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ESSAYS ON THE VALUE OF A FIRM'S ECO-FRIENDLINESS IN THE FINANCIAL ASSET MARKET

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Dissertation

A dissertation submitted in partial fulfillment of the
requirements for the degree of Doctor of Philosophy in the
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ABSTRACT OF DISSERTATION

ESSAYS ON THE VALUE OF A FIRM'S ECO-FRIENDLINESS
IN THE FINANCIAL ASSET MARKET

This dissertation presents three different closely related topics on the value of eco-friendliness in the financial market. The first essay attempts to estimate hedonic stock price model to find a contemporaneous relationship between stock return and firms' environmental performance and recover the value of investor's willingness to pay of eco-friendliness. This study follows stock and environmental performances of the 500 largest US firms from 2009 to 2012. The firms' environmental data come from the Newsweek Green Ranking, both aggregate measures: green ranking (GR) and green score (GS), and disaggregate measures: environmental impact score (EIS), green policy and performance score (GPS), reputation survey score (RSS), and environmental disclosure score (EDS). The results show a non-linear relationship between environmental variables and stock return, i.e. upside down bowl shape or increasing in decreasing rate. That means for low green ranking firms the marginal effect is positive while for high green ranking firms the marginal effect is negative. The investor's willingness to pay (WTP) for a greener stock for firms in the lowest 25 green ranking, on average, is 0.0096% higher stock price

The second essays attempt to determine if a firm's environmental performance affects future systematic risk. Systematic risk measures an individual stock's volatility relative to the market price. This study also uses the Newsweek Green Ranking's environmental variables. The results show significant evidence of a non-linear relationship between green variables and systematic (market) risk, but the shape is not unanimous for all environmental variables. The shape of the relationship for green ranking (GR), for example, is U-shape. This means that for the firms in the bottom rank, improving rank will lower systematic (market) risk, and for the firms in the top rank improving rank will increase systematic (market) risk. On average the marginal effect for the firms in the bottom and top 25 firms are -0.2% and 0.09% respectively.

The third essay is the effect of a firm's environmental performances on a firm's idiosyncratic risk. Idiosyncratic risk measures an individual stock's volatility independent from the market price. This study also uses the Newsweek Green Ranking's environmental variables. The results show significant non-linear relationships between environmental variables and idiosyncratic risk, even though there is no unanimous shape among the environmental variables. In the case of green ranking, for example, it has U-shape; for the firms in the bottom rank, improving green ranking will lower idiosyncratic risk and for firm in the top green ranking, improving green ranking will increase idiosyncratic risk. On average the marginal effect for firm in bottom and top 25 firms are -0.4% and 0.2% respectively.

KEYWORDS**:** Hedonic Stock Price Model, Newsweek Green Ranking,
CAPM, Systematic Risk, Idiosyncratic risk.

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December 17, 2014
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Almarhum Bapakku

Ibukku

Istriku

Sedulur-sedulurku

Anak-anakku

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Chapter 1: Introduction

The green movement in the United States has recently picked up pace dramatically and has branched toward consumers' preferences. The movement of environmentally conscientious consumers changes the way consumers shop. The last three Gallup polls, 2000, 2003, and 2008, showed that roughly 80% of consumers have made either minor or major changes in their shopping and living habits to protect the environment over the last five years (Jones 2008). As a consequence, producers responded by providing more environmentally friendly goods and services, ranging from biodegradable cups to hybrid or electric cars.

The movement also gained pace in the financial sector, particularly in consumers' decisions to invest their wealth in stocks and mutual funds. Over the last three decades, demand for socially responsible mutual funds[1] has reached 22% (1995) and 28% (2012) of total US investment in the fund market (Social-Investment-Forum 2012, Investment Company Institute (U.S.) 2014). Among the screens commonly used in selecting investment instruments is the environmental screen. This rapid growth of socially responsible funds attracted economists puzzled about the role of green values in the investment choice (Derwall, Guenster et al. 2005).

Numerous empirical studies have been conducted to investigate the effect of a firm's environmental consciousness on how the public values the firm's stock. In general, these studies found significant correlation between firms' environmental conduct and their

[1] Socially responsible investment define as an investment, usually in mutual funds, that use screen(s) in choosing stock for a portfolio. The screen will determine what stock will be included in a portfolio. The screen can be gun control, environmental performance, tobacco, diversity, etc.

stock prices or returns (Rao 1996, Gupta and Goldar 2005, Takeda and Tomozawa 2006, Ragothaman and Carr 2008, Yamaguchi 2008). The correlation between firms' greenness and the asset's return, however, is inconclusive with studies showing positive (Derwall, Guenster et al. 2005), negative (Statman 2000), and indifferent relationships (Bello 2005). The approaches mostly use portfolio, event, and regression studies (Wagner, Van Phu et al. 2002, Derwall, Guenster et al. 2005), which fall under the revealed preference method. There has been development in this field to explore the "back door" role of firm's environmental conduct in the stock market by finding the effect of the conduct to the stock risk (Oikonomou, Brooks et al. 2012).

This study contributes to the economic field in important ways. First, the result of this study enriches the field of environmental economics and finance. Second, the estimation of investor's willingness to pay (WTP) provides a significant piece of information for firms and investors to estimate cost and benefit analysis in deciding if green investment is feasible economically. Finally, the result of the second and third papers, which investigate the correlation between eco-friendliness and the market and idiosyncratic risk, benefit corporation and fund managers to foresee how being green affects the asset's risk in the market.

This dissertation conducts three different but closely related researches to complement what previous studies have found. First, this study uses Rosen's hedonic model to estimate investors' willingness to pay (WTP) for of eco-friendly characteristics in the stock market. This study uses the Newsweek Green Ranking of the 500 largest US companies and their stock price data to estimate the WTP. The second study attempts to explore the effect of improvement in environmental performance to systematic or market (beta) risk. Finally, the third study attempts to explore the effect of improvement in environmental performance to unsystematic (idiosyncratic) risk.

In brief, the results affirm most of the hypothesis. In all three studies, there are evidence of non-linear relationship between firm's environmental performances and stock return (upside down bowl shape) and firm's environmental performances and risks, either market or idiosyncratic risk (mostly U-shape). The value of investor's willingness to pay (WTP) for a greener firm is on average about 0.0185% higher stock price. For firms in low green ranking improving their green ranking by one rank lowers systematic (market) and idiosyncratic risk by as much as 0.2% and 0.4% respectively.

Chapter 2: A Hedonic Stock Price Model for Environmentally Friendly American Largest Firms

1. Introduction

Information on whether a firm is environmentally friendly or unfriendly has become readily available to the public, either in the news or in the form of third party publications. The news on the British Petroleum (BP) Gulf disaster, for example, became part of the 24-7 news cycle for months. There are also several third parties, government and non-government agents, reporting on firms' environmental policies and conduct; the Environmental Protection Agency (EPA) publishes firms' toxic release inventory (TRI), *Fortune Magazine* publishes environmental consciousness score, Kinder, Lynberg, and Domini (KLD) Research Analytic publishes environmental, social, and governance performances of US firms, etc. One of the newest rankings is the *Newsweek* Green Ranking[2] of the 500 largest public firms in the United States. The logical question for investors is how such an information explosion affects their financial assets in the market.

This study attempts to explain the relationship between firms' environmental and stock market performance. Economists developed the hedonic price model (Rosen 1974) in an attempt to capture the value of non-market environmental amenity. Utility maximizing consumers will choose a stock tangent with the characteristic of the product. Based on that choice we can estimate the value of an investor's willingness to pay (WTP) for firms' environmental conduct and policy using Rosen's hedonic price model as applied to aggregate stock price data.

[2] The Newsweek Green Ranking was inaugurated in 2009, and continue its annual report until 2012. It did not publish its ranking in 2013 due to acquisition by The *Daily Best*. It resumed publishing its green ranking in 2014. This dissertation uses data of the Newsweek Green Ranking from 2009 to 2012.

Numerous studies sought to find out the relationship of environmental and stock performances. Yet the results have been mixed: some show positive effects (Klassen and McLaughlin 1996, Konar and Cohen 1997, Derwall, Guenster et al. 2005, Ziegler, Schröder et al. 2008), negative effects (Thomas 2001, Filbeck and Gorman 2004, Brammer, Brooks et al. 2006, Bird, Hall et al. 2007), and some show no significant effect (Yamashita, Sen et al. 1999, Filbeck and Gorman 2004, Takeda and Tomozawa 2006, Mănescu 2011). See Table 1.1. Moreover, those studies indicate a lack of empirical works in investigating a non-dichotomous (non-linear) relationship between environmental and stock performances.

This study uses short panel data analysis, which will provide a robust estimate of the value of willingness to pay (WTP). The data included stock market data, firms' data, and the Newsweek Green Ranking for the period of 2009, 2010, 2011, and 2012. The use of short panel data in this study will help to mitigate the heterogeneity issues persisting in most cross section or firm-level studies. Furthermore, we will explore a non-linear relationship between environmental variables and the stock prices. Such relationship has been identified in previous studies (Wagner, Schaltegger et al. 2001, Wagner, Van Phu et al. 2002, Barnett and Salomon 2003), but only one study has pursued the non-linear relationship between environmental variables and stock return empirically (Barnett and Salomon 2006). In brief, the results show significant non-linear relationships between environmental and stock return, i.e. an upside down bowl shape (concave shape). Due to non-linear relationship, the investor willingness to pay is not constant. The investor's willingness to pay for eco-friendliness for the bottom 25 rank is about 0.0096%.

The remainder of this part will proceed as following. First, a review of previous studies provides a framework for an empirical test including the use of control variables. Second, a methodological approach outlining the organization of the hypothesis testing is presented. Finally, at the end of this part, results and discussion are presented and conclusions are drawn.

2. Literature Review

This section discusses three important aspects of the literature on the stock price model and environmental economics. The first section discusses earlier studies that examine the effect of firms' environmental performance to the stock price to describe how environmental economists answer the issues. The second section discusses how the hedonic model can be applied to stock prices to provide a theoretical framework on how investors value environmental attributes of stock. In the last section, we will provide a framework for estimating a hedonic price model using a known financial theory, i.e. the Capital Assets Pricing Model (CAPM).

2.1. Earlier Studies on Firms' Eco-friendliness and Stock Return

There are a vast number of studies on the stock market, and only a small section of those studies focus on environmental and stock performance. In general, the studies attempting to investigate the effect of environmental performances to stock return employs three different methods: event studies, portfolio studies, and regression studies. All of the studies use the capital asset pricing model (CAPM).

2.1.1. Event studies approach

The event study method is widely used in the finance field to identify unanticipated events impacting a firm's value (MacKinlay 1997). Environmental economists use this method to identify the effect of an environmental “event” to the value of firms. Examples of internal environmental events include disclosure of toxic release inventory (TRI) by a firm (Konar and Cohen 1997), announcement of environmental ranking: Newsweek Green Ranking, Fortune, India Green Ranking, or Japan Green Ranking (Yamashita, Sen et al. 1999, Gupta and Goldar 2005, Takeda and Tomozawa 2006, Yamaguchi 2008, Anderson-Weir 2010), unethical conduct of environmental pollution announced in the Wall Street Journal (Rao 1996). Examples of external environmental events include: a law suit triggered by environmental destruction or a new EPA regulation (Bosch, Eckard et al. 1998).

There are several basic steps in conducting the event study (Henderson Jr 1990, MacKinlay 1997). The first step is defining the date when an event occurs. The crucial aspect of this step is determining when the market realizes such an event. Based on this event date we can define an *event window*, several days, weeks, or months before or after the event date. This is the window where one can observe whether anything unusual occurred. Inability to pin point the event date can invalidate hypothesis testing. The second step is calculating the return of individual stock in the absence of the event, by using predicted value of the stock return or the industry’s average return. The third step is measuring abnormal return, the difference between the observed stock return and the stock return in the absence of the event. The fourth step is aggregating the abnormal return across time and across firms. Finally, a statistical test is used to find out if the abnormal returns are statistically significant.

Numerous studies examine the relationship between environmental and stock performances using the event study method. Some studies found that an announcement of negative news (e.g. unethical conduct and EPA rule violation) tends to lower stock return (Rao 1996, Konar and Cohen 1997, Bosch, Eckard et al. 1998, Gupta and Goldar 2005, Karpoff, Lott Jr et al. 2005). Different studies found that when there is positive news (e.g. publications of spending on environmental related research and development (R&D) and green rankings), stock performance increases (Klassen and McLaughlin 1996, Nagayama and Takeda 2006, Yamaguchi 2008). There are several arguments that underline such relationships: investors view a firm's EPA violation as a potential cost for holding their stocks, a firm's high level of toxic release inventory (TRI) as a signal of firms inefficiency, and a firm's good current environmental performances (e.g. green ranking) as a predictor of future financial success.

Some studies showed no significant correlation between environmental and stock performances (Yamashita, Sen et al. 1999, Takeda and Tomozawa 2006, Anderson-Weir 2010). Heteroskedasticity often plays an important role in the results of a study like in Takeda and Tomozawa (2006). This study did not find significant correlation between environmental performance and stock return. However, Yamaguchi (2008) revisited and reversed the result of the earlier study by Takeda and Tomozawa (2006) by incorporating heteroskedasticity.

Three critical assumptions underlie the identification of abnormal return. Not addressing these assumptions can invalidate event study results, in some cases, leading to a reversal of the results (McWilliams and Siegel 2000). The first assumption is that the market is efficient; the stock market incorporates all relevant information instantaneously into its price. The implication of this assumption to the design of an event study is by designing a short event window. Some studies use a long event window as long as ±90 to

±100 days, and some use a short event window as short as ±1 to ±5 days. An explanation of window length choice may be necessary to justify the use of a long event window in light of a potential violation of this hypothesis. The second assumption is that the event is unanticipated; the market previously did not know the information until the revelation of such an event. Because of this revelation the stock market will respond and the study will be able to identify an abnormal return. If the stock market knows of the event before it was revealed then the study will not be able to show the proper results. The last assumption is that there are no confounding effects; a researcher is able to isolate the effects of factors we seek to test from other factors. Failure to isolate other factors which could potentially affect the value of the stocks will invalidate the results.

To show how important the assumptions are, McWilliams and Siegel replicated three different event studies. Those studies show a significant relationship between corporate social responsibility (CSR) and stock return. The studies chose to use a long event window. That raises the possibility of a violation of the no confounding factors assumption. In one of the three studies, after eliminating firms which have confounding events, none of the sample remains. In another study, only 5 firms remain in the sample. In the other study only 13 firms remain in the sample. After performing event study statistical test to the remaining sample, as expected, the results reverse the earlier conclusions.

Only two studies, discussed in the previous section, addressed the issue of confounding factors (Rao 1996, Bosch, Eckard et al. 1998), but the rest of them did not. The validity of the other studies may be questionable. The issue of confounding factors may be less of a concern for studies who use shorter event windows (e.g. one to five days window (Konar and Cohen 1997, Karpoff, Lott Jr et al. 2005, Takeda and Tomozawa 2006)). This narrow window lowers the chance that confounding factor(s) can occur. However, Nagayama and Takeda's study did not address the confounding factors even in their long run event window, i.e. ±26 days.

2.1.2. Portfolio Studies approach

Markowitz (1952) in his seminal paper provides an early concept of how to select a portfolio with the goal of maximizing expected return by the diversification of assets. This can be done by choosing various securities and placing them in the portfolio "basket." This selection is conducted by sorting securities based on characteristics of interest, and identifying if there is a significant difference in the stock returns from different baskets. Environmental economists use this approach to find out if groups of security selections based on environmental performances have significant differences in their expected returns. The grouping can be in different fashions: green versus non-green basket, greener versus less-green, etc.

There are several models of efficient portfolio selection commonly used in modern financial fields. These models include Single-Index, Multi-Index and Multi-Group, Constant Correlation, Geometric Mean Model, Stochastic Dominance, and Skewness Portfolio (Arditti 1967, Cohen and Pogue 1967, Sharpe 1967, Wallingford 1967, Young and Trent 1969, Porter and Gaumnitz 1972, Bawa 1978). The multi-group model is most commonly used by researchers in environmental economics (Cohen, Fenn et al. 1997, Filbeck and Gorman 2004)

Elton, Gruber et al. (1977) explain in detail the multi-group model procedures in selecting portfolios. In practice, stocks are divided into different groups, say, by industries.

This model assumes that the correlation coefficient between firms in one group are identical. Furthermore, it assumes that the correlation matrix can be partitioned and the correlation coefficients in each partition are the same, while the correlation coefficient among sub-matrices may be different. The objective function for portfolio selection is to maximize risk adjusted return. From the objective function, one can derive a cut-off point to determine if a stock can be included in the optimal portfolio basket. The cut-off point itself is determined if a stock is, among other things, affected by the characteristics of the population of stocks under consideration. From this process we can compare the performance of groups of portfolio.

Environmental economists use the models of portfolio selection to examine if there is correlation between environmental conviction and a security's return. After various portfolios are constructed, a statistical test is performed if there is any significant differences in the stock return among different portfolios. At least one study seems to follow the procedure of efficient portfolio (Kempf and Osthoff 2007). The study uses Carhart's positive and negative screens (Carhart 1997). However, some portfolio studies use arbitrary choice in developing the baskets, instead of using the optimal portfolio approach as described in Elton, Gruber et al. See (Diltz 1995, Cohen and Fenn 1997, Blank and Daniel 2002, Filbeck and Gorman 2004, Derwall, Guenster et al. 2005). For example, Filbeck and Gorman's methodology, followed Cohen and Fen's methodology, created a portfolio by dividing firms into industry groups. The value of environmental conduct is ranked in each group. If a firm is ranked below average it is coded as "low," and if the rank is above average it is coded as "high." A statistical test is performed to test the main hypothesis if "low" firms perform financially differently from "high" firms. Environmental economists employ the methodology by "assuming" that a portfolio in a certain index (e.g. Domini Social Index (DSI) and Dow Jones sustainability index (DJSI)) is efficient. To examine the relationship, economists compare a socially (environmentally) responsible portfolio to a "comparable" conventional portfolio; for example, the Dow Jones sustainable index (DSJI) portfolio versus the Dow Jones portfolio (Statman 2000).

Numerous empirical portfolio studies attempt to examine the relationship between environmental and stock performances. In general, a portfolio with higher environmental performance have higher portfolio performances (Diltz 1995, Cohen, Fenn et al. 1997, Derwall, Guenster et al. 2005, Kempf and Osthoff 2007) and eco-friendly portfolios perform better than comparable portfolios consisting of S&P 500 stocks (Blank and Daniel 2002) . A study by Filbeck and Gorman (2004) follows the Cohen et.al. (1995) method by dividing sample into two portfolios: "more compliance to environmental regulation" and "less compliance to environmental regulation." The results, however, range from not significant to negatively significant (e.g. more compliance portfolio underperforms less compliance portfolio).

In general, these techniques have useful applications in the financial field, however several issues persist. Estimating historical value of market (beta) risk is possible, but forecasting the value accurately can be difficult. Without an accurate market beta risk providing a perfect portfolio selection can also be difficult. The techniques assume that there are degrees of independence among portfolios in analysis. However, in a situation where a market is in turmoil, securities tend to highly correlate one to another; therefore diversifying portfolio can be impossible (Leung 2009).

Grouping the securities based on characteristics (e.g. environmental ranking) of interest makes return-irrelevant characteristics appear significant and return-relevant characteristics appear insignificant (Roll 1977). Roll further explains that in the process of forming portfolio baskets, one may conceal return-relevant assets attributes within portfolio averages. The results tend not to reject null hypothesis that there is no effect the characteristics have on return. To overcome this problem Brennan et al. (2004) modified the Fama-McBeth approach by applying it on individual securities level, instead of applying it on portfolio level. Therefore, this approach uses cross-sectional regression type of study.

Ambec and Lanoie (2008), in their study, identified two major weaknesses of portfolio approach in studying environmental economics. Portfolio studies cannot easily separate the effect of management efforts from those caused by environmental factors. The success of a portfolio relies heavily on the ability of fund managers to manage their portfolio so it is not clear if a green portfolio performs better because of management's efforts or if they perform better because they are green. Ambec and Lanoie compare average performances between groups of green funds and group of regular funds. Such average performances are not easily attributable to green factors or other financial factors like market capitalization. In short, the challenge for researchers in using portfolio studies approach is the difficulties in incorporating control variables in the analysis.

2.1.3. Regression type of studies

This study takes different path in analyzing the effect of environmental factors to stock return, by using a regression type of study—circumventing the drawbacks inherent in the event study and portfolio studies approaches. This criticism of event studies and portfolio studies also became a major issue in financial literature, especially the inability to incorporate control variables. Using a regression type of model can mitigate some of the problems with using portfolio studies as discussed in previous section. This section outlines the strengths of regression type of studies, and also outlines some methodological issues that need a special attention.

Many studies use regression in an attempt to find the relationship between firms' environmental performance and their corporate performance. The measure of environmental performance ranges from third party environmental ranking, carbon emission, etc. The measure of corporate performance includes accounting based and market based performance (Van Beurden and Gössling 2008). Many market performances measures use Tobin's q, which is the ratio of market value of firm stock and the value of its assets (Russo and Fouts 1997, Konar and Cohen 2001, Surroca, Tribó et al. 2010, Guenster, Bauer et al. 2011). These studies show that positive environmental performance are associated with higher corporate performance (Tobin q), while negative environmental performance are associated with lower value of Tobin q. On the other hand, there are a number of studies that use stock return as a dependent variable (Feldman, Soyka et al. 1997, Thomas 2001, Bird, Hall et al. 2007, Brammer and Millington 2008, Ziegler, Schröder et al. 2008, Vasal 2009, Mănescu 2011).

Studies that examine the relationship between environmental and stock return show mixed results. Some show significant positive correlation between environmental and stock performances (Feldman, Soyka et al. 1997, Thomas 2001, Ziegler, Schröder et al. 2008, Vasal 2009). Other studies show the opposite result—environmental variable negatively affects stock return (Thomas 2001, Brammer, Brooks et al. 2006, Bird, Hall et al. 2007). Thomas found the effect of environmental policy is positive while the prosecution of violation of environmental regulation is negative. Even more interesting is the fact that when the sample was split to three sub-samples of time series, the relationships change sign. This results indicate the possibility of non-linear relationship between environmental and stock performance (Barnett and Salomon 2006).

The latest regression type of study by Mănescu (2011), uses US data, shows no significant effect of environmental performance and stock return. This study employes the Fama and McBeth model based on monthly data from more than 600 US firms throuout1992 to 2008. Such models are known to cause error-in-variables problem (EIV). To mitigate such problems, in this study, a "grouping technique" was used. However, the results do not change either with or without industry sector control (Mănescu 2011).

There are possible explanations for the contradicting results of the earlier studies. The study on CAPM uses the portfolio approach (Brammer, Brooks et al. 2006, Vasal 2009), as discussed in previous section, which has inherent weaknesses. Dividing firms into a portfolio based on a certain characteristics like "leader" vs. "laggard" in the environmental performance or industry sector, can create a new problem (Roll 1977, Brennan, Chordia et al. 2004). Empirical evidence shows that the characteristic itself significantly correlated to the return. Therefore, instead of using the characteristics to divide stocks into baskets, use the characteristics and apply them to each stocks in estimation of CAPM regression in the form of cross-sectional analysis. The model shows the effect of risk and non-risk factors to the stock expected-return. Later studies, attempted to remedy this problem by using Fama-McBeth based on cross-sectional analysis.

Researchers' persistent use of dichotomy relationships between environmental and stock performances, is also an issue in the study of environmental economics and stock market. Economists suggest that the relationship between the two variables can be in the form of curvilinear relationship (Wagner, Van Phu et al. 2002, Barnett and Salomon 2003, Brammer and Millington 2008). An empirical study by Barnett and Salomon (2006) found a curvilinear relationship between environmental and financial performances. At the lower levels of environmental ranking the effect of environmental conduct to the stock performance is positive (or negative) while at the other ends of the ranking the effect is negative (or positive).

Finally, there are econometric issues persistently and commonly presented in environmental and CAPM studies, especially in cross-sectional analysis, requiring special attention. The first problem is the failure of most procedure in estimation using Fama-McBeth type of regression in accounting for estimation error, serial correlation, or heterokedasticity (Pasquariello 1999, Brennan, Chordia et al. 2004). This problem can lead to inefficient estimates. One suggestion is to resolve the issue by employing generalized least square (GLS) estimation instead of ordinary least square (OLS). Another common issue in cross sectional studies is multicollinearity issue that can cause unreliable estimates. Brennan, Chordia et al. resolve this problem by replacing the collinear independent variables with new variables—using the deviation to their mean variables or centered value variables.

2.2. The Hedonic Model for Stock Price: A Theoretical Framework

Several theoretical frameworks attempt to link the social (environmental) responsibility and firms performances. Researchers in the accounting field commonly use disclosure theory to provide such framework. The disclosure theory argues the urgency for firms to disclose more on social and environmental performances information on the top of information they currently are disclosing (Spicer 1978, Trotman and Bradley 1981). Environmental disclosure plays an important role in drawing a true picture of firms' activities to outsiders, e.g. social decision makers including investors. Investors' decision making is regulated by maximization of return given risk preference. However, there is growing awareness among investors of firms' social and environmental conducts effecting their business activities. As consequence, Spicer identifies two important arguments regarding the existence of the relationship between environmental and security performance. First, investors have concerns about the "side-effects" of business activities which may increase regulations or sanctions. Costly sanctions may have negative effects to the firms' security value. Secondly, ethical convictions dictate that investors avoid investing in the security of a firm which causes environmental degradation from its operation.

The second theoretical framework commonly used by business researchers is stakeholder theory (McGuire, Alison et al. 1988, Ruf, Muralidhar et al. 2001). Stakeholder theory suggests that management is responsible for not only maximizing shareholders' wealth but also for satisfying other firm's stakeholders: consumers, workers, governments, local communities, etc. The value of a firm depends on the explicit and implicit claims each of the stakeholders has. Each stakeholder group may have conflicting claims. Management must therefore find balance in honoring those claims. Honoring stakeholders' claims can reduce cost and increase revenue. By maintaining a firm's environmentally friendly operation, for example, firms can avoid costly government regulation enforcement, while at the same time inviting environmentally conscious people to consume its product.

There is one important intersection between disclosure and stakeholder theory, with a few important differences. Both focus on the interest of stakeholders. Disclosure theory focuses on ascertaining if the value system of the firm is in sync with those of stakeholders'. On the other hand, stakeholders theory focuses on ascertaining that business activities benefit its stakeholders (Chen and Roberts 2010). The intersection of the theories, i.e. firm's value system choice, also is of interest to Rosen's hedonic price model, which indicated that investors decide to invest on firms that have certain attributes. Investors can choose among firms possessing values (attributes) that they feel satisfy investors' utility. Unfortunately, the model has not been explored in estimating the value of environmental conviction in the financial market. This study will explore such a theoretical framework.

