Evaluating the Impact of ESG on Financial Performance

DUKE
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Executive Summary

Our object of interest is the treatment effect; impact of ESG scores on financial performance.

- Utilizing a robust data from S&P 500, ESG scores from the Wharton database, our study leverages statistical methods, OLS regression, matching, and fixed effect models, to explore the intricate relationship between ESG practices and financial outcomes.

- Preliminary findings highlight the complexity of the ESG-financial performance link, suggesting sector-specific impacts and the importance of sustainable practices for long-term success and competitive advantage.

Introduction & Motivation

- With the increasing relevance of Environmental, Social and Governance (ESG) criteria, this analysis explores its impact on financial performance.

- Sustainable practices are recognized as vital for long-term success, capable of improving risk management, talent attraction, and uncovering new opportunities.

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Literature Review

- Academic investigations into this relationship have yielded mixed outcomes. Several studies assert a positive correlation, suggesting that strong ESG practices contribute to better financial performance by mitigating risks and unlocking new opportunities (Friede, Busch, & Basses, 2015).

- These studies often employ a variety of statistical methods to analyze the data. However, other research highlights the nuanced and sometimes sector-specific nature of ESG-financial performance links, suggesting the need for more sophisticated analytical approaches. (Khan, Serafeim, & Yoon, 2016)

- Furthermore, Industry reports firms and ESG rating agencies generally advocate for integrating ESG factors into investment analysis, positing that ESG engagement indicates a company's long-term viability & profitability.

Methodology

OLS Regression

We aim to establish a baseline relationship between ESG scores and financial performance metrics by employing OLS regression, controlling for various confounding factors. This technique quantifies the linear association between ESG engagement and economic outcomes, providing a clear starting point for our analysis.

Matching Methods

We implement matching methods to address potential biases arising from non-random assignment of ESG practices across companies. This approach enables us to compare companies with similar characteristics but differing levels of ESG engagement, thus isolating the effect of ESG criteria on financial performance more accurately. This technique helps to mitigate selection bias, enhancing the credibility of our findings.

Fixed Effects

Recognizing the importance of unobserved heterogeneity, using Fixed Effects models allows us to control for time-invariant characteristics that could influence ESG engagement and financial performance. This method is precious for examining how changes in ESG performance over time within the same company relate to changes in economic outcomes, providing insights into the dynamic nature of the relationship.

Differentiation in Approach

Our methodology stands out from previous research by combining these three robust statistical techniques, each addressing different aspects of the causal question. While many studies rely on a single method, our multi-method approach enables a more thorough exploration of the ESG financial performance nexus. This strategy allows for:

Greater Precision

By using matching methods, we improve the precision of our estimates by ensuring that the comparison groups are well-balanced in terms of observed covariates.

Causality Inference

Combining OLS regression with Fixed Effects models facilitates a more nuanced understanding of causality, distinguishing between cross-sectional and within-entity variations.

Addressing Bias

Through these methodologies, we aim to manage and reduce potential biases, such as omitted variables and selection bias, which are common challenges in ESG research.

Data Description

The project utilizes a combination of datasets to analyze the impact of Environmental, Social, and Governance (ESG) risk ratings on stock performance within the S&P 500 index. The primary datasets include:

S&P 500 Stock Data: This dataset provides comprehensive information on the companies listed in the S&P 500, encompassing stock prices, financial metrics, and other relevant attributes. It serves as the foundation for evaluating stock performance across the index.

S&P 500 ESG Risk Ratings: Complementing the stock data, the ESG risk ratings dataset offers insights into the sustainability and ethical impact scores of the S&P 500 companies. These ratings are pivotal in assessing the relationship between corporate responsibility practices and their financial outcomes.

Wharton Database via WRDS: An additional data layer was sourced from the Wharton Research Data Services (WRDS) platform, providing time-related ESG information. This dataset enriches the analysis by offering a broader range of variables for examination.

