ECONOMICS 620

Allegheny College

Meadville, Pennsylvania 16335

Investigating an Asset Pricing Model with Environmental, Social, and Governance Factors



Richard J. Swanson

April 8, 2024

Investigating an Asset Pricing Model with Environmental, Social, and Governance Factors

by

Richard J. Swanson

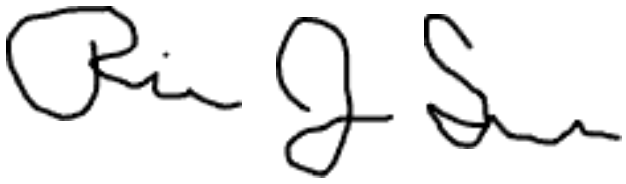
Submitted to The Department of Business and Economics

Project Advisor: Dr. Timothy Bianco

Second Reader: Dr. Francisco Navarro-Sanchez

Date: April 8, 2024

I hereby recognize and pledge to fulfill my responsibilities as defined in the Honor Code and to maintain the integrity of both myself and the College as a whole.



Richard J. Swanson

Acknowledgments

I would like to express my appreciation to everyone who helped me complete this paper. I want to thank the wonderful people in the Center for Business and Economics at Allegheny College for being a great home for four years. There, I found my passion and developed it into a skillset that I will carry with me for the rest of my career. I'd like to thank my first and second readers, Dr. Tim Bianco and Dr. Francisco Navarro-Sanchez. I would also like to thank Dr. Bianco for three great years as an academic advisor (and golf club advisor).

Lastly, I would like to thank my family—my parents, Shelley and Rick, and my sister, Emma. Many thanks also go to my girlfriend, Liv, for being my family while I am away from home. Lastly, thanks to my Delta Tau Delta brothers for being some of the best professional colleagues and friends I could have possibly imagined.

Table of Contents

Acknowledgements …….. iii

List of Tables …….. v

List of Figures ……... vi

Abstract …… vii

Chapter 1: Introduction …….. 1

Chapter 2: Literature Review ……. 3

Section 1: Asset Pricing Models …… 4

Section 2: Application of Asset Pricing Models to ESG Investing ……... 6

Section 3: Women's Leadership and Financial Performance …….. 10

Chapter 3: Data …… 13

Section 1: The Model ……. 13

Section 2: Obtaining the Data …….. 17

Section 3: Understanding the Data …….. 17

Section 4: Descriptive Statistics …….. 18

Chapter 4: Analysis …….. 23

Chapter 5: Conclusion …….. 26

Chapter 6: Appendix …… 28

Bibliography …… 31

About the Author ……. 36

List of Tables

Table 3.1 14

Table 3.2 18

Table 4.1 23

List of Figures

Figure 2.1 4
Figure 2.2 5
Figure 2.3 5
Figure 3.1 13
Figure 3.2 15
Figure 3.3 19
Figure 3.4 19
Figure 3.5 20
Figure 3.6 21
Figure 3.7 22
Figure 3.8 22

Abstract

Considering companies' environmental, social, and governance (ESG) factors has proven to be an effective method for investing for both intrinsic benefit and financial performance. However, research still has not concluded the exact relationship between ESG factors and a company's economic performance. This paper furthers the research in the ESG investing space by quantifying how the relationship between ESG variables connects to industry. The study centers around stocks held in the Vanguard ESG US Stock ETF, one of the most widely used ESG ETFs in the United States. An ETF is a bundle of securities sold in shares on a stock exchange. This study measures ten stocks each for two industries: technology and consumer staples. Bloomberg ranks greenhouse gas emissions as a top priority for the technology sector and a somewhat low priority for consumer staples, so this data is collected on each company to compare any differences in financial performance based on industry. An additional variable, gender diversity on the firm's board of directors, is included to see its impact on stock returns. The data is run through a series of regressions using Fama and French's five-factor model with the two additional ESG variables. The results for the two ESG variables are mixed. There is little relationship between greenhouse gas emissions and excess stock returns, but there is promising evidence for women on the board of directors and financial performance.

Chapter 1: Introduction

In 2004, the United Nations Global Impact issued a report titled “Who Cares Wins,” endorsed by 18 global financial institutions with over $6 trillion in assets under management (UNEPFI). It contains recommendations for financial firms to include Environmental, Social, and Governance (ESG) issues in investment analysis. It is the first time ESG is officially mentioned and precisely defined. Twenty years later, ESG remains as relevant and mainstream as ever. With more firms now including ESG components in their financial performance, investors now use these factors in their valuations of companies. It is a standard way for investors to quantify a firm’s level of social responsibility.

In 2015, Volkswagen installed devices on 11 million vehicles designed to cheat on emissions tests (MSCI). Traditional value models could not capture the full scope of this scandal's impact. However, several ESG indices downgraded Volkswagen’s governance practices before the scandal became public (MSCI). Had investors placed a heavier emphasis on ESG factors, they could likely have caught this. This example highlights the need for investors to consider ESG investment factors.

Fundamentally, ESG investing can be beneficial to investors. Kotsantonis demonstrated in their piece that companies that consider environmental and social issues experience economic benefits (Kotsantonis et al., 2016). There is a misperception that returns will be under the market average. However, companies have found ways to create value through environmental efforts that have resulted in cost savings, like reducing waste. From a risk management perspective, ESG initiatives make a company more compliant with regulators. It will also boost a company’s brand and image (Kotsantonis et al., 2016). When a company is known for doing “good,”

customers will become more loyal to the brand, and there will be a higher demand to work for the company. Moreover, when a company can impress investors with these actions, it can lead to better P/E ratios (Kotsantonis et al., 2016). However, while the academic literature surrounding ESG grows, some questions remain unanswered.

A common way for investors to value a company's level of social responsibility is by considering a company's ESG score. Rating providers issue scores based on assessing the firm's environmental, social, and governance practices. However, investors should be cautious, as this market area is not regulated. Earlier this year, investment firm MSCI announced revisions to its fund ESG score methodology, bringing ESG downgrades to over 31,000 ESG funds (Ilango, 2023). Such a large-scale change with no regulator scrutiny indicates a much larger problem with the ESG rating system. Much of the ESG scores depend on disclosure, but no governing body over ESG does not pressure companies to disclose more ESG information (Lyons, 2022). This makes defining the relationship between ESG companies and return on investment difficult. The academic literature surrounding this topic continues to grow, but some questions still need to be answered.

This paper addresses questions surrounding ESG scores and rating methodology ambiguity by testing ESG factors by industry. Bloomberg, one of the largest ESG rating providers, provides a framework for weighing an ESG issue priority for each industry. Greenhouse gas emissions are ranked differently among the technology and consumer staples sectors. Ten total panel regressions are run on ten stocks from each industry to determine if there are differences in financial performance for firms that prioritize an ESG issue versus ones that do not. An additional variable that measures gender diversity is also in the regression. The results

from the panel regressions have implications for women on the board of directors and financial performance but less for greenhouse gas emissions.

Chapter 2: Literature Review

Section 1: Asset Pricing Models

Harry Markowitz's modern portfolio theory laid the foundation for modern finance models. When constructing investment portfolios, Markowitz demonstrated that asset diversification reduces risk while retaining potential returns (Womack & Zhang, 2003).

One of the most important models is the Capital Asset Pricing Model developed by William Sharpe and John Litner in the 1960s. CAPM builds off of the relationship of risk and return characterized by Markowitz. It describes the expected return of an asset ($E(R_i)$ is the result of the sum of the risk-free rate of return (R_f), plus a risk premium [β_i ($E(R_m)$ - R_f)] (Fama & French, 2004). The risk premium is the expected return of the market (R_m) subtracted by the risk-free rate of return (R_f) and multiplied by beta (β_i) (Fama & French, 2004). Beta measures the investment's risk compared to systemic or overall stock market risk. If beta is one, it is as risky as the market; if beta is less than one, it is more conservative; and if it is more than one, riskier than the market. A riskier asset produces a higher expected return. *Figure 2.1* shows the CAPM (Womack & Zhang, 2003).

$$E(R_i) = R_f + \beta_i (E(R_m) - R_f) \quad (2.1)$$

The model assumes that investors are risk-averse. Additionally, the model assumes that there is only one risk factor, market risk, which is unavoidable even with diversification (Womack & Zhang, 2003). Therefore, an investor with the beta of their investment can calculate the asset's expected return. The main shortcoming of CAPM is that it only uses one risk factor. Fama and French challenge the model's reliance on beta; they reason that more factors determine the expected return on an asset than simply aggregate risk (Womack & Zhang, 2003).

