is impossible to obtain abnormal returns relying on the past performance. The returns should correctly reflect and respond to the available information efficiently. Therefore, the returns must follow the assumption of random walk. However, as Brav and Heaton (2002) show in their research, investors are active and ambitious to search for informative model or past information in order to increase their abnormal rewards. The above phenomenon is called experiential learning in stock markets and exists in investors' behavior as well.

Do green funds outperform conventional funds? There have been little relevant research or academic materials until now to prove that. However, many scholars are convinced that the green management leads to better performance and enhances competitive advantages. Florida and Davison(2001) mention that an environmental management system(EMS) seems to be an effective instrument for managing

environmental cost and risks inside or outside the company; Rennings, Ziegler, Ankele and Hoffmann(2006) conclude that the design of Environmental Management and Auditing Scheme(EMAS) plays a pivotal role in the environmental as well as economic performance. Furthermore, Darnall, Henriques, and Sadorsky(2008) believe that introducing a comprehensive Environmental Management System (EMS) can create potential business value. In addition, Dowell, Hart, and Yeung (2000) prove that stringent environmental regulation is connected with positive market value. Based on the previous conclusions, we can rationally suppose that green funds earn superior returns than conventional counterparts.

2. Fund Flow Volatility

Sirri and Tufano (1998) state that searching cost plays a dominant role in the variation of fund flows, the higher the searching cost is, the more reluctant investors would be to change their positions of portfolios. In general, green investors care not only about financial returns but also the issue of the ecosystem. They take green criteria and environmental regulation into account when making investment decisions. It is reasonable to assume that the volatility of green funds is smaller than that of common investment owing to their concern about the environment.

In terms of the relation between fund age and fund flows, this section presume that fund flows are negatively related to fund age because young funds lack of sufficient information for investors to evaluate their investments. It means that young

mutual funds endure more fluctuant fund flows while mature mutual funds own much steadier ones.

3. Flow-Performance Relation

Hypothesis 1: The flow-performance relation and fund flow volatility of green funds is equal to that of conventional funds.

This hypothesis assumes that investor preferences can be exhibited by a utility function defined over the moments of the return distribution of a portfolio. But this statement is the basis of the finance paradigm. Take the Capital Asset Pricing Model of Sharpe (1964), Linter (1965), and Mossin (1966) for example, the utility function is exclusive explained by expected returns and variance in their research. Furthermore, Berk and Green (2004) show a model which is used for investors to update the information of managerial ability as revealed in expected returns. They obtain a positive relation between past performance and subsequent fund flows owing to a rational rearrangement of capital to better managers. In addition, fund flow volatility increases on the sensitivity of investors to the past performance.

The first hypothesis hints that investors evaluate green funds the same way that they evaluate conventional funds.

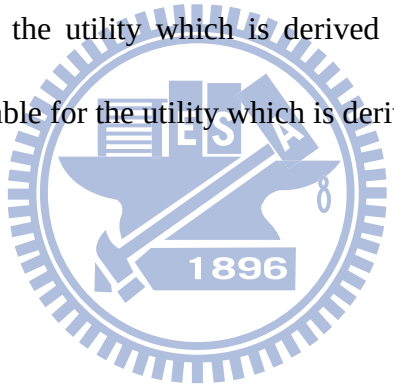
Hypothesis 2: The flow-performance relation of green funds is stronger than that of conventional funds.

The second hypothesis can be inspired by the assumption that preferences of green investors can be showed by a multi-attribute utility function which is defined over the moments of a portfolio's return as well as a variable which stands for if the investment decision is green. This combined goal not only fits the environmental demand but also satisfies the requirement for financial performance for companies when promoting green funds. This assumption is consistent with Statman (1999), who concludes that behavioral finance sees the investment decision as a kind of product selection in spite of the standard paradigm. As a result, "value-expressive" characteristic of an asset matters on its desirability.

This section assumes that green investors can obtain additional utility from devoting to the green investments. However, this situation only happens when the green investments would have been chosen on its financial advantages. In addition, I refer to this as a conditional utility function. If green investors are conditional, then the flow-performance relation of green funds would be stronger than that of conventional counterparts. Lagged positive returns may boost larger fund flows of green funds than that of conventional funds because green investors alter their expectations of fund performance, as would conventional investors, but green investors can add investment to their portfolios to consume the green attribute additionally.

Hypothesis 3: The flow-performance relation of green funds is weaker than that of conventional funds.

This hypothesis can be motivated by the assumption that preferences of green funds can be stated by a multi-attribute utility function defined over the moments of a portfolio's return distribution as well as if the investment decision is green. Additionally, the utility function is additive in the attributes. The same as the definition by Keeney and Raiffa (1993), which implies that preferences for one attribute is independent of the other attribute. Precisely, the assumption of an additive utility function means that the utility which is derived from the green attribute is separate from and substitutable for the utility which is derived from the risk and return of an investment.



4. Fund Variation in Consideration of Subprime Loan Crisis

This paper will discuss the influence of Subprime Loan Crisis on fund flow volatility of green and conventional funds. As Hamilton (1989) mentioned, the duration of cash flow is much shorter when the market is confronted with severe recessions. Therefore, we can rationally suppose the fund flow volatility will be greater for green and conventional funds during the financial crisis. However, unlike ordinary investors who purchase for superior performance and sell for the sake of averting from financial losses, green investors are eco-friendly people even though

they are also interested in the profit. It is reasonable to assume that green investors will be more reluctant to change their positions of portfolios during the financial crisis, which implies that the green fund flow volatility will be smaller than that of conventional funds in the period of recession.

IV. Data

The CRSP Survivor-Bias-Free US Mutual Fund Database is the main resource of mutual fund data. This database contains information about names, managers, the investment style, portfolios and asset allocation of mutual funds from 1962 to September 2009. In terms of SR mutual funds, there are 159 SR funds identified by Social Investment Forum (SIF)[4] which offers information about screening standards, fund portfolio, and fund general profile. As for green funds, I collect data from SR fund samples only for those funds which are engaging in positive or restricted investment in the "environment" category. In addition, non-green funds are defined as those funds without screening or investments on the "environment" category. After deleting unsuitable funds which own abnormal returns or lack of first offering date, there are 138 green funds in the end.

