

Research on the Norilsk Nickel under climate change-based on the Fama-French model

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Abstract. Global warming is becoming more serious, and climate change around the world poses enormous challenges and opportunities for economic activity in all fields. The risk of climate change has become a common risk faced by many companies around the world. Then this paper selected three different companies in the mining industry. They are Anglo American plc, BHP Group Limited and Norilsk Nickel gave a basic introduction to the company and counted their financial situation. Then this article collects the five-year monthly maximum temperature, minimum temperature and average temperature in the Arctic to directly show the direct and significant impact of global warming on the earth. Among them, a company in Russia was selected for Fama-French model analysis, and the linear regression results were obtained. It can be seen that climate change has different degrees of impact on MKT, SMB and HML. Among them, MKT (market risk premium) has the greatest impact on it, indicating that the company's own business is relatively stable, and the price is not significantly affected by its own fluctuations, but is greatly affected by the market and industry.

1 Introduction

Global warming is becoming more and more serious, and climate change around the world has brought great challenges and opportunities to economic activities in various fields. According to the 2018 Global Risk Report, between 1997 and 2016, global losses directly from extreme weather events reached 3.16 trillion US dollars. With the growth of risks, it is becoming more and more important for companies to solve and assess the problem of climate change.

This essay selected three companies in the mining industry for introduction and analysis, all of which have been affected by global climate change. They are Anglo American plc (AAL), BHP Group Limited (BHP) and Norilsk Nickel. Among them, I chose Norilsk Nickel to do Fama French model analysis and the result of linear regression is obtained. Results The surface market risk Premium has the greatest impact on the company, while SMB and HML will have an impact on the company, but the probability is low. Global warming has become a common problem in the international climate. Whether in the Arctic area or in various countries at the equator area, companies are becoming more and more important for the adaptation of nature. Scholars are of great significance for the analysis of the current situation and the study of adaptation development strategies in this regard.

2 Literature review

ESG investment from the aspects of theoretical basis, investment behavior and sustainable development of enterprises. This study holds that ESG performance is a combination of three dimensions: environment, society and corporate governance. This study innovatively introduces R&D investment into the relationship between ESG performance and enterprise innovation performance, and studies the intermediary role of R&D investment in ESG rating performance to improve enterprise innovation performance [1]. However, in academic circles, there are also diametrically opposite research results, which believe that enterprises bear the responsibility of environment, society and governance, and considering more long-term growth project investment in decision-making will affect the economic growth of enterprises in the short term, leading to environmental, social and governance performance, which is negatively related to the profitability of enterprises [2]. Enterprises are requested to assume a leadership position by adopting environmental, social, and corporate governance principles and policies, and providing information and reports on related performance in a consistent and standardized format. They ought to identify and convey key challenges and value drivers while prioritizing environmental, social, and governance issues accordingly. Our position is that this information is most effectively communicated to financial markets using traditional investor relation channels, and we advise companies to expressly mention it when relevant in their annual reports. Companies should accept both positive and critical

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findings generated by financial research in this domain. [3].

It has been found that when CAPM model is used to measure the relationship between expected return and market risk, the Beta value to measure the systemic risk of assets cannot fully represent all the excess returns, and besides market factors, there are also scale factors and value factors that may affect the excess returns [4]. And some literature believes that the excess income in the above differences is part of the compensation for the risk factors that Beta in CAPM fails to reflect. According to the ratio of circulating market value to book market value, Fama and French calculated the scale factor SMB and the value factor HML, and constructed Fama-French three-factor model (FF-3) [5]. All kinds of foreign empirical evidence strongly prove that FF-3 can effectively improve the explanation of portfolio excess returns and better explain the changes of stock returns [6].

As the core driving force of the operation of the social and economic system, the energy industry is affected by changes in climatic conditions in production, transportation, consumption and other links. This impact is mainly reflected in two aspects: one is the pulling effect of changes in meteorological conditions on energy demand and the other is the destructive effect of meteorological disasters on energy output [7]. In this sector, the key components comprise of extracting raw materials, transporting raw materials, generating energy, and transmitting energy. Among these components, energy production and transmission are particularly delicate and susceptible to the effects of climate change. Severe temperatures have the potential to alter the physical characteristics of the transmission infrastructure, leading to a significant reduction in energy transmission efficiency [8]. It has been analyzed that the extreme climate impact on the mining industry from the perspective of adaptability, and pointed out that the mining industry in Australia accounts for 7% of GDP. In recent years, floods caused by extreme precipitation have repeatedly attacked the mining industry in Australia, directly affecting the economic growth of the mining industry [9]. Also, other scholar used DEA method to analyze the coupling relationship between mining economy and environment from the perspective of ecological fragility, and considered that environment is an important factor affecting the economic growth of mining industry, and economic growth will also have a certain impact on the occurrence of environment [10].

