

Unravelling the ESG Conundrum: Using Regression Analysis to Assess the True Performance Reflected by ESG

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Abstract. This study mainly focuses on the financial performance of specific firms' stocks in relation to ESG performance. Economic performance is represented by its stock value and other financial standards, including return on asset (ROA). The ESG performance is represented by ESG scores from Eikon Refinitiv. A linear regression analysis was done on the database to explore their correlation, including all the S&P500 stocks from 126 industries. The statistical evidence shows a negative, weak relationship between the return on assets and ESG performance with the control variable of the natural log of net assets. Further analysis focuses on the individual's decision-making regarding investing. A linear regression testing the correlation of return rates based on different periods and ESG performance is done. The results show little relationship between the short-term return and ESG performance. This study implies that maintaining high ESG performance may result in higher costs, addressing the problem of whether individuals should care about the firm's ESG performance when investing their money in the stock market. Real investment situations can be more complex and more challenging to determine. Therefore, the result of this study can serve as a reference for individual investors.

Keywords: ESG scores, ESG performance, financial performance, investment, return on asset, short-term return.

1. Introduction

Environmental, social, and governmental (ESG) factors are becoming increasingly important when making an individual's investment decision. The concept of ESG arose in the fiftieth, and its crucialness started to emerge at the beginning of the twenty-first century [1]. People developed a set of considerations and standards to quantify a firm's performance based on corporate social sustainability, a specific evaluation that investors may consider during decision-making. Many businesses have a particular department for managing the ESG strategy and improving ESG performance. Also, the ESG performance disparity increases the effort put into green innovation and investment [2].

Some concerns and discussions may arise. People are worried about whether the ESG scores tell the whole picture of the business's actions, mainly its credibility. The most cared problem, in investors' view, is whether ESG scores can efficiently reflect how a company performs.

This paper will dig into these problems and determine the relationship between ESG scores and the financial performance of specific businesses. The method used throughout this paper is regression analysis, which will be discussed in detail in Methodology. The database used in this paper is the ESG score data of S&P500 stocks, and the financial performance of S&P500 stocks, including ROA, ROE, and returns, varies with time, which is extracted from Eikon. S&P 500, fully named standard and poor's 500, is an index that records the performance of the largest 500 businesses in the United States stock exchanges, including 126, the most representative stock in each industry [3].

2. Literature Review

Businesses significantly care for and promote ESG performance. Generally, businesses with higher ESG performance benefit from their reputation and public image, which is very useful in the long term. Thus, the impact of good ESG performance results in better growth in financial performance [4]. In some cases, in the long-term, ESG performance and other corporate social

responsibility-related performance are more important than purely financial matters. According to a previous study in central and Eastern Europe, environmental sustainability and consumer-based rules occupy many of the company's mission statements [5]. Several studies have explored the relationship between financial performance and ESG performance from different parts of the world, and the conclusions vary depending on region and time. In the short term, ESG performance is generally considered unrevealing to financial performance [6-8]. In the long term, some studies show that decent ESG performance will bring a jump in financial performance [6, 9, 10]. Past studies are done in different countries using data from other samples. Therefore, the results and conclusions may differ due to the inconsistency of global markets.

Studies have also shown an exciting point: the return on ESG-related investment is correlated with the stability of society and the economy. Studies show that the higher the degree of stability of the society and economy investors, the lower the degree of return from the ESG-related investment they would expect [11, 12]. Studies are mainly based on the effect of the COVID-19 pandemic, assuming societies and economies are unstable during the pandemic, which also implies that the current ESG-related investment will have less expected return.

On the other hand, studies have been done to test human behaviour and decision-making about investment choices toward ESG-related stocks. Though the high ESG performance attracts investors, it does not mean an immediate return [6]. Most studies believe that most investors consider ESG performance when investing [13-15]. At the same time, there are some contradictory opinions. Some may believe that human behaviour is not likely to be influenced by ESG performance, which includes estimating future stock prices and distributing money investment in different stocks [16]. The investor's decision is primarily based on personal preferences and emotions toward society. Therefore, the results and conclusions without specific quantitative evidence that could show one's choice are less relevant.

3. Methodology

3.1. Database

The data used in this study is extracted from Refinitiv Eikon, which includes the ESG combined scores, ESG pillar scores, net asset value, and financial performance, including return on asset, return on equity and return based on time. The targeted being chosen are "S&P 500 stocks", the most significant five hundred stocks listed on the stock change market. The incentive of choosing "S&P 500" is the credibility of both ESG and financial performance.