Executive Summary of Data Analysis

Key variables include stock symbols, sector and industry classifications, employee numbers, detailed ESG scores encompassing overall, environmental, social, and governance aspects, controversy levels, risk percentiles and levels, and essential financial indicators such as stock price, volume, market capitalization, EBITDA, and revenue growth.

Sectors and Industries: Spanning a wide array of sectors, including Technology, Healthcare, and Industrials, the dataset mirrors the S&P 500's broad composition, facilitating sector-specific ESG impact analyses.

ESG Scores: Displaying substantial variability, ESG scores indicate a broad spectrum of corporate sustainability practices, with preliminary analyses suggesting potentially higher ESG scores on average within the Technology and Healthcare sectors.

Financial Metrics: Financial metrics reveal a diverse distribution in market capitalization and stock prices, reflecting the varied sizes and economic health of S&P 500 companies.

# Executive Summary of Data Analysis

ESG Score Analysis

- Distribution: Analysis of ESG scores' distribution suggests varying degrees of commitment towards sustainability and governance across companies.
- Sector Comparison: Early observations point to variances in average ESG scores between sectors, hinting at sector-specific challenges or advantages in achieving high ESG standards.

Financial Performance Analysis

- Correlation with ESG Scores: Preliminary visual analyses hint at a positive correlation between higher ESG scores and specific financial performance metrics, such as market capitalization and EBITDA.
- Risk Level Impact: Initial findings suggest that companies with lower risk levels, potentially indicated by higher ESG scores, may exhibit more stable or favorable financial metrics.

Visual Analysis

Log ESG Score vs. Log Stock Price
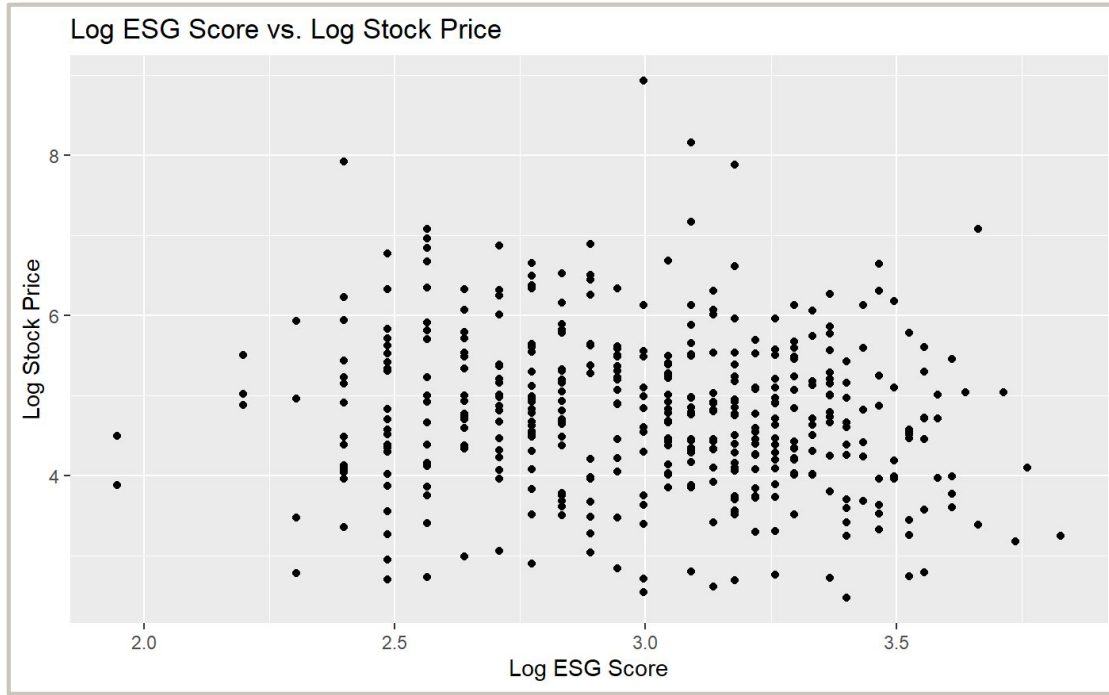
The dispersion of data points across different sectors suggests a variable influence of ESG scores on stock prices. This indicates the need for sector-specific analysis in understanding the ESG-stock price relationship.

