A New Trading Strategy Based on ESG scores and Futures Volatility

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Abstract

The paper constructs a CSI 300 index-enhanced strategy based on the ESG scores and volatility of CSI 300 index futures. This strategy outperforms the CSI 300 Index during 2017-2021.

1 Introduction

ESG refers to the philosophy of considering both traditional financial performance and the company's environmental, social, and governance performance. The concept is now receiving increasing attention in the industry. Investors try to include stocks with higher ESG ratings in their portfolios to undertake social responsibility and obtain a stable return curve.

ESG is also a hot topic in academia. The main areas of ESG research include 1) the relationship between ESG ratings and ESG reports, 2) the intersection of ESG ratings and corporate finance, and 3) the intersection of ESG ratings and asset pricing. Regarding the first aspect, [Wang and Sarkis, 2017] points out that many companies engage in "greenwashing", issuing ESG reports to disguise themselves as high-ESG rating companies without actually undertaking responsibilities. Concerning the second aspect, [Houston and Shan, 2022] found that a high ESG rating for a company can help alleviate difficulties in financing. As for the third aspect, no conclusive evidence exists on whether ESG ratings can bring excess returns. [Pedersen et al., 2021] proposes the concept of an "ESG frontier" and finds that investment portfolios with middle-range ESG ratings tend to have a higher Sharpe ratio than those with the lowest and highest ESG ratings. This theoretical

framework based on the Markowitz portfolio model is consistent with the result of [Hong and Kacperczyk, 2009] that "sin stocks" can generate excess returns. [Jacobsen et al., 2019] finds that investing in high-ESG companies may lead to lower volatility and better risk-adjusted returns.

A high ESG score brings less risk. [Oikonomou et al., 2012] points out that a portfolio with higher ESG scores has smaller market risk exposure. [Broadstock et al., 2021] finds that portfolios with higher ESG scores performed better than portfolios with lower ESG scores during COVID-19 periods.

In addition, Chinese studies have found that market volatility can be used to indicate downside risk in the stock market. Researchers find that abnormal increases in volatility indicate investor panic and signal downward risk in the stock market. Others find that futures prices have a leading effect on stock prices, and for CSI 300 futures, realized volatility models are more effective at predicting the stock market than ARCH models.

Based on existing ESG-related research, it can be found that high-ESG investment portfolios have better risk resistance capabilities against significant systemic downward risks brought about by the pandemic. As a proxy variable for corporate financing constraints and internal control, companies with higher ESG scores may be less sensitive to market downside risks due to fewer financing constraints and higher quality of internal control. However, investment portfolios based on ESG cannot bring ideal returns when the market is volatile or trending upwards. Therefore, if we can reasonably judge risk and increase the weight of the ESG investment portfolio during periods of high downside risk, then an index-enhanced model based on ESG will likely bring better returns than the market index.

2 Data

This paper uses monthly return data of constituent stocks of the CSI 300, 5-minute high-frequency data from the CSI 300 stock index futures, and Huazheng ESG rating data. The period of data is from 2017 to 2021. The reason for using constituent stocks of the CSI 300 as the research target is to exclude the effect of liquidity and shell value effects, following [Carpenter et al., 2021]. It also partially excludes the impact of size factors because CSI 300 selects the 300 companies with the largest size and highest liquidity in China Mainland. Therefore, It is reasonable to judge that there should be

Table 1: Descriptive Statistics

Variable	Mean	Std	Min	Median	Max
ret	0.0035	0.1306	-0.8041	-0.0116	4.559
rf	0.0026	0.0007	0.0012	0.0024	0.0040
EP	0.0141	0.1343	-7.692	0.02369	1.4286
$ALPHA$	-0.0015	0.03245	-0.1841	-0.0032	0.6392
$BETA$	0.9925	0.8834	-17.0282	0.9927	19.8152
$lnME$	22.6721	1.0699	20.1425	22.4622	28.6557
ESG	72.7261	6.4478	36.6200	73.2900	92.9300
RV	17.1075	11.1496	0.1495	14.7990	58.3971

little liquidity premium in stock prices. In terms of ESG scores, Huazheng ESG scores are released once a year. Every company will be scored from 0 to 100 and higher scores indicating higher ESG ratings.

Realized volatility has better forecasting ability and It is constructed according to the equation.

$$RV_t = \sqrt{(\sum_{i=1}^{n} r_i^2)}$$

In this equation, RV_t represents the realized volatility for the period t, n is the number of trading days within that period, and r_i is the log return for the i_{th} small time segment within period t.