The rest of mutual funds in the CRSP database are defined as conventional funds, and the number of conventional funds is 43194. This section includes all available data from CRSP even though some of them are dead funds. Daily returns range from September 1998 to September 2009 while monthly returns range from December 1961 to September 2009.

This paper conducts the fund characteristics analysis with monthly returns from CRSP. Furthermore, the data of size factor, value factor and momentum factor come

[4] http://www.socialinvest.org, the Social Investment Forum (SIF) is the US membership organization for professional, companies, and institutions, which are engaging in socially responsible investment. It also provides research information for the public.

from Kenneth R French data library which offers objective and balanced data from CRSP for academic research. In addition, the risk-free rate is the 90-day U.S. Treasury Bill collected from Datastream with the period from March 1990 to March 2010, and Crude Oil price is from Yahoo Finance in the period of September 2006 to December 2009.

Figure 1 exhibits total quarterly financial investment ($ billions) in clean energy from 2004 to 2009. It displays that financial investment in clean power had had steady growth before 2007. Under the condition of severe economic environment, the investment had dropped at a staggering rate after the fourth season in 2007. In the other hand, we can observe there is huge increase in the second season in 2009. The main reason lies in substantial investment in wind energy in China and U.K. In addition, Spain also put large amount of money to solar thermal electricity generation plants at the same time.

Figure 2 shows the comparison of total net assets between green funds and conventional funds. Obviously, the tendency of green funds is quite similar with that of conventional funds even after the breakout of financial crisis. There is an obvious discovery that Subprime Loan Crisis has greatly hampered the growth of total net assets for both green and conventional funds during the period from 2007 to 2008.

Figure 3 depicts the average monthly returns of green funds and conventional funds. By observing this figure, green funds and conventional funds seem to have

similar tendency in fluctuation. The average monthly returns of the two groups had dropped dramatically because of the financial crisis in 2007. The return of green funds decreased deeply to -0.15% around 2008. However, the average monthly returns of the two groups have increased gradually after 2008 as the economy recovers in recent years.

V. Methodology and Results

This chapter will describe the methodology and explain empirical results with different perspective, including fund performance, fund flows, fund characteristics, fund flow volatility, OLS regression, and fund variation in consideration of Subprime Loan Crisis for green funds and conventional funds. The formulas mentioned later will follow the steps in Bollen (2007).

1. Fund Performance

This section average the daily returns for green funds and conventional funds from 2000 to 2009, Table 1 [5]reveals the average of equally-weighted percentage daily returns for ten years. Accordingly, there is no significant difference in performance between green funds and conventional funds. Mallett and Michelson (2009) assert the same viewpoints. After comparing the performance of green funds, SR funds, and index funds, they find there is no real difference between green funds and index funds

[5] This paper also averages the daily returns for non-green funds and conventional funds from 2000 to 2009. Readers who are interested in this section can see Appendix 1

as well as green funds and SR funds with parametric and non-parametric tests.

2. Fund Flow

The formula of returns is defined as:

$$R_{i,t} = \frac{NAV_{i,t} - NAV_{i,t-1} + D_{i,t}}{NAV_{i,t-1}} \quad (1)$$

, where $NAV_{i,t}$ is the net asset value per share and $D_{i,t}$ is the distribution amounts per share during the period. As a result, fund flow can be computed by total net assets between time t and t-1, that is:

$$DF_{i,t} = TNA_{i,t} - TNA_{i,t-1}(1 + R_{i,t}) \quad (2)$$

, where $DF_{i,t}$ denote dollar fund flows. We can translate dollar fund flows to percentage through dividing $DF_{i,t}$ by $TNA_{i,t-1}$, which assumes the fund flows occurring at the end of the period. This method is consistent with the assumption in Del Guercio and Tkac(2002), Sirri and Tufano(1998), as well as Barber, Odean, and Zheng(2005). In the other hand, Sirri and Tufano(1998) also compute fund flows with the hypothesis that fund flow happens at the beginning of the period, that is:

$$DF_{i,t} = \frac{TNA_{i,t}}{1+R_{i,t}} - TNA_{i,t-1} \quad (3)$$

, for simplification, this section chooses (2) formula to analyze. In other words, this paper will use the following equation as the formula for fund flows.

$$F_{i,j} = (TNA_{i,t} - TNA_{i,t-1}(1 + R_{i,t}))/TNA_{i,t-1} \quad (4)$$

After removing abnormal outliers which lack of sufficient information such as returns or distribution amounts from CRSP, this section average the monthly fund flows computed by the above formula to compare the difference in fund flow volatility between green funds and conventional funds. Figure 4 depicts average fund flow of green funds and conventional funds. When the market is immature, two of the mutual funds are unstable at first. Especially, the fund flows of green funds fluctuate increasingly dramatically than that of conventional funds. However, the two group have had gradually stabilized after 1998 when the industry becomes more mature. Therefore, whether the industry is mature or not is an important factor in the volatility of mutual funds. The highest average fund flow of green funds is approximately 8.2% at the beginning while the lowest average fund flow of green funds drops to roughly 0.4% when the market is mature.

3. Fund Characteristic

This section conducts one factor CAPM model and four factor model (Fama and French, 1993; Cahart, 1997) to discuss the effect of risk exposure on green funds and conventional funds[6]. In addition, this progress uses the monthly returns which are obtained from CRSP while the risk-free rate comes from Datastream. The CAPM model is defined as:

[6] This paper also conducts one factor CAPM model and four factor model to discuss the effect of risk exposure on non-green funds, and conventional funds. Readers who are interested in this section can see Appendix.2.

$$R_{it} - R_{ft} = \alpha_i + \beta_i(R_{mt} - R_{ft}) + \varepsilon_{it} \quad (5)$$

, where R_{it} is the return of fund i; R_{ft} is the risk-free rate of return; R_{mt} is the market return. Basically, this model is too simplistic to explain comprehensively the performance by only one exposure to the market risk. Therefore, introducing the four-factor model to this paper is necessary. Four-factor model is defined as the following statement:

$$R_{it} - R_{ft} = \alpha_i + \beta_{i,M}(R_{mt} - R_{ft}) + \beta_{i,SMB}R_{SMB,t} + \beta_{i,HML}R_{HML,t} + \beta_{i,UMD}R_{UMD,t} + \varepsilon_{it} \quad (6)$$

, where $R_{SMB,t}$ is the return of the size factor; $R_{HML,t}$ is the return of the value factor, and $R_{UMD,t}$ is the return of momentum factor.

