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Empirical study of ESG ratings in China's A-share market: A focus on the CSI 800 stocks

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EMPIRICAL STUDY OF ESG RATINGS IN CHINA'S A-SHARE MARKET: A FOCUS ON THE CSI 800 STOCKS

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I hereby declare that this DBA dissertation is my original work and it has been written by me in its entirety.
I have duly acknowledged all the sources of information which have been used in this dissertation.

This dissertation has also not been submitted for any degree in any university previously.

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Tan Wenqing

Abstract

In this study, we focus on the Chinese A-share market, and particularly on the CSI 800 stocks. Our aim is to conduct a comparison analysis of the prominent environmental, social, and governance (ESG) rating agencies in an effort to reflect the growing importance of ESG investment, social responsibility, and sustainable development. We mainly use three mainstream rating agencies' rating data (i.e., the China Securities Index [CSI], Wind, and SynTao Green Finance) to conduct descriptive statistics and comparative analysis. Furthermore, we conduct grouping tests on the ESG scores in the CSI 800 and across various sectors to explore their effectiveness in stock selection.

Next, to explore the return sources of the ESG factors in the time series, we utilize the Fama–French five-factor model for regression on their long-short portfolios. The portfolio analysis shows that the G-score can only be explained by these five factors to a low degree and that it has a significant alpha (intercept). This finding indicates that some elements of the G-score cannot be explained by the classical asset pricing factors, and may offer financial portfolios additional information. Therefore, we consider the G factor to be one of the most important criteria for stock selection. In the long-short portfolio regression analysis, we find the return source of the ESG factors to be significantly correlated with the size factor (SMB) and the profitability factor (RMW). As such, we then perform grouping tests by controlling for the SMB and RMW factors both separately and simultaneously.

Furthermore, from a practical perspective, we construct the CSI 800 ESG Smart Beta index enhancement strategy by conducting sufficient grouping tests on various screening methods (i.e., positive screening and negative screening). A major finding is that a portfolio constructed by negative screening will not worsen return performance, but instead it may offer more space for the investment manager to generate alpha. These empirical results may serve as useful references for future ESG investment research in the Chinese market. By extension, we further test the effectiveness of the CSI G-score's bottom factors, by constructing the CSI G plus-score (with seven indicators underlying the CSI G-score) index enhancement strategy. Despite its limited effectiveness, it represents a valuable attempt in the current Chinese A-share market.

The main contributions of this study to empirical research are as follows. We compare three leading domestic ESG rating agencies in the Chinese market, expand the basic sample size, and include an analysis of CSI industry sectors while emphasizing corporate governance factors to provide a reference for further market research in China. Against the backdrop of multiple studies recognizing the importance of the governance factor, we empirically verify that the G factor has better return performance in the grouping tests. Especially in the area of excess return, the G factor offers additional information that cannot be explained by traditional asset pricing factors. Finally, we suggest new visions and directions for future ESG research.

Keywords: ESG factors, ESG rating, ESG investing, portfolio analysis, Chinese A-share stock market

Contents

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Chapter 1 Introduction

1.1 Research background

Stemming from socially responsible investing, environmental, social, and governance (ESG) are the three dimensions prioritized during the investment process. Unlike classical financial factors, ESG criteria focus on a company's social responsibility and the sustainability of its operations, which are assumed to have an increasing impact on the company's financial performance, especially in the long run. Specifically, environmental metrics mainly include a company's carbon footprint, pollution, and natural resource conservation. Social metrics focus on a company's efforts to improve its social impact and maintain healthy business relationships with all of its stakeholders, with consideration given to factors such as gender equality, racial diversity, and employee career development. Regarding governance, a company is evaluated based on every process related to the board and management, including information transparency, legitimacy, and shareholder interactions. All three of these areas are assessed through a company's risk exposure and evaluated by how the company manages those risks.

ESG investing has gradually become a mainstream investment concept in mature Western markets and emerging markets, such as China. According to a report published by the Global Sustainable Investment Alliance (GSIA; 2021), this global ESG trend has led to investments totaling US$35.3 trillion in sustainable development projects, a 15% increase compared with the previous 2 years. MorningStar (2020) data also show that global investment in ESG assets grew by 72% year-over-year through the second quarter of 2020.

In the global market, most of the capital inflows come from Europe and the U.S., where the concept of ESG has been widely accepted and ESG-related products are well established. In China, although ESG investment remains in its infancy, it has developed rapidly in recent years with bright prospects ahead. Accompanied by the construction and progress of the ESG index system, an increasing number of asset managers are taking ESG principles into their investment considerations. Although the number of pure ESG-themed funds is still small, they are on an explosive growth trend. Ping An (2020) reported that pure ESG indexes of the Chinese market carried higher value exposure than the CSI 300 and ESG-themed funds outperformed the average market in general. ESG investing strategies used in the Chinese market mainly include negative screening and ESG integration, which have gradually drawn increasing industry attention.

In addition, the continuous expansion of the capital market and the Chinese government's support of "green finance" are driving Chinese investors to recognize the importance of ESG. Meanwhile, under the support of the regulatory system, companies intentionally disclose more ESG-related information to demonstrate their social responsibility. With more enterprise participants involved, numerous third-party rating institutions, including global agencies such as Morgan Stanley Capital International (MSCI) and Chinese local agencies such as the China Securities Index (CSI), now provide detailed ESG ratings on companies listed on the Chinese A-share market. This prospective process is expected to further facilitate the incorporation of ESG factors into the investment process.

1.2 Research significance

In recent years, climate change, environmental pollution, population aging, and corporate governance have become the focus of global sustainability concerns, and these long-existing problems have been further exacerbated by the impact of the COVID-19 pandemic, leading the global market to pay more attention to responsible investment (CSI, 2021b). At the same time, China has set the ambitious target of achieving carbon neutrality by 2060, and the idea of integrating ESG factors into China's capital market is prevalent. This denotes carbon neutrality and sustainable development as essential elements of China's current and future economic development.

Therefore, in the contexts of post-COVID-19 society and carbon neutrality, ESG investment continues to receive attention from all sectors, the development of which also brings tremendous opportunities. Specifically, on September 27, 2022, the China Social Security Fund (SSF) issued its "Industrial Investment Guideline," which states that ESG thematic investments should be increased. Furthermore, on October 28, 2022, the National Development and Reform Commission (NDRC) announced the need to deeply study ESG evaluation, considering both international experience and the specific practices of the domestic capital market in terms of green finance. At the policy level, placing greater emphasis on ESG practices and investments has increasingly become one of the guidelines for long-term economic development. To echo the consensus regarding sustainability in long-term industrial goals, a large number of new energy and environmental industries with high potential growth have arisen. Thus, better understanding ESG evaluation could help investors screen out such promising industries and companies in the future.

From the social perspective, the concept of ESG encourages enterprises to pay more attention to their environmental and societal impacts, rather than just their operational performance and profitability. However, interconnected with a sustainable economy are the negative externality effects of a free market and the risk of regulatory penalties associated with monopolistic business practices in the market. Meanwhile, substantial evidence has shown that the ESG approach can help investors avoid “black swan” events (i.e., extremely rare event with severe consequences to the economy) in the related industries. For investors, integrating the ESG factors helps avoid potential regulatory risks, which may have a significant investment value. At the same time, certain social, cultural, and economic investor attributes (e.g., income, age, gender, and education), inherent growing social preferences, and personal taste for products can all have a long-term impact on ESG asset pricing. It seems evident that the pricing position of ESG factors will increase as more investors acknowledge its importance.

