PERFORMANCE OF GREEN FUNDS

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ABSTRACT

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Abstract

Global warming is becoming an issue and there is a wide consensus that everyone should care for environment. Investment in financial asset markets can also contribute to the actions to reduce global warming. However, if the investments are not profitable enough then it is difficult for investors to invest in environmental causes. This study assesses the performance of USA domicile based Green Equity Funds from five different categories: Healthcare Sector, Mid Cap Category, Large Cap Growth Category, Large Cap Value Category, and Technology Sector. The funds were selected based on Morningstar's ESG ratings as well as performance ratings and designation for low carbon emission. Since only the high-performance based funds are selected from Morningstar's rating, for comparison purpose high performance-based funds from USAnews.com ranking are selected. Monthly return data are used to conduct the study over a period of 129 months from December 2010 to August 2021. Different factor models: CAPM, Fama French Three Factor Model, Carhart's Four Factor Model, Fama French Five Factor Model and very recently introduced q5 Factor Model have been used to analyse the performance of the funds. Besides that, some descriptive statistics like average excess return, standard deviation, kurtosis, and skewness are also analysed in the study. The results show that considering only average excess return the conventional funds performed better than the green funds. However, the results from the factor models show that the return of the conventional funds and green funds are not statistically different. All the funds are sensitive to the market risk factor, some funds are sensitive to the value risk factor from Fama French and Carhart's factor models and only few founds are sensitive to investment and profitability risk factors. Overall, the study shows that there is no difference in the financial returns of conventional and green funds. Investors who are investing in the green funds if not gaining superior return compared to the conventional funds, at least are not losing anything.

Key words: Mutual Fund, SRI, ESG, Green Investment, Financial Performance, Factor Model

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1 INTRODUCTION

"Imagine all the people livin' for today" a line from a very popular song of even popular British singer John Lennon. Lennon said only to imagine, also in reality, we all know life or living is a long-term process though recent covid epidemic might have made us to think differently. However, that is why economists no matter normative or positive are always concerned about 'long run'.

In simple terms the word 'Invest' means to forgo something today with an expectation of something better in the future. While rational investors invest primarily (there can be other reasons which are not our concerns at this point) for positive return there is no point of being rational if returns are diminished by other causes like environmental cost which may not be evident in the short run but in the long run. For example, due to global warming the price of electricity may rise and that will cost extra money to everyone including investors. Therefore, a rational investor should also care for environment besides only financial return.

The concept of investing while caring for environmental causes may seem prominent for the last two decades; however, the root of modern concept of green investing can be traced back to 1960 (Schueth, 2003). The main root of green investment is Socially responsible Investing (SRI) and a subset of that is ESG investing where 'E' represents the word Environmental, 'S' represents the word Social, 'G' represents the Governance. There is a wide consensus among parties around the world that global warming is becoming an issue and we should care for environment (Eyraud, Celements & Wane, 2013). Many active groups and bodies including universities (Linnenluecke, Meath, Rekker, Sidhu, & Smith, 2015), different communities (McKibben, 2013), pension fund managers (Ansar, Caldecot, & Tibury, 2013), religious entities, and philanthropic organizations (Milne, 2015; Usborne, 2014) in North America and Europe have been pushed by their stakeholders to address climate change by divesting from fossil fuels because fossil fuels emit a lot of carbon dioxide which is the major cause of global warming.[1] According to a recent publication by ChicagoBoothReview by Booth school of business at University of Chicago fund managers across the globe includes ESG factors in their investment screenings.[2]Research related to environmentally friendly investments also gained popularity among the researchers around the world e.g., (Bessler &Wolff, 2015; Miralles-Quiros, ´ Miralles-Quiros, ´ & Nogueira, 2018; Rezec & Scholtens, 2017; Saeed, Bouri, & Tran, 2020). However, there are different views on the cost and benefit of sustainable and socially responsible investments. (Hamilton, Jo, & Statman, 1993). Investors who invest in socially responsible stocks do not necessarily seek only financial utility from

[1] A list of fossil fuel divestment commitment can be found here: https://gofossilfree.org/divestment/commitments/

[2] The full publication can be found here: https://review.chicagobooth.edu/finance/2021/article/when-green-investments-pay

their investments but also non-financial utility (Bollen, 2007). There are three different views on financial utility of economic feasibility of SRI investing (Preston & O'Bannon, 1997; Sauer, 1997). One of the views is that financial return is indeed positively related to ESG or SRI Investment. Which implies firms with higher SRI or ESG ratings can generate higher returns. The rationale for the view is that firms with superior financial performance have the so-called financial luxury to care for social causes including environment (Eichholtz, Kok, & Yonder, 2012). Since the firms are financially strong enough, they can invest in more sustainable production and operation processes and or green energies and social causes. The second view is just the opposite of the first view, which states that SRI or ESG based investing is prone to negative financial return. The rationale for this view is that firms use their financial resources to social and environmental causes and that activity destroys financial capabilities and values of the firms. The third and the last view is that SRI or ESG based investing does not create or destroy any extra value in form of financial return.

Since, there is a worldwide concern going on about environment, conservation of nature and global warming it is interesting to see whether caring for environment pays off in financial markets. Research on the financial benefits of SRI or ESG based investing is mainly focused on comparison of performances of SRI or ESG based mutual funds and traditional funds or unrestricted industry benchmarks. Though many research have been previously done on the same topic on different data sets, we believe till today this is an important topic. For our study purpose, we will compare the performances of Sustainable Funds with those of traditional/conventional funds. So, the broad objective of this research is,

- To look whether investing in environmentally friendly or green funds pays off. That is to compare the performances of green or sustainable funds to those of conventional and traditional funds

In next sections, first we will discuss some theoretical background of Mutual Funds, Portfolio of Financial Assets, How the value of an equity or funds is determined, SRI, ESG and Green Investments. Then, we will look at data and methodology of this research. After that we will discuss our findings. Lastly, we will conclude our discussion.

2 THEORETICAL FRAMEWORK

To understand the performances of Green or Sustainable funds and Traditional or Conventional funds it is useful to look at some theoretical background with brief history of concept green investing at first. Also, since we are focusing on the performance of funds rather than a single equity or stocks it is essential to look at modern portfolio theory and different measures of portfolio performance.

2.1 Value of Financial Asset

Investors invest their surplus fund today to get the original investment along with some positive return in the future. The value of any financial asset depends on the cashflows it generates during its lifetime. In simple terms, the value of any financial assets is equal to the present value of all expected future cash flows it will generate during its lifetime. The simplest way to calculate the present value of expected future cash flows is to use the discounted cash flow (DCF) formula. The discounted cash flow formula was in use from centuries ago; however, American economist Irving Fisher first formalized the formula in his book 'The Theory of Interest' which was published in 1930. According to Fisher, "the value of capital is the present value of the flow of (net) income that the asset generates". In case of an equity or stock the cash inflows are dividends it is expected to generate in the holding period and capital gain from selling the equity or stock. In case of any debt instrument i.e., bond, bill, commercial paper, or anything else which pays interest payments cash inflows are interest payments. In both kinds of financial assets cash outflows are any cost associated with the financial asset. A portfolio of assets or a fund can comprise of both equity and debt instruments. The value of any financial asset according to discounted cash flow model is,

$$\text{NPV}=-CF_0+\frac{CF_1}{1+r}+\frac{CF_2}{(1+r)^2}+\cdots\frac{CF_n}{(1+r)^n}$$

Where, NPV is Net present value of financial asset, CF is Cash flows in different time periods, r is Opportunity cost, n is Time periods

2.2 Efficient Market Hypothesis

Efficient market hypothesis or in short EMH is one of the most discussed topics in theoretical finance. The EMH was first presented by American noble winning economist Eugene F. Fama in 1970. EMH suggests that stock markets

are informationally efficient. According to Fama, ''A market in which prices always 'fully reflect' available information is called 'efficient.' '' Fama mentioned three types of market efficiency: Weak form of market efficiency, semi-strong form of market efficiency and strong form of market efficiency. In simple words, in weak form of market efficiency security prices reflect all historical price information. In semi strong form of market efficiency security prices reflect all available public information and in strong form of market efficiency security prices reflect all available information both private and public. The main essence of the EMH is that it is difficult or rather impossible to generate market above return continuously. If security prices reflect all the information already available in the market an investor can generate excess return only by talking excess risk.

However, whether market is efficient or not is a controversial issue. The test of market efficiency is subject to joint hypothesis problem (Cuthbertson, 1996). One hypothesis is related to test of market efficiency, and another is the test of investors' risk preferences. There are many papers both for (e.g., Malkiel, 2003) and against (e.g., Shiller, 1981) market efficiency.

The main essence of efficient market hypothesis relevant to green fund performance is that, if the market is efficiency green or sustainable fund should not get market above return. The green or sustainable funds should only get higher return than the conventional funds if they carry more risk than the conventional funds.

2.3 Modern Portfolio Theory

In finance portfolio means a collection of different financial assets bundled together. The primary motivation of creating a portfolio of assets is to reduce risk and increase expected return. The Modern Portfolio Theory (MPT) is developed by American economist Harry Markowitz in 1950s. The author first published theory in an essay in 1952 and later in a book called 'Portfolio Selection' in 1960. The modern portfolio theory segregates risk of an equity into diversifiable and non-diversifiable risk. Non-diversifiable risk is also called as systematic risk. Systematic risk is the risk which affect the whole economy or financial market. Diversifiable risk is also called unsystematic risk or firm specific risk since it is specific to individual stock or firm. MPT theory also introduced 'Efficient Frontier' which is a set of optimal portfolios those offer highest expected return for a given level of risk or the lowest risk for a given level or return.

According to the theory if a portfolio can be constructed properly diversifiable risk can be eliminated completely. An investor can reduce his or her investment risks and maximize return by constructing a diversified portfolio. According to the theory to minimize risk and maximize return of portfolio, assets included in the portfolio should be uncorrelated or negatively correlated. Applying screens like green stocks limits portfolio diversification and narrows universe of assets and as a result green funds can be expected to carry high unsystematic risk

(Kurtz, 1997). Theoretically, this implies that risk adjusted return of green funds will be lower than the conventional funds (CP & Marti-Ballester, 2019). Figure 1 given below, illustrates the relationship of number of securities in a portfolio and risk according to the modern portfolio theory.

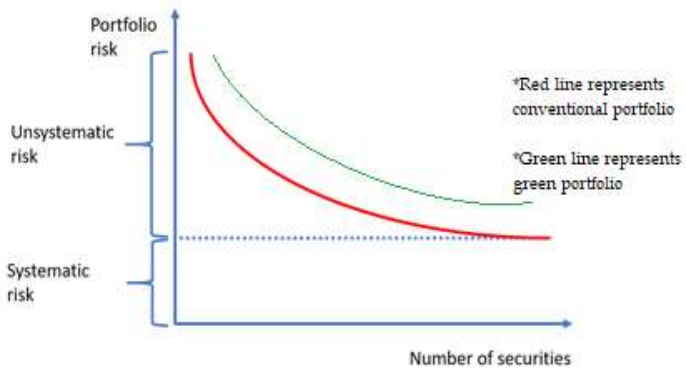

Figure 1: Portfolio Risk and Number of Securities, Source: intialreturn.com

As mentioned earlier MPT theory also introduced 'efficient frontier'. According to a very recent article published by Pedersen et al. (2021) the ESG frontier will be inside the standard efficient frontier. According to them restricting portfolio to any kind of ESG sore must yield a lower Sharpe ratio which is a measure of risk adjusted performance than a standard portfolio. Figure 2, given below illustrates standard efficient frontier and ESG efficient frontier as suggested by Pedersen et al. (2021).