So, Fama and French supplemented the CAPM by including two additional variables. From their research, Fama and French concluded that size and value risks are the two most important factors outside of market risk (2014). Size risk, called "Small Minus Big," is the excess returns investors earn for investing in companies with a small market capitalization (Womack & Zhang, 2003). It is calculated as the average return of 30% of the smallest stocks in the market minus the average return of 30% of the largest stocks in the market for each month. A negative SMB factor indicates that larger companies outperformed smaller ones in a given month (Womack & Zhang, 2003). Smaller companies should be more sensitive to risk due to their size. Value risk, called "High Minus Low," is the excess returns investors earn for investing in companies with high book-to-market (B/M) values. HML is calculated as the average return of the top half of companies with the highest B/M ratio minus the average return of companies with the lowest B/M ratio for each month (Womack & Zhang, 2003). Firms with higher B/M ratios should produce higher returns; the ratio could be high because the market value is low. This typically occurs when firms are in financial distress and, therefore, a more risky investment.

$$E(R_i) = R_f + \boldsymbol{\beta}_i (E(R_m) - R_f) + SMB_i + HML_i + e_{it}$$

(2.2)

Figure 2.2 shows the three-factor model. The SMB and HML are added to the end of the regression to the rest of the original CAPM. The three-factor model increases the model's ability to predict actual returns by adding two factors. Researchers have demonstrated that the explanatory power of the three factors is much superior to that of CAPM.

However, Fama and French even acknowledge that their model cannot fully explain specific patterns in the market (Womack & Zhang, 2003). They return to their own model, adding another two variables (*Figure 2.3*). They use evidence from other studies that prove their three-factor model needs adding factors related to profitability and investment (Fama & French, 2014). Profitability is denoted as RMW, measured as the returns of diversified stock portfolios with robust operating profitability minus those of diversified stock portfolios with weak operating profitability (Fama & French, 2014). Weak profitability also produces more risk in the investment, making expected returns higher. Investment is the level of capital reinvested back into the company—the difference between diversified stock portfolios of low and high investment in firms. High-investment firms are more likely to overinvest, which decreases their value when the return on invested capital is less than the weighted average cost of capital. After testing, the model has proven to produce better results than the three-factor model (Fama & French, 2014).

$$E(R_i) = R_f + \boldsymbol{\beta}_i (E(R_m) - R_f) + SMB_i + HML_i + RMW_i + CMA_i + e_{it}$$

(2.3)

Section 2: Application of Asset Pricing Models to ESG Investing

Researchers have applied Fama and French's framework to the ESG investing space to define the relationship between excess returns and ESG factors. Naffa and Fain (2022) used the five-factor model, along with an extra ESG factor for each pillar, to evaluate investments. This study will include ESG factors in the model but slightly differently.

Previous research has shown that a company's financial performance depends on its ESG score, but Halbritter and Dorfleitner (2015) investigate this concept further. They compare a firm's corporate financial performance (CFP) and corporate social performance (CSP). The CSP measures ESG criteria through three ESG rating providers: ASSET4 (part of Thomson Reuters) and Bloomberg. Their dataset includes over 1000 companies and ranges from 1991-2012. One of the most common methods for examining the relationship between ESG and returns is constructing ESG portfolios. Halbritter and Dorfleitner (2015) create two ESG portfolios, one containing the best 20% ESG companies and the worst 20% ESG companies. They regress the portfolios using factors from the Carhart Four Factor Model (Market Risk, Size, Value, Momentum). Additionally, they run a different test, instead using two cross-sectional regression models. Their results find that the high portfolio generated a positive alpha and was generally in line with the market, while the low portfolio slightly underperforms compared to the market (Halbritter & Dorfleitner, 2015). The test shows that ESG ratings are weak in influencing a company's financial performance. The ESG portfolios do not show a significant return difference between companies with high and low ESG scores. This paper leaves inconclusive results on the relationship and prompts further research.

The following year, Auer and Schuhmacher analyze new data over eight years by constructing industry portfolios based on what firms produce; the sectors are capital (cars,

machinery), consumption (food, retail, media), financial (banks, real estate, insurance), and miscellaneous (pharmaceuticals, chemicals, commodities). Sixty portfolios are organized by ESG scores, industry, and part of the world (US, Asia-Pacific, Europe). Analyzing the portfolios' performance in time series, the authors were able to find that in 15 of the 60 cases, the high-ESG portfolios showed higher Sharpe ratios than respective benchmarks, whereas, in 34 of the 60 cases, the low-ESG portfolios showed higher Sharpe ratios than their benchmarks (Auer & Schuhmacher, 2016). A few high-ESG portfolios outperformed in the United States, but no high-ESG portfolios outperformed their benchmarks in Europe.

Kumar also studied ESG investment and its relationship to returns and had better results (Kumar et al., 2016). Using a new quantitative model in their approach, there is substantial evidence of the link between ESG and risk-adjusted returns. They use the Dow Jones Sustainability Index to identify 157 companies with the best-in-class ESG performance grouped into 12 industries. That sample of stocks compares to 809 stocks that mimic average returns and are not listed on the DJSI. They consider the short-term performance indicators of the stock, weekly returns, and volatility. Their results show that conventional thinking of low risk equaling low return in the context of ESG may not be as accurate as previously thought (Kumar et al., 2016). Instead, the Risk-Premium model used in this study "uncovers hidden value" in ESG investments. In automobiles, durables, and banking, ESG stocks were less volatile at 20.12%, 24.54%, and 37.83%, respectively (Kumar et al., 2016). High ESG stocks exhibited a higher Treynor ratio or risk-adjusted performance. Therefore, ESG factors bring lower volatility and risk but higher risk-adjusted returns.

Investors seeking only profit would not be interested in ESG investments. However, for investors who seek *value* in their investments, ESG proves to be a considerable choice. Wimmer

analyzes the persistence of ESG scores in socially responsible mutual funds (2012). Using ESG data from ASSET4, Wimmer ranks four mutual funds based on the ESG scores of the individual companies in the funds. In total, he is tracking 274 components of the mutual funds to determine the persistence of ESG scores (Wimmer, 2012). He finds that ESG mutual funds will see decreases in average ESG scores over time for two reasons (Wimmer, 2012). First, fund managers could replace securities over time, and second, companies could make changes that negatively affect their scores. For investors interested in socially responsible investing, Wimmer recommends closely monitoring ESG holdings to ensure that the assets still have a high level of social responsibility (2012).

To further understand ESG in the investing space, we turn to Bradford Cornell's attempt to define ESG's relationship with returns more clearly through the lens of investor preferences and risk (2020). He analyzes a model that proves the expected return on investment equals the discount rate. The discount rate calculates the future value of money in the present day's dollars. When investors are interested in ESG stocks because of their social benefit (doing good for society), they may be willing to invest in ESG securities, even if they have a lower rate of return. Conversely, Cornell also examines what he calls "sin stocks" (gambling, alcohol, and tobacco)(2020). These stocks will have a higher expected return because of the reputational cost of owning that investment. For example, many institutions do not invest in these stocks because they do not want to be associated with companies that people consider bad for society. With both of these analyses, Cornell concluded that high investor preferences lower the discount rate, and that will raise value relative to companies with lower ESG scores (2020).

Next, Cornell looks at ESG through risk. There are direct risks associated with ESG that could influence its expected returns. For example, new government regulation could be risky for

fossil fuel companies, but renewable energy (ESG) companies would hedge that risk. Cornell uses the Ross Arbitrage model to reason for ESG's association with risk (2020). This model has two specifications: the risk factor has to be systematic, making it still a risk factor even to investors with a highly diversified portfolio, and the risk must have a risk premium, an excess return of the risk-free rate to compensate for taking on extra risk. Cornell connects this theory with another study conducted by Lioui (2018), which is directly related to ESG (2020). It called for stocks to be divided into portfolios based on high and low ESG scores. The portfolio with high ESG scores does well in bad ESG-related times and relatively worse in regular times. Therefore, the high ESG-score portfolio acted as a hedge against risks associated with climate change. However, Cornell argues that ESG risks are possibly mispriced and cannot be used to identify "superior" investments. To him, the jury is still out on whether there is an ESG risk factor (Cornell, 2020).

