The Influence of ESG Performance of Companies on Stock Excess Returns: A Case Study of Mining Companies in the U.S. Stock Market

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Abstract. The evaluation of environmental, social, and governance (ESG) performance has become increasingly important for companies to ensure their long-term sustainability and stability and for investors in assessing the financial performance and long-term prospects of companies. This paper selects 91 mining companies listed on the U.S. stock market from 2013 to 2022 and investigates the relationship between their ESG performance and stock excess returns. To contain more companies and to make the results more accurate, this paper classifies these companies into 12 groups according to their ESG scores from Bloomberg ESG database and uses them to construct four different investment portfolios. The relationship between ESG and excess return is further explored using descriptive statistics, regression analysis based on Fama-French three-factor model. The results show that the excess return on stocks varies widely between the best ESG performance companies and the worst performance ones, which could be explained by Market Risk Premium factor and Size factor in FF3 model. This paper provides valuable insights for investors and mining companies, demonstrating the importance of ESG factors when evaluating a company's long-term prospects and financial performance.

1 Introduction

Environmental, social, governance (ESG) is a comprehensive framework that aims to integrate into an organization's strategy while considering the diverse needs and ways of generating value for all stakeholders associated with the organization, including employees, customers, suppliers, and financiers. This framework has become increasingly important considerations in investment decision-making in recent years and gained significant attention as a way for companies to align their operations with societal and environmental concerns while simultaneously meeting their financial goals [1]. By incorporating ESG principles into their decision-making processes, organizations can enhance their reputation, reduce risk, and improve long-term sustainability. The mining industry is one of the sectors that have a significant impact on the environment and communities in which they operate. Mining activities can cause damage to local ecosystems and biodiversity, as well as negative impacts on the water, soil, and air quality of local communities, leading to land disputes and human rights issues [2-4]. Therefore, the ESG performance of mining companies is especially critical. All companies in this paper are selected in Basic Materials Sector on the U.S. stock market (NYSE, NASDAQ, OTCMarket), and their main business is mining (coking coal, copper, gold, silver, iron, non-ferrous, and other precious metals). These companies are divided into 12 groups in order of ESG scores, and every third group is constructed into a portfolio. In the OLS regression analysis, the excess return of each portfolio is set as the predicted variable, and Market Risk Premium factor, Size factor and Profitability factor in FF three-factor model calculated from these companies' stock prices and financial information are set as explanatory variables. The empirical results indicate that mining companies with good ESG performance have higher excess return compared with that with poor performance, which could be mainly explained by the market and size effect in FF three-factor model. This paper aims to contribute to the literature on ESG performance and its impact on stock returns, especially in areas related to the mining industry. The findings of this paper could help investors and mining companies make informed decisions about the im-portance of ESG factors when evaluating a company's financial performance and long-term prospects.

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2 Literature review

The ESG concept has its roots in the socially responsible investment (SRI) movement, which emerged in the 1960s and 1970s [5]. The United Nations Global Compact's report "Who Cares Wins: Connecting Financial Markets to a Changing World" (2004) identified ESG factors as important considerations for sustainable investment, which contributed to the increasing recognition of ESG in the 2000s [6]. Since then, the ESG concept has gained momentum, and the global sustainable investment market was valued at $31 trillion in 2020 [7].

ESG investing is motivated by ethical and financial considerations [8]. Ethical motivations include the desire to align investments with personal values, while fi-nancial motivations include the belief that ESG factors can enhance long-term fi-nancial performance [9]. Studies have shown that CSR activities can enhance firm value during periods of economic turmoil, and charitable giving can enhance firm value [10,11]. However, ESG integration in practice faces challenges such as data quality, standardization, and materiality issues [12]. Sustainable investing requires a deep understanding of ESG issues and a holistic approach to investment deci-sion-making [13].

Numerous studies have been conducted to investigate the relationship between ESG performance and stock returns. Some studies suggest that companies with high ESG scores tend to outperform those with low ESG scores, while others find no sig-nificant correlation between ESG performance and stock returns. For example, companies with strong ESG performance tend to have higher stock returns and lower volatility than those with poor ESG performance; firms with higher ESG ratings tend to have better stock performance than those with lower ESG ratings [14,15]. On the other hand, there is no evidence that ESG performance is associated with higher stock returns [16]. Therefore, the relationship between ESG performance and stock returns is complex, and the findings are not always consistent.