The enormous potential of the Chinese market and constant development of “green policies” have recently attracted the attention of global and domestic investors. However, few ESG studies have focused on the Chinese market, and related studies need to further understand the impact that ESG evaluation may have on investment. Thus, we aim to comprehensively and empirically explore the investment value of ESG ratings in China’s A-share market.

1.3 Research purposes

With the growing recognition of the investment value of ESG, the focus on ESG investing has increased worldwide. The first Ethical Fund was issued in

the U.S. in 1971; with the global ESG fund size expected to reach US$34 trillion by 2026, ESG may become the strongest driving force in wealth management (PWC, 2022). Meanwhile, resistance to the ESG concept shows negative effects, with the first new anti-ESG ETF (Exchange-Traded Fund) product, BAD ETF, listed in the U.S. in 2021, which invests exclusively in gambling, alcohol, and pharmaceutical companies (Jiemian, 2022). BAD ETF mainly considers paying high dividends in various tobacco and alcohol companies; its profitability is strong but has below-average beta coefficients, thus making it less cyclical and insensitive to economic fluctuations compared with ESG ETF (Ping An Securities, 2023). Furthermore, as a leading enterprise in the new energy vehicle industry, Tesla was kicked out of the S&P 500 ESG Index, sparking concern among global investors.

The Chinese capital market has gradually incorporated ESG factors into investment considerations and the decision-making process. In 2020, 49 fund companies issued 127 pan-ESG public funds, representing about twice the number issued in 2019. However, with the shift in investment style in the A-share market, investors have started to value quantitative research results more and high-net-worth clients are also becoming more rational. In addition to regulatory support and value selection, most investment institutions, especially Noah Holdings, which deals with high-net-worth individual investors, still require a prudential research process and quantitative analysis to inform investment decisions.

Improving the scientific characteristics of ESG evaluation and the stability of ESG products has also received more attention in the A-share market. The report “Fast-Growing A-Share ESG Investment: Status Quo and Characteristics”

(TF Securities, 2022) points out that although Chinese ESG indices and products have developed rapidly since 2020, the market remains in the starting stage and ESG index products are characterized by small tracking sizes and unstable risk-return features. In this regard, it is imperative to improve the stability of ESG products and the scientific nature of ESG evaluation.

In a rapidly evolving global market environment, more and more researchers are focusing on China's A-share market. Some empirical results emphasize that A-share companies with better ESG performance have higher returns. As mentioned in the 2020 Principles for Responsible Investment (PRI) report "ESG and ALPHA in the Chinese Market," a preliminary analysis based on the MSCI's ESG data, the Chinese market shares the same trend with international investments, also indicating that ESG is a source of alpha. In addition, for the MSCI ESG research data specifically, the PRI as a global organization found that ESG factors were more effective in generating alpha in Chinese stocks than emerging market stocks during the period from June 2013 to June 2019. In the Chinese A-share market, Ma (2019) indicated that companies with high ESG scores have positive excess returns and high Sharpe ratios. In line with this finding, Chen (2020) found that A-share market companies with good ESG performance have high returns, and correspondingly investors show more confidence in companies with high ESG scores. Therefore, we explore the effectiveness of ESG in generating alpha in the Chinese stock market.

In this study, we primarily focus on China's A-share market, with the goal of revealing the impact of ESG on investment returns and risks. Furthermore, we analyze whether ESG or its individual scores can serve as a stable factor for

stock selection. In the process, we explore ESG index enhancement investment strategies and extend empirical research within the field of ESG in China, providing a practical reference for institutional and individual investors who may be interested in ESG investment.

1.4 Research specific goals

First, we analyze the mainstream ESG rating agencies in China's A-share market (CSI, Wind, and SynTao Green Finance). We compare their rating methodologies to analyze the differences between them and to further explore the impact of these differences on investment returns and risks.

Next, focusing on the CSI 800 stocks, we conduct data testing and examination of ESG ratings with the following objectives:

1) To observe whether the total ESG score and its sub-scores are effective for stock selection, through group testing of the performance of the total ESG score, E-score, S-score, and G-score both across the entire market and within separate sectors (industries).

2) To determine the possible sources of excess returns from the ESG factors by regressing the long-short portfolio of ESG scores using the Fama–French five-factor model.

3) To explore the construction of a CSI 800 ESG Smart Beta index enhancement strategy based on the controlled testing of different variables.

Chapter 2 Literature Review

Stock performance is critical to investors, who mainly care about how ESG ratings can contribute to their stock market returns. With much attention from the investment community, numerous studies have examined the relationship between ESG and financial performance. It is not surprising that the topic of ESG generates much debate both theoretically and empirically. Under slightly different research contexts, studies may yield totally different or even opposing conclusions. Therefore, we review both the related theoretical and empirical literature.

2.1 Theoretical background

Hirigoyen and Poulain-Rehm (2014) summarized the hypotheses proposed to explain the link between different aspects of corporate social responsibility (CSR) and corporate financial performance. Two representative hypotheses are the social impact hypothesis and the trade-off hypothesis, which make competing arguments regarding this relationship. The social impact hypothesis was first proposed by Freeman (1984) and further elaborated by Perrini et al. (2011) based on stakeholder theory. It argues that stakeholders expect companies to consider CSR in their operations and that stakeholders prefer companies that meet these expectations, and thus provide support to boost the financial performance of these companies. Cornell and Shapiro (1987) also contributed to this hypothesis, suggesting that companies satisfy stakeholders' expectations by improving their business reputation and reducing commercial risks. The trade-off hypothesis was originally proposed by Friedman (1970). In contrast to the social impact hypothesis, it proposes that investment in CSR

creates additional costs that diminish firms' profitability and competitiveness (Aupperle et al., 1985) due to the limited resources of companies aand eventually negatively affect their performance. From a principal-agent perspective, Prior et al. (2008) also suggests that management acquires vanity for building the image of social good, which ultimately has a negative impact on corporate performance.

Building on historical theories, recent studies continue to investigate the relationship between ESG and financial performance. Giese et al. (2019) explained the link between ESG and financial performance through three transmission channels: the cash-flow channel, the idiosyncratic risk channel, and the valuation channel. Through the cash-flow channel, companies with high ESG ratings are more competitive than their rivals due to strengths in areas such as effective utilization of resources, human capital development, and long-term business planning. These companies can use their competitive advantages to obtain higher profits, leading to higher dividends. Through the idiosyncratic risk channel, companies with superior ESG practices generally have better risk management, which reduces the chances of severe incidents such as fraud and corruption. Avoiding these risk events significantly minimizes the downside risk of their stocks. Through the valuation channel, companies with a strong ESG profile are less vulnerable to market shocks and thus have low systematic risk than their counterparts. Lower systematic risk, which corresponds to a lower beta in the capital asset pricing model (CAPM), attracts a more extensive investor base and translates into a lower cost of capital, as investors require a lower return on these ESG assets. Therefore, companies with a lower cost of capital would have a high valuation according to the DCF model. These three

transmission channels imply that investing in companies with superior ESG practices could bring excess returns while reducing the corresponding risks, especially downside risks.

