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Is ESG a Novel Pricing Risk Factor for the Chinese Stock Markets during COVID-19?

Weitao Zhou[1,a,*]

[1]*King's Business School, King's College London, London, WC2R 2LS, United Kingdom*
a. weitao.zhou@foxmail.com
**corresponding author*

Abstract: This paper examines the potential of ESG as a novel risk factor, explaining different industry portfolio returns from 2018 to 2021 (including two years of the unique COVID-19 window). The ESG factor(SMU) is designed as the spread between the top 30% high-ESG(Sustainable) group and the bottom 30% low-ESG(Unsustainable) group. Based on empirical evidence from the Chinese stock markets, this paper finds: 1) The ESG factor significantly explains industry returns along with Fama-French three factors; 2) Sustainable portfolios consistently outperform unsustainable groups, particularly during the pandemic period; 3) Modified models with ESG factors slightly outperform the classic FF-3 model according to the GRS F-test; and 4) Industry portfolio returns during COVID-19 are surprisingly higher than in normal times, most likely due to the central bank and government's Quantitative Easing(QE) policies.

Keywords: ESG Risk Factor, COVID-19, China Stock Markets, Asset Pricing, Fama-French models.

1. Introduction

ESG(environmental, social, and governance) investing, which originated in Europe, has gradually become a mainstream investing principle among global institutional investors. According to the Global Sustainable Investment Review 2020[1], ESG investment has reached a scale of $35.3 trillion globally in 2020 (representing 36% of worldwide investments), 15.1% higher than in 2018 and 54.2% higher than in 2016. In China, ESG investing is not yet as mature as in developed markets. However, this philosophy has recently been accepted and supported by governments, regulatory departments, and institutional investors, particularly in mutual funds. Until the end of 2o21, the size of narrow-sense ESG investing(mutual funds and private equity funds) had exceeded 749(549 and 200, respectively) billion RMB [2]. Companies with high ESG ratings face fewer downside risks and, as a result, are more resilient during crises [3].

In December 2019, the first known cases of novel contagious pneumonia, later named 'COVID-19', were identified in Wuhan, China. Shortly after the lockdown of Wuhan in 2020-01-23, China's stock markets closed for the Spring Festival. On February 3, 2020, stock markets reopened, and the CSI ALL(Comprehensive Index) plummeted 8.2% from 4489 to 4121 points [4]. Markets rebounded quickly, fluctuating around 4600 points for the remainder of February.

The Fama-French Three-Factor Model (abbreviation FF-3 Model) [5] is an asset pricing model developed in 1992, adding size risk and value risk factors to the original market risk factor in the

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capital asset pricing model (CAPM). Although FF-3 performed well in explaining the variation of US stock market returns from 1963 to 1991, the model's performance faded over time and across countries, especially in emerging countries like China. The evolution of risk factors and asset pricing models is an ongoing and endless development [6]. Meanwhile, the ESG investing strategy is becoming prevalent across the world. Therefore, this paper proposes a meaningful hypothesis that ESG could be a new risk factor in asset pricing models. A more comprehensive pricing model that integrates ESG rating is worth investigating, particularly during a pandemic when investors seek safe investments.

The structure of the paper is as follows. Section 2 reviews relevant literature, and Section 3 describes data, factor construction, and pricing models. Empirical results are presented in Section 4, and Section 5 concludes the paper. To the author's knowledge, this is the first paper considering ESG ratings in China Stock Markets during the COVID-19 pandemic as a new systematic risk factor in addition to the Fama-French asset pricing models. Taking advantage of the special circumstances, the author contributes to the literature by empirically testing: 1) whether ESG is a competent, novel risk factor that could be added to traditional asset pricing models; and 2) whether investors could earn higher returns and mitigate downside risks by adopting an ESG investing strategy, especially during times of crisis.

2. Literature Review

Recent literature primarily supports the view that ESG rating is positively related to market return, though early evidence on the benefits of ESG investment is mixed. Gillan, Koch, and Starks [7] point out that high ESG ratings can significantly decrease companies' risks, including systematic, credit, legal, and downside risks. Further, this would affect firms' cost of capital and investors' required rate of return. Ultimately, the change in cost can influence firm value and market performance. Díaz, Ibrushi, and Zhao [8] empirically prove that ESG is indispensable in asset pricing and significantly explains portfolios' returns during COVID-19. Broadstock et al. [3] found that ESG could mitigate financial risks during the financial crisis and a high-ESG portfolio generally performed better than a low-ESG portfolio. Three-factor models with market, size, and ESG factors outperform the Fama-French three-factor model [9].