Table 2A shows the regression results of CAPM and four-factor model. In CAPM model, the table presents that green funds are more sensitive to market risk compared to conventional funds. As for four-factor model, green funds are more sensitive to size factor than conventional funds with 50th and 75th percentile. Table 2B shows the significance of parameter estimators. Obviously, performances of green and conventional funds are significantly related to market risk with the CAPM model. As for four-factor model, performance of conventional funds is significantly associated with the market risk, size factor, value factor, and momentum factor while performance of green funds is only significantly related to market risk as well as size factor .

4. Fund Age and Volatility

This section concentrates on the relation between fund age and fund flow. Table 3 depicts the results in detail. “All” groups refer to those funds whose age range from 1 to 20 years; “Young” groups stand for those funds whose age are below 5 years old. “Mature” groups mean those funds whose age are larger than 5 years old, but less than 20 years old (Bollen, 2007). This paper conducts the analysis after discarding outliers and irrational data which returns are below-100% or above 100%, from my samples.

Based on Table 3, all percentiles in “All”, “Young”, and “Mature” category show that the fund flow volatility of green funds is lower than that of conventional funds. In terms of age, the fund flow volatility in "Young" category is larger than that in "Mature" category. For instance, with the 25th data, the green fund flow volatility in "Young" category is 0.0079 while the green fund flow volatility in "Mature" category is 0.0002. Obviously, the older the funds are, the lighter the volatility will be. In addition, Bollen (2007) proves that there is strong evidence to show that cash flow is much lower in social responsible mutual funds than that in conventional counterparts.

Furthermore, there exist significant difference in the fund flow volatility between these two groups, which is consistent with the conclusion in Bollen(2007). Bollen states similar consequences that there is significantly difference in fund flow volatility between conventional funds and social responsible funds in the “All”, “Young”, and “Mature” categories. Finally, this paper average the fund flow volatility on the basis

of age as well as types of funds and find that the mean of fund flow volatility exhibits consistent outcomes with the quartiles. That is, the means of fund flow volatility for green funds and conventional funds in "Young" category are bigger than that in "Mature" category.

5. OLS Regression

This section will examine the relation between performance and fund flow with the OLS regression[7], which is described in Bollen (2007). The regression is defined as:

$$F_{i,t} = \alpha_0 + \alpha_1 S_i + (\beta_0 I^1_{i,t-1} + \beta_1 I^2_{i,t-1} + \beta_2 I^3_{i,t-1} + \beta_3 I^4_{i,t-1}) R_{i,t-1} + \varepsilon_{i,t} \quad (7)$$

, where $F_{i,t}$ is percentage dollars flow of fund i; $R_{i,t-1}$ is 3-month lagged return; S_i is a dummy variable and equal to 1 if fund i is an green fund and 0 otherwise; $I^1_{i,t-1}$=1 if fund i is conventional and has positive lagged return and 0 otherwise; $I^2_{i,t-1}$=1 if fund i is green and has positive lagged return and 0 otherwise; $I^3_{i,t-1}$=1 if fund i is conventional and has negative lagged return and 0 otherwise; $I^4_{i,t-1}$=1 if fund i is green and has negative lagged return and 0 otherwise; The positive and negative coefficients can be considered as cash inflows and outflows. On the one hand, a positive coefficient on positive lagged returns can be interpreted as investors' cash

[7] This paper also examines the relation between performance and fund flow for SR funds as well as examines the relation between performance and fund flow for green funds with one-month lagged returns. In addition, this paper add an additionally variable which stands for growth rate of crude price to analyze with a more comprehensive perspective. Readers who are interested in this section can see Appendix 3, 4, 5.

inflows. On the other hand, a positive coefficient on negative lagged returns means investors' outflows.

Table 4 shows that most of the variations associated with green funds following positive returns are statistically significant, and the variation related to conventional funds following positive returns are also statistically significant. In addition, most of the variations associated with green funds following negative returns are statistically insignificant. However, the variation related to conventional funds following negative returns is statistically significant. For each 1% increase in previous period, cash inflow of conventional funds in the "Mature" category increases 0.0465% in the situation lagged positive returns exist while cash inflows of green funds increases 0.1328% instead. In addition, for every 1% increase in previous month, cash outflow of conventional funds in the "Mature" category increase 0.0620% whereas cash outflow of green funds increase 0.0285% when lagged negative returns exist.

This asymmetric situation also exists in the "All", "Young", and "Mature" categories. The fund flow is significantly related to the lagged positive return, but the fund flow is not significantly associated with the lagged negative return for green funds. The above phenomenon fit previous assumption which implies that green investors are active to pursue financial performance as well as are deriving utility from consumption for green investment. In addition, based on Table 4, β_2 is not significantly different from β_3 in "All", "Young", and "Mature" categories. β_0 is also not significantly different from β_1 except for the "Mature" category, which

implies that there exists significantly difference in the flow-positive lagged returns relation between green and conventional funds.

This result has same conclusion as Bollen (2007) who addresses on the asymmetric difference between SR funds and conventional funds. Bollen claims that SR investors demonstrate a significant reaction to positive returns. In the other hand, SR investors reveal lighter response to negative returns

6. The Effects of Subprime Loan Crisis on Mutual Fund Flow Volatility

Figure 5 shows the fund performance volatility before and during Subprime Loan Crisis from 2006 to 2009. The performance reveal similar tendency for green funds and conventional funds even during the financial crisis. Figure 6 shows the fund flow volatility before and during Subprime Loan Crisis for green funds and conventional funds from 2006 to 2009. Obviously, most of the fund flow volatility of green funds is lower than that of conventional funds whether it is in the “Before” or “During” period.

