

Department
of Economics And Finance

Course of EMPIRICAL FINANCE

Do Firms with High ESG Rating Perform Well in The Market? Evidence From Market Performance in China.

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Abstract

This article examines whether high-rating ESG index companies perform better. This paper uses the relevant data of Chinese companies for research. Companies with high ESG rating among Chinese companies are combined to form an ESG-related index. The index is further analyzed using a time series model to obtain the volatility and excess return of the index. This article will further explore in combination with China's national conditions. By analyzing the current situation of China's national conditions to optimize the selection of samples, we then obtain more complete results. Finally, it is concluded that companies with high ESG ratings will perform better when Chinese ESG ratings are reliable.

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§1.Backgroud

§1.1 The Concept of ESG

ESG is a comprehensive evaluation indicator of the environment, society and governance. It is not only the value concept, investment strategy and corporate evaluation standards that focus on the company's financial performance, but also focus on corporate environment, society, and corporate governance performance. Although there may be some differences in the ESG standards of various countries, it is generally not much different.

Environment can be from these five aspects, climate change, pollution and waste, natural resources, environment management and environment opportunities. Climate change concludes the carbon emissions, which we most talk about nowadays, the management measures taken directly or indirectly by the companies to reduce the gas emissions and the waste discharge, especially taken place in traditional industry factories. Pollution and waste is always related with many penalties although the aim is to supervise whether the company is properly treated with pollution and garbage generated by the process and the effective use of the energy. Natural resources include water resources, land resources and the biodiversity. Environment management means the green finance. Environmental Opportunities measure the application of clean energy and environmental materials for enterprises.

Social can be measured by the stakeholders, responsibility management and the social opportunities. The stakeholders contain the customers and the supply chain, which play very important roles in the daily business of an enterprise. If one or both of the two do not work well, it may cause a big problem. The responsibility management and the social opportunities have something common. They all consider how much contribution of the company's contribution to society. For example, company is committed to helping public welfare. The company is willing to donate to the foundation or the group of people who need help.

Corporate Governance involves six fields, shareholder governance, governance structure, management, management operations, information disclosure and abnormal corporate governance. First four fields are related with the stability of the company and the efficiency of the company operation. The information disclosure means more to the society. People can know the status of the companies from that, so it is important whether the information is valid and comprehensive. The abnormal corporate concludes the abnormal or negative information in various aspects of one company.

§1.2 ESG in China

With the development of the economy and the development of society, Chinese pay more and more attention to ESG ratings in recent years, and it has become an important reference indicator for Chinese investors in investment decisions. At the same time, this also makes people ask companies to disclose ESG related information and ask that the government promote enterprises to complete ESG responsibilities better.

On June 21, 2020, the Shenzhen Stock Exchange issued the disclosure requirements of the report of listed company's social responsibility, which clarified that the report should cover the protection of shareholders' and creditors' rights and interests, the protection of employee's rights, supplier customers' and consumers' rights protection, environmental protection, sustainable development, public relations and social welfare undertakings, and precision poverty alleviation, etc. On June 28, 2021, the China Securities Regulatory Commission added the relevant chapters of social responsibility in the semi -annual report and the annual report to strengthen the disclosure of environmental and social responsibility. On December 11, 2021, Chinese Ministry of Ecology and Environment disclosed the management measures in accordance with the law and required to be implemented on February 8, 2022. In 2022, the stock listing rules revised by the Shanghai Stock Exchange required listed companies to disclose social responsibilities in accordance with regulations. On January 12, 2022, the Fifth CRO Global Responsibility Summit in 2022 was held in Shanghai. The conference was launched around ESG investment to promote high -quality development, and dual carbon targets. On March 10, 2022, the ULI China ESG theme Forum was held in Shanghai. On May 30, 2022, the Ministry of Finance issued the "Opinions of Financial Supporting Carbon and Carbon Neutralization", which clarified the target of the Ministry of Finance to support carbon neutrality.

It can be seen that Chinese relevant units and investors in China are increasingly paid attention on ESG, and the relevant systems are becoming more and more complete. However, the Chinese cognition to ESG is relatively late, and there is still a long way to go, compared to some ESG systems in European and American countries. Therefore, we conduct research on this in this paper, and verify and discuss several other hypotheses.

§2.Hypotheses

§2.1 Benefits of High Rating ESG

Although ESG rating is very important reference to the investors and the society, if the company cannot gain many benefits from improving its ESG ratings, the company's execution will be relatively poor. The truth is

that when one company do more on the ESG, it can not only benefit from the related policies, but also gain longer benefits in some invisible aspects.

The company with higher ESG ratings will be easier to get preferential treatment from the government. On the one hand, it may be a looser policy, and on the other hand, it is a tax reduction. For example, following the 2015 Paris agreement the European Commission launched the Sustainable Finance Action Plan which resulted in a set of regulations. The EU Sustainable Finance Disclosure aims to help investors to channel investment towards sustainable investment and overcome green washing. The EU Green Bond Standard is aimed to define a market standard for green bonds to enhance the effectiveness, transparency, comparability and credibility of this market and to encourage the investors to take part in activities of EU green bonds. Besides, in the US, there also exist regulations which benefit the ESG. The Sustainable Accounting Standards Board (SASB) is an independent nonprofit organization. It help companies to how to launch the financially material sustainability information and help investors know about the companies. The Task Force on Climate-related Financial Disclosures (TCFD), established by the Financial Stability Board, could promote more informed investment, credit, and insurance underwriting decisions so that companies can attract more investors. Besides, TCFD enable stakeholders to understand better the concentrations of carbon-related assets in the financial sector and the financial system's exposures to climate-related risks, which can help shareholders reduce the risks and be more willing in low- carbon activities.

In addition, as the ESG ratings consider the company governance at the same time, companies with high ESG ratings, especially the ones doing good in corporate governance ratings, tend to have better management structures and better leadership. This makes their company's decisions better and execute more efficiently.

At the same time, the higher ratings in the social part of the ESG ratings means that the company contribute more to society. This kind of companies tends to have better reputations in the investors' mind. This also makes them more competitive in the same industry.

§2.2 Volatility

On this basis, we generally believe that companies with high ESG ratings have a better advantage in their field, no matter in which field, environment, social and corporate governance, they do better. With the help of the support of government policy, its own excellent corporate structure or a stronger social influence, we believe that this kind of company has better resistance when encountering some negative news, which will lead to have relatively less volatility.

Therefore the first hypothesis comes out.

H1: Chinese companies with high ESG ratings have lower volatility.

§2.3 Alpha (Excess Return)

In the learning process of CAPM, we already know that alpha can represent the excess return of a stock. As mentioned in the paper of Soh Young In, Ki Young Park and Ashby Monk^[4], "long carbon-efficient firms and short carbon inefficient firms" would earn abnormal returns of 3.5-5.4% per year, and indicates that investing in carbon-efficient firms can be profitable even without government incentives. To the social and the corporate governance part, if the company has better management and decisions in daily process and have stronger effects in the society, we usually consider they can do better in their field. Therefore, when we want to measure what extent excess return that the higher ESG ratings Chinese companies can make, we can use alpha.

Then we get the second hypothesis.