Measuring the value of an environmental amenity can be problematic because there is no market where one can find a direct signal demonstrating how much an environmental amenity is worth. To measure this non-market environmental value, economists use a revealed preference approach, one of the approaches in market valuation. One technique in this revealed preference valuation is the hedonic price model (Rosen 1974).

The hedonic price model was first formally introduced by Rosen (1974) in his seminal paper. The model assumes that products are differentiated with unique characteristics. In this model, a consumer maximizes utility by choosing goods with a certain attributes, and a seller will maximize profit by supplying the goods with the desired attributes. The equilibrium price therefore represents goods with an array of attributes and forms a locus of prices. The slope of the hedonic function with respect to a certain characteristics represents the value of consumers' willingness to pay for the attribute.

This estimation method assumes that prices reflect equilibrium behavior for repeated decision-making. Stocks traded in secondary markets change hands with high frequency and are often used as a perfect example of a competitive market. Investors make decisions based on available information. This repeated decision-making provides strong support that the choices represent equilibrium behavior. Additionally, the large number of publicly traded stocks supports the hedonic assumption that many choice bundles are available along the attribute spectrums, so that buyers' decisions reflect marginal valuations rather than corner solutions. The last assumption requires that weak complementary exists between observed goods and environmental quality. At minimum, firm quality measured by possible violations of environmental regulation will cause investors to shy away from purchasing the stock, worrying the firm may have to pay a hefty fine from the environmental authority. Those three assumptions are all satisfied in the case of stock market.

The hedonic price model has been used in other applications in environmental research, such as the price of houses in the presence of environmental degradation or in positive externalities like beautiful sceneries. Using this model economists can recover the value of an attribute such as "in the proximity of a lake" for a property. In another case, a study estimated the value of clean water; see Leggett and Bockstael (2000), and Lansford and Jones (1995). However, the application of the hedonic model in examining the relationship between environmental variables and stock returns has not been explored. This research attempts to apply the hedonic price model in this stock price context.

In developing this hedonic stock price model, this study uses precedents from previous hedonic price models for housing. There are similarities between stock and housing markets. The supplies in both markets are fixed, at least in the short run. In the long run, a firm may raise capital by issuing new stocks. This will shift the supply curve to the right. A firm issues stock in Initial Public Offering (IPO) when they need to finance their investment. Once stocks are issued the stock will be traded in the secondary market. The number of the stocks will remain the same for some time until the firm issues new stocks. The firm has an important stake in the value of the stocks because that value directly determines its market value. The firm does not have direct control over its stocks. However, the firm's performance will affect the value of its stock.

Demand for an asset can increase or decrease depending on available information about the asset. This information can include a firm's risk or non-risk characteristics. This information can be produced and controlled by either the firm itself or by third parties. Information related to environmental conduct and performance includes carbon emissions, publication of violations of environmental regulations, lawsuits for environmental destruction, and rankings for any environmental worst or best practice.

In applying Rosen's model to stock choices, the scheme maintains that a stock traded in the market can be represented by a vector of observable attributes. The attributes include risk, liquidity, profitability, environmental performance, etc. Early investment theoretical framework indicated that a choice of stock is mainly determined by risk (Sharpe 1964, Lintner 1965). However, there is evidence that non-risk characteristics, like firms' size, sales, profit, and the characteristic of the stocks themselves, also affect the choice; see Brennan, Chordia et al. (2004) and Fama and French (2004). Other studies show that nonpecuniary factors like management style, social responsibility, environmental conduct and performance also affect stocks' return (Spicer 1978, Yamaguchi 2008).

Suppose that investor maximizes utility, U, given different characteristic of firms/stock, Z, and environmental attributes, Q.

(1) $$Max\ U = U(Z, Q)$$

Assuming well behaved utility function the equation (1)'s first order condition gives the decomposed price of the stock representing a bundle of firms' specific environmental characteristics in the equation,

(2) $$P_k = f(Z_k, Q_k)$$

where P_k is the hedonic stock price of firm k, Z_k is an m-length vector of firm $k's$ characteristics and Q_k is an n-length vector of firm $k's$ environmental attributes. By estimating P_k we can derive the implicit price of a specific environmental attribute. In the second stage, to estimate underlying demand, we need to estimate the hedonic stock price, P_k with respect to the characteristics of investors. Unfortunately, information on investors' characteristics that can be matched with the stock market data may not be readily available. In this study we assume that investors are homogeneous.[3] The hedonic stock price model, P_k represents the inverse demand of the stock. See Figure1.1 and Figure 1.2. The variables inside $U(.)$ are the shift variables.

[3] We can relax the assumption by using choice experiment in conjoint analysis study. In such study, the investors' heterogeneous background can be tested.

Given the inverse demand P_k, we can find an implicit price attributed to a specific environmental characteristic. This also can be interpreted as the value of investors' willingness to pay for a firm's environmental attribute of stock. This implicit price can be derived from hedonic stock price P_k, by taking the derivative with respect to a certain environmental attribute, $\frac{\partial P_k}{\partial Q_n}$.

2.3. The Capital Assets Pricing Model (CAPM)

To estimate the inverse demand for stock as described in Equation (2), this study uses the Capital Assets Pricing Model (CAPM). The early concept of CAPM was first developed by Sharpe (1964) and Lintner (1965). The model assumed that if a market portfolio is efficient then only the risk factor affects the expected return, and no other variables affect the stock return (Fama and French 2004).

The expected return on any asset i is a risk-free interest rate, R_f, plus a risk premium which is the risk of asset i in the portfolio market M, β_{iM}, times the market risk premium. The systematic risk premium is the covariance of the asset i's price to the market's price index, $\beta_{iM} = \frac{Cov(R_i R_M)}{\sigma_M^2}$.

(3) $$E(R_i) = R_f + [E(R_M) - R_f)]\beta_{iM}),\ i = 1, \ldots, N$$

The model became a tool in investment decisions until some studies from the early 1970s to the early 2000s found that not only do risk factors affect return on stock investment, but non risk stock characteristics like bid-ask-spread[4], debt-equity[5], market

[4] Bid-ask-spread is the price difference between the maximum of stock price a buyer willing buy and the lowest price that the seller willing to sell it for.

[5] Debt-equity ratio is a measure of a firm leverage, which is the ratio between its total liabilities and shareholder equity

capitalization[6], book-to-market ratio[7], etc. also play important role (Brennan, Chordia et al. 2004, Fama and French 2004, Bello 2005).

(4) $$E(R_i) = R_f + [E(R_M) - R_f)]\beta_{iM}) + \sum_j c_{ij}Z_{ij}\ ,\ i = 1, \dots, N$$

where Z_{ij} represent the value of non risk characteristics j for security i.

Studies in environmental economics focus their attention on investigating the effect of environmental attributes on firms' stock prices. Some studies show that firms' environmental attributes have a significant positive effect on stock returns (Diltz 1995, Klassen and McLaughlin 1996, Rao 1996, Cohen, Fenn et al. 1997, Feldman, Soyka et al. 1997, Konar and Cohen 1997, Bosch, Eckard et al. 1998, Thomas 2001, Blank and Daniel 2002, Derwall, Guenster et al. 2005, Gupta and Goldar 2005, Karpoff, Lott Jr et al. 2005, Nagayama and Takeda 2006, Kempf and Osthoff 2007, Yamaguchi 2008, Ziegler, Schröder et al. 2008, Vasal 2009). Some studies show significant negative effect of environmental and stock return performance (Thomas 2001, Filbeck and Gorman 2004, Brammer, Brooks et al. 2006, Bird, Hall et al. 2007).

(5) $$E(R_i) = R_f + [E(R_M) - R_f)]\beta_{iM}) + \sum_j c_{ij}Z_{ij} + \sum_j d_{ij}Q_{ij}\ ,\ i = 1, \dots, N$$

where Q_{ij} represent the value of environmental characteristics j for security i. This is the CAPM that we wish to estimate.

[6] Market value is consolidated company-level market value which is the sum of all issue-level market values, including trading and non-trading issues. Market value for single issue companies is common shares outstanding multiplied by the month-end price that corresponds to the period end date (Standard&Poor. "Standard & Poor's Compustat Expressfeed." Retrieved November 2 2010, from http://wrds-web.wharton.upenn.edu/wrds/. This is an annual data measured in millions of dollars.

[7] Book-to-market ratio measures the ratio of book value of a firm to its market value. Book value is historical value of the firm's stock value. See note 5 for Market value definition.

3. Methodology

This section discusses methodology for the study we conducted for this dissertation. The discussion covers topics related to empirical models, data, and some issues that arise in estimating the models. The analysis of this study employs short panel data analysis; it captures variation over different firms and over period of time. Panel data analysis provides solution for a biased estimate due to unobserved heterogeneity. Such issue is common in an estimation using cross sectional data. Moreover, panel data analysis allows to estimate dynamic relationships between firms' environmental scores and their stock returns. As suggested in many CAPM studies, the use of dynamic systematic risk will provide more efficient estimations (Barnes and Hughes 2001).

3.1. Empirical Model

Using data of the Newsweek's 500 largest firms in the United States and following them over some period of time, we wish to estimate equation (5), the modified CAPM, using the following empirical model. Given a firm stock i, and observe it over the period of time $t, where\ t = 2009,\ 2010,\ 2011,\ and\ 2012,$ we wish to estimate:

$$R_{it} = c_{0i} + c_{1i}\,\beta_{it} + \sum_j c_{mi} Z_{it} + \sum_j c_{ni} Q_{it} + e_{it} \quad (6)$$

where β_{it} is systematic risk of stock $i\ at\ time\ t$, Z_{it} is non-risk characteristic of stock $i\ at\ time\ t$, Q_{it} is environmental characteristics of firm $i\ at\ time\ t$, c_{0i} are random firm-specific effects, e_{it} is idiosyncratic errors, and R_{it} is return on investments at time t.

3.2. Data for the Study

Data for this study is considered short panel data, covering a four year time series (2009-2012) of stock prices, firms' characteristics, and the Newsweek Green Ranking. The data includes the 500 largest firms in the US which are included in the sample used by the Newsweek green ranking. There are data conditions requiring special attention (Cameron and Trivedi 2009). First, the data must be observed at regular time periods. The data on stocks and other variables used in this study are published regularly. Second, potentially, some firms which may be included in the current ranking were not included in last year's ranking, and vice versa. The attrition and addition in ranking data may lead to unbalanced panel data. Third, the data is considered to be short panel data, e.g. a large number of observations within a short period of time. This type of data has its own consequence in type of estimation and inference. Fourth, model errors may be correlated across observation. A correction may be necessary to increase efficiency in model estimation by using the generalized least square (GLS).

The data for this study comes from three different sources. Data on environmental performance comes from the Newsweek Green Ranking. This report includes the 500 largest firms in the United States. The definition of the largest firms is based on revenue, market capitalization and number of employees (Newsweek 2009). This report contains firms' environmental performances including green ranking (GR), green score (GS), environmental impact score (EIS), green policy and performance score (GPPS), reputation survey score (RSS), and Environmental Disclosure Score (EDS). There is methodological change in 2011. In earlier scoring systems the value of the score was normalized using Z distribution. Since 2011, the scores were published based on the absolute value.

The EIS measures the total environmental impact of the firm's operation based on data compiled by Truecost®. This score is an index of over 700 variables. Four major elements contribute to the EIS: greenhouse gas emission, solid waste disposed, water use, and acid rain emissions. All of the measures are normalized using the firm's revenue. The higher the score the better the value of a firm's environmental conduct (the score ranges from 1 to 100). This score looks into the severity of the effect of firms' operations on the environment; the more severe the impact, the lower the score the firm receives.

The GPPS measures an analytical assessment of the firms' environmental policy and performances conducted by Sustainalytics. The important elements of this score include climate change policy and performance, pollution policies and performance, product impacts, environmental stewardship, and environmental management. The score maxes out at 100, which is the highest quality of a firm's environmental conduct.

The RSS is developed using surveys measuring levels of corporate social responsibility to numbers of respondents—groups made up of professionals, academics, CEOs or high ranking officials of all companies included in the Newsweek Green Ranking 500 list, and other environmental experts. The survey asked respondents to rank the companies as "leaders" or "laggards" in five keys issues related to environmental areas including green performance, commitment communications, track record, and ambassadors. The value of this score is from 1 to 100, the higher the value the better reputation of a firm.

The Environmental Disclosure Score (EDS) has replaced RSS since 2011 survey. This score measures the breadth and quality of two important aspects of company reporting based on Truecost's data. First, it evaluates how companies report the environmental impact of their operation. Also, the EDS evaluates company engagement in environmental initiatives, for instant, the Global Reporting Initiative and Carbon Disclosure Project.

The GS is the overall score among the earlier three scores (EIS, GPPS, and RSS/EDS). All of the three scores are normalized to a 100 point scale. The weight of the three scores is 45-45-10 for EIS, GPPS, and RSS respectively for the green score 2009-2010. For the green score of 2011-2012 the composition is EIS, GPPS, and EDS. This score indicates the ranking of a firm in the green ranking. The highest-scored firm has a score of 100.

The green ranking (GR) measures the rank the 500 firms from the least environmentally friendly to the most environmentally friendly, 1 to 500. The rank itself is determined by the value of the green score (GS).

To calculate individual stock market beta risk we use the following formula $\beta_{iM} = \frac{Cov(R_i R_M)}{\sigma_M^2}$ or by recovering the value of regression coefficient of a firm's daily stock price and daily Standard & Poor 500 (S&P500) stock index. Data on stock prices is collected from The Center for Research in Security Prices (CRSP) database, provided by Wharton Research Data Services (WRDS). From this database we collect information on daily firms stock prices and Standard & Poor 500 (S&P500) stock index for 2009-2012.

We collect monthly stock prices for September and December 2009-2012 to calculate stock return. To calculate stock return for each firm, R_i, we use the following fromula $R_i = \left[(P_{Dec} - P_{Sept} + D_i)/P_{Sept}\right] * 100$ where P_{Dec} and P_{Sept} are firm's stock price on the month of December and September respectively and D_i is the firm's dividend. The Newsweek's green ranking is annouced by the end of September. To capture the effect of such announcement to the stock performance, studies use different windows ranges from days to several months. This study choses three months windows from October to December return. However, this study will also show the results of up to six moths accumulated return as robusness check. See robustness check at the end of this chapter.

Data on firm-specific characteristics are collected from Compustat, a database on U.S. firms that is provided by Wharton Research Data Services (WRDS). From Compustat, we collect data on market value or market capitalization[8], earning before taxes and interest (EBIT), and dividend per share (DPS). The data are values based on fiscal year of 2009-2012. The EBIT data are values based on fiscal year of 2008-2012, needed to calculate profit growth of 2009. To calculate profit growth we use: $Profit\ Growth_t = [(EBIT_t - EBIT_{t-1}) / EBIT_{t-1}] * 100$.

From our analysis, out of the 500 firms included in Newsweek's Green Ranking we found a small number of data unavailable in both the CRSP and Compustat database. This is due to the missing value in some of the variables we used in the model estimation. Table 1.3 depicts descriptive statistics for key variables.

3.3. Some Issues in the Model Estimation

There are several issues we have encountered in conducting the model estimation. The first problem is omitted variable bias. This problem may occur because some variables that are not included in the model that may affect the stock price also are correlated to the variables that are included in the model. The use of panel data may mitigate such issue

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[8] Consolidated company-level market value is the sum of all issue-level market values, including trading and non-trading issues. Market value for single issue companies is common shares outstanding multiplied by the month-end price that corresponds to the period end date (Standard&Poor. "Standard & Poor's Compustat Expressfeed." Retrieved November 2 2010, from http://wrds-web.wharton.upenn.edu/wrds/. This is an annual data in a billion dollar.

because if omitted variables are time-invariant, any change in dependent variables can not be caused by the variables. We also include known variables in finance theory including risk factors, i.e. market beta coefficient, and non-risk stock characteristics, i.e. market capitalization (size) and annual profit growth variables.

The second problem is multicollinearity among the right hand side variables. This problem is shown to exist in the hedonic literature (Leggett and Bockstael 2000). The existence of multicollinearity can produce unreliable parameter estimates. A formal test in looking for the sign of multicollinearity is a test for variance inflation factor (VIF). We perform this test on each model we developed to make sure that the multicollinearity is minimized. As a benchmark, if VIF > 10 we conclude that there is the incidence of a high multicollinearity problem. Table 1.5 depicts the results of VIF test. The tests show that all of the models suffer collinearity issues. To mitigate the problem we replace the collinear independent variables with their deviation to their mean (Brennan, Chordia et al. 2004). The VIF tests show that the modified models have significantly lower VIF value to less than 10.

The third problem is serial correlation issue or autocorrelation problem. The presence of autocorrelation in panel data will cause bias in standard error and inefficient estimates. To identify the problem we use Wooldridge's Test for autocorrelation in panel data (Drukker 2003). Table 1.5 depicts the results of the test; it does not reject the null hypothesis of no autocorrelation degree one, AR(1). No further treatment is necessary for the models estimation.

The fourth problem is the presence of heteroskedasticity. When N is large, heteroskedasticity problem commonly plagues model estimation, particularly in short-panel studies similar to what we are conducting. To find out if there is a violation of homoscedasticity assumption we use the Modified Wald test for groupwise heteroskedasticity (Baum 2001). Table 1.5 depicts the result of the test; it indicates that the models we developed are heteroskedastic. Therefore, we employ Feasible Generalized Least Square (FGLS) to estimate the model. See (Cameron and Trivedi 2009).

Suppose we estimate OLS panel model of the firm i, where $i = 1, \dots m$, and observe them at time t where t $= 1, \dots T$

(7) $$y_{it} = x_{it}\beta + e_{it}$$

We can rewrite equation (7) in the following matrix form.

(8) $$\begin{bmatrix} y_1 \\ y_2 \\ \vdots \\ y_m \end{bmatrix} = \begin{bmatrix} x_1 \\ x_2 \\ \vdots \\ x_m \end{bmatrix} \beta + \begin{bmatrix} \varepsilon_1 \\ \varepsilon_2 \\ \vdots \\ \varepsilon_m \end{bmatrix}$$

The variance matrix of the error terms is

(9) $$E[\varepsilon\varepsilon'] = \Omega = \begin{bmatrix} \sigma_{1,1}\Omega_{1,1} & \sigma_{1,2}\Omega_{1,2} & \cdots & \sigma_{1,m}\Omega_{1,m} \\ \sigma_{2.1}\Omega_{2,1} & \sigma_{2,2}\Omega_{2,2} & \cdots & \sigma_{2,m}\Omega_{2,m} \\ \vdots & \vdots & \ddots & \vdots \\ \sigma_{m,1}\Omega_{m,1} & \sigma_{m,2}\Omega_{m,2} & \cdots & \sigma_{m,m}\Omega_{m,m} \end{bmatrix}$$

The OLS estimators are efficient given the error terms are zero-mean independent and homoscedastic.

$$E[\varepsilon_{i,t}] = 0$$

$$Var[\varepsilon_{i,t}] = \sigma^2$$

$$Cov[\varepsilon_{i,t}, \varepsilon_{j,s}] = 0 \; if \; t \neq s \; or \; i \neq j$$

This means we assume that the value of Ω is

$$\Omega = \sigma^2 I = \begin{bmatrix} \sigma^2 I & 0 & \cdots & 0 \\ 0 & \sigma^2 I & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & \sigma^2 I \end{bmatrix}$$

Heteroskedasticity seems to occur in this cross-sectional time series studies. We found the test indicates that the models we developed are heteroskedastic. The variance for each panel is different, $\Omega \neq \sigma^2 I$. As a result the OLS estimation is biased. Greene (1993) suggests to revise the estimation technique by using GLS, taking into account the heteroskedasticity, by allowing the variances to differ for each firm. Therefore, the variance matrix becomes

$$\Omega = \sigma_i^2 I = \begin{bmatrix} \sigma_1^2 I & 0 & \cdots & 0 \\ 0 & \sigma_2^2 I & \cdots & 0 \\ \vdots & \vdots & \ddots & \vdots \\ 0 & 0 & \cdots & \sigma_m^2 I \end{bmatrix}$$

We can recover unbiased parameter estimates from the FGLS regression as

(10) $$\hat{\beta} = (X' \hat{\Omega}^{-1} X)(X' \hat{\Omega}^{-1} Y)$$

where $\hat{\Omega}$ is the estimate of Ω. The results of these FGLS regressions are presented in Table 1.6.

Earlier studies suggested the important of nonlinear relationship of environmental variables and stock return (Wagner, Van Phu et al. 2002, Barnett and Salomon 2003, Barnett and Salomon 2006, Brammer and Millington 2008). This study will introduce quadratic form in the regression model to capture the nonlinear relationship. Therefore, the model will include the square of the following variables: green ranking (GR), green score (GS), environmental impact score (EIS), green policy and performance score (GPPS), environmental disclosure score (EDS), and reputation survey score (RSS).r

4. Results and Discussion

4.1. The general condition of the 500 largest public firms in the US in the sample

The sample for this study is the firms included in The Newsweek Green Ranking's sample from 2009 to 2012. The determination of the largest firms is based on revenue, market capitalization and number of employees (Newsweek 2009). Because of this screening some firms were purged in the proceeding samples. There are 56 firms in the 2009 sample that were replaced with new firms in 2010. Out of 500 firms in the 2010 sample, 36 firms were replaced with new firms in 2011. Out of 500 firms in the 2011 sample, 24 firms were replaced with new firms in 2012 sample. Overall, only 404 firms are included in all four years. See Table 1.2.

Table 1.3 and 1.4 depict a general description of the firms' characteristics and performances of firms in the sample.

Stock Return (%) measures the three months cumulative raw return of firms' stock performances. Over the period of study, the stock returns experience ups and down. In the first three years, the years soon following the great recession of 2008, the stock returns improved dramatically from single digit, 7.93%, to double digit in two consecutive years of 14.04% and 13.62% respectively in 2010 and 2011. However, the stock return then dropped dramatically to only 4.73% in 2012, the period when stock market captured the Dow Jones Industrial (DJI) stock price index to pre-recession level. The variability of return among the 500 firms are huge with the range of about 250% for all first three years and even wider in the year 2012, i.e. about 430%. The stock return is also slightly higher as firms ranked higher in their green ranking over the period of study.

Market Risk (Beta Coefficient) measures the riskiness of a stock. The average level of market risk is slightly lower from, 1.17 to 1.14, from 2009 to 2011. The market risk was significantly lower as the stock market recaptured its DOW index to pre-recession level. The risk level seems to be elevated slightly for firms with higher green ranking.

Market Capitalization ($ Billion) measures the size of firms. Over the period of the study, the size of the firms increased significantly from the average level of $20 billion in the beginning of the study in 2009 to $26 billion in 2012, over a four year period. The largest firm in the sample doubled in size from $322 billion to $626 billion. Over the period of 2009-2012 the market cap was also higher among firms with higher green ranking.

Annual Profit Growth (%) measures percentage change of earnings before tax and interest (EBIT) over the previous year. In 2009, following 2008 recession, the profit of 288 firms out of the 500 largest firms in the US decreased on average of 16%, with the lowest drop by 0.21% to the highest drop of 2,088%. The number of firms in the red reduced by a half in the following year. That makes the average profit growth increased by 35%, 13%, and 7% in 2010, 2011, and 2012 respectively.

4.2. Overall Hedonic Stock Price Model Estimates

Table 1.6 presents the complete results of the regression analysis. The model estimations are separated into three parts, the periods of 2009-2010, 2011-2012, and 2009-2012. The model estimation for the overall period of 2009-2012 only include the green ranking (GR), the environmental impact score (EIS), and the green policy and performance score (GPPS)[9]. The results show overall goodness of fit of the models. First, the accuracy

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[9] The estimation of the models is separated into three different time periods, i.e. 2009-2010, 2011-2012, and 2009-2012. The main reason is *Newsweek* changed one of three specific measures of greenness in

of the model shown by the Wald-Chi-Square statistics indicates that the models are efficient; all models are significant at 1% level of significance. Second, after transforming some variables using centered value[10], the tests of the models show that multicollinearity is minimized in the models indicated by low Variance Inflation Factor (VIF) of the variables in the right hand side of the equations to below 10. Third, as consequence of transforming some variables to the deviation to their mean, the regression coefficients do not represent the marginal effect of the variable. See Appendix 1.1 for a mathematical explanation on how to recover the marginal effect. Forth, the violation of homoscedasticity is present in all models. The modified Wald's Test for group-wise heteroskedaticity in panel data test reject the null hypothesis at levels of significance at 1% (See Table 1.5). In estimating the models, therefore, we use a Feasible Generalized Least Square (FGLS) to recover non-biased parameter estimates by assuming heteroskedatic matrix of variance. See Table 1.6.

4.3. The Effect of Firm and Stock Characteristics to the Stock Return

See Table 1.6 for reference. The risk factor (market beta), market capitalization, and profit growth, as expected, are significant factors that affect stock return. The risk factor shows a strong significant non-linear affect in all eight models, column 1 to 8. Since we use the original value we can use the parameter estimates as its marginal effect. Each unit of risk gives a boost in stock return increasing in decreasing rate. On average the marginal effect of market (beta) risk is 3.44% to 5.76%. Please note that the value of beta

2011, replacing RSS with EDS. Since the two measures are conceptually different therefore this study separated the time periods before and after the event.

[10] Centered value of variable x, i.e. $ctrx$, is defined as the deviation of variable x from its means, $ctrx = x - \bar{x}$

market risk in this study ranges from 0 to 5, with one extreme outlier of beta of 16. The average value is average of 1.14. This result is consistent with Amihud anf Mendelson (1989) at least in the direction of association. Both indicate significant (positive) effect. The magnitude of the parameter estimate in our study shows stronger effect, 3.44% to 5.76%, compared to 0.7%. There are several possible explanations for the differences. First, this study uses a short run accumulated return of three months while the prior study uses an average monthly return for one year of return. This study uses raw return while the previous study uses excess return. This study uses data only included in the 500 largest public firms in the US as its sample.

Table 1.6 depicts the effect of market capitalization, measuring the size of the companies, to the stock return. All parameter estimates are significant and show non-linear relationships, increasing in decreasing rate. The results, at least the direction of the relationship, are consistent with previous studies (Amihud and Mendelson 1989, Jaffe, Keim et al. 1989). The parameter estimates from this study are stronger compare to the prior studies. Evaluating at the mean value, for every billion dollar increase/decrease of the value of market capitalization, it will increase/decrease the stock return about 0.03%.

