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How Does the Stock Market React to Corporate Environmental News?

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How Does the Stock Market React to Corporate Environmental News?

Abstract

The environmental decisions of corporations can have a huge impact on both the environment and a company's value. This paper finds that the stock market reacts negatively to news about the environmental behavior of firms. A 2009 Newsweek study on the "greenness" of companies is used in the study. The event study methodology is used with stock prices to measure the stock market reaction by creating Cumulative Abnormal Returns. The average abnormal returns of all the companies are significantly negative suggesting that investors react adversely to "green" news.

Keywords

Stock Market, Green, Event Study, Environment, Newsweek

Cover Page Footnote

This was written for the Senior Integrative Exercise at Carleton College under advisement of Aaron Swoboda. I would like to thank everyone in the Economics Department and all of my friends who helped make this paper possible.

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1. Introduction

Environmental performance, being green, clean-tech, corporate sustainability, and many other “green” issues are on the forefront of the current economic discussion. To help better understand the consequences of firm environmental behavior it will be useful to examine the relationship between corporate environmental decisions and stock market reaction. Therefore, this paper analyzes the effects of the 2009 Newsweek Green Rankings on firms’ financial performance, as measured by stock market returns. There have been two major trends in the literature to determine the link between corporate environmental decisions and financial performance. One group has used the event study methodology by looking at the stock market reaction to major environmental news. The other group has compared financial measurements, such as Tobin’s q[1], to some kind of environmental measure (such as pollution emissions). The stock market is complex and prices reflect vast amounts of information and knowledge about the profitability of companies. Using stock prices correctly can be a challenging task, one that requires knowledge of many possible avenues of calculations.

An event study model is used to try to capture the effects of the Newsweek Rankings. An event study examines some variable or measure before and after an event occurs. Therefore, the effect of the event is captured by the change of the variable. Since it is known that the event occurs before the reaction a strong case for causality is present. This paper uses stock prices and abnormal returns of companies to measure the stock market reaction to the Newsweek Rankings. The stock prices are the changing variables that helps explain more about the Newsweek Rankings and how investors react to their release.

This study finds evidence that the stock market does not react to most of the individual firm rankings, but does react negatively to the Newsweek Rankings as a whole. This could mean that investors do not consider the relative environmental choices of firms or that the stock market does not like hearing about environmental news. The data also suggests that investors react negatively to news that a company is more environmentally friendly than previously thought. This potentially means that investors place a negative value on environmentally conscious corporations.

The structure of the paper follows the outline of the Table of Contents. The first main section will be about theory and the underlying economic assumptions and variables that provide context for the economic relationships studied. Next, relevant literature from past studies is presented to form a basis for what has already been found and how the path led to where we are today. After

[1] A financial ratio that measures: total market value divided by the total asset value of a firm.

that, the methods section breaks down the process used to gather and form the data in preparation for statistical analysis. Section six is the true heart of the paper as it examines all of the statistical results and implications. Finally, the further research and conclusion sections bring the entire paper together to examine how everything fits within economic work and reality.

2. Theory

Firm Choice and the Environment

Before going into more detail about possible financial measurements it is important to consider the choices faced by firms. Many decisions that a company has to evaluate will effect the total environmental treatment by that corporation. Choices about product choice, different inputs that can be used, level of pollution cleaning, waste output, and all aspects of the environmental performance of a firm. Firms will not just consider the impact on the environment when making these decisions; this would not be acting in the best interest of their shareholders. Companies also need to consider the differing costs and benefits of each possible option. The goal of a corporation is to maximize overall profit and therefore take the course of action which adds the most value to the firm. While in reality firms almost never have one hundred percent perfect information, companies do put in significant effort to have all available information present before making a decision. Therefore, for the purpose of this paper, I will assume that companies have perfect information when making decisions.

After a company decides on which path to pursue it is possible that the choice was either friendly or unfriendly to the environment (Konar & Cohen 2001). The distinction between these two outcomes can be hard to define and even harder to determine in reality. This paper will look at the aggregate of firm decisions and compare the resulting measurements across firms. Hence, one decision or one company will not be either friendly or unfriendly to the environment but each company will be evaluated on its environmental performance relative to the other companies being studied. The relative comparison is actually performed by the 2009 Newsweek Green Rankings, which will be explained later in more detail. The Newsweek (2009) comparison uses pollution levels, green house gas emissions, water use, disposal levels, fuel use, and others variables to measure the relative "greenness" of companies.[2]

Once again looking at individual decisions, after a positive environmental decision is made by a firm, two paths are predicted by economic theory (Konar & Cohen 2001). One theory suggests that positive benefits will be greater than the costs of the environmentally friendly behavior. The positive benefits arise from things such as: increased demand due to a better public image, less input waste in

[2] The comparison normalizes figures using revenue figure to control for differing sizes and industries.

production, less negative attention from regulators, etc (Konar & Cohen 2001). If this theory is correct then the end result will be increased profitability to the firm and the stock market should reflect this association. The other economic explanation for the various impacts after firms engage in environmentally friendly behavior has a much different result. The other theory suggests that this behavior leads to high operating costs due to the high cost of pollution reducing technology and other factors that are friendly to the environment. If this theory is true then positive environmental choices will have a negative effect on the value of a company. A visual representation of these relationships is displayed in Figure 1 below, which is flowchart of the process.

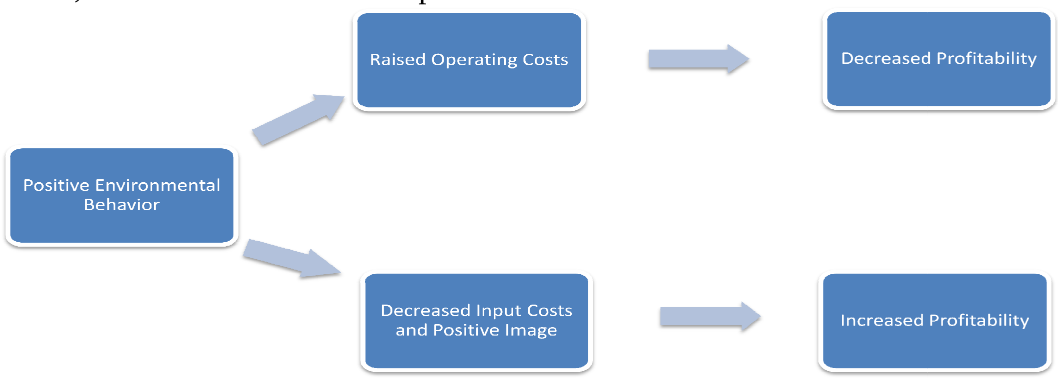

Figure 1: Flowchart of Environmental Choices Consequences

Unanticipated News

It is important for the news or event in an event study to be unanticipated, otherwise the study will be significantly flawed. Stock prices, in theory, should represent all available information about the company that the security, another name for a stock, represents (Bromiley & Marcus 1989). Therefore, any anticipated news that is publicly released should already be calculated into the price of a stock. Conversely, unanticipated news will cause an adjustment in price of a stock due to a change in belief about future cash flows or the risk of the stock. News and events are not strictly binary with regards to whether or not they are unanticipated. There are varying levels of how anticipated an event is by the market. For example, Bromiley & Marcus (1989) discuss how automotive recalls are somewhat anticipated because the market expects about two to three recalls in any given year. The rankings by Newsweek used in this study were the first annual rankings and hence represent unanticipated news.