Visual Analysis

Log ESG Score vs. Log Market Cap
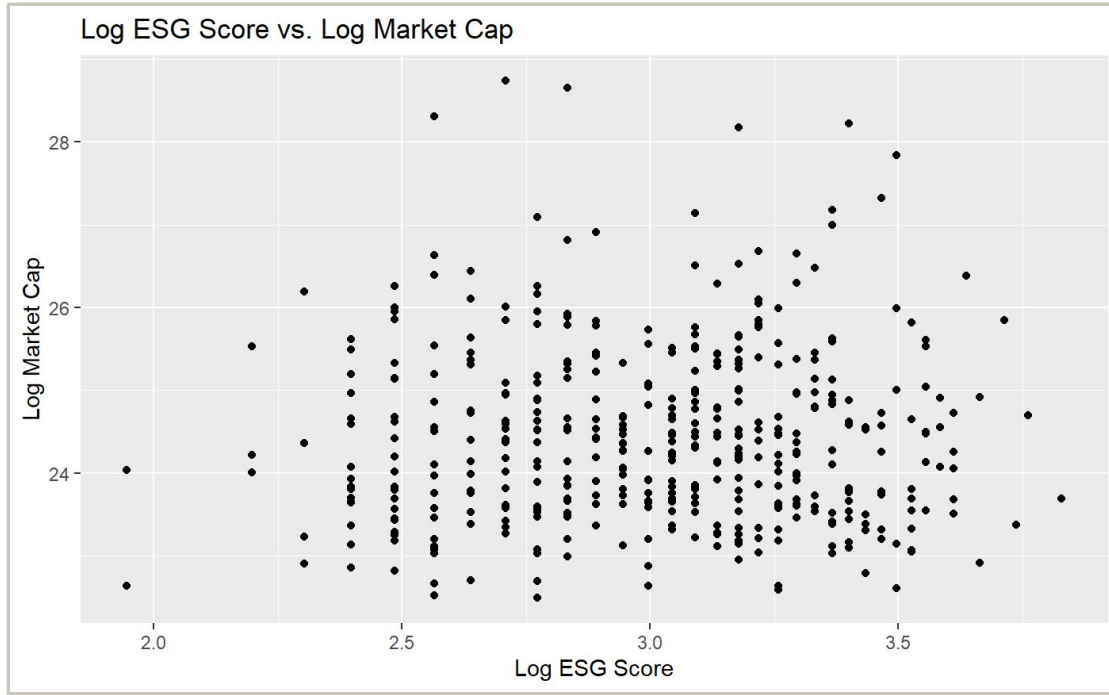
The wide scatter of points implies that the relationship between ESG scores and market capitalization may not be captured by a simple linear model.