Finally, the effects of profit growth to the stock return are all significant at alpha of 0.007% to 0.02%. The direction of the relationship is consistent with previous studies that show that profitability affects stock return positively (Lee and Zumwalt 1981, Peavy and Goodman 1985).

4.4. The effect of Firm's Green Performances to its Stock Return

Compared to other green measures of a firm environmental performances that focus more on a specific measure, the Newsweek's green scores provides both broad or aggregate measure: green ranking ((GR) and green score (GS)), and detail or disaggregate measure: (impact (EIS), policy (GPPS), disclosure (EDS), and reputation (RSS)). That allows this study not only to look at the effect of broad measures of firms' environmental performance, but also to find out specific aspects of firms' environmental performance, i.e. environmental impact of firm operation (EIS), management policy (GPPS), environmental image (RSS), and disclosure (EDS).

Table 1.6 depicts the regression results estimations with eight different models that include environmental variables in quadratic forms. The environmental variables include the green ranking (GR), the green score (GS), the environmental impact score (EIS), the green policy and performance score (GPPS), the reputation survey score (RSS), and the environmental disclosure score (EDS). Most regression coefficients are significant at level of significance at 1% and one occasion at 10%. Only three estimates failed to reject the null hypothesis and all of them are the square of environmental variables.

Green ranking (GR) effect on stock return. The firms in the sample was ranked 1 to 500, from lowest to highest environmental scores. We found that green ranking has a significant effect on stock return. Previous studies that use green ranking as a measure of a firm's environmental consciousness show conflicting results. Some studies found positive effects between green ranking and stock (Derwall, Guenster et al. 2005, Yamaguchi 2008) and some did not find a significant relationship (Yamashita, Sen et al. 1999, Takeda and Tomozawa 2006, Anderson-Weir 2010). We confirm previous studies that there is a positive relationship between green ranking and stock performances. Furthermore, the relationship follows diminishing marginal return, non-linear. See Table 1.6 column 1, 4, and 7.

Since the regression was calculated using centered value to mitigate muticollinearity, the interpretation of the result needs further explanation. Figure 1.4 Panel A shows the simulated effect of green ranking (GR) to stock return for three different models: 2009-2010, 2011-2012, and 2009-2012 model. The curves show that the effect of green ranking (GR) increases for the low green ranking firms and decreases for high green ranking firms. The inflection points for the three models are at green ranking (GR) of 110 (Model 1: 2009-2010), 118 (Model 4: 2011-2012), and 160 (Model 7: 2009-2012) respectively. The investor's willingness to pay (WTP) for green a firm to the left of the inflection point is positive, while for a firm to the right of the inflection point is negative.

Green score (GS) effect on stock return. Green score is a linear combination value of EIS, GPPS, EIS, and RSS or EDS. The value ranges from the lowest of 1 to the highest of 100. We found significant relationship between green score (GS) and stock performance, contrary to Anderson-Weir (2010)'s finding. The earlier study uses cross-sectional data of 2009 Newsweek Green Ranking; he did not find evidence that the green score (GS) effects stock return. Different from Andeson-Weir's study, this study uses short panel data and includes a non-linear relationship between the variables. Moreover, we provide treatment for potential econometric issues including heteroskedasticiy and multicolliearity. See Table 1.6 column 2 and 5.

Again, since the regression is using centered value to avoid multicollinearity, to interpret the regression results refer to Figure 1.4 panel b and c. Both panels show that the relationship follows diminishing marginal return, the investor's willingness to pay (WTP) for a greener firm increases at the lower level of green score (GS) and decreases as pass the inflection point. The inflection point of green score (GS) 28 (model 5: 2011-2012). We found linear relationship between green score (GS) and stock return for the model 2: 2009-2010.

The effect of disaggregate environmental score: impact (EIS), management and policy (GPPS), reputation (RSS), and disclosure (EDS). We found that most of the disaggregate scores are statistically significant, affecting stock return. See Table 1.6 column 3, 6, and 8. The results confirm previous findings for environmental impact (Konar and Cohen 1997, Bosch, Eckard et al. 1998, Gupta and Goldar 2005, Bird, Hall et al. 2007), environmental management and policy (Feldman, Soyka et al. 1997, Thomas 2001), and reputation (Karpoff, Lott Jr et al. 2005) and disclosure (Rao and Hamilton III 1996).

The investor's willingness to pay (WTP) of the environmental impact score (EIS) increases before the infection point of 35 (Model 3: 2009-2010). Model 6: 2011-2012 and Model 8: 2009-2012, even though the squared EIS are significant, they have inflection point close to. For the management and policy score (GPPS) the investor's WTP increases before inflection point of 39 and 199 (Model 8: 2009-2012), and WTP decreases afterward. The investor's WTP for reputation score (RSS) increases before the inflection point of 64 (2009-2010 model) and the WTP decreases afterward. Finally, the investor's WTP for environmental disclosure score (EDS) increases before the inflection point of 4 (Model 6: 2011-2012) and decreases afterward.

Table 1.7 provides examples of a special case of investor's willingness to pay (WTP) for green ranking (GR) based on Model 7: 2009-2012. On average investor's WTP for greener firms on the bottom 25 green ranking is about 0.0184% higher stock price than otherwise, but for greener firms on the top 25 green ranking is about 0.0185% lower stock price than otherwise.[11]

For firm in the bottom 25 out of 500 green ranking, the majority are firms in the utility, energy and material sectors of business: FirstEnergy, Monsanto, Amaren, etc. For investors in FirstEnergy's stock, for example, their willingness to pay (WTP) for a better green ranking is 0.0186% higher stock price. That means an investor is willing to pay a greener stock at 0.0186% higher stock price. From the firm's point of view, improving ranking by one ranking will increase its return on investment by 0.0185%. Assuming the dividend and number of stocks in circulation remain constant, the firm's value increased as measured by market capitalization by 0.0185%. If FirstEnergy, with market capitalization of approximately $14 billion in 20012, improved its green ranking by one it will increase the firm's value approximately $2.6 million. The improvement in green ranking, therefore, rewards firms too.

The top 25 of 500 green performers, on the other hand, are dominated by firms in Information and Technology sectors like Google, IBM, Dell, Intel, Cysco, HP, Microsoft, etc. For investors who purchase Google stock, as an example, the investor's willingness to pay (WTP) for higher green ranking stock is lowers return on investment by 0.0185%. If we assume the dividend and number of stock remain constant, the improvement of ranking will lower the firm's value by 0.0185%. For Google with market value of $200 billion in 2012, the improvement of green ranking by one level will cost the firm's value approximately $37 million.

[11] Stock return is loosely defined as percentage change of stock price, assuming dividend remains constant.

Curvature of relationship between environmental performance and stock return. One interesting, unexplored study is an examination of non-linear relationship between these two variables. This notion was first suggested more than a decade ago by economists (Wagner, Schaltegger et al. 2001, Wagner, Van Phu et al. 2002, Barnett and Salomon 2003), but only one study has attempted to explore the relationship (Barnett and Salomon 2006). This study found the relationship between environmental variable and stock return follows increasing in decreasing rate (concave). Investors willing to pay for eco-friendly stock at higher stock price if they are in the group of dirty firms or low green ranking. This contradicts the result of the study by Barnett and Salomon. They found that the relationship is decreasing in increasing rate (convex or U-shape). Unlike this study, Barnett and Salomon used mutual fund data. The measure of environmental performance is how the environmental screen is use in choosing stock included in a fund. The environmental screens pose due burden for fund managers by weeding out firms that do not meet the screen criteria, at the price of lower return. This study uses hedonic price model that is allowing investors to choose a stock based on a firm's financial and environmental attributes. Unlike in the case of a mutual fund, we do not screen out any firms. Investors will see all choices of firms available, i.e. the largest 500 U.S. firms.

4.5. Robustness Check for the Models

This study uses two attempts of robustness check: (1) Dividing data into three different time periods in estimating the models, and (2) Using different month to calculate stock return as dependent variable in estimating the model. The first robustness check based on Table 1.6. Model 1, 2, and 3 are for the period of 2009-2010, Model 4,5, and 6 are for period of 2011-2012, and model 7 and 8 are for period of 2009-2012. The results of estimating the models shows strong indication of robust results, at least in the direction of relationships.

The second robustness check is based on the result depicted in Table 1.7. The table depicts the estimation of the model using stock return as dependent variables calculated based on 1, 2, 3, 4, 5, and 6 month cumulative return. The results show that the models we estimate are consistent and robust at least in term of the direction of the relationship. Most of the variables in the models are significant at least at $p<10\%$ and most of the direction of the relationship on parameter estimates are consistent. Since the environmental variables were transformed using centered value, the direction of the results may not reflect the actual relationship. To further perform robustness check, simulated graph of environmental variables and stock return are presented in Figure 1.4. The results show most of curves are consistent.

5. Conclusion

5.1. Summary of Results

This study attempts to estimate Rosen's (1976) hedonic model to find out if firms' green characteristics affect investor preference in buying stocks. The estimation follows the concept of the capital assets pricing mode (CAPM). The firm's green attributes are measured using the Newsweek Green Ranking 2009-2012 which include the green score (GS), the environmental impact score (EIS), the green policy and performance score (GPPS), and the reputation survey score (RSS). In addition to green variables, we also include control variables that are commonly used in the CAPM studies, including the firm's/stock's risk and non-risk characteristics. Based on the hedonic model we can calculate (recover) the investor's willingness to pay (WTP) for a certain environmental characteristic of a stock.

This study found that all known financial variables affecting stock return are significant; we found that environmental variables are also significant. These findings will add a new addition to the array of studies in the Capital Assets Pricing Model (CAPM). More importantly, this study sheds light on a new application of the Rosen hedonic pricing model in the stock market.

Practically, this study provides one piece of information both for the investors and firms to make cost and benefit analyses. As measured in its increase of market capitalization, a firm can recover the expected return on an investment to improve its environmental conduct and performance. Investor can benefit by finding out how much additional return he or she can earn by purchasing stock of a firm with better environmental conduct and performance.

5.2. Future research Agenda

This study has shown significant contemporaneous relationships between corporate's environmental performance and stock return. From the results the value of willingness to pay (WTP) can be derived. The use of revealed preference such as the hedonic model in deriving the value of WTP employed a strong assumption of homogeneity of investors. Such assumption may not be supported empirically. That is the main limitation of the revealed preference study. Such assumption can be relaxed by using stated preference like the use of choice experiment using conjoint analysis. In choice experiment, investor's characteristic like demographic, socio-economic, and risk preference, can be explored and use them as determinant of portfolio choice. From the analysis we can test the heterogeneity of investors. Moreover, we can estimate more accurately the value of willingness to pay (WTP) of environmentally friendly attributes in investment choices like in mutual fund.

Table 1. 1: Type and Model of Previous Studies

		Shape of Relationship between Environmental Variable and Stock Performance			
		Dichotomous (Linear)			Non-linear
		Significant Positive	Significant Negative	Not Significant	
Type Studies	Event Studies	▪ Klassen & McLaughlin (1996) ▪ Rao (1996) ▪ Konar & Cohen (1997) ▪ Bosch, Eckard, & Lee (1998) ▪ Gupta & Goldar (2004) ▪ Karpoff et.al. (2005) ▪ Nagayama & Takeda (2006) ▪ Yamaguchi (2008)		▪ Yamashita, Sen, and Roberts (1999) ▪ Takeda &Tomozawa (2006) ▪ Anderson-Weir (2010)	
	Portfolio Studies	▪ Diltz (1995) ▪ Cohen, Fenn, et.al. (1997) ▪ Blank & Daniel (2002) ▪ Derwall, Guenster, et.al. (2005) ▪ Kempf & Osthoff (2007)	▪ Fillbeck & Gorman (2004)	▪ Fillbeck & Gorman (2004)	
	Regression Studies	▪ Feldman, Soyka et.al. (1996) ▪ Thomas (2001): Policy ▪ Ziegler, Schroeder, et.al. (2008) ▪ Vasal (2009)	▪ Brammer, Brooks et.al. (2006) ▪ Bird, Hall, et.al. (2007) ▪ Thomas (2001): Conduct	▪ Manescu (2011)	▪ Barnet & Salomon (2006)
	Conjoint Studies	▪ Bauer & Smeets (2010)			

Table 1. 2: Firms Sample Dynamic: Who is in or out

a. Who stays in the panel

	2009	2010	2011	2012
2009	496	440	427	429
2010		500	464	458
2011			500	476
2012				500

b. Who is added to the panel

	2009	2010	2011	2012
2009	0	56	69	67
2010		0	36	42
2011			0	24
2012				0

Table 1. 3: Summary Statistic of Relevant Variables

Variable	Year	Mean	Std. Dev.	Min	Max	Obs.
Stock Return (%)	2009	7.93	15.27	-50.52	200.85	492
	2010	14.04	14.27	-42.04	189.02	494
	2011	13.62	14.36	-88.18	61.36	496
	2012	4.73	19.80	-47.14	380.86	498
Green Ranking (GR)*	2009	248.50	143.33	1	496	496
	2010	250.50	144.48	1	500	500
	2011	250.50	144.48	1	500	500
	2012	250.50	144.48	1	500	500
Green Score (GS)**	2009	70.47	9.98	1	100	496
	2010	70.54	11.11	1	100	500
	2011	51.47	10.18	19.90	82.5	500
	2012	53.24	10.40	21.40	82.90	500
Environmental Impact Score (EIS)	2009	50.13	28.88	0.20	100	496
	2010	50.45	28.65	1	100	500
	2011	55.93	18.37	0.2	88.5	500
	2012	56.39	18.38	0	89	500
Green Policy and Performance Score (GPPS)	2009	39.89	18.23	1	100	496
	2010	42.22	19.32	1	100	500
	2011	52.11	13.18	26.70	96.2	500
	2012	53.64	13.89	21.30	91.9	500
Reputation Survey Score (RSS)**	2009	34.44	13.54	1	100	496
	2010	47.46	14.02	1	100	500
Environmental Disclosure Score (EDS)**	2011	28.57	27.71	0	99.6	500
	2012	37.31	30.95	0	100	500
Market Risk (Beta)	2009	1.17	0.64	0.05	4.90	496
	2010	1.12	0.40	0.31	2.68	500
	2011	1.13	0.39	0.35	2.67	500
	2012	1.14	0.83	0.01	16.52	500
Market Capitalization (Billion)	2009	20.39	34.39	0.20	322.33	494
	2010	23.15	38.23	0.31	364.06	496
	2011	22.79	40.27	0.12	401.25	499
	2012	25.83	48.83	0.26	626.55	492
Profit growth (%)	2009	-16.32	128.06	-2081.19	669.23	478
	2010	34.84	247.74	-2458.23	3125.30	481
	2011	12.82	66.28	-471.46	947.17	487
	2012	7.60	74.45	-384.26	928.81	493

*Green Ranking (GR) ranges from 1=the lowest rank, and 500=the highest rank
**Newsweek Green Ranking has been modified in 2011 and 2012 version, i.e. replacing Reputation Survey Score (RSS) with Environmental Disclosure Score (EDS).

Table 1. 4: The Firms' Green Ranking Vs. Relevant Variables,

Green Ranking*	2009	2010	2011	2012	Overall
			Stock Return (%)		
401-500	7.74	11.81	10.16	4.67	4.67
301-400	10.29	15.66	13.53	6.36	6.36
201-300	6.94	15.61	15.48	5.42	5.42
101-200	6.59	12.66	12.13	3.06	3.06
001-100	8.09	14.55	16.92	4.19	4.19
Overall	7.93	14.04	13.62	4.73	4.73
			Market Beta Risk		
401-500	1.28	1.03	1.03	1.34	1.19
301-400	1.21	1.18	1.18	1.01	1.15
201-300	1.24	1.20	1.20	1.05	1.15
101-200	1.21	1.10	1.10	1.18	1.13
001-100	0.94	1.09	1.09	1.13	1.08
Overall	1.17	1.12	1.12	1.14	1.14
			Market Capitalization(Billion $)		
401-500	39.93	48.00	43.01	14.24	36.48
301-400	22.69	26.30	22.40	19.95	22.84
201-300	12.06	15.27	17.29	17.30	15.53
101-200	15.01	13.52	18.96	29.23	19.08
001-100	12.72	12.12	12.14	48.03	21.27
Overall	20.39	23.15	22.79	25.83	23.04
			Profit Growth (%)		
401-500	-14.37	22.04	1.87	6.55	4.28
301-400	-21.01	-9.22	13.73	22.00	1.62
201-300	-24.03	72.06	8.29	1.40	14.40
101-200	-11.79	68.69	14.02	2.74	18.39
001-100	-10.53	19.63	26.07	5.25	10.03
Overall	-16.32	34.84	12.82	7.60	9.77

*Green Ranking (GR) ranges from 1 = the lowest rank, and 500 = the highest rank
**Newsweek Green Ranking has been modified in 2011 and 2012 version, i.e. replacing Reputation Survey Score (RSS) with Environmental Disclosure Score (EDS)

Table 1. 5: Multicollinearity, Heteroskedasticity, and Autocorelation Test

Variation Inflation Factor (VIF)	2009-2010						2011-2012						2009-2012			
	1		2		3		4		5		6		7		8	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
Firm's Environmental Performances:																
Green ranking (GR)	52.42	1.15 §					38.01	1.09 §					39.01	1.10 §		
Square of green ranking (GR^2)	32.01	2.19 §					24.33	2.24 §					25.16	2.11 §		
Green score (GS)			121.41	1.44 §					45.19	1.10 §						
Square of green score (GS^2)			82.97	1.46 §					24.95	1.52 §						
Environmental Impact Score (EIS)					60.95	1.04 §					124.61	1.51 §			70.59	1.20 §
Square of Environmental Impact Score (EIS^2)					34.91	2.11 §					61.64	1.73 §			39.51	1.94 §
Green Policy & Performance Score (GPPS)					67.15	1.35 §					79.53	1.85 §			48.79	1.18 §
Square of Green Policy & Performance Score ($GPPS^2$)					30.40	1.75 §					31.19	1.99 §			23.31	1.69 §
Reputation Survey Score (RSS)					81.10	1.49 §										
Square of Reputation Survey Score (RSS^2)					30.77	1.73 §										
Environmental Disclosure Score (EDS)											34.71	2.18 §				
Square of Environmental Disclosure Score (EDS^2)											22.63	2.72 §				
Stock's Risk Characteristics:																
Beta Coeficient	21.97	10.07	46.49	8.26	48.39	10.94	6.99	3.19	11.33	2.49	12.83	4.20	6.66	2.82	9.61	3.25
Square of Beta Coeficient	9.33	7.04	15.40	6.51	16.34	7.07	2.48	1.72	3.14	1.63	3.32	1.91	2.05	1.58	2.31	1.64
Firm's Characteristics:																
Market Capitalization	1.01	1.01	8.32	1.01	8.85	8.15	4.85	4.56	5.16	4.49	5.50	4.70	4.79	4.59	4.98	4.37
Square of Market Capitalization (CAP^2)	8.03	7.96	5.97	7.66	6.10	5.83	3.67	3.57	3.79	3.54	3.94	3.64	3.54	3.48	3.61	3.42
Profit Growth (%)	5.86	5.84	1.01	5.72	1.01	1.01	1.03	1.03	1.03	1.03	1.04	1.04	1.01	1.01	1.01	1.01
AVERAGE	18.66	5.04	40.05	4.58	35.05	1.58	11.62	2.49	13.51	2.26	34.63	2.50	11.75	2.38	22.63	2.19
Wald's Chi-Square Test for Heterokedasticity - Ho: $\delta(i)^2 = \delta^2$ for all i	2.60E+36 **		3.30E+33 ***		2.40E+35 ***		3.10E+38 ***		2.40E+36 ***		1.50E+35 ***		3.30E+35 ***		1.40E+34 ***	
Wooldridge F-test for autocorrelation in panel data - Ho: No AR(1)	NA		NA		NA		NA		NA		NA		0.7238		0.5310	

Note: *Significant at P≤0.10; **significant at p P≤0.05; and *** significant at p P≤0.01

§The variable is modified to the difference from its mean value to mitigate collinearity

Table 1. 6: The Estimation of Environmentally Friendly Hedonic Price Model

Dependent Variable: Stock Return	**2009-2010**			**2011-2012**			**2009-2012**	
	1	2	3	4	5	6	7	8
Firm's Environmental Performances:								
Green ranking (GR)	-0.0030 ***			-0.0089 ***			-0.0051 ***	
Square of green ranking (GR^2)	-1.12E-05 **			-3.36E-05 ***			-2.82E-05 ***	
Green score (GS)		-0.0581 ***			-0.1018 ***			
Square of green score (GS^2)		-0.0001			-0.0021 ***			
Environmental Impact Score (EIS)			-0.0536 ***			-0.0586 ***		-0.0597 ***
Square of Environmental Impact Score (EIS^2)			-0.0003 ***			-0.0005 **		-0.0005 ***
Green Policy & Performance Score (GPPS)			-0.0020			-0.0996 ***		-0.0633 ***
Square of Green Policy & Performance Score ($GPPS^2$)			-0.0006 *			-7.74E-05		-0.0001
Reputation Survey Score (RSS)			0.0725 ***					
Square of Reputation Survey Score (RSS^2)			-0.0016 ***					
Environmental Disclosure Score (EDS)						-0.0155 *		
Square of Environmental Disclosure Score (EDS^2)						-0.0002		
Stock's Risk Characteristics:								
Beta Coeficient	16.0597 ***	16.7233 ***	16.2300 ***	6.0812 ***	6.1862 ***	5.5687 ***	3.9713 ***	4.9343 ***
Square of Beta Coeficient	-4.7709 ***	-4.9507 ***	-4.5881 ***	-0.3516 ***	-0.3595 ***	-0.3309 ***	-0.2341 ***	-0.2959 ***
Firm's Characteristics:								
Market Capitalization	4.24E-05 ***	4.19E-05 ***	3.78E-05 ***	1.93E-05 ***	2.52E-05 ***	3.35E-05 ***	2.88E-05 ***	3.85E-05 ***
Square of Market Capitalization (CAP^2)	-1.18E-10 ***	-1.18E-10 ***	-1.18E-10 ***	-9.45E-11 ***	-1.03E-10 ***	-1.16E-10 ***	-1.13E-10 ***	-1.27E-10 ***
Profit Growth (%)	0.0077 ***	0.0076 ***	0.0058 ***	0.0202 ***	0.0179 ***	0.0175 ***	0.0080 ***	0.0076 ***
Constant	-0.4768	-1.1436 **	-0.2780	3.1458 ***	2.5976 ***	2.9484 ***	5.8464 ***	4.5244 ***
Number of observations (N)	958	958	958	972	972	972	1930	1930
Time period (T)	2	2	2	2	2	2	4	4
Wald's Chi-Square	749 ***	875 ***	5629 ***	4941 ***	1538 ***	1447 ***	142 ***	405 ***

*Significant at P≤0.10; **significant at p P≤0.05; and *** significant at p P≤0.01. Due to multicolinearity, the following variables are transformed to the deviation to their mean: all environmental variables. transformation, please be cautious in interpreting the regression coefficients. See Figure 1.3 or Appendix 1.1 for the presentation of the simulation of the effect of each variable

Table 1. 7: The Willingness to Pay (WTP)* of Environmentally Friendliness

The Bottom 25 Firms in 2012				The Top 25 Firms in 2012			
Company Name	**Sector**	**Green Ranking**	**WTP (%)**	**Company Name**	**Sector**	**Green Ranking**	**WTP (%)**
BlackRock	Financials	1	0.0191	Allergan	Healthcare	476	-0.0178
Alpha Natural Resources	Energy	2	0.0191	American Express	Financials	477	-0.0179
CF Industries Holdings	Materials	3	0.0190	Best Buy	Retailers	478	-0.0179
T. Rowe Price Group	Financials	4	0.0189	Google	Information Technology & Services	479	-0.0180
Monsanto	Materials	5	0.0189	Autodesk	Information Technology & Services	480	-0.0180
Invesco	Financials	6	0.0188	Motorola Solutions	Technology Equipment	481	-0.0181
CONSOL Energy	Energy	7	0.0188	Cisco Systems	Technology Equipment	482	-0.0182
Peabody Energy	Energy	8	0.0187	Baxter	Healthcare	483	-0.0182
Archer-Daniels-Midland	Food, Beverage & Tobacco	9	0.0187	Citigroup	Financials	484	-0.0183
FirstEnergy	Utilities	10	0.0186	Manpower	Professional Services	485	-0.0183
Tyson Foods	Food, Beverage & Tobacco	11	0.0185	McGraw-Hill	Media & Publishing	486	-0.0184
Ralcorp Holdings	Food, Beverage & Tobacco	12	0.0185	Hartford Financial Services Grp.	Financials	487	-0.0184
Ameriprise Financial	Financials	13	0.0184	Cognizant Technology	Information Technology & Services	488	-0.0185
Allegheny Technologies	Materials	14	0.0184	Microsoft	Information Technology & Services	489	-0.0185
AES	Utilities	15	0.0183	EMC	Technology Equipment	490	-0.0186
Ameren	Utilities	16	0.0183	Staples	Retailers	491	-0.0187
PPL	Utilities	17	0.0182	Office Depot	Retailers	492	-0.0187
Mead Johnson Nutrition	Food, Beverage & Tobacco	18	0.0182	Accenture	Information Technology & Services	493	-0.0188
Bunge	Food, Beverage & Tobacco	19	0.0181	Intel	Technology Equipment	494	-0.0188
Edison International	Utilities	20	0.0180	Nvidia	Technology Equipment	495	-0.0189
SCANA	Utilities	21	0.0180	CA Technologies	Information Technology & Services	496	-0.0189
Airgas	Materials	22	0.0179	Dell	Technology Equipment	497	-0.0190
Nucor	Materials	23	0.0179	Sprint Nextel	Telecommunications	498	-0.0191
Lorillard	Food, Beverage & Tobacco	24	0.0178	Hewlett-Packard	Technology Equipment	499	-0.0191
Precision Castparts	Aerospace & Defense	25	0.0178	IBM	Information Technology & Services	500	-0.0192

*was calculated using the following formula: $WTP = B - 2C\bar{x} + 2Cx$ where B and C are the parameter estimates for the variables and their square respectively and x is the independent variables. See Figure 1 4.