Hypothesis 2: Companies with high ESG ratings in China have more excess returns (i.e., have larger alpha)

§2.4 The Effect of COVID-19

Under the background of COVID-19, stock markets around the world have shown sharp declines. This is also a normal situation, as COVID-19 represents the negative sentiment of investors towards the stock market. So would this negative emotion effect the ESG performance? In the literature of the past few years, we can easily find that most literature shows that companies with high ESG ratings will be less affected by this negative sentiment. A company with a high ESG score is inherently more stable, and this stability will make it more resistant to negative emotions than most companies. Many investors are also willing to choose to buy stocks with good ESG performance to achieve a safe-haven purpose.

Since the above two are based on the better performance and the better stability of the higher ESG rating companies, we believe that the company will have a brighter performance under the background of COVID-19. Therefore, we do not consider the effect of the COVID-19 for the time being.

§3. Model Establishment

§3.1 Sample Picking

In terms of time selection, because of Covid-19 and other market news, we hope to obtain the length of our data as long as possible to eliminate the impact of the short -term special fluctuation. But unfortunately, we can't get a very long-term ESG rating data. The first reason is that on the public website we can only obtain

the current ESG rating of Chinese companies. If we want to use this ESG rating for a long time, there are problems on missing data and inaccurate ESG ratings. The second reason is that the development of ESG rating of China is relatively late. In the early years, there were very few companies with this awareness. They just wanted to earn as much money as they can without considering the ESG factors. The changes come out just in the recent years. Therefore, in order to get the length of the data as long as possible, we choose to use the earliest publicly recognized ESG index as the research object, ESG 40 and ESG 100.

3.2 ESG 40 & ESG 100

CSI ECPI ESG Sustainability 40 Index (index abbreviation : ESG 40) conclude 40 listed company securities with higher ESG ratings selected from the SSE 180 Corporate Governance Index sample as the index sample, according to the ECPI ESG rating method. The index uses June 30, 2010 as the base date, with a base point of 1000 points. The index calculation formula is the followings.

Index during the reporting period = The adjusted market value of the sample during the reporting period/Divisor \times 1000

The adjusted market value = \sum (security price \times adjusted share capital \times weight factor).

The weight factor is between 0 and 1 so that the individual samples are equally weighted.

CSI Caitong China Sustainability 100 (index abbreviation : ESG 100) selects 100 securities of listed companies with higher ESG ratings from the CSI 300 Index as the index sample, according to the ECPI ESG rating method. The index takes June 30, 2011 as the base date and 1000 points as the base point.

The index calculation formula is the followings.

Index during the reporting period = Adjusted market value of the sample during the reporting period/Divisor \times 1000

The adjusted market value = \sum (security price \times adjusted share capital \times weight factor). The weight factor is between 0 and 1.

We choose CSI 300 (also HS300) as the comparison index. Although ESG 40 is chosen from the SSE180, not CSI 300, we take into account that the CSI 300 is more representative in the Chinese stock market.

Then we conduct the first experiment. We collect the data of ESG40, ESG 100 and CSI 300 from January 4, 2012 to December 31, 2021 and calculate the cumulative returns and volatility of the three indices. Regarding the cumulative rate of return, we use the data on January 4, 2012 as the benchmark, multiplied the daily rate of return, and plotted the graph. For volatility, we chose the time series model to observe its volatility, unconditional volatility, and a reaction to negative news.

3.3 ESG 300 & ESG 300 LEAD

Because China's awareness of ESG has developed relatively late compared to the international community, we also select a set of relatively new data, which are ESG 300, ESG 300 LEAD and CSI 300. These two indices and the above two indices belong to the same company. We hope that this group of samples have a better selection of samples as the way of selection is improved.

Although the short-term data in recent years will involve the impact of the epidemic, it is pointed out in the relevant literature that the prices of stocks with high ESG ratings will show stronger stability. We will combine this conclusion to evaluate our results.

CSI 300 ESG Benchmark Index (index abbreviation : ESG 300) removes 20% of listed company securities with the lowest ESG scores in the CSI tier-one industry from the CSI 300 samples, and selects the remaining securities as index samples to provide performance benchmarks and investment targets for ESG investment.

The index releases on April 30,2020 and uses June 30,2017 as the base date.

The adjusted market value = \sum (security price \times adjusted share capital \times weight factor).

The weight factor is between 0 and 1, so that the sample is weighted by the free float market capitalization adjusted by the ESG skew factor, and the difference between the first-level industry weight of the index CSI and the corresponding industry weight of the CSI 300 index does not exceed 3%, and a single sample The weight should not exceed 10%, and the total weight of the top five samples should not exceed 40%.

The CSI 300 ESG Leading Index (index abbreviation : ESG 300 Lead) selects the 100 securities of listed companies with the highest ESG scores from the CSI 300 Index samples as index samples. In the CSI primary industry, the securities with the highest ESG score one third are selected as index samples. If the number of securities selected in a certain industry is not an integer, the method of rounding down is adopted. If the number of securities is less than 100, select the securities with the highest ESG score from the remaining securities as index samples until the number of securities reaches 100.

§3.4 Model

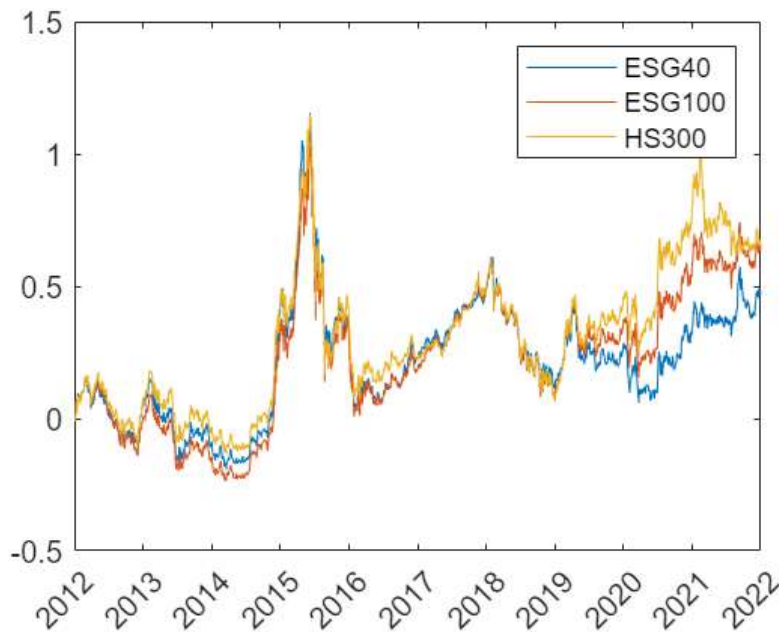
As the index is time-series data, we choose to use the Garch, T-Garch and E-Garch. In fact, during the experiment, we find the T-Garch has an unreasonable P-value, so we do not use it.

§4.Results

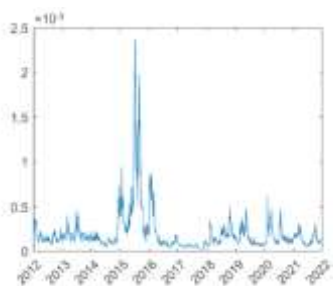
§4.1 The First Experiment

First, we focus on the cumulative return. It can be found that these three indices have the similar trend.

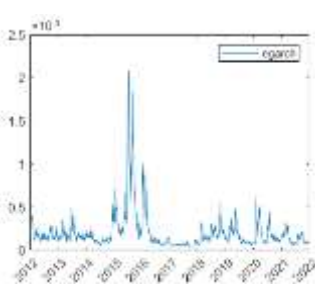
Unlike our assumptions, when the index falls, ESG related indices do not have a good ability to resist the fall. Whether from 2013 to 2015 or after 2019, we find that the ESG-related indices show that the yield performance is weaker than the market. Although at individual time, the ESG index will perform better. For example, in the first half of 2015, ESG40 had better performance. But in general, the three are similar to most of the time, and when they fall, the ESG related indices will fall more. At the same time, we also refute our original guess on the influence of COVID19. When facing negative messages, the income performance of the ESG related index may be relatively worse.



