Research on the Relationship between Listed Companies' Carbon Footprint, Environmental Social and Governance Investment and Market Valuation Based on Experimental and Mathematical Statistics Analysis

XiJie Wang

2671137391@qq.com

Anshan XinYuan Senior high school, Anshan, China

Abstract—Environmental finance is an emerging and interdisciplinary field of research because issues surrounding the environment are a worldwide problem that affects the entire world including the economy. Academia in recent years has initiated to put a premium on this domain. This paper will mainly utilize statistical methods (specifically quantitative methods including regression models) to expound and analyze the correlation between corporations' valuation and ESG performance, and the purpose of this paper is to bring together finance (particularly the valuation of a corporation) and environmental indicators (intensity of CO_2) to construe whether it is applicable to set ESG performance as a criterion to determine whether to invest or not for stakeholders. Corporations can also base on the results of this paper to adjust their annual reports to compensate for deficiencies. Results of this paper can be stretched out on other industries to improve and perfect their mechanisms.

Keywords-Listed companies' carbon footprint; environmental social; governance investment; market valuation

1 INTRODUCTION

Under the tendency of global collaboration to resolve climate-change problems, carbon footprint and Environmental, Social, and Governance (ESG) have progressively become pivotal criteria for investors to make investment decisions, especially long-term value investors. Nevertheless, there are still plentiful institutions and investors suspicious of whether lowering carbon footprint and plunging money into ESG can veritably yield value for a publicly-traded company. To understand the correlations between ESG expenditure and financial performance indicators, researchers have published more than 2000 empirical research studies. However, the majority of these research studies do not reveal the relationships between ESG expenditure and company financial performance from the traditional equity valuation approach. This paper aims to

ICIDC 2022, June 17-19, Qingdao, People's Republic of China

DOI 10.4108/eai.17-6-2022.2322635

evaluate a particular industry-apparel industry, utilizing quantitative research modality to investigate whether reducing carbon footprint and spending on ESG can help apparel companies gain abnormal equity returns. By constructing a valuation model and utilizing regression measures to analyze corporate greenhouse gas emissions, financial disbursement, and performance, this research strives to explore the ESG spending- equity return ratio for the apparel industry. The main frustration encountered by this research is the availability and accessibility of carbon emission data. The innovation point of this research is that this paper will utilize valuation approaches of listed corporations upon a sought-after topic-carbon footprint, and link pivotal financial indicators to investigate concrete contributions of these measures. The established methods can be introduced to miscellaneous types of industries to conduct investigations.

1.1 Literature review and hypothesis

Since the beginning of a industrial revolution, implications of industrial activities have become increasingly salient both on human beings and the ecosystem, and systematic efforts on pinpointing impacts of economic activities on the environment were initiated in the 1960s, during which ecological problems became increasingly visible. However, hitherto, the number of existing empirical research investigating business up shots and environmental circumstances is comparatively limited [1]. Back in 1962, Rachael Carson published her book “Silent Spring” and pioneered environmental studies that aimed to raise environmental awareness of the public.

Business is considered as the pivotal constituent for retaining environmental sustainability and business is accountable for 35% of global greenhouse emissions. The textile and apparel industry (t&a thereafter) is a $1.3 trillion business, which is the third-largest industry worldwide merely after the automobiles and technology industry [2]. The carbon footprint of this industry contemporarily surpasses the combination of international aviation and maritime transport [3]. It is estimated that along this path, emissions in the t&a industry will constitute a quarter of the world’s carbon emissions by 2050. During the period between 1970 to 1980, governments of developed economies established environmental laws and regulations to address environmental issues, which required firms to generate and finance environmental compliance functions.

During the early days after environmental laws were implemented, many corporations criticized these standards as modalities to gather unwarranted impost. Moreover, Orsato pinpointed that corporations’ environmental protection requires a prodigious amount of equipment, which doubtless increases operating costs [4]. Plentiful conventionalists like Palmer and Oates also maintained that as environmental regulations trigger companies to utilize extra-cost, the relationship between the profitability of companies and environmental performance is negative (Palmer, K., Oates, W. E. & Portney, P. R., 2009) [5].

As time lapses, attitudes for corporations towards the environment embark on changes, as companies pinpoint that profit can be acquired just from pollution control and waste reduction proceedings. Russo and Fouts claim that the aforementioned responses would be well-advised to be referred to as “beyond compliance” for companies that are driven by market incentives in preference to regulatory compliance [6]. Consumers nowadays are more environmentally conscious. Lifecycle assessment (-LCA) is a comprehensive tool to evaluate the environmental and human health impacts of a product. LCA results can provide a certain degree of transparency of a product's environmental performance. However, not many consumer products have a comparable and third-party independently verified LCAs.