On the contrary, investors could earn a risk premium by bearing the risk of poor ESG performance. Furthermore, investing in companies with strong ESG performance may result in lower expected returns because they provide a hedge against ESG-related risks (Cornell, 2021).

2.2 Empirical studies on the relationship between ESG ratings and stock performance

2.2.1 ESG and stock returns

The empirical evidence on the relationship between ESG and stock returns varies, with no consensus on this relationship reached as yet. It is important to note that studies conducted using different data sources or focusing on different regions and sample periods will have completely different results.

Friede, Busch, and Bassen (2015) summarized more than 2,000 empirical studies on the relation between ESG criteria and stock returns conducted since the 1970s. Most of those studies documented non-negative relations (the majority of which were positive), with the positive relations being stable across time and different study contexts. Whelan et al. (2021) conducted similar research on over 1,000 studies from 2015 to 2020 and concluded that nearly 60% of studies indicate a positive relationship between ESG and stock returns. Some studies with other results arrive at neutral or mixed conclusions, with only a few studies reporting a negative relationship.

Earlier studies on CSR mostly have demonstrated that CSR can help

enhance a firm's value (Malik, 2014), as reflected by higher profit margins (Shen & Chang, 2009) and stock performance. Firms adopting ESG-friendly policies generally outperform their peers in the stock market (Ashwin Kumar et al., 2016), especially in the long run (Eccles et al., 2014). Echoing such long-term effects, Hvidkjær (2017) highlighted in a literature review evidence that stocks with a high ESG rating have high future returns. The relevant empirical evidence is strongest in the 1991–2004 period, while the returns of stocks with high ESG ratings do not appear to differ from the 2005–2012 benchmark. Some results also suggest that stock returns have been high again since 2012. Hvidkjær's (2017) review suggests a relative trend in which returns for stocks with high ESG ratings first decrease and then increase, which can be interpreted as an overall upward trend over the long term.

The positive impacts of ESG on financial performance and company performance have been shown in different markets. Meanwhile, incorporating ESG into trading strategies is also proven to generate higher abnormal returns (Kempf & Osthoff, 2007; Nagy et al., 2016). In the U.K. market, Ahmad, Mobarek, and Roni (2021) found that ESG significantly and positively affects financial performance. Khan (2019) even proved the predictability of ESG measures. In a related CSI (2021c) report, "The Impact of ESG on the Performance, Risk and Valuation of Listed Companies from the CSI ESG Evaluation System," it is mentioned that the results of multiple international studies among listed companies in foreign stock markets show that high ESG rating groups have higher profitability and dividend levels than low ESG rating groups. Similarly, in an empirical study, Giese et al. (2019) found that companies with high ESG ratings have higher profitability and pay higher

dividends, especially when compared with firms in the bottom quintile. Furthermore, Gupta et al. (2016) emphasized the importance of higher dividends for long-term performance development.

Delving specifically into the Chinese market, similar conclusions have been drawn on the higher profitability and dividend yield of companies with higher ESG ratings. Based on evaluation data on the CSI's ESG from 2017 onward, the report "Global ESG Investment Development Report in 2020," indicates that high ESG rating groups demonstrate higher return on assets and dividend yields than low ESG rating groups, both in the current period and in the coming year. This finding suggests that companies with higher ESG ratings demonstrate higher and more sustainable profitability and a greater willingness to pay dividends (CSI, 2021a). Additionally, Hu et al. (2018) examined listed manufacturing firms on the Shanghai and Shenzhen stock exchanges and found a positive relationship between CSR and firm value. The most recent reports verify the ability of ESG to generate alpha through negative and positive screening among mid-to-large-cap stocks (Everbright Securities, 2020; Huaxi Securities, 2020).

Extensive empirical findings suggest that firms with high ESG scores have correspondingly high profitability and earnings performance. However, this does not imply that higher profitability is derived from a firm's high ESG score, but rather that firms have more capital to improve their ESG performance and practices accordingly because of their high profitability. As observed by Melas et al. (2017), large companies, with more stable revenues, tend to have better ESG scores. This is also shown in a New Fortune (2022) report, in which the top 50 listed companies led the market in terms of revenue and profit; these

companies were equally committed to social responsibility and improving their ESG performance, and they simultaneously demonstrated steadily increasing profitability.

Despite positive reports, some studies have taken a negative or neutral position. According to the article "Ask a Scientist: What's Up With the Attack on ESG Investing?" written by Negin (2022), former U.S. Vice President Mike Pence publicly posted in the Wall Street Journal in May 2022 and expressed his hope to legislatively "end the use of ESG investment principles nationwide." Although ESG investing has become one of the dominant international investment trends, it has also been met with skepticism and growing negative perceptions.

Some have argued that optimizing portfolios' CSR or ESG exposure does not necessarily bring excess returns (Alessandrini & Jondeau, 2020; Chan et al., 2020; Hirigoyen & Poulain-Rehm, 2014). Hong and Kacperzyk (2009) showed that sin stocks (companies involved in the alcohol, tobacco, and gaming industries), which violate the ESG principles entirely, outperform non-sin stocks, mainly through higher exposure on profitability and investment factors (Blitz & Fabozzi, 2017). In favor of trade-off theory, Dorfleitner et al. (2020) demonstrated the significant underperformance of an equally weighted ESG score Best-Minus-Worst portfolio.

Furthermore, a few studies have proposed a non-linear relationship between the ESG factors and stock performance. Chen & Lee (2016) found that CSR does not positively affect company value until it exceeds a certain threshold, which is consistent with the U-shaped relationship found by Barnett and Salomon (2006).

2.2.2 ESG and stock risk

In addition to its impact on stock returns, ESG investing is often mentioned in relation to risk management.

Godfrey, Merrill, and Hansen (2009), Jo and Na (2012), and Oikonomou, Brooks, and Pavelin (2012) discussed the effect of ESG factors on the risk of listed companies. Listed companies with higher ESG levels generally have better risk control capabilities, which results in fewer litigation disputes and regulatory penalties. The lower percentage of risk events in turn reduces the impact on the company's share price, maximum drawdown, and tail risk.

In the CSI (2021c) report, "The Impact of ESG on Listed Companies' Performance, Risk and Valuation from the CSI ESG Evaluation System," it is pointed out that companies with higher ESG have lower systematic risk and are less likely to suffer large losses. In the report, it is also argued that companies with higher ESG scores have lower levels of drawdown, based on data from the Chinese market starting in 2017.

