ESG and the U.S. stock market equity returns – take the pharmaceutical industry as an example

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Abstract. It is commonly accepted that market participants use ESG (Environment, social and governance) scores as an indicator of a company's sustainability performance in terms of finances and reputations. Pharmaceutical industry is highly social related and increasingly exposed to climate change risks. In this study, 251 pharmaceutical companies and three leading enterprises are chosen to make out how ESG scores affect pharmaceutical industry's stock returns and other financial performance. Using data from Wind and Bloomberg, we do an empirical analysis combined with theoretical analysis. We establish a linear regression model, to make regression of stock returns of the overall industry and ESG scores. The E, S and G scores are also analyzed respectively. Through the regression results, we find that better ESG performance doesn't increase stock returns, which might due to a lagged effect of ESG performance on fi-nancial indicators. Also, higher systematic risks would decrease stock returns. As for specific companies, there are difference between their result and the overall industry. Higher ESG scores do effect stock returns of big companies, for instance, AbbVie and Pfizer, of which the stock returns are positively correlated to ESG scores, while Merck's fact is negative but better suit for the model.

1 Introduction

In the context of climate change-related global systematic risks, government organizations, civil societies, and businesses start standardizing and putting into practice appropriate climate change adaptation strategies. In terms of ESG performance, it has emerged as a crucial metric for assessing the sustainability of businesses, particularly among investors, businesses, and governments. The pharmaceutical industry has been gradually exposed to climate change, which will add risks or opportunities to their ESG scores, thus affecting stock returns and other financial indicators.

Different evidence supporting the correlation between ESG and stock returns may be found, according to the study that has already been done. The majority of studies show that companies with high ESG ratings experience greater excess returns. This is consistent with the idea that market participants view ESG characteristics as a reliable indicator of a company's financial stability. A two-step methodology analyzing the performance of companies included in the Eurostoxx50 index over the 2010-2018 period shows that the selected ESG Overall indicator contributes only to a very small extent when modeling returns [1]. A study based on data from socially responsible institutions which focus more on ESG performance finds that ESG may have received more attention, which may have affected stock return

patterns [2]. However, it's still important to involve ESG in the foundation of responsible financial decisions for companies [3]. A study in China shows that higher corporate environmental, social, and governance ratings and environmental scores significantly decrease the relationship between carbon intensity and stock yields, indicating that environmental governance is conducive to reducing carbon emission risks, while increased market regulatory pressure increases carbon risk premiums [4]. Climate change brings both risks and opportunities to companies, which may offset their financial performance. The financial performance of manufacturing enterprises was unaffected by variations in ownership arrangements, the level of disclosure of climate change-related risks and opportunities, or the number of environmental performance indicators. In order to analyze, it builds a multilayer quadratic growth model [5]. When the market is concerned about the risk of climate change, corporate measures aimed at improving environmental performance pay off nicely [6]. Additionally, there is methodology-focused research that offers a template for evaluating the physical risks of climate change for businesses [7].

Governments and enterprises have been taking motions to adapt to the potential risks, stressing the society forward to decrease climate change risks while creating uncertainty. For instance, carbon control policy risk can hurt corporate ESG performance,

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according to a study focused on industrial firms in China [8]. The chance of a corporation experiencing a crash may be decreased with the help of a firm-level view on climate change [9].

For pharmaceutical industry, there are few of empirical studies to analyze the ESG performance's effect on their stock returns. However, since the pharmaceutical industry is highly socially related and highly dependent on natural resources, this question deserves discussion.

Using the ESG scores and stock returns data of selected 251 pharmaceutical companies in the U.S. stock market from 2011 to 2022, this study establishes a model to analyze the effects of ESG scores, especially risk disclosure for climate change and opportunities of ESG on the stock returns of pharmaceutical industry firms. Additionally, we choose three big companies, Merck (MRK), Pfizer (PFE) and AbbVie (ABBV), making regression analysis to test the industry results and make comparisons.

The results and findings of this study showed that stock returns are significantly negatively correlated with ESG in pharmaceutical industry, which is somehow unexpected. This might because there's a lagged effect of ESG performance on stock price. Also, it is demonstrated that the higher the systematic risk is, the lower the stock price will be. There is heterogeneity existed in different companies. Normally good ESG performance will contribute to higher stock returns, like PFE and ABBV. Financial success and environmental performance metrics were often shown to have a distinctively positive correlation.