Cerqueti et al. tested risk further to determine whether ESG hedge risk in times of volatility in the market (2020). Using assets in the portfolios of equity mutual funds characterized by different ESG ranks, the authors measured their quarterly performance from March 2016 to June 2018. Their studies showed that in periods of low volatility in the market, the high-ESG portfolios lost less of their value than the low-ESG portfolios (Cerqueti et al., 2020). In times of high volatility, the results could have clarified which ESG class portfolio kept more of its value.

Perhaps the most critical evidence for this study was the research done by Moinak Maiti (2021). Maiti builds a portfolio of 426 companies from the STOXX Europe 600 index. The portfolio is regressed using six nuanced asset pricing models, all of which are derived in some

way from the Five Factor model. All models included the ESG total score and the score of each pillar as factors. Maiti found that there is statistical significance at a 5% confidence level.

This study lays the most crucial foundation for this paper. There is potential for including ESG risk factors in an asset pricing model. The study focuses on European stocks, while this study will only use US companies. This research will test whether similar results carry over. European countries often have better ESG scores due to stricter environmental regulations and disclosure policies by the EU.

The research in this study is based on the previous academic literature and proves the relevance of incorporating the Five Factor model. Naffa Fain (2022) also uses the five-factor model and an extra ESG factor for each pillar to evaluate investments but finds little conclusion. However, as this and other studies have shown, including ESG scores in the Five Factor model has yet to show much consensus on the relationship between returns and ESG factors. Considering the unreliability of ESG scores, this finds a relationship through measurable ESG factors that contribute to a score. As institutions often use mutual funds or ETFs when investing their funds, this study will be centered around ESG ETF portfolios and the individual stocks held within them.

Section 3: Women's Leadership and Financial Performance

A common theme in corporate responsibility initiatives is a push for more women in key leadership roles in firms. Previous research focuses on the link between gender diversity on the board of directors and the firm's financial performance. Fundamentally, a homogenous group leading a company makes decisions that may not reflect the society in which it does business. A diverse board brings in more perspectives in decision-making. In particular, women are more

sensitive to corporate social responsibility and environmental policies (Francoeur et al., 2017). Women also have higher ethics and maintain better customer and supplier relationships (Miller & Triana, 2009). Logically, an increase in women on the board of directors would increase the governance component of their ESG score. If there is a definite link between ESG factors and financial performance, there should also be a link between gender diversity on the board of directors and the value of a company.

A study on U.S. companies from 2000 to 2006 examines this theory further. Hussein and Kiwia create an econometric model to capture a relationship using five variables concerning the female labor force. Their study shows mixed results. The dependent variable, return on assets, could be more precise than the explanatory variables.

Catalyst published a report that shows contrary results. Researchers at Catalyst rank 520 companies in 2001 and 2003 and sort them according to the average percentage of women on the companies' boards of directors (Luckerath-Rovers, 2011). They find that the companies in the top quartile of women on the board of directors have a higher return on equity, return on sales, and return on invested capital than those in the bottom quartile. They also find that financial performance increases when companies have at least three women on the board of directors. While this paper has a weak methodology and no statistical significance, it is important to note that it leaves the door open for further research.

A study by Luckerath-Rovers builds off these studies with an attempt to quantify this relationship in a model. She examines 116 Dutch companies on the Amsterdam Euronext stock exchange in 2008 (2011). The ordinary least squares regressions Luckerath-Rovers runs have firm performance (measured as ROE, ROS, ROIC) as the dependent variables and gender diversity on the board of directors as the explanatory variable; other factors, such as firm size

and board size, are held as control variables (2011). She finds that the model confirmed previous research but did not give statistical significance (Luckerath-Rovers, 2011). The firms with more gender diversity outperform those with less gender diversity in each category of firm performance.

Another study conducted by Martinez and Rambaud supports Luckerath-Rovers' findings. They investigate the link between women on the board of directors and Spanish companies' financial performance. While some previous studies have hinted at a link between women in leadership roles and the increased financial performance of firms, they attempt to solidify the empirical evidence. They create a model that analyzes the largest and most significant companies in the Madrid Stock Exchange IBEX35 (the 35 most liquid Spanish stocks) from 2003 to 2017 (Martinez & Rambaud, 2014). Martinez and Rambaud then run a two-stage regression analysis; the first stage tests for mandatory European laws' effect on gender diversity, and the second stage tests for financial performance due to gender diversity (2014). The model's results confirm that more gender diversity on the board of directors is connected to an increase in the financial performance of firms (Martinez & Rambaud, 2014).

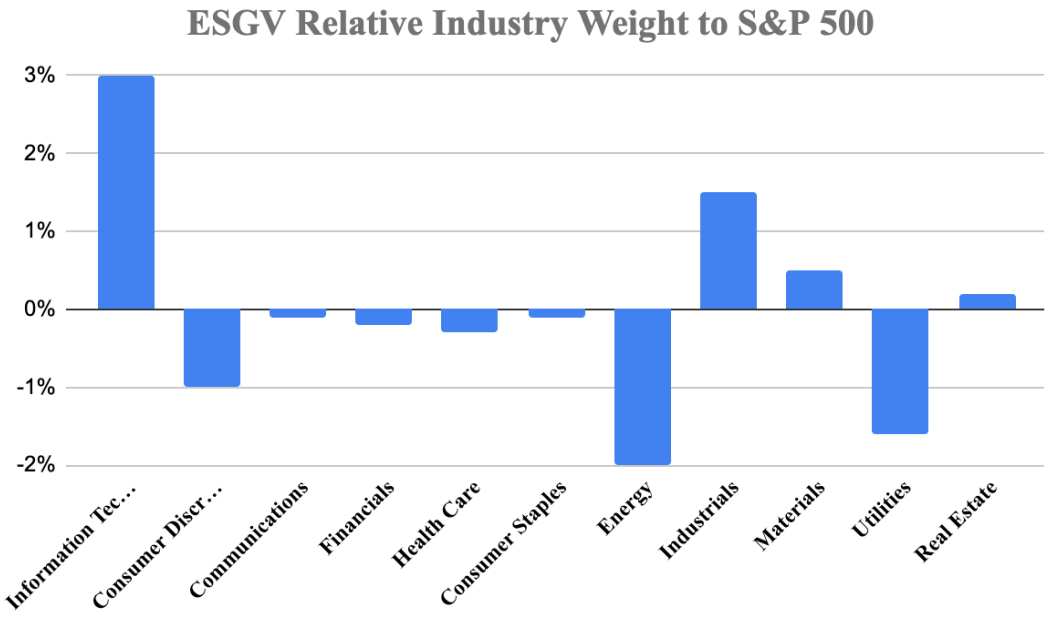
Therefore, the previous research proves a link between an increase in women on the board of directors and a company's financial performance. Because this is a governance issue within the ESG realm, the percentage of women on the board of directors is an additional topic of interest for this paper.

Chapter 3: Data

Section 1: The Model

Prior studies include ESG total and pillar scores with the Five-Factors model, but this model uses accurate data beyond the scores. Using this raw data compared to an ESG score gives a better picture of the company's actual practices for a specific ESG concern. The ESG factor in this model focuses on the top industry priority as ranked by Bloomberg. In aggregate, ESG ETFs tend to hold technology stocks the most out of any industry, as shown in *Figure (3.1)*. The Vanguard ESG US ETF (ESGV), one of the most widely used ESG ETFs in the United States, is the source of the stocks used in the regression models. ESGV is a general ESG ETF that tracks the performance of the FTSE US All Cap Choice Index and screens for specific ESG criteria. The ETF excludes stocks from the following industries: adult entertainment, alcohol, tobacco, cannabis, gambling, chemical and biological weapons, cluster munitions, anti-personnel landmines, nuclear weapons, conventional military weapons, civilian firearms, nuclear power, and coal, oil, or gas (Vanguard). ESGV also does not invest in companies that do not meet Vanguard's labor, diversity, human rights, environmental, and anti-corruption standards set by

(3.1)



Vanguard. Based on the background of this ETF, all of the stocks used in the regression should already possess some level of ESG deemed worthy of holding by a major ESG ETF.

For technology stocks, the highest ESG priority issue is Energy Management. It ranks as a number one priority among its subsectors, as shown in *Table (3.1)*. A lower number for Issue Priority indicates a higher priority for the ESG factor in that industry.