Another concern arises from the leakage of information from inside the company (Klassen & McLaughlin 1996). Insider trading could occur before a major announcement that may appear to be unanticipated news to an outsider. This insider trading could distort the results of an event study by changing the price of the relevant stocks before the event period studied. To help control for this possibility Klassen & McLaughlin (1996) did not include the ten days before the event in the estimation period and also included one day before the event in the event period. Bromily & Marcus (1989) ended the estimation period sixteen days before the studied event and use fifteen days before and ten days after for the bonds on the event period.

Event Studies with Stock Prices

Stock prices can be used to gain significant insight into corporations and how an event specifically affects a company. According to the efficient market theory, stock prices represent all available information about each company (Fama 1970). Using all available information a security's price should, in theory, represent the expected net present value of all future cash flows (Bromiley & Marcus 1989). When unanticipated or unpredictable news becomes available this should result in stock market adjustments to the prices of affected stocks. Therefore, a good way to determine the relationship between an event and a company is to look at the change in the stock price following the event becoming public knowledge. This event study methodology has been successfully used many times in the past (Bromiley & Marcus 1989, Brown & Warner 1985, Klassen & McLaughlin 1996, Gupta & Goldar 2005, Jarrell & Peltzman 1985, McNichols & Dravid 1990, Horsky & Swynedouw 1987, and many others). These event studies normally use stock prices for the dependent variable and independent variables, such as environmental awards (Klassen & McLaughlin 1996), automotive recalls (Bromily & Marcus 1989), company name change (Horsky & Swynedouw 1987), and others.[3]

It is not enough to simply examine if the stock price went up during the event period. Different securities have varying risks and fundamentals behind them. Therefore, it is more important to consider how much better the stock performed during the event period relative to what one would normally expect the performance to be without the event. This measure-the return observed above the expected return-is referred to as abnormal return in the literature (Brown & Warner 1980). The important question is then, how does one determine what a normal return for a security should be? A baseline is the best way to solve this problem.

A benchmark must be created that can then be compared to the returns found during the actual event period (Brown & Warner 1980). There are three main models used to create this benchmark: mean adjusted returns, market adjusted returns, and market and risk adjusted returns (Brown & Warner 1980).[4] One of the important strengths of an event study is the inference of causality that comes from the timing of the event and the corresponding change in stock return

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[3] More detailed information on these studies is presented later in the relevant literature section.

[4] These three models are discussed in greater detail in the appendix.

(Klassen & McLaughlin 1996). This is important to show a correlation, and also to provide evidence of the direction of causality. One potential weakness of the event study methodology arises from the possibility of another event happening during the event period (Klassen & McLaughlin 1996). A good way to control for this factor is by keeping the number of days during the event study limited. This decreases the likelihood of confounding events entering the data and affecting the regression results.

Estimation Period for Event Study

Stock prices can be a useful indication of possible relationships, but they must be analyzed correctly. With stocks all starting at differing prices and varying numbers of shares outstanding, simple changes in stock prices will not properly model stock reaction. A common approach to this problem is to examine the returns of a stock for a given period previous to the event being studied, usually between 20 and 250 trading days. Pre-event estimation time frames have been used by Bromiley & Marcus (1989), Klassen & McLaughlin (1996), and Gupta & Goldar(2005), with respective durations of; 228, 200, and 150 days. The average number of trading days in a calendar year is around 250. Therefore, an estimation period that is close to this number is good because it will include all possible seasonally cycles a company may go through. There is a danger, of using too long of an estimation period, that companies will have a significant change to their profitability, operations, or other parts of their company that will affect the path of their stock returns. Hence, an estimation period in the lower 200's is a good way to capture a baseline for the normal performance of a company.

3. Relevant Literature

Event Studies

Environmental economic papers have used event studies many different ways. Klassen & McLaughlin (1996) examined how major environmental news related to corporations affect daily stock prices of those firms. Another study by Bromily and Marcus (1989) examined how the stock market reacts to automotive recalls in attempt to determine if this might represent a deterrent to automakers to make unsafe products. Bromily and Marcus (1989) used previous work by Fama (1976), who looked at both daily and monthly stock price returns, to help construct their model. However, unlike Klassen & McLaughlin (1996) and others, Bromily & Marcus (1989) used Mean Adjusted Returns to calculate abnormal returns. Bromily and Marcus (1989) found 147 major recalls from 1972 to 1983. Similarly, Klassen & McLaughlin (1996) took a sample of 140 positive (environmental awards) news events and 22 environmental negative news events. More details of these studies can be found in the appendix.

4. Methods

This paper uses abnormal stock returns of companies as a proxy for the market reaction to an event. The stock market has no reason to intentionally misprice any securities because this would result in an arbitrage possibility (where someone could basically use the stock market to generate an amount of "free" money). The event in question, the Green Rankings, should also be accurate because Newsweek wants to maintain its credibility in the news industry and thus will not intentionally produce fraudulent rankings. The purpose of this paper is to explain how the stock market reacts to environmental news about corporations and use the information gained to better understand environmental decisions and consequences.

It is necessary to use ordinary least squares for the relationship between the Green Rankings and abnormal stock returns because the Newsweek Rankings are both positive and negative. The Green Rankings only compare the environmental behavior of the largest companies and is not a top or bottom list. Therefore the Green Rankings are neither a positive nor negative event and it is prudent to use some kind of a scale, such as the linear relationship used in ordinary least squares. It is possible that the stock market will place either a positive or negative value of good rankings by Newsweek. If the stock market believes that environmentally friendly actions by firms add positive value to a company then it is expected stock prices would increase when the rankings are released. It is also possible that the stock market believes costs associated with environmentally friendly behavior will have a negative effect on the value of the firm, leading to a drop in stock price for these companies. The Newsweek study is a ranking of companies and therefore comparison among companies is possible. The Newsweek Green Rankings provide a good opportunity to examine the linear relationship between how a company ranks and its stock price around when the study is released. There is no reason to believe that any other relationship, besides linear, will exist between the two variables. Therefore, this paper will examine the possible linear relationship using ordinary least squares.

This paper will use the Market and Risk Adjusted Returns model when looking at company stock returns. It provides the best estimation of the relationship between a company and a market proxy. This method helps control for the different growth rates of companies because each company has its own regression of returns versus a market proxy. This is observed in the different alphas of each company. Companies also react differently to the movements of the market proxies and this method controls for this by the estimation of beta, which measures how much the stock changes in relation to the market proxy. For example, if a company has a beta of two then a five percent increase in the market portfolio will result in a ten percent increase of the individual company's stock return.

5. The Model and Data

Event Study Model

Before looking at the stock prices and returns around the release of the 2009 Newsweek Green Rankings a determination of normal return for each company is necessary. Otherwise it will be almost impossible to interpret the stock prices and determine significance. An estimation period from October 17, 2008 to September, 17, 2009 was used to create a baseline for each company. This period has 230 trading days which produces 230 data observations for each company. The return for both individual companies and the entire S&P 500 index is calculated the same way as follows:

$$Stock\ Return = \frac{Close\ Price - Open\ Price}{Open\ Price} \tag{6}$$

The return of each company is regressed against the S&P 500 return on the corresponding days. The equation for this regression is displayed below in Equation 7:

$$Company\ i's\ \ Return = \alpha_i + \beta_i\ (S\&P\ 500\ Return) \tag{7}$$

The Alpha (α) is the intercept estimation from the regression analysis and the Beta (β) is the estimation of the slope for the S&P 500 Return variable. The slope measures how much the dependent variable (Company's Return in this case) varies with a one unit increase in the independent variable (S&P 500 Return). This is the characteristic, or normal, return of the firm giving the performance of the S&P 500. This regression is run for each company and hence 394 Alpha's and Beta's are estimated, which are then used in the calculation of abnormal returns.