In conclusion, the findings of this study may be utilized as a guide for company managers to improve their decision-making in relation to actions, strategies, and planning in response to risks and opportunities associated with climate change within the context of ESG performance indicators.

2 Esg and pharmaceutical industry

Frequent natural catastrophes brought on by harsh climatic conditions not only put human existence in danger but also have a significant negative influence on the world economy and industrial supply chains. Extreme weather like extreme heat, floods, and tsunamis, decrease labor productivity and brought about the shutdown of commercial activities. The pharmaceutical sector is particularly hard hit, making it crucial for linked businesses to take action on climate change.

Products of the pharmaceutical industry are highly dependent on natural resources and environment. The decrease in biodiversity caused by climate change may have an impact on the supplement ingredients. Extreme weather like extreme heat would impact on the normal commute of employees, which is crucial for scientific research and production. Managers in businesses and key stakeholders are paying more attention to ESG and climate change problems. Nowadays, ESG risk is an index revealing a company's sustainability in future development. These are all potential risks and opportunities for the pharmaceutical industry related to climate change.

Since the pharmaceutical industry has characteristics of high investment, high risk, long circle, and high yield, investors will be more cautious when distributing investments. Generally, a pharmaceutical company has the lowest score on environmental risk (which means low environmental risk), a higher score on governance risk, and the highest score on social risk, in terms of its highly social-related services and medical products.

With total revenues of $1,226.3 billion in 2021, the global medicines industry saw a compound annual growth rate (CAGR) of 5.6%. Comparatively, over the same time period, the US and Asia-Pacific markets increased at CAGRs of 4.3% and 8.9%, respectively, to reach respective values of $379.0 billion and $397.0 billion in 2021. By far the largest pharmaceuticals market in the world, the US accounted for 32.4% of the overall market value in 2021, while the whole Asia-Pacific and European regions contributed 30.9% and 27.6%, respectively [10].

In order to compare the performance of different companies within pharmaceutical industry, firstly we selected 252 companies to represent overall industry performance. Then we choose 3 pharmaceutical companies for analysis, which are Merck (MRK), Pfizer (PFE), and AbbVie (ABBV). MRK and PFE are two of the biggest pharmaceutical firms in the world, followed by AbbVie. Their market capital is 283.99 billion dollars, 234.52 billion dollars, and 283.67 billion dollars, respectively, according to global ranking website. The three company's products are all sold in more than 80 countries over the world, which are highly exposed to risks of environment, society, and governance.

3 Environmental risk of pharmaceutical industry

Climate-related and environmental risks could translate into financial losses on company, for example, increased direct costs, increased capital expenditures, de-creased asset values etc.

Table 1. Environmental risks and potential financial impacts

Risk	Potential Financial Impact
Biodiversity Reduction	Decreased patent count, cut cost in research
Biodiversity Conservation Risks	Lawsuit from NGOs, decreased company reputation, decreased investors, increased costs for materials

Water scarcity and drought impact on operations	Increased direct (operating) costs and decreased revenues due to reduced production capacity
Extreme heat impact on operations and supply chain	Increased direct costs and decreased revenues due to reduced production capacity.
Carbon related risks	Increased capital expenditures, decreased asset value or asset useful life leading to write-offs, and asset impairment or early retirement of existing asset
Antimicrobial Resistance (AMR) Risk	Increased institutional cost, pollution treatment facilities cost in the future

4 Models and variables

To investigate the relationship between environmental risk and corporate stock returns, this paper takes an ESG perspective and proposes the following hypotheses:

H1. Stock returns of pharmaceutical industry are positively related to ESG.

H2. Higher systematic risk would cause decrease in stock returns.

H3. There is heterogeneity among different companies and pharmaceutical industry.

To test the above hypothesis, we set up the following model.

$$RETURN = \beta_1 \times ESG + \delta_1 \times CONTROLS + \varepsilon_1 \quad (1)$$

$$RETURN = \beta_2 \times E + \delta_2 \times CONTROLS + \varepsilon_2 \quad (2)$$

$$RETURN = \beta_3 \times S + \delta_3 \times CONTROLS + \varepsilon_3 \quad (3)$$

$$RETURN = \beta_4 \times G + \delta_4 \times CONTROLS + \varepsilon_4 \quad (4)$$

This paper selects 251 listed companies in the U.S. stock market from 2011-2022 to study the impact of environmental risk on asset pricing through regression analysis of stock returns and ESG scores in the pharmaceutical industry. The sample data are obtained from Wind and Bloomberg.