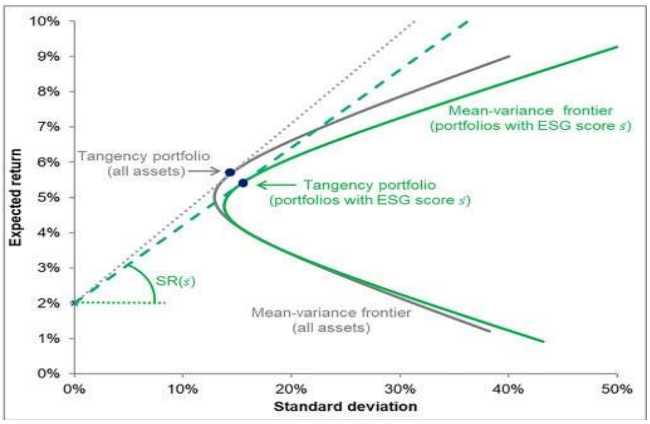

Figure 2: Standard & ESG Efficient Frontiers Efficient Frontier, Pedersen et al. (2021)

There is an opposing view to the idea of diversification which is called resource-based view. This view suggests that restricting portfolio construction only to green or sustainable stock offers specialization. Which enables fund managers to identify well performed green funds with a higher potential of risk-adjusted returns (Porter & van der Linde, 1995; Waddock & Graves, 1997). This kind of specialization also reduces research and other related costs, which is normally

higher in case of widely diversified portfolios because it requires research knowledge of different economic sectors (Revelli & Viviani, 2015). This rationale imply that green or sustainable funds should perform better than traditional or conventional funds.

2.4 Mutual Fund

In general, mutual fund is a professionally manged financial instrument or vehicle which pools off fund from a large group of investors and invest the money in different securities and in financial and real assets. According to The Investment Institute of Canada the first modern mutual fund named 'Massachusetts Investors Trust' was launched on March 21, 1924, in USA.[3] The Security and Exchange Commission of USA or more popularly known as SEC defines mutual as following,

''A mutual fund is a company that brings together money from many people and invests it in stocks, bonds, or other assets. The combined holdings of stocks, bonds, or other assets the fund owns are known as its portfolio. Each investor in the fund owns shares, which represent a part of these holdings.''

According to Staista.com which is a leading firm for providing market and consumer information, there were 7636 mutual funds available in USA market in 2020. Figure 3, given below portrays exclusively number of mutual funds in the last ten years in the USA market

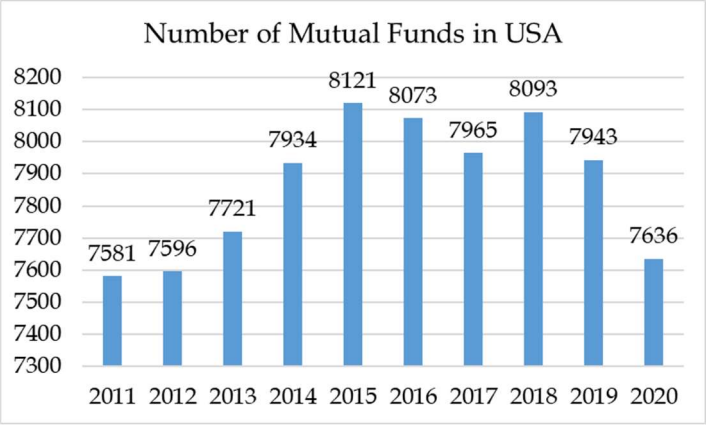

Figure 3: Number of Mutual Funds in USA in The Last Ten Years, Source: Staista.com

Mutual funds can be classified based on their maturities or asset holdings. Based on the maturity or tenure a mutual fund can be either close-end or open-end. Close-end mutual funds have limited tenure which means that they are liq-

[3] A brief history of mutual funds can be found at https://www.ific.ca/en/articles/who-we-are-history-of-mutual-funds/

uidated after their maturity, whereas open-end mutual funds normally have unlimited lifetimes. Based on the holdings mutual funds can be classified as equity based mutual funds, debt based mutual funds or hybrid mutual funds.

Finally, mutual funds have some advantages over individual stocks. A mutual fund is a collection different types of equities or other assets; so, a mutual itself is like a portfolio managed by professionals who have expertise in the field of investment. Theoretically a mutual fund should carry less risk than a single stock. However, there are costs to these benefits as well. Transaction costs related to a mutual fund can be higher than that of managing own portfolio since mutual fund managers normally charges a fee or commission for management of the fund. Also, mutual funds are managed by professional fund managers and investor cannot decide what type of assets should be included in the fund which reduces the discretionary power of an ordinary investor.

2.5 Socially Responsible Investing (SRI)

Socially responsible investing is the root of green or sustainable investment. Not only Green or sustainable investment it is the root of other responsible investment practices like ESG or impact investment. According to CNBC news in 2020 sustainable investing accounted for 33% of total assets under management (AUM) in United States of America (USA). [4] Figure 4 given below, illustrates exclusively number of sustainable funds in USA in the last ten years.

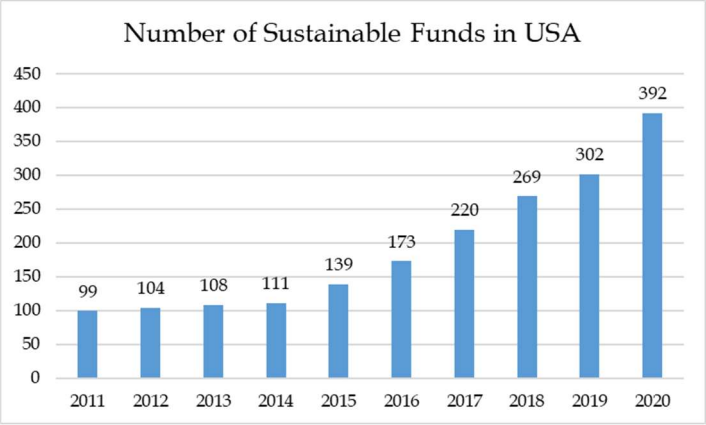

Figure 4: Number of Sustainable Funds in USA as of 31.12.2020. Source: Morning Star Sustainable Funds Landscape Report 2021

Socially responsible investing or more popularly known as SRI is an investment concept which dates to medieval times. In medieval times SRI was mainly driven by religious faith and common social values. In 1700 founder of

[4] The full article can be found at https://www.cnbc.com/2020/12/21/sustainable-investing-accounts-for-33percent-of-total-us-assets-under-management.html

Methodist belief John Wesley stated that the use of money is second most important issue of New Testament teachings from the Holy Bible (Schueth 2003). In that time churches or activists used to advocate to stop funding to the organizations or authorities who are involved in trading of slaves or prostitution or war. However, the modern root of SRI can be traced back to 1960 when USA got engaged in Vietnam war. There were movements in USA to stop investing in the firms which produces weapon (Schueth, 2003). After that movement SRI got more prominence during 1970-1990 due to management and labour issue, anti-nuclear sentiment, racism in south Africa, Chernobyl and Exxon incidents, and growing concerns about global warming. There is no universal definition of SRI. Different researchers and different bodies define SRI investment differently, though the main theme is similar across all notions. Majority of definitions state ''Integrating personal values and societal concerns with investment decisions'' (Statman 2006; Schueth 2003). SRI investment is also termed as 'ethical investment' considers factors such as respect for human rights, environmental preservation, and other social issues. (Renneboog et al., 2008). SRI investment, which mainly focuses on SRI funds; SRI equity indexes; and SRI stocks, allow investors to match their individual investment goals with their moral and ethical principles. However, there is no financial or mathematical model to determine investors' social responsibility preference or optimality of social responsibility. More precisely, there is no model to determine the appropriate trade-off between social responsibility and other investment criteria, primarily risk and return.

There are mainly two approaches to socially responsible investing, **exclusionary** approach, and **inclusionary approach** (Berry & Junkus, 2013). Exclusionary approach is more popular than inclusionary approach since inclusionary approach is more difficult to apply than exclusionary approach. Exclusionary approach involves eliminating or avoiding certain types of stocks or so called 'Sin Stock' from investment universe. Sin stocks includes but not limited to stocks of tobacco, alcohol, weapon companies and gambling. Inclusionary approach is more complicated to use because there is no scale to measure which company or activity is more socially responsible. Under this approach an investor can use point-based system to give positive points to companies for acting in favour of SRI and vice versa. However, this approach is highly subjective.

To understand and guide investors about the social responsibility of a company there many standards. A company achieve a standard for complying some rules mentioned in the standard and acting in a particular way. For example, Social Accountability 8000 system which uses International Labor Organization (ILO) standards of United Nations (UN) human rights convention to certify companies and production facilities for certifying ethical workplace conditions. There are external SRI evaluators as well, which are the organizations which maintains SRI, Corporate Social Responsibility (CSR) or other data to help to choose SRI based investments. For example, Sustainanalytics.com[5] which main-

[5] The website can be accessed using the link: https://www.sustainalytics.com/

tains a database on SRI to help investors to choose SRI investments. For an individual or general investor, the easiest way to invest in SRI index listed companies. SRI indexes are indexes which are made of companies which follow SRI principles. There are many SRI indexes and one of the most popular is MSCI KLD 400 Social Index.

Lastly, SRI investment can be driven by religious views. Many churches in United States follow catholic principles to manage church funds. Also, muslim communities follow Shariah principles for their investments which can also be termed as SRI Investment.

2.6 Environmental, Social, Governance (ESG) Investing

ESG investment is an investment style to care for environment, social and governance causes. The root of ESG is SRI and sometimes they are used interchangeably. The phrase 'ESG' was introduced for the first time in a report by United Nations (UN), Global Compact (2004) ´Who Cares Wins: Connecting Financial Markets to a Changing World'. For the report a combined effort was called by UN general secretary "to develop guidelines and recommendations on how to better integrate environmental, social and corporate governance issues in asset management, securities brokerage services and associated research functions" (Eccles et al., 2020). The final report was certified by twenty organizations who deal in financial sector, including big names in the banking sector like HSBC, asset owners like Aviva PLC, asset manage firms and other stakeholders. The UN Environmental Program Finance Initiative's (UNEP-FI, 2005) Freshfields Report, published after a year, provided first documentation on the financial implication of ESG and explained in detail the matters of fiduciary duty in related to use of ESG information in investment practices. These two reports are considered as the cornerstones of the United Nations (UN) supported principles for responsible investment, which was introduced in 2006 and had attracted as co-signer financial institutions around the world that altogether manages different types of asset worth around U.S.$ 89 trillion (Principles for Responsible Investment Annual Report, 2018). Since then, ESG Investment is ever increasing. Funds flows react strongly with ESG ratings of mutual funds (Hartzmark and Sussman, 2019). Figure 5 given below, illustrates the number of ESG funds and assets under management in the USA market.