It is now possible to turn to the event period, the time around the release of the rankings, to calculate if there are any unexpected returns. With the baseline already established through the estimation of all of the Alphas and Betas, the question to ask is: how much different are stock prices from what we expect given the performance of the S&P 500? Therefore, the next step is simply to examine a day during the event period and to calculate the expected return of a company and subtract it from the real return that was observed on the given day, all of this is displayed on the next page in Equation 8.

$$Abnormal\ Return_i \ = \ AR_i - \ \alpha_i \ + \ \beta_i \ * \ Market\ Portfolio\ Return \tag{8}$$

Where:

AR_i : The individual stock return for company$i$: $\frac{Close\ Price - Open\ Price}{Open\ Price}$

α_i : Constant term for firm i (From OLS regression of stock data)

β_i : Slope of characteristic return of firm i (From OLS regression of stock data)

Market Portfolio Return: The S&P 500 Return: $\frac{S\&P\ 500\ Close\ - S\&P\ 500\ Open}{S\&P\ 500\ Open}$

The calculation of abnormal return only looks at one day during the event period. To get the full picture of the effect of the Green Rankings more than one day must be examined. Hence, a calculation of multiple days is necessary. Cumulative Abnormal Returns (CAR) is the summation of the all of the abnormal returns during the given event period. For this paper, the first event period examined is the three trading days around the release of the 2009 Newsweek Green Rankings (9/18/09 to 9/22/09). This period is used because it includes the actual day the rankings were releases, the 21^{st}, and one day before and after. This study will also look at an event period of ten trading days that also starts on the 18^{th}.

$$Cumulative\ Abnormal\ Return_i = \sum Abnormal\ Returns_i \tag{9}$$

All of the previous calculations and regressions are all for the purpose of getting the Cumulative Abnormal Returns values which represent the dependent variable in the ultimate regression that attempts to answer the main question of this paper: Did the 2009 Newsweek Rankings have a significant effect on the ranked companies and if so, what was the direction and magnitude of the influence? To answer this question it's necessary to use an equation similar to that of Klassen & Mclaughlin (1996) to run a regression analysis. The regression equation is displayed on the next page in Equation 10.

$$CAR_i = \delta_0 + \delta_1\ Green\ Score_i \tag{10}$$

Where:

$Green\ Score_i$: The Green Score associated with company i

δ_0 : The Intercept

δ_1 : The Slope of the Independent Variable (Green Score)

The only differences from Equation 6 will be the independent variable. The dependent variable, CAR, will always stay the same because it measures how much abnormal change occurred in stock prices. The independent variable can also be changed to include other variables from the 2009 Newsweek Green Rankings, such as; Green Ranking, Environmental Impact Score, Green Policies Score, or Reputation Score. However, these regressions would not be heavily supported by economic theory and thus the results would not be as relevant to the purpose of the paper.

The Data

Newsweek (2009) released, both online and in print, its first annual Green Rankings on September 21, 2009. The project took over 18 months to complete. Newsweek (2009) ranked the 500 largest public US companies based on revenue, market capitalization, and employees. The ranked companies are identified by industry (using the Dow Jones Industry Classification Benchmark). In the methodology sections Newsweek (2009) writes, “Our goal was to assess each company's actual resource use and emissions and its policies and strategies, along with its reputation among its peers.” Each company is ranked from one to five hundred based on its overall “Green Score”. The Green Score is based on three weighted components: Environmental Impact Score (45%), Green Policies score (45%), and Reputation Score (10%). However, since the Green Score also uses an undisclosed environmental impact ratio score it is impossible for an outsider to apply the weights to the individual components to get the overall Green Score.

The three weighted components all measure different aspects of the environmental behavior of firms. The Environmental Impact Score is based on data from Trucost and examines over 700 variables to calculate the overall cost of environmental impacts compared to a company’s revenue. This comparison helps control for size and enables comparison among different companies and sectors. The Green Policies Score comes from KLD Research & Analytics data that includes: company initiatives, lawsuits, and regulatory fines. The Reputation Score is from a survey conducted by Corporate Register exclusively for Newsweek. Corporate level executives and other “sector specialists” ranked other companies based on five green areas: green performance, commitment, communications, track record, and ambassadors (Newsweek 2009). Histograms of the overall green scores and each of the three components are located in the appendix in Figures 2-5 for a visual representation of the distribution of scores. The overall green score is skewed to the left, with most of the observations between 60 and 80. The environmental impact score exhibits almost perfect uniform distribution. The Green Policies Score and Reputation Score both have a relatively normal distribution. Descriptive statistics for the 2009 Newsweek Green Ranking are displayed in Table 1 below.

	Green Rank	Green Score	Environmental Score	Green Policies Score	Reputation Score
Mean	239.841	70.952	49.709	41.742	35.357
Standard Deviation	147.184	10.565	29.244	18.425	14.182
Median	235.0	71.080	49.40	40.190	33.390
Skewness	0.101	-1.422	0.017	0.418	1.266

Table 1: 2009 Newsweek Green Ranking Summary Statistics

The Newsweek Green Rankings represent the first major attempt at trying to quantify how environmental friendly major US corporations are across industries. Due to the new formula and data used for the study, it would be nearly impossible for someone to try to predict the rankings before Newsweek released them. Therefore, the release of this report to the public constitutes as unanticipated news and the market reaction will be able to show an accurate snapshot of how the market values green behavior.

From the Newsweek Green Rankings emerged data for the 500 companies that were ranked. Next, stock prices for these companies were needed to shed some light on these companies' valuations over time. The Green Rankings examined the largest 500 publicly traded corporations in the United States at the time of the study, but this is not a static list (Newsweek 2009). Newsweek determined the size of companies by looking at revenue, market capitalization and the number of employees. Standard and Poor's publishes an index of the 500 largest public companies as measured by unadjusted market capitalization (Standard and Poor's 2010).[5] The market capitalization of companies' change every day due to stock price changes, issuing of new shares, share buybacks, and many other reasons. Standard and Poor's makes changes to the companies used in the companies as needed on a daily basis. The varying changes in market capitalization and different measures used to calculate size by Newsweek and Standard and Poor's results in incomplete overlap between the two lists. In the end there were 394 that had complete data in both lists and were able to be used in the statistical analysis.

The correlation matrix for the Newsweek Rankings is displayed in Table 2 on the next page. The overall Green Score and all three of its components are shown. Column one is important because the relationship between the Green Score and the individual parts of the study. Especially important is the correlation of .44 between the Green Score and the Reputation Score. If this number was very close to one it would mean that the Green Score and Reputation Score are extremely correlated and indicate that the market would not be surprised by the Newsweek Green Rankings.[6] However, this is not the case; the correlation of only .44 provides support for the assumption that the Green Rankings are indeed unanticipated news. Therefore, the release of the 2009 Newsweek Green Rankings should have triggered an adjustment of the stock market, if investors truly considered environmental behavior by firms.

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[5] Market Capitalization is the total dollar value of outstanding shares for a company and is calculated by multiply the number of shares outstanding by the share price.

[6] Remember that the Reputation Score comes from a survey of many different professionals with knowledge of companies in the Newsweek study.