In general, green fund investors are more reluctant to change their positions through selling and buying owing to environmental awareness. Tables 5 depicts the fund flow volatility of green funds before and during the subprime loan crisis. To focus on the impact in a specific period, this section choose July 2007 as a dividing month because it is the period that two hedge funds of Bear Stearn run into large losses owing to huge holding of subprime mortgages and are forced to dump assets.

Therefore, this section split the sample period into two sub-periods, which are “before” and “during” July 2007. In the “before” period, the average fund flow of green funds is 0.0120 while the average fund flow of conventional funds is 0.0039. In addition, the average fund flow of green funds is 0.0137 in the “During” period while that of conventional funds is 0.0073. Obviously, the average fund flow of green funds is larger than that of conventional funds. However, the fund flow standard deviation of green funds is lighter than that of conventional funds no matter it is in the “Before” period or “During” period. As for the p-value, there is significant difference in the “Before” as well as in the “During” period between the two groups. Consequently, we can observe there is significant difference in fund flow volatility between green funds and conventional funds due to the financial crisis. However, the difference is much more significant in the “During” period than that in the “Before” period. The p-value in the “Before” period is 0.0295 while the p-value in the “During” period is 0.0078.

VI. Conclusion and Future Research

This paper investigates the fund performance, fund characteristic, fund flow ,and the impact of subprime loan crisis on fund flow volatility respectively. In terms of fund performance, the result shows that there is no significant difference in performance between green funds and conventional funds. As for fund characteristics, CAPM model reveals that green funds are more sensitive to market risk than conventional funds with the 25^{th} and 50^{th} percentile. Four-factor model exhibits that green funds are more sensitive to size factor compared to conventional funds. On the

other hand, green funds are less sensitive to the momentum factors than conventional funds.

In consideration of age, fund flow volatility is much lighter when mutual funds are mature. After conducting the OLS regression which is described in Bollen (2007), there exists asymmetric phenomenon for green funds in the “All”, “Young”, and “Mature” categories. That is, fund flows of green funds are significantly related to the lagged positive return but not significantly associated with lagged negative returns.

When discussing the impact of subprime loan crisis on fund flow volatility, the result is consistent with the previous assumption, which states that the fund flow volatility of green funds should be lighter than that of conventional funds owing to green investors’ concerns for the environment.

We can conclude that green fund investors are really socially responsible due to three factors. First of all, the fund flow volatility of green funds is significantly lither than that of conventional funds in the “All”, “Young” and “Mature” categories. Secondly, fund flows of green funds are significantly related to the lagged positive returns but are not significantly associated with the lagged negative returns. This phenomenon implies that green investors seek good performance due to human nature to earn abnormal rewards. Additionally, they consider investments as an environmental consumption. Thirdly, during the period of financial crisis, the fund flow volatility of green funds is significantly lighter than that of conventional funds.

Consequently, we can rationally infer that green fund investors are really socially responsible on the basis of above factors.

However, there is still limitation in this paper. This paper selects green funds from SIF, but there must be some green funds which are not defined in SIF. Due to lacking of sufficient database of green funds, this paper collects information from SIF because SIF owns clear categories when screening for funds. Therefore, this paper can choose green funds based on the "environmental" category defined by SIF.

In addition, general momentum-driven investors in green funds are considered as those people who invest in the "climate/ clean technology" subset of the "environment" category, but this paper defines green funds as those funds with positive or restricted investment in the "environment" category which includes "climate/clean technology", "pollution/toxic", and "environment/other" subsets. As a result, future researchers can discuss the funds which invest in the "climate/ clean technology" subset of the "environment" category to examine if those investors are really socially responsible or just active to pursue superior performance?

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Table 1: Average of Equally-Weighted Percentage Daily Returns for Green Funds and Conventional Funds (%)

Listed is the average of equally-weighted percentage daily returns of green and conventional mutual funds in the CRSP database for ten years from 2000 to 2009. The returns are calculated by net asset value including reinvested dividends from one period to the next. The p-value is calculated for the differences between the two groups.

Year	Green	Conventional	Diff(Green-Conventional)	P-value
2000	0.2792	0.1557	0.1235	0.9516
2001	0.0789	0.0621	0.0168	0.7237
2002	0.0019	0.0015	0.0004	0.3907
2003	-0.0294	-0.0213	-0.0081	0.4510
2004	-0.0632	-0.0431	-0.0201	0.5953
2005	0.0930	0.0802	0.0128	0.3797
2006	0.0431	0.0368	0.0064	0.7930
2007	0.0192	0.0251	-0.0059	0.8236
2008	0.0451	0.0431	0.0020	0.3935
2009	0.0227	0.0268	-0.0040	0.6370

Table 2: Fund Characteristics for Green funds and Conventional Funds

Listed are values of the first, second and third quartiles of OLS parameter estimators for green and conventional mutual funds in the CRSP database. Panel A shows the results of the Capital Asset Pricing Model. Panel B shows the results of the four-factor model.

Panel A: CAPM Model

Conventional Funds	α	β_M
25th	0.0831	0.0056
50th	0.2941	0.7103
75th	0.5443	0.9908
Green Funds	α	β_M
25th	-0.0191	0.8085
50th	0.3222	0.9355
75th	0.7040	1.0249

Panel B: Four-Factor Model

Conventional Funds	α	β_M	β_{SMB}	β_{HML}	β_{UMD}
25th	0.0898	0.0092	-0.0860	-0.1055	-0.0103
50th	0.2752	0.6933	0.0003	-0.0054	0.0149
75th	0.5344	0.9913	0.2128	0.0762	0.0596
Green Funds	α	β_M	β_{SMB}	β_{HML}	β_{UMD}
25th	-0.2192	0.7577	-0.0703	-0.1890	-0.1591
50th	0.0983	0.9100	0.0704	-0.0120	-0.0164
75th	0.4455	1.0253	0.3597	0.1060	0.0640

Table 2(Continued): Significance of Parameter Estimator

Listed is the Significance of Parameter Estimator for Green and Conventional funds. Panel A shows the results of CAPM. Panel B shows the results of Four-Factor Model.