Table 1. 8: Robustness Check for the Models

Model 1	Dependent Variable: Accumulated Return					
	October	November	December	January	February	March
Green ranking (GR)	0.0060 ***	0.0036 ***	-0.0030 ***	0.0045 ***	0.0071 ***	0.0040 ***
Square of green ranking (GR^2)	-2.17E-05 ***	-2.14E-05 ***	-1.12E-05 **	-2.44E-05 ***	-2.67E-06	-2.25E-05 **
Beta Coeficient	1.6346 ***	5.4103 ***	16.0597 ***	18.2589 ***	23.2210 ***	22.0951 ***
Square of Beta Coeficient	-1.2935 ***	-2.0669 ***	-4.7709 ***	-5.4877 ***	-6.7690 ***	-5.7687 ***
Market Capitalization	5.65E-05 ***	7.02E-05 ***	4.24E-05 ***	3.30E-05 **	-1.99E-06	-4.52E-05 **
Square of Market Capitalization (CAP^2)	-1.06E-10 ***	-1.92E-10 ***	-1.18E-10 ***	-6.44E-11	3.89E-12	1.92E-10 **
Profit Growth (%)	0.0033 ***	0.0051 ***	0.0077 ***	0.0116 ***	0.0142 ***	0.0112 ***
Constant	2.1076 ***	1.7972 ***	-0.4768	-1.7788 ***	-0.9997	3.1047 ***
Number of observations (N)	950	951	958	950	949	946
Time period (T)	2	2	2	2	2	2
Wald's Chi-Square	2953 ***	583 ***	749 ***	1795.54 ***	1665 ***	764 ***

Model 2	Dependent Variable: Accumulated Return					
	October	November	December	January	February	March
Green score (GS)	0.0571 ***	0.0029	-0.0581 ***	0.0403 **	0.0608 ***	0.0236
Square of green score (GS^2)	0.0015 ***	0.0007 *	-0.0001	0.0009	0.0014 **	-0.0013
Beta Coeficient	1.8083 ***	4.8160 ***	16.7233 ***	17.7970 ***	24.0434 ***	22.9999 ***
Square of Beta Coeficient	-1.3192 ***	-1.8821 ***	-4.9507 ***	-5.2971 ***	-7.0394 ***	-5.9561 ***
Market Capitalization	5.21E-05 ***	6.36E-05 ***	4.19E-05 ***	2.54E-05 *	-4.84E-07	-4.03E-05 ***
Square of Market Capitalization (CAP^2)	-9.15E-11 ***	-1.52E-10 ***	-1.18E-10 ***	-2.64E-11	9.63E-12	1.79E-10 **
Profit Growth (%)	0.0032 ***	0.0061 ***	0.0076 ***	0.0118 ***	0.0140 ***	0.0110 ***
Constant	1.5150 ***	1.7278 ***	-1.1436 **	-2.0973 ***	-1.6590 ***	1.9485 ***
Number of observations (N)	950	951	958	950	949	946
Time period (T)	2	2	2	2	2	2
Wald's Chi-Square	1172 ***	258 ***	875 ***	1370.73 ***	5469 ***	43339 ***

Model 3	Dependent Variable: Accumulated Return					
	October	November	December	January	February	March
Environmental Impact Score (EIS)	-0.0213 ***	-0.0358 ***	-0.0536 ***	0.0082 **	0.0201 ***	0.0124 **
Square of Environmental Impact Score (EIS^2)	0.0003 ***	-0.0003 **	-0.0003 ***	-0.0003 *	-0.0010 ***	-0.0015 ***
Green Policy & Performance Score (GPPS)	0.0375 ***	0.0268 ***	-0.0020	0.0024	0.0069	0.0028
Square of Green Policy & Performance Score ($GPPS^2$)	-0.0012 ***	-0.0013 ***	-0.0006 *	-0.0006 *	0.0002	-0.0008 **
Reputation Survey Score (RSS)	0.1406 ***	0.0446 ***	0.0725 ***	0.2099 ***	0.2161 ***	0.1020 ***
Square of Reputation Survey Score (RSS^2)	-0.0032 ***	-0.0025 ***	-0.0016 ***	-0.0050 ***	-0.0041 ***	-0.0038 ***
Beta Coeficient	1.5991 **	4.8019 ***	16.2300 ***	13.5800 ***	20.1922 ***	20.0827 ***
Square of Beta Coeficient	-1.1262 ***	-1.7560 ***	-4.5881 ***	-4.0005 ***	-5.8616 ***	-4.9887 ***
Market Capitalization	3.21E-05 ***	9.01E-05 ***	3.78E-05 ***	1.14E-05	-4.95E-05 ***	-3.85E-05 **
Square of Market Capitalization (CAP^2)	-3.27E-11	-2.08E-10 ***	-1.18E-10 ***	4.74E-11	2.17E-10 ***	1.96E-10 ***
Profit Growth (%)	0.0021 ***	0.0046 ***	0.0058 ***	0.0119 ***	0.0139 ***	0.0117 ***
Constant	2.7184 ***	2.5222 ***	-0.2780	2.5021 ***	3.1653 ***	5.9797 ***
Number of observations (N)	950	951	958	950	949	946
Time period (T)	2	2	2	2	2	2
Wald's Chi-Square	1312 ***	1337 ***	5629 ***	1363.51 ***	3083 ***	2081 ***

*Significant at P≤0.10; **significant at p P≤0.05; and *** significant at p P≤0.01

Table 1.8: Robustness Check for the Models (Continued)

Model 4	Dependent Variable: Accumulated Return					
	October	November	December	January	February	March
Green ranking (GR)	-0.0099 ***	-0.0099 ***	-0.0089 ***	-0.0065 ***	-0.0050 ***	0.0031 **
Square of green ranking (GR^2)	-5.47E-05 ***	-6.81E-05 ***	-3.36E-05 ***	-9.10E-05 ***	-9.53E-05 ***	-8.54E-05 ***
Beta Coeficient	7.3024 ***	5.9553 ***	6.0812 ***	18.0878 ***	19.0565 ***	16.8207 ***
Square of Beta Coeficient	-0.4357 ***	-0.3406 ***	-0.3516 ***	-1.3141 ***	-1.3829 ***	-1.2549 ***
Market Capitalization	1.79E-05 ***	6.48E-06	1.93E-05 ***	-4.38E-06	-5.38E-06	-1.71E-05
Square of Market Capitalization (CAP^2)	-7.72E-11 ***	-6.66E-11 ***	-9.45E-11 ***	-7.20E-11 *	-5.61E-11	-5.52E-11
Profit Growth (%)	0.0108 **	0.0198 ***	0.0202 ***	0.0190 ***	0.0132 ***	0.0211 ***
Constant	3.5380 ***	5.1096 ***	3.1458 ***	2.2144 ***	4.1365 ***	10.1037 ***
Number of observations (N)	967	967	972	965	964	963
Time period (T)	2	2	2	2	2	2
Wald's Chi-Square	531 ***	335 ***	4941 ***	4652.45 ***	2424 ***	2186 ***

Model 5	Dependent Variable: Accumulated Return					
	October	November	December	January	February	March
Green score (GS)	-0.1197 ***	-0.1001 ***	-0.1018 ***	-0.0692 ***	-0.0491 ***	0.0242 **
Square of green score (GS^2)	-0.0031 ***	-0.0025 ***	-0.0021 ***	-0.0044 ***	-0.0048 ***	-0.0041 ***
Beta Coeficient	7.8616 ***	5.9589 ***	6.1862 ***	18.1994 ***	18.8146 ***	17.0204 ***
Square of Beta Coeficient	-0.4738 ***	-0.3461 ***	-0.3595 ***	-1.3242 ***	-1.3709 ***	-1.2685 ***
Market Capitalization	2.71E-05 ***	4.19E-06	2.52E-05 ***	1.10E-06	-4.74E-06	-1.73E-05
Square of Market Capitalization (CAP^2)	-9.55E-11 ***	-6.29E-11 ***	-1.03E-10 ***	-9.02E-11 **	-5.13E-11	-5.17E-11
Profit Growth (%)	0.0086 ***	0.0181 ***	0.0179 ***	0.0193 ***	0.0152 ***	0.0207 ***
Constant	2.9445 ***	4.4897 ***	2.5976 ***	1.2421 ***	3.7071 ***	9.2077 ***
Number of observations (N)	967	967	972	965	964	963
Time period (T)	2	2	2	2	2	2
Wald's Chi-Square	5567 ***	359 ***	1538 ***	25427.66 ***	4594 ***	2070 ***

Model 6	Dependent Variable: Accumulated Return					
	October	November	December	January	February	March
Environmental Impact Score (EIS)	-0.0687 ***	-0.0990 ***	-0.0586 ***	-0.0961 ***	-0.0917 ***	-0.0531 ***
Square of Environmental Impact Score (EIS^2)	-0.0016 ***	-0.0028 ***	-0.0005 **	-0.0045 ***	-0.0058 ***	-0.0045 ***
Green Policy & Performance Score (GPPS)	-0.1537 ***	-0.1707 ***	-0.0996 ***	-0.0828 ***	-0.0790 ***	-0.0062
Square of Green Policy & Performance Score ($GPPS^2$)	-0.0005	-0.0002	-0.0001	-0.0007 *	-0.0030 ***	-0.0022 ***
Environmental Disclosure Score (EDS)	0.0395 ***	0.0385 ***	-0.0155 *	0.0402 ***	0.0348 ***	0.0106
Square of Environmental Disclosure Score (EDS^2)	-0.0015 ***	-0.0020 ***	-0.0002	-0.0027 ***	-0.0024 ***	-0.0024 ***
Beta Coeficient	6.9095 ***	6.4309 ***	5.5687 ***	16.4063 ***	17.5592 ***	17.2753 ***
Square of Beta Coeficient	-0.4215 ***	-0.3846 ***	-0.3309 ***	-1.2286 ***	-1.3114 ***	-1.2981 ***
Market Capitalization	2.24E-05 ***	1.69E-05 ***	3.35E-05 ***	-8.68E-06	-1.43E-05	-4.55E-06
Square of Market Capitalization (CAP^2)	-7.76E-11 ***	-7.89E-11 ***	-1.16E-10 ***	-8.03E-11 **	-1.63E-11	-1.10E-10 *
Profit Growth (%)	0.0038	0.0140 ***	0.0175 ***	0.0190 ***	0.0081 **	0.0175 ***
Constant	4.6703 ***	6.5490 ***	2.9484 ***	6.0444 ***	9.3919 ***	12.8404 ***
Number of observations (N)	967	967	972	965	964	963
Time period (T)	2	2	2	2	2	2
Wald's Chi-Square	656 ***	924 ***	1447 ***	2508.30 ***	6865 ***	1930 ***

*Significant at P≤0.10; **significant at p P≤0.05; and *** significant at p P≤0.01

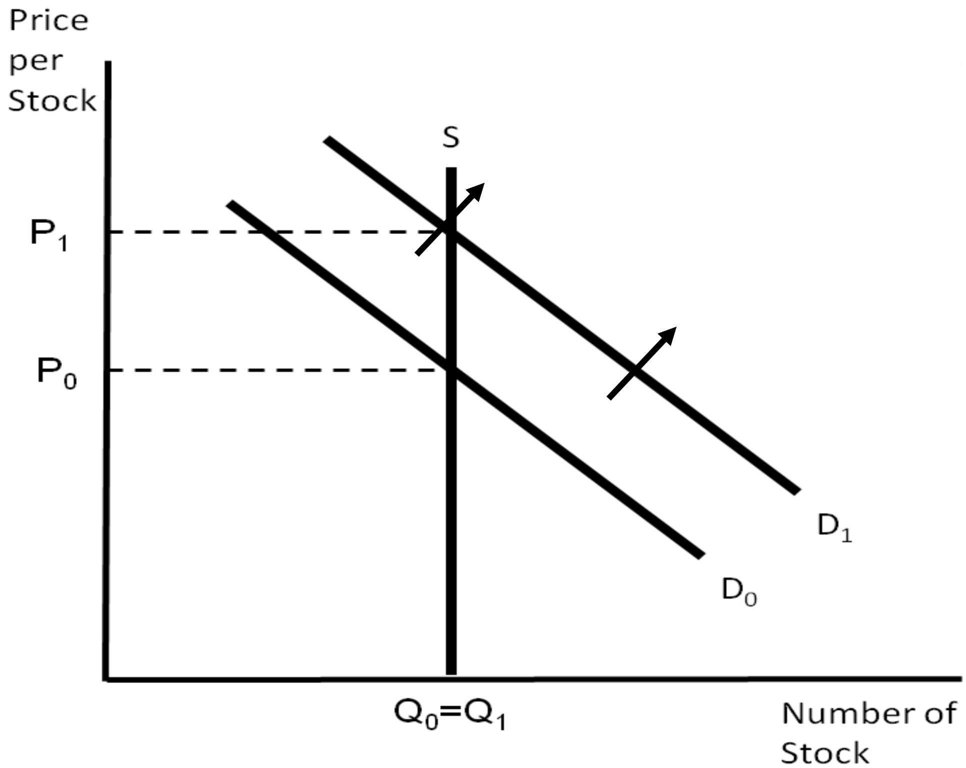
Table 1.8: Robustness Check for the Models (Continued)

Model 7	Dependent Variable: Accumulated Return					
	October	November	December	January	February	March
Green ranking (GR)	-0.0045 ***	-0.0045 ***	-0.0051 ***	-0.0008	-0.0014	0.0045 ***
Square of green ranking (GR^2)	-3.13E-05 ***	-4.20E-05 ***	-2.82E-05 ***	-5.72E-05 ***	-5.16E-05 ***	-4.81E-05 ***
Beta Coeficient	1.8617 ***	2.6018 ***	3.9713 ***	10.7362 ***	11.4900 ***	11.6640 ***
Square of Beta Coeficient	-0.1161 ***	-0.1419 ***	-0.2341 ***	-0.8922 ***	-0.9561 ***	-0.9584 ***
Market Capitalization	2.10E-05 ***	2.00E-05 ***	2.88E-05 ***	2.51E-05 ***	1.02E-05	-1.98E-05
Square of Market Capitalization (CAP^2)	-6.30E-11 ***	-7.86E-11 ***	-1.13E-10 ***	-1.43E-10 ***	-9.65E-11 *	-3.51E-11
Profit Growth (%)	0.0041 ***	0.0083 ***	0.0080 ***	0.0116 ***	0.0145 ***	0.0142 ***
Constant	4.6935 ***	5.4978 ***	5.8464 ***	4.5849 ***	7.5152 ***	10.9790 ***
Number of observations (N)	1917	1918	1930	1915	1913	1909
Time period (T)	4	4	4	4	4	4
Wald's Chi-Square	102 ***	220 ***	142 ***	814.76 ***	6355 ***	660 ***

Model 8	Dependent Variable: Accumulated Return					
	October	November	December	January	February	March
Environmental Impact Score (EIS)	-0.0128 ***	-0.0336 ***	-0.0597 ***	0.0048	-0.0024	0.0177 *
Square of Environmental Impact Score (EIS^2)	-0.0018 ***	-0.0018 ***	-0.0005 ***	-0.0022 ***	-0.0033 ***	-0.0033 ***
Green Policy & Performance Score (GPPS)	-0.0330 ***	-0.0372 ***	-0.0633 ***	-0.0121	-0.0022	0.0130
Square of Green Policy & Performance Score ($GPPS^2$)	-0.0013 ***	-0.0008 ***	-0.0001	-0.0001	-0.0009 **	-0.0003
Beta Coeficient	1.9654 ***	2.5631 ***	4.9343 ***	9.5868 ***	11.1867 ***	11.1114 ***
Square of Beta Coeficient	-0.1270 ***	-0.1484 ***	-0.2959 ***	-0.8322 ***	-0.9447 ***	-0.9412 ***
Market Capitalization	2.51E-05 ***	2.22E-05 ***	3.85E-05 ***	1.35E-05	-1.45E-05	-3.11E-05 **
Square of Market Capitalization (CAP^2)	-7.57E-11 ***	-8.07E-11 ***	-1.27E-10 ***	-1.27E-10 ***	-3.11E-11	-1.55E-11
Profit Growth (%)	0.0063 ***	0.0086 ***	0.0076 ***	0.0134 ***	0.0154 ***	0.0120 ***
Constant	5.6957 ***	6.1318 ***	4.5244 ***	5.7787 ***	9.2631 ***	12.9878 ***
Number of observations (N)	1917	1918	1930	1915	1913	1909
Time period (T)	4	4	4	4	4	4
Wald's Chi-Square	64909 ***	484 ***	405 ***	790.24 ***	1073 ***	1231 ***

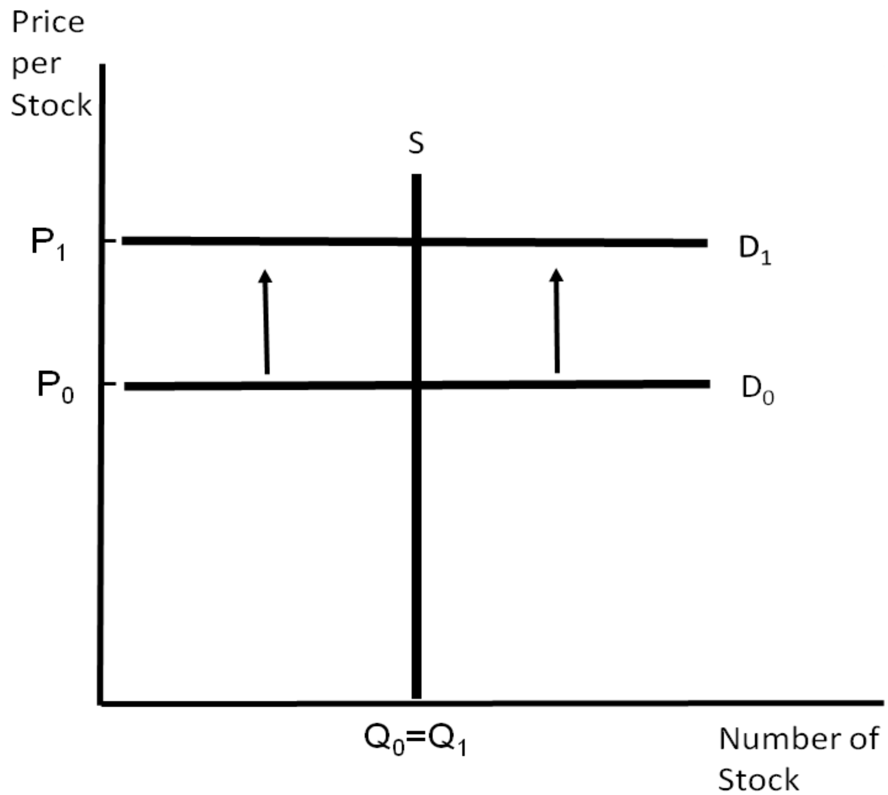
*Significant at P≤0.10; **significant at p P≤0.05; and *** significant at p P≤0.01

Figure 1. 1: A Market for a Typical Stock with Elastic Demand Curve



Source: Modified from Johnson and Lambert (1965), Levin and Wright (2002), and Hall and Lieberman (2010)

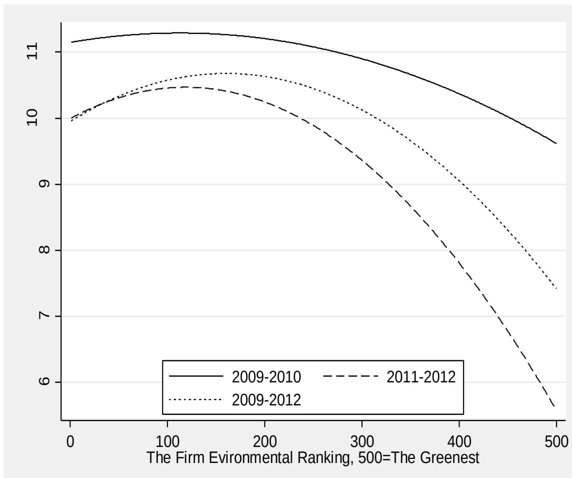
Figure 1. 2: A Market for a Typical Stock with Perfectly Elastic Demand Curve



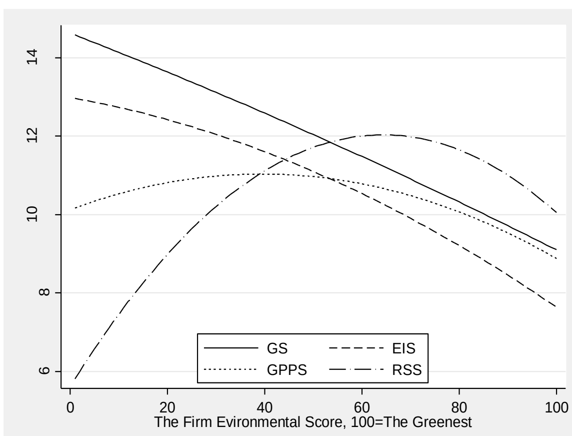
Source: Modified from Johnson and Lambert (1965), Levin and Wright (2002), and Hall and Lieberman (2010)

Figure 1. 3: The Simulated effect of The Firms' Environmental Attributes to Stock Return

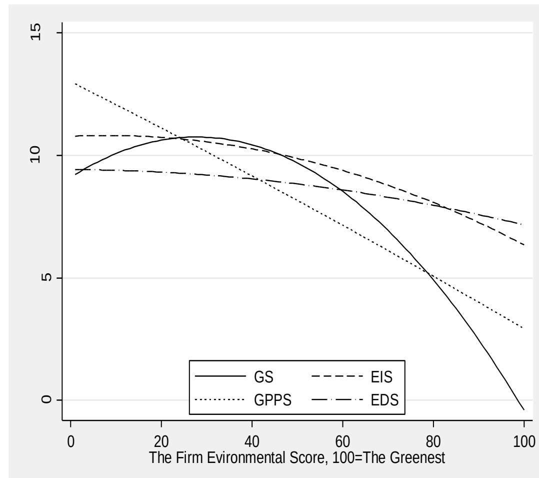
a. Green Ranking (GR)



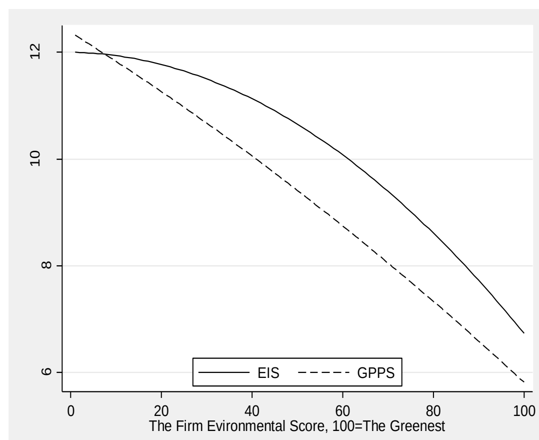
b. Environmental Scores 2009-2010



c. Environmental Scores 2011-2012



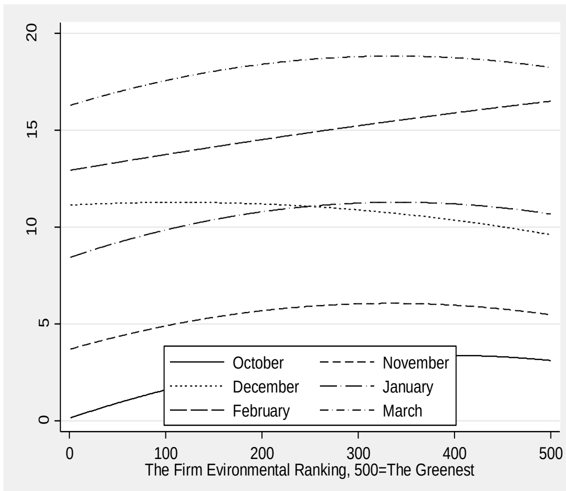
d. Environmental Scores 2009-2012



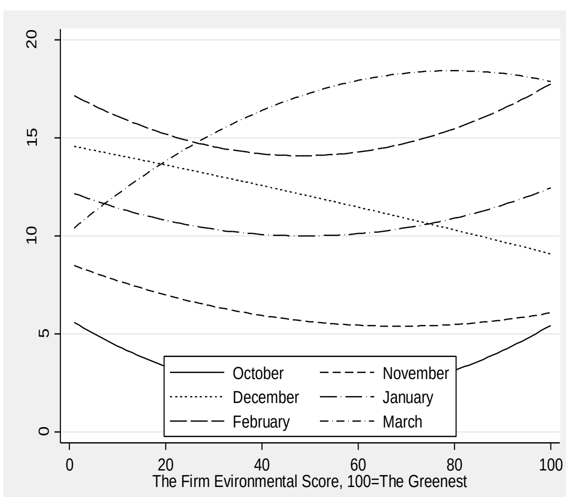
Note: Based on FGLS Estimation, given all other variables constant at mean values. Environmental Attributes include: Green Ranking (GR), Green Score (GS), Environmental Impact Score (EIS), Reputation Survey Score (RSS), and Environmental Disclosure Score (EDS)

Figure 1. 4: Robustness Check for the Model using Simulated Effect of Environmental Variables

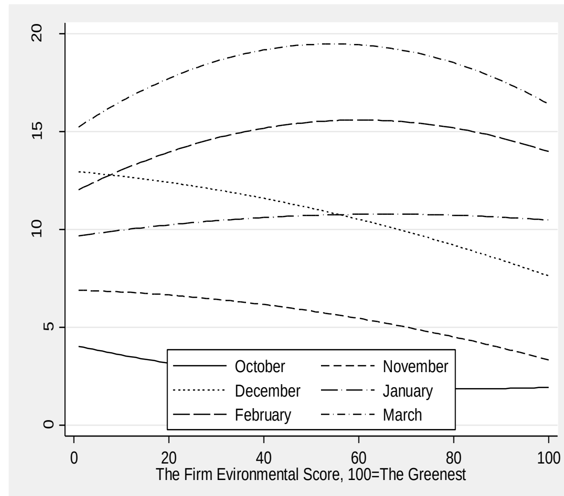
a. Model 1: GR 2009-2010



b. Model 2: GS 2009-2010



c. Model 3: EIS 2009-2010



d. Model 3: GPPS 2009-2010

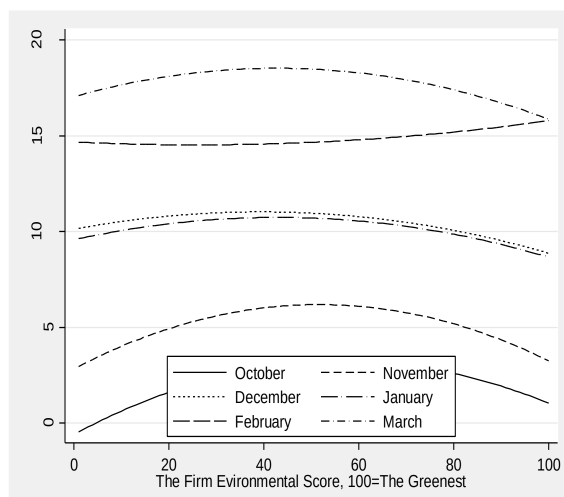
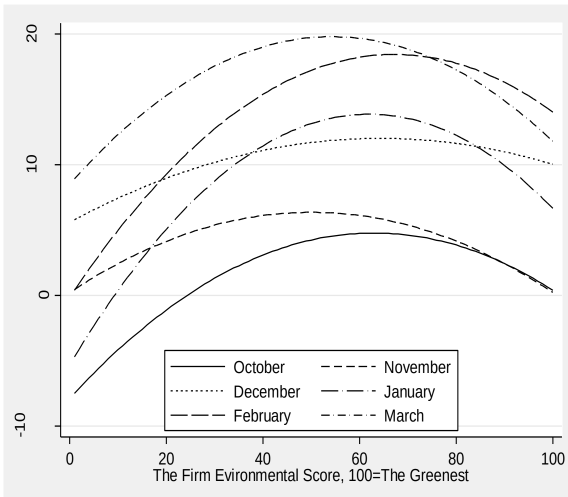
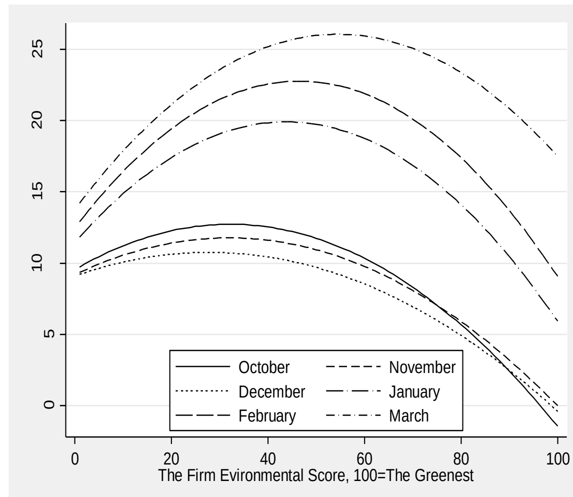