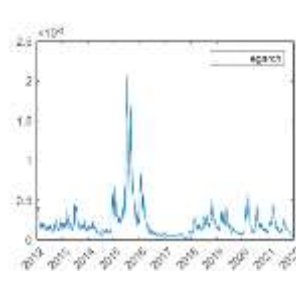
	ESG40	ESG100	CSI300
Average Daily Yield	0.0264%	0.0311%	0.0315%
Unconditional Volatility	0.000272	0.000263	0.000435



ESG40



ESG100

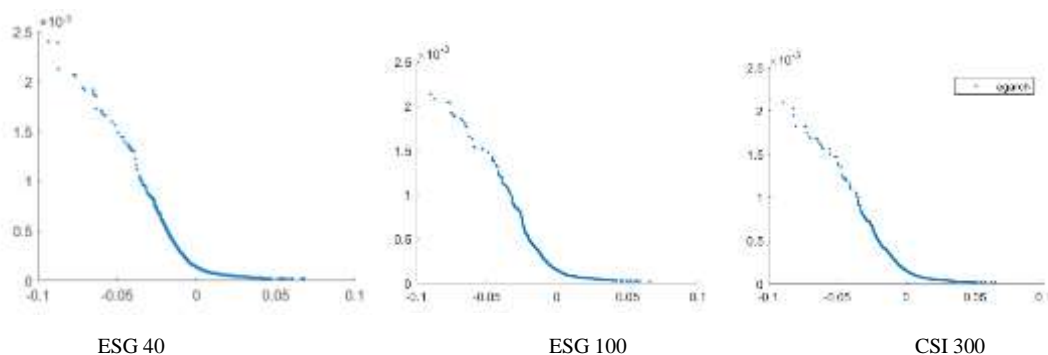


CSI300

To the daily average yield, we find that the yield of the ESG index is generally low. And it is shocking that the yield of ESG 40 will be relatively lower than the ESG100's yield.

To the volatility, if you only consider the overall unconditional volatility, the two ESG indices do have a lower volatility, which is the same as our assumptions. However, at some individual time, the volatility of

our ESG related index does not perform better. For example, from 2015 to 2016, the volatility of the ESG40 is significantly higher than the volatility of CSI300. In addition, it is surprising that the volatility of the ESG100 will be smaller than the ESG40.



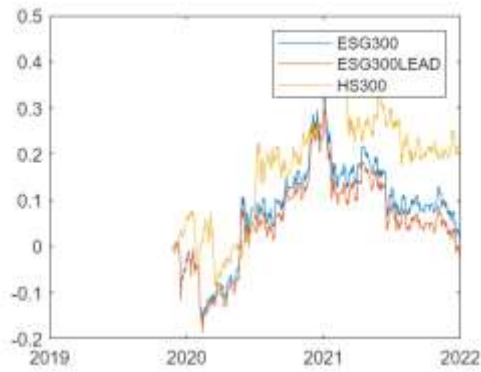
In the face of negative messages, we can clearly find that these three indexes will be more sensitive to negative messages. In addition, opposite to us, we can find that the CSI300's resistance to this negative message is relatively strong. It is specifically reflected in the relatively gentle left curve of CSI300.

	ESG40	ESG100
alpha	-0.0013	0.0000

Similar to the conclusion of cumulative yield obtained, we can find that the ESG related index has not obtained excess returns. The difference between ESG100 and the CSI 300 is similar, while the ESG40's income is relatively poor. This violates our assumptions 2.

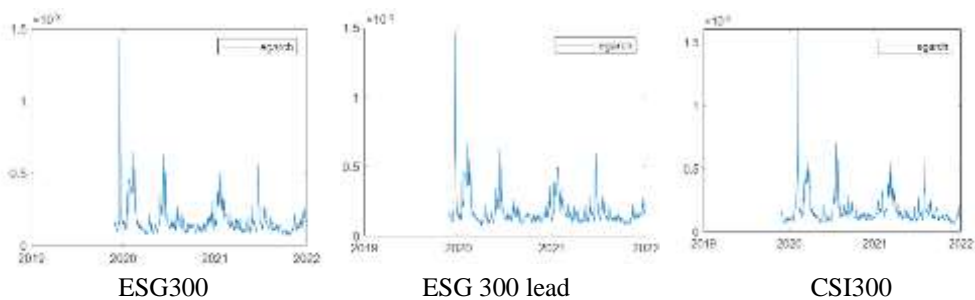
§4.2 The Second Experiment

First of all, we still analyze the cumulative return. On the whole, the cumulative return of CSI 300 is higher than ESG300 and ESG300Lead. However, in some time periods, ESG300 and ESG300Lead will have more than CSI300 income. However, at the same time, in early 2020 and in early 2021, there were changes in CSI300's revenue, that is, a decline appeared. Then analyze the daily average income, the yield of ESG300 and ESG300Lead is significantly lower than CSI300. It can be seen that we originally had a problem with COVID19's speculation on yields.

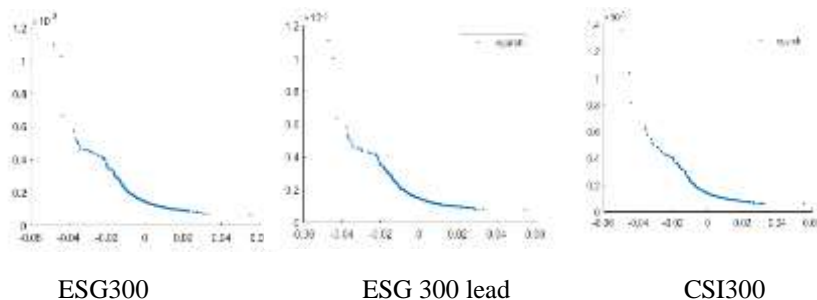


We then analyze the volatility of the three indexes. From the perspective of unconditional volatility, the volatility of the ESG -related index is still relatively smaller, but the difference is very little. Moving to the volatility chart, in early 2020, the CSI300's volatility will be greater, but the volatility of the ESG related index in 2021 will be relatively larger. With different changes in the market environment, the volatility will change differently.

	ESG300	ESG300 LEAD	CSI300
Average Daily Yield	0.0076%	0.0148%	0.0467%
Unconditional Volatility	0.000186	0.0001842	0.0001876



We analyze the performance of the ESG related index on negative messages. We find that in this set of samples, the CSI300's response to negative messages will be stronger. This is consistent with our assumptions. Therefore, we speculate that the volatility of Covid-19 has a smaller effect on the volatility of the ESG related index compared to CSI300.



For excess returns, we have also obtained a conclusion similar to cumulative yields. The ESG related index

does not have a better excess yield. ESG300 Lead and CSI 300 are similar. ESG300 even has a negative excess income.

	ESG300	ESG300 LEAD
alpha	-0.0148	0

§ 5. Staging Summary and Improvement

§ 5.1 Staging Summary

We can draw a preliminary conclusion from the above two sets of data. ESG score -high stocks can reduce volatility. However, at the same time, as stability increases, risk reduction has reduced. the excess returns are also reduced, Meanwhile, the resistance capabilities when encountering negative messages may change according to different occasions.