Panel A: CAPM Model

Green	p-value
α	<0.0001
β_M	<0.0001
Conventional	p-value
α	<0.0001
β_M	<0.0001

Panel B: Four-Factor Model

Green	p-value
α	<0.0001
β_M	<0.0001
β_{SMB}	<0.0001
β_{HML}	0.7096
β_{UMD}	0.6235
Conventional	p-value
α	<0.0001
β_M	<0.0001
β_{SMB}	<0.0001
β_{HML}	<0.0001
β_{UMD}	<0.0001

Table 3: Monthly Fund Flow Volatility and Quantity Comparisons

Listed are values of the first, second and third quartiles of volatility of percentage monthly fund flows for Green, and Conventional mutual funds in the CRSP database from January 1989 to September 2009. “Mean” refers to the average quantity of percentage dollar flows. The p-value is calculated for the differences of percentage dollar flows between the two categories. The estimations must include at least 12 months of fund flow data.

	all funds		young funds		mature funds	
	Green	Conventional	Green	Conventional	Green	Conventional
25th	0.0055	0.0060	0.0079	0.0085	0.0002	0.0005
50th	0.0123	0.0155	0.0151	0.0202	0.0005	0.0020
75th	0.0311	0.0330	0.0314	0.0381	0.0010	0.0082
Mean	0.0249	0.0275	0.0268	0.0315	0.0012	0.0095
p-value	<0.0001		<0.0001		<0.0001	

Table 4: OLS Regression Results

Listed are OLS parameter estimators of coefficients of the following regression from 1989 to 2009. The "F-value" tests for the differences between the coefficients of variances. And the p-value is calculated for the difference of percentage dollar flows between the two categories.

	All Funds		Young		Mature	
	Estimator	P-Value	Estimator	P-Value	Estimator	P-Value
α_0	0.0083	<0.0001	0.0214	<0.0001	-0.0019	<0.0001
α_1	0.0045	0.0077	0.0063	0.0565	0.0050	0.0010
β_0	0.1275	<0.0001	0.1476	<0.0001	0.0465	<0.0001
β_1	0.1871	<0.0001	0.1809	0.0310	0.1328	0.0026
β_2	0.0423	<0.0001	0.0642	<0.0001	0.0620	<0.0001
β_3	0.0105	0.7804	0.0478	0.4706	0.0285	0.4333
R-Square	0.0010		0.0011		0.0008	
	F-Value		F-Value		F-Value	
$\beta_0 = \beta_1$	1.62	0.2029	0.16	0.6914	3.88	0.0503
$\beta_2 = \beta_3$	0.71	0.4003	0.06	0.8054	0.84	0.3593

Table 5: Fund Volatility Before and During Subprime Loan Crisis

Listed are the mean as well as standard deviation of fund flow before and during the financial crisis for green and conventional mutual funds. In addition, it also exhibits the difference in standard deviation in the “Before” and “During” sub-periods.

		Green		Conventional		Difference in S.D(Green-Conventional)		
		Mean	Standard Deviation	Mean	Standard Deviation	Mean	Standard Deviation	p-value
Monthly Fund Flow	Before	0.0120	0.1362	0.0039	0.1520	-0.0325	0.0561	0.0295
	During	0.0137	0.1037	0.0073	0.1283	-0.0383	0.0539	0.0078

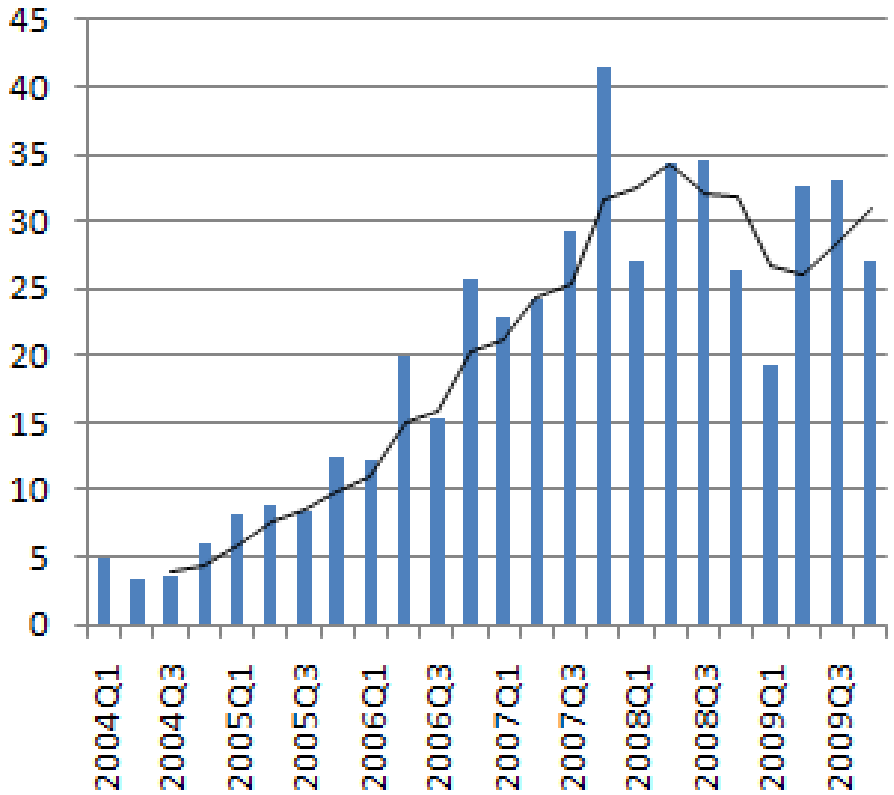


Figure 1: Total Quarterly Financial investment (US$ billions) in clean energy 2004 to 2009 from world economic forum (WEF). The substantial improvement in the second season is involved with the investment of wind industry in China, wind farms in the UK, and solar thermal electricity generation plants in Spain.