Figure 1. 4: Robustness Check of the Model using Simulated Effect of Environmental Variables (Continued)

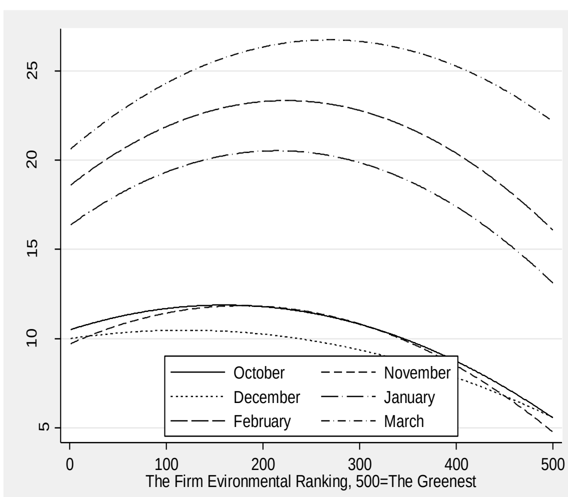
e. Model 3: RSS 2009-2010



g. Model 5: GS 2011-2012



f. Model 4: GR 2011-2012



h. Model 6: EIS 2011-2012

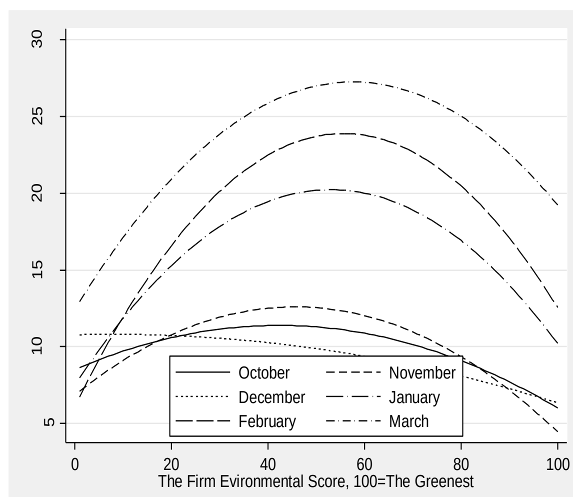
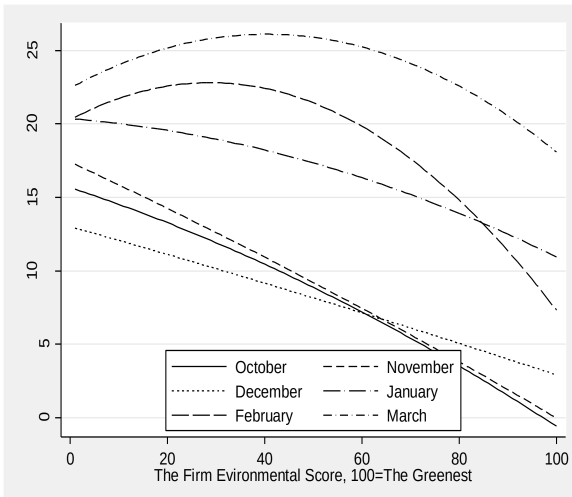
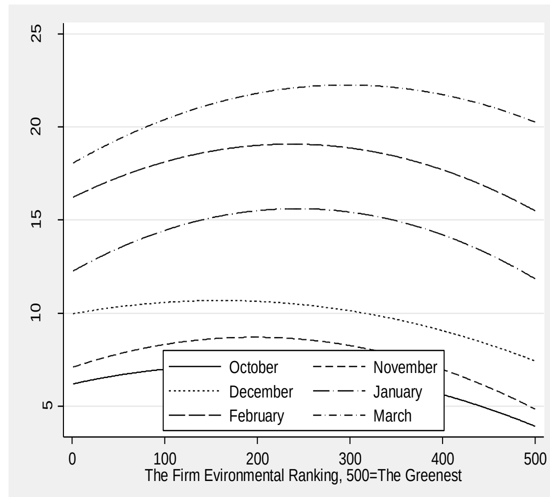


Figure 1. 4: Robustness Check of the Model using Simulated Effect of Environmental Variables (Continued)

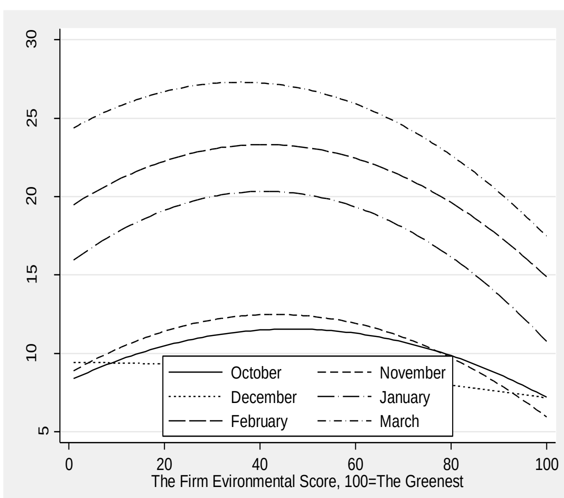
j. Model 6: GPPS 2011-2012



l. Model 7: GR 2009-2012



k. Model 6: EDS 2011-2012



m. Model 8: EIS 2009-2012

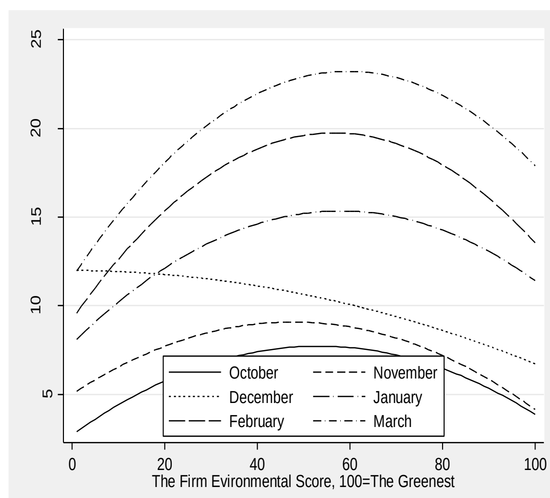
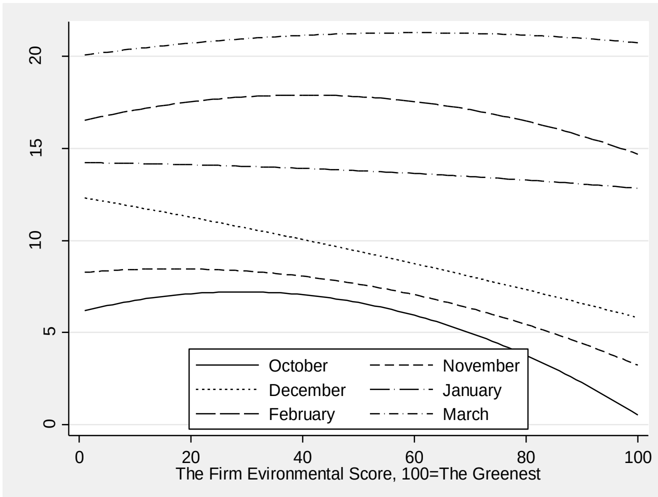


Figure 1. 4: Robustness Check of the Model using Simulated Effect of Environmental Variables (Continued)

n. Model 8: GPPS: 2009-2012



Appendix 1. 1: Deriving Marginal effect based on centered value regression

Suppose we have regression of

(11) $$y = a + bx + cx^2 + e$$

Because of multicolinearity among the variables on the right hand side therefore we estimate the regression by using centered-value of the independent variables.

(12) $$y = A + B(x - \bar{x}) + C(x - \bar{x})^2 + E$$

From the regression estimate we have the estimate of parameter A, B, and C from equation (12). To recover the value of a, b, and c from equation (11) therefore we need to rearrange deterministic part of the parameter estimates from the right hand side of equation (12).

(13)
$$\begin{aligned} y &= A + Bx - B\bar{x} + C(x^2 - 2x\bar{x} + \bar{x}^2) \\ &= A + Bx - B\bar{x} + Cx^2 - 2Cx\bar{x} + C\bar{x}^2 \\ &= Bx + Cx^2 - 2Cx\bar{x} + (A + C\bar{x}^2 - B\bar{x}) \\ &= (A + C\bar{x}^2 - B\bar{x}) + (B - 2C\bar{x})x + Cx^2 \end{aligned}$$

Therefore,

a=$(A + C\bar{x}^2 - B\bar{x})$
b=$(B - 2C\bar{x})$
c=C

The value of marginal effect or willingness to pay (WTP) is given by the following.

(14) $$Marginal\ Effect = WTP = \frac{dy}{dx} = (B - 2C\bar{x}) + 2Cx$$

(15) $$Inflection\ point = (B - 2C\bar{x})/-2C$$

Chapter 3: The Effect of Firm's Environmental Performances on Its Market Risk

1. Introduction

A firm's environmental conduct can have an obvious effect on the firm's stock systematic risk level; which is the co-movement of a stock return and the stock market return which measures an undiversified riskiness of a stock. For example, the British Petroleum (BP) gulf oil spill in early 2010 increased BP's stock volatility between two to four times higher than pre-disaster (Fodor and Stowe 2010). However, such an extreme type of event seldom occurs; typical events are more subtle and seamless. There are numerous measures which provide information on the level of firms' environmentally risky behaviors, like information about the environmental impact of a firm's operation, the sophistication, or lack thereof, of a firm policy dealing with environmental issues, or in the form of a report on people's perception, including expert evaluation, of a firm environmental conduct. Studies show that given such information, investors respond immediately to such information as they are published (Klassen and McLaughlin 1996, Konar and Cohen 1997).

The intriguing question is whether such information about a firms' environmental performance can affect their future stock systematic risk. Knowing this relationship will be useful for investors in predicting the riskiness of an investment to maximize utility. There are numerous studies attempting to investigate the effect of a firm's environmental conduct to a firm's stock systematic risk. Some studies argue that economic factors play an important role in shaping the financial risk (Rosenberg and Guy 1976); some show that a firm's environmental policy and conducts can mitigate the riskiness of a firm's stock, while the others argue that this measure will add cost to the firm (Spicer 1978, Feldman, Soyka et al. 1996).

The purpose of this study is to determine whether a firm's environmental performance affects its future systematic risk. We attempt to investigate the causal relationship between environmental and systematic risk performances. Importantly, this study addresses the issue of non-linearity relationship between environmental and risk performance as suggested by several studies (Wagner, Schaltegger et al. 2001, Wagner, Van Phu et al. 2002, Barnett and Salomon 2003). This study uses data from the Newsweek Green Ranking of the 500 largest US firms and follow them from 2009 to 2012, which provide information reports on a firms' environmental conduct and performances. In brief, the results show a significant non-linear relationship (U-shape) between environmental conduct and systematic risk. For the 25 firms in the worst environmental ranking, every improvement of green ranking by a point in rank reduces systematic risk around 0.2%.

The remainder of this report will proceed as the following: (1) A review of previous studies that will provide a framework for empirical tests including the use of control variables; (2) Presentation of a methodological approach that will outline the organization of the hypothesis testing; (3) Results and discussion are presented and a conclusion will be drawn.

2. Literature Review

2.1. Firm's Market (Beta) Risk

In any portfolio choice, investors are exposed to systematic and unsystematic risks. The un-systematic or idiosyncratic risk associated with the variability of a firm's stock itself is independent of the market in general. This risk measures the volatility of stock price due to how a firm conducts itself, i.e. management culture and values, marketing strategies: pricing, development, placement, etc. This type of risk can be minimized by diversifying a portfolio.

The systematic risk, on the other hand, is a risk that cannot be avoided by diversifying a portfolio. To avoid risk investors must give up return. The measure of the systematic risk is market beta or market risk; the beta value shows the co-movement of a stock's price with the kernel of index of assets prices, the sensitivity of a stock price to the market price.

Both risk measures, systematic and unsystematic risk, are derived from equation (16) below, following Sharp (1964). One common measures of stock market price is the stock index like the Standard and Poor's 500.

$$R_{it} = a_i + B_i R_{mt} + e_{it} \quad (16)$$

where R_{it} is a return of stock i at time t; a_i is the value of stock i's return which independent from market return; B_i is the measure of systematic risk, the value of stock i's return which dependent on the market return; R_{mt} is the market return at time $t\ of\ firm\ m$, and e_{it} is the error term of stock i at time t. Based on this regression we can recover the standard deviation of error term for a stock and that is the measure of firm's idiosyncratic risk. Systematic risk accounts for about 20% of total risk, while idiosyncratic risk accounts for about 80% of total risk (Goyal and Santa-Clara 2003, José-Miguel Gaspar and Massimo Massa 2006).

The value of stock systematic risk can be affected by several variables. To investigate the effect of environmental factors on a firms' stock this study will start from the earlier models that explain the determinant of risk. Many studies show that the systematic risks can be affected by firms' financial condition like operating leverage, and environmental factors.

2.2. Firms' Financial Factors and risks profiles: the control variables

By definition market (beta) risk is affected by market wide events; events that influence all stocks in the market, e.g. interest rate change, unemployment, etc. Firm specific events like corporate financial condition, environmental conducts, etc., affects idiosyncratic risk. Grouping the events into the two categories, however, is "highly abstractive" (Beaver, Kettler et al. 1970). Empirically, the firm specific events also have influence on shaping the market risk. It was Beaver, Kettler et al. (1970) who pioneered linking the effect of corporate financial performances, i.e. accounting risk and market risk. Based on Beaver et al.'s notions, Hamada (1972) further show theoretically that such a firm specific events affect market risk.

The effect of a firm's financial factors on its stock systematic risk has been well documented in numerous studies. Hamada (1972) synthesized the capital asset pricing model (CAPM)[12] and the Modigliani and Miller (MM)[13] theory; and showed and found empirically that the value of the systematic risk should be greater for a stock of a firm

[12] The efficient set of portfolios to any individual investor will always be some combination of lending at risk-free rate and "market portfolio" Hamada, R. S. (1972). "The Effect of the Firm's Capital Structure on the Systematic Risk of Common Stocks." The Journal of Finance **27**(2): 435-452.
[13] The value of a firm is unaffected by the way how the firm is financed, via personal or corporate borrowing. **.Modigliani, F. and H. M. Merton (1965). "The Cost of Capital, Corporation Finance, and the Theory of Investment: Reply." The American Economic Review 55(3): 524-527.**

which has high value of debt-equity ratio than that of a firm with low debt-equity ratio. His study also found that firm's leverage does significantly affect the firm's stock systematic risk.

To mitigate the heterogeneity issue across industry, Melicher (1974) conducted a study in a homogenous industry sample and employed various measures of corporate financial condition as determinants of systematic risk. The study confirmed Hamada's findings that there is a significant positive relationship between a firm's financial leverage and a firm's stock systematic risk. The effects of the other variables on its stock beta are also significant, including the lag of financial factors, the equity return, the firm size, and dividend payout policy.

Beside finding the effect of financial leverage, like earlier studies, more recent studies investigated the effect of operating leverage of a firm to its stock's systematic risk (Hill and Stone 1980, Mandelker and Rhee 1984, Huffman 1989). The studies used different measures of operating risk. The results showed that both operating leverage and financial leverage have a significant effect on the firm's stock's systematic risk. Moreover, Hill and Stone (1980) found a nonlinear relationship between the firm's financial leverage and systematic risk. Mandelker and Rhee (1984) found that the firms engaged in a trade-off between the degree of operating leverage[14] and the degree of financial leverage[15]. In more comprehensive measures, Iqbal and Shah (2012) showed that liquidity, assets turnover, profitability, size, dividend payout, and equity value significantly affect systematic risk.

[14] $OL = (Sales - Variable\ Cost)/(Revenue - Variable\ Cost - Fix\ Cost)$
[15] $FL = Total\ Assets/Shareholders'Equity$

2.3. Firm's Environmental and Systematic Risk Performances

2.3.1. Theoretical Argument

There has been growing interest in linking the effect of a firm's environmental conducts and the market risk. There are several theoretical arguments used in justifying the effect of environmental factors to the systematic risk: the information disclosure theory (Spicer 1978, Trotman and Bradley 1981, García-Ayuso and Larrinaga 2003), the financial and profitability theory (Feldman, Soyka et al. 1996, Klassen and McLaughlin 1996), and the stakeholder theory (Salama, Anderson et al. 2011). The accounting information disclosure theory argues that disclosing a firm's information reduces information asymmetry which reduces systematic risk in investing. If investors are blindsided about a firm's condition they will put a premium to offset a potential cost that may occur in the future in case a bad portfolio selection is made. Similarly, the environmental information disclosure also reduces information asymmetry among environmental conscious consumers that lead to increasing demand for the products. In turn this leads to higher profitability of the firm.

The financial point of view argues that the better the environmental conducts and performances, the higher the firm's bottom line. Better environmental management lowers cost and increases demand (Feldman, Soyka et al. 1996, Klassen and McLaughlin 1996). Firms that invest in environmental management systems may be able to avoid costly environmental catastrophes in the future. On the revenue side, there have been changes in consumer preference toward more environmentally friendly operations. This leads to a more stable stock performance and risk.

Finally, Stakeholder theory suggests that management is responsible for not only maximizing shareholders' wealth but also for satisfying other firm's stakeholders: consumers, workers, governments, local communities, etc. The value of a firm depends on the explicit and implicit claim each of the stakeholders has. Each stakeholder group may have conflicting claims. Management must therefore find balance in honoring those claims. Honoring stakeholders' claims can reduce cost and increase revenue. By maintaining a firm environmentally friendly operation, for example, firms can avoid costly government regulation enforcement, while at the same time inviting environmentally conscious people to consume its product. If a firm is unable to strike a balance among different claimants by providing socially and environmentally friendly operation can create financial risk (Kramer and Porter 2007).

All of the arguments have one thing in common: there are some ambiguities in showing that corporate social (environmental) responsibility does affect systematic risk; instead, the arguments only show that CSR affects risk in general. The luxury good principle may offer a different theoretical argument in connecting a firm's environmental friendliness and systematic risk. A firm's eco-friendliness create positive brand image to the environmentally conscious consumers. Studies show that CSR affects consumers' identification with firms (Sen and Bhattacharya 2001). The higher the value of a firm's environmental performance the higher the value of consumers' brand identification, creating luxury good like relationship. In a good market condition this firm will perform better than the rest of the firms in the market, therefore lower systematic risk, and vice versa.

2.3.2. Previous Empirical Study

Empirically, however, studies on the effect of environmental information disclosures and market risk showed mix results. Spicer (1978) studied 18 firms in pulp industries in the United Sates. The firms were ranked based on their control of pollution. Among other things, he found that better pollution control lowered beta risk. However, a study on environmental disclosure in Spain shows otherwise (Garcia-Ayuso and Larrinaga 2003). This study observes 112 firms' annual reports for several years, and found some information on environmental conduct and performance information disclosed. The result shows that the firm's environmental disclosure associated with higher stock systematic risk. Finally, Trotman and Bradley (1981) found that there is no association between firms' systematic risk and environmental and other social responsibility. A study by Fuller and Hinman (1990) found that there is significant differences in systematic risk between utility companies that use nuclear and non-nuclear power plants, the nuclear power plants has higher systematic risk than its counterpart.

Firms' with better social responsibility or environmental conduct and performance will gain more stable stocks' returns (Roberts 1992, Klassen and McLaughlin 1996). Furthermore, socially responsible firms may gain better access to capital (Moskowitz 1972), and investors view socially responsible firms as better managed, and therefore less risky (Roberts 1992). His study found that socially responsible conduct negatively associated with the systematic risk.

Aforementioned empirical studies show no unanimous finding in studies on social (environmental) performance and systematic risk; they show mixed results at best. Early studies on this subject showed no significant relationship (Alexander and Buchholz 1978, Trotman and Bradley 1981, García-Ayuso and Larrinaga 2003). Some studies show negative relationship (Spicer 1978, McGuire, Alison et al. 1988, Feldman, Soyka et al. 1996, Salama, Anderson et al. 2011, Jo and Na 2012), and positive relationship (Oikonomou, Brooks et al. 2012).

3. Methodology

This section discusses the methodology including data and empirical models. Since some of the variable definitions are similar to those which are used in the first essay, to avoid any redundancies, this section will not repeat the definition; instead, such concepts will be referred to the relevant section.

3.1. Empirical Model

Equation (16) provides a basic model to calculate a stock's systematic and unsystematic risk. Several studies estimated the model to find the beta value given different values of a firms' financial conditions (Hamada 1972, Melicher 1974, Hill and Stone 1980, Mandelker and Rhee 1984, Huffman 1989), and a firms' environmental conducts (Spicer 1978, Fuller and Hinman 1990, Feldman, Soyka et al. 1996, Klassen and McLaughlin 1996, Garcia-Ayuso and Larrinaga 2003, Bansal and Clelland 2004, Lee and Faff 2009, Mishra and Modi 2013).

This study , following Melicher (1974), Hill and Stone (1980), and Mandelker and Rhee (1984), will simultaneously and explicitly estimate a model to find out if firms' systematic risk is affected by aforementioned factors.

(17) $$\beta_{it} = a_{0i} + \sum_{l} a_{li} X_{lit} + \sum_{m} a_{mi} Q_{mit} + e_{it}$$

where the β_{it} is the systematic (beta) risk for firm i at time t, the a_{0i} are the random firm-specific effects, the a_{li} is the parameter estimate of firms' financial variables m for stock i, the X is the vector of firms' financial characteristics, the a_{mi} is the stock i parameter estimates of environmental performances, the Q is the vector of environmental characteristics, and the e_{it} is idiosyncratic errors. This study is interested in finding the causal effect of the relationship, therefore we modify equation (17) above by using 1st lag value of dependent and independent variables on the right hand side. The financial characteristic, as control variables, include: liquidity or quick ratio, leverage or debt to total asset ratio, operating efficiency using asset turnover (ASTO), profitability using return on assets (ROA), size using the value of market capitalization, and growth (Iqbal and Shah 2012). The environmental variables include green ranking (GR), Green score (GS), Environmental impact score (EIS), Reputation Survey Score (RSS), and Environmental Disclosure score (EDS) based on Newsweek's Green Rangking 2009-2012. Overall, we will estimate eight models for each systematic and unsystematic risk models.

3.2. Data

Data for this study comes from three sources. Data on environmental performance comes from the 2009, 2010, 2011, and 2012 the Newsweek Green Ranking. The reports include the 500 largest firms in the United States. The definition of the largest firms is based on revenue, market capitalization and number of employees (Newsweek 2009). The report contains firms' environmental performances (rankings) including green score (GS), environmental impact score (EIS), green policy and performance score (GPPS), and reputation survey score (RSS).[16]

Data on stock prices and volume are collected from The Center for Research in Security Prices (CRSP) database provided by Wharton Research Data Services (WRDS). From this database we collect information on daily stock prices for 2009, 2010, 2012, and 2013 to calculate individual market stock beta risk for the particular years. This study attempts to finding causal effect of environmental variables and future risk. Data on environmental variables are only available for 2009-2012; therefore data on stock risk will be one year ahead of envronmental variable, i.e. 2010-2013.

Data on firm-specific characteristics are collected from Compustat, a database on U.S. firms that is provided by Wharton Research Data Services (WRDS). From Compustat, we collect data on total value of cuurent assets (ACT), total assets (AT), earning before interest and tax (EBIT), total incentory (INVT), total current liabilties (LCT), total liabilities (LT), net income (NI), total revenue (REVT), sales (SALE), and total market capitalization (MKTVALT). These data are used to calculate independent variables: liquidity or quick ratio, leverage or debt to totsl asset ratio, operating efficiency using asset turnover (ASTO), profitability using return on assets (ROA), size using the value of market capitalization, and growth (Iqbal and Shah 2012). The formula to calculate the independent variables are:

$$Liquidity = (ACT - INVT)/LCT,$$

$$Leverage = LT/AT,$$

$$ASTO = REVT/AT,$$

[16] The concepts of the GR, GS, EIS, GPPS, RSS, and EDS are defined on page 23

$ROA = NI/AT$,

$Liquidity = (ACT - INVT)/LCT$, and

$Growth = \%\Delta\, EBIT$.

All of the data are the values recorded fiscal year of 2009, 2010, 2011, 2012 and 2013.