Mining companies have significant impacts on the environment and the commu-nities in which they operate. Therefore, ESG performance is especially critical for mining firms. Mining companies with strong ESG performance tend to have higher stock returns than those with poor ESG performance [17]. Additionally, Mining firms with high ESG scores tend to have lower idiosyncratic risk, indicating that ESG per-formance can reduce a company's exposure to risk [18].

3 Data and Methodology

3.1 Data

There exist various ratings and scores to assess ESG data disclosure. This paper employed Bloomberg's ESG scores to provide comparable data for analysis. Bloomberg's ESG scores represent a data-based metric for evaluating corporate ESG performance, which investors can employ to rapidly assess performance on key issues such as climate change, health and safety, and governance policies of companies [19]. The ESG_DISCLOSURE_SCORE in the database represents each company's year-end ESG scores; in this paper data from 2012 to 2021 were selected and deferred as 2013-2022 ESG scores of each company. History monthly data of stock prices, market cap and financial information from 2013 to 2022 were also got from Bloomberg database. In this paper, the history monthly data of U.S. Historical data of Market Risk Premium factor used in FF3 model, which is calculated as market returns minus risk-free returns, was replaced by monthly three-factor data for North America in Professor Kenneth R. French's data library [20].

The monthly returns of the sample stocks are calculated based on the monthly stock prices on Bloomberg as,

$$Stock\ monthly\ return = \frac{(Monthly\ stock\ price_{t+1} - Monthly\ stock\ price_t)}{Monthly\ stock\ price_t} \quad (1)$$

The companies' book-to-market ratio(B/M) at the end of each year is the inverse of the price-to-book ratio(P/B) available in Bloomberg database,

$$B/M = \frac{1}{P/B} \quad (2)$$

3.2 ESG Portfolios

Based on the ESG scores of companies, this paper establishes different investment portfolios and calculates the stock returns of equally weighted investment portfolios [21]. The range of Bloomberg's ESG scores is 100, with higher scores indicating better ESG performance. After sorting the ESG data, it was found that the number of companies with very high or very low ESG scores is relatively small, and the ESG scores of most companies are concentrated between 25-70 points, as shown in Figure 1. Therefore, considering the need for sufficient diversification of non-systematic risk in the investment portfolio and the actual data situation, this paper arranges all ESG scores of 91 companies from 2013 to 2022 in ascending order and divides them into 12 small groups, and then adjusts scores to each group. The group with the lowest ESG scores is assigned to group 1, while the group with the highest ESG scores is assigned to group 12. Based on this, this article uses these 12 small groups to construct investment portfolios. The groups assigned with adjusted scores of 10-12 are used to create a high ESG rating investment portfolio, referred to as Portfolio 1; the groups assigned with adjusted scores of 1-3 are used to create a low ESG rating investment portfolio, referred to as Portfolio 4. There are also two investment portfolios with ESG ratings in the middle, namely, groups with ESG adjusted scores between 7 and 9 and groups with ESG adjusted

scores between 4 and 6, referred to as Portfolios 2 and Portfolio 3, respectively.

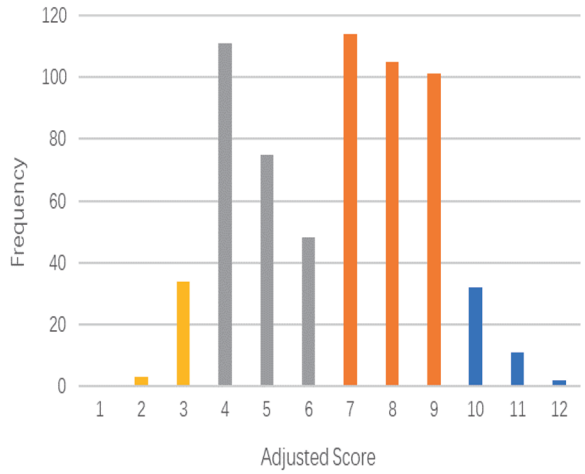

Fig. 1. Histogram of ESG scores.
Source: Bloomberg [22]