This study focuses on two points of view. One is to analyze a firm's profit-making ability using ROA as a quantitative standard.

The other is from the average investor's view, which uses the return rate based on time. In this scenario, the study assumes that investors bring a certain amount of money to the market and tries to determine the relationship between the return on the amount of money and ESG scores. Also, the study will assume that the average investor's behaviour explicitly considers a 1-yearly return rate. To elaborate, the analysis assumes that investors will check the return result of their former investment and refine their decision-making yearly.

3.2. Linear Regression Models

The linear regression model is a statistical tool to measure and analyze the relationship between one or more independent variables and one dependent variable. This model assumes that changes in independent variables will result in independent variable changes.

$$y = \beta_0 + \beta_1 x + \varepsilon_1 \quad (1)$$

Equation (1) is the formula of a simple linear regression. During the study process, more factors that may affect the result would be found and taken into consideration. To enhance the result, adding control variables is a perfect approach to make the result more reliable.

$$y = \beta_0 + \beta_1 x + \beta_2 w_1 + \varepsilon_2 \quad (2)$$

Equation (2) is the formula for adding one control variable.

$$y = \beta_0 + \beta_1 x + \beta_2 w_1 + \cdots \beta_\theta w_{\theta-1} + \varepsilon_3 \quad (3)$$

Equation (3) is the ultimate mathematical expression of linear regression with various control variables. Based on the equation (1), (2), and (3), we can conclude that $\varepsilon_1 > \varepsilon_2 > \varepsilon_3$, which means the more control variable is added to the model, the smaller the error term is. The study focuses on the correlation between ESG scores and financial performance, so it may only consider the net asset value as the control variable.

3.3. Variables

3.3.1. Independent Variables

The independent variable in this study is ESG scores, which third parties determine. ESG scores indicate how sustainable the business acts.

3.3.2. Dependent Variables

The dependent variables in this study are return on assets and return rate based on different times, as the study tries to determine how ESG performance can affect financial performance. Return on Asset is A Financial ratio that determines a business's ability to make a profit in relation to its total net asset value.

3.3.3. Control Variables

The control variables are variables held to be constant in the linear regression analysis, which is not of interest to the study's objective. Therefore, the correlation coefficient of the control variable does not affect the correlation prediction between the dependent and independent variables. The purpose of control variables is to eliminate the systematic error that may cause a problem in the outcome. In this study, the control variable is net asset value. Note that the net asset value is too huge to a percentage value of ROA and ESG scores. Therefore, the study uses the natural log value of net assets.

$$ROA = \beta_0 + \beta_1 ESG + \varepsilon_1 \quad (4)$$

$$Return Rate = \beta_0 + \beta_1 ESG + \varepsilon_1 \quad (5)$$

$$ROA = \beta_0 + \beta_1 ESG + \beta_2 \ln(Net\ asset) + \varepsilon_2 \quad (6)$$

$$Return Rate = \beta_0 + \beta_1 ESG + \beta_2 \ln(Net\ asset) + \varepsilon_2 \quad (7)$$

Equation (4) and Equation (5) are the original simple linear equations in this study. As shown in Equations (6) and Equation (7), these two equations are the primary equations with the control variable that will be used in this model. Note that $\varepsilon_2 < \varepsilon_1$.

4. Results

Table 1. Statistic Result – 1.

Dependent variable: Return on asset (ROA) Independent variable: ESG score	The correlation coefficient of independent variable	R^2
Control variable: None	-0.042935	0.0055
Control variable: Net asset value	-0.062651	0.0645

The study seeks to find out the relationship between ESG scores and the ability of specific stocks to earn profit. Therefore, return on asset (ROA) is the dependent variable, and ESG scores are the independent variable. However, Table 1 shows little relationship between them, indicated by a shallow correlation coefficient. Therefore, the simple linear regression analysis without a control

variable is invalid. Control variables, including net asset value, are added to the test to enhance and solidify the result. The result shows a negative, weak correlation coefficient with a value of around 0.0645 throughout the process. Note that the coefficient of correlation also has a minimal negative value.

Table 2. Statistic Result – 2.