The technology stocks are comparable to those of an industry that prioritizes energy management less. This study compares technology stocks to stocks in the consumer staples industry. The issue priorities rank among consumer staples subsectors. Because the ESGV excludes alcoholic beverages and tobacco products, those subsectors are excluded from this study. The average priority score among subsectors in the industry is four, much lower than technology. *Table 3.1* shows Bloomberg's priority rating for consumer staples.

Industry	Issue Priority
Technology	
Software & Technology Service	1
Consumer Staples	
Agriculture	7
Packaged Food	1
Non-Alcoholic Beverages	4
Home Products	4
Personal Care	4
Retail	3
Wholesale	3

(3.1)

The regression model uses the Fama and French factors and the ESG factor of greenhouse gas emissions. Given the research linking women in leadership roles and firms, the

model also includes an additional variable measuring the percentage of women on the companies' boards of directors. Thus, *Figure (3.1)* shows the pane regression.

$$Y_{it} = \beta_0 + \beta_1 (R_{Mt} - R_{Ft})_t + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 RMW_t + \beta_5 CMA_t + \beta_6 GHG_{it} + \beta_7 WOM_{it} + e_i$$

(3.2)

The top ten highest-held stocks with all available ESG disclosures for each industry are the observation points in the model. The study period is from 2014 to 2022 because this period has the most firm ESG disclosures.

The five factors used in the model are measured similarly to those described in the literature review.

Excess Returns (Y_i) in the five-factor model are the stock returns subtracted from the risk-free rate of return. All the stock prices in this model are from Yahoo Finance and compiled into dates matching the five-factor model and ESG data. The returns measure the percentage increase or decrease in stock price from the prior month. That percentage subtracts from the risk-free rate along with the five factors.

GHG emissions per sales (β_6 GHG) are the millions of metric tons of scope 1 (direct from the company) emissions of greenhouse gasses divided by the company's total sales for a given year. This study measures the variable as greenhouse gas (GHG) emissions divided by the company's total sales for a given year. The smaller the ratio, the better; when a company reduces its emissions, the ratio decreases, or when it generates more sales under the same level of emissions, it becomes more efficient.

GHG emissions are also subject to heavy weight in ESG due to their relevance in directly combating climate change. An article from The Economist in 2022 provides an interesting take

on the current state of ESG. The author claims that the only part of ESG that matters is emissions. While there is more to the story than simply emissions, there is some truth to what the author is conveying. Trahan and Jantz note an association between the environmental pillar and a direct response to climate change, usually through carbon emissions (Trahan & Jantz, 2023). They argue that the E pillar and decarbonization should be the only focus.

However, the significance of the environmental pillar varies among different factors, making it difficult to fit into one universal model. Different industries view emissions differently due to the nature of the goods and services they produce. Some firms rely more heavily on emitting to do business than others. In parallel, industries can have different environmental regulations that affect how they conduct their business. From the perspective of investors, looking at the environmental factors dealing with climate change is more prevalent so that they can ensure a long-run return on their investment.

Board gender diversity is the percentage of women on the firm's board of directors for a year.

Despite measuring the ESG and five-factor data over time, the model is actually a panel regression. This is because the company's ESG factors are multiple observations for different firms within the same month. For each month, the excess returns and ESG factors are recorded for twenty companies. The five factors are repeated for each time period.

Section 2: Obtaining the Data

The five factors and risk-free rate data come from the data library on Kenneth French's Dartmouth website. It is used for this paper because of its accuracy and accessibility. Bloomberg Intelligence is used to gather the ESG data partly because of its availability and reputation as a

leader in ESG ratings. BI ESG has a dashboard that offers data on companies that go beyond just the scores of a specific company. The filter function allows users to specify the data based on company, job title, race/ethnicity, and gender. The years of data have varied due to ESG only becoming mainstream recently. Some companies have data reported as far back as the early 2000s, while others barely have an entire decade of data available. This presented a slight challenge in figuring out the years for the data in the model. Additionally, all of the ESG data collected is measured yearly. To match the monthly data of the five-factor models, the ESG data is the same value for each month of a reported year.

Section 3: Understanding the Data

2014 is the earliest available data from Bloomberg, as companies have not reported enough ESG data until around 2010. The companies selected for the model have disclosures for each year of the study. Several of the top ten firms held in ESGV for both industries reported very little ESG data. This can create a sample selection bias, as these companies with little disclosure were excluded from the study. Nevertheless, the larger companies with data reported each year are big enough to represent the entire industry.

Section 4: Descriptive Statistics

Before delving into the regressions, looking at the raw data gives a few takeaways. *Table 4.1* displays the summary statistics of the data collected for this study.

	Technology	Consumer Staples
Average Excess Returns	1.78%	.76%
Median Excess Returns	1.70%	.81%
Variance	0.01	0.03
Average GHG	16.27	67.11
Median GHG	9.79	53.55
Variance	293.98	3152.14
Average WOM	26.88%	30.74%
Median WOM	25.00%	30.00%
Variance	0.01	0.01

(3.2)

Excess Returns

Excess returns, plotted for each respective industry in *Figures 3.3* and *3.4*, show similar trends. Consumer staples stocks closely follow each other during the period. Technology stocks do the same, except Nvidia (NVDA) and AMD. Those two outliers saw a few years of slightly higher returns but ultimately finished back down with the rest of the industry at the end of the period. Those outliers could, however, contribute to the technology stocks' slight outperformance in average excess returns against consumer staples stocks.

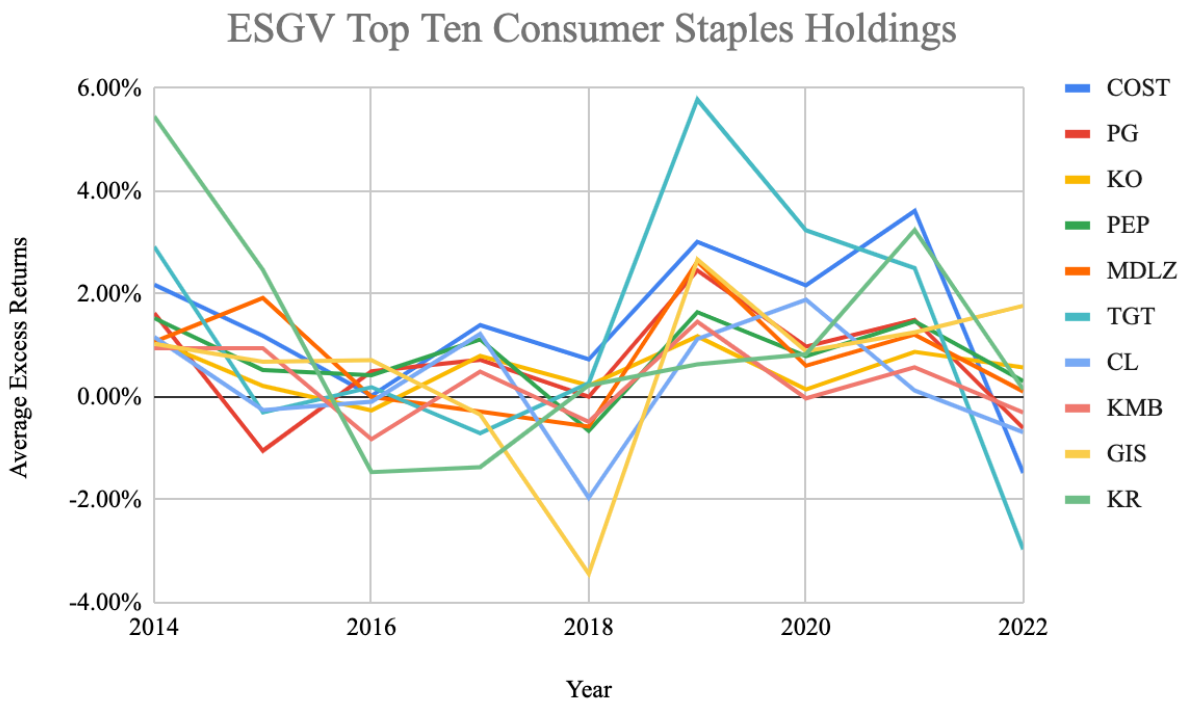
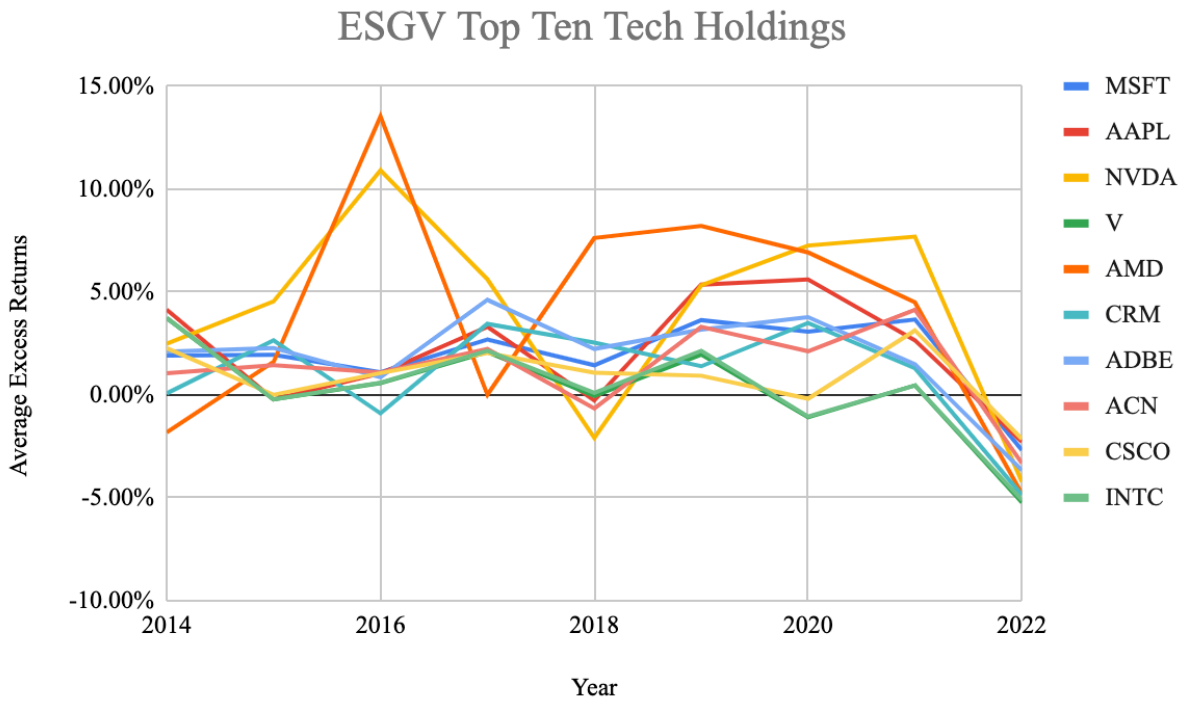