3 Mining and some selected companies

The focus of this scholarly article centers on the analysis of the mining industry, delving into the complex process of extracting valuable geological materials from the Earth and other celestial bodies. It is widely known that agriculture and manual manufacturing are incapable of producing most materials that require mining, hence making it essential for the development of various industries. However, the mining process is dependent on investment, labor, energy, refining, and transportation

costs. Large amounts of water are required, with mining operations and transportation strongly influenced by geographical and weather factors.

Despite mining's beneficial impact on various industries, it can cause adverse effects on the environment, leading most world countries to pass legislation to mitigate its impact. Notwithstanding, mining still plays a vital role in generating business for rural, remote, or economically depressed communities. Production safety has been a significant concern for a while, with modern practices leading to significant safety improvements in mining. Nevertheless, unregulated or poorly managed mining, especially in developing economies, can lead to local human rights abuses and resource conflicts.

Three companies deserve attention within the mining industry, namely Anglo American plc (AAL), BHP Group Limited (BHP) and Norilsk Nickel. AAL, a multinational mining company based in London, UK, is the leading global producer of platinum, as well as a significant producer of coal for steelmaking, diamonds, copper, nickel, and iron ore. With operations spanning six continents, AAL has mining activities in Africa, Asia, Australia, Europe, North America, and South America. BHP, an Australian firm that deals with mining, natural gas, metals, and petroleum, boasts the largest market capitalization of any mining company globally. Norilsk Nickel, a smelting and mining company that handles nickel and palladium, is the world's top refined nickel producer and ranks 11th in global copper production. Although Norilsk Nickel holds stakes in mines in northern Europe and South Africa, all its mining activities are located in the colder latitudes of Russia.

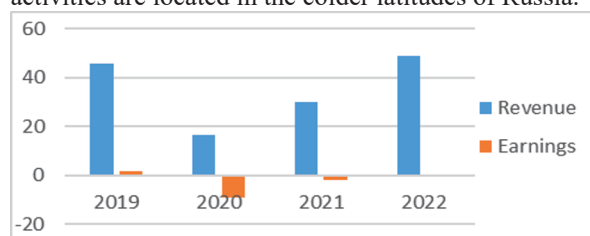


Fig.1. Revenue and earnings in AAL (in billion)
 Source: Yahoo Finance [11]

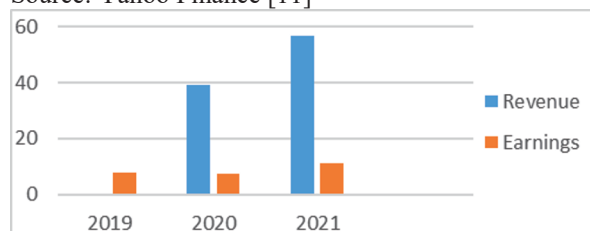


Fig.2. Revenue and earnings in BHP (in billion)
 Source: Yahoo Finance [12]

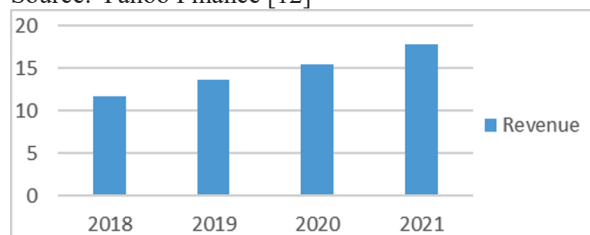


Fig.3. Revenue in Norilsk Nickel (in billion)
 Source: Nornickel [13]

4 Arctic temperature conditions

Due to the influence of global warming, the temperature around the world has generally risen, and at the same time, it has caused many extreme weathers. For example, in 2014, the Indian capital, New Delhi, suffered from high temperature weather for several days, the highest of which was 47.8 degrees Celsius, and several circuits failed, resulting in the interruption of power supply and water supply. Secondly, from the impact point of view, the most direct impact of climate warming is the melting of glaciers and the rise of sea level. The Arctic is the most typical, and the temperature in the Arctic rises, even reaching 38 degrees Celsius in 2020.