After adopting eco-friendliness, corporations can garner positive corporate social performance (CSL), which is testified to represent a positive correlation with a financial performance by Orlitzky et al. [7]. Moreover, higher environmental performance may diametrically elicit prominent financial performance. Jian Xu et al. claim the correlation between environmental investment and financial performance can be illustrated by a virtually U-shaped curve, which elucidates that investing more in greenness can give rise to better financial performance and vice versa [8]. On the basis of 243 firms utilizing independently developed environmental ratings, Russo and Fouts established a model grounded on the resource-based view of firms, corroborating high levels of environmental performance corresponding to enhanced profitability. The research conducted by Klassen and Why bark convinces us that improved fabricating performance could transpire synchronously with ESG investment, which can be fair to presume higher financial performance in the long run [9]. As for equity return, portfolio analysis shows that eco-efficient companies offer shareholders positive equity returns. Yue found a positive linkage between corporate ESG investment and financial performance for the papermaking and printing industry [10].

1.2 Hypothesis

Pursuant to statistical data, 58% of studies focusing on operational metrics such as ROE and ROA reveal positive correlations between ESG and financial performance, the hypothesis of this paper also follows this trend. Whilst the majority of researchers aspire to analyze environmental impacts on its stock, which is rewarding, this paper will not limit the trend of stock price but on the valuation of the corporation. The following section is the hypothesis of this research.

H1: better ESG performance (specifically lower carbon emission) leads to higher abnormal equity return.

2 Data and Methods

2.1 Sample Selection

We have conducted extensive research on the carbon emission disclosure of apparel companies. Due to extrinsic limitations, plentiful small corporations that do not disclose any carbon footprint emissions are not involved in our considerations. The corporations we select are predominantly from the U.S, and two corporations are from Sweden (Hennes&Mauritz) and Germany (ADIDAS). Simultaneously, these 15 corporations are the top textile companies in the s&p 500. The particular reason we select these corporations as our main subjects is that these companies may be accountable for a huge amount of CO_2 emissions across the entire industry. We have been focusing on scope 1 and 2 emissions which the target companies have more direct control over than scope 3 emissions. For those companies we've selected, CDP was the primary data source for scope 1 and 2 emissions and a small portion of data is derived from corporations' social responsibility reports. As for financial data, we mainly select them from Yahoo finance and Wind. As for section scope 2 emission, we selected location-based scope 2, which reveals what the company is physically putting into the air, in preference to market-based one. As for the regression model it is carried out by Minitab. In order to prevent the negative implication of COVID-19, this project selects the intensity of carbon emission (metric tons of CO_2eq/EBITDA) data in 2015-2018 and financial performance (stock return) data in 2016-2019 since investors may rely on the previous year's carbon emission results to determine their portfolio in the next year. The main obstacle of this project is that it is arduous to acquire precise carbon emission data, because plentiful corporations are determined not to disclose those data, and dissimilar calculation methods exerted by different institutions may vary, resulting in inevitable nuance. With regard to data not disclosed both on CDP and corporate's social responsibility report, this research follows the mainstream trend that the previous CO_2 emission may be higher than that of baseline year and added different values based on the scale of CO_2 emission of these companies.

2.2 Variables

Dependent variable

The annual stock returns of listed 15 corporations are set as the dependent variable, which can be the most straightforward modality to reflect the investment return on these companies.

Independent Variable

Carbon emission intensity is the independent variable, which is measured as the annual number of emissions (metric tons of CO_2-eq) per 1 billion USD EBITDA (per 0.1 billion dollars).

Control variables

In the multiple regression model, we selected net income (0.1 billion dollars) and capital expenditure (0.1 billion dollars) referred to as CAPEX as two controlled variables.

2.3 Methods

The research utilizes four multiple regression (from 2016-2019) models to testify the hypothesis, because whether the model represents a linear pattern can be efficacious to measure whether correlations exist between stock return and intensity of CO_2. Results from 4 different years can also be effective in eliminating implications brought by extrinsic factors.