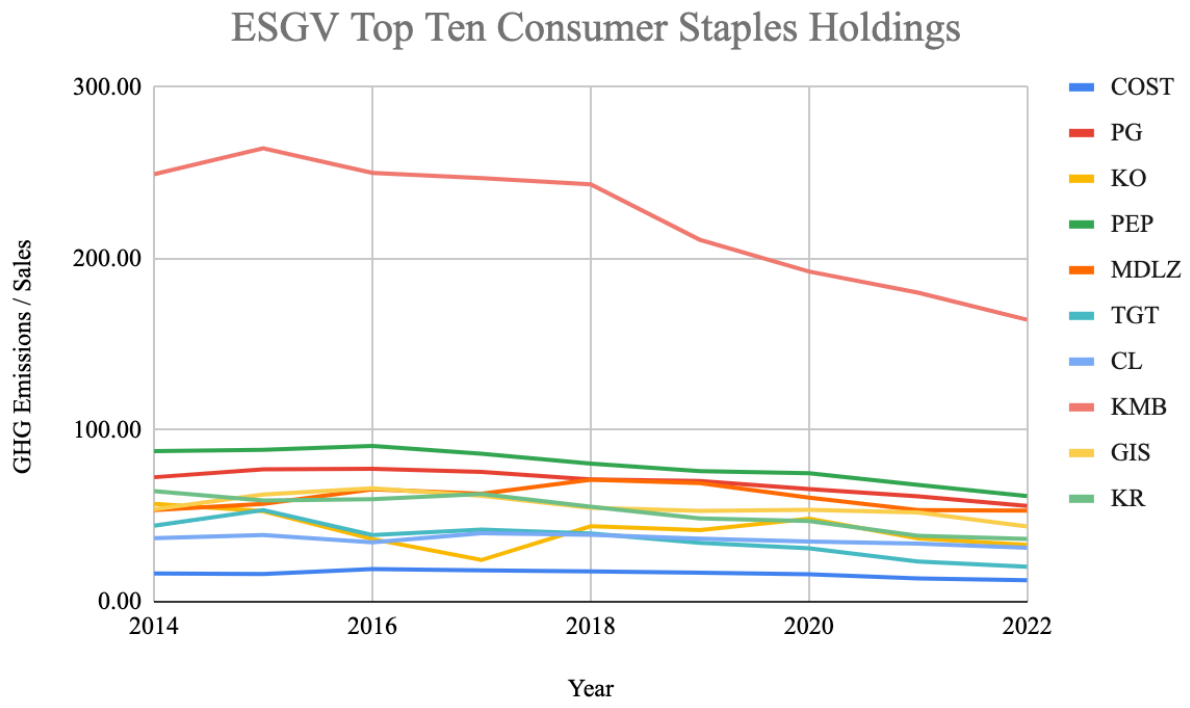
Figure 3.3 (top) and Figure 3.4 (bottom)

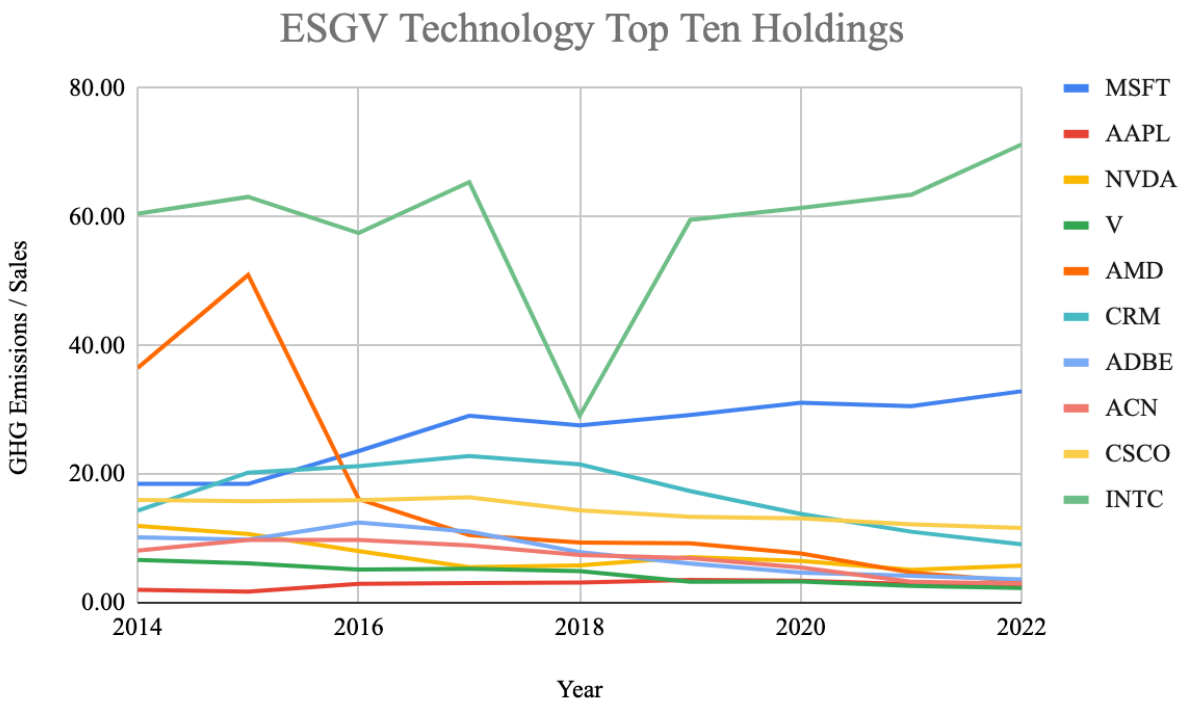


GHG

Figures 3.5 and 3.6 display the industries' GHG / Sales ratios. Technology stocks have a lower ratio than companies that do not place a high priority on the ESG issue. Something to note is that Intel (INTC) has the highest technology ratio. Research on Intel's carbon emission shows that the high ratio results from lower sales than higher emissions compared to its peers. Consumer staples stocks follow a general trend again, except for Kimberly-Clark (KMB). While having a much higher ratio, Kimberly-Clark also experienced a substantial decrease over the period.