Norilsk Nickel is located in Russia and will be affected by climate change.

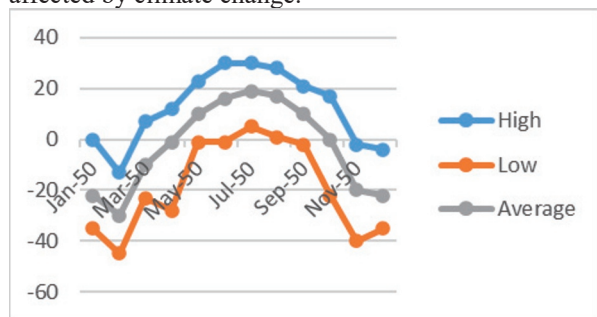


Fig.4. Arctic temperature in 1950 [14]

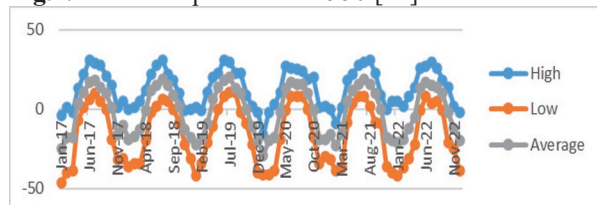


Fig.5. Arctic temperature in recent five years (2017-2022)

Table. 1. Linear regression result

	Coef.	Std.Err	t	P>t	[95% Conf.	Interval]
MKT	1.000056	0.0259224	38.58	0.000	0.9481274	1.051985
SMB	-0.0066179	0.0112769	-0.59	0.560	-0.292082	0.0159723
HML	-0.0012118	0.0073224	-0.17	0.869	-0.158805	0.0134568
_cons	0.0685039	0.1575707	0.43	0.665	-0.2471481	0.3841559

Above all, in the regression results, if the P value of MKT is 0.000 less than 0.01, the significance level of 1% is significant. The baseline regression result is better, and the Coefficients value is 1.000056, which will have a positive impact.

The regression results showed that the Coefficients values of SMB and HML were -0.0066179 and -0.0012118, respectively, indicating a negative impact. However, the P value of both of them is large, the significance level is not significant, and the possibility of occurrence is small.

7 Conclusion

5 Fama and French Model

5.1 Introduction

Fama and French extracted three important influencing elements from the many factors that can explain stock yield, namely, market risk premium factor, market value factor and B/M Ratio. Then a linear model is built by imitating CAPM model with these three factors to explain the return rate of stocks.

- Market risk premium factor (Mkt-RF): the rate of return corresponding to the market portfolio.
- Small Minus Big (SMB): The yield of a portfolio that is long smaller companies and short larger companies.
- High Minus low (HML): corresponds to the yield of a portfolio that is long a high B/M ratio and short a low B/M ratio.

5.2 Formula

$$R_m(t) - R_f(t) = a + b(R_m(t) - R_f(t)) + s \text{ SMB}(t) + h \text{ HML}(t) + e(t) \quad (1)$$

$R_m(t) - R_f(t)$ stands for market premium

SMB stands for Market value factor

HML stands for Book market capitalization ratio factor

6 Results

Since the business scope of AAL and BHP is too wide and ESG risk data is difficult to obtain and classify, we chose Norilsk Nickel, whose business is all within Russia and both located in the mid- to high-latitude region, as the subject of our study alone.

The issue of climate change has affected many fields to varying degrees, and Norilsk Nickel in the mining industry have also been challenged. According to the temperature chart of the Arctic in the past five years, it can be seen that the highest temperature in the Arctic is gradually rising, and the average temperature is also higher than before. This is a huge challenge for the Norilsk Nickel in Russia. According to the linear regression model, it can also be seen that during the period of global warming, the company has indeed been greatly affected. Among them, market risk Premium has the greatest impact on it, indicating that the company's own business is relatively stable, and the price is not significantly affected by its own fluctuations, but is greatly affected by the market and industry. This also

shows that it is particularly important for companies to make changes to adapt to environmental changes.

14. Weather Spark, <https://zh.weatherspark.com/>

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