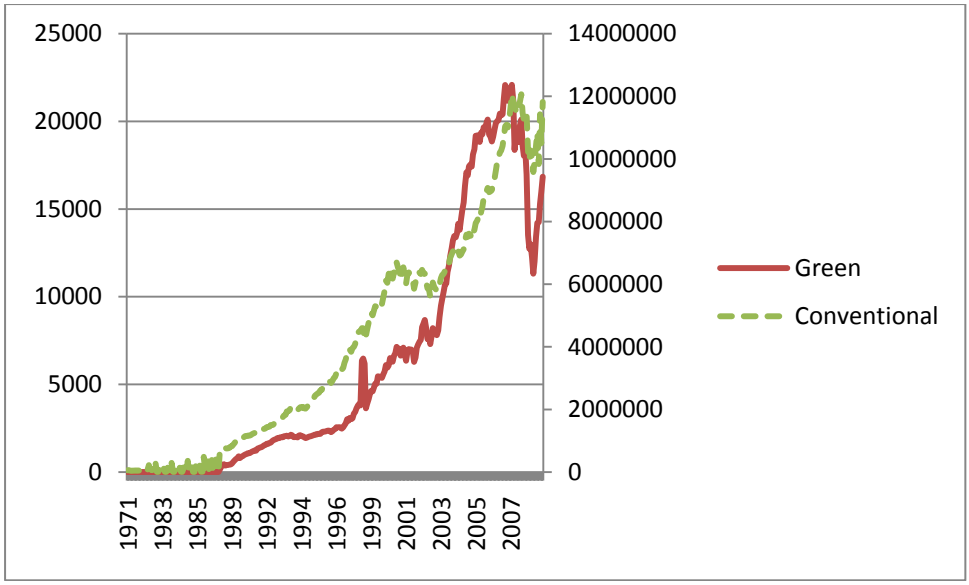


Figure 2: Growth in Total Net Assets for Green and Conventional funds

Below picture is the total net asset (in USD millions) for green and conventional funds from 1971 to 2009.

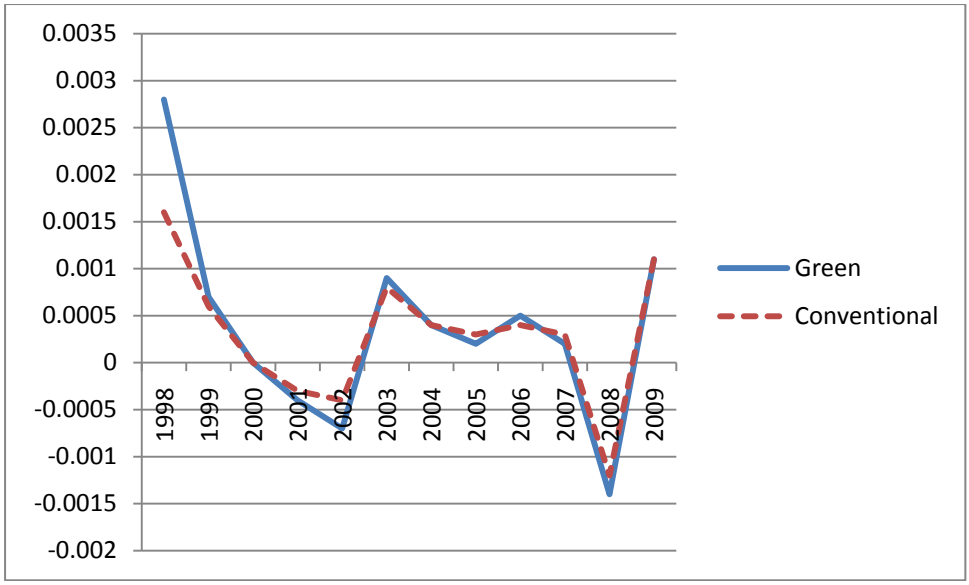


Figure 3: Performance of Mutual Fund for Green and Conventional Funds
Depicted is the average monthly return of two groups from 1998 to 2009.

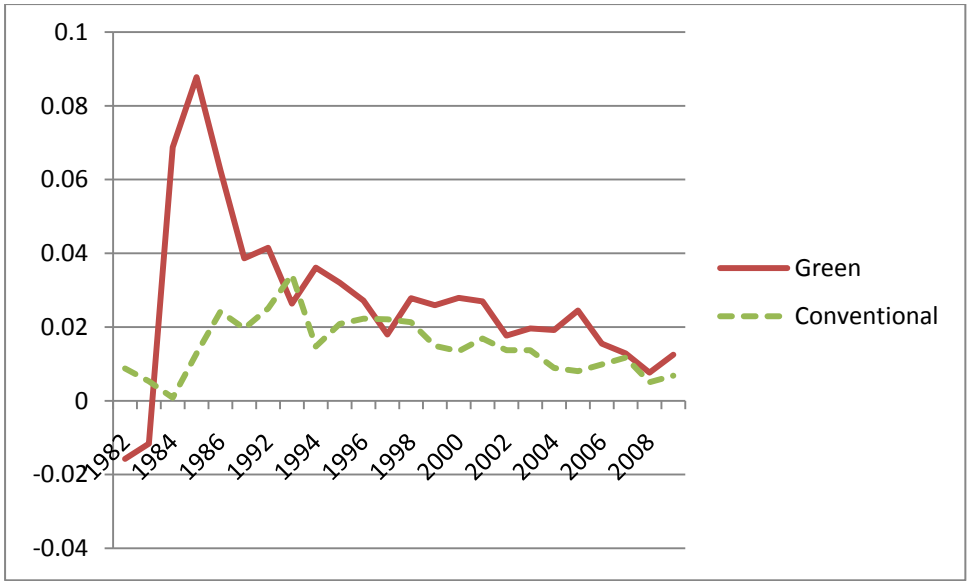


Figure 4: Fund Flow of Mutual Fund for Green and Conventional funds
Depicted is the average monthly fund flow of two categories from 1982 to 2009.