(3.5)





(3.6)

WOM

All of the stocks from both industries experience the same gradual increase in the number of women on the board of directors. Consumer staples have a slightly higher average and median than technology (Shown in *Figures 3.7* and *3.8)*.

Analyzing the summary statistics is necessary to understand the regressions in the best way possible. The movement in different variables among the stocks can foreshadow what the results may look like.

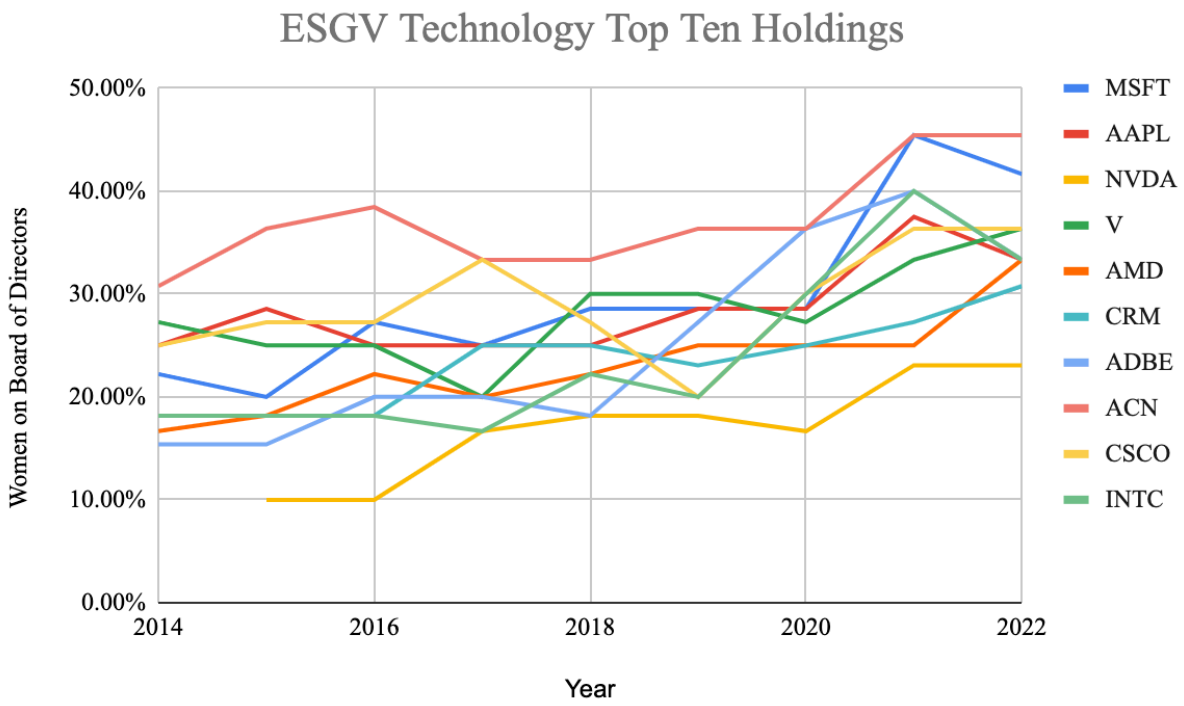
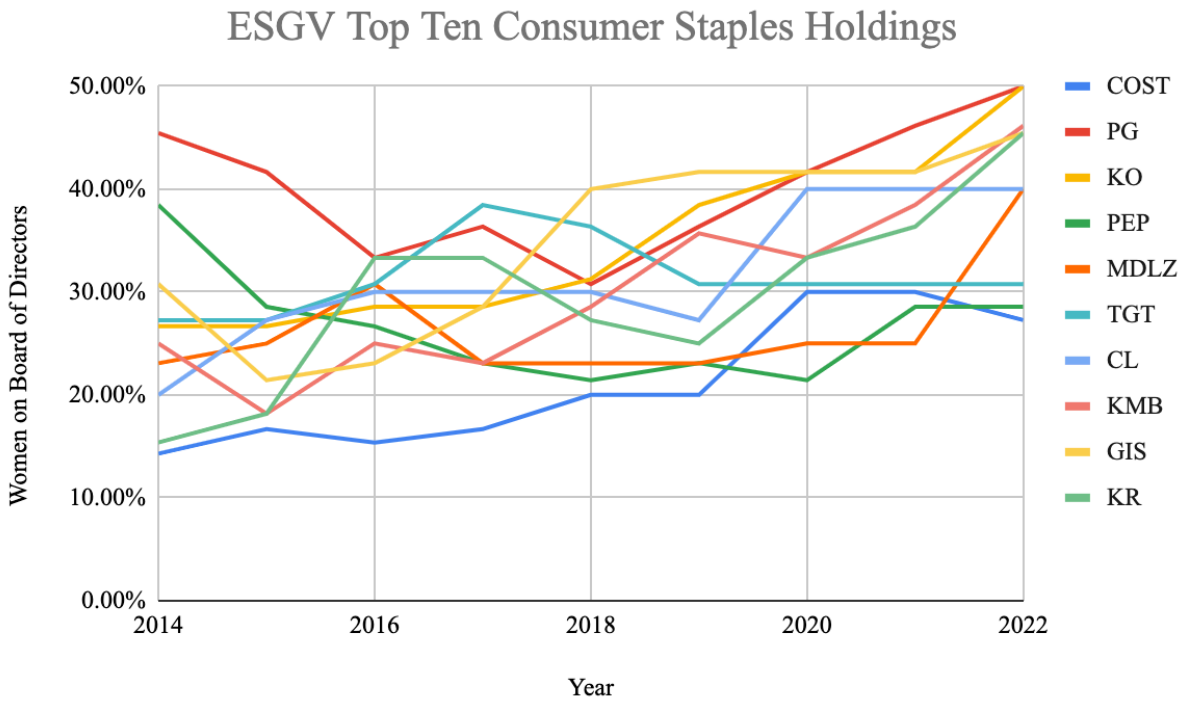


Figure 3.7 (top) and Figure 3.8 (bottom)



Chapter 4: Analysis

After compiling and analyzing the data, the panel regression runs in Stata. *Table 4.1* shows the results of ten regressions run from the data. The values in each cell are the increase by one unit of the independent variable, which results in an increase (or decrease if negative) in the percentage of excess returns of the dependent variable. Across the different tests, most of the variables from the five-factor model have similar values and are generally statistically significant at some level. They are essential to include so that the stock returns have accurate prices. However, the ESG variables GHG and WOM vary more.

In Regression 1, all of the variables run normally with no constraints. GHG shows that greenhouse gas emissions have no effect on returns but are statistically significant. The coefficient indicates that an increase in the GHG/sales ratio decreases excess stock returns by .0001%, which is not economically significant. WOM shows a stronger negative relationship between excess returns and women on the board of directors; an increase of 1% of the women on the board of directors results in a .05% decrease in excess returns.