Independent variable: ESG scores Control variable: None	The correlation coefficient of independent variable	R^2
Dependent variable		
Weekly return rate	0.02463	0.0081
Monthly return rate	-0.01456	0.0011
One-yearly return rate	-0.04825	0.0017
Two-yearly return rate	-0.31228	0.0074

Table 3. Statistic Result – 3.

Independent variable: ESG scores Control variable: Net asset value	The correlation coefficient of independent variable	R^2
Dependent variable:		
Weekly return rate	0.014173	0.0017
Monthly return rate	-0.005801	0.0024
One-yearly return rate	-0.061766	0.0013
Two-yearly return rate	-0.328751	0.0053

Referring to Table 2 above, the study uses four different return rates based on various time intervals: weekly, monthly, 1-yearly, and 2-yearly. Without any control variable, the result shows that the correlation coefficient between the return rate based on time and the ESG scores is very small, which means there is little correlation between them. Table 3 shows the result of the correlation coefficients with the control variables of the net asset value added. The result also shows no correlation between return rate and ESG performance.

To explore the return rate based on time and ESG scores, a 1-year total return rate is set to represent a typical investor's situation, which will be analyzed later.

5. Discussion

Current studies can predict several things, including financial performance based on ESG performance. Also, the analysis shows that short-term return is not influenced much by ESG performance, which conservatively implies that ESG performance should not be considered when making short-term investments.

However, the current study still has some limitations. First, the linear regression model has its limitations. The outliers significantly affect the performance and fitness of the line. In this data set, stocks like Moderna, NVIDIA, and Micro Technology Inc. have substantial returns on assets compared with most stocks. Moderna's return on asset is dropping to a very low value after the COVID-19 pandemic. With NIVDIA's newest graphic card technology, its return on assets increases significantly. Therefore, the deviation between the y-predicted and actual values is tremendous and substantially influences the linear model.

The dataset used in the study is S&P 500 stocks from Eikon Refinitiv, which is credible and authoritative but not representative and applicable to all markets. The S&P 500 stocks are all well-developed businesses with decent scale. Therefore, some theories that apply to this sample, such as the cost of improving ESG performance, may not apply to others. If the same linear regression analysis is done on the other sample, other factors or control variables should be considered carefully.

6. Conclusion

The study shows three phenomena based on the statistical results.

(1) There is a negative, weak correlation between return on assets and ESG performance.

(2) There is no correlation between the short-time return based on different times and the ESG performance.

(3) There is no correlation between the 1-yearly return of a specific stock and its ESG performance, which may influence investor's strategy.

Note that all the predictions and conclusions are drawn from the database of S&P 500 stocks. This may not apply to other samples if the same process is done.

From prediction 1, results imply that there may be a harmful and moderate correlation between the dependent and independent variables, which means an increasing ESG performance score will result in a decreasing return on assets. The reason for a declining return on assets with an increasing ESG performance could be higher costs implemented during the production process, higher costs to manage and treat employees better and higher costs for advertising the environmental-friendly image of the business. However, this may contradict some previous studies, in which people say a higher ESG performance will result in a higher financial performance. To clarify, this study only focuses on the short-term effects of ESG performance, which does not reveal any long-term predictions of economic performance. Plus, return on assets also has its limitations. Return on asset shows how effectively a business can generate profit from its average asset, which can be unstable. For example, a company may experience a large-scale acquisition, which may result in a lower or negative return on asset value. Therefore, the Net asset value and recent events of a business are significant factors that organization investors must consider during decision-making.

From prediction 2, from individual household investors' view, results imply no short-term correlation between the return rate based on different times and the ESG performance. Most previous studies and surveys confirmed that ESG performance is considered while investing. However, the short-term results do not show any reason investors should care about the ESG performance of a stock.

From prediction 3, the study assumes that an average household individual investor will check the return rate yearly and make further adjustments. The result shows no correlation between 1-yearly return and the ESG performance while considering other factors, including net asset value. Based on predictions two and three, the study can make recommendations that individual household investors do not need to care about the ESG performance of a stock if the primary purpose is to make money from the stock market. However, this simple prediction is not suitable for all situations. For investors with large sum of money wishing for long-term returns or acquiring shares of specific businesses, the situation is more complex and harder to be determined by this model.

Investors should look at the recent ESG events on the intended business they are about to invest in, even though investors do not care about the ESG performance. An improper ESG-related action conducted by a company, which may cause public outrage, will strongly influence the financial return of its stock in the short term.

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