Table 2. Variable Description

Variables	Name	Description
Explained Variable	RETURN	Annual stock return (%)
Explaining Variable	ESG	Bloomberg ESG score
	E	E score of ESG
	S	S score of ESG
	G	G score of ESG
Control Variable	BETA	Calculated by Wind
	VALUE	Market value at the end of each year
	I	Reciprocal of PB at the end of each year
	LEVERAGE	Annual asset-liability ratio
	EPS	Annual earnings per share
	ROA	Annual return on assets
	ROIC	Annual return on invested capital
	SALES	Total operating revenue for the year
	QR	Annual quick ratio

5 Regression results

This section shows the results of the empirical study in this paper. This paper firstly examines the relationship between ESG evaluation and stock returns from the pharmaceutical industry as a whole, and on this basis regresses each of the three aspects of environmental, social and corporate governance to analyze the results of the study. After that, this paper uses the same model to regress on the three selected listed companies to make a preliminary judgment on the impact of ESG performance on stock returns by the positive and negative coefficients.

According to the descriptive statistical results, the average stock return is 10.92%, and the average annual return is positive. The minimum value of ESG is 11.16, and the maximum value is 78.76, indicating that the performance of ESG varies greatly among enterprises in the pharmaceutical industry, and the mean value of 35.08 indicates that the average ESG level of enterprises still needs to be improved. The average BETA is 1.086, indicating that the average systemic risk of the industry is not high, and it is slightly above the market and slightly below the market when the market returns are rising and falling, respectively. The range of VALUE and SALES is large, and the sample data covers enterprises of different sizes in the industry. The average LEVERAGE is 0.52 and the average Leverage of QR is 3.56, indicating that the enterprises in the sample have good long-term and short-term average solvency. The mean value of ROA and ROIC is negative, indicating that the profitability and return on capital investment of pharmaceutical industry enterprises are poor.

Table 3. Decriptive statistics

Variables	Number	Mean	Standard deviation	Min	Max
RETURN	1,692	10.92	60.25	-86.91	263.50
ESG	1,692	35.08	10.86	11.16	78.76
E	1,692	8.43	17.76	0.00	76.20
S	1,692	13.79	12.24	0.00	65.93
G	1,692	82.91	6.80	40.19	100.00
BETA	1,692	1.086	0.475	-0.102	2.522
VALUE	1,692	15,797	41,505	8	248,277
I	1,692	0.292	0.411	-0.924	2.541
LEVERAGE	1,692	0.519	0.310	0.072	1.683
EPS	1,692	0.25	3.80	-12.61	17.75
ROA	1,692	-0.173	0.358	-1.679	0.408
ROIC	1,692	-0.323	0.992	-7.425	0.721
SALES	1,692	4,932	13,326	0	82,059
QR	1,692	3.561	3.098	0.495	16.640

According to the regression results, stock returns are significantly negatively correlated with ESG at the 1% level, i.e., good corporate ESG performance does not enhance stock returns, which is somewhat different from the hypothesis of this paper. On the one hand, it may be because, there is a lagged effect of ESG performance on stock returns, i.e., it is not reflected in the annualized returns of the current year, but in subsequent years. On the other hand, companies may invest certain costs in environmental and corporate governance to improve ESG performance, but the benefits of this part will not be directly reflected in corporate performance, which may lead to the company's financial situation not meeting market expectations and affect stock returns. Separate regressions from E, S, and G dimensions all show a negative relationship with stock returns at the 1% level, and the absolute value of the coefficients, i.e., the effect on stock returns, increases sequentially.

In terms of the performance of the coefficients of the control variables, the coefficient of BETA is significantly negative at the 5% level, indicating that the higher the systematic risk, the lower the stock return, which is basically in line with expectations.