Motivated by Lewellen, Nagel and Shanken[10], this paper runs models on six industry portfolios instead of the traditional double sort portfolios used by Fama and French[5][11]. They evaluated a group of asset pricing models (including FF-3) and mainly criticized overestimated R2 caused by similar construction of LHS portfolios and RHS factors [10]. One suggestion proposed is to build LHS portfolios based on characteristics different from those utilized to develop RHS factors, such as industry portfolios.

Previous ESG-related work mainly focused on developed markets, such as the USA [8][11] and Europe [9], over regular periods. Nevertheless, empirical evidence based on emerging markets like China, whose economic environments and capital market openness are quite different from those of developed countries, is quite limited. As a result, the author is motivated to contribute to and enrich the extant literature, especially under such unique circumstances.

3. Data and Models

3.1. Data

Stock returns and company fundamentals are obtained from CSMAR [12], a top Chinese financial data solution provider. The sample consists of 3430 stocks that had Wind ESG ratings in January 2018. Approximately 40% of the sample stock is listed on the Shanghai Main Board, 40% on the Shenzhen Main Board, and 20% on the Growth Enterprise Market(GEM). To avoid abnormal return

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biases caused by infrequent events such as mergers and acquisitions suspensions, the author deletes stock returns for months with fewer than 15 trading days. Monthly return and market cap are winsorized at 1% and 99%.

ESG data is downloaded from Wind [13]. The distinguishable advantages of Wind ESG data are preciseness, richness, and timeliness: ESG scores with percentile accuracy are updated quarterly and cover almost all A-share stocks. The Wind rating system is constructed following top-down approaches: 3 primary dimensions (environmental, social and governance), 27 secondary specific topics, and 300+ AI-driven tertiary indicators. Meanwhile, firm ratings are downgraded in the case of negative incidents, such as penalties from regulators and media coverage of controversial events. Based on indicator scores and 62 sector-specific weighting matrices, each company is assigned an ESG score ranging from 0.01 to 9.99 every quarter. Higher scores indicate better ESG performance and lower ESG risks.

3.2. Portfolio Construction

Stockpool is divided into six left-hand-side(LHS) industry portfolios (Finance, Utilities, Properties, Conglomerates, Industrials, and Commerce) according to the CSMAR Industry Classification Standard. Each month, industry portfolio returns are computed from the total market value weighted-average monthly excess return of stocks within the group.

Four right-hand-side(RHS) factors(market, size, value, and ESG premium) are used in this paper. Monthly data of traditional Fama-French 3 factors, weighted on total market value, are retrieved from the CSMAR database. Market risk premium is computed as the mean return of the market portfolio minus the risk-free rate(3-month benchmark time deposit rate set by China's central bank). Size and value premium factors are calculated following Fama-French's approach of 2*3 sorts. Specifically, stocks are split at the median market cap into two size groups: small(S) and big(B). Similarly, the universe is separated into three B/M groups: the top 30%(high, H); the middle 40%(neutral, N); and the bottom 30%(low, L). Size factor SMB(Small minus Big) is the return difference between small-sized and large-sized firm portfolios, whereas value factor HML(high minus low) represents the return difference between high-B/M and low-B/M stock portfolios.

ESG factor is constructed following similar methodologies. On the first trading day of each quarter from 2018 to 2021, the pool of shares is grouped into three ESG portfolios according to ESG score: the top 30%(sustainable, S); the middle 40% (neutral, N); and the bottom 30%(unsustainable, U). Then SMU is calculated as the variation of the mean monthly return between the sustainable and unsustainable groups.

3.3. Factor Models

$$R_{it} - R_{ft} = \alpha_{it} + \beta_1(R_{Mt} - R_{ft}) + \epsilon_{it} \quad (1)$$

$$R_{it} - R_{ft} = \alpha_{it} + \beta_1(R_{Mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \epsilon_{it} \quad (2)$$

$$R_{it} - R_{ft} = \alpha_{it} + \beta_1(R_{Mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 SMU_t + \epsilon_{it} \quad (3)$$

$$R_{it} - R_{ft} = \alpha_{it} + \beta_1(R_{Mt} - R_{ft}) + \beta_2 HML_t + \beta_3 SMU_t + \epsilon_{it} \quad (4)$$

$$R_{it} - R_{ft} = \alpha_{it} + \beta_1(R_{Mt} - R_{ft}) + \beta_2 SMB_t + \beta_3 HML_t + \beta_4 SMU_t + \epsilon_{it} \quad (5)$$

Where:

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R_{it} = monthly return of portfolio i at time t;
R_{ft} = risk-free rate of return at time t;
R_{Mt} = total market portfolio return at time t;
SMB_t = Size Premium(Small minus Big) at time t;
HML_t = Value Premium(High minus Low) at time t;
SMU_t = ESG Premium(Sustainable minus Unsustainable) at time t;
$\beta_{1,2,3,4}$ = factor coefficients;
α_{it} = alpha of portfolio i at time t;

Equation(1) is the fundamental asset pricing model, CAPM. Later in 1993, Fama and French[5] developed this model by adding two risk factors(size and value premium in equation(2). This paper further hypothesizes the ESG premium as a new risk factor, thereby generating three additional models based on FF-3.