	Green Score	Environmental Score	Green Policies Score	Reputation Score
Green Score	1.00			
Environmental Score	0.33	1.00		
Green Policies Score	0.74	-0.07	1.00	
Reputation Score	0.44	-0.06	0.47	1.00

Table 2: Correlation Matrix of Newsweek Components

Cumulative Abnormal Returns (CARs) were calculated using regression output from company returns and the S&P 500 returns, as described earlier in the Model Section of this paper. The CAR value shows what returns were observed during the event period that were not explained by the S&P 500 returns during the event period. The summary statistics are displayed in Table 3 below. The mean of all of the CARs is negative .026 and represents an average abnormal loss of 2.6 percent for the companies studied. Figure 6 in the appendix displays a visual representation of the distribution of the cumulative abnormal returns.

	Cumulative Abnormal Returns
Mean	-0.026
Standard Deviation	0.026
Median	-0.025
Skewness	0.397

Table 3: Abnormal Returns Summary Statistics

6. Results

Newsweek Rankings and Cumulative Abnormal Returns

The results of the statistical analysis using the model presented in previous sections are presented here. The linear regressions examine the effect of different variables on the Cumulative Abnormal Returns (CARs). The regressions used a two tailed linear regression because of uncertainty of whether environmentally friendly behaviors have a positive or negative effect on stock returns. A scatter plot of both variables is displayed in the appendix in Figure 7. Regression 1, displayed below, looks at the relationship between the Green Score (the actual score assigned to each company, not the ranking) and the corresponding CAR of each company. The coefficient values are the estimates of deltas (δ) from

Equation 6 in the Model Section. The coefficient for the Green Score (-.00005989) indicates that an one unit increase in the Green Score of a company results in a decrease of .006% for the company's CAR during the event period. The negative sign of the coefficient is interesting because it weakly suggests that green behavior by firms results in lower stock returns for a company. The estimator value is small and also insignificant, as shown by both the small T-Statistic and large P-Value. The T-Statistic is the coefficient divided by the standard error and helps provide a quick analysis of significance.[7] The P-Value calculates the probability, assuming that the true coefficient equals zero, of observing a sample with a test statistic as high as or higher than the one in this sample. The low R-squared values tell us that the model does a poor job of explaining the variation in the variables. The .000607 R-squared value is an estimate that the model only explains .06 percent of the model.

Regression 1: Green Score on Cumulative Abnormal Returns

	Coefficient	Standard Error	T-Statistic	P-Value
Intercept	-.02197**	.008770	-2.505	.0126
Green Score	-.00005989	.0001223	-0.490	.6245

Multiple R-squared: 0.000607 Adjusted R-squared: -0.001923
* Significant at the 95% level **Significant at the 99% level

A good way to examine how effectively ordinary least squares modeled the relationship studied is by looking at a residual plot of the independent variable, Green Score in this case. A residual is the difference between the actual value of one observation and the value expected by the model. The residuals of the Green Score are displayed in Figure 8 below.

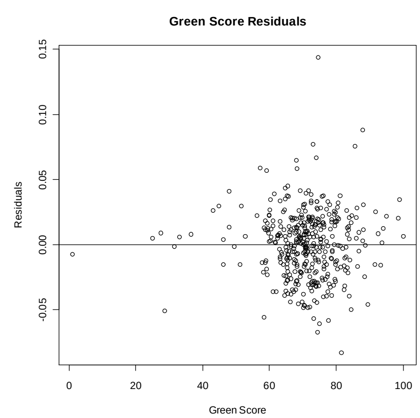

Figure 8: Residual Plot from Regression 1.

[7] The variable is likely significant if the absolute value of the T-Statistic is greater than two.

In this case the residual plot helps bring to light a couple important features of the relationship between Green Score and CAR. First, it highlights a potential outlier (the one extremely large residual). Outliers will be dealt with later on in this section. Second, the plot seems to show a trend that the variance of the residuals increases with the value of the Green Score. This is represented by the "fanning out" of residuals farther to the right in the plot. The variance of residuals should be fairly constant and not exhibit any patterns. A pattern of low variance in one section and high variance in another could suggest the presence of heteroskedasticity in the data. Heteroskedasticity can cause standard error estimates to be incorrect for a data sample. This is important because standard error estimates are important in determining statistical significance. There are varying statistical tests that exist to test a data set for heteroskedasticity. Two tests, the Cameron & Trivedi IM-Test and the Breusch-Pagen/Cook-Weisberg Test, were used to understand if heteroskedasticity was present in the data. The results of the tests are displayed below. The null hypothesis for these tests is that the variance of residuals is normal and hence P-Values of less than .05 provide evidence of heteroskedasticity.

Heteroskedasticity Test Results

	P-Value
Cameron & Trivedi IM-Test	.4728
Breusch-Pagen/Cook-Weisberg Test	.0675

The Breusch-Pagen/Cook-Weisberg Test is close to the .05 threshold but the Cameron & Tivedi IM-Test is far from it, suggesting results about the presence of heteroskedasticity. With unclear test results it can be helpful to examine the consequences of adjusting for heteroskedasticity. One way to do this is by using robust standard errors in place of normal standard errors. Robust Standard errors are unaffected by outliers and heteroskedasticity and hence will provide correct significance tests. The regression results when using robust standard errors are displayed in Table 4. The new robust standard errors are almost exactly the same as in Regression 1. This implies that heteroskedasticity in the data is minimal and did not largely affect the results.

	Coefficient	*Robust Std. Error*	T-Statistic	P-Value
Intercept	-.02197**	*.007866*	2.790	0.005
Green Score	-.00005989	*.000112*	-0.530	0.593

Table 4: Regression 1 Results Using Robust Standard Errors.

The next relationship examined is between CARs and Green Rankings. It is important to note that Green Rankings are inversely related to Green Scores since the number one ranking is associated with the highest Green Score. Therefore high numbers in the independent variable, Green Rankings, represent more environmentally unfriendly companies and hence the sign on the coefficient should be opposite of the previous regression. Regression 2 is displayed below and as expected the coefficient is positive. The Green Ranking variable is also insignificant in relationship to CAR, as evidenced by the T-Statistic. A scatter plot of both variables and a residual plot are located in the appendix in Figure 9 and 10, respectively. The scatter plot shows a relatively uniform distribution and the residual plots show a healthy random distribution, suggesting that heteroskedasticity is not present.