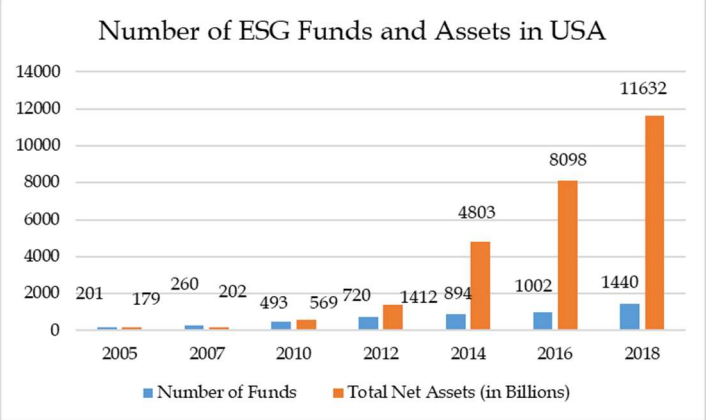

Figure 5: Number of ESG Funds and Assets in the USA as of 2018. Source: USA SIF Foundation Annul Report 2019

Today, there are many ESG ratings available in the market. According to a report published by Sustainability Institute by ERM in 2020 there are 600+ ESG ratings available.[6] According to a report published by iShares by Blackrock in 2019 there are more 1000 ESG ratings available.[7] Some of the most popular ESG ratings are provided by, MSCI, iShares, Morningstar.

2.7 Green Investing

After SRI and ESG now we will discuss about green investing. While SRI and ESG investment philosophies care about broader aspects of social and environmental investing, green investing care for environment. Green funds are the most precise form secondary form investments caring for environment. There is no common definition for green mutual funds (Inderst et al., 2012). However, most common goals of green funds include but not limited to reducing greenhouse gases emission, fossil fuel divestment, energy preservation, solar energy utilization, addressing global warming and most importantly tackling climate change (Inderst et al., 2012). SRI Funds, ESG Funds, Green Funds largely overlaps with each other. As mentioned earlier there are lack of common definitions for these three categories of investment styles and often these three terms are used interchangeable though there are slight differences between them. Therefore, it is difficult to gain precise data related to green funds or segregate 'only' green funds from the funds which are rated as SRI or ESG funds by different rating agencies.

[6] The full report can be found here: https://www.sustainability.com/globalassets/sustainability.com/thinking/pdfs/sustainability-ratetheraters2020-report.pdf
[7] The full report can be found here: https://www.ishares.com/us/literature/whitepaper/an-evolution-in-esg-indexing.pdf

3 PERFORMANCE MEASURES

In this section we will discuss about the different performance measures we will use to assess and compare the performances for green and conventional funds.

3.1 CAPM

Capital Asset Pricing Model or more popularly CAPM is an outcome of modern of portfolio theory (MPT) and the most widely used asset pricing model. As mentioned earlier modern portfolio theory segregated total risk of an asset into unsystematic and systematic risk. According to capital asset pricing model an asset should be priced only for time value of money as denoted by risk free rate and systematic risk. The simplest way to assess and compare the performances of equities or mutual funds can be to calculate monthly returns of respective equities or funds and compare them. However, not all the equities or fund carry same amount of systematic risk, some are more prone to economic downturns and vice versa. So, that method of calculating only monthly returns without considering risks will not give a clear picture of performance. CAPM considers both risk and return of a financial asset. CAPM was formulated in 1960s by William Sharpe (1960), Jack Treynor (1962), John Lintner (1965) and Jan Mossin (1966) (Perold, 2004). The idea of CAPM can be expressed by the following equation,

$$E(r_i)=r_f + \beta_i\left[E(r_m - r_f)\right] \qquad (1)$$

Where, $E(r_i)$ is expected return of portfolio i, r_f is the risk-free rate of return which accounts for time value of money, β_i is a measure of systematic risk which measures how much risky an asset is compared to overall market, $E(r_m)$ expected return of the market portfolio, it is generally termed as market premium. β_i can be measured as,

$$\beta_i = \frac{cov(r_i, r_m)}{var(r_m)}$$

Which implies β_i measures how much asset i's return fluctuates compared to than that of a market portfolio. The higher the fluctuation the higher the beta and vice versa. The β of the market portfolio or market is always 1. The main essence of CAPM is that unsystematic risk can be eliminated completely if a portfolio is well diversified and β assumes liner a relationship between systematic risk and return. Which means, return of an asset should move in direct proportion to its β. This relationship can be demonstrated in graph by a line called security market (SML) line. Figure 6 given below, illustrates security market line.

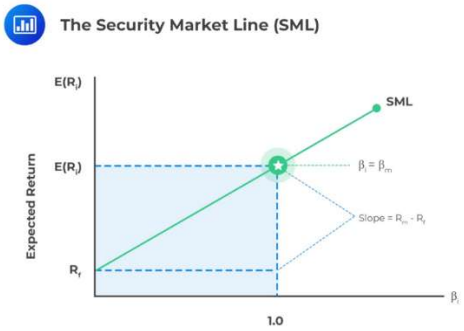

Figure 6: Security Market Line, Source: Analystprep.com

According to CAPM all the assets priced correctly should be on the security market line. Assets below the SML are overpriced and vice versa. These kinds of deviations from SML are measured by Jensen Alpha.

3.2 Jensen's Alpha

Jensen's Alpha or Jensen's measure measures the excess portfolio return, excess return means extra return than the return should be according to CAPM. Since this is just an extension of CAPM it is also a risk adjusted performance measure like CAPM. Jensen Alpha was introduced by Michael Jensen in 1968. Jensen Alpha can be calculated using the following formula,

$$\alpha = r_{pi} - r_f - \beta_i(r_m - r_f) \qquad (2)$$

Where, α is Jensen's Alpha, r_p is actual or observed return of the portfolio 'i', r_f is the risk-free rate, β_i is the beta of the portfolio 'i', r_m is market risk premium or reward for systematic risk. If the α is positive, then it implies that portfolio earned better return than predicted by CAPM and vice versa. A positive alpha indicates portfolio is under-priced and above the SML line and demonstrates superior performance compared to the market benchmark or index. (Brown et al. 2009).

3.3 Sharpe Ratio

We will consider another risk adjusted performance measure and that is Sharpe Ratio. Sharpe Ratio was introduced by one of the contributors of CAPM William Sharpe in 1966. The formula of the Sharpe ratio is,

$$S_p = \frac{r_P - r_f}{\sigma_P} \qquad (3)$$

Where, S_p is the Sharpe ratio of portfolio p, r_P is actual or observed return of portfolio p, r_f is the risk-free rate, σ_P standard deviation of portfolio excess returns

which is a statistical measure of risk. The numerator of the formula comprises portfolio return in excess of risk-free rate and the denominator is the standard deviation of the return of the portfolio which implies that Sharpe ratio measures portfolio return per unit of risk. The higher the Sharpe ratio the better the portfolio performance. Negative Sharpe ratio means portfolio return is less that risk free rate or portfolio is generating negative return.

3.4 Fama French Three Factor Model

Till today CAMP has been one of the most prominent financial theory of assets' risks and returns relationships. However, one of the major drawbacks of CAMP is that, it considers only one type of risk. Also, many researchers questioned the validity of CAPM after 1980s. When portfolios were formed on the basis market capitalizations of firms, Banz (1980) found out that firms with small market capitalizations provided higher return than predicted by CAPM. Also, Rosenberg et al. (1985) as well as Frama and French found out that stocks with high book to market value ratios or so-called values stocks had much higher return than CAPM could predict. To address these kinds of market anomalies Eugene F. Fama and Kenneth French introduced three factor model in 1992. This model is basically an extension of CAPM model. Fama and French add two other risk factors namely size risk and value risk besides only the market risk as suggested by CAPM in their model to predict market return of stocks. The model is based on the following equation,

$$E(r_{it}) - r_{ft} = \alpha_{it} + \beta_1(r_{mt} - r_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \varepsilon_{it} \qquad (4)$$

Where, $E(r_i)$ is the expected return on the portfolio 'i' at time t, r_{ft} is the risk-free rate at time t, $\beta_1, \beta_2, \beta_3$ are the factor coefficients, r_{mt} is the market premium at time t, SMB_t is the size premium (small minus big) at time t, HML_t(high minus low) is the value premium at time t, α_{it} is the regression constant or the Jensen's Alpha and lastly, ε_{it} is an error term which represents other factors which affect the return but the model is unable to explain those factors.

According to this model return on asset is depended on three factors: excess return on market portfolio, size premium which is the difference between returns of well diversified portfolios of stock with small capitalization and large capital capitalization and value premium which is the difference between well diversified portfolios of stocks with high book to market values and low book to market values.

3.5 Carhart 4 Factor Model

First in 1993 Jegadeesh et al. and later other researchers showed that, the three-factor model did not capture the momentum effect on asset returns. Momentum factor is related to price momentum which is based on the notion that assets with recent negative returns tend to earn negative returns and vice versa (Bello, 2008). Considering this momentum effect in 1997 Mark Carhart add another factor to original Fama and French three factor model which is known as Carhart four factor model. The fourth factor is the momentum factor. Where the price momentum factor denoted as (MOM) is the weighted average return on securities with the highest 11-month return lagged by one month minus the average return on securities with the lowest corresponding return. The momentum is also known as 'WML' factor that stands for winners minus losers. The equation for the model is,

$$E(r_{it}) - r_{ft} = \alpha_{it} + \beta_1(r_{mt} - r_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 MOM_t + \varepsilon_{it} \quad (5)$$

Where everything else same as the three-factor model only the MOM is the new addition and as have discussed MOM stands for price momentum.

3.6 Fama French Five Factor Model

Fama French five factor model is an extension of standard Fama French model or Fama French three factor model. In 2015 Fama and French added two new factors to the already existing three factor model. The two additional factors are: profitability and investment. The profitability factor is the spread of return of the firms with high or robust and low or weak operating profitability. The investment factor is the spread of return of the firms who invest conservatively and the firms who invest aggressively. The equation for the five-factor model is,

$$E(r_{it}) - r_{ft} = \alpha_{it} + \beta_1(r_{mt} - r_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 RMW_t + \beta_5 CMA_t + \varepsilon_{it} \quad (6)$$

Where all the other signs are the same as three factors model except for RMW_t , CMA_t, β_4, β_5. RMW_t is the return spread of the firms with robust and weak profitability at time t, CMA_t is the return spread of the firms who invest conservatively and the firms who invest aggressively and β_4, β_5 are the regression coefficients of the factors.

It is noteworthy to mention that addition of these two factors makes the HML factor somewhat redundant in the model since the time series of HML factor are fully explained by other four factors for example according to studies CMA has a correlation or 0.7 with HML.

3.7 q^5 Factor Model

In 2015 USA based Chinese researchers and University Professors Kewei Hou, Chen Xue, Lu Zhang in 2015 in their paper named 'Digesting Anomalies: An Investment Approach' introduced q factor model. Initially there were four factors: market excess return, size factor which is the spread of the returns on portfolios of small size equities and big size equities, investment factor which is the spread of the returns of the portfolios of low investment stocks and high investment stocks, profitability factor which spread of the returns of portfolios of stocks with high return on equity (ROE) and low ROE. In 2018 the researchers included expected growth factor into the model and thus it became q5 Factor Model. The q5 can be written in equation as the following,

$$E\left[R^i - R^f\right] = \alpha_i + \beta^i_{MKT}E[R_{MKT} - R^f] + \beta^i_{Me}E[R_{Me}] + \beta^i_{I/A}E\left[R_{I/A}\right] + \beta^i_{ROE}E[R_{ROE}] + \beta^i_{Eg}E\left[R_{Eg}\right] \quad (7)$$

Where, 'i' stands for portfolio i. α_{it} is the regression constant or Jensen's Alpha. R^f is the risk free rate. $E[R_{MKT}]$, $E[R_{Me}]$, $E\left[R_{I/A}\right]$, $E[R_{ROE}]$, $E\left[R_{Eg}\right]$ are expected factor premiums consecutively for market return, size factor, investment factor, profitability factor, and expected growth factor. $\beta^i_{MKT}, \beta^i_{Me}, \beta^i_{I/A}, \beta^i_{ROE}, \beta^i_{Eg}$ are the regression coefficients of expected factor premiums consecutively for market excess return, size factor, investment factor, profitability factor, and expected growth factor.