This paper first calculates daily realized volatility using 5-minute high-frequency returns from CSI 300 stock index futures, then calculates monthly realized returns using these daily realized returns.

Descriptive statistics are shown in Table 1. In Table 1, ret represents the stock returns after subtracting the risk-free interest rate, and rf represents the monthly risk-free interest rate. EP represents the market factor. $BETA$ and $ALPHA$ separately represent the beta and alpha obtained from the regressions of FF3. $lnME$ represents the log of market value. RV represents the monthly realized volatility of futures of the CSI 300 index. All data apart from ESG ratings are from the RSSET dataset, while ESG ratings are from WIND.

3 ESG Scores as a Factor

To evaluate the effect of ESG scores as a factor, the author employs Fama-MacBeth regression and double sort to test whether higher ESG scores bring higher excessive returns.

3.1 Fama-MacBeth Regression

Fama-MacBeth regression consists of two steps. In the first step, a cross-sectional regression is performed on the data for each point in time to determine each stock's beta exposure. The time series for every coefficient can be obtained.

$$R_{(i,t)} = \alpha_{(i,t)} + \beta_1 x_{(i,1,t)} + \beta_2 x_{(i,2,t)} + \beta_3 x_{(i,3,t)} + \cdots + \epsilon_{(i,t)}$$

Where $R_{(i,t)}$ represents the excess return of sample i at time t, $x_{(i,j,t)}$ represents the j_{th} independent variable of sample i at time t, and $\epsilon_{(i,t)}$ represents the residual term.

In the second step, the T-ratio and other statistics can be calculated from the time series obtained in the first step. Therefore, the inference of these coefficients can be done.

Following [Carpenter et al., 2021], the paper uses log market value, EP, and a dummy variable of EP as control variables. When $EP > 0$, the dummy variable $EP_d = 1$, otherwise $EP_d = 0$.

$$\begin{aligned} ret_i = \beta_0 + \beta_1 EP_i + \beta_2 ALPHA_i + \beta_3 BETA_i + \beta_4 lnME_i \\ + \beta_5 EP_d + \beta_6 ESG_i + \epsilon_i \end{aligned}$$

Employ Fama-MacBeth regression on the constituents of the CSI 300 index. The result is in Table 2. The factor loading of the ESG factor is insignificant, hinting that ESG scores are not an effective risk factor.

3.2 Double sorting

Double sorting categorizes and groups stocks based on two key variables. In double sorting, research subjects are initially sorted based on one key variable, and then within each group, further sorted based on the target factor. These processes generate several subsamples. In each subsample, an

Table 2: Fama-MacBeth, CSI 300

Variable	Mean	P-value
EP	-0.0826	0.04254
$ALPHA$	0.3039	0.0008
$BETA$	0.003	0.1494
$lnME$	-0.01387	0.0000
EP_d	-0.0237	0.0095
ESG	0.0000	0.8205
$Const$	0.3469	0.0000

Table 3: Double sorting, CSI 300

	ESG_{all}	ESG_{Q1}	ESG_{Q2}	ESG_{Q3}
EP_{all}	1.594938	1.581812	1.735616	1.470168
EP_{Q1}	3.567392	3.475456	3.767632	3.467782
EP_{Q2}	1.263345	0.810601	1.227693	1.75166
EP_{Q3}	-0.05967	-0.21804	0.07039	-0.04125

equally weighted monthly updating portfolio will be built. These different portfolios will be used to study the profitability of the target factor.

This study employs the double-sorting method on the constituents of CSI 300 using EP and ESG scores. The reason why we chose EP but not $lnME$ is that the stocks selected are the stocks with the largest market value and the highest liquidity among all Chinese stocks. Therefore, the size factor has already been partially controlled.

Because the total number of stocks in the pool is less than 300 (276), the article employs a 3-category classification instead of a traditional 5-category classification to ensure every subsample has enough observations in cross-sectional regression. The result demonstrates no sign of the effectiveness of the ESG factor. The result is consistent with [Pedersen et al., 2021] that the stocks group with middle ESG score have the highest risk premium.

4 ESG Portfolio

The ineffectiveness of the ESG factor does not necessarily mean that it has no potential in the pricing of stocks. Stocks with higher ESG scores may

perform better in turbulent times or bearish markets. In this section, the potential of the ESG factor is explored.

4.1 ESG Long-Short Portfolio

The sorting method is used to build an ESG long-short portfolio as the baseline model. In detail, the monthly updating portfolio is built by taking a long position in a high ESG score portfolio and a short position in a low ESG score portfolio. The ESG score of a stock is the average ESG score in the past three months. The portfolio is held for 3 months, and the monthly average portfolio returns for the holding period are calculated as the return for the portfolio for this month.