Visual Analysis

Log ESG Score vs. Log EBITDA
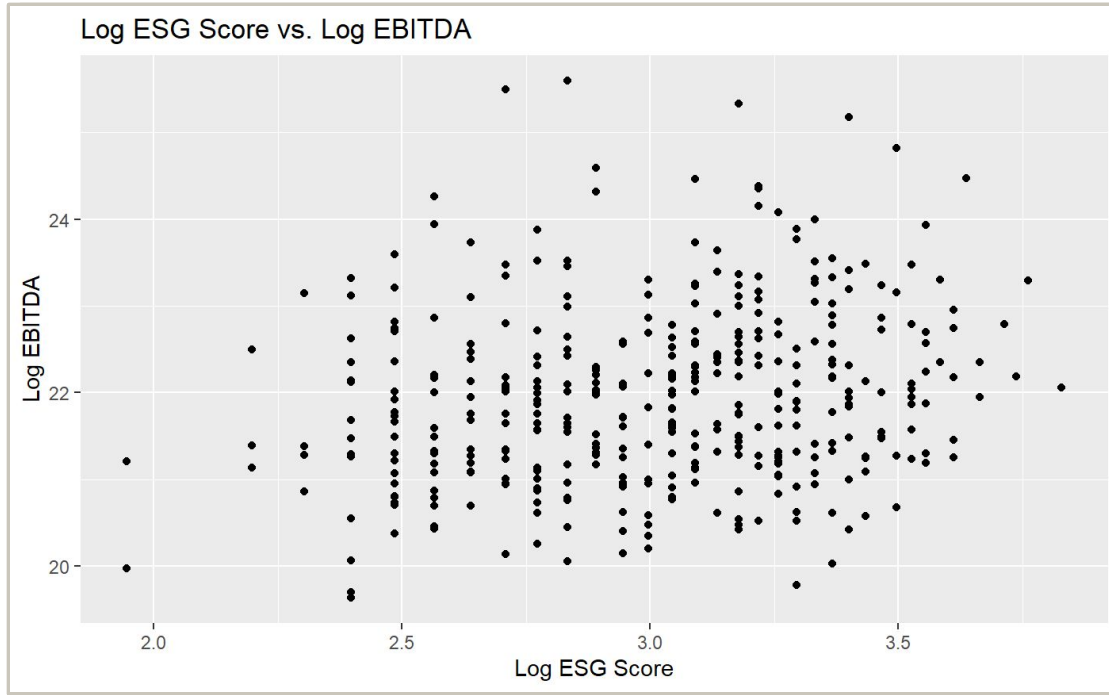
The lack of a discernible trend in this plot indicates a complex or non-linear relationship between ESG scores and EBITDA.

Key Insights OLS Regression Analysis

The linear regression model presents an attempt to quantify the relationship between ESG scores and stock prices, adjusting for sectors and other variables. However, the key takeaways include:

- **Low R-squared Value:** The model explains a small fraction of the variance in stock prices, indicating that ESG scores and the included variables do not strongly predict stock price movements.

- **Statistical Significance:** Most variables, including ESG score interactions with sectors, do not show a statistically significant relationship with stock prices. This calls into question the predictive power of ESG scores in the context of this model.

- **Sectoral Influence:** The inclusion of sector interaction terms suggests varying impacts of ESG scores across sectors, though these were not statistically significant in the model.

Matching

Method

Previous study by Darren et al. (2013) examines stock performance by comparing high and low-ranked corporate social performance. They decide that, high-ranked (low-ranked) CSP portfolio represents those firms with ESG scores above (below) the median. Our study follows a similar grouping method: companies with ESG scores above median as high-ranked ESG (more emphasis on sustainability) and below median as low-ranked ESG.

For the matching process, we implement "matchit" with *ESG score* on *Sector, employee number, Volume*, and *market capital* using the "full" method.

As result, we generate 209 matches, leaving 13 companies in control group unmatched.