3 RESULTS

3.1 Stock return, net income, CAPEX, and emission/EBITDA. Formulas 1 through 4 are stockreturn expressions for 2016, 2017, 2018, and 2019, respectively.

$$Stock\ return\ 2016 = 0.1663 + 0.000001\left(\frac{CO2}{NetIncome}\right) - 0.000002\left(\frac{CO2}{EBITDA}\right) + 0.000000CO2/CAPEX \quad (1)$$

$$Stock\ return\ 2017 = -0.0394 + 0.000009\left(\frac{CO2}{Netincome}\right) - 0.000019\left(\frac{CO2}{EBITDA}\right) + 0.000001CO2/CAPEX \quad (2)$$

$$Stockreturn\ 2018 = 0.0041\ -\ 0.000007\ CO2/EBITDA\ -\ 0.000001\ CO2/NET\ INCOME\ +\ 0.000002\ CO2/CAPEX \quad (3)$$

$$Stockreturn\ 2019 =\ 0.292\ -\ 0.000003\ (\frac{CO2}{EBITDA})\ -\ 0.000001\ (CO2/NET\ INCOME)\ +\ 0.000000\ (\frac{CO2}{CAPEX}) \quad (4)$$

The *P* values of CO_2/Net income, CO_2/EBITDA, and CO_2/CAPEX in stock return 2019 (Table 1) are 0.767, 0.82, and 0.85. As for stock return 2018 (Table 3), *P* values are 0.019, 0.307, and 0.136. In stock return 2017 (Table 5), *P* values are 0.52, 0.76, and 0.87. In stock return 2016 (Table 7), *P* values are 0.48, 0.44, and 0.58. Descriptive statistics of variables of all these years are described in Table 2, Table 4, Table 6 and Table 8. All these results actively demonstrate that these indicators do not have any statistical significance, and we can assume that the *P*-value of the intensity of CO_2 (measured by net income) in 2018 is due to some external factors. In a nutshell, all four multiple regression models do not elucidate our hypothesis very effectively that we dedicate to find, but it turns out that even though the net income is not very significant, it possesses the strongest relationship with stock return.

TABLE 1 DATA FOR 2019 STOCK RETURN

STOCK CODE	CO_2/EBITDA	STOCK RETURN	CO_2/NET INCOME	CO_2/CAPEX
COLM	84268	20.45%	131603	538005
TPR	5387	-18.81%	9062	21263
VFC	12045	51.12%	18515	76016
RL	7260	14.81%	14903	32483
CRI	12434	37.47%	21244	93954
TJX	15479	38.30%	25586	69581
GPS	20897	-29.57%	39836	56674
ADDDF	1974	53.92%	3381	8138
NKE	5405	38.48%	7472	26903
HNNMY	23181	45.48%	46203	-46521
LEVI	8236	-16.75%	19777	35127
HBI	29571	19.64%	52538	336742
GES	30761	8.99%	258454	33705
LULU	2153	94.25%	3728	7988
JWN	17698	-11.53%	45374	39130

TABLE 2 DESCRIPTIVE STATISTICS OF VARIABLES 2019

Variables	N	Mean	Mean Standard Error	Standard Error	Minimum Value	Median	Maximum Value
CO_2/EBITDA	15	18450	5269	20406	1974	12434	84268
STOCK RETURN	15	0.2308	0.0861	0.3336	-0.2957	0.2045	0.9425
CO_2/NET INCOME	15	46512	17242	66780	3381	21244	258454
CO_2/CAPEX	15	88613	38800	150273	-46521	35127	538005

TABLE 3 DATA FOR 2018 STOCK RETURN

STOCK CODE	CO_2/EBITDA	STOCK RETURN	CO_2/NET INCOME	CO_2/CAPEX
COLM	117097	16.62%	364382	717974
TPR	5499	-23.80%	12881	19147
VFC	12910	-5.18%	37978	99491
RL	8117	-1.58%	40017	40314
CRI	11833	-0.31%	19818	86366
TJX	16878	14.00%	30073	74155
GPS	20486	-24.98%	48246	55968
ADDDF	2183	4.71%	5178	7548
NKE	4867	16.70%	12974	24395
HNNMY	19023	-33.20%	34021	-44343
LEVI	9663	0.00%*	19399	46019
HBI	36514	-41.95%	498295	354436
GES	25031	21.50%	-432383	40296
LULU	3520	36.18%	7732	12669
JWN	16953	-5.00%	58775	35136

TABLE 4 DESCRIPTIVE STATISTICS OF VARIABLES 2018

Variables	N	Mean	Mean Standard Error	Standard Error	Minimum Value	Median	Maximum Value
CO_2/EBITDA	15	20705	7281	28198	2183	12910	117097
STOCK RETURN	15	-0.0175	0.0561	0.2172	-0.4195	-0.0031	0.3618
CO_2/NET INCOME	15	50492	50797	196735	-432383	30073	498295
CO_2/CAPEX	15	104638	49406	191351	-44343	40314	717974