Regression 2 takes the same test as Regression 1 and compares GHG and WOM based on industry. GHG shows the same relationship, but technology is the only statistically significant sector. Both industries for WOM display the same coefficient as Regression 1 and are still statistically significant. The negative relationship between women on the board of directors and stock returns in Regressions 1 and 2 does not make logical sense based on the research from Chapter 2. This relationship faces further scrutiny in the following regressions.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
MKTRF	0.9293***	0.9292***	0.8768***	0.8761***	1.0373***	1.0387***	0.8832***	0.8810***	1.0397***	1.0444***
SMB	-0.2530***	-0.2531***	-0.1832**	-0.1827**	-0.2661***	-0.2670***	-0.1866*	-0.1877*	-0.2683***	-0.2721***
HML	-0.2701***	-0.2698***	-0.3488***	-0.3478***	-0.1152	-0.1122	-0.3552***	-0.3449***	-0.1041	-0.0977
RMW	0.3100***	0.3101***	0.4156***	0.4175***	0.2939**	0.2979*	0.4062***	0.4223***	0.3041*	0.3155*
CMA	0.2429*	0.2425*	0.3758***	0.3761***	-0.1287	-0.1346	0.3705***	0.3660***	-0.1494	-0.1632
GHG	-0.0001**		-0.0001*		-0.0001***		-0.0005		-0.0005	
GHG x Industry										
Technology		-0.0001**		-0.0001**		-0.0000*		-0.0000		0.0000
Consumer Staples		-0.0002		-0.0002		-0.0002*		0.0013		-0.0007
WOM	-0.0536***		-0.0235		-0.1034***		-0.0245		-0.0722	
WOM x Industry										
Technology		-0.0563***		-0.0223		-0.1178***		0.1379**		-0.1361*
Consumer Staples		-0.0537**		-0.0403		-0.0585		-0.1211**		0.1696
Industry	No	Yes	No	Yes	No	Yes	No	Yes	No	Yes
> 2018			Yes	Yes	No	No	Yes	Yes	No	No
≤ 2018			No	No	Yes	Yes	No	No	Yes	Yes
Fixed Effects	No	No	No	No	No	No	Yes	Yes	Yes	Yes
R-Squared	0.3278	0.3477	0.1322	0.2011	0.4759	0.5431	0.1073	0.0577	0.2377	0.3354
Observations	2118	2118	960	960	1158	1158	960	960	1158	1158
										* p < 0.10
										** p ≤ 0.05
										*** p ≤ 0.01

(4.1)

Regressions 3 and 4 build off the last two tests by adding a time constraint. Regressions 3 and 4 are the only tests for the years in the dataset after 2018. Regression 3 shows the same statistically significant coefficients as Regressions 1 and 2. However, the results for WOM are much different. The coefficient for WOM is still negative, but it is now much weaker than the prior tests and no longer significant. This indicates that the previously established relationship has yet to hold in recent years. Regression 4 takes Regression 3 and accounts for industry. The results for GHG and WOM are the same as Regression 3, and an F-test shows no differences between sectors for the variables.

Regressions 5 and 6 run the same tests as 3 and 4, but they are only testing for years in the sample that are 2018 or earlier. Again, the GHG variable shows no difference in effects and is statistically insignificant. The most profound finding of the study is the WOM variable for Regressions 5 and 6. Before 2018, the negative statistically significant relationship between women on the board and stock returns is not only back but also more substantial. The coefficient -0.1034 in Regression 5 indicates that an increase of 1.0% of women on the board of directors of a firm results in a 0.10% decrease in stock returns in a given year. This is 0.05% stronger than the coefficient in Regression 1. Technology keeps the same coefficient and statistical significance when accounting for industry, but consumer staples show a weaker and insignificant negative correlation.

Regressions 7-10 repeat the same tests as Regressions 3-6 but with fixed effects. Fixed effects create a dummy variable to control for the industry in this study. The GHG coefficients

for the whole portfolio and between industries remain unchanged from the previous tests but lose statistical significance.

The tests reveal more mixed results for WOM. Regressions 7 and 8 look at the dataset after 2018 and with fixed effects. Regression 7 produces the same coefficient as Regression 3 and is also insignificant. Regression 8, however, shows differences from fixed effects compared to Regression 4. Both industries are statistically significant, but technology has become positive, and consumer staples remain negative. The results from Regressions 9 and 10 are even more perplexing. The WOM coefficient for Regression 9 is insignificant and much weaker than in Regression 5. For the industries, the coefficients have now flipped. Consumer staples is now positive but insignificant, and technology is negative and significant.

Chapter 5: Conclusion

This paper's model continues the research on using ESG factors in an asset pricing model, and the result is a thought-provoking conclusion. The GHG coefficient stays the same throughout the regressions, showing virtually no relationship between GHG and excess returns. The technology sector did not differ significantly from consumer staples.

The more significant takeaway from the tests is the evolution of women on the board of directors concerning stock returns. Before 2018, there was a strong coefficient with a significant negative correlation. After 2018, the coefficient changed to a weaker, insignificant negative correlation. This trend indicates that the negative connection set in the regressions before 2018 becomes less as the year progresses. Technology and consumer staples showed differences in results for the WOM variable with applied fixed effects. Before 2018, technology stocks showed a negative significant correlation, which became positively correlated and significant after 2018.

In short, the findings show some promise for a connection to excess returns. Over the period, more women on the board of directors leads to a decrease in negative returns. This also presents an opportunity for future research. The trajectory of the WOM coefficient could continue upward and have positive significance in the future. The jury may still be out on whether the industry shows any effects. Still, the differences between technology and consumer staples for the tests with fixed effects may provide an area for future study.

Some of the limitations contributing to this study's lack of results also stem from the need for more disclosure. Despite ESG being mainstream for almost a decade, the little data available on certain companies makes finding quantitative variables to test on companies very difficult. This problem brings the current state of ESG into question. Much still needs to be done to make ESG more universal. Some scholars point to government oversight, perhaps through the Securities and Exchange Commission, as a way to standardize ESG (Lyons, 2022).

Despite a lack of a direct connection between Greenhouse gas emissions and women on the board of directors with excess stock returns, that should not necessarily stop investors from considering ESG companies as potential investments. Some investors have intrinsic satisfaction from investing in companies that display corporate social responsibility. Investors primarily concerned with their bottom-line return on investment may consider ESG investments less because they will receive less return. Investor preference makes the nature of ESG investing subjective. The investor could receive extra benefits or none at all from investing in ESG.

Chapter 6: Appendix

The interest for this research project comes from investigating ESG investing methods for the newly-formed Student Managed Investment Fund (SMIF) and the Bruce R. Thompson Center for Business and Economics (CBE) at Allegheny College. The Bloomberg Market Concepts program offered in the CBE allows students to earn an ESG certificate by completing modules on the topic. This study's results hope that future student investors may gain more insight into how socially responsible investing is related to investment gains.

The authors apply their study to how schools can effectively bridge the ESG gap. Their recommendation: Student-Managed Investment Funds (2021). The training method fits a financial concept still considered "non-traditional." The applied learning approach in the SMIFs creates the perfect opportunity for students to gain experience through real investing.

This idea has caught on, as over 600 student-managed investment funds are in the United States. With its rise in popularity among college campuses also came an increase in studies on SMIFs and how they operate. In 2013, two professors at the Scott College of Business at Indiana State University founded the Student Managed Investment Fund Consortium[1] (the Consortium). Since its foundation, SMIFC has grown to include 114 member SMIFs. Its purpose is to act as a flagship organization that records best practices in investment management and promotes investment education in the SMIF community. Every year, the SMIFC hosts a conference with members from each fund in attendance.

SMIFs are proven to be the best avenue for ESG student investing. Ascioglu and Maloney (2019) tracked the progress of Bryant University's Archway Investment Fund (AIF). Founded in 2005, the AIF began as an equities-only portfolio but soon grew to include a fixed-income portfolio (Ascioglu & Maloney, 2019). Both portfolios under the AIF operated

under the oversight of an Advisory Board. Each board was composed of alumni, along with two standing members, the CFO of Bryant University and the chair of the Finance Department. Students first begin as Securities Analysts in FIN450, the first class offered by the AIF (Ascioglu & Maloney, 2019). In this course, they study the characteristics of their assigned sectors and develop an understanding of stock valuation methods. Recently, students have incorporated ESG factors into their stock selection process. AIF was the first SMIF with over $1mm in assets to have ESG integration into their investment portfolio. As of 2018, over 22% of all US assets (roughly $8.7 trillion) were invested while considering ESG criteria (Ascioglu & Maloney, 2019). Since 2015, the CFA exam has asked questions about ESG. The Bryant University faculty recognizes ESG as a crucial financial trend for students to understand.

As mentioned earlier, ESG techniques incorporate risk strategies into the AIF. To achieve a better alpha in the portfolio, AIF established a new committee devoted to just ESG (Ascioglu & Maloney, 2019). Open to AIF students with a further passion for ESG, the committee surveys the entire ESG realm and creates a roadmap for AIF to follow.