3.3 Fama-French Three-Factor Model

The FF three-factor model extends the CAPM model by incorporating the Size and Profitability factors that have explanatory power for stock returns. The model suggests that the expected excess return on a portfolio is primarily explained by three factors: the market premium, the return of portfolios with different market capitalizations, and the return of portfolios with different book-to-market ratios [23,24]. The specific formulation of the model is as follows:

$$R_{it} - R_{ft} = \alpha_i + \beta_{i1}(R_{mt} - R_{ft}) + \beta_{i2}SMB_t + \beta_{i3}HML_t + \varepsilon_{it} \quad (3)$$

where R_{it} represents the return on assets, R_{ft} represents the risk-free return, $R_{mt} - R_{ft}$ is the excess market return, SMB_t represents the market capitalization size factor, HML_t represents the book-to-market ratio factor; β_{i1}, β_{i2}, β_{i3} are the coefficients of $R_{mt} - R_{ft}$, SMB_t, HML_t respectively, ε_{it} is the residual term, and α_i is the intercept term [25].

Table 1. Construction of SMB & HML.

		B/M		
		H (33%)	M (33%)	L (33%)
Market Capitalization	B (50%)	BH	BM	BL
	S (50%)	SH	SM	SL

The monthly historical data in the U.S. market of $R_{mt} - R_{ft}$ was replaced by monthly three-factor data for North America in Professor Kenneth R. French's data library [20]. To calculate SMB_t and HML_t, the sample stocks are then cross grouped using a 2x3 matrix as shown in Table 1, which is adjusted every 12 months. Firstly, the total market value data of each stock at the end of December is found, and the sample stocks are sorted by the size of their total market value, and then divided into two groups, small-sized (S) and large-sized (B) stocks. Secondly, the book-to-market ratio of each stock at the end of each year is calculated, and the sample stocks are sorted into low-value (L), middle-value(M) and high-value (H) stocks according to the size of their book-to-market ratio in both the S and B groups. Finally, the sample stocks are divided into six portfolios, namely, the BH, BM, BL, SH, SM and SL portfolios. For convenience, the monthly average returns of each portfolio are denoted as BH, BM, BL, SH, SM and SL, respectively. Furthermore, based on the cross-grouping results, time series for the size factor SMB_t and the book-to-market ratio factor SMB_t (where t= 1,2,3. . . 120) can be constructed, and their calculation methods are as follows:

$$SMB = \frac{(SL+SM+SH)}{3} - \frac{(BL+BM+BH)}{3} \quad (4)$$

$$HML = \frac{(SH+BH)}{2} - \frac{(SL+BL)}{2} \quad (5)$$

4 Empirical Results and Discussion

4.1 Excess returns and ESG portfolios

According to ESG scores from Bloomberg database, this paper categorizes the stocks of major mining companies listed on the U.S. stock market into four portfolios. The monthly average returns of these portfolios are shown in Figure 2. Overall, it can be seen that during the period from 2013 to 2022, the monthly average returns of the high ESG rating portfolios were higher than those of the low rating portfolios. The monthly average return of Portfolio 1 (consisting of companies with the highest ESG scores) is nearly three times that of Portfolio 4 (consisting of companies with the lowest ESG scores).

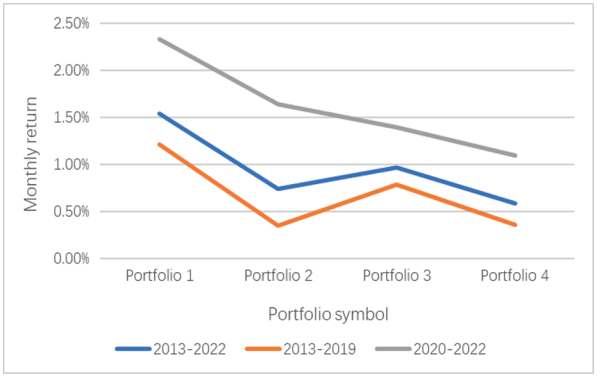

Fig. 2. Monthly return of portfolios.
Source: Bloomberg [26]

This paper further tests the relationship between ESG performance and stock excess returns based on Equation

(3). Using the ten-year excess returns as the explanatory variable and the three factors $R_{mt} - R_{ft}$, SMB_t and HML_t as the explanatory variables, the following results in Table 2 were obtained.