With this mixed definition of risk, Everbright Securities (2020) specified that the residual volatility in the CAPM is lower for firms with higher ESG ratings than for their counterparts. Several studies have proven that stocks with poor ESG characteristics suffer from high volatility (Ashwin Kumar et al., 2016; Dunn et al., 2018; LaBella et al., 2019) and have shown that portfolio managers can control such risk by incorporating ESG criteria into their investment strategies (Jagannathan et al., 2018). Diemont, Moore, and Soppe (2016) further showed that both volatility and downside risk are reduced through integrating ESG factors into the investment process. To control the impacts of other factors, risk should be divided into systematic risk and idiosyncratic risk. Regarding the

systematic risk transmission mechanism, Eccles, Ioannou, and Serafeim (2014) concluded that companies with good ESG profiles are less susceptible to systematic risk shocks and therefore exhibit lower risk than those with bad ESG profiles. Studies generally agree with the definition and the adjustment of systematic risk (Albuquerque et al., 2019; Mohanty et al., 2021; Sassen et al., 2016). The CSI's 2017–2018 data shows that the group with higher ESG ratings has lower systemic risk in the upcoming year compared with the group with lower scores; the former group also has lower tail risk (CSI, 2020b).

Still, idiosyncratic risk is defined differently in different models. As concluded in the CSI (2020b) report "ESG Investment Value and ESG Index Investment," many studies have summarized the transmission mechanism of idiosyncratic risk as follows: companies with strong ESG characteristics have above-average risk control and are less affected by negative events; having relatively fewer risk events eventually reduces the tail risk of these companies' stock prices.

2.2.3 ESG and classical asset pricing factors

A discussion of the impact of ESG must consider its relationship with other classical asset pricing factors, namely size, value, and profitability. Firms with higher ESG ratings tend to have more outstanding market shares (Huaxi Securities, 2020) and higher dividend yields (Everbright Securities, 2020). It is also well accepted that large companies have more available resources to enhance sustainable performance than small companies.

Drempetic et al. (2019) suggested a significant and positive relationship between firm size and a firm's CSR performance. In contrast, Ahmad et al.

(2021) demonstrated that firm size undermines the relationship between ESG and financial performance. Furthermore, multiple aspects of ESG criteria are primarily exposed to traditional factors. The 300ESG Index, a typical ESG index in China's A-share market, exhibits the characteristics of considerable size, high profitability, and low valuation in its composition.

The correlation between ESG and traditional financial metrics has also been reflected in numerous studies and reviews. As mentioned in the PRI (2020) report, "ESG and ALPHA in China," various studies and reviews have identified correlations between ESG rankings and financial metrics, such as quality, price-to-net ratio, profitability, volatility, earnings, and market capitalization. The strength of these correlations typically varies depending on the period and geographic region sampled. Most, but not all, ESG surveys have found corporate governance to be the most correlated and consistent indicator of earnings. The strength of correlations also varies over time. Some studies have highlighted that correlations increase during periods of increased market volatility or market disruption (PRI, 2020).

In addition to geography and time, the correlation between corporate financial performance and ESG rankings varies by industry. This correlation is higher in industries that are more subject to regulatory influence or require "social licensing" than in other industries. For example, the statistical relationship between ESG and company financial performance is stronger in the resources, consumer, and utilities industries (PRI, 2020).

2.2.4 ESG factors and Fama–French factor models

Numerous financial studies have used the Fama-French factor models to

explore the relationship between classical pricing factors and stock returns.

As illustrated in Kumar's (2019) ESG empirical study, the Fama–French (2015) five-factor model aims to reflect the size, value, profitability, and investment patterns of average stock returns. Kumar (2019) examined the return pattern of the MSCI USA ESG Index using CAPM and asset pricing model variants (e.g., Fama–French three-factor model and Fama–French five-factor model), and concluded that involving ESG scores in portfolio construction may not generate alpha.

The explanatory power of Fama–French models has been disputed. Most recent research has outlined the benefits of the Fama–French five-factor model for assessing portfolios (Zaremba & Czapkiewicz, 2017; Paliienko et al., 2020). To investigate the applicability of the Fama–French five-factor model across international markets, Chiah et al. (2016) tested an extensive sample of Australian equities and discovered that the Fama–French five-factor model can explain more asset pricing anomalies than other pricing models, which can be regarded as evidence of its superiority. Lin (2017) also presented similar, positive results in the Chinese equity market, with the Fama–French five-factor model outperforming the Fama–French three-factor model. However, in the Indonesian capital market, Saleh (2020) revealed that the Fama–French five-factor model has lower explanatory power than the Fama–French three-factor model.

In a systematic review of over 30 studies using Fama–French factor models to examine ESG factors and portfolio alphas, Kumar (2023) highlighted that no significant association has been found between ESG factors and portfolio alphas in the context of a globally diversified portfolio, whereas positive results

have been found in terms of a regional portfolio.

Despite the debates surrounding the Fama–French factor models, it is still broadly discussed in ESG studies. For instance, it has been used for portfolio construction (Maiti, 2021) in ESG study, leaving much space for furthur exploration.

2.2.5 ESG subcategory score effect

By extension, a large body of literature has examined the effect of three ESG subcategory scores (i.e., the E-score, the S-score, and the G-score) on financial performance.

Madhavan, Sobczyk, and Ang (2020) found that funds with higher environmental scores (E-score) tend to have higher quality and momentum factor loadings. Chan et al. (2020) found that green intangible value and corporate culture quality improve the value and quality of factors, respectively. In a review of 16 academic studies, Mercer (2009) found that the link between environmental factors and a firm's performance is the most controversial relationship, while social and governance factors are commonly shown to have a positive effect on portfolio performance. The prevention of environmental violations may not result in positive subsequent financial returns (Balabanis et al., 1998; Olsson, 2007). Nevertheless, the intangible market value of environmental performance still exists in some contexts (Konar & Cohen, 2001). The social score (S-score) has usually been studied in terms of more detailed dimensions, such as gender equality (Balabanis, Philipps, and Lyall, 1998), racial diversity (Richard et al., 2007), and employee satisfaction (Edmans, 2011). Such studies have tended to support a positive effect of social

factors on financial returns.

Finally, governance has been the most studied factor, and its influences remain significant in the literature. Ammann et al. (2011) confirmed a strong and positive relationship between corporate governance and firm valuation. In portfolio construction, governance scores are more useful than total ESG scores in terms of stock selection (Hauxi Securities, 2020). John Hill (2022), President and CEO of Derivatives Strategy Group, made the same argument in the chapter "*What's next for ESG investing*?" of his book *ESG in practice: From theoretical elements to sustainable portfolio construction*. He argued that the most important ESG factor is corporate governance (Hill, 2022). Among the three categories of ESG factors, governance has been shown to have the strongest correlation with positive financial performance (Hill, 2022).

Conversely, regarding risk, Sassen et al. (2016) concluded that environmental and social performance generally help reduce firm risk, while there is no significant link between corporate governance and risk.

2.2.6 ESG rating differences

The most convenient way to quantify firms' ESG performance is through ESG ratings provided by third-party agencies. Thus, the problem of rating disagreement must be considered. However, there is currently a large variation in the ratings of both international and domestic ESG rating agencies. This is reflected by the weak correlation between the ESG ratings of different agencies.

Many studies have recognized the divergence among ESG ratings. Berg, Kölbel, and Rigobon (2022) obtained ESG data from six prominent rating agencies and found that the variation is mainly driven by the differences in the

scope and measurement of categories. Under the consensus of significant disagreement among rating agencies, Abhayawansa & Tyagi (2021) and LaBella et al. (2019) attributed this divergence to the differences in definition and methodology. In an empirical study, Dorfleitner et al. (2015) found similar results for three rating agencies, namely ASSET4, Bloomberg, and KLD, which demonstrated a clear lack of consistency in ESG measurement. They argued that such large differences stem from the raters' diverse composition and weighting methods for the ESG scores and underlying indicators.