4 LITERATURE REVIEW

In this section we will discuss relevant previous works done by other researchers. First, we will look at the previous literature about the performance of mutual funds in general. Though are research is mainly focused on performance of Green Funds, we will discuss about previous works regarding performances SRI and ESG Funds as well. Since SRI and more modern ESG concepts are the main roots of Green investing it will be wise to discuss about the previous literature about them. Finally, we will discuss about some literature related to Green Funds performance.

4.1 Mutual Fund Performance

Since its introduction mutual fund has gained popularity among all the stakeholder i.e., general investors, fund managers, academic researchers. The basis for first empirical analysis of performance of mutual funds was presented by Friend, Brown, Herma and Vickers in 1962. Later, Treynor (1965), Sharpe (1966), Jensen (1968) developed three different ratios namely Treynor ratio, Sharpe ratio and Jensen's Alpha. We have discussed about Sharpe Ratio and Jensen's Alpha in details in the previous section 'Performance Measurements'. These are mainly the beginning of the studies of mutual funds' performances.

Many of the previous studies during 1990s and early 2000s used standard Fama French or Fama French three factor model and Carhart's four factor model to evaluate the performance of mutual funds. According to some prominent studies among them studies the mutual funds generated negative alphas (Gruber, 1996; Carhart, 1997; Fama & French, 2010; Brek & Van Binsbergen, 2012, etc.) which means mutual funds underperformed than the market. However, some limited number of other studies (Wermers 2000, Kosowski, Timmermann, White, & Wermers, 2006, etc.) imply that mutual funds can beat the market, that is they generate statistically and economically significant positive alphas. Therefore, it is evident that there are different evidences related to mutual fund performance in the market.

While most of the studies already mentioned are focused on USA market there are some studies outside of USA market as well. A very recent study on Canadian mutual funds by Samarbakhsh & Shah (2021) imply that mutual funds' performance was worse than the market at time of 2008's financial crisis. Leite & Armada (2017) studied the bond funds in Europe and their finding is like previous studies that the mutual funds significantly underperformed the market.

Based on the previous studies it can be concluded that in most cases mutual funds underperformed than the market though there are few examples of mutual funds performing better than the market.

4.2 SRI Performance

As discussed earlier, though the modern history of SRI can be traced back to 1960s it gained more popularity in last two decades. Academics around the world are also addressing different aspects of SRI investment. Stakeholders of SRI look for more sophisticated and detailed information related to SRI today than before. There are many studies on the performance of individual SRI Funds and SRI Indexes.

Domini 400 social index is a popular SRI index. Statman (2000), Kurtz (1997), Sauer (1997) and analysed performance of Domini 400 social index and according to their results the social index performed similarly compared to benchmark index. Kurtz et al. studied Domini 400 social index in 1999 and that time the SRI index slightly outperformed the benchmark index; however, the result was not statistically significant. Some other studies based on SRI indexes i.e., Mallett et al. (2010), Adler et al. (2008), Statman (2006) show the similar result that there is no additional financial benefit of SRI. Dow Jones Sustainability Index (DJSI) is another popular SRI index and Garz et al. (2002) analysed the performance of Dow Jones Sustainability Index (DJSI) for European markets and compared it with the performance of DJ STOXX600 index. According to their study the SRI index performed slightly better than the conventional index. The result from other previous studies of Grossman & Sharpe (1986), Luck & Pilotte (1993), Diltz (1995), Hutton et al. (1998) also show that SRI indexes perform better than conventional indexes.

There are many studies on the performance of individual SRI funds as well. A recent study by Kiymaz (2019) presented mixed evidence on SRI fund performance relative to different standards and reported noteworthy dissimilarities of the performance of different types of funds. According to the research fixed income SRI funds earned highest risk adjusted returns and global SRI funds performed the worst among the funds included in the sample. Gil-bazo et al. (2010) considered the effect of different fees on SRI fund performance. According to the result of the study SRI funds perform better than conventional funds if fund management fees are considered. According to another study by Kempf & Osthoff (2007) trading strategy comprised of purchasing stocks with good socially responsible ratings and selling stocks with bad socially responsible ratings can earn positive abnormal returns of up to 8.7 percent on yearly basis. There are some studies on the faith based or ethical SRI funds. Faith based SRI funds were analysed by Lyn & Zychowicz (2010) among others and ethical SRI funds were analysed by Mallin et al. (1995) and Luther et al. (1992). The results of the studies show that SRI funds perform better than conventional funds. Many studies also reported that there is no difference in the performance of SRI and conventional funds across the globe. Guerard (1997) studied the SRI funds listed in USA based stock exchanges, Luther & Matatko (1994) and Gregory et al. (1997) studied SRI

funds listed in United Kingdom, Tippet (2001) studied SRI funds based in Australia and Kreander et al. (2005) studied European SRI funds. None of these studies found any evidence of financial benefit of SRI funds.

Therefore, according to different literatures, there are mixed views among researchers about the financial performance of SRI funds.

4.3 ESG Performance

In essence ESG is more modern and precise version of responsible investing. Though the concept of SRI is age old, ESG is more a new concept. It is quite challenging to find studies which are solely focused on ESG and financial. Most of the studies of ESG are based on common SRI literature. Like SRI there is mixed opinion regarding relationship of ESG investing and financial performance among academic researchers.

However, Friede et al. (2015) studied around 2000 empirical studies regarding SRI and ESG and financial performance and according to them 90% of the studies found a positive relation between SRI and ESG and corporate financial performance. There are some studies related ESG and financial risk as well for example according Hopener et al. (2018) engagement of ESG issues reduces downside risk of investment. According to Ilhan et al. (2021) Firms with low ESG profiles measure by high carbon emissions have high tail risks.

There are also limited number of studies about the ESG performance during the times of financial crises. According to Lins et al. (2017) US non-financial firms with high ESG ratings performed better than other firms during 2008-2009 global financial crisis period. There is another study by Cornett et al. (2016) which shows that USA based banks with high ESG ratings performed better than other banks during the same crisis period.

Overall, according to academic studies ESG does have impact on the financial performance of the firms.

4.4 Green Funds Performance

Green investment is the most streamlined concept of investment to care for the environment. While SRI and ESG deal with somewhat border perspective the only motto of green investment is to care for environment. More precisely, to reduce carbon emission and global warming. The history of academic research on green funds is not very old, since most of the studies are based on common principles of SRI. However, there are some recent studies on green funds financial performance. While there are mixed evidence of SRI and ESG performance in academic literature, majority of the studies on green funds found that green funds usually underperforms than traditional funds.

According to Climent & Soriano (2011) USA based green funds performed worse than conventional funds during (1987-2009) period and performed similarly to conventional funds during (2001-2009) period. Chang et al. (2012) studied USA based green funds and according to the study green fund generated lower returns and similar risk compared comparable conventional funds. There are some studies focused on European market. For example, according to Ibikunle & Steffan (2017) green funds underperformed than the conventional funds in European markets during (1991-2014) period. Similar result has been found according to Reboredo et al. (2017) who studied alternative energy mutual funds and the funds performed worse than conventional funds. A more recent study focusing on European market is done by Fernandez et al. (2019) who studied green funds in German market which is the biggest financial market in Schengen area and according to the study environmental mutual funds underperformed conventional funds based on the data from 2007-2018. Another recent study done by Naqvi et al. (2021) based on the data from 27 emerging markets showed that renewable energy funds underperformed conventional energy funds which is also not in favour of green investing.

There are some very recent studies in favour of green funds as well. Ji et al. (2021) studied equity mutual funds in BRICS countries and according to the study green funds outperformed other funds. Giao et al. (2021) studied European green funds based on the data from 2005-2020 and according to them green funds outperformed traditional peers.

Based on the discussion it is evident that, though majority of the studies do not provide evidence for green funds good financial performance there are more recent studies which are in support for green funds.

5 DATA AND METHODOLOGY

In this section we will discuss about data and method used for empirical analysis: method of Fund selection, sources of data, method of analysis.

5.1 Fund Selection

Most of the previous studies used mutual funds managed by USA SIF member firms. USA SIF is a prime body for sustainable investment in USA. We are also focusing on USA based funds because USA is one of the most sophisticated financial markets in the world and data from USA market is widely available compared to many other markets around the world. However, we decided to use funds using Morningstar ESG Screener instead of USA SIF fund list. Morningstar has a 5-tier sustainable rating system. Funds which highest ESG standards receive 5 globes and funds with the highest ESG risks receive 1 globe and other funds falls in between 1 and 5 globes according to their rankings. Currently, the rating covers around 25000 funds around the world. The reason we choose Morningstar ESG Fund screener are the following,

- Morningstar is a highly reputed and trusted investment research firm based in USA. So, the ESG ratings provided by Morningstar should be valid and can be trusted.
- As mentioned earlier, there are no widely accepted definitions of SRI, ESG and Green Funds. USA SIF mainly a prime body for SRI investment. Whereas Morningstar's ESG screener is for ESG funds which is a more so-called modern version of SRI investment; also, the screener allows to identify funds which has low carbon designation which is one of the most important factors to choose a green fund.
- Today internet is widely available around the world and investors can easily get to access to most of the information they need to make investment decisions. It is reasonable that before investing a general investor will look at fund ratings provided by any reputed firm and invest in highly rated firms. Morningstar ESG screener do not only allow to choose funds with high sustainability ratings but also with high ratings provided by Morningstar based on their performances.

Therefore, using the screener we selected 5 five groups of green funds: 1. USA Mid Cap Funds, 2. USA Value Large Cap Funds, 3. USA Growth Large Cap Funds 4. Equity Funds from USA Healthcare sector, 5. Equity Funds from USA Technology Sector. Here the 'Cap' means market capitalization.

- **USA Health Care Sector:** In this group we selected only 4 and 5 globe rated funds with low carbon designation in Morningstar sustainability rating. There were in total 5 funds and we included all the funds in this group which matched our criteria.
- **USA Mid Cap:** In this group we selected only 5 globe rated funds with low carbon designation in Morningstar sustainability rating which also have 5 in Morningstar performance rating. There were in total 12 founds which matched all these criteria; however, there were 4 funds which are quite new and there are not enough data for analysing them. So, finally we selected 8 funds in this category.
- **USA Growth Large Cap:** In this group we selected only 4 and 5 globe rated funds with low carbon designation in Morningstar sustainability rating which also have 5 in Morningstar performance rating. There were in total 13 funds but due to unavailability of data we get select only 4 funds.
- **USA Value Large Cap:** In this group we selected only 4 and 5 globe rated funds with low carbon designation in Morningstar sustainability rating which also have 5 in Morningstar performance rating. There were in total 11 funds but due to unavailability of data we selected only 4 funds.
- **USA Technology Sector:** In this group we selected only 4 and 5 globe rated funds with low carbon designation in Morningstar sustainability rating. There were in total 7 funds and we included 6 the funds in this group which matched our criteria. One fund is excluded because it is a quite new fund and there is not enough data for analysis.