We then work on why our experimental conclusions will be different from our assumptions. The first reason may be the ESG index we choose. The ESG index is more common to respond to the phenomenon of the market, but in fact, there are still few companies with high ESG scores. In addition, different ESG institutions have a certain tendency for ESG scores. Some institutions prefer the companies that do well on corporate governance and then give better scores. Others may pay more attention to the environment and give more high scores to companies with good environmental performance.

The second reason is that there are some problems with the timeliness and authenticity of the enterprise when disclosing related ESG information. Even if there are relevant policies to disclose, it is still a problem to disclose the integrity and submission time of the disclosure. Taking Chinese banks as an example, in 2022, although various banks have the basis of disclosing social responsibility reports, only 11 banks disclose this year. In the reports' content, green credit is the most concerned content. However, in terms of standards, some are based on the CBRC's standards, and some are the standards of the People's Bank of China. In addition, only some banks have disclosed the content of social levels such as inclusive finance and the proportion of female employees.

The third reason is that the Chinese government's related welfare policies are still weak for enterprises. For example, since China launched the first batch of solar demonstration projects in 2016, China has not implemented relevant policies. Although there are some policies, the cost of solar development has not been reduced due to the continuity of the policy. When the cost compares with the cost of traditional energy, the clean energy has no advantage. This has also made some trouble on the development.

§5.2 Improvement

Based on the above reasons, we decided to go on the experiment with a new investment portfolio for further research. In the new investment portfolio structure, we have considered the ESG rating problems, but the problem of time length is still difficult to solve.

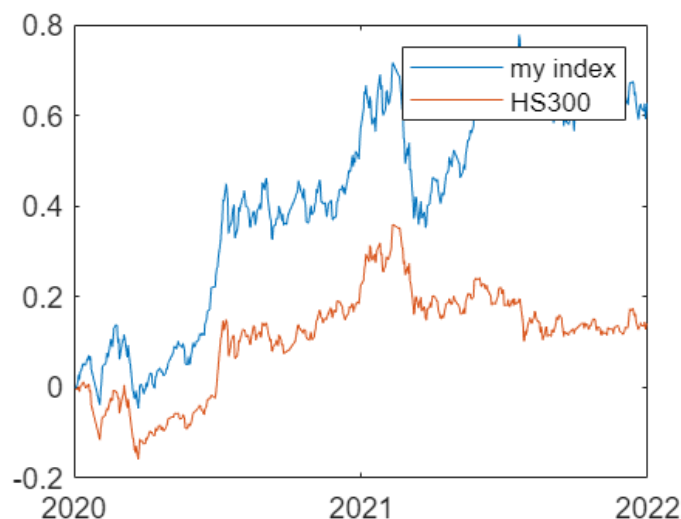
Then we construct the index after the following steps:

1. Considering the gap of ESG ratings, the samples we choose have two ESG rankings that are both grade B or above.
2. Taking into account the ESG ratings changing with time and that some companies we select are founded in recent years, we start our data from 2020/1/1 to 2021/12/31.
3. The weight we use is equal.

Then we start the model again and get the new results.

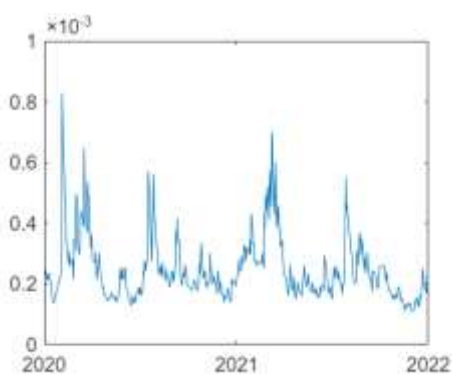
§6. Results of new experiments

It is amazing that after we replace the sample group, we find that the cumulative yield of the ESG related index is significantly higher than the cumulative yield of the CSI 300 index, and the average daily yield is much higher than the average daily yield on the CSI300. It can be seen from the figure that in June 2020, the yield of the ESG index we built was larger than that of CSI300. In March 2021, the decline in the ESG-related index was also large. In the next few months, the ESG related index rose back but the CSI 300 index did not.

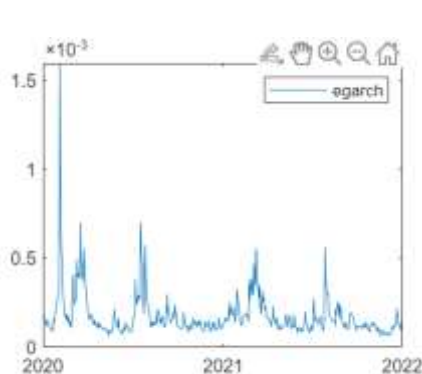


	New index	CSI300
Average Daily Yield	0.0011	0.0004
Unconditional Volatility	0.0003	0.0002

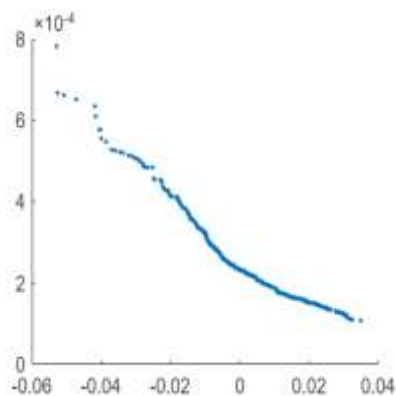
In terms of volatility, the volatility of the ESG related index we construct is higher than the volatility of the CSI 300. From the diagram of volatility, we can find that in early 2020, the decline in the CSI 300 was greater than the ESG -related index, so the volatility of the CSI 300 during this period was also greater than the volatility of the ESG -related index. At the same time, in middle of 2021, with the rise of the ESG -related index, the volatility of the ESG index is also larger than the volatility of CSI300. This can also be seen from the response of the two indexes to negative messages. CSI 300's response to negative messages is stronger.



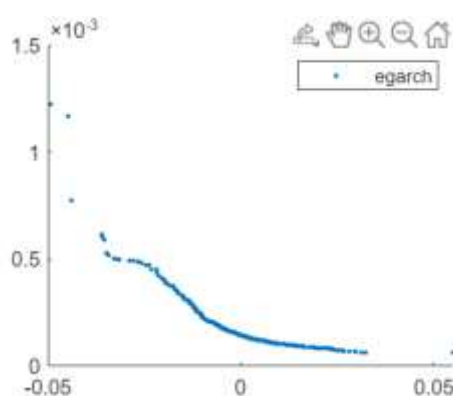
My index



CSI 300



My index



CSI 300

In terms of alpha, alpha is 0.0016. The ESG index we built has a positive excess income.

§7. Conclusion

From the three models above, we can find some of the common points to draw conclusions. High ESG ranking companies will have higher stability. Although the volatility of the ESG -related index in the Model III is high, the response of the index to negative messages is weak, and the reason for its high volatility from

the volatility diagram is the additional rising part. The volatility caused by the rise in stocks is welcomed for investors and cannot be regarded as a risk. Therefore, we have concluded that companies with high ESG ratings do have stronger stability and can resist the impact of negative messages to a certain extent.

In terms of excess returns, the excess return can be seen in the index we built. Whether excess returns exist depends largely on the choice of individual stocks. When the samples in the ESG index is indeed a relatively high rating, the excess yield does exist. When we add some samples with the middle rating or middle-high ratings, the excess return may not exist.