Gibson et al. (2021) further investigated the connection between ESG rating disagreement and stock returns, documenting a positive relationship primarily driven by dispute about the environmental score. In contrast, from the perspective of predicting future prices, Serafeim and Yoon (2022) found that rating disagreement weakens the market's response to ESG news.

2.2.7 ESG with Smart Beta as an innovative direction

The combination of ESG and Smart Beta is based on a similar investment philosophy and a focus on long-term value. According to the CSI (2021a) report, "Global ESG Investment Development Report in 2020," some investment institutions are already using ESG factors as Smart Beta in practical applications. The report shows that nearly 44% of institutions using Smart Beta globally want to integrate ESG factors into their Smart Beta strategies, in which large asset managers are more active. By combining ESG and Smart Beta, institutional investors can achieve their goals of long-term risk avoidance, good social impact, and enhanced return performance (CSI, 2021a).

Most importantly, the in-depth combination of ESG investment and Smart

Beta strategy reflects the synergy between ESG investing and index investment as two long-term approaches. In the CSI (2020a) report, "When ESG Meets Smart Beta," the research results for the A-share market show that ESG factors last longer than Smart Beta factors, and combining them with value factors can smooth out the cyclicality of factor returns; for example, since 2019, value factor returns have weakened, whereas ESG factor returns have strengthened, reflecting the value of ESG and Smart Beta factor integration (CSI, 2020a).

2.3 ESG investment: dynamic process and long-term development

The objectives of ESG investment are constantly evolving, with no solid correlation with performance. Furthermore, the practical impact on companies is difficult to define and even harder to quantify. On this basis, ESG investment indeed requires both the dynamic evaluation process and long-term goals of development.

In Goldman Sachs Research's (2020) report on sustainable investing, "Sustainable ESG Investing: Turning Promise into Performance," it is emphasized that ESG is an investment style, not a form of pursuing goodness and beauty. Given the lack of consensus and stable or uniform metrics on the "goodness" of ESG investing, we can mainly view it as a rational and long-term investment principle (Goldman Sachs Research, 2020).

ESG investing is also a process that needs to be evaluated dynamically. At the same time, Goldman Sachs Research (2020) identified a number of deep-rooted problems with static ESG assessments of company behavior. Specifically, static indicators of ESG may misjudge the validity of overspending. Most importantly, from an investment perspective, static metrics

do not reflect a company's potential to improve from bad to good, which may actually be more valuable than a well-performing company in the first place. Therefore, a dynamic assessment process is required when measuring ESG metrics, which may also include the flexibility and insights of investment managers (Goldman Sachs Research, 2020). Overall, a dynamic ESG evaluation process is one dependent on the competencies of the investment manager and the long-term objectives of the company.

More importantly, researchers in the Chinese market are also continuously exploring the dynamics and long-term development process of ESG. For example, the CBN Research Institute, Rankins ESG Ratings (RKS), and Noah Holdings jointly launched the "ESG Rating Analysis Report for China A-Share Companies" in 2022, which takes ESG dynamic development into consideration by analyzing the absence of key ESG issues within the industry, exploring the best practices of ESG management, and providing guidelines that companies can use to improve their ESG management.

2.4 Research questions

The above literature review highlights the disagreement regarding how ESG ratings affect stock returns and alpha. Most empirical studies have been based on international rating data, such as those of the MSCI. For the Chinese A-share market, research on the impacts of ESG on stock returns remains in its initial stages and relatively limited. Through this study, we hope to further enrich the empirical results of localized ESG research. With this in mind, the following research questions are raised:

Research Question 1: Does ESG and its individual scores or specific

portfolios have a significant and positive impact on stock returns in the Chinese A-share market?

Research Question 2: Does ESG and its individual scores or specific portfolios lead to mid- to long-term alpha and serve as a stable factor for stock selection?

Numerous studies have concluded that ESG factors are correlated with a firm's size and profitability. However, the relationship between ESG factors and stock price has been explored without controlling the influence of these pricing factors. We explore whether the impact of ESG on stock returns can arise through other factors. Thus, the following research question is raised:

Research Question 3: As larger and more profitable companies have more capital to maintain their environmental and social responsibility spending, could the impact of ESG ratings on stock returns arise from other factors?

Meanwhile, many empirical studies have concluded that the G factor is most strongly correlated with positive financial performance. However, in the current Chinese market, little empirical evidence for individual scores exists and the potential impact of the G-score on stock prices has not been analyzed in depth. To fill this gap, we focus on the G-score in this study. Thus, the following research question is raised:

Research Question 4: As higher E- and S-scores may require cash outflows, a higher G-score would theoretically have a positive effect on a company's future cash flows. Does a higher G-score have a significant and positive effect on stock returns?

Chapter 3 Comparative Analysis of the Mainstream ESG Rating Systems

3.1 Global standards and frameworks

3.1.1 Global standards: GRI

The Global Reporting Initiative (GRI) standards were developed by the Global Sustainability Standards Board (GSSB) through a unique multi-stakeholder consultation process, involving a wide range of organizations and users of reporting information around the world. This standard enables organizations to report information about their impacts on the economy, the environment, and people more consistently and credibly, as well as to promote sustainable development on a global scale.

The GRI standards constitute a modular system of interconnected standards, consisting of three series of standards: the GRI Universal Standards, the GRI Sector Standards, and the GRI Topic Standards. The GRI has introduced a library of specific indicators for environmental, corporate governance, and social issues, requiring companies to select indicators based on their own choices, disclose organizational details (e.g., activities and policies), and integrate financial reporting standards to disclose specific information on material topics.[1]

3.1.2 UN sustainable development goals: SDGs

In response to the enormous economic, environmental, and social challenges under the global context, the United Nations (UN) Sustainable

[1] See the GRI standards for details: https://www.globalreporting.org/search/?que.

Development Goals (SDGs) have clarified the global vision and priorities for 2030, with the goal of promoting further sustainable development. To help enterprises better identify their strengths and weaknesses for sustainability through the SDGs, the UN has also launched a corporate disclosure guide based on the SDGs. The guide divides the environmental, economic, and social dimensions into four areas, namely environmental, economic, social, and corporate governance. It further provides specific rules for enterprises: choose SDGs that match their business models, choose indicators at both the macro and micro levels, select comparable indicators with double materiality, and ensure that the time cycle of disclosure data is consistent with the enterprise's annual report.[1]

The continuous updating of international standards and frameworks have promoted sustainable development globally, and also provided basic concepts and innovative directions for the domestic ESG rating systems' development. This allows more Chinese rating agencies to integrate the characteristics of the Chinese market while aligning with international standards.