Table 4. Regression results of the industry

Variables	(1)	(2)	(3)	(4)
ESG	-1.588***			
	(-6.07)			
E		-0.817***		
		(-5.21)		
S			-0.983***	
			(-4.95)	
G				-1.221***
				(-3.82)
BETA	-11.652**	-11.469**	-11.584**	-10.677**
	(-2.29)	(-2.24)	(-2.27)	(-2.09)
VALUE	0.000***	0.000***	0.000***	0.000***
	(4.01)	(3.36)	(3.54)	(2.95)
I	-52.136***	-53.272***	-51.794***	-51.728***
	(-6.76)	(-6.71)	(-6.69)	(-6.50)
LEVERAGE	-36.428***	-39.471***	-34.811***	-38.344***
	(-2.93)	(-3.11)	(-2.75)	(-3.08)
EPS	0.469	0.593	0.412	0.630
	(0.49)	(0.62)	(0.43)	(0.67)
ROA	13.638	11.471	15.359	12.026
	(0.87)	(0.73)	(0.98)	(0.77)
ROIC	1.022	0.563	0.897	1.294
	(0.31)	(0.17)	(0.27)	(0.41)
SALES	-0.002*	-0.002**	-0.002**	-0.002**
	(-1.96)	(-2.14)	(-2.00)	(-2.14)
QR	0.224	0.311	0.284	0.273
	(0.25)	(0.34)	(0.31)	(0.30)
Constant	116.310***	70.374***	74.236***	164.326***
	(8.38)	(6.04)	(6.40)	(5.89)
Observations	1,692	1,692	1,692	1,692
Number of codes	251	251	251	251
R-squared	0.101	0.095	0.099	0.094
FE	YES	YES	YES	YES
F test	0	0	0	0

Variables	(1)	(2)	(3)	(4)
r2_a	0.0961	0.0899	0.0937	0.0890
F	12.62	11.11	11.39	10.35

Notes: Robust t-statistics in parentheses, *** stands for $p<0.01$, ** stands for $p<0.05$, * stands for $p<0.1$

Using the data of the three companies for multiple regression, it can be found that for the regression coefficient of ESG, MERK is negative while that of the other two companies is positive, indicating that the good ESG performance of ABBV and PFE contributes to the improvement of stock returns in that year. MERK's data is consistent with the overall industry. In terms of the Goodness of Fit, the model fits ABBV data best.

Table 5. Regression results of each company

Variables	(1) MERK	(2) ABBV	(3) PFE
ESG	-10.797	4.225	2.761
	(-0.78)	(.)	(1.75)
BETA	-748.382	-247.722	35.193
	(-0.83)	(.)	(1.59)
VALUE	0.008	-0.003	0.003
	(0.86)	(.)	(2.17)
I	4,296.415	-	1,211.404
	(0.79)		(1.68)
LEVERAGE	5,671.327	-1,191.835	834.861
	(0.76)	(.)	(1.36)
EPS	-78.590	51.715	-3.308
	(-1.37)	(.)	(-0.05)
ROA	15,345.006	-10,786.999	1,498.796
	(0.86)	(.)	(1.09)
ROIC	-9,402.781	6,436.587	-1,248.894
	(-0.79)	(.)	(-2.05)
SALES	-0.027	-0.008	-0.002
	(-0.81)	(.)	(-1.18)
QR	278.468	-63.198	-7.648
	(0.83)	(.)	(-0.62)
Constant	-3,666.474	1,841.540	-1,452.979
	(-0.77)	(.)	(-1.79)
Observations	12	10	12
R-squared	0.918	1.000	0.989
F test	0.0365		0.109
r2_a	0.0931		0.876
F	455.1		50.88

Notes: Robust t-statistics in parentheses, *** stands for $p<0.01$, ** stands for $p<0.05$, * stands for $p<0.1$

6 Conclusion

Based on the research, this paper finds a significant negative relationship between ESG and U.S. stock returns in the pharmaceutical industry, and the regression by three individual indicators, E, S and G, yields the same result, which differs from existing studies. This paper suggests that part of the possible reason is that the Bloomberg ESG ratings referenced in this paper are usually disclosed at the end of the year, and thus changes in ESG ratings may not be reflected in current stock returns, but rather there will be some lag. According to the aforementioned statistical results, it can be found that the ESG data of the sample companies have a large extreme difference, indicating that the data cover both good and poor ESG performers, so the ESG of some companies may indeed have a negative impact on investors' decisions, thus affecting the overall industry results. In contrast, the ESG of both ABBV and PFE of the companies studied in this paper has a positive effect on stock returns. On the other hand, ESG ratings consider the non-financial performance of companies from three dimensions: environmental, social and corporate governance. Companies need to spend more to maintain their good ESG performance, but this part of expenditure may not be able to correspondingly increase revenue or profit, thus affecting corporate performance and pulling down stock investment returns. In the future, further refinements can be made based on the above-mentioned studies, such as grouping ESGs according to their high and low levels and studying their effects on stock returns separately. In addition, the specific impact path of ESG on stock returns of pharmaceutical industry companies can be studied, so that more effective suggestions can be made for pharmaceutical industry companies to improve their own ESG construction and capital market performance.

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