Regression 2: Green Ranking on Cumulative Abnormal Returns

	Coefficient	Standard Error	T-Statistic	P-Value
Intercept	-.02788**	.002468	-11.299	0
Green Ranking	.0000069	.0000088	0.789	0.431

Multiple R-squared: 0.002 Adjusted R-squared: -0.0001
* Significant at the 95% level **Significant at the 99% level

Another interesting relationship to examine is the difference between the ranking of companies based on overall Green Score and the ranking of companies based on reputation score. This calculation is as follows:

Unexpected Green Ranking$_i$ = Green Score Ranking$_i$ – Reputation Ranking$_i$ *(11)*

This calculation represents the unanticipated news that is released in the 2009 Newsweek Green Rankings. Investors had already been thinking about the environmental behavior of firms before the Green Rankings, therefore investors had an idea of what the rankings might look like. A great estimation of this ranking comes from the reputation ranking in the Newsweek report because it represents the results of a survey on how people view the “greenness” of companies. Therefore, Equation 11 calculates how unexpected the green rankings were to the general public for each company. A histogram of the distribution of Unexpected Green Rankings is displayed in Figure 13, in the appendix. A positive value for the Unexpected Green Ranking means that the public thought a company was more environmentally friendly than it was ranked by Newsweek (Since the Green Score Ranking was larger than the Reputation Ranking). The stock market should adjust to any unanticipated news by correcting to new stocks prices for the affected companies. Hence, it may be more relevant to see the results from Equation 12:

$$CAR_i = \delta_0 + \delta_1\, Unexpected\ Green\ rankings_i \qquad (12)$$

The statistical analysis of Equation 8 is displayed in Regression 3 and has interesting implications. The Unexpected Green Ranking variable is significant at the 95 percent threshold. This provides evidence that a single unit increase in Unexpected Green Ranking has a .0014 percent effect on the abnormal return of a company. It is important to keep in mind how Unexpected Green Ranking is calculated (Reputation Rank is subtracted from Green Rank). For example, the model predicts that a company with an Unexpected Green Ranking value of 100 will have a .14 percent abnormal return during the event period. Also note that a positive Unexpected Green Ranking means that a company is more environmentally unfriendly than the market previously thought (Based on the Reputation Score). This sign on the independent variable in this regression, along with the previous ones, suggests that the stock market places a negative value of friendly environmental behavior by firms. The scatter and residual plot of this regression can be found in the appendix.

Regression 3: Unexpected Green Ranking on Cumulative Abnormal Returns

	Coefficient	Standard Error	T-Statistic	P-Value
Intercept	-.02658**	.001236	-21.504	0
Unexpected GR	.0000144*	.00000804	1.797	0.0731

Multiple R-squared: 0.008 Adjusted R-squared: 0.006

* Significant at the 95% level **Significant at the 99% level

The obvious outlier that is present in every graph, due to the extremely high Cumulative Abnormal Return value, is the company American International Group (AIG). The company had a CAR of .1175 (equivalent to 11.75%). This high value is likely due to a news story other than the Newsweek Green Rankings. The biggest story during the event period for AIG was the news about a government proposal to cut the interest rate on the loans given to AIG and to give AIG the option of lending additional money (Holzer & Benoit 2009). This announcement about AIG conflicts with this study because the abnormal return is catching both this story and the Newsweek Ranking. Since the affects of each cannot be untangled it makes sense to remove AIG from the dataset. Running Regressions 1-3 again produces a minimal change in results. For example, the coefficient for Green Scores changes to -.000072 and the new t-stat is -.612 (A difference from the first regression of .000012 and .122, respectively). Complete results from the first three regressions without the outlier can be found in the appendix, in Table 5. All of the changes are relatively small and hence the results are not exceedingly informative.

Cumulative Abnormal Returns Significance

Looking at the linear relationship between the Newsweek Study and the Cumulative Abnormal Returns (CARs) is not the only statistical process to examine the effects of the study. Another tool is to look at the average of all the CAR values during the event period. This represents how the stock market reacts to all of the companies in the Newsweek Rankings. The null hypothesis with the mean of the CARs is that the average is equal to zero (Representing no relationship between the rankings and abnormal stock returns). The mean CAR of the sample is -.0262 and suggests that, on average, companies featured in the Newsweek Rankings will have a 2.62 percent decrease in stock returns above what is expected by the daily performance of the S&P 500. The results of a one-sample t-test are displayed below. It is important to note that the mean CAR is significant at the 95 percent level.

One Sample T-Test: Cumulative Abnormal Returns

	Mean	Standard Error Mean	T-Statistic	Degrees of Freedom
Cumulative Abnormal Return	-.0262**	.00129	-20.344	396

* Significant at the 95% level **Significant at the 99% level

Using a Different Event Period

There is no consensus in event study methodology about how many days to use in the event period to calculate abnormal returns. For example, Pritamani & Singal (2001) examine how their results differ with the different event period, ranging between one and twenty trading days. The lack of certainty comes from the fact that it is hard to determine how long it takes for the stock market to react to unanticipated news. The lack of precision on the optimal length of an event period presents an opportunity to observe differences in results with another event period. It is possible to do this by re-calculating the abnormal returns for a longer period and adding them up for a new Cumulative Abnormal Return value. The regressions with an event period of ten trading days are displayed below. As before, the dependent variable in the regressions is CAR. The results are similar to the original regressions, with slightly larger coefficients values. One important difference is that Unexpected Green Ranking is no longer significant when using a ten day event period. The T-Statistic is now 1.137 (As compared to 1.797 in the original regression) and is not statistically significant. The changing significance could be due to multiple reasons. The Unexpected Green Ranking may not actually have a significant effect on CAR values. However, it is also possible that the stock market reacted quickly to the Newsweek Rankings and hence the ten day trading period is too long for accurate results.

Regression Results with 10 Day Event Period

	Coefficient	Standard Error	T-Statistic	P-Value
Intercept	-.09828**	.02233	-4.40	0
Green Score	-.00020	.000312	-0.65	.516
Intercept	-.11270**	.003255	-34.60	0
Unexpected GR	.000029	.000021	1.371	0.17

* Significant at the 95% level **Significant at the 99% level

The one sample t-test results with a ten trading day event period are displayed following this paragraph. The mean CAR decreases by .08 to -.1142 or an average CAR of 11.42 percent. The CAR is still significant at the 99 percent level and provides more evidence in support of a negative market reaction to all companies featured in the Newsweek study. The mean CAR represents a return of 11.42 percent less than expected, based on the S&P return during the event period.

One Sample T-Test with 10 Day Event Period

	Mean	Standard Error Mean	T-Statistic	Degrees of Freedom
Cumulative Abnormal Return	-.1142**	.00329	-34.739	396

* Significant at the 95% level **Significant at the 99% level

7. Further Research

This paper provides an initial examination of the 2009 Newsweek Green Rankings and the stock market reaction. Newsweek makes the claim that it controls for industry, size, revenue, and other variables. However, future research could include these variables and others into the model to determine if the variables are having a significant effect on abnormal returns. The inclusion of factors that were omitted in this paper could bring clarity to the importance of the Newsweek Rankings. For example, the stock market may react differently depending on the industry of each individual company. There are many different quantitative and qualitative data publicly available that could be considered, especially since the rankings look at the largest 500 companies.

Future work could also use a different dependent variable in place of stock prices. Stocks prices are influenced by many factors per minute and it is difficult to create a model that can completely isolate one factor from all of the others.

One common variable used, instead of stock returns, is Tobin's q. As mentioned earlier in the paper, Tobin's q is a ratio of total market value to total assets for an individual company. Tobin's q provides an interesting measure of firm health, however, it is hard to tell which variable is having the influence on the other, when dealing with snapshot data like Tobin's q[8].

The Unexpected Green Ranking could also be constructed using a different variable as the control for investor beliefs about the relative environmental behavior of firms. Other surveys or studies might provide a more accurate current sentiment of investors to corporate "greenness". If the Reputation Score is not a good representation of what the stock market thinks about how companies rank relative to each other in terms of environmental decision then the calculation of the Unexpected Green Ranking will be incorrect. It is important to remember that the reputation score is based on surveys of industry expects and not stock investors. It would better to examine multiple estimates on the beliefs of the stock market to provide a more concrete understanding of the relationship between environmental news and the stock market.