Table 2. OLS regression estimation for the relationship of ESG and returns I.

	Portfolio 1	Portfolio 2	Portfolio 3	Portfolio 4
Adjusted R^2	0.2157	0.2415	0.2242	0.1000
R_{mt}-R_{ft}	1.1096***	1.1103***	1.1483***	0.7478***
	(5.4633)	(5.8990)	(5.9763)	(2.7971)
SMB_t	-0.2916**	-0.1998	-0.1750	0.4174**
	(-2.1285)	(-1.5743)	(-1.3507)	(2.3149)
HML_t	0.0274	0.0816	-0.0053	0.1720
	(0.2338)	(0.7530)	(-0.0481)	(1.1167)
Intercept	0.0085	0.0015	-0.0002	0.0003
	(0.8591)	(0.1681)	(-0.0189)	(0.0245)

Note: The values in parentheses represent the t-values; ***, ** and * represent significant at 1%, 5% and 10% levels, respectively.

The regression coefficients of the $R_{mt} - R_{ft}$ factors of the four portfolios, β_{i1}, are all greater than 0, indicating that they follow the stock market fluctuations in the same direction; at the same time, the first three β_{i1} are all greater than 1, but the last portfolio's is smaller than 1, indicating that the market has a negative view of the future prospects of companies with the most poor ESG performance compared to those with other ESG performance. That is because companies with poor ESG performance may be seen as riskier investments due to potential regulatory or legal risks, reputational risks, or financial risks. This could result in lower expected returns for these stocks. The P-values for all four portfolios are less than 0.01, indicating that the finding that mining companies face more risk than the market risk is valid at the 99% significance level.

At the 95% significance level, we can compare the difference between mining companies in the first and last portfolio. The regression coefficients β_{i2} of the SMB_t factors of companies with good ESG performance is negative, while that of companies with poor performance is positive and their absolute value are all smaller than 1, which suggests that the market perceives small mining companies with good ESG performance to have lower expected returns than large mining companies, while small mining companies with poor ESG performance are expected to have higher returns than large mining companies; and the SMB factor is not a very significant driver of expected returns for either group of companies. In other words, the difference in expected returns between small and large mining companies is not very large compared to the overall market risk premium.

The regression coefficients β_{i3} of the HML_t factors for all four portfolios are relatively close with P-values greater than 0.1, indicating that the market does not perceive a significant difference in expected returns between value and growth stocks within the mining industry, regardless of their ESG performance. There could be several reasons for this. Firstly, the mining industry may not be strongly influenced by value or growth factors, or the market may not perceive a strong distinction between value and growth stocks within the industry. Secondly, the HML factor may not be a strong driver of expected returns in the mining industry compared to other industries.

4.2 The impact of Covid-19

The regression results of SMB and HML in the above regression are not significant. This paper continues to explore whether this phenomenon is caused by the influence of the mining industry itself or other external factors. Considering the events that have had a significant impact on the global economy in recent years, this paper selects Covid-19 as the starting point and divides the time series of the above regression into two segments for further regression analysis: one is from 2013 to 2019 before the outbreak of the pandemic, and the other is from 2020 to 2022 after the outbreak of the pandemic. The regression results are shown below.

Table 3. OLS regression estimation for the relationship of ESG and returns II.

	Portfolio 1'	Portfolio 2'	Portfolio 3'	Portfolio 4'
Adjusted R^2	0.1660	0.1416	0.1502	0.0285
R_{mt}-R_{ft}	0.9154***	0.8587***	0.9617***	0.5226
	(2.7465)	(2.8246)	(3.0230)	(1.5239)
SMB_t	-0.6905***	-0.5090***	-0.5130***	0.1564
	(-3.4495)	(-2.7878)	(-2.6849)	(0.7593)
HML_t	0.1457	0.1748	0.2054	0.2637
	(0.7237)	(0.9514)	(1.0685)	(1.2729)
Intercept	0.0110	0.0030	0.0074	0.0061
	(0.8235)	(0.2486)	(0.5832)	(0.4441)

Note: Portfolio i' represents ESG portfolios from 2013 to 2019 (where i=1,2,3,4). The values in parentheses represent the t-values; ***, ** and * represent significant at 1%, 5% and 10% levels, respectively.