There are issues that arise in the measurement of liqudity. An issue arose in the financial reporting of the different firms in the sample. The sample contains about 90 firms in the financial sector (i.e. banking, insurance, real estate, and any other finanical services) with different methods for finanical reporting. In non financial sectors, corporate balance sheets contains items that are easily classified into liquid assets and liabilities, like account receivables. These items do not exist in balance sheets of financial service firms. The data on current assets and current liability are not available on Compustat database and are not explicitly reported in the firm balance sheets. Because of this issues, data on current assets and liabilities are proxied [17] based on balance sheets acquired from the Security Exchchange Comission (SEC) [18]. Second, when we ran simple correlation among independent variables, even though VIF did not show possible multicolinearuty, we found that realtively high correlation between variable liqudity and leverage and between variable liquidity and return on assets, -0.4433 and 0.5397 respectively. Those corelation cefficients are relatively higher than the correlation coefficient among the rest of variables on the right hand side (RHS), which are below ±0.1. To make sure that there will be no significance different empirically, in estimating the regression models, this study includes four different posibilitlies of regression: (1) include all firms and liquidity on the right hand side (RHS),

[17] Current assets include cash, receivables (from other banks) or marketable securities. Current liabilities includes demand deposits and dividends. Calculate liquidity=(current assets/current liabilities)

[18] The data was drawn from SEC website www.sec.org using EDGAR Search Tools

(2) include all firms but drop liquidity on RHS, (3) only using non-financial firms and include liquidity on the RHS, and (4) only using non-financial firms and exclude liquidity on the RHS. See Table 2.3.

The initial sample for this study uses samples from Newsweek Green Ranking which include the 500 largest US publicly traded firms. The purpose of this study is to find a causal effect empirically between green ranking variables and systematic risks. That means we advance the variable risks one year ahead. Data for independent variables cover 2009-2012 while data on risk variables (dependent variables) cover 2010 to 2013. Statistic descriptives of variables are found in Table 2. 2. The market risk for the firms in the sample stabilizes (lower) as the economy recovers from the great recession of 2008. Similar trends also happen to the financial or accounting volatility measure (liquidity, leverage, asset turnover, and growth).

3.3. Issues in Estimating Models

We estimate eight models for each systematic and unsystematic risk models. Similar to the first essay, in this second essay we have encountered several issues in conducting the model estimation. The first problem is omitted variable bias. This problem may occur because some variables that are not included in the model that may affect the firm's financial risks also are correlated to the variables that are included in the model. The use of panel data may mitigate such issue. We also include an exhaustive list of variables known in finance theory as control variable.

The second problem is multicollinearity among the right hand side variables. This problem is shown to exist in the hedonic literature (Leggett and Bockstael 2000). The existence of multicollinearity can produce unreliable parameter estimates. A formal test in looking for the sign of multicollinearity is a test for variance inflation factor (VIF). We perform this test on each model we developed to make sure that the multicollinearity is minimized. As a benchmark, if VIF > 10 we conclude that there is the incidence of a high multicollinearity problem. Table 2.1 depicts the results of VIF test. The tests show that all of the models suffer collinearity issues. To mitigate the problem therefore we replace the collinear independent variables with their deviation to their mean (Brennan, Chordia et al. 2004). The VIF tests show that the modified models have significantly lower VIF value to lower than 10.

The third problem is serial correlation issue or autocorrelation problem. The presence of autocorrelation in panel data causes bias in standard error and inefficient estimate. To identify the problem we use Wooldridge's Test for autocorrelation in panel data (Drukker 2003). Table 2.1 depicts the results of the test; The tests show rejection of null hypothesis of no autocorrelation degree one, AR(1). Therefore, we will include first lag autoregressive process, AR(1), in the market risk model estimations.

The fourth problem is the presence of heteroskedasticity. When N is large, heteroskedasticity problems commonly plagues model estimation, particularly in short-panel studies similar to what we are conducting. To find out if there is a violation of homoscedasticity assumption we use Modified Wald test for groupwise heteroskedasticity (Baum 2001). Table 2.1 depicts the results of the test; it indicates that the models we developed are heteroskedastic. Therefore, we employ Feasible Generalized Least Square (FGLS) to estimate the models. See (Cameron and Trivedi 2009).

Finally, earlier studies suggested the importance of nonlinear relationship of environmental variables and financial performances (Wagner, Van Phu et al. 2002, Barnett and Salomon 2003, Barnett and Salomon 2006, Brammer and Millington 2008), this study will introduce quadratic form in the regression model to capture the nonlinear relationship. Therefore, the model will include the square of the following variables: green ranking (GR), green score (GS), environmental impact score (EIS), green policy and performance score (GPPS), environmental disclosure score (EDS), and reputation survey score (RSS).

4. Results and Discussion

The model of causal effect of environmental performances on systematic risk (beta) is presented in Table 2.3: Model 1-8. The estimations use FGLS for short panel data assuming heteroscedasticity and first lag autoregressive process (AR1) for all models. In general, the models are efficient, indicated by the values of Wald's Chi-Square that reject null hypothesis at $p<0.01$.

4.1. The causal effect of financial performances and future market risk

This study uses a firm's financial performance measures as control variables. Most financial variables are significant but the sign of most of the relationships, like the results in most of previous studies, are not unanimous. This study found that liquidity causes higher future systematic risk. In previous studies, the effect of liquidity to the market risk is not consistent; some show negative effects (Iqbal and Shah 2012) and some show positive effects (Salama, Anderson et al. 2011). In one study, the signs switch for different segments (period) of the sample (Beaver, Kettler et al. 1970). That is also true in the case of leverage, models from the first segment of period 2009-2011 (Model 1, 2, and 3) are negative while the second segment 2011-2013 (Model 3, 4, and 5) are positive.

4.2. The causal effect of environmental performances and market risk

This study investigates the causal relationship of both broad category of environmental performance and disaggregate category of environmental performance and future systematic risk. The estimates results of Model 1-8 are depicted in Table 2.1: panel a, b, and c. In order to be able to identify potential issues that arise from the inclusion of variable liquidity that are inherently different for financial and non-financial institutions, four different estimates are presented for each model. Majority estimates are significant at least at $p<0.10$. However, the inclusion of variable liquidity seems to have serious problems for the estimates of broader environmental variables of green ranking (GR) and green score (GS) and systematic risk (Beta), Model 1, 2, and 7. The effect of the inclusion of liquidity to estimation result is minimal for the second time period 2011-2013, i.e. Model 4 and 5 estimate. For the disaggregate estimates, Model 3, 6, and 8, the issue does not appear to affect the results of estimation.

One of the interesting results of this study shows a non-linear relationship between environmental performance and a firm's risk performances. Most parameter estimates of the squared of environmental variables are significant at least at $p<0.10$. This result provides an alternative explanation of the results of previous study where some results are positive and some are negative. Since the estimates of the models use centered value of the environmental variables, the interpretation of estimates require special care. The number of coefficient regression only indicates if the estimate is significant or not. Figure 2.1 and Table 2.4 provide information to help interpretation of the results.

<u>The Aggregate Environmental Performances and Systematic Risk</u>. The results are presented in, Table 2.3 and Figure 2.1, Model 1 (GR: 2009-2011), Model 4 (GR: 2011-

20013), and Model 7 (GR: 2009-2013) for Green Ranking (GR) Models and Model 2 (GS: 2009-2011) and Model 5 (GS: 2011-2013) for Green Score (GS) models. Model 4, 5, and 7 show decreasing in increasing rate (U-shape) relationships, the higher the environmental ranking or score the lower the market risk until it reaches inflection point, then the risk elevated as the ranking or score increased. The inflection points are 293, 255, and 325 respectively. This findings were consistent with the study by Jo and Na (2012). While Model 1 and 2 do not have curvature but show an inverse relationship between environmental and risk performances, the higher the environmental ranking and score the lower the systematic risk.

A sample of the marginal effect of green ranking (GR) can be derived using Model 4 (GR: 2011-20013), See Table 2.4. For any firm in the bottom 25 firms based on their green ranking (GR), an improvement of a ranking by ten points will reduce a firm's systematic risk on average of 2%. Most firms in this bottom 25 are in utilities, energy, and material sectors. FirstEnergy, a firm in the utilities sector, by improving its rank ten points, will lower its market risk by 4.3%. For any firm in the top 25 firms, however, an improvement of ranking will raise its market risk on average by 1%. Most firms in this top 25 are in information technology and technology equipment, like Intel, Microsoft, Dell, Nvidia, etc.

<u>The Dis-aggregate Environmental Performances and Systematic Risk</u>. The results are presented in Table 2.3 and Figure 2.1, Model 3, 6, and 8. The results show robust relationship between dis-aggregate environmental variables and systematic risk performances, importantly, the curvatures indicated by the square of environmental variables also are significant. Most of the model estimates are significant at $p<0.01$. The

aggregate environmental score has a U-shape relationship with systematic risk, but that is not the case of disaggregate environmental scores. Some stylus facts are worth noting in this study. Environmental impact score (EIS) and reputation survey score (RSS) have a relationship of increasing at decreasing rate (upside-down bowl shape) with market risk, with inflection point of around midpoint. EIS reflects damages a firm causes from its operations. That means "dirty" firms improving environmental conduct will be punished with higher future market risk, but for "clean" firms, such improvement will be rewarded with decreasing future risk. This stylus fact is also true for the RSS. Reputation survey score (RSS) measures "public" perception of firm's environmental conducts.

Interestingly, the results show that green policy and performance score (GPPS) and environmental disclosure score (EDS) has decreasing at increasing rate (U-shape relationship) at various inflection points. If a firm provides a good plan of action to deal with environmental conducts even if the firm is "dirty," it will lower future market risk. Similarly, if a firm discloses more of its environmental conducts, even if the firm is "dirty," it will also lower its future market risk.

5. Conclusion

This study attempt to find the causal effect of a firm's environmental performances and market (beta risk). The environmental data comes from the Newsweek Green Ranking from 2009 to 2012 that include aggregate environmental measures: green ranking (GR) and green score (GS), while the disaggregate data include environmental impact score (EIS), green policy and performance score (GPPS), reputation survey score (RSS), and environmental disclosure score (EDS). The models also include control variables, i.e.

known financial variables: liquidity, asset turnover, growth, leverage, firm size, and return on assets.

Even though they are not unanimous, most of the results show robust non-linear relationship between environmental variables and market (beta) risk, most of the relationships are decreasing at increasing rate (U-shape). Firms at a lower level of green ranking, an improvement of its rank by one point will lower market risk by about 0.2%.

Table 2. 1: Multicolinearitu, Heteroheneity, and Autocorrelation Test

Variation Inflation Factor (VIF) Dependent variable: Beta	**2009-2011**						**2011-2013**						**2009-2013**			
	Model 1		**Model 2**		**Model 3**		**Model 4**		**Model 5**		**Model 6**		**Model 7**		**Model 8**	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
1st Lag of Firm's Environmental Performances:																
Green ranking (GR)	50.02	1.11					42.73	1.08					42.10	1.08		
Square of green ranking (GR^2)	30.72	2.08					27.47	2.22					27.02	2.11		
Green score (GS)			102.77	1.40					59.74	1.08						
Square of green score (GS^2)			76.77	1.44					34.49	1.58						
Environmental Impact Score (EIS)					64.31	1.03					90.67	1.56			77.01	1.23
Square of Environmental Impact Score (EIS^2)					36.68	2.20					48.72	1.95			42.18	2.01
Green Policy & Performance Score (GPPS)					73.43	1.37					76.96	1.97			49.99	1.23
Square of Green Policy & Performance Score ($GPPS^2$)					32.13	1.81					31.28	2.03			23.82	1.78
Reputation Survey Score (RSS)					71.73	1.53										
Square of Reputation Survey Score (RSS^2)					28.87	1.80										
Environmental Disclosure Score (EDS)											34.93	2.37				
Square of Environmental Disclosure Score (EDS^2)											20.64	2.87				
1st Lag Firm's Characteristics:																
Assets Turn Over	5.64	1.86	2.83	1.82	2.91	1.92	2.53	2.13	2.70	2.12	2.79	2.31	2.43	1.94	2.75	1.96
Beta	4.58	3.91	6.79	3.81	6.75	4.22	4.02	3.38	4.53	3.25	4.70	3.42	4.07	3.42	4.73	3.42
Growth	2.67	1.01	1.01	1.01	1.01	1.01	1.02	1.06	1.01	1.06	1.02	1.07	1.01	1.01	1.01	1.01
Leverage	2.37	1.63	1.75	1.60	1.80	1.73	1.74	1.61	1.89	1.59	1.89	1.72	1.65	1.59	1.75	1.66
Liquidity	1.64	4.54	4.96	4.45	4.97	4.58	3.39	2.97	3.77	2.95	3.82	3.18	3.68	3.52	3.98	3.60
Size	1.55	1.52	1.62	1.48	1.84	1.70	1.54	1.46	1.51	1.45	1.59	1.48	1.49	1.44	1.52	1.39
Returnn on Assets	1.01	2.66	2.66	2.66	2.68	2.68	2.43	2.28	2.47	2.28	2.49	2.31	2.22	2.22	2.24	2.24
AVERAGE	11.13	2.26	22.35	2.19	25.32	2.12	9.65	2.02	12.46	1.93	24.73	2.17	9.52	2.04	19.18	1.96
Wald's Chi-Square Test for Heterokedasticity - Ho: $\delta(i)^2 = \delta^2$ for all i	1.59E+04 ***		1.70E+05 ***		7.68E+03 ***		2.38E+03 ***		3.00E+05 ***		2.70E+06 ***		1.59E+04 ***		1.64E+04 ***	
Wooldridge F-test for autocorrelation in panel data - Ho: No AR(1)	51.12 ***		50.03 ***		47.58 ***		4.59 **		2.54 *		5.64 **		27.24 ***		29.21 ***	

"Before" and "After" are the VIF after the variables were modified using center value (differenced to its mean value)

Legend: *** p < 1%   ** p < 5%   * p < 10

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Table 2. 2: Statistics Descriptive Overtime for all Variables

Variable	Year	Mean	Std. Dev.	Min	Max	Obs.
Market Risk (Beta)	2009	1.23	0.68	0.05	4.90	586
	2010	1.12	0.41	-0.03	2.68	587
	2011	1.13	0.41	-0.03	2.67	578
	2012	1.14	0.81	-0.03	16.52	565
	2013	1.06	0.32	-0.79	2.07	561
Idiosyncratic Risk	2009	2.94	6.28	0.62	95.62	586
	2010	1.64	3.96	0.22	95.37	587
	2011	1.67	2.47	0.00	56.00	578
	2012	1.82	7.92	0.13	187.59	565
	2013	1.24	0.56	0.07	5.24	561
Green Ranking (GR)*	2009	248.50	143.33	1	496	496
	2010	250.50	144.48	1	500	500
	2011	250.50	144.48	1	500	500
	2012	250.50	144.48	1	500	500
Green Score (GS)**	2009	70.47	9.98	1	100	496
	2010	70.54	11.11	1	100	500
	2011	50.93	16.10	1.00	100	500
	2012	52.26	16.74	1.00	100	500
Environmental Impact Score (EIS)	2009	50.13	28.88	0.20	100	496
	2010	50.45	28.65	1	100	500
	2011	63.49	20.60	1	100	500
	2012	63.73	20.45	1	100	500
Green Policy and Performance Score (GPPS)	2009	39.89	18.23	1	100	496
	2010	42.22	19.32	1	100	500
	2011	37.19	18.78	1	100	500
	2012	46.35	19.48	1	100	500
Reputation Survey Score (RSS)**	2009	34.44	13.54	1	100	496
	2010	47.46	14.02	1	100	500
Environmental Disclosure Score (EDS)**	2011	29.40	27.54	1	100	500
	2012	37.94	30.64	1	100	500
Liquidity	2009	1.48	1.56	-1.34	28.59	566
	2010	1.38	1.00	-1.64	11.07	566
	2011	1.32	1.00	-2.08	13.44	555
	2012	1.31	0.96	-1.68	11.95	549
Leverage	2009	0.26	0.44	-0.86	2.35	577
	2010	0.25	0.42	-0.83	2.42	573
	2011	0.29	0.43	-0.86	2.56	564
	2012	0.30	0.46	-0.84	3.73	556
Assets Turnover (ASTO)	2009	0.91	0.74	0.03	5.29	578
	2010	0.93	0.78	0.02	5.40	575
	2011	0.96	0.81	0.03	5.35	566
	2012	0.93	0.76	0.03	5.15	559
Return on Assets (ROA)	2009	0.05	0.14	-0.44	2.76	577
	2010	0.06	0.06	-0.14	0.40	575
	2011	0.06	0.06	-0.38	0.37	566
	2012	0.06	0.07	-0.33	0.34	559
Market Captitalization ($B)	2009	20.39	34.39	0.20	322.33	494
	2010	23.02	38.18	0.31	364.06	497
	2011	22.64	40.19	0.12	401.25	500
	2012	25.77	48.75	0.27	626.55	494
Growth	2009	-16.34	128.32	-2081.19	669.23	476
	2010	35.08	246.20	-2458.23	3125.30	433
	2011	11.57	69.12	-471.46	947.17	463
	2012	5.36	63.33	-384.26	725.68	474

*Green Ranking (GR) ranges from 1=the lowest rank, and 500=the highest rank
**Newsweek Green Ranking has been modified in 2011 and 2012 version, i.e. replacing Reputation Survey Score (RSS) with Environmental Disclosure Score (EDS).

Table 2. 3: Causal Relationship of Firm's Environmental Performance and Market Risk (Beta)

Dependent Variable: Systematic Risk (Beta)	**2009-2011**											
	Model 1				**Model 2**				**Model 3**			
	All Firms		Non-Financial Firms Only		All Firms		Non-Financial Firms Only		All Firms		Non-Financial Firms Only	
	1	2	3	4	5	6	7	8	9	10	11	12
1st Lag of Firm's Environmental Performances:												
Green ranking (GR)	-4.91E-05 **	7.75E-06	-1.50E-04 ***	8.18E-05 ***								
Square of green ranking (GR^2)	-4.46E-07 ***	5.10E-08	3.23E-08	-2.62E-08								
Green score (GS)					-1.65E-03 ***	1.53E-04	-1.98E-04	-1.21E-03 ***				
Square of green score (GS^2)					-5.16E-06	-1.00E-05	3.04E-05 *	-1.08E-07				
Environmental Impact Score (EIS)									1.27E-04	-5.11E-04 ***	-9.75E-04 ***	6.28E-04 ***
Square of Environmental Impact Score (EIS^2)									-5.69E-05 ***	-4.87E-05 ***	-3.24E-05 ***	-2.33E-05 ***
Green Policy & Performance Score (GPPS)									-1.09E-03 ***	-2.13E-03 ***	6.88E-04 ***	-1.33E-03 ***
Square of Green Policy & Performance Score ($GPPS^2$)									2.68E-05 ***	3.65E-05 ***	1.39E-05 ***	2.35E-05 ***
Reputation Survey Score (RSS)									1.34E-03 ***	2.04E-03 ***	-1.32E-03 ***	-1.58E-04
Square of Reputation Survey Score (RSS^2)									-4.42E-05 ***	-5.25E-05 ***	-2.93E-05 ***	-1.87E-05 ***
Environmental Disclosure Score (EDS)												
Square of Environmental Disclosure Score (EDS^2)												
1st Lag of Firm's Characteristics:												
Beta	0.4705 ***	0.3080 ***	0.7032 ***	0.4018 ***	0.5591 ***	0.3463 ***	0.5230 ***	0.7191 ***	0.5134 ***	0.6236 ***	0.4025 ***	0.6852 ***
Liquidity	0.0218 ***		0.0283 ***		0.0245 ***		0.0294 ***		0.0212 ***		0.0289 ***	
Leverage	-0.0585 ***	-0.1655 ***	-0.0413 ***	-0.0468 ***	-0.1041 ***	-0.0448 ***	-0.0440 ***	-0.0758 ***	-0.0368 ***	-0.0990 ***	-0.0231 ***	-0.0631 ***
Assets Turn Over	-8.34E-03	-1.17E-02 ***	1.40E-02 ***	-0.0762 ***	2.96E-02 ***	-9.59E-03 *	-4.23E-03 ***	5.39E-03 **	-9.54E-03 **	1.57E-02 ***	-5.22E-02 ***	-9.84E-03 **
Returnn on Assets	-7.01E-01 ***	-5.99E-01 ***	-5.64E-01 ***	-3.23E-01 ***	-5.52E-01 ***	-6.30E-01 ***	-4.65E-01 ***	-4.55E-01 ***	-7.47E-01 ***	-4.72E-01 ***	-3.93E-01 ***	-3.78E-01 ***
Size	-1.68E-07 **	-1.70E-06 ***	7.67E-08 **	-1.83E-06 *	-3.51E-07 ***	-3.48E-07 ***	-7.41E-07	2.12E-08	-2.47E-07 ***	-1.90E-07 **	-1.81E-06 ***	-7.50E-08
Growth	-7.27E-06	-8.75E-05 ***	-2.60E-05	-9.88E-06	-1.07E-04 ***	-5.72E-06	-4.57E-06	-2.35E-05	1.74E-07	-6.18E-05	-2.18E-05 ***	-5.12E-06
Constant	0.5936 ***	0.7939 ***	0.2932 ***	0.7632 ***	0.4361 ***	0.7536 ***	0.5069 ***	0.3245 ***	0.5877 ***	0.4510 ***	0.6731 ***	0.3934 ***
Number of observations (N)	820	836	720	726	820	836	720	726	820	836	720	726
Time period (T)	2	2	2	2	2	2	2	2	2	2	2	2
Wald's Chi-Square	2703 ***	47869 ***	25871 ***	34659 ***	1065425 ***	24148 ***	2787 ***	58452 ***	7766 ***	372146 ***	682217 ***	6573 ***
Auto Regressive process	AR1	AR1	AR1	AR1	AR1	AR1	AR1	AR1	AR1	AR1	AR1	AR1

Legend: *** p < 1% ** p < 5% * p < 10%

Table 2.3. (Continues)

Dependent Variable: Systematic Risk (Beta)	2011-2013											
	Model 4				Model 5				Model 6			
	All Firms		Non-Financial Firms Only		All Firms		Non-Financial Firms Only		All Firms		Non-Financial Firms Only	
	1	2	3	4	5	6	7	8	9	10	11	12
1st Lag of Firm's Environmental Performances:												
Green ranking (GR)	-2.44E-04 ***	8.54E-05 ***	-2.05E-04 ***	1.20E-04 ***								
Square of green ranking (GR^2)	2.80E-06 ***	2.00E-06 ***	1.70E-06 ***	5.00E-07 *								
Green score (GS)					-6.93E-04 ***	5.91E-04 *	-7.84E-05	9.38E-04 ***				
Square of green score (GS^2)					6.85E-05 ***	-6.60E-06	-7.60E-06	-7.11E-05 ***				
Environmental Impact Score (EIS)									-1.35E-03 ***	-3.18E-03 ***	-1.30E-03 ***	-1.60E-03 ***
Square of Environmental Impact Score (EIS^2)									-3.22E-04 ***	-1.38E-04 ***	-1.71E-04 ***	-2.96E-04 ***
Green Policy & Performance Score (GPPS)									-3.70E-03 ***	-5.19E-04 **	-1.43E-03 ***	-1.75E-04
Square of Green Policy & Performance Score ($GPPS^2$)									1.26E-04 ***	1.35E-04 ***	3.34E-05 **	1.94E-04 ***
Reputation Survey Score (RSS)												
Square of Reputation Survey Score (RSS^2)												
Environmental Disclosure Score (EDS)									6.20E-06	-1.40E-03 ***	-1.29E-04	-1.04E-03 ***
Square of Environmental Disclosure Score (EDS^2)									7.99E-05 ***	3.11E-05 ***	3.67E-05 ***	6.18E-05 ***
1st Lag of Firm's Characteristics:												
Beta	1.2424 ***	-1.2641 ***	-1.2274 ***	0.4848 ***	0.4094 ***	0.5019 ***	0.2378 ***	-0.9855 ***	-0.8105 ***	0.7581 ***	0.1130 ***	-0.7222 ***
Liquidity	0.0268 ***		-0.0134 **		0.0928 ***		0.0988 ***		0.1758 ***		0.0901 ***	
Leverage	0.4889 ***	0.2263 ***	-0.0568 **	0.0920 ***	0.6051 ***	0.1074 ***	0.1720 ***	0.2415 ***	0.6953 ***	0.5716 ***	0.1622 ***	0.1863 ***
Assets Turn Over	0.0346 ***	-0.1209 ***	-0.0325 ***	-0.0103	0.0116 ***	-0.0193 ***	0.0292 ***	-0.0396 ***	-0.0763 ***	-0.0197 ***	0.0034	-0.0486 ***
Returnn on Assets	4.3780 ***	0.0567	-0.1005 *	1.0069 ***	3.5458 ***	0.7706 ***	0.7378 ***	-0.0229	1.4736 ***	4.4351 ***	0.4186 ***	0.8024 ***
Size	-2.00E-07 ***	-5.80E-06 ***	-4.20E-06 ***	-1.10E-06 ***	-1.80E-06 ***	-7.00E-07 ***	-1.20E-06 ***	8.00E-07 **	-4.00E-06 ***	-1.30E-06 ***	-1.10E-06 ***	-4.40E-06 ***
Growth	-1.44E-03 ***	4.55E-04 ***	4.70E-04 ***	-2.87E-04 ***	-6.97E-04 ***	-3.25E-05	-1.90E-04	2.56E-04 ***	1.84E-04 ***	-1.05E-03 ***	-3.47E-04 **	1.57E-05
Constant	-0.7786 ***	2.7635 ***	2.6212 ***	0.4801 ***	0.1827 ***	0.4901 ***	0.5925 ***	4.3713 ***	1.7245 ***	-0.1077 ***	0.7972 ***	1.9509 ***
Number of observations (N)	905	919	851	861	850	866	750	756	850	866	750	756 -----
Time period (T)	2	2	2	2	2	2	2	2	2	2	2	2
Wald's Chi-Square	1690 ***	1251 ***	28070 ***	2390 ***	499300 ***	699 ***	536 ***	104500 ***	20440 ***	12980 ***	337 ***	662 ***
Auto Regressive process	AR1	AR1	AR1	AR1	AR1	AR1	AR1	AR1	AR1	AR1	AR1	AR1

Legend: *** p < 1%   ** p < 5%   * p < 10%

Table 2.3. (Continues)