Different from developed countries in European countries and the United States, Chinese ESG development road has still a long way to go. First, there are certain defects in China's ESG ratings system. Secondly, the implementation of related ESG welfare policies in China is also a problem. Finally, Chinese companies have not timely disclosure of ESG -related indicators and problems of incomplete information. There are very few companies with such ESG consciousness in China. Although related policies have been continuously followed up, many companies are not willing to implement due to the limitations of income which ESG may bring them.

In the Chinese market, companies with high ESG ratings will perform better as a whole, whether in terms of stability and yields. But this conclusion is based on the reliable ESG ratings. In terms of ESG ratings, investors should compare the ESG ratings of different institutions when choosing.

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Appendix

The program is as follows

```
clear;
clc;
[data1,txt]=xlsread('xx.xlsx');

price_index=data1(:,1);
price_300=data1(:,2);
r_index=diff(log(price_index));
r_300=diff(log(price_300));
date=datetime(txt(3:end,1));

sr_index=nan(485,1);
sr_index(1,1)=r_index(1,1);
for i=2:485
    sr_index(i)=(sr_index(i-1)+1)*(1+r_index(i))-1;
end

sr_300=nan(485,1);
sr_300(1,1)=r_300(1,1);
for i=2:485
    sr_300(i)=(sr_300(i-1)+1)*(1+r_300(i))-1;
end

figure
plot(date,[sr_index sr_300])
datetick('x','yyyy');
legend('my index','HS300')

%new index
garch_index=garch(1,1);
est_garch_index=estimate(garch_index,r_index);
h_garch_index=infer(est_garch_index,r_index);
z_index=(r_index-est_garch_index.Offset)/sqrt(h_garch_index);
[h1,pvalue_lb] = lbqtest(z_index,'Lags',[5,10,22]);%null is no autocorrelation
[h2,~]=jbttest(z_index);
unc_garch_index=est_garch_index.Constant/(1-cell2mat(est_garch_index.ARCH)-cell2mat(est_garch_index.GARCH))
%gir p>0.1
%
egarch_index=egarch(1,1);
est_egarch_index=estimate(egarch_index,r_index);
h_egarch_index=infer(est_egarch_index,r_index);
%
figure
plot(date,[h_egarch_index])
datetick('x','yyyy');
```

```

%plot([h_garch_long40 h_egarch_long40 r_long40.^2])
%legend('garch','egarch','r-squared')
%
%NIC(GARCH)=(omega+beta*sigma^2_t)+(alpha)r^2_t
nic1_index=nan(size(h_garch_index,1),1);
for i=2:size(nic1_index,1)
    nic1_index(i)=(est_garch_index.Constant+ ...
        cell2mat(est_garch_index.GARCH)*h_garch_index(i-1))+...
        (cell2mat(est_garch_index.ARCH))*(r_index(i-1))^2;
end

%NIC(EGARCH=EXP(omega+beta*log(sigma^2_t)+alpha*(|r|/sigma-m+gamma*r/sigma)))
% m=E(|z|)=sqrt(2/pi)
nic3_index=nan(size(h_egarch_index,1),1);
for i=2:size(nic3_index,1)
    nic3_index(i)=exp(est_egarch_index.Constant+ ...
        cell2mat(est_egarch_index.GARCH)*log(h_egarch_index(i-1))+...
        cell2mat(est_egarch_index.ARCH)*(abs(r_index(i-1))/sqrt(h_egarch_index(i-1))-sqrt(2/pi)+ ...
        cell2mat(est_egarch_index.Leverage)*r_index(i-1)/sqrt(h_egarch_index(i-1))));
end
figure
scatter(sort(r_index,'descend'),sort([nic3_index],'.'))

%long300
garch_300=garch(1,1);
est_garch_300=estimate(garch_300,r_300);
h_garch_300=infer(est_garch_300,r_300);
z_300=(r_300-est_garch_300.Offset)/sqrt(h_garch_300);
[~,pvalue_lb] = lbqtest(z_300,'Lags',[5,10,22])
[h2,pval_jb]=jbttest(z_300);
unc_garch_300=est_garch_300.Constant/(1-cell2mat(est_garch_300.ARCH)-cell2mat(est_garch_300.GARCH))
%
egarch_300=egarch(1,1);
est_egarch_300=estimate(egarch_300,r_300);
h_egarch_300=infer(est_egarch_300,r_300);
%
figure
plot(date,[h_egarch_300])
datetick('x','yyyy');
legend('egarch')
%
%NIC(GARCH)=(omega+beta*sigma^2_t)+(alpha)r^2_t
nic1_long300=nan(size(h_garch_300,1),1);
for i=2:size(nic1_long300,1)
    nic1_long300(i)=(est_garch_300.Constant+cell2mat(est_garch_300.GARCH)*h_garch_300(i-1))+

```

```

CH))*(r_300(i-1))^2;
end
%NIC(EGARCH=EXP(omega+beta*log(sigma^2_t)+alpha*(|r|/sigma-m+gamma*r/sigma)))
% m=E(|z|)=sqrt(2/pi)
nic3_300=nan(size(h_egarch_300,1),1);
for i=2:size(nic3_300,1)
    nic3_300(i)=exp(est_egarch_300.Constant+cell2mat(est_egarch_300.GARCH)*log(h_egarch_300(i-1))+...

cell2mat(est_egarch_300.ARCH)*(abs(r_300(i-1))/sqrt(h_egarch_300(i-1))-sqrt(2/pi)+cell2mat(est_egarch_300.Leverage)*r_3
00(i-1)/sqrt(h_egarch_300(i-1))));
end
figure
scatter(sort(r_300,'descend'),sort([nic3_300]),'.')

legend('egarch')

[unc_garch_index unc_garch_300;mean(r_index) mean(r_300)]

excess_market_index=r_300-0.015;
excess_index=r_index-0.015;
alpha=ones(485,1);
results=ols_ex1(excess_index,[alpha excess_market_index]);
alpha_index=results.beta(1,1);

```

Summary

§1.1 The Concept of ESG

ESG is a comprehensive evaluation indicator of the environment, society and governance. It is not only the value concept, investment strategy and corporate evaluation standards that focus on the company's financial performance, but also focus on corporate environment, society, and corporate governance performance. Although there may be some differences in the ESG standards of various countries, it is generally not much different.

Environment can be from these five aspects, climate change, pollution and waste, natural resources, environment management and environment opportunities. Social can be measured by the stakeholders, responsibility management and the social opportunities. Corporate Governance involves six fields, shareholder governance, governance structure, management, management operations, information disclosure and abnormal corporate governance.

§1.2 ESG in China

With the development of the economy and the development of society, Chinese pay more and more attention to ESG ratings in recent years, and it has become an important reference indicator for Chinese investors in investment decisions. At the same time, this also makes people ask companies to disclose ESG related information and ask that the government promote enterprises to complete ESG responsibilities better. However, the Chinese cognition to ESG is relatively late, and there is still a long way to go, compared to some ESG systems in European and American countries. Therefore, we conduct research on this in this paper, and verify and discuss several other hypotheses.

§2.Hypotheses

§2.1 Benefits of High Rating ESG

Although ESG rating is very important reference to the investors and the society, if the company cannot gain many benefits from improving its ESG ratings, the company's execution will be relatively poor. The truth is that when one company do more on the ESG, it can not only benefit from the related policies, but also gain longer benefits in some invisible aspects.