For comparison purpose, we used USANews.com fund ranking. According to several researchers for example: Bauer et al. (2005), Renneboog et al. (2008) and Nofsinger et al. (2014) for comparison and portfolio construction green funds and conventional funds should be of similar attributes. They can be of same market capitalization, asset under management, tenure, geographic location, or other attributes. It is very challenging task to choose funds with similar attributes since according to Yahoo Finance there are more than 7000 mutual funds in USA market. However, we selected funds with same market capitalization and sectoral categories using USANews.com ranking. USANews.com is another USA based research-based organization which publishes several rankings in different sectors. USANews.com ranking includes only high-performance funds, since we selected green funds with only 5 and 4 performance rating from Morningstar rating at least for three of our fund categories, it is reasonable to USANews.com ranking. Finally, all our funds are only Equity funds and based in USA domicile. Equity Funds means the funds do not have any investment in any kind of debt securities.

In the appendix we provided a list of funds under our consideration with some other attributes. The information provided in the list is collected from MarketWatch.com.

5.2 Data

For all our calculation except for q5 model we used monthly time series data staring from December 2010 to August 2021. So, there are in total, 129 months in our consideration. Since our analysis is based on return of the funds for 129 months of price data, we got 128 return data for each fund. For q5 model we used price data from December 2010 to December 2020. So, there are 121 sets of price data and 120 sets of return data of the funds. The price return data are calculated using monthly adjusted closing prices from Yahoo Finance. We also, want to precisely mention that we used only price data which implies we excluded any dividend data or any related transactional cost e.g., fund management fee or commission etc.

In total 10 portfolios are created for five categories of funds: two in each category, one consisting of only green funds and another consisting of conventional funds to compare the performance of green and conventional funds. All the portfolios carry equal weights of funds. Not all the portfolios include same number of funds but every two portfolios in each category include same number of funds. For portfolio construction we used inspiration from the previous studies of Bauer et al. (2005), Renneboog et al. (2008) and Nofsinger et al. (2014).

For CAPM, Fama French three factor model, Carhart's four factor model and Fama French five factor model we collected monthly risk-free rate, size factor, book to market value factor, excess return on market, profitability factor, investment factor from December 2010 to August 2021 from Kenneth R. French's website kennenthfrench.com. For q5 factor model we collected monthly data for market excess return, size factor, investment factor, profitability factor and expected growth factor from the global-q.org website.

5.3 Survivorship Bias

According to Elton et al. (2011) one common problem of empirical analysis of mutual fund performance is that studies fail to control survivorship bias in mutual fund data. In case of mutual fund selection survivorship bias generally arises from the fact that, only funds available in the present are selected to represent the market and funds which have been liquidated are excluded. In our analysis supervisorship bias arises from the three facts,

- As first mentioned by Brown et al. (1992) exclusion of non-surviving funds can cause supervisorship bias. In our study we included only the funds which currently available and ignored the funds which are liquated before or during our sample period.

- As mentioned earlier there is no common definition or universally accepted rating of green funds. We used Morningstar's ESG rating with designation of low carbon emission. However, this may not be enough to identify truly green funds.
- For fund selection and performance comparison we selected only funds with high performance ratings from two sources. For conventional funds we used USAnews.com's ratings and for green funds we used Morningstar's ESG rating. Only the funds which have performed highly may not be the representation of the mutual fund industry or green mutual funds. However, for comparison purpose it is difficult to choose funds with matching characteristics. As mentioned earlier, according to Statista.com there are more than 7000 mutual funds available in USA market. We selected only highly performed funds because it is rational to compare conventional funds with high performance ratings with green funds with high performance ratings. We also, tried to compare the funds with similar market capitalizations. We could have selected funds otherwise, but it is difficult to choose funds randomly without any basis for choosing.

5.4 Methodology

Firstly, we will calcualte some descriptive statistics for the funds and portfolios: monthly average excess returns, standard deviation of monthly excess returns, skewness of monthly returns, kurtosis of monthly returns. For the performance analysis and portfolio performance comparisons we used following methods,

- **Sharpe Ratio:** Sharpe ration is calculated using equation (3) mentioned in the performance measurement section.
- **CAMP:** CAMP model is estimated using the following equation,

$$E(r_i) - r_f = \alpha_i + \beta_i\left[E(r_m - r_f)\right] \quad (8)$$

- **Fama French Three Factor Model:** Three factor model is estimated using the equation (4) mentioned in the performance measurement section.
- **Carhat Four Factor Model:** Four factor is estimated using the equation (5) mentioned in the performance measurement section.
- **Fama French Five Factor Model:** Five factor model is estimated using the equation (6) mentioned in the performance measurement section.
- $\boldsymbol{q^5}$ **Factor Model:** Q4 model is estimated using the using the equation (7) mentioned in the performance measurement section.

6 RESULTS AND ANALYSIS

In this section we will discuss our findings from empirical data analysis. We have selected funds from five different categories: Healthcare sector, Mid Cap, Large cap growth, Large Cap value and Technology sector. First, for each sector we will present some descriptive statistics of the funds as well as portfolios. Portfolio is denoted as 'Port' in all the applicable tables in this section. Then we will discuss about results related to Sharpe Ratio, CAPM & Factor Models.

6.1 Health Care Sector

Table 1: Descriptive Statistics

Type	Ticker	Average Excess Return	Min Excess Return	Max Excess Return	S.D.	Skewness	Kurtosis
Green Fund	FSHCX	1.38%	-19.08%	17.28%	0.054	-0.080	1.227
	LOGSX	1.18%	-22.29%	23.44%	0.052	-0.091	4.775
	SHPAX	1.09%	-26.39%	30.01%	0.062	0.477	7.329
	SHPCX	1.07%	-29.57%	35.74%	0.069	0.741	9.034
	SBHIX	1.10%	-24.98%	27.62%	0.058	0.367	6.602
	Port	1.16%	-24.46%	26.72%	0.056	0.266	6.483
Conventional Fund	FSMEX	1.73%	-12.53%	15.61%	0.056	0.035	0.093
	PRHSX	1.75%	-16.19%	18.43%	0.057	0.168	0.799
	FSPHX	1.62%	-14.80%	16.81%	0.056	0.126	0.424
	PHLAX	1.72%	-22.52%	25.70%	0.074	0.301	1.476
	JFNAX	1.55%	-19.79%	23.46%	0.055	0.137	2.990
	Port	1.67%	-16.94%	19.09%	0.057	0.131	0.846

From Table 1, it is evident that average excess return of the conventional portfolio is higher than that of the green portfolio. Both portfolios have almost similar standard deviation and positive skewness. Which imply that both portfolios have larger median returns than their mean returns. However, the return distribution of green portfolio is more positively skewed than the conventional portfolio which implies that the green portfolio had more small losses and larger gains than conventional portfolio. If we consider excess kurtosis then the green portfolio is leptokurtic and conventional portfolio is platykurtic. From the kurtosis value it is evident that, conventional portfolio has smaller outliers in its return distribution compared than that of green portfolio which is plus for conventional portfolio.

Table 2: Sharpe Ratio

Name	Sharpe Ratio
Green Portfolio	0.2078
Conventional Portfolio	0.2931

Table 2 presents Sharpe Ratios of portfolios from healthcare sector. Sharpe ratio is a risk adjusted measure of performance which measures the excess return per unit of risk as measured by standard deviation. In terms of Sharpe ratio, the conventional portfolio performed better than the green portfolio.

Table 3: Regression Results of CAPM & Factor Models

Green Portfolio						
Measures	**Ad. R^2**	**Intercepts & Factors**	**Coeff.**	**T stat**	**P-Value**	**No of Observations**
CAPM	0.3579	Intercept	0.0014	0.3308	0.7414	128
		Mkt-RF	**0.8424***	8.4727	0.0000	
Fama French 3 Factor Model	0.3628	Intercept	0.0004	0.0882	0.9299	128
		Mkt-RF	**0.8628***	8.0736	0.0000	
		SMB	0.0568	0.3241	0.7464	
		HML	-0.2400	-1.7160	0.0887	
Carhart´s Four Factor Model	0.3576	Intercept	0.0003	0.0771	0.9387	128
		Mkt-RF	**0.8663***	7.6592	0.0000	
		SMB	0.0579	0.3284	0.7432	
		HML	-0.2326	-1.4597	0.1469	
		MOM	0.0137	0.0984	0.9218	
Fama French 5 Factor Model	0.3671	Intercept	0.0004	0.0901	0.9283	128
		Mkt-RF	**0.9124***	8.2149	0.0000	
		SMB	-0.0462	-0.2291	0.8191	
		HML	**-0.3392***	-2.0231	0.0453	
		RMW	-0.2736	-1.0338	0.3033	
		CMA	0.4116	1.3476	0.1803	
q^5 Factor Model	0.3612	Intercept	-0.0001	-0.0259	0.9794	128
		R_MKT-RF	**0.9014***	6.9091	0.0000	
		R_ME	-0.2189	-1.0522	0.2949	
		R_IA	0.0413	0.1429	0.8867	
		R_ROE	-0.1664	-0.6599	0.5107	
		R_EG	0.0665	0.2184	0.8275	
Conventional Portfolio						
Measures	**Ad. R^2**	**Intercepts & Factors**	**Coeff.**	**T stat**	**P-Value**	**No of Observations**
CAPM	0.3831	Intercept	0.0059	1.4221	0.1575	128
		Mkt-RF	**0.8874***	8.9364	0.0000	
	0.4974	Intercept	0.0044	1.1465	0.2538	128

Measures	Ad. R^2	Intercepts & Factors	Coeff.	T stat	P-Value	No of Observations
Fama French 3 Factor Model		Mkt-RF	**0.8583***	8.8766	0.0000	
		SMB	**0.5200***	3.2773	0.0014	
		HML	**-0.6064***	-4.7920	0.0000	
Carhart´s Four Factor Model	0.4970	Intercept	0.0040	1.0413	0.2998	128
		Mkt-RF	**0.8888***	8.7151	0.0000	
		SMB	**0.5295***	3.3292	0.0011	
		HML	**-0.5424***	-3.7757	0.0002	
		MOM	0.1187	0.9427	0.3477	
Fama French 5 Factor Model	0.5097	Intercept	0.0053	1.3820	0.1695	128
		Mkt-RF	**0.8802***	8.8363	0.0000	
		SMB	0.3169	1.7530	0.0821	
		HML	**-0.5737***	-3.8153	0.0002	
		RMW	-0.5350	-2.2546	0.0259	
		CMA	0.0423	0.1545	0.8775	
q^5 Factor Model	0.4258	Intercept	0.0049	1.1001	0.2736	128
		R_MKT-RF	**0.8338***	6.6236	0.0000	
		R_ME	0.1653	0.8235	0.4119	
		R_IA	-0.3812	-1.3659	0.1746	
		R_ROE	**-0.4842***	-1.9899	0.0490	
		R_EG	0.3879	1.3200	0.1895	

*Significant at 5% significance level

Table 3 summarizes the results of CAPM and factor models for healthcare sector portfolios. The main things to look at here are the intercepts or the alphas of the portfolios. From the results it is evident that none of the intercepts or alphas from any model is statistically significant. Which implies that there is no difference between return of the green portfolio and return of the conventional portfolio and statistically the returns are not different from zero. Results from all the models also show that both portfolios are sensitive to market risk factor. The green portfolio is sensitive also to value risk factor but only in five factor model. The conventional portfolio has positive sensitivity to size factor in three factor model as well as four factor model and negative sensitivity to value factor in three factor, four factor and, five factor models. This kind of results imply that the funds are comprised largely of small and growth stocks. According to the results of q5 factor model the conventional portfolio is sensitive to investment factor. Another thing to notice is that the values of adjusted R squared is higher in all factor models of conventional portfolio compared to than that of factor models of green portfolio and overall, for both portfolios the values are not very high. Which implies that the models, specially for the green portfolio are missing factor(s) which may better explain the returns of the portfolios.