Dependent Variable: Systematic Risk (Beta)	2009-2013							
	Model 7				**Model 8**			
	All Firms		Non-Financial Firms Only		All Firms		Non-Financial Firms Only	
	1	2	3	4	5	6	7	8
1st Lag of Firm's Environmental Performances:								
Green ranking (GR)	2.09E-05	3.64E-05	-8.58E-05 ***	2.81E-05 ***				
Square of green ranking (GR^2)	-2.64E-07	-3.00E-07	5.65E-07 ***	-1.14E-07				
Green score (GS)								
Square of green score (GS^2)								
Environmental Impact Score (EIS)					-2.21E-04	4.18E-04 **	3.13E-05	3.10E-04
Square of Environmental Impact Score (EIS^2)					-6.00E-05 ***	-5.71E-05 ***	-5.60E-05 ***	-4.54E-05 ***
Green Policy & Performance Score (GPPS)					-5.21E-04 **	-7.04E-04 ***	-7.98E-04 ***	-6.57E-04 ***
Square of Green Policy & Performance Score ($GPPS^2$)					2.03E-05 **	1.78E-05 **	3.75E-05 ***	1.70E-05 *
Reputation Survey Score (RSS)								
Square of Reputation Survey Score (RSS^2)								
Environmental Disclosure Score (EDS)								
Square of Environmental Disclosure Score (EDS^2)								
1st Lag of Firm's Characteristics:								
Beta	0.3486 ***	0.4090 ***	0.9917 ***	0.5748 ***	0.3052 ***	0.2934 ***	0.1360 ***	0.3774 ***
Liquidity	0.0344 ***		0.0274 ***		0.0415 ***		0.0438 ***	
Leverage	0.0241 *	-0.0209 *	0.0991 ***	-0.0314 ***	0.0596 ***	-0.0075	0.0319	-0.0287 *
Assets Turn Over	-1.38E-02 ***	-1.90E-02 ***	2.05E-02 ***	-0.0076	-2.27E-02 ***	-3.74E-02 ***	-1.99E-02 ***	-2.54E-02 **
Returnn on Assets	-3.27E-01 ***	-1.67E-01 **	9.09E-01 ***	2.50E-03	-4.10E-01 ***	-2.90E-01 ***	-3.73E-01 ***	-2.05E-01 ***
Size	-6.40E-07 **	-5.00E-07 ***	-9.83E-09	-4.80E-07 ***	-6.60E-07 ***	-8.00E-07 ***	-1.05E-06 ***	-7.12E-07 ***
Growth	-4.19E-06	-1.14E-05	-2.48E-05	-5.28E-05	6.65E-06	2.05E-05	-6.24E-06	-2.68E-05
Constant	0.6776 ***	0.6625 ***	-0.1355 ***	0.4585 ***	0.7454 ***	0.8538 ***	0.9045 ***	0.7219 ***
Number of observations (N)	1721	1751	1514	1527	1721	1751	1514	1527
Time period (T)	4	4	4	4	4	4	4	4
Wald's Chi-Square	993 ***	1258 ***	1214103 ***	1861 ***	728 ***	832 ***	233 ***	554 ***
Auto Regressive process	AR1	AR1	AR1	AR1	AR1	AR1	AR1	AR1

Legend: *** $p < 1\%$ ** $p < 5\%$ * $p < 10\%$

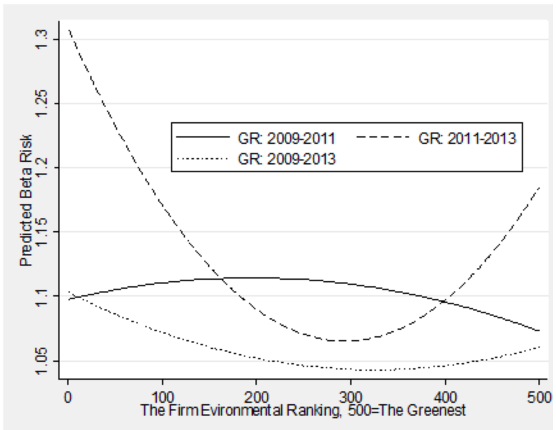
Table 2. 4: Marginal Effect of Firm's Green Ranking on Its Market Risk (Beta)

The Bottom 25 Firms in 2012						The Top 25 Firms in 2012					
Company Name	Sector	Green Ranking	Beta Risk	Marginal Effect	%	Company Name	Sector	Green Ranking	Beta	Marginal Effect	%
BlackRock	Financials	1	1.0096	-0.0016	-0.1623%	Allergan	Healthcare	476	0.7721	0.0010	0.1323%
Alpha Natural Resources	Energy	2	2.4992	-0.0016	-0.0653%	American Express	Financials	477	1.1598	0.0010	0.0885%
CF Industries Holdings	Materials	3	1.6497	-0.0016	-0.0987%	Best Buy	Retailers	478	0.8857	0.0010	0.1166%
T. Rowe Price Group	Financials	4	1.3746	-0.0016	-0.1180%	Google	Information Technology & Services	479	0.8525	0.0010	0.1218%
Monsanto	Materials	5	1.0637	-0.0016	-0.1520%	Autodesk	Information Technology & Services	480	1.8092	0.0010	0.0577%
Invesco	Financials	6	0.8015	-0.0016	-0.2010%	Motorola Solutions	Technology Equipment	481	0.8448	0.0010	0.1242%
CONSOL Energy	Energy	7	1.4902	-0.0016	-0.1077%	Cisco Systems	Technology Equipment	482	1.0663	0.0011	0.0989%
Peabody Energy	Energy	8	2.0535	-0.0016	-0.0779%	Baxter	Healthcare	483	0.7368	0.0011	0.1439%
Archer-Daniels-Midland	Food, Beverage & Tobacco	9	0.9255	-0.0016	-0.1722%	Citigroup	Financials	484	2.0746	0.0011	0.0514%
FirstEnergy	Utilities	10	0.3680	-0.0016	-0.4317%	Manpower	Professional Services	485	1.8185	0.0011	0.0589%
Tyson Foods	Food, Beverage & Tobacco	11	0.8936	-0.0016	-0.1771%	McGraw-Hill	Media & Publishing	486	0.9132	0.0011	0.1180%
Ralcorp Holdings	Food, Beverage & Tobacco	12	0.4412	-0.0016	-0.3575%	Hartford Financial Services Grp.	Financials	487	1.8751	0.0011	0.0577%
Ameriprise Financial	Financials	13	1.6143	-0.0016	-0.0974%	Cognizant Technology	Information Technology & Services	488	1.2678	0.0011	0.0859%
Allegheny Technologies	Materials	14	2.3188	-0.0016	-0.0675%	Microsoft	Information Technology & Services	489	1.1006	0.0011	0.0994%
AES	Utilities	15	0.8831	-0.0016	-0.1767%	EMC	Technology Equipment	490	1.4871	0.0011	0.0739%
Ameren	Utilities	16	0.4399	-0.0016	-0.3534%	Staples	Retailers	491	1.2418	0.0011	0.0890%
PPL	Utilities	17	0.2260	-0.0015	-0.6855%	Office Depot	Retailers	492	2.1978	0.0011	0.0505%
Mead Johnson Nutrition	Food, Beverage & Tobacco	18	0.5144	-0.0015	-0.3001%	Accenture	Information Technology & Services	493	1.2432	0.0011	0.0898%
Bunge	Food, Beverage & Tobacco	19	0.8707	-0.0015	-0.1766%	Intel	Technology Equipment	494	1.0923	0.0011	0.1027%
Edison International	Utilities	20	0.3913	-0.0015	-0.3916%	Nvidia	Technology Equipment	495	1.3683	0.0011	0.0824%
SCANA	Utilities	21	0.4142	-0.0015	-0.3686%	CA Technologies	Information Technology & Services	496	0.9291	0.0011	0.1220%
Airgas	Materials	22	0.9274	-0.0015	-0.1640%	Dell	Technology Equipment	497	0.9454	0.0011	0.1205%
Nucor	Materials	23	1.2347	-0.0015	-0.1227%	Sprint Nextel	Telecommunications	498	1.7071	0.0011	0.0670%
Lorillard	Food, Beverage & Tobacco	24	16.5212	-0.0015	-0.0091%	Hewlett-Packard	Technology Equipment	499	1.4124	0.0012	0.0814%
Precision Castparts	Aerospace & Defense	25	1.0334	-0.0015	-0.1456%	IBM	Information Technology & Services	500	0.8566	0.0012	0.1349%

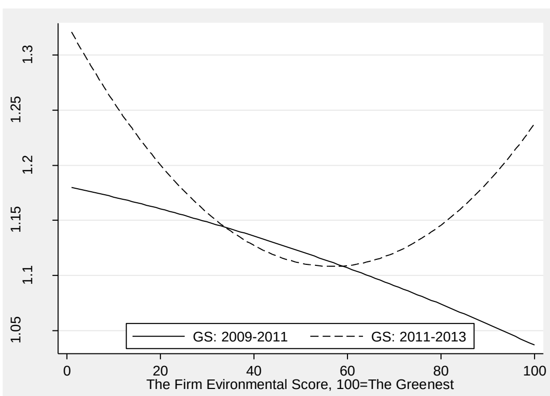
*was calculated using the following formula: $Marginal\ Effect = B - 2C\bar{x} + 2Cx$ where B and C are the parameter estimates for the variables and their square respectively and x is the independent variables. See Figure 2.1.

Figure 2. 1: Simulated Causal Effect of Environmental Performance and Market Risk (Beta)

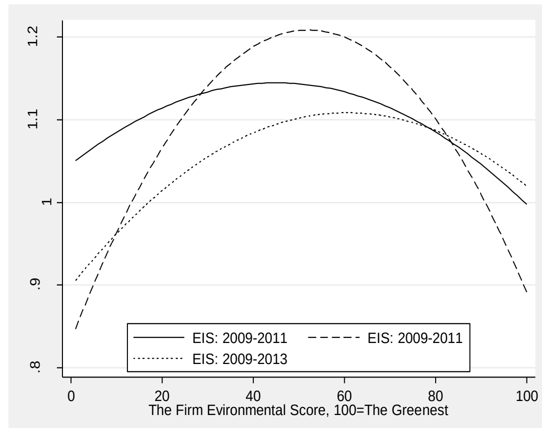
a. Green Ranking (GR)



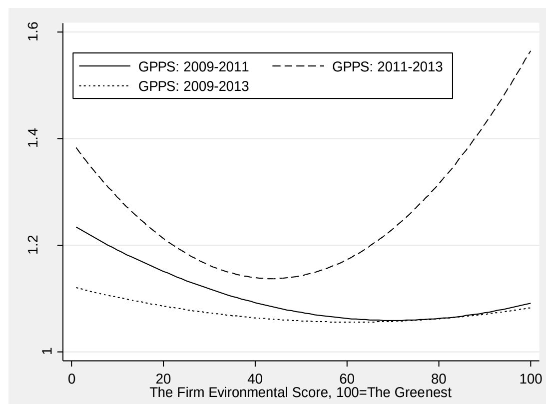
b. Green Score (GS)



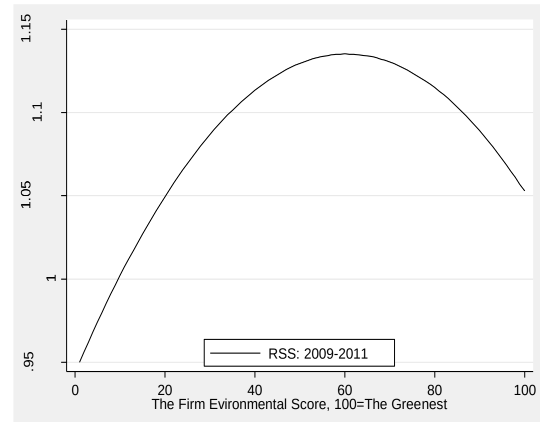
c. Environmental Impact (EIS)



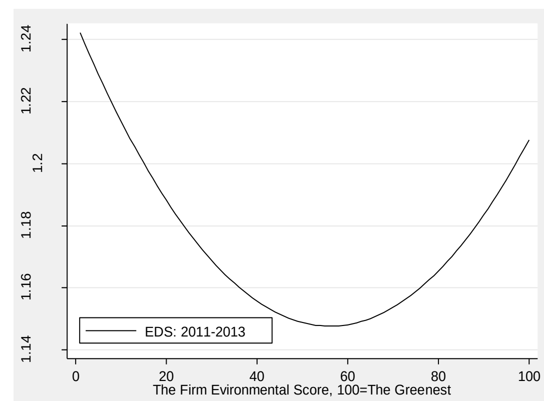
d. Green Policy & Performance



e. Reputation Survey Score (RSS)



f. Environmental Disclosure Score



Note: The graphs are simulated based on results of FGLS estimates holding other independent variables constant

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Chapter 4: The Effect of Firm's Environmental Performances on Its Idiosyncratic Risk

6. Introduction

Even though idiosyncratic risk can be minimized by diversifying a portfolio, it does not undermine the importance of finding its determinant. In the stock market, idiosyncratic risk accounts for about 80% of total risk, while systematic risk accounts for about 20% of total risk (Goyal and Santa-Clara 2003, José-Miguel Gaspar and Massimo Massa 2006). A study shows that a firm's idiosyncratic risk is priced in the market (Lee and Faff 2009). Typical investors hesitates to diversify or under-diversify in choosing a portfolio (Falkenstein 1996), and they prefer to invest in security with a low idiosyncratic risk (Aaker and Jacobson 1987). More importantly, idiosyncratic risk affects stock return (Goyal and Santa-Clara 2003).

A limited number of studies attempt to determine the effect corporate social responsibility (CSP) factors, including environmental performance as one aspect in CSP, on idiosyncratic risk (Lee and Faff 2009, Luo and Bhattacharya 2009, Mishra and Modi 2013). Bansal and Clelland (2004) focus their study on corporate environmental performance and its effect on idiosyncratic risk. They investigate two aspects of corporate environmental performances, corporate environmental legitimacy and impression management.

This study extends the existing literature in several aspects. First, the use of extensive measures of corporate environmental performances that include green ranking (GR) and green score (GS) as broad measures of the performance, and environmental impact score (EIS), green policy and performances (GPPS), reputation survey (RSS), and environmental disclosure (EDS) as disaggregate measures of environmental performances. Moreover, This study explores the use of non-linear relationship between corporate environmental performances and idiosyncratic risk. In brief, the results support the hypothesis of non-linear relationship between environmental performances and idiosyncratic risk. An increase in green ranking by a points, for a firm in the bottom twenty five of green ranking, will reduce its idiosyncratic risk by 0.4%.

The remainder of this report will proceed as the following: (1) Review of previous studies that will provide a framework for empirical tests that include the use of control variables; (2) Presentation of methodological approach that will outline the organization of the hypothesis testing; (3) Results and Discussion are presented and conclusion will be drawn

7. Literature Review

The unsystematic or idiosyncratic risk associated with the variability of a firm's stock itself is independent of the market in general. This risk measures volatility of stock price due to how a firm conducts itself, i.e. management culture and values, marketing strategies: pricing, development, placement, etc. This type of risk can be minimized by diversifying a portfolio. Idiosyncratic risk is derived from equation (17). A firm's idiosyncratic risk, equation (18), is the standard deviation of error term of regression between a firm's daily stock return and daily market return. The market return is the return of S&P 500 stock index. The δ^2 is the variance of error term.

(18) $$Idiosyncratic\ Risk = \sqrt{\delta^2}$$

Unsystematic risk measures volatility of a firm's stock price that are caused by any events that only affect the firm, e.g. merger, oil spill, law suit. These kind of events may shape investors' predictions of a firm's future profitability and that may lead them either to buy, sell, or hold the security. Ultimately, it will affect the volatility of the stock itself, the value unsystematic risk.

There are several theoretical arguments that attempt to find the effect of corporate responsibility (environmental) policy to the idiosyncratic risk: institutional (stakeholder) theory (Bansal and Clelland 2004, Mishra and Modi 2013), and risk management theory and marketing's responsibility principle (Luo and Bhattacharya 2009). According to institutional theory, a corporation's job is to seek legitimacy from its stockholders by meeting their diverse expectations. For example, when the BP gulf oil disaster occurred, the gulf community worried about losing their livelihood, the government worried about illegal business practices, while investors were concerned about BP's possible financial liabilities. This is an example where a corporation did not earn stakeholders' legitimacy. Investors' actions caused volatility in its stock prices, and ultimately its idiosyncratic risk heightened.

The other argument that is not that far away from stakeholder theory is risk management and marketing approach. Corporate social responsibility (environmental) program creates positive moral capital for the firm. This capital provides "insurance like" coverage for the firm; in turn, it will increase stakeholders' wealth (Luo and Bhattacharya 2009). From a marketing point of view, this program creates "brand" identification and positive value for the firm. Together, "insurance like" protection and favorable brand identification will provide shields for the firm in case of a catastrophic event that can potentially tarnish its brand image. They hope that society will not punish them because of their good practices in taking care of the environmental impact of its operation. They hope that society will see this as pure accident instead of negligence.

Studies linking environmental and idiosyncratic risk are limited and most studies include environmental conducts as a part of corporate social responsibility performances. Previous studies in this field use various measures of corporate social and environmental responsibility. Some studies found a broader category of corporate (environmental) responsibility reduces firm idiosyncratic risk (Lee and Faff 2009, Luo and Bhattacharya 2009). Since there are complex aspects of corporate environmental performances, Bansal and Clelland (2004) focus their study on finding more specific aspects of environmental performances: environmental legitimacy, liability disclosure, and expression of environmental commitment. They found environmental legitimacy reduces unsystematic risk, environmental liability disclosure raised the risk, and expression of environmental commitment does not affect the risk.

Environmental conduct can manifest itself in the form of positive conduct like energy conservation or negative environmental conduct like carbon emission or toxic discharged. A study shows that positive environmental conduct reduces idiosyncratic risk while negative environmental conduct raises idiosyncratic risk (Mishra and Modi 2013).

8. Methodology

1.1.Empirical Model

Equation (16) provides a basic model to calculate a stock's systematic and unsystematic risk. Since idiosyncratic risk measures the error part of the equation (16), it is a “surrogate” for market risk. As a consequence, variables that affect systematic risk may also affect idiosyncratic risk. Several studies investigate the effect of different values of a firm’s financial conditions to systematic risk (Hamada 1972, Melicher 1974, Hill and Stone 1980, Mandelker and Rhee 1984, Huffman 1989). Some studies attempt to investigate the effect of a firm’s environmental conducts to systematic or idiosyncratic risk (Spicer 1978, Fuller and Hinman 1990, Feldman, Soyka et al. 1996, Klassen and McLaughlin 1996, Garcia-Ayuso and Larrinaga 2003, Bansal and Clelland 2004, Lee and Faff 2009, Mishra and Modi 2013).

This study , following Melicher (1974), Hill and Stone (1980), and Mandelker and Rhee (1984), will simultaneously estimate a model to find out if a firm’s stock unsystematic risk is affected by aforementioned factors.

(19) $$\delta_{it} = a_{0i} + \sum_{l} a_{li} X_{lit} + \sum_{m} a_{mi} Q_{mit} + e_{it}$$

where the δ_{it} is unsystematic (idiosyncratic) risk for firm i at time t, the a_{0i} are the random firm-specific effects, the a_{li} is the parameter estimate of firms’ financial variables m for stock i, the $X$is the vector of firms’ financial characteristics, the a_{mi} is the stock i parameter estimates of environmental performances, the Q is the vector of environmental characteristics, and the e_{it} is idiosyncratic errors. Since this study is interested in estimating the causal effect of the relationship, we modify equation (19) by using 1st lag value of dependent and independent variables on the right hand side. The financial characteristics, as control variables, include: liquidity or quick ratio, leverage or debt to total asset ratio, operating efficiency using asset turnover (ASTO), profitability using return on assets (ROA), size using the value of market capitalization, and growth (Iqbal and Shah

2012). The environmental variables include green ranking (GR), Green score (GS), Environmental impact score (EIS), Reputation Survey Score (RSS), and Environmental Disclosure score (EDS) based on Newsweek's Green Rangking 2009-2012. Overall, we will estimate eight models for each systematic and unsystematic risk models.

1.2. Data

This third essay uses similar data used in the second essay. Refer to section 3.2 of the second essay page 71.

1.3. Issues in Estimating Models

We estimate eight models for unsystematic (idiosyncratic) risk models. Similar to the second essay, in this third essay we have encountered several issues in conducting the model estimation. The first problem is omitted variable bias. This problem may occur because some variables that are not included in the model that may affect the firm's financial risks are also correlated to the variables that are included in the model. The use of panel data may mitigate such issue. We also include an exhaustive list of variables known in finance theory as control variables.

The second problem is multicollinearity among the right hand side variables. This problem is shown to exist in the hedonic literature (Leggett and Bockstael 2000). The existence of multicollinearity can produce unreliable parameter estimates. A formal test in looking for the sign of multicollinearity is a test for variance inflation factor (VIF). We perform this test on each model we developed to make sure that the multicollinearity is minimized. As a benchmark, if VIF >10 we conclude that there is the incidence of a high multicollinearity problem. Table 3.1. depicts the results of VIF test. The tests show that all of the models suffer collinearity issues. To mitigate the problem therefore we replace the collinear independent variables with their deviation to their mean (Brennan, Chordia et al. 2004). The VIF tests show that the modified models have significantly lower VIF value to less than 10.

The third problem is serial correlation issue or autocorrelation problem. The presence of autocorrelation in panel data causes bias in standard error and inefficient estimates. To identify the problem we use Wooldridge's Test for autocorrelation in panel data (Drukker 2003). Table 3.1. depicts the results of the test; it rejects the null hypothesis of no autocorrelation degree one, AR(1), except for idiosyncratic model of second period 2011-2013. Therefore, we will include first lag autoregressive process, AR(1), in the idiosyncratic model estimation for first period 2009-2011 and overall period of 2009-2013, but not for the period of 2011-2013.

The fourth problem is the presence of heteroskedasticity. When N is large, heteroskedasticity problem commonly plagues model estimation, particularly in short-panel studies similar to what we are conducting. To find out if there is a violation of homoscedasticity assumption we use the modified Wald's test (Baum 2001). Table 1.3. depicts test results that indicates the models are heteroskedastic. Therefore, we employ Feasible Generalized Least Square (FGLS) to estimate the model. See (Cameron and Trivedi 2009).

Finally, earlier studies suggested the importance of nonlinear relationship of environmental variables and financial performances (Wagner, Van Phu et al. 2002, Barnett and Salomon 2003, Barnett and Salomon 2006, Brammer and Millington 2008). This study will introduce quadratic form in the regression model to capture the nonlinear relationship.

Therefore, the model will include the square of the following variables: green ranking (GR), green score (GS), environmental impact score (EIS), green policy and performance score (GPPS), environmental disclosure score (EDS), and reputation survey score (RSS).

9. Result and Discussion

This study also uses firm financial performance measures as control variables. Most financial variables are significant but the sign of most of the relationships, like the results in most of the previous studies, are not unanimous. The effect of first-lag of idiosyncratic risk on current risk is significant and has positive sign, consistent with the previous study (Luo and Bhattacharya 2009). First-lag idiosyncratic risk has a marginal effect of as much as 50% of future risks. This study found that liquidity causes future idiosyncratic risk to be lower. In previous studies, the effect of liquidity to the risk is not consistent; some show a negative effect (Iqbal and Shah 2012) and some show a positive effect (Salama, Anderson et al. 2011). In one study, the sign switches for different segments (period) of sample (Beaver, Kettler et al. 1970). That is also true in the case of the effect of leverage. The effect in some periods are negative and some other periods are positive.

This study also attempts to find out the effect of both the aggregate measure of environmental conducts and the disaggregate aspects of the conducts to its future idiosyncratic risk. The regression results are presented on Table 3.3, the graphs showing the simulated causal effect are presented in Table 3.2, and the marginal effect of green ranking (GR) to idiosyncratic risk for the top and bottom 25 firms are presented in Table 3.3.

The effect of green ranking (GR) and green score (GS) to future idiosyncratic risk: a broad measures. The regression estimates are presented in Table 3.3: panel a, b, and c, Model 9, 10, 12, 13, and 15. All parameter estimates for the broad measure of environmental variables are significant except Model 15. Figure 3.1 panel a, and b present the graphical presentation of the Models to find out the direction of the relationship. The relationship of green ranking (GR) and green score (GS) and future idiosyncratic risk are decreasing in increasing rate (U-shape). For firms that have a lower rank and score below inflection point, improving its environmental performance will lower its idiosyncratic risk. However, for firms in higher rank and score, improving its environmental performance will increase its idiosyncratic risk. At least, in the first part of the relationship, this finding support earlier findings (Lee and Faff 2009, Luo and Bhattacharya 2009).

The effect of disaggregate environmental variables: environmental impact score (EIS), green policy and performance score (GPPS), reputation survey score (RSS), and environmental disclosure score (EDS). The regression estimates are presented in Table 3.3: panel a, b, and c: Model 11, 14, and 16 and Figure 3.2. Panel c, d, e, and f. Almost all of estimates are significant at $p<0.01$ including most of squared of environmental variables.

Unlike variables in aggregate environmental measures (i.e. GR and GS), the dis-aggregate environmental variables (EIS, GPPS, RSS, and EDS), do not have a uniform shape of relationships. For the RSS and EDS, the causal relationship with future idiosyncratic risk is increasing at decreasing rate (upside down bowl shape), and for GPPS the relationship is decreasing in increasing rate (U-shape), and for EIS the relationship tends to decreases. The striking result is the effect of EIS to the idiosyncratic risk. This shows that the lower a firm causes environmental degradation due to its operation the less likely it faces lawsuit, government fine, and any other enforcement action by government; therefore, the lower the value of idiosyncratic risk.

10. Conclusion

This study focuses on risk that is inherent to the firm itself, regardless of what is going on in the market. This study found that the environmental variables significantly affect future idiosyncratic risk. Moreover, this study also found that the relationship follows a non-linear relationship. Four out of six different environmental variables have U-shape relationship or near downward relationship. And two of them have upside down bowl shape relationship. Finally, the marginal effect of green ranking (GR) on idiosyncratic risk is twice as strong as on market (beta) risk, i.e. -0.4%.