TABLE 5 DATA FOR 2017 STOCK RETURN

STOCK CODE	STOCK RETURN	CO_2/EBITDA	CO_2/NET INCOME	CO_2/CAPEX
COLM	22.40%	208444	125804	800208
TPR	27.00%	8145	4813	17112
VFC	38.00%	23324	13981	113841
RL	14.00%	-70493	32558	24648
CRI	34.00%	25571	13253	74529
TJX	1.10%	35984	18611	80703
GPS	50.00%	65959	25774	85092
ADDDF	28.80%	5193	2758	8112
NKE	20.30%	5466	4094	20975
HNNMY	-24.90%	25412	15041	-35447
LEVI	0.00%*	19253	9350	54429
HBI	-4.53%	42137	27183	272514
GES	37.80%	165189	30119	41507
LULU	19.20%	5026	2987	10199
JWN	-1.90%	82899	21327	34688

TABLE 6 DESCRIPTIVE STATISTICS OF VARIABLES 2017

Variables	N	Mean	Mean Standard Error	Standard Error	Minimum Value	Median	Maximum Value
CO_2/EBITDA	15	23177	7771	30097	2758	15041	125804
STOCK RETURN	15	0.1742	0.0519	0.2011	-0.2490	0.2030	0.5000
CO_2/NET INCOME	15	43167	17513	67829	-70493	25412	208444
CO_2/CAPEX	15	106874	52743	204274	-35447	41507	800208

TABLE 7 DATA FOR 2016 STOCK RETURN

STOCK CODE	STOCK RETURN	CO_2/EBITDA	CO_2/NET INCOME	CO_2/CAPEX
COLM	21.70%	240912.7	137732.5	600712.3
TPR	8.20%	11305	6024.881	12845.05
VFC	-12.10%	21014.65	13328.08	81443.69
RL	-18.08%	18181.82	8154.02	17224.88
CRI	-2.84%	28592.81	14616.71	65702.39
TJX	7.40%	36520.19	19186.95	93526
GPS	-6.97%	54949.57	24576.37	69633.06
ADDDF	64.90%	9310.419	3937.858	11506.43
NKE	-16.80%	5427.074	3847.247	17852.84
HNNMY	-19.00%	20285.52	12710.23	-35217.9
LEVI	0.00%*	27183.01	11543.16	55646.67

HBI	-25.42%	53177.73	32445.76	229480.8
GES	-34.67%	42102.63	26882.75	41103.29
LULU	21.00%	5907.16	3556.622	10952.68
JWN	-3.78%	48637.83	18262.02	26971.07

TABLE 8 DESCRIPTIVE STATISTICS OF VARIABLES 2016

Variables	Mean	Mean Standard Error	Standard Error	Minimum Value	Median	Maximum Value
CO_2/EBITDA	22454	8541	33081	3557	13328	137732
STOCK RETURN	-0.0110	0.0627	0.2430	-0.3467	-0.0378	0.6490
CO_2/NET INCOME	41567	14874	57607	5427	27183	240913
CO_2/CAPEX	86626	39838	154293	-35218	41103	600712

4 DISCUSSION AND CONCLUSION

The particular reason that the intensity of CO_2 and EBITDA do not represent a linear pattern maybe that implications of CO_2 may not be considered by investors in the valuation of corporations. Based on this regression model, we can infer that carbon emission intensity alone and with other variables do not have a linear relationship with the annual stock return, based on the intensity of 2018 carbon emissions and 2019 stock return data. The deficiencies of this project are that we do not find an adequate number of corporations disclosing carbon emissions, thus the number of samples is restricted to 15 (lower than 40). Further specific research containing adequate data along with the perfection of the database should be conducted to fully understand the pattern between stock return and the intensity of carbon emission.

REFERENCES

[1] Schramade, W. (n.d.). Integrating ESG into valuation models and investment decisions: the Value Driver Adjustment Approach.

[2] Boscacci, E. (2018). Cicular economy in the Fashion Industry: turning waste into resources.

[3] Foundation, E. M. (2017). Beyond plastic Waste.

[4] R.J., O. (2006). Competitive environmental strategies: When does it pay to be green? California Mnagement Review.

[5] Palmer, k., Oates, W. E. & Portney, P. R. (2009). Measuring the effectiveness of Environmental Management Systems.

[6] Russo, M. V. (1997). A resource-Based Perspective on Corporate Environmental Performance and Profitability. Academy of management Journal.

[7] Orlitzky, Marc, Frank L. Schmidt, and Sarah L. Rynes. (2003). Corporate Social and Financial Performance: A Meta-Analysis.

[8] Zhenji Jin, Jian Xu. (2020). Impact of environmental investment on finance performance: Evidence from Chinese Listed Companies.
[9] Klassen, R.D. & Whybark, D. C. (1999). The impact of environmental management on firm performance. Management science.
[10] PENG Y., YUE J.G. (2016). Corporate environmental investment and financial performance based on investment structure.