The company with higher ESG ratings will be easier to get preferential treatment from the government. On the one hand, it may be a looser policy, and on the other hand, it is a tax reduction. In addition, as the ESG ratings consider the company governance at the same time, companies with high ESG ratings, especially the

ones doing good in corporate governance ratings, tend to have better management structures and better leadership. This makes their company's decisions better and execute more efficiently.

At the same time, the higher ratings in the social part of the ESG ratings means that the company contribute more to society. This kind of companies tends to have better reputations in the investors' mind. This also makes them more competitive in the same industry.

§2.2 Volatility

On this basis, we generally believe that companies with high ESG ratings have a better advantage in their field, no matter in which field, environment, social and corporate governance, they do better. With the help of the support of government policy, its own excellent corporate structure or a stronger social influence, we believe that this kind of company has better resistance when encountering some negative news, which will lead to have relatively less volatility.

Therefore the first hypothesis comes out.

H1: Chinese companies with high ESG ratings have lower volatility.

§2.3 Alpha (Excess Return)

In the learning process of CAPM, we already know that alpha can represent the excess return of a stock.. To the social and the corporate governance part, if the company has better management and decisions in daily process and have stronger effects in the society, we usually consider they can do better in their field. Therefore, when we want to measure what extent excess return that the higher ESG ratings Chinese companies can make, we can use alpha.

Then we get the second hypothesis.

Hypothesis 2: Companies with high ESG ratings in China have more excess returns (i.e., have larger alpha)

§2.4 The Effect of COVID-19

Under the background of COVID-19, stock markets around the world have shown sharp declines. This is also a normal situation, as COVID-19 represents the negative sentiment of investors towards the stock market. So would this negative emotion effect the ESG performance? We can easily find that most literature shows that companies with high ESG ratings will be less affected by this negative sentiment. A company with a high ESG score is inherently more stable, and this stability will make it more resistant to negative emotions than most companies. Many investors are also willing to choose to buy stocks with good ESG performance to achieve a safe-haven purpose.

Since the above two are based on the better performance and the better stability of the higher ESG rating

companies, we believe that the company will have a brighter performance under the background of COVID-19. Therefore, we do not consider the effect of the COVID-19 for the time being.

§3. Model Establishment

§3.1 Sample Picking

In terms of time selection, because of Covid-19 and other market news, we hope to obtain the length of our data as long as possible to eliminate the impact of the short-term special fluctuation. But unfortunately, we can't get a very long-term ESG rating data. The first reason is that on the public website we can only obtain the current ESG rating of Chinese companies. If we want to use this ESG rating for a long time, there are problems on missing data and inaccurate ESG ratings. The second reason is that the development of ESG rating of China is relatively late. In the early years, there were very few companies with this awareness. They just wanted to earn as much money as they can without considering the ESG factors. The changes come out just in the recent years. Therefore, in order to get the length of the data as long as possible, we choose to use the earliest publicly recognized ESG index as the research object, ESG 40 and ESG 100.

3.2 ESG 40 & ESG 100

CSI ECPI ESG Sustainability 40 Index (index abbreviation : ESG 40) conclude 40 listed company securities with higher ESG ratings selected from the SSE 180 Corporate Governance Index sample as the index sample, according to the ECPI ESG rating method.

CSI Caitong China Sustainability 100 (index abbreviation : ESG 100) selects 100 securities of listed companies with higher ESG ratings from the CSI 300 Index as the index sample, according to the ECPI ESG rating method.

We choose CSI 300 (also HS300) as the comparison index. Although ESG 40 is chosen from the SSE180, not CSI 300, we take into account that the CSI 300 is more representative in the Chinese stock market.

Then we conduct the first experiment. We collect the data of ESG40, ESG 100 and CSI 300 from January 4, 2012 to December 31, 2021 and calculate the cumulative returns and volatility of the three indices. Regarding the cumulative rate of return, we use the data on January 4, 2012 as the benchmark, multiplied the daily rate of return, and plotted the graph. For volatility, we chose the time series model to observe its volatility, unconditional volatility, and a reaction to negative news.

3.3 ESG 300 & ESG 300 LEAD

Because China's awareness of ESG has developed relatively late, compared to the international community, we also select a set of relatively new data, which are ESG 300, ESG 300 LEAD and CSI 300. These two indices and the above two indices belong to the same company. We hope that this group of samples has a

better selection of samples as the way of selection is improved.

Although the short-term data in recent years will involve the impact of the epidemic, it is pointed out in the relevant literature that the prices of stocks with high ESG ratings will show stronger stability. We will combine this conclusion to evaluate our results.

CSI 300 ESG Benchmark Index (index abbreviation : ESG 300) removes 20% of listed company securities with the lowest ESG scores in the CSI tier-one industry from the CSI 300 samples, and selects the remaining securities as index samples to provide performance benchmarks and investment targets for ESG investment. The index releases on April 30,2020 and uses June 30,2017 as the base date.

The CSI 300 ESG Leading Index (index abbreviation : ESG 300 Lead) selects the 100 securities of listed companies with the highest ESG scores from the CSI 300 Index samples as index samples. In the CSI primary industry, the securities with the highest ESG score one third are selected as index samples.

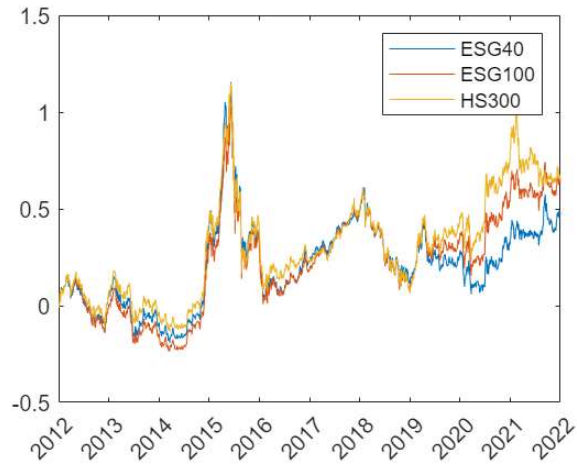
§3.4 Model

As the index is time-series data, we choose to use the Garch, T-Garch and E-Garch. In fact, during the experiment, we find the T-Garch has an unreasonable P-value, so we do not use it.

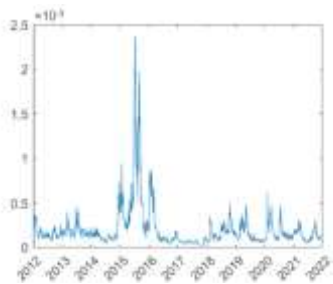
§4.Results

§4.1 The First Experiment

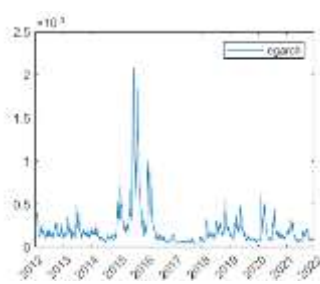
First, we focus on the cumulative return. It can be found that these three indices have the similar trend. Unlike our assumptions, when the index falls, ESG related indices do not have a good ability to resist the fall. Whether from 2013 to 2015 or after 2019, we find that the ESG-related indices show that the yield performance is weaker than the market. Although at individual time, the ESG index will perform better. For example, in the first half of 2015, ESG 40 had better performance. But in general, the three are similar to most of the time, and when they fall, the ESG related indices will fall more. At the same time, we also refute our original guess on the influence of COVID19. When facing negative messages, the income performance of the ESG related index may be relatively worse.