6.2 Mid Cap Category

Table 4: Descriptive Statistics

Type	Ticker	Average Excess Return	Min Excess Return	Max Excess Return	S.D.	Skewness	Kurtosis
Green Fund	LBGAX	1.43%	-18.59%	24.35%	0.060	0.060	2.652
	FAMEX	1.18%	-14.69%	12.76%	0.041	0.041	1.997
	JNVIX	1.09%	-17.38%	15.31%	0.051	0.051	2.367
	LSLTX	1.11%	-17.23%	13.87%	0.045	0.045	2.277
	OTCIX	0.04%	-2.82%	1.92%	0.008	0.008	0.928
	OTCHX	1.32%	-13.10%	16.67%	0.047	0.047	1.644
	JNVSX	1.07%	-17.24%	15.13%	0.050	0.050	2.365
	OTCJX	1.34%	-13.07%	16.34%	0.047	0.047	1.583
	Port	1.07%	-12.80%	12.83%	0.038	-0.270	2.068
Conventional Fund	JCNAX	1.14%	-18.58%	21.58%	0.055	-0.163	2.824
	PARMX	1.10%	-16.52%	10.83%	0.039	-0.670	2.947
	AASCX	0.05%	-2.87%	2.57%	0.009	0.070	0.332
	PFSLX	1.28%	-18.27%	19.71%	0.057	-0.247	2.274
	SBMAX	1.11%	-19.76%	17.48%	0.052	-0.328	2.716
	FMCSX	1.14%	-21.59%	21.96%	0.054	-0.514	4.393
	VSEQX	1.26%	-22.80%	22.70%	0.057	-0.505	4.422
	GCMAX	1.04%	-22.97%	28.29%	0.064	-0.197	5.335
	Port	1.04%	-21.17%	23.86%	0.043	-0.487	4.259

Table 4 summarizes descriptive statistics of mid cap category funds and portfolios. According to the descriptive statistics conventional portfolio has the higher average excess return compared to green portfolio. Conventional portfolio has slightly higher standard deviation of excess return than that of green portfolio which imply than excess return of conventional portfolio is slightly more volatile than the excess return of green portfolio. Both portfolios have negatively skewed distribution of excess return which implies there are many small wins and a few large losses for both portfolios. We can also see that as opposed to healthcare sector portfolios, here green portfolio is platykurtic and conventional portfolio is leptokurtic.

Table 5: Sharpe Ratio

Name	Sharpe Ratio
Green Portfolio	0.2792
Conventional Portfolio	0.2372

Table 5 shows that green portfolio has higher Sharpe ratio compared to than that of conventional portfolio. Therefore, in terms of Sharpe ratio the performance of green portfolio is better than conventional portfolio.

Table 6: Regression Results of CAPM & Factor Models

Green Portfolio						
Measures	**Ad. R^2**	**Intercepts & Factors**	**Coeff.**	**T stat**	**P-Value**	**No of Observations**
CAPM	0.8206	Intercept	-0.0003	-0.1796	0.8577	128
		Mkt-RF	**0.8695***	24.122	0.0000	
Fama French 3 Factor Model	0.8228	Intercept	-0.0004	-0.2848	0.7763	128
		Mkt-RF	**0.8631***	22.332	0.0000	
		SMB	0.0787	1.2417	0.2167	
		HML	-0.0775	-1.5327	0.1279	
Carhart´s Four Factor Model	0.8214	Intercept	-0.0004	1.0413	0.2998	128
		Mkt-RF	**0.8614***	8.7151	0.0000	
		SMB	**0.0782***	3.3292	0.0011	
		HML	**-0.0811***	-3.7757	0.0002	
		MOM	-0.0067	0.9427	0.3477	
Fama French 5 Factor Model	0.8245	Intercept	-0.0003	-0.1920	0.8481	128
		Mkt-RF	**0.8427***	21.013	0.0000	
		SMB	0.0952	1.3082	0.1933	
		HML	-0.0240	-0.3966	0.6924	
		RMW	0.0445	0.4654	0.6425	
		CMA	-0.1926	-1.7466	0.0832	
q^5 Factor Model	0.8252	Intercept	-0.0002	-0.1390	0.8897	128
		R_MKT-RF	**0.8319***	17.581	0.0000	
		R_ME	0.0406	0.5376	0.5919	
		R_IA	**-0.2515***	-2.3980	0.0181	
		R_ROE	0.0422	0.4618	0.6451	
		R_EG	-0.0795	-0.7199	0.4730	
Conventional Portfolio						
Measures	**Ad. R^2**	**Intercepts & Factors**	**Coeff.**	**T stat**	**P-Value**	**No of Observations**
CAPM	0.7505	Intercept	-0.0015	-0.7807	0.4364	128
		Mkt-RF	**0.9263***	19.576	0.0000	
Fama French 3 Factor Model	0.7564	Intercept	-0.0008	-0.3877	0.6989	128
		Mkt-RF	**0.8846***	17.534	0.0000	
		SMB	0.1438	1.7371	0.0849	
		HML	0.0811	1.2289	0.2214	
	0.7545	Intercept	-0.0008	-0.3761	0.7075	128

Measures	Ad. R^2	Intercepts & Factors	Coeff.	T stat	P-Value	No of Observations
Carhart´s Four Factor Model		Mkt-RF	**0.8833***	16.548	0.0000	
		SMB	0.1434	1.7218	0.0876	
		HML	0.0784	1.0428	0.2991	
		MOM	-0.0050	-0.0759	0.9397	
Fama French 5 Factor Model	0.7610	Intercept	-0.0005	-0.2677	0.7894	128
		Mkt-RF	**0.8539***	16.386	0.0000	
		SMB	0.1634	1.7271	0.0867	
		HML	**0.1639***	2.0829	0.0394	
		RMW	0.0532	0.4284	0.6691	
		CMA	**-0.2935***	-2.0473	0.0428	
q^5 Factor Model	0.7638	Intercept	0.0000	-0.0197	0.9843	128
		R_MKT-RF	**0.8266***	13.538	0.0000	
		R_ME	0.0452	0.4643	0.6433	
		R_IA	-0.2044	-1.5092	0.1340	
		R_ROE	-0.0562	-0.4759	0.6351	
		R_EG	-0.2172	-1.5230	0.1305	

*Significant at 5% significance level

Table 6 summarizes the result of CAPM and factor models of mid cap category portfolios. The results show that none of the portfolios has statistically significant intercepts or alphas. Thus, we can conclude that there is no difference in the returns of the green and the conventional portfolios and statistically they are not different from zero. The portfolios are sensitive to market risk factor according to the results of all the models under our consideration. The green portfolio has positive sensitivity to the size factor and negative sensitivity to the value factor as per the result of four factor model. Which implies that the assets of the funds include more small and growth stocks than big and value stocks. The conventional portfolio has positive relationship with value factor and negative relationship with investment factor according to the results of five factor model. It implies that the conventional funds are comprised largely of value stocks. It also, indicated that the conventional funds largely include stocks which invest aggressively rather than conservatively. The values of adjusted R squared across all models in this category is above 70% which is an indication that the models can explain the returns of the portfolios quite well.

6.3 Large Cap Growth Category

Table 7: Descriptive Statistics

Type	Ticker	Average Excess Return	Min Excess Return	Max Excess Return	S.D.	Skewness	Kurtosis
Green Fund	EGFIX	1.68%	-12.23%	14.55%	0.043	-0.087	0.869
	EGFFX	1.66%	-12.44%	14.52%	0.044	-0.088	0.865
	LCGFX	1.55%	-20.97%	25.15%	0.051	0.023	5.327
	LCGNX	1.53%	-21.53%	25.89%	0.052	0.042	5.700
	Port	1.60%	-16.79%	19.41%	0.046	-0.099	2.924
Conventional Fund	FOCPX	1.72%	-12.07%	15.37%	0.056	-0.117	-0.096
	TRLGX	1.61%	-14.63%	20.29%	0.052	0.316	2.247
	FDGRX	1.78%	-14.74%	18.37%	0.056	0.198	0.901
	FKDNX	1.63%	-11.89%	15.56%	0.049	-0.048	0.352
	Port	1.69%	-12.58%	16.20%	0.051	0.053	0.587

Table 7 represents descriptive statistics of large cap growth category funds and portfolios. The table shows that, conventional portfolio has slightly better average excess return compared to green portfolio. Considering standard deviations of excess returns, the conventional portfolio is more volatile than the green portfolio. Excess return distribution of the green portfolio is negatively skewed which means it has frequent small wins and few large losses where conventional portfolio positively skewed excess return distribution and the interpretation for that is just the opposite than that of green portfolio. Both portfolios are platykurtic; however, conventional portfolio is more platykurtic than the green portfolio.

Table 8: Sharpe Ratio

Name	Sharpe Ratio
Green Portfolio	0.3466
Conventional Portfolio	0.3315

According to the Table 8 both portfolios have almost similar Sharpe ratios; however, Sharpe ratio of the green portfolio is a bit higher than that of conventional portfolio. Therefore, excess return considering per unit risk is a bit higher for green portfolio than conventional portfolio.

Table 9: Regression Results of CAPM & Factor Models

Green Portfolio

Measures	Ad. R^2	Intercepts & Factors	Coeff.	T stat	P-Value	No of Observations
CAPM	0.7140	Intercept	0.0037	1.6056	0.1109	128
		Mkt-RF	**0.9775***	17.836	0.0000	

Measures	Ad. R^2	Intercepts & Factors	Coeff.	T stat	P-Value	No of Observations
Fama French 3 Factor Model	0.7679	Intercept	0.0018	0.8455	0.3994	128
		Mkt-RF	**1.0335***	19.396	0.0000	
		SMB	-0.0181	-0.2067	0.8366	
		HML	**-0.3855***	-5.5292	0.0000	
Carhart´s Four Factor Model	0.7660	Intercept	0.0018	0.8486	0.3977	128
		Mkt-RF	**1.0316***	18.297	0.0000	
		SMB	-0.0187	-0.2123	0.8323	
		HML	**-0.3895***	-4.9036	0.0000	
		MOM	-0.0074	-0.1064	0.9154	
Fama French 5 Factor Model	0.7757	Intercept	0.0023	1.1020	0.2726	128
		Mkt-RF	**0.9988***	18.283	0.0000	
		SMB	-0.0410	-0.4139	0.6797	
		HML	**-0.2702***	-3.2779	0.0014	
		RMW	-0.0584	-0.4487	0.6544	
		CMA	**-0.3711***	-2.4705	0.0149	
q^5 Factor Model	0.7540	Intercept	0.0013	0.5787	0.564	128
		R_MKT-RF	**1.0184***	15.203	3E-29	
		R_ME	-0.2053	-1.9221	0.0571	
		R_IA	**-0.4841***	-3.2605	0.0015	
		R_ROE	-0.0544	-0.4220	0.6738	
		R_EG	0.0707	0.4523	0.6519	
Conventional Portfolio						
Measures	**Ad. R^2**	**Intercepts & Factors**	**Coeff.**	**T stat**	**P-Value**	**No of Observations**
CAPM	0.7444	Intercept	0.0031	1.2790	0.2032	128
		Mkt-RF	**1.0984***	19.260	0.0000	
Fama French 3 Factor Model	0.8282	Intercept	0.0008	0.3987	0.6908	128
		Mkt-RF	**1.1477***	22.758	0.0000	
		SMB	0.1017	1.2290	0.2214	
		HML	**-0.5252***	-7.9565	0.0000	
Carhart´s Four Factor Model	0.8269	Intercept	0.0007	0.3628	0.7174	128
		Mkt-RF	**1.1529***	21.606	0.0000	
		SMB	0.1034	1.2417	0.2167	
		HML	**-0.5143***	-6.8404	0.0000	
		MOM	0.0203	0.3087	0.7581	
Fama French 5 Factor Model	0.8542	Intercept	0.0019	1.0510	0.2953	128
		Mkt-RF	**1.1045***	22.788	0.0000	
		SMB	-0.0176	-0.1996	0.8421	
		HML	**-0.3380***	-4.6202	0.0000	