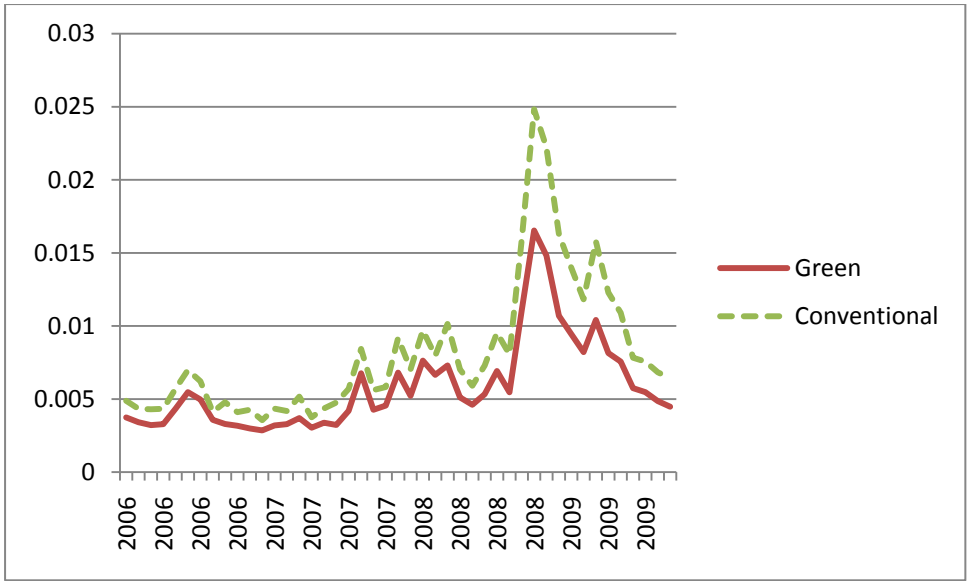


Figure 5: Fund Performance Volatility Before and During Subprime Loan Crisis for Green and Conventional funds. Depicted is the daily standard deviation of fund performances for two categories from 2006 to 2009.

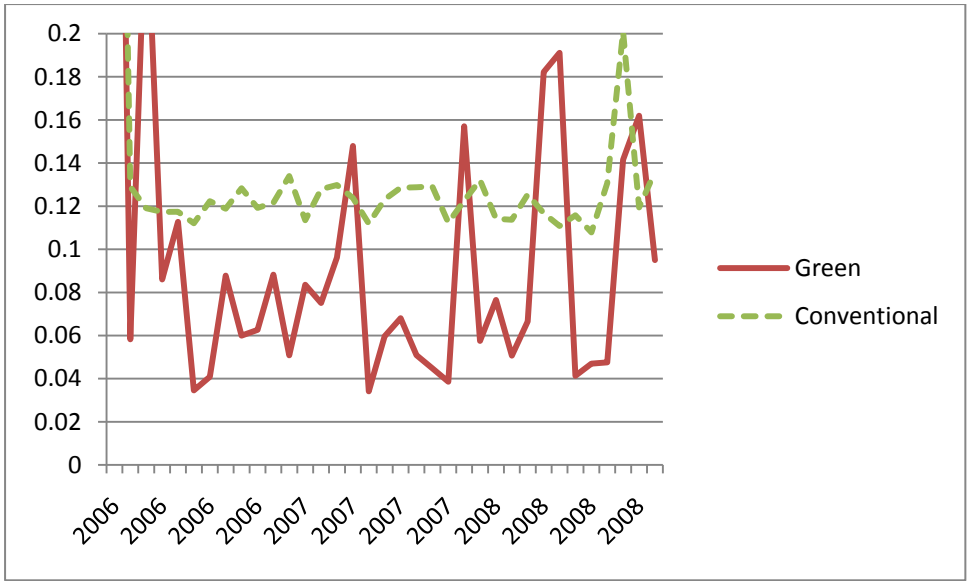


Figure 6: Fund Flow Volatility Before and During Subprime Loan Crisis for Green and Conventional funds. Depicted is the monthly standard deviation of fund flows for two categories from 2006 to 2009.

Appendix 1: Average of Equally-Weighted Percentage Daily Returns for Non-Green Funds and Conventional Funds (%)

Listed is the average of equally-weighted percentage daily returns of non-green and conventional mutual funds in the CRSP database for ten years from 2000 to 2009. The returns are calculated by net asset value including reinvested dividends from one period to the next. "Non-Green" refers to socially responsible funds classified by SIF as well as lacking for screens or investment in the "environment" category. "Conventional" refers to all other funds which are not SR funds in CRSP. The p-value is calculated for the differences between the two groups.

Year	Non-Green	Conventional	Diff(NonGreen-Conventional)	P-value
2000	0.1996	0.1557	0.0439	0.3497
2001	0.0508	0.0621	-0.0112	0.0188
2002	0.0209	0.0015	0.0194	0.2580
2003	0.0209	-0.0213	0.0422	0.0466
2004	-0.0312	-0.0431	0.0119	0.1597
2005	0.0584	0.0802	-0.0218	0.3270
2006	0.0280	0.0368	-0.0087	0.4433
2007	0.0200	0.0251	-0.0051	0.4574
2008	0.0372	0.0431	-0.0060	0.0104
2009	0.0199	0.0268	-0.0069	0.3897

Appendix 2: **Fund Characteristics for Non-Green funds and Conventional Funds**

Listed are values of the first, second and third quartiles of OLS parameter estimators for non-green and conventional mutual funds in the CRSP database. Panel A shows the results of the Capital Asset Pricing Model. Panel B shows the results of the four-factor model.