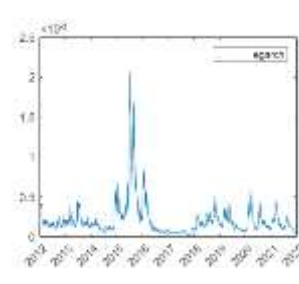
	ESG40	ESG100	CSI300
Average Daily Yield	0.0264%	0.0311%	0.0315%
Unconditional Volatility	0.000272	0.000263	0.000435



ESG40



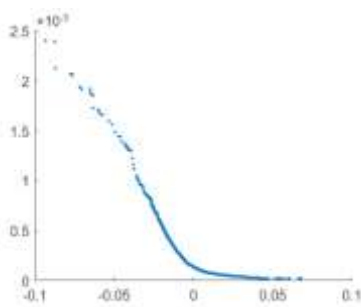
ESG100



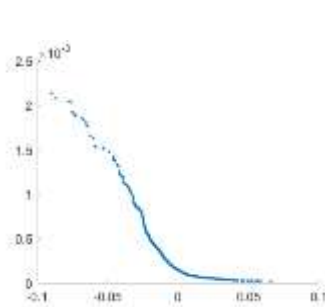
CSI300

To the daily average yield, we find that the yield of the ESG index is generally low. And it is shocking that the yield of ESG 40 will be relatively lower than the ESG100's yield.

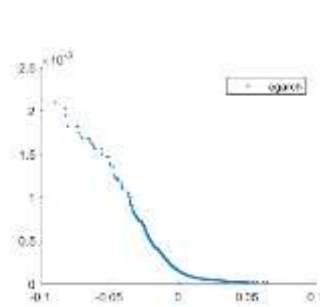
To the volatility, if you only consider the overall unconditional volatility, the two ESG indices do have a lower volatility, which is the same as our assumptions. However, at some individual time, the volatility of our ESG related index does not perform better. For example, from 2015 to 2016, the volatility of the ESG40 is significantly higher than the volatility of CSI300. In addition, it is surprising that the volatility of the ESG100 will be smaller than the ESG40.



ESG40



ESG100



CSI300

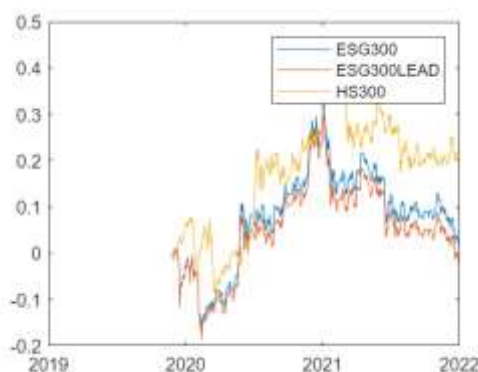
In the face of negative messages, we can clearly find that these three indexes will be more sensitive to negative messages. In addition, opposite to us, we can find that the CSI300's resistance to this negative message is relatively strong. It is specifically reflected in the relatively gentle left curve of CSI300.

	ESG40	ESG100
alpha	-0.0013	0.0000

Similar to the conclusion of cumulative yield obtained, we can find that the ESG related index has not obtained excess returns. The difference between ESG100 and the CSI 300 is similar, while the ESG40's income is relatively poor. This violates our assumptions 2.

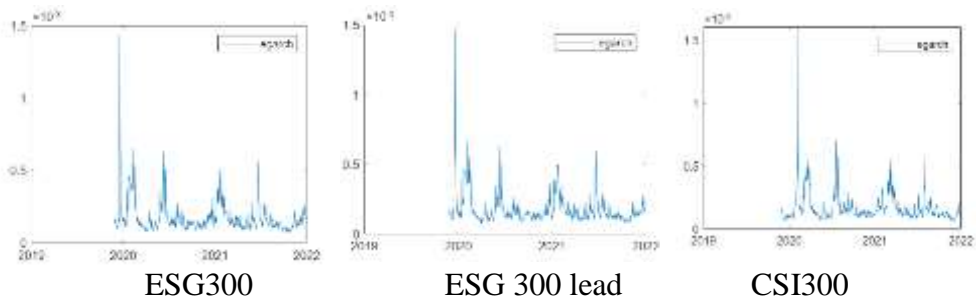
§4.2 The Second Experiment

First of all, we still analyze the cumulative return. On the whole, the cumulative return of CSI 300 is higher than ESG300 and ESG300Lead. However, in some time periods, ESG300 and ESG300Lead will have more than CSI300 income. However, at the same time, in early 2020 and in early 2021, there were changes in CSI300's revenue, that is, a decline appeared. Then analyze the daily average income, the yield of ESG300 and ESG300Lead is significantly lower than CSI300. It can be seen that we originally had a problem with COVID19's speculation on yields.

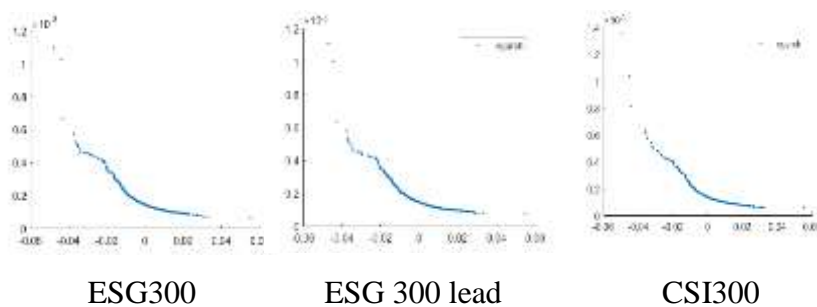


We then analyze the volatility of the three indexes. From the perspective of unconditional volatility, the volatility of the ESG -related index is still relatively smaller, but the difference is very little. Moving to the volatility chart, in early 2020, the CSI300's volatility will be greater, but the volatility of the ESG related index in 2021 will be relatively larger. With different changes in the market environment, the volatility will change differently.

	ESG300	ESG300 LEAD	CSI300
Average Daily Yield	0.0076%	0.0148%	0.0467%
Unconditional Volatility	0.000186	0.0001842	0.0001876



We analyze the performance of the ESG related index on negative messages. We find that in this set of samples, the CSI300's response to negative messages will be stronger. This is consistent with our assumptions. Therefore, we speculate that the volatility of Covid-19 has a smaller effect on the volatility of the ESG related index compared to CSI300.



For excess returns, we have also obtained a conclusion similar to cumulative yields. The ESG related index does not have a better excess yield. ESG300 Lead and CSI 300 are similar. ESG300 even has a negative excess income.

	ESG300	ESG300 LEAD
alpha	-0.0148	0

§ 5. Staging Summary and Improvement

§ 5.1 Staging Summary

We can draw a preliminary conclusion from the above two sets of data. ESG score -high stocks can reduce volatility. However, at the same time, as stability increases, risk reduction has reduced. the excess returns are also reduced, Meanwhile, the resistance capabilities when encountering negative messages may change according to different occasions.

We then work on why our experimental conclusions will be different from our assumptions. The first reason may be the ESG index we choose. The ESG index is more common to respond to the phenomenon of the market, but in fact, there are still few companies with high ESG scores. In addition, different ESG

institutions have a certain tendency for ESG scores. Some institutions prefer the companies that do well on corporate governance and then give better scores. Others may pay more attention to the environment and give more high scores to companies with good environmental performance.