Considering the general lack of significance of the independent variables in the regressions, it is possible that the stock market is not impacted by the specific ranking of companies in the Newsweek study. If investors believe that the environmental choices by firms have no effect on stock returns, then there will be no adjustment to news of this kind. Further research could examine other environmental rankings and their relationship with abnormal returns to see if there is any significant reaction by investors. It is also possible that the Newsweek Ranking is simply perceived as a poor study of the environmental traits of companies by investors.

The mean of Cumulative Abnormal Returns is significantly negative for this study. This could represent a trend of negative reactions by investors to any environmental news about companies. However, this is hard to determine since the Newsweek Rankings is only one environmental study. Further research could examine whether all announcements about the environmental behavior of a group of corporations has a negative effect on stock returns or just the Newsweek Green Rankings. The negative stock market reaction could be a behavioral response by investors who have a bad association with any environment news. This is not contradictory to the last paragraph there is a difference between the reaction to the individual rankings and the reaction to the study as a whole. It may also be

[8] Snapshot referring to the fact that Tobin's q only looks at the financial health of a company on at one time and cannot be charted over time in the same frequency as stock prices because the numbers used in calculating Tobin's q ratio come out quarterly at best.

beneficial to construct a portfolio of large companies that were not ranked by Newsweek and examine the abnormal returns for any interesting patterns.

It appears the Newsweek will continue to come out with new rankings every year, as Newsweek referred to this year's rankings as the first annual. Future Newsweek Green Rankings could be reveal interesting information by examining the movement of companies from year to year in the rankings. The stock market reaction to company Green Score movements over time could present some revealing information about how the stock market reacts to the Newsweek Green Rankings.

8. Conclusion

The relationship between a company's "greenness" and its stock market performance is complicated and not completely understood. This paper contributes to the environmental economic literature by providing evidence that there is no, or at most a minimal, effect on abnormal returns by Green Scores and Rankings. This paper also found that the Unexpected Green Rankings had a significant effect on abnormal returns, suggesting that the stock market did react to the unanticipated component of the Newsweek Ranking. The study found that a company that was ranked worse than expected by the market experienced positive abnormal return. The paper also presents evidence that the overall Newsweek Green study has had a negative effect on the stock returns for all the companies in the study. There is still much to be studied in environmental economics to understand these relationships and issues. This paper sets up a method for examining the relationship between a ranked unanticipated environmental data source and stock prices. Hopefully this framework can be applied to other environmental rankings in order to see a clearer picture of the effects of corporate environmental behavior. The initial findings, the negative coefficients and negative average CAR values, from this paper suggest that the stock market reacts somewhat negatively to corporate environmental news. Ultimately this may mean that stock markets do not believe that environmentally friendly behavior adds any value to a company, and even might place negative pressure on firm value. This would be in line with the economic theory discussed earlier that positive environmental behavior leads to decreased profitability.

Appendix

Mean Adjusted Returns

There are several different methods that are used in the literature to deal with stock price data. These methods help control for variations among companies, including: overall size, shares outstanding, stock levels, etc. The Mean Adjusted Returns model is the simplest event study model that uses stock prices. The calculation used to determine normal return is simply the average of the stock returns during the estimation period. The abnormal return is then calculated by subtracting this expectation from the observed return during the event period. Both of these calculations are displayed following this paragraph. The model assumes that the expected return of a stock is constant and only varies among different stocks (Brown & Warner 1980). The model also assumes that the risk of individual stocks does not vary (Brown & Warner 1980).

$$\text{Normal Return} = \frac{1}{(\text{b})} \sum_{\text{a}}^{\text{b}} \text{Daily Return}$$ *Where a to b is the estimation period (1)

$$\text{Abnormal Return} = \text{Obserevered Return} - \text{Normal Return} \qquad (2)$$

Market Adjusted Returns

The assumptions of the Market Adjusted Returns model are similar to the Mean Adjusted Returns. The major difference is that the model does not assume that expected returns are constant for an individual security. The model assumes that the expected return of a security on a given day is equal to the expected return of a relevant market portfolio of stocks on that same day. Therefore, the model calculates abnormal returns to be the value of the observed individual stock less the return of the market portfolio. Both of these equations are displayed following this paragraph. This model assumes that risk is constant among stocks and that the variation of stocks returns in the market portfolio is not relevant. Furthermore, it assumes all stocks normal return should simply be the average of the performance of the portfolio (Brown & Warner 1980).

$$Normal\ Return = Expected\ Value\ (Market\ Portfolio) \qquad (3)$$

$$Abnormal\ Return = Obserevered\ Return - Normal\ Return \qquad (4)$$

Market and Risk Adjusted Returns

The Market and Risk Adjusted Returns model is a commonly used model that incorporates a more complex process the previous two models. The model estimates two variables, alpha and beta, from an Ordinary Least Squares (OLS) regression of the estimation period. The stock returns for an individual company are regressed against the returns on a relevant market portfolio (Brown & Warner 1980). This regression yields the estimates for a security of alpha and beta which are used in the calculation of abnormal returns (Dimson 1979). The formula for abnormal returns is displayed following this paragraph. Instead of using the assumption that individual stock returns should simply equal the return of the market, like in the Market Adjusted Model, this model uses the assumption that the relationship between the market and an individual stock is linear and attempts to estimate that relationship (Klassen & McLaughlin 1996).

$$Abnormal\ Return = Observed\ Return - (\alpha + \beta^{*}\ Market\ Portfolio\ Return) \qquad (5)$$

* α: constant term for firm,
β: slope of characteristic return of firm (both OLS estimates)

Event Studies Continued

Klassen & McLaughlin (1996) used a 200 day period prior to each event was used to form a benchmark using the Market and Risk Adjusted Returns model. The event period consisted of three days that started the day before the event. For Bromily and Marcus (1989) the event period started fifteen days before the event and ended ten days after. The days before were included due to the likelihood of a leakage of information or speculation before the official announcement. The event period was used to calculate the Cumulative Abnormal Returns (CAR) of each company.

Klassen & McLaughlin (1996) found a mean CAR of .82 percent, for positive environmental awards, which means that a company receives a bump in stock price by .82 percent (above its normal return and controlling for the general stock market during the event period). This mean increase is statistically significant at the 99 percent level. Klassen & McLaughlin (1996) also find interesting results for a negative environmental event (environmental crisis) with an average of negative 1.50% Cumulative Abnormal Return. This decrease is also significant at the 99 percent level. Both the .82% increase and 1.50% decrease are after Klassen & McLaughlin (1996) cleaned their sample by eliminating companies with other significant news stories during the event period. The mean CAR for positive and negative events before controlling for confounding events were .63 percent and -.81 percent respectively (Klassen & McLaughlin 1996).

Instead of looking at Cumulative Abnormal Returns, like Klassen & McLaughlin (1996), Bromily and Marcus (1989) looked at the abnormal return for each day during the event period. Their results present the average abnormal returns for each day during the event period. As expected the abnormal returns are significantly negative on the day of the news release and the day before. The average abnormal returns are negative .32 percent for both days, which is significant at the 90 percent level (Bromily & Marcus 1989). On the sixth day after the news release of the recall the average abnormal return is positive at .83 percent (Significant at 95 percent level). The reason for this increase is not clear but Bromily and Marcus (1989) discussed how it may be due to the overreaction of investors immediately following the event which leads to this adjustment about six days afterwards. Overall, Bromily and Marcus (1989) results are conflicting and do not paint a clear picture of the relationship between the stock market and automotive recalls.