3.2 Mainstream ESG rating systems

3.2.1 CSI ESG rating system

The CSI ESG evaluation methodology is centered on sustainable development, examining the three dimensions of environmental, social, and corporate governance and consisting of 13 themes, 22 units, and over 200 indicators. The logic of the evaluation methodology is as follows. First, an environmental focus on input and output processes reflects environmental risks

[1] See the SDGs for details: https://sdgpulse.unctad.org/.

and opportunities. Second, at the core of the social dimension is the responsibility to defend stakeholders other than shareholders. Third, corporate governance focuses on the institutional design of internal and external governance.

Table 3.1: Overview of CSI ESG rating system tiers

Tier 1	**Tier 2**	**Tier 3 (examples)**
Environmental (E)	Climate Change	Carbon Emissions
	Pollution & Waste	Pollution & Waste
	Natural Resources	Water Resources/Biodiversity & Land Use
	Environmental Management	Environmental Management System
	Environmental Opportunities	Environmental Opportunities/Green Finance
Social (S)	Stakeholders	Employee/Supply Chain/Customer
	Social Responsibility Management	Social Responsibility Management
	Social Opportunities	Charities/Corporate Contribution
Governance (G)	Shareholder Rights	Minority Shareholder Protection/Controlling Shareholders' Behavior
	Governance Structure & Operation	Institutional Setting/Institutional Operation/Incentive & Restraint Mechanism
	Information Disclosure	Disclosure Quality
	Corporate Governance Risk	Corporate Governance Risk
	Management Performance	Financial Risks/Financial Quality

The CSI ESG evaluation methodology is characterized by a balance between both international standards and the local reality. Characteristics of the CSI ESG evaluation methodology include references to the international mainstream ESG system structure and indicators with Chinese traits (e.g., poverty alleviation). It also has a clear risk and return transmission effect, and is a professional evaluation system for investment.

This rating system principally examines both ESG risk management factors and opportunity factors as well as ESG risks, while focusing on a company's

investment and effectiveness in reducing risks. The weighting of indicators considers the characteristics of different industries, and they are thus processed with neutralization. Overall, the CSI's ESG rating results are divided into ten levels: AAA, AA, A, BBB, BB, B, CCC, CC, C, and D.[1]

3.2.2 Wind ESG rating system

The Wind ESG rating framework considers management, practice, and controversy assessment. Under the three ESG pillars, it is composed of 28 issues (e.g., environmental management, employees, and ESG management) and more than 1,000 data points.

The logic of the Wind ESG rating methodology is as follows. Wind refers to an international, mainstream ESG system structure. It combines the development of China's capital market and regulatory policies, identifies substantive ESG issues and indicators with significant impacts on Chinese companies, and provides a scientific basis for investment decisions. In addition to the three Tier 1 indicators E, S, and G, Wind incorporates scores for public opinion information. Wind's ESG rating results are categorized into seven levels: AAA, AA, A, BBB, BB, B, and CCC.[2]

3.2.3 SynTao Green Finance ESG rating system

The ESG score of SynTao Green Finance is made up of the ESG management score and the ESG risk score. Fourteen key issues (e.g., environmental disclosure, social controversies, and business ethics) and more than 200 tertiary criteria, created from over 700 data points, constitute the

[1] Details of the CSI data provider can be found at: https://www.csindex.com.cn/#/esg?anchor=Methodology.

[2] Details of the Wind data provider can be found at: https://www.wind.com.cn/portal/en/ESG/esgRating.html.

SynTao Green Finance rating system for the three ESG dimensions.

The logic of the SynTao Green Finance ESG rating methodology is as follows. SynTao Green Finance offers maximum coverage of material, accessible, and representative ESG indicators. It mainly combines the actual Chinese situation and the international market, while taking industry characteristics into consideration. It has 51 industry ESG models, with indicator weights for specific industries. Overall, SynTao Green Finance's ESG rating results are categorized into ten levels: A+, A, AA, B+, B, BB, C+, C, CC, and D.[1]

3.3 Comparisons of ESG ratings between the CSI and Wind

From the accessibility of data and the relatively large differences between ESG rating logics, we hereby prioritize the CSI and Wind ratings for a refined comparison. Specifically, the CSI adds China-specific indicators and Wind focuses more on adding risk management-related indicators; they both have several similar evaluation dimensions, which can be further compared. Table 3.3 compares the relative strengths of CSI ESG ratings with those of Wind ESG ratings across three dimensions: "similarity with international rating agencies," "localization of indicators," and "materiality and practicality."

Table 3.2: Comparisons of ESG ratings between the CSI and Wind

	CSI	**Wind**
Value	Committed to establishing Chinese ESG standards and promoting ESG best practices in China.	Build an ESG rating system that is applicable to the Chinese market and aligned with international standards, with open and transparent underlying

[1] Details of the SynTao Green Finance data provider can be found at: https://en.syntaogf.com/pages/esg01.

	CSI	**Wind**
	(localization + investment)	data and real-time risk monitoring. (internationalization+ risk control)
Measurement (metrics)	Similarities 1) Quantitative > Qualitative (CSI: Qualitative 44%, Quantitative 56%; Wind: Qualitative 40%, Quantitative 60%) 2) Indicators all emphasize systems and outcomes of a given issue	
	Differences 1) More substantive: indicator units are related to efficiency and capital input share 2) Attempts to create a new pool of indicators: whether companies disclose CSR reports; whether companies disclose CSR reports according to the international framework; whether they have pro-poverty projects; the goodwill to net assets ratio; and whether they have carbon-neutral training	Differences 1) Indicator selection is relatively straightforward but poorly matched to financial indicators (emissions, headcount, and share) 2) Too many indicators of parallel features (e.g., wastewater emissions and wastewater emissions per million dollars of revenue)
Scope (ESG scope)	1) There are more G indicators at the secondary level: governance structure, disclosure, investor relations, management operations, management board, and corporate governance exceptions 2) CSI emphasizes environmental opportunities and social opportunities directly in the secondary-level indicators in Scope, as the MSCI does	G-score's logical line similar to the MSCI: first divided into corporate governance and business ethics and then into ESG governance, directors and supervisors, equity and shareholders, business continuity management, audit, corruption, anti-trust, and fair competition

	CSI	Wind
Weight	1) Emphasis on localization 2) Emphasis on industry weights	1) Emphasis on internationalization 2) Emphasis on industry weights

Table 3.3: Advantages of CSI ESG ratings versus Wind ESG ratings

	CSI	Wind
Similarity with international rating agencies		√
Localization of indicators	√	
Materiality and practicality	√	

3.3.1 Comparison of internationalization of indicators – Wind is relatively better

Within the same scope, Wind's entry point and wording are more similar to those of international rating agencies, such as the MSCI and the DJSI (Dow Jones Sustainability Indexes). Additionally, Wind, like international rating agencies, pays more attention to feminism-related issues (e.g., repeatedly asking about anti-discrimination initiatives, the percentage of female executives, the percentage of female directors, and related party transactions). The CSI shows relatively weak performance in this area; for example, the S and G sections are missing scoring areas that overseas rating agencies would focus on, such as product liability, anti-trust and related party transactions, revenue generation per capita, and anti-corruption.

3.3.2 Comparison of localization of indicators – The CSI is relatively better

The CSI is more localized, but because of the relatively heavy policy bias,

future evaluations will need to consider how frequently these biased policy indicators are modified or added.