Table 3. 1: Multicolinearity, Heterogeneity, and Autocorrelation Test

Variation Inflation Factor (VIF) Dependent variable: Idiosyncratic	**2009-2011**						**2011-2013**						**2009-2013**			
	Model 9		**Model 10**		**Model 11**		**Model 12**		**Model 13**		**Model 14**		**Model 15**		**Model 16**	
	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After	Before	After
1st Lag of Firm's Environmental Performances:																
Green ranking (GR)	37.54	1.10					38.47	1.08								
Square of green ranking (GR^2)	25.60	2.01					25.65	2.12								
Green score (GS)			88.09	1.40					49.54	1.08	83.77	1.57	35.69	1.08		
Square of green score (GS^2)			74.36	1.43					31.11	1.57	46.15	1.95	24.36	2.03		
Environmental Impact Score (EIS)					63.17	1.03					76.09	1.96			72.81	1.22
Square of Environmental Impact Score (EIS^2)					36.49	2.05					30.94	2.00			40.86	1.97
Green Policy & Performance Score (GPPS)					71.21	1.38									47.62	1.22
Square of Green Policy & Performance Score ($GPPS^2$)					31.24	1.80									22.97	1.76
Reputation Survey Score (RSS)					68.68	1.54					34.96	2.37				
Square of Reputation Survey Score (RSS^2)					27.98	1.81					20.64	2.79				
Environmental Disclosure Score (EDS)																
Square of Environmental Disclosure Score (EDS^2)																
1st Lag Firm's Characteristics:																
Assets Turn Over	2.37	1.64	2.77	1.56	2.86	1.70	2.50	2.00	2.70	1.97	2.79	2.21	2.41	1.74	2.74	1.75
Idiosynratic	1.01	1.01	1.01	1.01	1.01	1.01	1.02	1.06	1.01	1.06	1.02	1.07	1.01	1.01	1.01	1.01
Growth	1.47	1.26	1.69	1.18	1.74	1.46	1.61	1.40	1.87	1.34	1.86	1.51	1.52	1.32	1.69	1.41
Leverage	3.79	2.96	4.68	2.72	4.68	3.24	2.97	2.46	3.61	2.34	3.66	2.62	3.23	2.68	3.80	2.80
Liquidity	1.56	1.51	1.61	1.45	1.84	1.67	1.54	1.46	1.51	1.45	1.58	1.48	1.49	1.43	1.52	1.38
Size	1.14	1.11	1.15	1.11	1.15	1.14	1.11	1.13	1.11	1.13	1.11	1.13	1.11	1.10	1.11	1.11
Returnn on Assets	2.42	2.27	2.45	2.26	2.51	2.31	2.46	2.31	2.50	2.31	2.51	2.35	2.17	2.14	2.19	2.15
AVERAGE	8.55	1.65	19.76	1.57	24.20	0.14	8.59	1.67	10.55	0.58	23.62	1.92	8.11	1.61	18.03	1.62
Wald's Chi-Square Test for Heterokedasticity - Ho: $\delta(i)^2 = \delta^2$ for all i	5.00E+12 ***		1.20E+15 ***		1.80E+13 ***		1.40E+09 ***		5.40E+09 ***		4.50E+08 ***		1.10E+12 ***		1.00E+13 ***	
Wooldridge F-test for autocorrelation in panel data - Ho: No AR(1)	386.39 ***		407.67 ***		365.63 ***		1.23		1.23		1.27		7.31 ***		7.30 ***	

"Before" and "After" are the VIF after the variables were modified using center value (differenced to its mean value)

Legend: *** $p < 1\%$ ** $p < 5\%$ * $p < 10\%$

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Table 3. 2: Statistics Descriptive Overtime for all Variables

Variable	Year	Mean	Std. Dev.	Min	Max	Obs.
Market Risk (Beta)	2009	1.23	0.68	0.05	4.90	586
	2010	1.12	0.41	-0.03	2.68	587
	2011	1.13	0.41	-0.03	2.67	578
	2012	1.14	0.81	-0.03	16.52	565
	2013	1.06	0.32	-0.79	2.07	561
Idiosyncratic Risk	2009	2.94	6.28	0.62	95.62	586
	2010	1.64	3.96	0.22	95.37	587
	2011	1.67	2.47	0.00	56.00	578
	2012	1.82	7.92	0.13	187.59	565
	2013	1.24	0.56	0.07	5.24	561
Green Ranking (GR)*	2009	248.50	143.33	1	496	496
	2010	250.50	144.48	1	500	500
	2011	250.50	144.48	1	500	500
	2012	250.50	144.48	1	500	500
Green Score (GS)**	2009	70.47	9.98	1	100	496
	2010	70.54	11.11	1	100	500
	2011	50.93	16.10	1.00	100	500
	2012	52.26	16.74	1.00	100	500
Environmental Impact Score (EIS)	2009	50.13	28.88	0.20	100	496
	2010	50.45	28.65	1	100	500
	2011	63.49	20.60	1	100	500
	2012	63.73	20.45	1	100	500
Green Policy and Performance Score (GPPS)	2009	39.89	18.23	1	100	496
	2010	42.22	19.32	1	100	500
	2011	37.19	18.78	1	100	500
	2012	46.35	19.48	1	100	500
Reputation Survey Score (RSS)**	2009	34.44	13.54	1	100	496
	2010	47.46	14.02	1	100	500
Environmental Disclosure Score (EDS)**	2011	29.40	27.54	1	100	500
	2012	37.94	30.64	1	100	500
Liquidity	2009	1.48	1.56	-1.34	28.59	566
	2010	1.38	1.00	-1.64	11.07	566
	2011	1.32	1.00	-2.08	13.44	555
	2012	1.31	0.96	-1.68	11.95	549
Leverage	2009	0.26	0.44	-0.86	2.35	577
	2010	0.25	0.42	-0.83	2.42	573
	2011	0.29	0.43	-0.86	2.56	564
	2012	0.30	0.46	-0.84	3.73	556
Assets Turnover (ASTO)	2009	0.91	0.74	0.03	5.29	578
	2010	0.93	0.78	0.02	5.40	575
	2011	0.96	0.81	0.03	5.35	566
	2012	0.93	0.76	0.03	5.15	559
Return on Assets (ROA)	2009	0.05	0.14	-0.44	2.76	577
	2010	0.06	0.06	-0.14	0.40	575
	2011	0.06	0.06	-0.38	0.37	566
	2012	0.06	0.07	-0.33	0.34	559
Market Captitalization ($B)	2009	20.39	34.39	0.20	322.33	494
	2010	23.02	38.18	0.31	364.06	497
	2011	22.64	40.19	0.12	401.25	500
	2012	25.77	48.75	0.27	626.55	494
Growth	2009	-16.34	128.32	-2081.19	669.23	476
	2010	35.08	246.20	-2458.23	3125.30	433
	2011	11.57	69.12	-471.46	947.17	463
	2012	5.36	63.33	-384.26	725.68	474

*Green Ranking (GR) ranges from 1=the lowest rank, and 500=the highest rank
**Newsweek Green Ranking has been modified in 2011 and 2012 version, i.e. replacing Reputation Survey Score (RSS) with Environmental Disclosure Score (EDS).

Table 3. 3: Causal Relationship of Firm's Environmental Performance and Idiosyncratic Risk

Dependent Variable: Idiosyncratic Risk	2009-2011											
	Model 9				Model 10				Model 11			
	All Firms		Non-Financial Firms Only		All Firms		Non-Financial Firms Only		All Firms		Non-Financial Firms Only	
	1	2	3	4	5	6	7	8	9	10	11	12
1st Lag of Firm's Environmental Performances:												
Green ranking (GR)	5.42E-04 ***	1.72E-04 ***	-1.79E-05	8.37E-05								
Square of green ranking (GR^2)	4.78E-06 ***	5.90E-06 ***	-6.31E-07	-2.12E-07								
Green score (GS)					5.32E-03 ***	7.01E-03 ***	9.04E-04	-2.40E-03 ***				
Square of green score (GS^2)					1.18E-04 ***	1.45E-04 ***	-4.40E-06	-4.75E-05				
Environmental Impact Score (EIS)									7.91E-05	-4.52E-03 ***	7.05E-04 *	6.46E-04 ***
Square of Environmental Impact Score (EIS^2)									2.54E-05 ***	-1.69E-05 ***	-1.92E-05	-2.16E-05 ***
Green Policy & Performance Score (GPPS)									2.17E-03 ***	2.53E-03 ***	5.68E-04	-1.11E-03 ***
Square of Green Policy & Performance Score ($GPPS^2$)									1.40E-04 ***	2.54E-04 ***	9.20E-05 ***	3.03E-05 *
Reputation Survey Score (RSS)									-1.84E-03 ***	2.01E-03 ***	-4.51E-03 ***	-2.53E-03 ***
Square of Reputation Survey Score (RSS^2)									-2.82E-05	-1.53E-04 ***	4.67E-05 *	5.00E-05 ***
Environmental Disclosure Score (EDS)												
Square of Environmental Disclosure Score (EDS^2)												
1st Lag of Firm's Characteristics:												
Idiosyncratic Risk	0.2079 ***	0.5159 ***	0.4627 ***	0.4296 ***	0.2825 ***	0.2735 ***	0.4358 ***	0.7242 ***	0.3227 ***	0.4727 ***	0.4074 ***	0.5287 ***
Liquidity	-0.1246 ***		-0.0230 ***		-0.0425 ***		-0.0296 ***		-0.0377 ***		-0.0326 ***	
Leverage	-0.1850 ***	-0.7557 ***	-0.1307 ***	-0.1028 ***	-0.1923 ***	-0.1447 ***	-0.1387 ***	-0.1086 ***	-0.2306 ***	-0.3133 ***	-0.1443 ***	-0.0928 ***
Assets Turn Over	-4.59E-02 ***	8.63E-02 ***	2.87E-02 ***	0.0224 ***	-7.26E-03	-1.12E-03	2.98E-02 ***	2.19E-02 ***	1.05E-02	7.78E-02 ***	3.19E-03	1.26E-02 *
Returnn on Assets	6.66E-01 ***	9.43E-01 ***	8.70E-01 ***	9.43E-01 ***	7.34E-02	-6.94E-02	9.23E-01 ***	1.26E+00 ***	-1.02E-01	-3.76E-01 ***	5.10E-01 ***	3.00E-01 ***
Size	2.12E-07	-2.00E-06 ***	-1.53E-06 ***	-1.73E-06 ***	-3.25E-07	-7.00E-07	-1.79E-06 ***	-2.33E-07 ***	6.31E-07	7.00E-07 ***	-1.52E-06 ***	-1.32E-06 ***
Growth	7.86E-04 ***	5.26E-05	2.68E-04 ***	2.76E-04 ***	8.41E-04 ***	8.41E-04 ***	2.84E-04 ***	-3.86E-04 ***	7.97E-04 ***	2.24E-04 ***	3.37E-04 ***	1.26E-04 **
Constant	1.1046 ***	0.2373 ***	0.5871 ***	0.6007 ***	0.9721 ***	0.9266 ***	0.6314 ***	-0.0465 ***	0.8280 ***	0.4844 ***	0.6800 ***	0.4887 ***
Number of observations (N)	820	836	720	726	820	836	720	726	820	836	720	726
Time period (T)	2	2	2	2	2	2	2	2	2	2	2	2
Wald's Chi-Square	1076 ***	318700 ***	1300 ***	1098 ***	870 ***	1055 ***	1223 ***	484416 ***	997 ***	294700 ***	992 ***	3147 ***
Auto Regressive process	AR1	AR1	AR1	AR1	AR1	AR1	AR1	AR1	AR1	AR1	AR1	AR1

Legend: *** $p < 0.01$ ** $p < 0.05$ * $p < 0.10$

Table 3.3. (Continues) Panel b

Dependent Variable: Idiosyncratic Risk	2011-2013											
	Model 12				Model 13				Model 14			
	All Firms		Non-Financial Firms Only		All Firms		Non-Financial Firms Only		All Firms		Non-Financial Firms Only	
	1	2	3	4	5	6	7	8	9	10	11	12
1st Lag of Firm's Environmental Performances:												
Green ranking (GR)	-9.65E-04 ***	-1.08E-03 ***	-9.24E-04 ***	-1.02E-03 ***								
Square of green ranking (GR^2)	9.20E-06 ***	1.24E-05 ***	7.70E-06 ***	1.44E-05 ***								
Green score (GS)					-9.14E-03 ***	-8.74E-03 ***	-1.07E-02 ***	-9.46E-03 ***				
Square of green score (GS^2)					1.25E-04 **	4.37E-04 ***	1.14E-04 *	4.53E-04 ***				
Environmental Impact Score (EIS)									-8.01E-03 ***	-6.54E-03 ***	-7.60E-03 ***	-8.74E-03 ***
Square of Environmental Impact Score (EIS^2)									-2.19E-04 ***	-2.16E-04 ***	-1.61E-04 ***	-1.23E-04 ***
Green Policy & Performance Score (GPPS)									-1.37E-02 ***	-8.48E-03 ***	-1.25E-02 ***	-9.91E-03 ***
Square of Green Policy & Performance Score (GPPS^2)									5.89E-04 ***	4.62E-04 ***	5.25E-04 ***	5.73E-04 ***
Reputation Survey Score (RSS)												
Square of Reputation Survey Score (RSS^2)												
Environmental Disclosure Score (EDS)									-3.78E-03 ***	-5.04E-03 ***	-2.70E-03 ***	-5.85E-03 ***
Square of Environmental Disclosure Score (EDS^2)									7.19E-05 ***	8.94E-05 ***	3.12E-05	8.06E-05 ***
1st Lag of Firm's Characteristics:												
Idiosyncratic Risk	0.1419 ***	0.1788 ***	0.2150 ***	0.2483 ***	0.1755 ***	0.1982 ***	0.2459 ***	0.2821 ***	0.1195 ***	-0.0056	0.1246 ***	0.1385 ***
Liquidity	0.2041 ***		0.2632 ***		0.1548 ***		0.3186 ***		0.2124 ***		0.2615 ***	
Leverage	1.4572 ***	1.4329 ***	1.1840 ***	1.4499 ***	1.6026 ***	1.3128 ***	1.5535 ***	1.3214 ***	1.7727 ***	1.2146 ***	1.5287 ***	1.4806 ***
Assets Turn Over	2.33E-01 ***	1.61E-01 ***	1.99E-01 ***	0.1133 ***	2.16E-01 ***	1.79E-01 ***	2.13E-01 ***	1.45E-01 ***	2.03E-01 ***	1.50E-01 ***	1.86E-01 ***	8.25E-02 ***
Returnn on Assets	6.93E+00 ***	9.09E+00 ***	4.80E+00 ***	8.21E+00 ***	9.42E+00 ***	8.11E+00 ***	8.64E+00 ***	7.91E+00 ***	8.44E+00 ***	6.30E+00 ***	6.72E+00 ***	8.20E+00 ***
Size	-3.10E-06 ***	-3.00E-06 ***	-3.00E-06 ***	-4.40E-06 ***	-2.40E-06 ***	-3.00E-06 ***	-2.00E-06 ***	-3.20E-06 ***	-3.00E-06 ***	-2.80E-06 ***	0.0000 ***	-2.20E-06 ***
Growth	-1.71E-03 ***	-1.30E-03 ***	-1.18E-03 ***	-1.80E-03 ***	-2.21E-03 ***	-1.93E-03 ***	-1.60E-03 ***	-2.26E-03 ***	-1.79E-03 ***	-6.02E-04	-0.0018 ***	-0.0003
Constant	-0.2560 ***	-0.1896 ***	-0.1912 **	-0.1597 ***	-0.2800 ***	-0.0117	-0.5453 ***	-0.0556	-0.3687 ***	0.3580 ***	-0.2769 ***	-0.0042
Number of observations (N)	905	919	851	861	905	919	851	861	905	919	851	861
Time period (T)	2	2	2	2	2	2	2	2	2	2	2	2
Wald's Chi-Square	2145 ***	1459 ***	3677 ***	2074 ***	1618 ***	3320 ***	1478 ***	1538 ***	3763 ***	871 ***	761 ***	34800 ***
Auto Regressive process	No	No	No	No	No	No	No	No	No	No	No	No

Legend: *** $p < 0.01$ ** $p < 0.05$ * $p < 0.10$

Table 3.3. (Continues) Panel c

Dependent Variable: Idiosyncratic Risk	2009-2013							
	Model 15				Model 16			
	All Firms		Non-Financial Firms Only		All Firms		Non-Financial Firms Only	
	1	2	3	4	5	6	7	8
1st Lag of Firm's Environmental Performances:								
Green ranking (GR)	7.96E-05	1.59E-04	2.46E-05	2.38E-05				
Square of green ranking (GR^2)	2.00E-06 ***	1.90E-06 **	2.60E-06 ***	2.30E-06 **				
Green score (GS)								
Square of green score (GS^2)								
Environmental Impact Score (EIS)					-3.65E-04	-3.80E-04	-1.25E-03 *	-9.11E-04
Square of Environmental Impact Score (EIS^2)					-2.92E-05	-4.81E-05 ***	-1.06E-04 ***	-6.79E-05 ***
Green Policy & Performance Score (GPPS)					-1.16E-03	-1.84E-03 ***	-3.82E-03 ***	-1.81E-03 **
Square of Green Policy & Performance Score ($GPPS^2$)					1.04E-04 ***	1.66E-04 ***	2.14E-04 ***	1.26E-04 ***
Reputation Survey Score (RSS)								
Square of Reputation Survey Score (RSS^2)								
Environmental Disclosure Score (EDS)								
Square of Environmental Disclosure Score (EDS^2)								
1st Lag of Firm's Characteristics:								
Idiosyncratic Risk	0.0858 ***	-0.0211	0.0558 **	-0.0109	0.0397 **	0.0834 ***	0.1154 ***	0.0821 ***
Liquidity	0.0878 ***		0.0849 ***		0.0686 ***		0.1158 ***	
Leverage	0.6515 ***	0.6057 ***	0.7256 ***	0.5847 ***	0.5883 ***	0.3509 ***	0.7048 ***	0.5071 ***
Assets Turn Over	1.01E-01 ***	1.06E-01 ***	6.09E-02 **	0.0648 **	1.15E-01 ***	8.84E-02 ***	5.34E-02 **	3.79E-02 *
Returnn on Assets	1.44E+00 ***	1.17E+00 ***	1.37E+00 ***	1.16E+00 ***	1.03E+00 ***	1.13E+00 ***	1.05E+00 ***	1.04E+00 ***
Size	-1.90E-06 ***	-2.00E-06 ***	-2.70E-06 ***	-2.70E-06 ***	-1.90E-06 ***	-1.90E-06 ***	-2.80E-06 ***	-2.90E-06 ***
Growth	3.79E-04 ***	3.08E-04 ***	1.97E-04 *	1.51E-04	3.10E-04 ***	2.40E-04 ***	2.92E-04 ***	2.26E-04 **
Constant	0.7624 ***	1.0423 ***	0.8734 ***	1.1288 ***	0.8929 ***	0.9513 ***	0.8529 ***	1.0833 ***
Number of observations (N)	1721	1751	1514	1527	1721	1751	1514	1527
Time period (T)	4	4	4	4	4	4	4	4
Wald's Chi-Square	379 ***	162 ***	194 ***	92 ***	181 ***	301 ***	557 ***	218 ***
Auto Regressive process	AR1	AR1	AR1	AR1	AR1	AR1	AR1	AR1

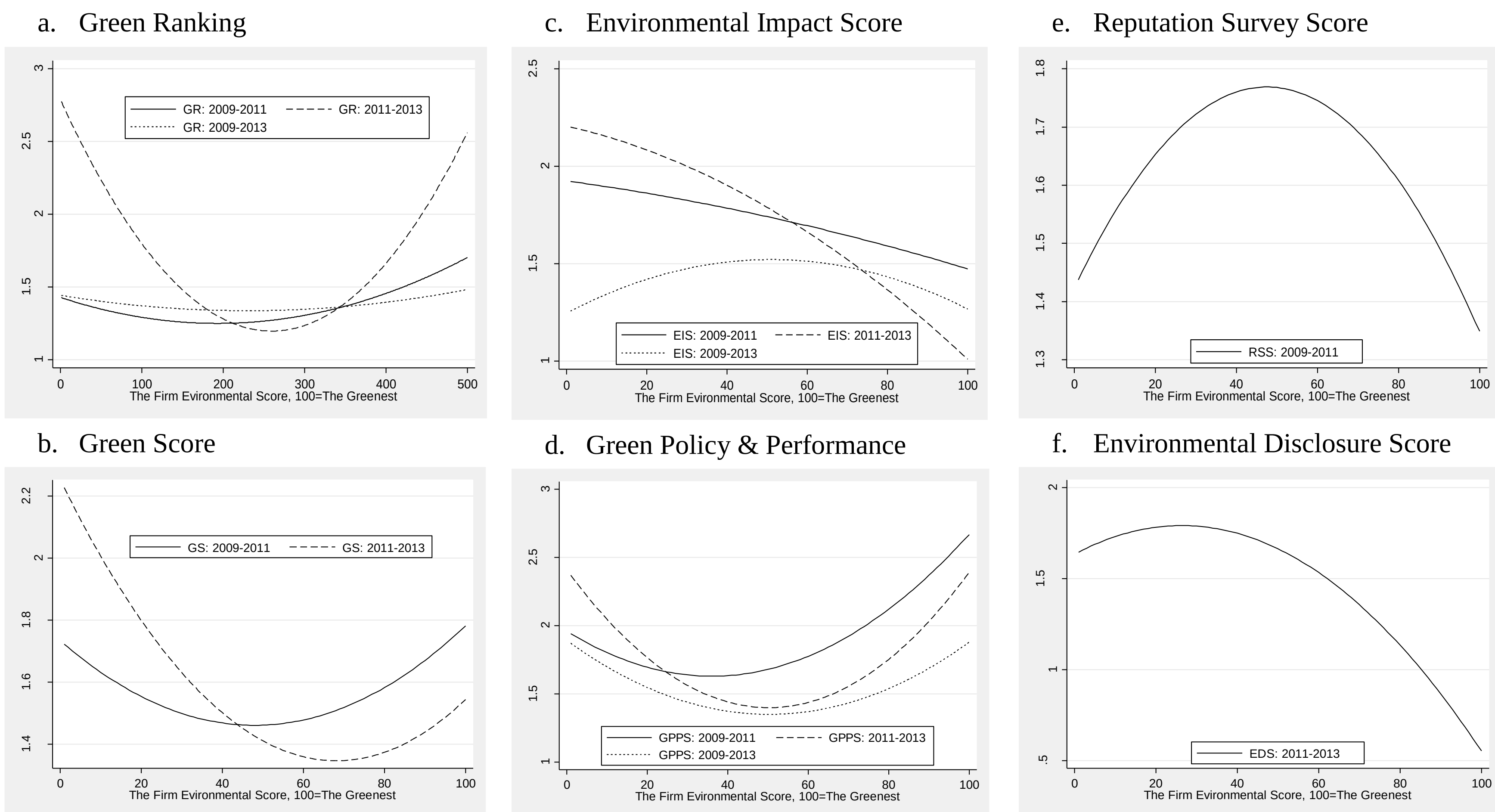
Legend: *** $p < 0.01$ ** $p < 0.05$ * $p < 0.10$

Table 3. 4: Marginal Effect of Firm's Green Ranking on Its Idiosyncratic Risk

The Bottom 25 Firms in 2012						The Top 25 Firms in 2012					
Company Name	**Sector**	**Green Ranking**	**Idiosyncratic Risk**	**Marginal Effect**	**%**	**Company Name**	**Sector**	**Green Ranking**	**Idiosyncratic Risk**	**Marginal Effect**	**%**
BlackRock	Financials	1	0.7644	-0.0048	-0.6225%	Allergan	Healthcare	476	0.9219	0.0026	0.2773%
Alpha Natural Resources	Energy	2	4.1812	-0.0047	-0.1134%	American Express	Financials	477	0.8800	0.0026	0.2923%
CF Industries Holdings	Materials	3	1.6945	-0.0047	-0.2790%	Best Buy	Retailers	478	2.9133	0.0026	0.0888%
T. Rowe Price Group	Financials	4	0.7800	-0.0047	-0.6041%	Google	Information Technology & Services	479	1.2821	0.0026	0.2030%
Monsanto	Materials	5	1.1065	-0.0047	-0.4245%	Autodesk	Information Technology & Services	480	1.9135	0.0026	0.1368%
Invesco	Financials	6	1.2589	-0.0047	-0.3719%	Motorola Solutions	Technology Equipment	481	1.1823	0.0026	0.2227%
CONSOL Energy	Energy	7	2.1521	-0.0047	-0.2168%	Cisco Systems	Technology Equipment	482	1.4160	0.0026	0.1871%
Peabody Energy	Energy	8	2.6572	-0.0047	-0.1750%	Baxter	Healthcare	483	0.9359	0.0027	0.2847%
Archer-Daniels-Midland	Food, Beverage & Tobacco	9	1.0879	-0.0046	-0.4261%	Citigroup	Financials	484	1.5654	0.0027	0.1712%
FirstEnergy	Utilities	10	0.9297	-0.0046	-0.4969%	Manpower	Professional Services	485	1.6940	0.0027	0.1591%
Tyson Foods	Food, Beverage & Tobacco	11	1.5415	-0.0046	-0.2987%	McGraw-Hill	Media & Publishing	486	0.9271	0.0027	0.2923%
Ralcorp Holdings	Food, Beverage & Tobacco	12	2.2178	-0.0046	-0.2069%	Hartford Financial Services Grp.	Financials	487	1.3742	0.0027	0.1984%
Ameriprise Financial	Financials	13	1.0112	-0.0046	-0.4523%	Cognizant Technology	Information Technology & Services	488	1.8407	0.0027	0.1489%
Allegheny Technologies	Materials	14	1.8082	-0.0046	-0.2521%	Microsoft	Information Technology & Services	489	0.9894	0.0028	0.2786%
AES	Utilities	15	1.1093	-0.0045	-0.4095%	EMC	Technology Equipment	490	1.3955	0.0028	0.1986%
Ameren	Utilities	16	0.7677	-0.0045	-0.5898%	Staples	Retailers	491	1.7826	0.0028	0.1564%
PPL	Utilities	17	0.7651	-0.0045	-0.5897%	Office Depot	Retailers	492	3.7169	0.0028	0.0754%
Mead Johnson Nutrition	Food, Beverage & Tobacco	18	1.4481	-0.0045	-0.3105%	Accenture	Information Technology & Services	493	0.9819	0.0028	0.2870%
Bunge	Food, Beverage & Tobacco	19	0.9904	-0.0045	-0.4525%	Intel	Technology Equipment	494	1.0300	0.0028	0.2751%
Edison International	Utilities	20	0.7684	-0.0045	-0.5812%	Nvidia	Technology Equipment	495	1.7353	0.0028	0.1642%
SCANA	Utilities	21	0.5979	-0.0045	-0.7443%	CA Technologies	Information Technology & Services	496	1.2751	0.0029	0.2246%
Airgas	Materials	22	1.0288	-0.0044	-0.4311%	Dell	Technology Equipment	497	1.8331	0.0029	0.1571%
Nucor	Materials	23	0.9700	-0.0044	-0.4557%	Sprint Nextel	Telecommunications	498	2.9886	0.0029	0.0969%
Lorillard	Food, Beverage & Tobacco	24	187.5889	-0.0044	-0.0023%	Hewlett-Packard	Technology Equipment	499	1.9517	0.0029	0.1491%
Precision Castparts	Aerospace & Defense	25	0.9969	-0.0044	-0.4402%	IBM	Information Technology & Services	500	0.7745	0.0029	0.3778%

*was calculated using the following formula: $Marginal\ Effect = B - 2C\bar{x} + 2Cx$ where B and C are the parameter estimates for the variables and their square respectively and x is the independent variables. See Figure 3.1.

Figure 3. 1: Simulated Causal Effect of Environmental Performance and Idiosyncratic



Note: The graphs are simulated based on results of FGLS estimates holding other independent variables constant

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