	Total Abnormal Return	Green Rank	Green Score	Environ -mental Score	Green Policies Score	Reputation Score	Reputation Score Rank
Mean	-0.026	239.8	70.9	49.7	41.7	35.4	240.3
SD	0.026	147.2	10.6	29.2	18.4	14.2	147.5
Median	-0.025	235	71.1	49.4	40.2	33.4	230
Skewn-ess	0.397	0.10	-1.42	0.02	0.42	1.27	0.20

Table 1: 2009 Newsweek Green Ranking Summary Statistics

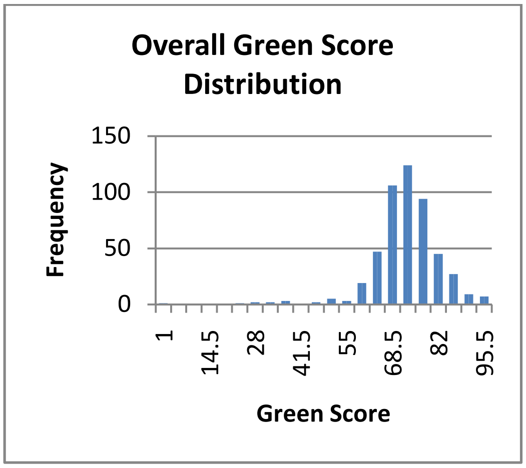

Figure 2: Green Score Histogram

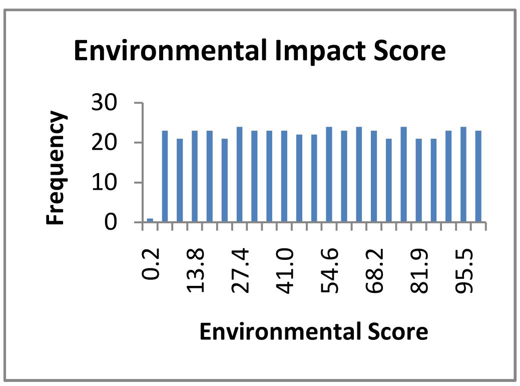

Figure 3: Environmental Score Histogram

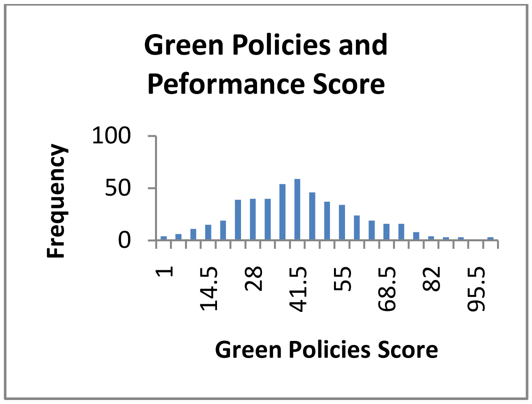

Figure 4: Green Policies and Performance Histogram

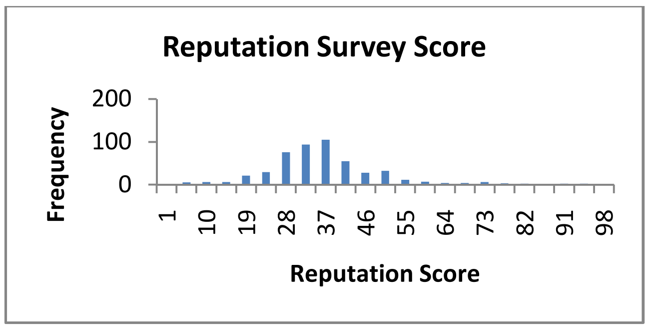

Figure 5: Reputation Score Histogram

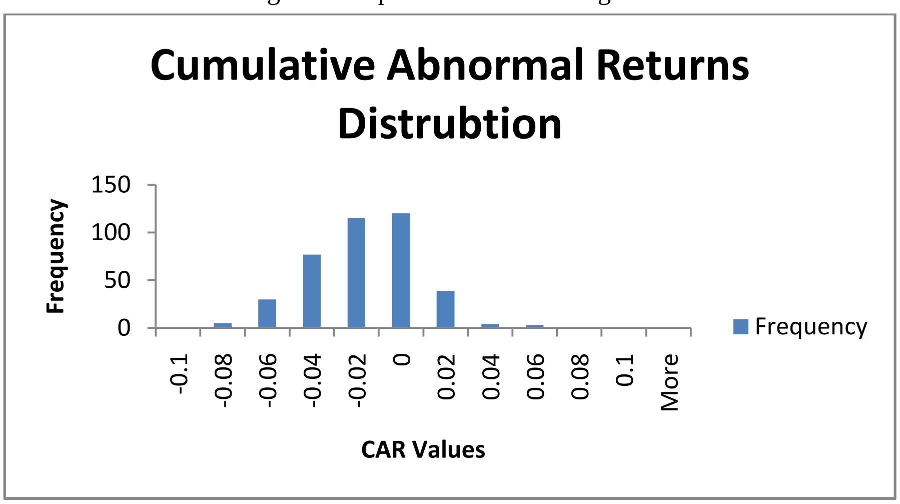

Figure 6: Cumulative Abnormal Returns Histogram

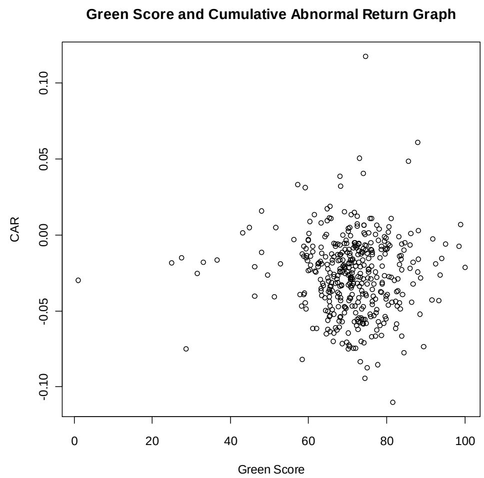

Figure 7: Scatter Plot Displaying Relationship of Regression 1.

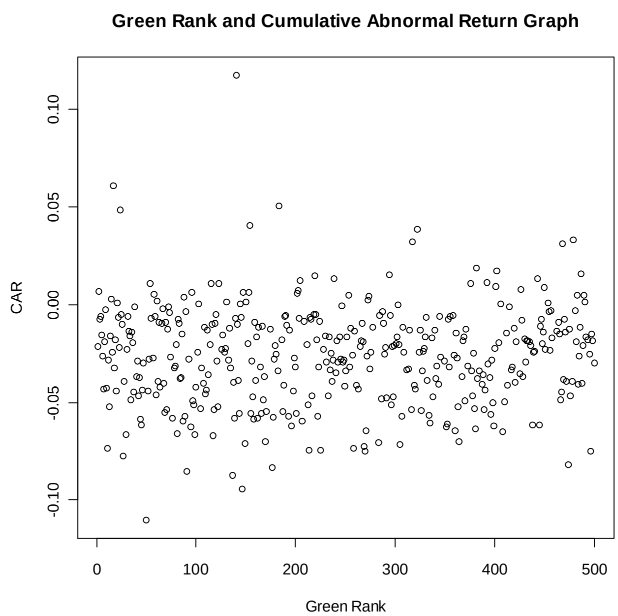

Figure 9: Scatter Plot Displaying Relationship of Regression 2.