In terms of the environmental dimension, the CSI incorporates questions regarding whether there is a green financial business development policy in place and whether projects are green funds, green bonds, or green credit projects. Such questions are more in line with China's green financial environment. In contrast, Wind only lays out the scope of inquiries, such as emissions level and fuel consumption.

As for the social dimension, Wind, much like the MSCI and the DJSI, does not include too many evaluation criteria for social responsibility; the CSI divides social opportunities into charitable activities and corporate contributions. Among them, charitable activities also emphasize the number of hope schools donated to with "rural revitalization" at the core and whether the company has set up poverty alleviation projects (social capital and political capital). In addition, the CSI includes corporate tax and corporate tax per capita in the social contribution section. The CSI's social-level questions are more relevant to China's current weaknesses demonstrated in the SDGs. Specifically, for employee benefits, the CSI emphasizes questions regarding per capita injury insurance premiums, per capita maternity insurance premiums, and the per capita housing provident fund. In comparison, Wind asks in a simple and general way, such as by inquiring whether there are employee satisfaction surveys and whether there is a relevant welfare system. Regarding fairness in the workplace, Wind asks about the anti-discrimination system; the CSI asks more detailed questions, such as whether a company offers assistance for employees in difficulty and special employee groups (e.g., pregnant women and

breastfeeding women), whether the company has published the educational composition of its employees, regarding the proportion of its female employees, regarding the proportion of ethnic minorities, and regarding the proportion of employees with disabilities.

With respect to the governance dimension, the CSI puts research and development (R&D) investment in the context of China's high-quality development environment, which is not mentioned by Wind. Although related party transactions in the Chinese context are considered a gray area, Wind asks eight questions on this topic.

3.3.3 Comparison of substantiveness of indicators—The CSI is relatively better

In terms of qualitative indicators, the CSI asks more initiative questions to understand practical, corporate ESG behavior. For example, in the corporate ESG system, Wind asks whether there is a climate change management system, and the CSI asks whether there is an environmental protection committee and related training on the subject.

In terms of quantitative indicators, those of the CSI are more oriented toward financial results, with some indicators being more substantive. For example, in the environmental dimension, Wind mainly asks about energy consumption and emissions, whereas the CSI proposes "environmental performance: the amount of corporate environmental protection investment; the amount of corporate environmental protection investment to the business revenue." In the social dimension, Wind directly inquires about the average salary of employees; the CSI asks about the average salary of employees other

than executives, the number of hope schools, and the number of poverty alleviation projects to enhance the storytelling of the enterprise, which could be incorporated into investment products. In the governance dimension, the CSI proposes a "goodwill to net assets ratio," which is not necessarily presented by many institutions for Level 3 or Level 4 indicators.

3.3.4 Comparison of logical framework and indicator settings

3.3.4.1 CSI's framework and indicator setting

1) A strong sense of logic between different levels of CSI indicators, with a clear focus on results.

2) The CSI's quantitative indicators may be prone to bias in investment performance. For example, at the social level, it asks how many hope schools companies have donated to and the amount of tax revenue for the year. Often the better the performance in this social area, the more financial power the company itself may have, thus making it more likely to have better market performance.

3) Some CSI indicators are not representative of ESG. At the social level, the CSI asks whether "companies have announced the social responsibility honors and awards they received in the previous year." However, the number of awards does not necessarily equate to high quality, and thus the data may not necessarily be representative.

4) The CSI ignores the importance of some international indicators; anti-corruption, anti-trust, product security, and data privacy should also be included.

3.3.4.2 Wind's framework and indicator setting

1) Wind covers the metrics comprehensively, but the coverage is too broad and redundant.

2) Wind indicators demonstrate high repetition. The indicators have too much internal repetition, resulting in a lack of logical clarity. For example, Wind asks about eight questions on the topic of party transactions and makes repeated inquiries about the energy consumption issue in the environmental section. It is clear that Wind wants to include many evaluation dimensions, but too much repetition can blur the orientation and purpose of the total ESG score.

3) The logic of Wind's indicators is not clear enough: "supply chain management system and regulation," "supplier ESG evaluation access and due diligence," and "supplier ESG dynamic assessment and exit mechanism" are placed along one horizontal line, when actually they should form two layers (with "management system" as the first level and "supplier specific evaluation" as the second level).

Combined with the literature review above and the characteristics of the current Chinese market, the G-score takes priority over the environmental and social scores. Therefore, in this study, we further compare the similarities and differences contained in the G-scores of different rating agencies.

3.3.5 Comparison on governance (G-score) underlying indicators

Diverse ESG rating agencies focus differently on the underlying indicators of corporate governance (G-score). Appendix 1 listed the G-score's basic indicators of AMAC (Asset Management Association of China), CSI, Wind, SynTao Green Finance, MSCI and Rayliant.

In general, we find that the CSI, Wind, and the AMAC all focus on the specific performance of financial aspects, although the CSI and the AMAC further consider innovative initiatives (e.g., R&D investment) and pay more attention to the performance of the ESG concept in value creation.

Chapter 4 Data and Descriptive Statistics

4.1 Data and sample selection

Our initial sample includes A-share companies listed on the CSI. To ensure the reliability and accuracy of this study, we exclude listed companies with missing and unavailable information. To measure a company's ESG performance and the differences across multiple rating systems, we obtain ESG data from three data providers (i.e., the CSI, Wind, and SynTao Green Finance), which are the leading ESG rating systems in China.

The final sample is composed of 800 observations (CSI 800) during the 2015–2021 period (see Table 4.1). For Wind, the CSI 1000 sample is included for additional reference only.

Table 4.1: Background information on the ESG rating sample[1]

ESG Rating system	Rating sample	Rating starting timepoint	Rating frequency
CSI	CSI 800	June 2017	Per half year
Wind	CSI 800 + CSI 1000	January 2018	Per 3 months
SynTao Green Finance	CSI 800	June 2015	Per half year

4.2 Distribution of the sample in the CSI sectors

To explore the diversity between the three ESG data providers, we first investigate the distribution of their ESG rating samples (companies in the Chinese A-share stock market) regarding the 10 CSI sectors in 2020. The 10 CSI sectors include communication services, industrials, utilities, financials and

[1] CSI 800 refers to constituent stocks of the CSI 800 Index; CSI 1000 refers to constituent stocks of the CSI 1000 Index in the Shanghai and Shenzhen securities markets. The CSI 800 Index and the CSI 1000 Index are compiled by the China Securities Index Co., Ltd.

real estate, consumer discretionary, energy, information technology, health care, materials, and consumer staples.

The industry's diverse characteristics lead to a relatively skewed ESG rating sample distribution. Specifically, the observations for the communication services, utilities, and energy sectors across the three ESG raters demonstrate the lowest percentages (see Table 4.2).