Measures	Ad. R^2	Intercepts & Factors	Coeff.	T stat	P-Value	No of Observations
		RMW	-0.3111	-2.6941	0.0081	
		CMA	**-0.5410***	-4.0590	0.0001	
q^5 Factor Model	0.8305	Intercept	0.0006	0.2759	0.7831	128
		R_MKT-RF	**1.1223***	18.289	0.0000	
		R_ME	-0.1408	-1.4391	0.1529	
		R_IA	**-0.7084***	-5.2062	0.0000	
		R_ROE	**-0.3640***	-3.0677	0.0027	
		R_EG	**0.3485***	2.4321	0.0166	

*Significant at 5% significance level

Table 9 summarizes the results of CAPM and factor models of large cap growth category portfolios. According to the results none of the portfolios has statistically significant alphas or intercepts in any model. Which imply that there is no difference between the returns of the conventional and the green portfolios and statistically they are not different from zero. Both portfolios are prone to market risk according to the results of all the models. Both portfolios have negative sensitivities to value factor according to three factors, four factor and five factor models. Which implies that the funds are comprised largely of growth stocks. Indeed, category wise funds in this category should be based on growth stocks. Both portfolios have statistically significant negative coefficients for investment factor from five factor model. The implication of this kind result is that the funds are comprised of stocks which invest aggressively rather than conservatively. The results from q5 factor models show the green portfolio is sensitive to investment factor only whereas the conventional portfolio is sensitive to all the factors apart from the size factor.

6.4 Large Cap Value Category

Table 10: Descriptive Statistics

Type	Ticker	Average Excess Return	Min Excess Return	Max Excess Return	S.D.	Skewness	Kurtosis
Green Fund	GMUEX	-0.87%	-16.10%	21.45%	0.052	0.753	3.026
	GMCQX	1.21%	-17.78%	19.33%	0.052	-0.132	2.150
	VWNAX	1.17%	-17.78%	18.96%	0.049	-0.316	3.200
	VWNFX	1.16%	-17.74%	18.88%	0.049	-0.319	3.200
	Port	0.67%	-14.27%	13.86%	0.040	-0.293	2.061
Conventional Fund	GMUEX	1.10%	-13.60%	15.92%	0.041	-0.372	2.155
	GMCQX	1.17%	-17.42%	18.70%	0.048	-0.474	3.521
	VWNAX	1.01%	-15.89%	13.19%	0.041	-0.430	2.915

Type	Ticker	Average Excess Return	Min Excess Return	Max Excess Return	S.D.	Skewness	Kurtosis
	VWNFX	1.10%	-15.76%	15.20%	0.040	-0.577	4.373
	Port	1.10%	-14.96%	13.54%	0.041	-0.499	3.306

Table 10 presents some descriptive statistics of the funds and portfolios from large cap value category. If we consider the average excess return, then conventional portfolio is a winner. Both portfolios have similar standard deviations. The excess return distributions of both portfolios are negatively skewed which implies than there are frequent small wins and few but large losses for both portfolios. The green portfolio is platykurtic whereas the conventional portfolio is slightly leptokurtic.

Table 11: Sharpe Ratio

Name	Sharpe Ratio
Green Portfolio	0.1676
Conventional Portfolio	0.2658

Results from the Table 12 show that the conventional portfolio has a slightly better Sharpe ratio than that of the green portfolio.

Table:12 Regression Result of CAPM & Factor Models

Green Portfolio

Measures	Ad. R^2	Intercepts & Factors	Coeff.	T stat	P-Value	No of Observations
CAPM	0.5969	Intercept	-0.0032	-1.3419	0.1820	128
		Mkt-RF	**0.7717***	13.757	0.0000	
Fama French 3 Factor Model	0.6025	Intercept	-0.0031	-1.2926	0.1986	128
		Mkt-RF	**0.7908***	13.152	0.0000	
		SMB	-0.1543	-1.5643	0.1203	
		HML	0.1029	1.3080	0.1933	
Carhart´s Four Factor Model	0.5997	Intercept	-0.0030	-1.2441	0.2158	128
		Mkt-RF	**0.7836***	12.314	0.0000	
		SMB	-0.1566	-1.5781	0.1171	
		HML	0.0879	0.9814	0.3283	
		MOM	-0.0278	-0.3539	0.7240	
Fama French 5 Factor Model	0.5966	Intercept	-0.0030	-1.2245	0.2231	128
		Mkt-RF	**0.7843***	12.415	0.0000	
		SMB	-0.1615	-1.4088	0.1614	
		HML	0.1258	1.3194	0.1895	
		RMW	-0.0185	-0.1230	0.9023	
		CMA	-0.0717	-0.4129	0.6804	

Measures	Ad. R^2	Intercepts & Factors	Coeff.	T stat	P-Value	No of Observations
q^5 Factor Model	0.6263	Intercept	-0.0041	-1.6107	0.1100	128
		R_MKT-RF	**0.8107***	11.427	0.0000	
		R_ME	**-0.3217***	-2.8439	0.0053	
		R_IA	-0.0647	-0.4114	0.6815	
		R_ROE	0.0085	0.0622	0.9505	
		R_EG	-0.1904	-1.1497	0.2527	
Conventional Portfolio						
Measures	**Ad. R^2**	**Intercepts & Factors**	**Coeff.**	**T stat**	**P-Value**	**No of Observations**
CAPM	0.8851	Intercept	-0.0013	-0.9988	0.3198	128
		Mkt-RF	**0.9709***	31.299	0.0000	
Fama French 3 Factor Model	0.9077	Intercept	-0.0005	-0.4058	0.6856	128
		Mkt-RF	**0.9606***	32.024	0.0000	
		SMB	-0.0905	-1.8394	0.0682	
		HML	**0.2195***	5.5927	0.0000	
Carhart´s Four Factor Model	0.9092	Intercept	-0.0003	-0.2248	0.8225	128
		Mkt-RF	**0.9432***	30.076	0.0000	
		SMB	-0.0960	-1.9620	0.0520	
		HML	**0.1831***	4.1443	0.0001	
		MOM	-0.0676	-1.7457	0.0834	
Fama French 5 Factor Model	0.9064	Intercept	-0.0005	-0.3742	0.7089	128
		Mkt-RF	**0.9640***	30.590	0.0000	
		SMB	-0.1030	-1.8013	0.0741	
		HML	**0.2152***	4.5252	0.0000	
		RMW	-0.0329	-0.4389	0.6615	
		CMA	0.0240	0.2767	0.7825	
q^5 Factor Model	0.9120	Intercept	-0.0005	-0.4219	0.6739	128
		R_MKT-RF	**0.9582***	26.740	0.0000	
		R_ME	**-0.1269***	-2.2218	0.0283	
		R_IA	0.1507	1.8972	0.0603	
		R_ROE	-0.0026	-0.0380	0.9698	
		R_EG	**-0.2012***	-2.4061	0.0177	

*Significant at 5% significance level

Table 12 shows that none of the portfolios has statistically significant alpha in any model. Thus, we can conclude that there is no difference between returns of the conventional portfolio and the green portfolio. The adjusted R squared values across different models are much lower for the green portfolio compared to than those of the conventional portfolio. Which strongly indicates that there is (are) a missing factor(s) that may help to explain the return of the green portfolio better.

If we consider the risk factors then like the previous categories, also in this category market risk factor has statistically significant influence on the return of both portfolios according to every model. The results from q5 factor model shows that both portfolios are sensitive to size risk. Also, the conventional portfolio has negative sensitivity to expected growth factor. According to three factor model, four factor model and, five factor model conventional portfolio is positively sensitive to value risk factor. Which implies that funds are comprise largely of value stocks. Deviation from this kind of result would have been surprising since our portfolios for this sector are comprised of large cap value funds.

6.5 Technology Sector

Table 13: Descriptive Statistics

Type	Ticker	Average Excess Return	Min Excess Return	Max Excess Return	S.D.	Skewness	Kurtosis
Green Fund	FADTX	1.78%	-25.79%	31.02%	0.065	0.229	4.562
	FTHCX	1.73%	-28.29%	35.21%	0.068	0.372	6.274
	FATIX	1.80%	-24.82%	29.47%	0.064	0.182	3.975
	FATEX	1.76%	-26.50%	32.19%	0.066	0.265	5.031
	FSCSX	1.83%	-11.43%	16.39%	0.052	0.198	0.195
	VITAX	1.73%	-9.97%	14.54%	0.047	-0.030	0.033
	Port	1.77%	-20.93%	24.70%	0.058	0.153	2.688
Conventional Fund	FSELX	1.95%	-22.31%	32.43%	0.073	0.134	2.568
	FSPTX	1.76%	-16.90%	17.55%	0.063	0.040	0.364
	JATAX	1.72%	-16.08%	18.42%	0.056	-0.073	1.061
	PGTAX	1.75%	-16.73%	21.76%	0.057	0.226	1.404
	BGSAX	1.81%	-12.44%	18.86%	0.055	0.130	0.371
	GITAX	1.62%	-26.74%	38.46%	0.069	0.810	7.570
	Port	1.77%	-17.34%	23.73%	0.057	0.174	1.693

Results from Table 13 show that both portfolios in this sector have same average excess return, similar standard deviation, and skewness. The positive skewness implies for both portfolios there are frequent small losses and few large gains. Both portfolios are platykurtic which implies there are small outliers in their excess return distributions.

Table 14: Sharpe Ratio

Name	Sharpe Ratio
Green Portfolio	0.3032
Conventional Portfolio	0.3080

Table 14 consists of Sharpe ratios of the portfolios shows that both portfolios have similar Sharpe ratios. Which implies that returns per unit of risk are similar for both portfolios.