Table 4. OLS regression estimation for the relationship of ESG and returns III.

	Portfolio 1''	Portfolio 2''	Portfolio 3''	Portfolio 4''
Adjusted R^2	0.5143	0.5250	0.5452	0.1320
R_{mt}-R_{ft}	1.3034***	1.3288***	1.3214***	0.9303*
	(6.0295)	(6.0806)	(6.5498)	(1.9512)
SMB_t	0.0619	0.0811	0.0100	0.6689*
	(0.3731)	(0.4840)	(0.6462)	(1.8291)
HML_t	0.1550	0.1863	0.0514	0.2599
	(1.1866)	(1.4107)	(0.4212)	(0.9020)
Intercept	0.0191	0.0131	0.0040	0.0006
	(1.3489)	(0.9134)	(0.2995)	(0.0184)

Note: Portfolio i'' represents ESG portfolios from 2020 to 2022 (where i=1,2,3,4). The values in parentheses represent the t-values; ***, ** and * represent significant at 1%, 5% and 10% levels, respectively.

The outbreak of Covid-19 led to widespread market disruptions and volatility, which could have affected the regression coefficients of Mkt-Rf. As it shows in Table 3, the initial shock of the pandemic led to a sharp decline in the stock market, which may have influenced investors' perceptions of the relationship between the market and individual assets. One possible explanation for the increase in the regression coefficients of Mkt-Rf after the outbreak of Covid-19 is that investors became more risk-averse and sought out assets that were more closely tied to the overall market. As a result, assets that were previously less sensitive to market movements may have become more closely correlated with the overall market, leading to an increase in the regression coefficients of Mkt-Rf. Additionally, government stimulus measures

and other market interventions may have influenced market dynamics in ways that were not captured by the pre-pandemic coefficients. For example, the Federal Reserve implemented a series of interest rate cuts and other measures to support the economy and financial markets, which could have affected the relationship between the market and individual assets. It is important to note that changes in the regression coefficients of Mkt-Rf may reflect changes in market dynamics and investor perceptions, but they do not necessarily reflect changes in the fundamental value of the underlying assets. Therefore, it is important to interpret the results of the model in conjunction with other information about the assets and the broader market environment.

The regression coefficients of SMB showed similar changes. It is possible that the regression coefficients of SMB changed from negative to positive after the outbreak of Covid-19 due to changes in market dynamics. The outbreak of Covid-19 led to widespread market disruptions and volatility, which could have affected the relative performance of small and large companies. One possible explanation is that smaller companies were hit harder by the pandemic due to their smaller scale and resources, while larger companies were better able to weather the storm. This could have led to a temporary shift in market expectations, with investors perceiving small companies as having lower expected returns than large companies. However, as the markets began to recover from the initial shock of the pandemic, the relative performance of small and large companies may have started to shift again. This could have led to a change in the regression coefficients of SMB, with small companies once again being perceived as having higher expected returns than large companies.

5 Conclusion

This paper's empirical results and discussion demonstrate a positive correlation between the ESG performance of major mining companies listed on the U.S. stock market from 2013 to 2022 and their stock returns. Specifically, companies with higher ESG scores exhibit higher monthly average returns than those with lower scores, while companies with poorer ESG performance are viewed unfavorably compared to their peers. Additionally, smaller mining companies with good ESG performance are expected to yield lower returns than larger counterparts, and vice versa for those with poor ESG performance. Notably, the market appears indifferent to ESG considera-tions when evaluating value and growth stocks within the mining industry. However, the outbreak of Covid-19 has impacted market dynamics, which may affect the Mkt-Rf and SMB regression coefficients. Therefore, it is necessary to interpret the model results in conjunction with other information on assets and the broader market environment. In conclusion, our findings emphasize the importance of ESG perfor-mance as a key consideration for investors in the mining industry. Companies with better ESG performance may possess a competitive advantage in terms of expected returns.

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