4. Empirical Results

4.1. Summary Statistics

Table 1 reports descriptive statistics(mean, standard deviation) and a correlation matrix for four independent variables, namely market premium(MKT), size factor (SMB), value factor(HML), and ESG factor(SMU), during the period of Jan. 2018 through Dec. 2021(48 months). All variables except HML have a positive mean, suggesting small market-value and sustainable firms have higher returns on average. For instance, investors could enjoy a 0.13% monthly premium by investing in sustainable companies. The market premium has the highest mean of 0.50% per month, while HML has the lowest mean of -0.65%, implying that high B/M stocks in China earn lower returns than their low B/M counterparts. Panel B shows four pairwise correlations between factors are negative, three of which are significant. Only the correlations between MKT and SMB, SMU and HML are positive. Interestingly, the correlation between SMB and SMU is the lowest(-0.63), probably because larger firms tend to have higher ESG scores in China.

Table 1: Summary statistics and Correlation Matrix.

Panel A: Summary Statistics			Panel B: Correlation Matrix (*p<0.05)			
Variable	Mean	Std. Dev.	MKT	SMB	HML	SMU
MKT	0.50%	4.63%	1.00			
SMB	0.11%	3.90%	0.13	1.00		
HML	-0.65%	3.42%	-0.36*	-0.45*	1.00	
SMU	0.13%	1.47%	-0.01	-0.63*	0.10	1.00

Table 2: Descriptive statistics of ESG scores by size group.

Size	Mean	Median	Std. Dev.
1	5.85	5.81	0.64
2	6.01	5.97	0.66
3	6.14	6.08	0.72
4	6.46	6.40	0.87
Total	6.12	6.03	0.76

This explanation is supported by Table 2, which shows the mean, median, and std of ESG scores in four size groups. Each month, stocks are sorted by total market value and distributed into the relative size groups(group 1 consists of stocks with the smallest capital, and group 4 comprises the largest-cap stocks). From Table 2, it is evident that ESG score is positively correlated with size. For

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example, Group 4 has the highest mean score of 6.46, in contrast to the lowest mean score of 5.85 in Group 1.

Figure 1 plots the cumulative value of two quarterly re-balanced ESG subgroup portfolios and a market benchmark(CSI ALL Index) over 48 months. For the convenience of comparison, all three portfolios' values are set as 100 at the beginning of 2018. Every quarter, stocks with the top 30% ESG score are allocated to the sustainable portfolio, while the bottom 30% stocks constitute the unsustainable portfolio. Choosing the CSI ALL Index as the benchmark is mainly due to the similarity in composition between sample stocks and the index. From Figure 1, the sustainable group consistently dominates the unsustainable portfolio, especially after the outbreak of COVID-19 at the end of 2019. In addition, the value of the sustainable portfolio is higher than that of the CSI ALL index most of the time. In sum, a sustainable investing strategy in the Chinese market allows investors to earn significantly higher returns even during regular times, not to mention during pandemic periods.

Figure 1: Value Comparison for Sustainable, Unsustainable portfolio and CSI ALL Index.

Another interesting observation from Figure 1 is that the value of all portfolios increases substantially during the pandemic, mainly in response to efficient anti-pandemic measures and monetary support from the central bank. This phenomenon is not unique to China, but is found in almost every country, including the United States, Japan, and European countries. For instance, FTSE All-World Index saw a 35% growth from 370 points at the beginning of 2020 to 500 points at the end of 2021, triggered by aggressive fiscal and monetary policies(worth a tremendous amount of 32 trillion US dollars) enacted by central banks of major economies worldwide.