Matching

Assessment: How balanced was our matches?
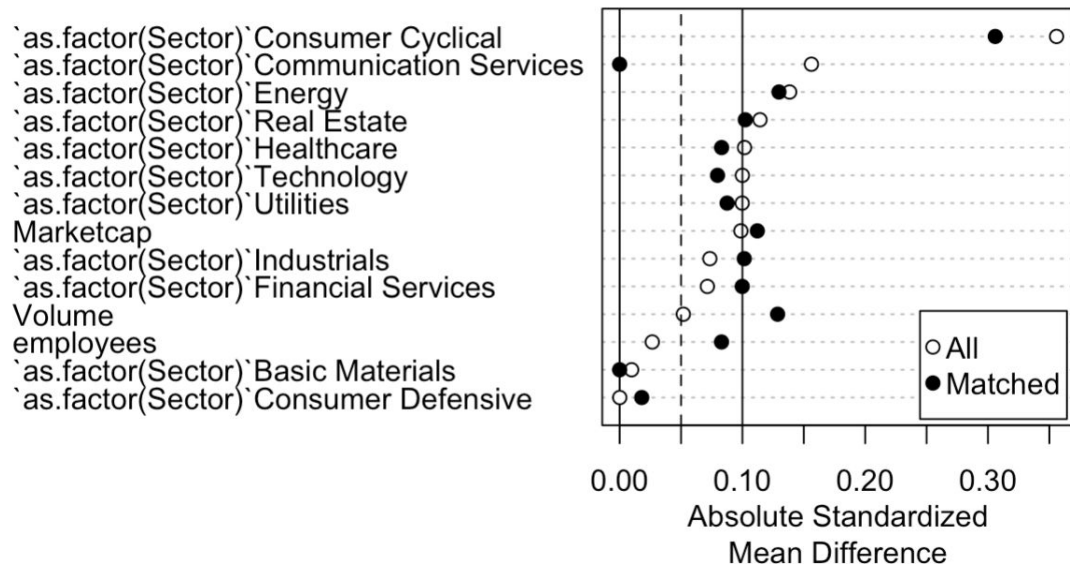
- The results for **Std Mean Diff Plot** shows that most of the covariates seem reasonably well-balanced, though companies in consumer cyclical might raise small concerns, which we should be cautious about implementing the results in such sectors.

- Assessment through **QQ plots** and **density plots** (Appendix) also imply covariate balance.

Matching

Results

All the p-value were ***, thus all TE were statistically significant.

Results show that ESG scores have a negative impact on stock prices.

TE summarization

	PotOutlow <dbl>	PotOutWhigh <dbl>	TE <dbl>	TE2.5CI <dbl>	TE97.5CI <dbl>
Treated	184.1097	164.5022	−19.60746	−65.57185	26.35693
Control	166.8285	197.8784	−31.04989	−90.53764	28.43786
All	166.8285	197.8784	−31.04989	−90.53760	28.43782

However, this model is rough as it differs only by median, and does not account for time change and other economical impacts. Thus, we further implement fixed effect model.

Fixed Effects

Method

We tried three models with fixed effects:

- ● Company FE
- ● Company and Time FE
- ● Volume Weighting

All F-statistic was significant, thus fixed effect was needed.. Given R-squared, residual sum of squares, we decide that Company and Time FE was the best model for exploring our question.

we used stock_price and log(stock_price) as outcome variable. log(stock_price) performs as a better model.

Fixed Effects

Results

Increasing 1 unit in ESG score increased stock price by 0.0000024.

While it may seem small in absolute terms, the p-value is *** thus this result was significant.

This model with company and time FE implies that making efforts to increase ESG score could have positive effects on financial performance. However, the increase might not be large.

```
Residuals:
      Min.     1st Qu.     Median      3rd Qu.       Max.
-3.0992707  -0.1448881   0.0068623    0.1470680   1.5866914

Coefficients:
             Estimate Std. Error t-value  Pr(>|t|)
scorevalue 0.00154871 0.00040789  3.7969 0.0001485 ***
---
Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Total Sum of Squares:      378.29
Residual Sum of Squares: 377.07
R-Squared:       0.0032343
Adj. R-Squared: -0.10961
F-statistic: 14.4165 on 1 and 4443 DF, p-value: 0.00014847
```

Tentative Results

- While the current estimate causal relationship might not seem significant, we require further robust analysis before making concrete conclusions.

- Further analysis would require a richer dataset with ESG scores over time and more data to help us model a company's stock price, additionally, to eliminate the OVB (Omitted Variable Bias).

References

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