For example, in month t,

- According to the average ESG score of stocks in the pool in months $t-1$, $t-2$, $t-3$, arrange them in ascending order and divide them into five intervals, Q1-Q5. Construct an equally weighted stock portfolio for each interval
- Hold each interval portfolio for three months ($t+1$, $t+2$, $t+3$), and return in month$t$ obtained is average monthly return from t to $t+3$
- Repeat the above steps to obtain monthly returns for different portfolios.
- Take a long position in Q5 and a short position in Q1 to constitute the returns of the ESG long-short portfolio.

Employing the strategy, the descriptive statistics of 5 ESG portfolios in in Table 4.

The result in Table 4 is consistent with the result of the Fama-MacBeth regression and double sorting that ESG is not a risk factor.

4.2 Volatility Strategy

The author built a simple strategy with the volatility of CSI 300 futures. The main idea is to hold an ESG portfolio when the market is turbulent while holding the CSI 300 index when the market is peaceful. The author uses volatility to predict whether the market is turbulent or not because the sudden increase in volatility comes before a turbulent time. Suppose the

Table 4: Descriptive Statistics of ESG Portfolio

	Q1	Q2	Q3	Q4	Q5	Long-Short
Count	54	54	54	54	54	54
Mean	0.0015	0.0029	0.0041	0.0043	0.0050	0.0035
Std	0.0387	0.0362	0.0365	0.0350	0.0326	0.0124
Min	-0.0631	-0.0621	-0.0617	-0.0584	-0.0584	-0.0245
25%	-0.0223	-0.0188	-0.0185	-0.0183	-0.0146	-0.0031
50%	-0.0068	-0.0036	-0.0021	-0.0018	0.0017	0.0020
75%	0.0233	0.0225	0.0240	0.0235	0.0182	0.0119
Max	0.1076	0.1042	0.1017	0.0986	0.0999	0.0275

monthly realized volatility follows the normal distribution, when the realized volatility exceeds the 80 percentile of all samples, the market is predicted to be turbulent next month.

The strategy can be criticized for being too easy or for using future volatility data. The reason behind this is the lack of data, the author only has access to high-frequency data of the future from 2017. However, if the easy strategy can obtain satisfying performance, complex strategies involving deep learning are expected to achieve a better result.

4.3 ESG Portfolio with Strategy

Based on the above analysis, the author constructed an ESG-enhanced strategy with realized volatility of the CSI 300 option. Several other strategies are also created to do comparisons. Rf represents a risk-free asset. Rm represents the market portfolio, the CSI 300 index. Long-short ESG (ESG Long-Short) represents the baseline model of the ESG portfolio. Long-short ESG-Enhanced represents the main strategy of volatility. Rf-Rm represents the strategy of holding risk-free assets when the market is turbulent, otherwise holding the CSI 300 index.

The cumulative return curve for these strategies is in Fig1. From Fig1, It is obvious that the ESG-enhanced strategy performs better than another 4 strategies. Another interesting point is that the ESG long-short portfolio demonstrates stable positive returns during the market downturn of 2018-2019 and consistent negative returns during the market upturn of 2020-2021. The author also employs some metrics to evaluate these strategies in Table

Figure 1: Cumulative Return Curves from 2017 to 2021

Table 5: Performance Metrics

	Std	MDD	SR	CR	Return(%)
Rm	0.0455	0.0942	0.3282	0.5490	0.2328
Long-short ESG-Enhanced	3.6585	8.9184	0.7228	1.0271	41.2212
Rf-Rm	2.7816	11.6371	0.3755	0.3109	16.2831
Long-short ESG	0.0123	0.0245	0.9812	1.7084	0.1885

5. According to Table 5, the ESG-enhanced strategy performed better than all other strategies. Compared to the Long-short ESG strategy and CSI 300 index, it exhibits twice the Sharpe ratio, Calmar ratio, and cumulative excess return. These metrics, apart from the return curves highlight the superiority of the constructed ESG-enhanced strategy.

5 Conclusion

Although the article finds no evidence that ESG scores are an effective risk factor, its ability to resist the downturn market can be useful in portfolio construction. The article's main conclusion is a new ESG-enhanced strategy that obtained higher returns and lower volatility than the market index. The theoretical foundation of this strategy is the predictive ability 5of realized volatility and profitability of stocks with high ESG scores in a bearish market.

The strategy is of high potential. Considering ESG scores update yearly, the lack of available data points leads to the effectiveness of advanced methods like deep learning will not be effective. With more data available, the strategy can be improved like other timing strategies.

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