4.2. ESG and Model Performance

Table 3 reveals the excellent performance of ESG models, no matter in terms of R2 or SMU significance. Five asset pricing models(CAPM, FF-3, and three ESG-modified models) are examined with the return of all industry portfolios as the dependent variable. As for R2, model 5 explains as much as 83.44% of the monthly returns, in contrast to 79.51% explained by CAPM. ESG factor(SMU) is significant at the 1% level in all three models, implying that ESG is a reasonable risk factor in asset pricing models. The coefficient of SMU is positive in model 3(0.20) and 5(0.11) but negative in model 4(-0.26). The negative sign is primarily because of the negative correlation (-0.63) between

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SMU and the omitted factor SMB, as provided in Table 1. After adding SMB in model 5, the coefficient of SMU(0.11) becomes positive again.

Table 3: Empirical results of different models.

	CAPM	FF-3	ESG Models		
Factors	(1)	(2)	(3)	(4)	(5)
MKT	1.05***	0.99***	1.02***	0.99***	0.99***
	(827.2)	(716.1)	(841.9)	(701.1)	(711.1)
SMB		0.20***	0.31***		0.23***
		(111.8)	(158.8)		(104.8)
HML		-0.15***		-0.24***	-0.13***
		(-59.0)		(-106.3)	(-51.9)
SMU			0.20***	-0.26***	0.11***
			(37.8)	(-55.7)	(19.6)
_cons	0.011***	0.011***	0.011***	0.011***	0.010***
	(184.3)	(186.6)	(186.4)	(175.4)	(179.7)
R2	0.7951	0.8339	0.8298	0.822	0.8344

t statistics in parentheses * p<0.1 ** p<0.05 ***p<0.01

Table 4 demonstrates that, for most industries, ESG is imperative in explaining returns and has a positive impact. The regression adopts the four-factor ESG Model (Model 5 in Table 4) for six industries. R-square is above 80% across five industries, except in Conglomerates(39%). The main reason is that the Conglomerates industry portfolio only averages 76.3 stocks per month, accounting for 2.3% of the whole sample. For the same reason, SMU is not significant in Conglomerates portfolio but significant at 1% in any other sector. The coefficient of SMU is positive in four out of six industries (Utilities(0.98), Properties(0.30), Conglomerates(0.064) and Commerce (0.94)), revealing SMU's beneficial effects on the returns of these industry portfolios.

Table 4: Empirical Results of Four-Factor ESG Model by six sectors.

	Finance	Utilities	Properties	Conglomerates	Industrials	Commerce
Factors	(1)	(2)	(3)	(4)	(5)	(6)
MKT	1.20***	0.97***	1.18***	1.01***	0.97***	1.01***
	(139.7)	(347.2)	(238.4)	(56.5)	(770.6)	(168.4)
HML	0.57***	-0.13***	1.05***	0.054**	-0.29***	0.21***
	(51.0)	(-44.6)	(109.0)	(2.2)	(-130.2)	(22.8)
SMB	-0.095***	0.50***	0.52***	0.21***	0.12***	0.70***
	(-9.4)	(157.8)	(50.6)	(7.7)	(84.7)	(71.2)
SMU	-0.13***	0.98***	0.30***	0.064	-0.18***	0.94***
	(-5.6)	(101.5)	(11.8)	(0.9)	(-37.4)	(35.3)
_cons	0.0027***	0.0025***	0.0027***	0.013***	0.014***	0.00038
	(8.6)	(28.1)	(10.4)	(13.3)	(287.8)	(1.2)
N of Stocks	93.1	597.3	173.9	76.3	2270.5	163.1
R-sq	0.88	0.91	0.84	0.39	0.93	0.80

t statistics in parentheses * p<0.1 ** p<0.05 *** p<0.01

Table 5 displays the regression results of COVID-19 on portfolio returns, depicting the positive impact of pandemic and insurance traits of sustainable stocks. COVID-19 is a binary dummy variable(equals one after Dec. 2019, zero otherwise), reflecting the pandemic's fixed time effect on returns over a regular period. SMU multiplied by the COVID-19 dummy separately captures the influence of ESG during the epidemic. R-square climbs slightly with the inclusion of factors, and all

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independent factors are significant at the 1% level in 4 models. In model 3, COVID-19's surprisingly positive coefficient(0.0063) indicates that monthly portfolio returns are even 0.63% higher than in ordinary times, primarily caused by the effect of Quantitative Easing(QE) mentioned earlier. It is interesting to note that the coefficient on SMU(-0.13) is negative in model 4. Such results are also recognized in recent literature and explained by the insurance function of sustainable stocks[3]. Investors are willing to pay insurance premiums through lower returns over regular periods in exchange for the benefits of resilience during a crisis. The positive coefficient of SMU*COVID-19 (0.30) in model 4 also supports the protective effect of High-ESG firms.

Table 5: The Impact of COVID-19 on Portfolio Returns.