The second reason is that there are some problems with the timeliness and authenticity of the enterprise when disclosing related ESG information. Even if there are relevant policies to disclose, it is still a problem to disclose the integrity and submission time of the disclosure. Taking Chinese banks as an example, in 2022, although various banks have the basis of disclosing social responsibility reports, only 11 banks disclose this year. In the reports' content, green credit is the most concerned content. However, in terms of standards, some are based on the CBRC's standards, and some are the standards of the People's Bank of China. In addition, only some banks have disclosed the content of social levels such as inclusive finance and the proportion of female employees.

The third reason is that the Chinese government's related welfare policies are still weak for enterprises. For example, since China launched the first batch of solar demonstration projects in 2016, China has not implemented relevant policies. Although there are some policies, the cost of solar development has not been reduced due to the continuity of the policy. When the cost compares with the cost of traditional energy, the clean energy has no advantage. This has also made some trouble on the development.

§5.2 Improvement

Based on the above reasons, we decided to go on the experiment with a new investment portfolio for further research. In the new investment portfolio structure, we have considered the ESG rating problems, but the problem of time length is still difficult to solve.

Then we construct the index after the following steps:

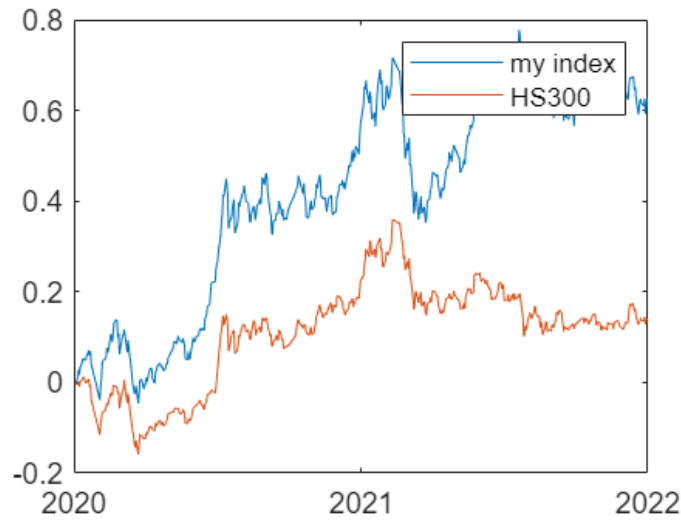
1. Considering the gap of ESG ratings, the samples we choose have two ESG rankings that are both grade B or above.
2. Taking into account the ESG ratings changing with time and that some companies we select are founded in recent years, we start our data from 2020/1/1 to 2021/12/31.
3. The weight we use is equal.

Then we start the model again and get the new results.

§6.Results of new experiments

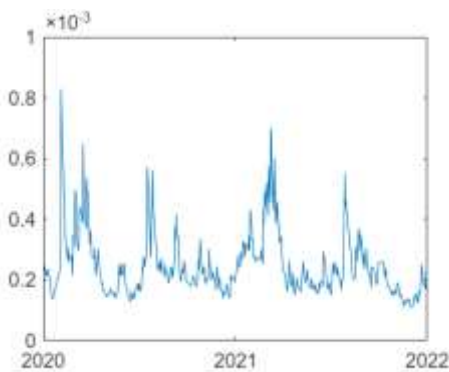
It is amazing that after we replace the sample group, we find that the cumulative yield of the ESG related index is significantly higher than the cumulative yield of the CSI 300 index, and the average daily yield is

much higher than the average daily yield on the CSI300. It can be seen from the figure that in June 2020, the yield of the ESG index we built was larger than that of CSI300. In March 2021, the decline in the ESG -related index was also large. In the next few months, the ESG related index rose back but the CSI 300 index did not.

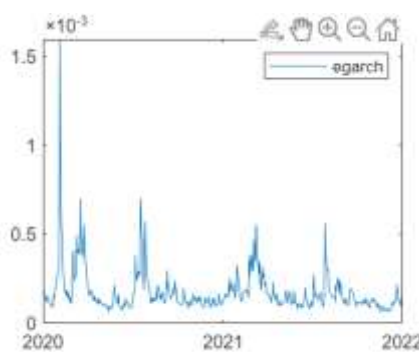


	New index	CSI300
Average Daily Yield	0.0011	0.0004
Unconditional Volatility	0.0003	0.0002

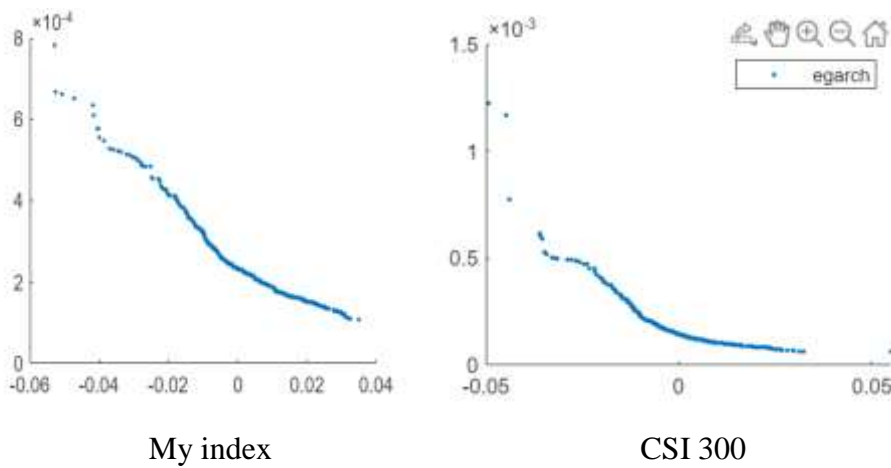
In terms of volatility, the volatility of the ESG related index we construct is higher than the volatility of the CSI 300. From the diagram of volatility, we can find that in early 2020, the decline in the CSI 300 was greater than the ESG -related index, so the volatility of the CSI 300 during this period was also greater than the volatility of the ESG -related index. At the same time, in middle of 2021, with the rise of the ESG -related index, the volatility of the ESG index is also larger than the volatility of CSI300. This can also be seen from the response of the two indexes to negative messages. CSI 300's response to negative messages is stronger.



My index



CSI 300



In terms of alpha, alpha is 0.0016. The ESG index we built has a positive excess income.

§7. Conclusion

From the three models above, we can find some of the common points to draw conclusions. High ESG ranking companies will have higher stability. Although the volatility of the ESG -related index in the Model III is high, the response of the index to negative messages is weak, and the reason for its high volatility from the volatility diagram is the additional rising part. The volatility caused by the rise in stocks is welcomed for investors and cannot be regarded as a risk. Therefore, we have concluded that companies with high ESG ratings do have stronger stability and can resist the impact of negative messages to a certain extent.

In terms of excess returns, the excess return can be seen in the index we built. Whether excess returns exist depends largely on the choice of individual stocks. When the samples in the ESG index are indeed a relatively high rating, the excess yield does exist. When we add some samples with the middle rating or middle-high ratings, the excess return may not exist.

Different from developed countries in European countries and the United States, Chinese ESG development road has still a long way to go. First, there are certain defects in China's ESG ratings system. Secondly, the implementation of related ESG welfare policies in China is also a problem. Finally, Chinese companies have not timely disclosure of ESG -related indicators and problems of incomplete information. There are very few companies with such ESG consciousness in China. Although related policies have been continuously followed up, many companies are not willing to implement due to the limitations of income which ESG may bring them.

In the Chinese market, companies with high ESG ratings will perform better as a whole, whether in terms of stability and yields. But this conclusion is based on the reliable ESG ratings. In terms of ESG ratings, investors should compare the ESG ratings of different institutions when choosing.