Table 15: Regression Results of CAPM & Factor Models

Green Portfolio						
Measures	**Ad. R^2**	**Intercepts & Factors**	**Coeff.**	**T stat**	**P-Value**	**No of Observations**
CAPM	0.6960	Intercept	0.0024	0.8136	0.4174	128
		Mkt-RF	**1.2190***	17.072	0.0000	
Fama French 3 Factor Model	0.7575	Intercept	3.4E-05	0.0124	0.9901	128
		Mkt-RF	**1.2797***	18.606	0.0000	
		SMB	0.0481	0.4261	0.6708	
		HML	**-0.5241***	-5.8237	5E-08	
Carhart´s Four Factor Model	0.7576	Intercept	0.0003	0.1200	0.9047	128
		Mkt-RF	**1.2560***	17.327	0.0000	
		SMB	0.0406	0.3596	0.7198	
		HML	**-0.5739***	-5.6214	0.0000	
		MOM	-0.0924	-1.0321	0.3041	
Fama French 5 Factor Model	0.7758	Intercept	0.0012	0.4502	0.6534	128
		Mkt-RF	**1.2347***	17.905	0.0000	
		SMB	-0.0676	-0.5405	0.5899	
		HML	**-0.3334***	-3.2024	0.0017	
		RMW	-0.3016	-1.8360	0.0688	
		CMA	**-0.5557***	-2.9302	0.0040	
q^5 Factor Model	0.7641	Intercept	-0.0004	-0.1186	0.9058	128
		R_MKT-RF	**1.2728***	15.223	3E-29	
		R_ME	-0.2408	-1.8065	0.0735	
		R_IA	**-0.6990***	-3.7721	0.0003	
		R_ROE	**-0.3960***	-2.4510	0.0158	
		R_EG	0.3485	1.7862	0.0767	
Conventional Portfolio						
Measures	**Ad. R^2**	**Intercepts & Factors**	**Coeff.**	**T stat**	**P-Value**	**No of Observations**
CAPM	0.6159	Intercept	0.0035	1.0636	0.2895	128
		Mkt-RF	**1.1277***	14.303	0.0000	
Fama French 3 Factor Model	0.6666	Intercept	0.0017	0.5503	0.5831	128
		Mkt-RF	**1.1535***	14.555	0.0000	
		SMB	0.1757	1.3516	0.1790	
		HML	**-0.4685***	-4.5181	0.0000	
Carhart´s Four	0.6639	Intercept	0.0018	0.5551	0.5798	128
		Mkt-RF	**1.1510***	13.728	0.0000	

Measures	Ad. R^2	Intercepts & Factors	Coeff.	T stat	P-Value	No of Observations
Factor Model		SMB	0.1749	1.3373	0.1836	
		HML	**-0.4738***	-4.0112	0.0001	
		MOM	-0.0100	-0.0962	0.9235	
Fama French 5 Factor Model	0.6992	Intercept	0.0032	1.0743	0.2848	128
		Mkt-RF	**1.0985***	13.998	0.0000	
		SMB	0.0181	0.1271	0.8991	
		HML	-0.2270	-1.9159	0.0577	
		RMW	**-0.4112***	-2.1987	0.0298	
		CMA	**-0.6951***	-3.2200	0.0016	
q^5 Factor Model	0.7136	Intercept	0.0001	0.0398	0.9683	128
		R_MKT-Rf	**1.1728***	13.078	0.0000	
		R_ME	-0.1527	-1.0678	0.2879	
		R_IA	**-0.8131***	-4.0887	0.0001	
		R_ROE	**-0.3589***	-2.0695	0.0408	
		R_EG	0.3800	1.8147	0.0722	

*Significant at 5% significance level

Results from the Table 15 show that none of the portfolios has statistically significant alphas or intercepts in any factor model. It is a clear indication that the returns of the green portfolio and the conventional portfolio are statistically not different from zero. The green portfolio has negative sensitivity to value factor in three factor, four factor and five factor models. The results also show that, the green portfolio is also sensitive to investment factor in five factor model and investment factor as well as profitability factor in q5 factor model. The conventional portfolio has negative sensitivity to value risk factor, investment factor, profitability factor according to the results of the different models.

7 CONCLUSIONS

Everything comes to an end sooner or later; however, it is almost certain that we all want our environment as well lives to live long. There is a growing concern for our environment and global warming. Investing in the green funds can help to reduce that concern. However, if there is no financial benefit then it is difficult for everyone to continue investing in the green funds. Throughout our writeup we tried to discuss about green funds and did some empirical analysis, now it is time to warp everything up, summarize our findings as well as thoughts and provide some guidance for the future.

Though there have been many studies done before on the performance of SRI and ESG funds there have been considerably limited number of studies solely on the green funds. Also, most of the studies used funds listed in US SIF database. Our study is novel in that way that we used completely new sets of funds from the Morningstar ESG screener. We used the screener with mandate for low carbon emission which is one of the major goals of any green fund to make sure that our funds are not only SRI or ESG funds but as green as possible. We also selected funds from five different sectors or categories to see whether there are any sectoral differences of performance of funds. We selected only small number of high-performance funds and we discussed in detail in survivorship bias section why we did so and how it may limit our results.

To summarize our results, despite choosing funds from five different categories according to the factor models we did not find any statistically significant evidence that green funds perform better or worse than the conventional funds or the market. Our finding is consistent with finding with many previous studies for example with Climent & Soriano (2011). According to our wisdom since statistically the performance or green funds and conventional funds are similar it is not a bad thing to invest in green funds especially since they contribute to reduce the global warming. As per our results in different factor models the funds are sensitive to market risk factors mainly. In many cases the funds show negative sensitivity to value risk factor and positive sensitivity to size risk factor. This kind of finding indicates that the funds are largely comprised of small and growth stocks. Adjusted R squared values in health care sector and technology sector for both portfolios and in large cap value sector for green portfolio suggest that there is a need for better models or factors to explain the returns of the funds, especially green funds. If we look at the descriptive statistics only, like many general investors, conventional funds from all the five categories performed better than the green funds though the performance of green funds is not very far behind. In this case we need to also remember that for comparison purpose we choose all only high performance, or the best funds ranked by USAnews.com.

The scope of our study is somewhat limited since we considered only limited number of high-performance based equity funds. There are a lot do in the

field of research in the future. Some of them includes but not limited to, 1) research on the green bond funds, 2) research on green funds from rating agency other than Morningstar or USA SIF.

Finally, we want to conclude by writing that according to our study by investing in green funds investors are not losing anything. If someone is concerned about global warming or concerned about environment it is not bad idea to invest in at least highly rated green funds based on their performance by a rating firm or agency.

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APPENDIX 1

List of Funds							
Green Funds				Conventional Funds			
Name	Ticker	Ineption	Net Assets ($ million)	Name	Ticker	Ineption	Net Assets ($ million)
Health Care							
Fidelity Select Health Care Services Portfolio	FSHCX	Jun 30, 1986	1,141	Fidelity Select Medical Technology and Devices Portfolio	FSMEX	Apr 28, 1998	10,385
Live Oak Health Sciences Fund	LOGSX	Jun 29, 2001	51	T. Rowe Price Health Sciences Fund	PRHSX	Dec 29, 1995	16,893
Saratoga Health & Biotechnology Portfolio Fund Class A	SHPAX	Jul 15, 1999	5	Fidelity Select Health Care Portfolio	FSPHX	Jul 14, 1981	10,227
Saratoga Health & Biotechnology Portfolio Fund Class C	SHPCX	Jan 18, 2000	0.7	PGIM Jennison Health Sciences Fund- Class A	PHLAX	Jun 30, 1999	929
Saratoga Health & Biotechnology Portfolio Fund Class Institutional	SBHIX	Jan 28, 2003	8	Janus Henderson Global Life Sciences Fund Class A	JFNAX	Jul 06, 2009	298
Mid Cap							
ClearBridge Mid Cap Growth Fund Class A	LBGAX	Aug 31, 2010	122	Janus Henderson Contrarian Fund Class A	JCNAX	Jul 06, 2009	67
FAM Dividend Focus Fund Investor Class	FAMEX	Apr 01, 1996	623	Parnassus Mid Cap Fund	PARMX	Apr 29, 2005	2,997
Jensen Quality Value Fund Class I	JNVIX	Mar 31, 2010	82	Thrivent Mid Cap Stock Fund Class A	AASCX	Jun 30, 1993	1,590
Leuthold Select Industries Fund	LSLTX	Jun 19, 2000	17	Paradigm Select Fund	PFSLX	Jan 03, 2005	132.00
MFS Mid Cap Growth Fund Class I	OTCIX	Jan 02, 1997	4,382	ClearBridge Mid Cap Fund Class A	SBMAX	Sep 01, 1998	1,376
MFS Mid Cap Growth Fund Class R3	OTCHX	Apr 01, 2005	758	Fidelity Mid-Cap Stock Fund	FMCSX	Mar 29, 1994	6,104
Jensen Quality Value Fund Class J	JNVSX	Mar 31, 2010	41	Vanguard Strategic Equity Fund Investor Shares	VSEQX	Aug 14, 1995	8,262
MFS Mid Cap Growth Fund Class R4	OTCJX	Apr 01, 2005	386	Goldman Sachs Mid Cap Value Fund Class A	GCMAX	Aug 15, 1997	529
Large Cap Growth							
Edgewood Growth Fund Class Institutional	EGFIX	Feb 28, 2006	31,959	Fidelity OTC Portfolio	FOCPX	Dec 31, 1984	23,336
Edgewood Growth Fund Retail Class	EGFFX	Feb 28, 2006	967	T. Rowe Price Large-Cap Growth Fund I Class	TRLGX	Oct 31, 2001	24,478
William Blair Large Cap Growth Fund Class I	LCGFX	Dec 27, 1999	630	Fidelity Growth Company	FDGRX	Jan 17, 1983	53,776
William Blair Large Cap Growth Fund Class N	LCGNX	Dec 27, 1999	192	Franklin DynaTech Fund Class A	FKDNX	Jan 02, 1968	13,047
Large Cap Value							
GMO U.S. Equity Fund Class II	GMUEX	Sep 18, 1985	109	Fidelity Growth & Income Portfolio	FGRIX	Dec 30, 1985	7,215
GMO U.S. Equity Fund Class VI	GMCQX	Jun 30, 2003	353	T. Rowe Price Value Fund	TRVLX	Sep 30, 1994	5,654
Vanguard Windsor II Fund Admiral Shares	VWNAX	May 14, 2001	46,833	Fidelity Value Discovery Fund	FVDFX	Dec 10, 2002	3,080
Vanguard Windsor II Fund Investor Share	VWNFX	Jun 24, 1985	13,734	Vanguard Equity-Income Fund Investor Shares	VEIPX	Mar 21, 1988	5,533
Technology Sector							
Fidelity Advisor Technology Fund Class A	FADTX	Sep 03, 1996	2,002	Fidelity Select Semiconductors Portfolio	FSELX	Jul 29, 1985	9,393
Fidelity Advisor Technology Fund Class C	FTHCX	Nov 03, 1997	434	Fidelity Select Technology Portfolio	FSPTX	Jul 14, 1981	13,230
Fidelity Advisor Technology Fund Class I	FATIX	Sep 03, 1996	1,592	Janus Henderson Global Technology and Innovation Fund Class A	JATAX	Jul 06, 2009	338
Fidelity Advisor Technology Fund Class M	FATEX	Sep 03, 1996	677	Putnam Global Technology Fund Class A	PGTAX	Dec 18, 2008	547
Fidelity Select Software & IT Services Portfolio	FSCSX	Jul 29, 1985	13,205	BlackRock Technology Opportunities Fund Investor A Shares	BGSAX	May 15, 2000	2,825
Vanguard Information Technology Index Fund Admiral Shares	VITAX	Mar 25, 2004	7,514	Goldman Sachs Technology Opportunities Fund Class A	GITAX	Oct 01, 1999	486