Lastly and most importantly, ESG is becoming an industry standard for investment managers. So, universities need to prepare their students to meet that market demand. Oldford, Willcott, and Kennie surveyed 17 Canadian business schools accredited by the Association to Advance Collegiate Schools of Business (2021). They examined each school's introductory finance textbooks and instructor slide decks. The results showed that professors should present ESG issues more meaningfully in introductory finance courses. While the study shows that first-year students have virtually no exposure to ESG investing concepts, that is not to say that they will learn about it in more advanced courses. The authors argue that for ESG to become as ubiquitous in the classroom as it is in industry, the concepts must be introduced at the earliest

levels (Oldford et al., 2021). This claim presents a strong case for SMIFs at colleges and universities.

Works Cited

Ascioglu, Asli, and Kevin John Maloney. “From Stock Selection to Multi-Asset Investment Management.” *Managerial Finance*, vol. 46, no. 5, 2019, pp. 647–661, https://doi.org/10.1108/mf-07-2018-0304.

Ashwin Kumar, N. C., et al. “ESG Factors and Risk-Adjusted Performance: A New Quantitative Model.” *Journal of Sustainable Finance & Investment*, vol. 6, no. 4, 2016, pp. 292–300, https://doi.org/10.1080/20430795.2016.1234909.

Auer, Benjamin R., and Frank Schuhmacher. “Do socially (ir)responsible investments pay? new evidence from international ESG Data.” *The Quarterly Review of Economics and Finance*, vol. 59, 2016, pp. 51–62, https://doi.org/10.1016/j.qref.2015.07.002.

Brown, Keith C., et al. “Asset Allocation and Portfolio Performance: Evidence from University Endowment Funds.” *Journal of Financial Markets*, vol. 13, no. 2, 2010, pp. 268–294, https://doi.org/10.1016/j.finmar.2009.12.001.

Cerqueti, Roy, et al. “ESG Investment Funds: A Chance to Reduce Systemic Risk.” *SSRN Electronic Journal*, 2020, https://doi.org/10.2139/ssrn.3631205.

Cornell, Bradford. “ESG Preferences, Risk and Return.” *SSRN Electronic Journal*, 2020, https://doi.org/10.2139/ssrn.3683390.

Fama, Eugene, and Kenneth French. “A Five-Factor Asset Pricing Model.” *Journal of Financial Economics*, 29 Oct. 2014, www.sciencedirect.com/science/article/abs/pii/S0304405X14002323.

Fama, Eugene, and Kenneth French. “The Capital Asset Pricing Model: Theory and Evidence - American ...” *The Tuck School of Business at Dartmouth*, 2004, pubs.aeaweb.org/doi/abs/10.1257/0895330042162430.

Francoeur, Claude, et al. “To What Extent Do Gender Diverse Boards Enhance Corporate Social Performance?” *SpringerLink*, Springer Netherlands, 17 Apr. 2017, link.springer.com/article/10.1007/s10551-017-3529-z.

Gibson, Rajna, et al. “ESG rating disagreement and stock returns.” *SSRN Electronic Journal*, 2019, https://doi.org/10.2139/ssrn.3433728.

Halbritter, Gerhard, and Gregor Dorfleitner. “The Wages of Social Responsibility — Where are They? A Critical Review of ESG investing.” *Review of Financial Economics*, vol. 26, no. 1, 2015, pp. 25–35, https://doi.org/10.1016/j.rfe.2015.03.004.

Hortsmeyer, Derek, et al. ``Fama and French: The Five-Factor Model Revisited.” *CFA Institute Enterprising Investor*, 14 Jan. 2022, blogs.cfainstitute.org/investor/2022/01/10/fama-and-french-the-five-factor-model-revisited/.

Hussein, Kassim, and Bill Kiwia. *Examining the Relationship Between Female Board Members and Firm Performance- a Panel Study of US Firms*, 2009, www.researchgate.net/publication/216811238_Examining_the_Relationship_between_Female_Board_Members_and_Firm_Performance_-_a_Panel_Study_of_US_Firms.

Ilango, Hazel. “An Unregulated ESG Rating System Reveals Its Flaws.” *IEEFA*, 2023, ieefa.org/resources/unregulated-esg-rating-system-reveals-its-flaws.

Kotsantonis, Sakis, et al. *Journal of Applied Corporate Finance - Wiley Online Library*, 2016, onlinelibrary.wiley.com/doi/epdf/10.1111/jacf.12166.

Lerner, Josh, et al. *Secrets of the Academy: The Drivers of University Endowment Success*, 2008, https://doi.org/10.3386/w14341.

Luckerath-Rovers, Mijntje. "Women on Boards and Firm Performance - Journal of Management and Governance." *SpringerLink*, Springer US, 2 Aug. 2011, link.springer.com/article/10.1007/s10997-011-9186-1.

Lyon, Tom. "How a Sustainability Index Can Keep Exxon but Drop Tesla – and 3 Ways to Fix ESG Ratings to Meet Investors' Expectations." *Michigan Ross*, 26 May 2022, michiganross.umich.edu/news/how-sustainability-index-can-keep-exxon-drop-tesla-and-3-ways-fix-esg-ratings-meet-investors.

Maiti, Moinak. "Is ESG the Succeeding Risk Factor? ." *Taylor & Francis Online*, www.tandfonline.com/doi/full/10.1080/20430795.2020.1723380. Accessed 20 Dec. 2023.

Martinez, Maria del Carmen Valls, and Salvador Cruz Rambaud. "Women on Corporate Boards and Firm's Financial Performance." *Women's Studies International Forum*, Pergamon, 28 July 2019, www.sciencedirect.com/science/article/pii/S0277539519302432.

Miller, Toyah, and Maria Del Carmen Triana. "Demographic Diversity in the Boardroom: Mediators of the Board Diversity - Firm Performance Relationship." *Wiley Online*, 2009, onlinelibrary.wiley.com/doi/full/10.1111/j.1467-6486.2009.00839.x.

Oldford, Erin, et al. “Can student managed investment funds (smifs) narrow the environmental, social and governance (ESG) skills gap?” *Managerial Finance*, vol. 48, no. 1, 2021, pp. 57–77, https://doi.org/10.1108/mf-07-2021-0317.

OpenAI. (2024). *ChatGPT* (3.5) [Large language model]. https://chat.openai.com/share/7656ecd2-64b2-4609-b623-1d8c16d0525b

[1]“Scott College of Business.” *SMIFC: Research: SMIFC Statistics | Scott College of Business*, www.indstate.edu/business/SMIFC/research/SMIFCstats. Accessed 31 Oct. 2023.

Trahan, Thomas, and Brad Jantz. *What Is ESG? Rethinking the “E” Pillar*, Wiley Online, 2023, onlinelibrary.wiley.com/doi/full/10.1002/bse.3371.

“Volkswagen Scandal.” *MSCI*, www.msci.com/volkswagen-scandal. Accessed 18 Mar. 2024.

Who Cares Wins, United Nations Environment Programme Finance Initiative, www.unepfi.org/fileadmin/events/2004/stocks/who_cares_wins_global_compact_2004.pdf . Accessed 18 Mar. 2024.

Wimmer, Maximilian. “ESG-Persistence in Socially Responsible Mutual Funds.” *SSRN Electronic Journal*, 2012, https://doi.org/10.2139/ssrn.2138882.

Womack, Kent, and Ying Zhang. *Understanding Risk and Return, the CAPM, and the Fama-French Three-Factor Model* , Tuck School of Business at Dartmouth, 2003,

www.researchgate.net/publication/228169038_Understanding_Risk_and_Return_the_CAPM_and_the_Fama-French_Three-Factor_Model.

About the Author



R.J. Swanson ‘24 is a fourth-generation Allegheny Gator. He is an Economics major with a double Communications and Political Science minor. He was a Distinguished Alden Scholar for 2022 and 2023.

During his four years at Allegheny, R.J. became the most involved with the Delta Tau Delta fraternity. In 2022, he served as the public relations chair. In 2023, he was elected president of the chapter. Under his administration, the chapter received the prestigious Hugh Shields Award, which is given to the top ten ranked chapters in the country.

R.J.’s love of finance is demonstrated by his work at the Center for Business and Economics. R.J. served as a CBE fellow for two years. In addition, he was the president of the Wealth Management Club, a group that raised $1 million for the department to start a student-managed investment fund. After graduation, he will continue his love of finance with a job at PNC Bank in a finance development program.

On a nice Meadville day, you can find R.J. somewhere nearby on a golf course. He was the president and founder of the Golf Club at Allegheny.