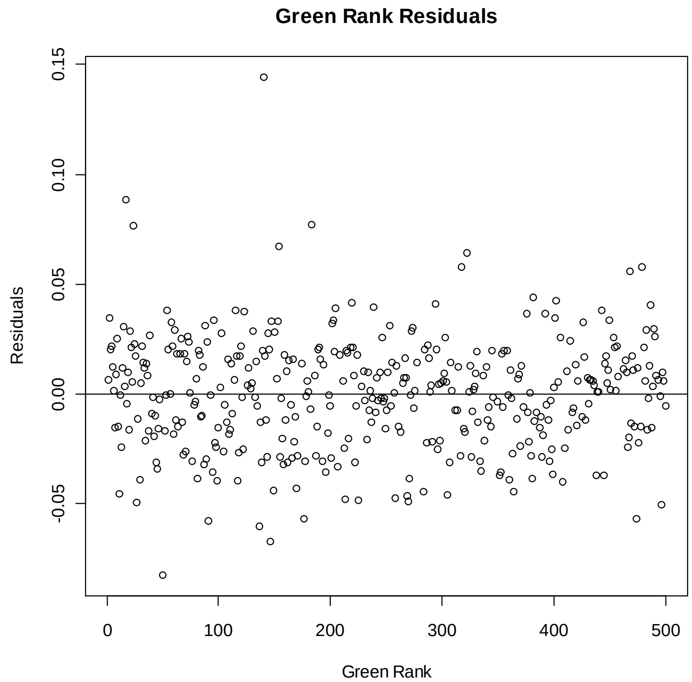

Figure 10: Residual Plot from Regression 2.

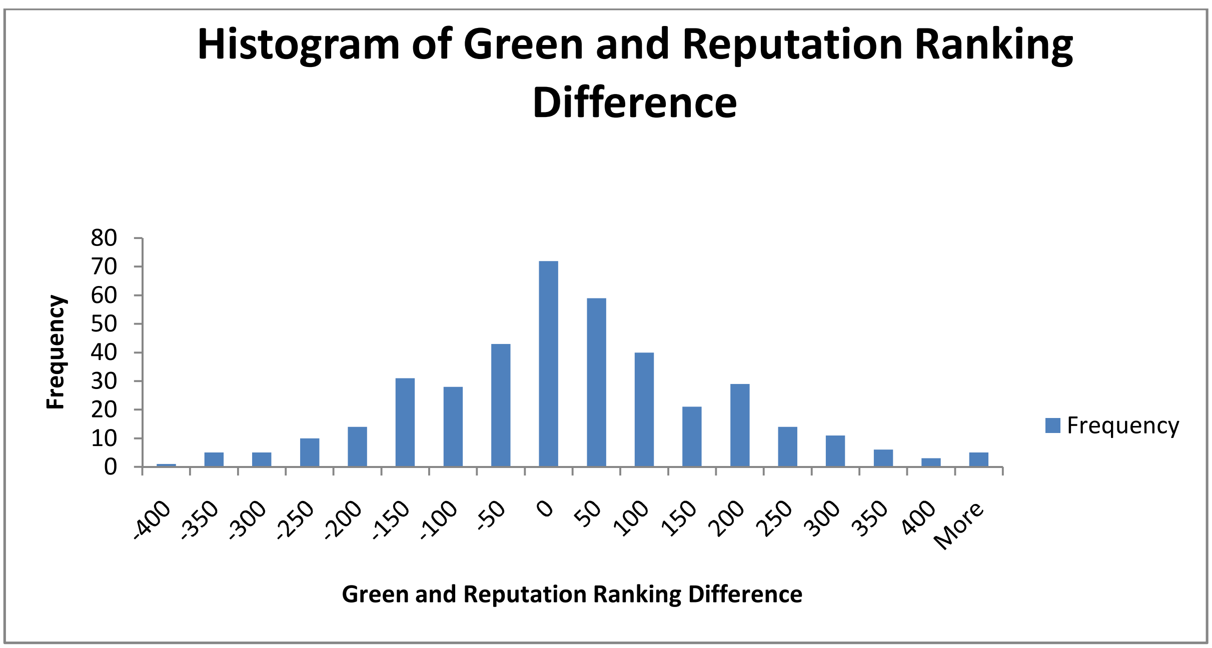

Figure 11: Green and Reputation Ranking Difference Histogram

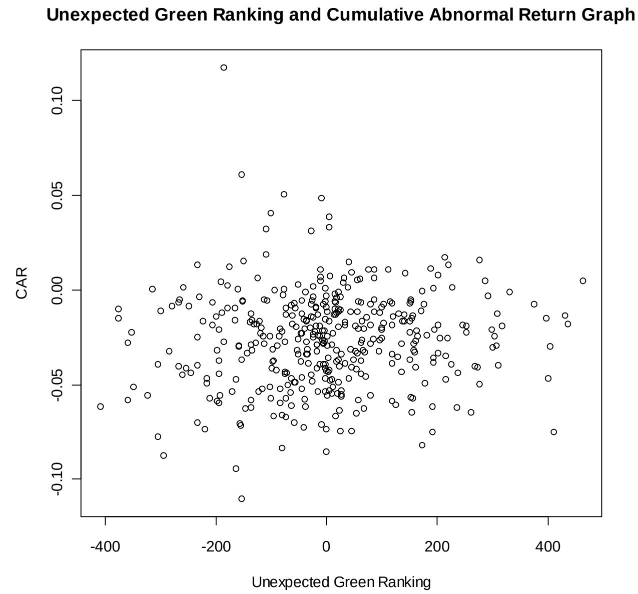

Figure 12: Scatter Plot Displaying Relationship of Regression 3.

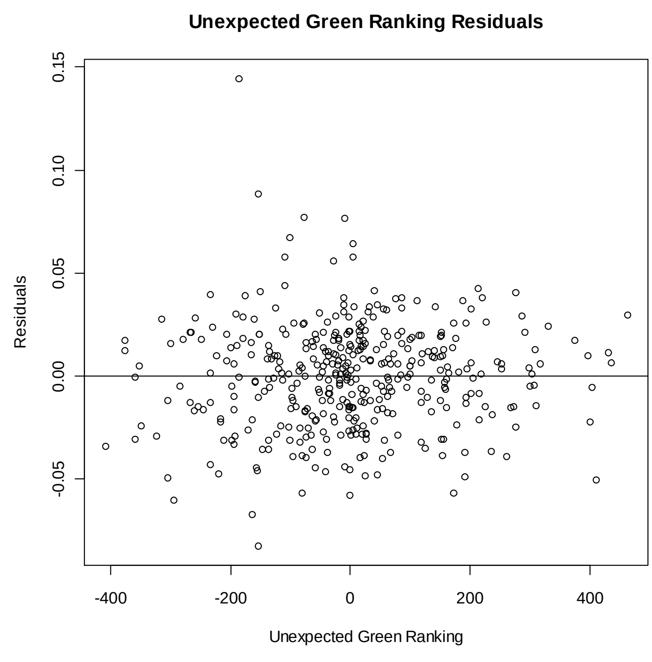

Figure 13: Residual Plot from Regression 3.

Regression Results without the AIG Outlier

	Coefficient	Standard Error	T-Statistic
Intercept	-.0214*	.008424	-2.550
Green Score	-.0000719	.0001174	-0.612
Intercept	-.02865**	.00237	-12.074
Green Ranking	.0000086	.0000084	1.021
Intercept	-.02658**	.001236	-21.504
Unexpected GR	.0000145*	.00000806	1.797

Table 5: Regressions 1-3 without Outlier

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