Panel A: CAPM Model

Conventional Funds	α	β_M
25th	0.0831	0.0056
50th	0.2941	0.7103
75th	0.5443	0.9908
Non-Green Funds	α	β_M
25th	0.2197	0.0043
50th	0.4049	0.6996
75th	0.5021	0.9650

Panel B: Four-Factor Model

Conventional Funds	α	β_M	β_{SMB}	β_{HML}	β_{UMD}
25th	0.0898	0.0092	-0.0860	-0.1055	-0.0103
50th	0.2752	0.6933	0.0003	-0.0054	0.0149
75th	0.5344	0.9913	0.2128	0.0762	0.0596
Non-Green Funds	α	β_M	β_{SMB}	β_{HML}	β_{UMD}
25th	0.2443	-0.0059	-0.0914	-0.1476	-0.0951
50th	0.3583	0.7676	0.0431	0.0293	0.0031
75th	0.5031	0.9559	0.1446	0.0712	0.0253

Significance of Parameter Estimator (continued)

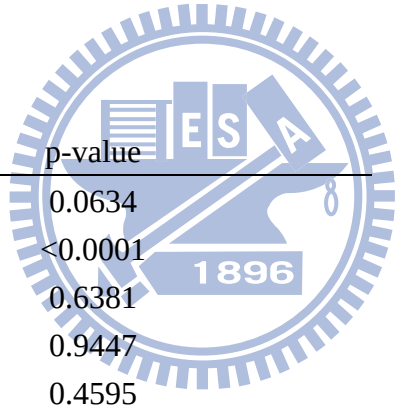
Panel A: CAPM Model

Non-Green	p-value
α	0.0931
β_M	<0.0001

Panel B: Four-Factor Model

Significance of Parameter Estimator

Non-Green	p-value
α	0.0634
β_M	<0.0001
β_{SMB}	0.6381
β_{HML}	0.9447
β_{UMD}	0.4595



Appendix 3: OLS Regression Results for SR funds

The “F-value” tests for the differences between the coefficients of variances. And the “P-value” is calculated for the difference of percentage dollar flows between the SR and conventional funds..

	All Funds		Young		Mature	
	Estimator	P-Value	Estimator	P-Value	Estimator	P-Value
α_0	0.0104	<0.0001	0.02813	<0.0001	0.0084	<0.0001
α_1	0.0047	0.0125	-0.0071	0.1689	0.0060	0.0030
β_0	0.1244	<0.0001	0.0341	0.0013	0.1290	<0.0001
β_1	0.2002	<0.0001	0.3131	0.0136	0.1441	0.0107
β_2	0.0534	<0.0001	0.0902	<0.0001	0.0691	<0.0001
β_3	0.0095	0.8149	-0.0379	0.6722	0.0590	0.2203
	F-Value		F-Value		F-Value	
$\beta_0 = \beta_1$	2.24	0.1349	4.80	0.0284	0.07	0.7891
$\beta_2 = \beta_3$	1.17	0.2787	2.03	0.1541	0.04	0.8352

Appendix 4: OLS Regression Results for Green funds with 1-Month Lagged Returns

The "F-value" tests for the differences between the coefficients of variances. And the "P-value" is calculated for the difference of percentage dollar flows between green funds and conventional funds.

	All Funds		Young		Mature	
	Estimator	P-Value	Estimator	P-Value	Estimator	P-Value
α_0	0.0094	<0.0001	0.0236	<0.0001	-0.0019	<0.0001
α_1	0.0069	<0.0001	0.0107	0.0013	0.0056	0.0003
β_0	0.1724	<0.0001	0.2014	<0.0001	0.0760	<0.0001
β_1	0.1604	0.0006	0.1252	0.1337	0.1279	0.0032
β_2	0.0639	<0.0001	0.0776	<0.0001	0.1017	<0.0001
β_3	0.0789	0.0419	0.1499	0.0274	0.0629	0.0851
R-Square	0.0019		0.0019		0.0021	
	F-Value		F-Value		F-Value	
$\beta_0 = \beta_1$	0.06	0.7988	0.83	0.3618	1.42	0.2327
$\beta_2 = \beta_3$	0.15	0.7004	1.13	0.2881	1.12	0.2899

Appendix 5: OLS Regression Results for Green Funds with Oil Price Variable.

$F_{i,t} = \alpha_0 + \alpha_1 S_i + (\beta_0 I^1_{i,t-1} + \beta_1 I^2_{i,t-1} + \beta_2 I^3_{i,t-1} + \beta_3 I^4_{i,t-1}) R_{i,t-1} + (\beta_4 I^5_{i,t} + \beta_5 I^6_{i,t}) G_{i,t} + \varepsilon_{i,t}$

, where $F_{i,t}$ is percentage dollars flow of fund i; $R_{i,t-1}$ is 3-month lagged return; $G_{i,t}$ is the growth rate of crude oil price; S_i is a dummy variable if fund i is an green fund and 0 otherwise; $I^1_{i,t-1}$=1 if fund i is conventional and has positive lagged return and 0 otherwise; $I^2_{i,t-1}$=1 if fund i is green and has positive lagged return and 0 otherwise; $I^3_{i,t-1}$=1 if fund i is conventional and has negative lagged return and 0 otherwise; $I^4_{i,t-1}$=1 if fund i is green and has negative lagged return and 0 otherwise; $I^5_{i,t}$=1 if fund i is conventional and 0 otherwise. $I^6_{i,t}$=1 if fund i is green and 0 otherwise. The "F-value" tests for the differences between the coefficients of variances. And the "P-value" is calculated for the difference of percentage dollar flows between green funds and conventional funds.

	All Funds		Young		Mature	
	Estimator	P-Value	Estimator	P-Value	Estimator	P-Value
α_0	0.0067	<0.0001	0.0240	<0.0001	-0.0030	<0.0001
α_1	-0.00035	0.8960	-0.0070	0.1949	0.0033	0.2801
β_0	0.0347	<0.0001	0.0441	<0.0001	-0.0049	0.2619
β_1	0.1943	0.0058	0.2582	0.0368	0.0286	0.7153
β_2	0.0393	<0.0001	0.0517	<0.0001	0.0594	<0.0001
β_3	-0.0221	0.6372	-0.0349	0.6830	0.0418	0.3993
β_4	0.0125	<0.0001	0.0159	<0.0001	0.0094	<0.0001
β_5	0.0190	0.2094	0.0305	0.2850	0.0083	0.5890
	F-Value		F-Value		F-Value	
$\beta_0 = \beta_1$	5.11	0.0238	2.98	0.0844	0.18	0.6699
$\beta_2 = \beta_3$	1.71	0.1913	1.02	0.3125	0.12	0.7244
$\beta_4 = \beta_5$	0.18	0.6722	0.26	0.6109	0.01	0.9245