	Dependent Variable: Portfolio Returns							
Factors	(1)	(t-stats)	(2)	(t-stats)	(3)	(t-stats)	(4)	(t-stats)
MKT	0.99***	(716.1)	0.99***	(711.1)	0.99***	(706.6)	0.98***	(700.1)
HML	-0.15***	(-59.0)	-0.13***	(-51.9)	-0.13***	(-52.4)	-0.12***	(-48.5)
SMB	0.20***	(111.8)	0.23***	(104.8)	0.23***	(102.2)	0.21***	(94.8)
SMU			0.11***	(19.6)	0.13***	(23.4)	-0.13***	(-16.7)
COVID-19					0.0063***	(57.6)	0.0057***	(51.8)
SMU*COVID-19							0.30***	(33.7)
_cons	0.011***	(186.6)	0.010***	(179.7)	0.0073***	(111.8)	0.0082***	(123.0)
R-sq	0.8339		0.8344		0.8375		0.8384	

t statistics in parentheses * p<0.1 **p<0.05 *** p<0.01

Table 6. GRS F-test of Models

Right-Hand Side Models	Panel A: Industry Portfolios(t-statistics)			Panel B: Left-Hand Side Models(p-value)		
	GRS F-test	mean |alpha|	Mean adj R2	FF-3	MKT SMB SMU	MKT HML SMU
(1) FF-3	14.75***	0.0062***	0.765	-	0.1095	0.1095
		(106.76)			(0.95)	(0.95)
(2) MKT SMB SMU	15.18***	0.0055***	0.714	0.2724	-	-
		(109.86)		(0.85)		
(3) MKT HML SMU	14.04***	0.006***	0.74	0.0016	-	-
		(101.64)		(0.99)		
(4) MKT SMB HML SMU	14.41***	0.0059***	0.773	-	-	-
		(107.02)				

* p<0.1 ** p<0.05 *** p<0.01

To test the performance of FF-3 and ESG-related models, the author follows many scholars, including Fama and French [11], to conduct the GRS F-test proposed by Gibbons, Ross, and Shanken[14]. The null hypothesis is that the joint alphas of the right-hand side model are equal to zero. Accepting the null means the right-hand-side model perfectly prices the left-hand-side portfolios(or other models). In other words, lower absolute alpha, t-statistics, GRS F-statistics, and higher p-value signal better model performance. The summary results of the test on four models are presented in Table 6: the dependent variables of panel A are six industry portfolios, and those of panel B are 3 three-factor models. The test rejects all four models from panel A, but 2 ESG models(3 and 4) outperform FF-3 in terms of GRS F-statistics and mean absolute alpha. In panel B, model 3

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dominates FF-3 with a low alpha of 0.0016 and a high p-value of 0.99, while model 2 under-performs FF-3. Overall, models with the ESG factor modestly beat the FF-3 model.

5. Discussion

There are three interesting findings. Firstly, COVID-19 has positive impacts on portfolio returns, explained by the effect of Quantitative Easing, which is not exclusive to China but is found in almost every country. Secondly, consistent with Broadstock et al.'s findings [3], sustainable stocks are found to behave like insurances, i.e. resilience during pandemic compromised by lower returns at standard times. Lastly, according to the results of the GRS F-test, one ESG 3-factor model(MKT HML SMU) and ESG 4-factor model(MKT SMB HML SMU) slightly outperform the FF-3 model. ESG factor plays a crucial role in predicting returns, so it should not be ignored when making investment decisions. Investors could earn higher returns and mitigate downside risks by investing in High-ESG stocks.

6. Conclusion

For summary statistics, the mean value of the ESG factor(SMU) is 0.13%, implying that investors could enjoy a 0.13% monthly ESG premium by investing in sustainable companies. In China, larger companies tend to have higher ESG scores, leading to a negative correlation between the size factor(SMB) and SMU. Figure 1 illustrates that the High-ESG group consistently dominates the Low-ESG portfolio, especially during COVID-19. For model regressions, ESG models perform better than FF-3 in explaining returns for the whole sample. Further, the SMU factor is imperative and positively impacts the return of most industry portfolios. Taking advantage of the unique environmental setting, the author contributes to the literature by empirically substantiating that ESG is an excellent, novel risk factor in the Chinese stock market, which could be added to asset pricing models. However, the performance of the ESG model is not as strong as expected, possibly due to the modest size of sample data during the COVID-19. Therefore, future research could enhance ESG model performance by using data for extended periods as the pandemic continues. In addition, the strength of ESG models could be improved if more frequent ESG data (monthly or even weekly) were available in the future, as is now the case in developed markets.

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