Table 4.2: Sample distribution for the top 10 CSI sectors[1]

CSI Sector	CSI		Wind		SynTao Green Finance	
	No. of stocks	Percentage of the sample (%)	No. of stocks	Percentage of the sample (%)	No. of stocks	Percentage of the sample (%)
Communication Services	20	2.51%	45	2.59%	20	2.51%
Industrials	145	18.22%	375	21.58%	145	18.22%
Utilities	27	3.39%	46	2.65%	27	3.39%
Financials and Real Estate	122	15.33%	161	9.26%	122	15.33%
Consumer Discretionary	92	11.56%	225	12.95%	92	11.56%
Energy	18	2.26%	37	2.13%	18	2.26%
Information Technology	114	14.32%	309	17.78%	114	14.32%
Health Care	71	8.92%	157	9.03%	71	8.92%
Materials	123	15.45%	266	15.30%	123	15.45%
Consumer Staples	64	8.04%	117	6.73%	64	8.04%

[1] The top 10 sector categories are adopted from the CSI (China Securities Index Co., Ltd.). More details can be found at: https://www.csindex.com.cn/zh-CN/indices/index-detail/000852#/dataService/industryClassification.

4.3 Descriptive statistics

For the CSI 800 sample, we have comparable datasets from the three ESG rating providers (i.e., the CSI, Wind, and SynTao Green Finance), including variables for the total ESG score (ESG) as well as for the individual pillar scores, namely the environmental (E), social (S), and governance (G) scores. With respect to the characteristics and features of the three ESG raters, their ESG data may demonstrate notable differences.

4.3.1 ESG rating systems

Intuitively, the means of the CSI's ESG/E/S/G-scores are relatively similar (around 0.5), whereas the means of Wind and SynTao Green Finance's ESG/E/S/G-scores demonstrate more considerable differences.

The E-scores of the CSI and SynTao Green Finance are slightly below the average of their total ESG scores. Regarding Wind and SynTao Green Finance, the standard deviations of the E-scores (2.83 and 8.48, respectively) are roughly twice the size of the standard deviations of their total ESG scores (1.01 and 5.58, respectively).

Regarding the S-score, the means of the CSI S-score and the total CSI ESG score are both 0.56. Conversely, the mean of SynTao Green Finance's S-score is much higher than the average of its ESG score (S: 54.04; ESG: 50.03).

Regarding the G-score, the mean value of the CSI G-score is 0.5505, with a minimum value of 0.0019. This indicates that the corporate governance demonstrated by the CSI 800 sample is relatively below global standards.

Table 4.3: Descriptive statistics of the ESG ratings among the three raters[1]

	Mean	SD	Min	Max	Observations
CSI ESG ratings (CSI 800)					
ESG	0.5641	0.2936	0.0017	1.0000	800
E	0.5066	0.3125	0.0017	1.0000	800
S	0.5687	0.2906	0.0043	1.0000	800
G	0.5505	0.2937	0.0019	1.0000	800
Wind ESG ratings (CSI 800)					
ESG	6.8060	1.0101	3.2600	9.8200	800
E	2.8640	2.8333	0.0000	10.0000	800
S	5.5500	2.1990	0.0000	10.0000	800
G	7.3130	0.8940	2.4500	9.9400	800
Wind ESG ratings (CSI 800 and CSI 1000)					
ESG	6.6250	0.9295	3.2600	9.8200	1,800
E	2.1910	2.5297	0.0000	10.0000	1,800
S	5.2670	2.1004	0.0000	10.0000	1,800
G	7.1810	0.8198	2.3600	9.9400	1,800
SynTao Green Finance ESG ratings (CSI 800)					
ESG	50.0300	5.5791	34.2500	72.1200	800
E	49.7600	8.4759	29.3800	82.3900	800
S	54.0400	6.5147	0.0000	76.5200	800
G	46.1600	6.7308	26.3400	70.6900	800

4.3.2 ESG rating systems in the CSI sectors

In terms of all of the historical records, we calculate the descriptive statistics of the three raters (i.e., the CSI, Wind, and SynTao Green Finance) across the 10 CSI sectors in 2020.

Across the different sectors, the means of the CSI's ESG/E/S/G-scores are relatively similar, with a maximum value of 1. This indicates that the CSI has

[1] This table presents the summary statistics of the ESG scores, separated into providers and pillars (accessed in June 2021). Wind's ESG ratings based on the CSI 800 and CSI 1000 are mainly considered for reference purposes (as they cover more companies in the market).

made standardized adjustments, which may reduce the influence of various sectors. Specifically, the means of the total ESG scores across the industrials, materials, and consumer discretionary sectors are 0.524, 0.521, and 0.524, respectively, with the same pattern for their sub-scores (see Table 4.4).

In this vein, the standardization of the CSI's ESG ratings lays the groundwork for this study to further explore the applicability among the top 10 CSI sectors, which could resonate with the features and advantages of the CSI described previously.

For Wind and SynTao Green Finance, the means of the ESG/E/S/G-scores among the 10 CSI sectors demonstrate relatively large differences, with much distinctiveness in their minimum and maximum values (see Appendix 2).

Table 4.4: Descriptive statistics of the CSI ESG ratings in the CSI sectors[1]

	Mean	SD	Min	Max	Observations
Communication Services					
ESG	0.6084	0.2958	0.0319	1	151
E	0.5987	0.3055	0.0106	1	151
S	0.5938	0.2717	0.0909	1	151
G	0.6102	0.2776	0.0426	1	151
Industrials					
ESG	0.5243	0.2927	0.0083	1	1,440
E	0.5045	0.3102	0.0040	1	1,440
S	0.5440	0.2921	0.0083	1	1,440
G	0.5387	0.2941	0.0083	1	1,440
Utilities					
ESG	0.5600	0.2878	0.0556	1	243
E	0.5524	0.2961	0.0093	1	243
S	0.5713	0.2812	0.0556	1	243
G	0.5512	0.2864	0.0556	1	243
Financials and Real Estate					

[1] The samples for the top 10 CSI sectors are based on the overall historical records of the CSI.

	Mean	SD	Min	Max	Observations
ESG	0.5398	0.2856	0.0127	1	1,037
E	0.5259	0.3022	0.0043	1	1,037
S	0.5385	0.2825	0.0043	1	1,037
G	0.5250	0.2894	0.0127	1	1,037
Consumer Discretionary					
ESG	0.5237	0.2887	0.0119	1	995
E	0.4387	0.3484	0.0119	1	995
S	0.5259	0.2919	0.0119	1	995
G	0.5339	0.2939	0.0119	1	995
Energy					
ESG	0.5415	0.294	0.0714	1	188
E	0.5086	0.3015	0.0286	1	188
S	0.5948	0.283	0.0642	1	188
G	0.5840	0.284	0.0769	1	188
Information Technology					
ESG	0.5257	0.2955	0.0017	1	997
E	0.4724	0.3303	0.0017	1	997
S	0.5390	0.2949	0.0068	1	997
G	0.5247	0.2922	0.0068	1	997
Health Care					
ESG	0.5141	0.2918	0.0179	1	605
E	0.4876	0.2957	0.0179	1	605
S	0.5215	0.2842	0.0179	1	605
G	0.5301	0.2926	0.0179	1	605
Materials					
ESG	0.5206	0.2951	0.0085	1	1,046
E	0.5035	0.2915	0.0027	1	1,046
S	0.5574	0.2906	0.0116	1	1,046
G	0.5327	0.2932	0.0116	1	1,046
Consumer Staples					
ESG	0.5783	0.2858	0.0303	1	490
E	0.5305	0.2916	0.0135	1	490
S	0.6076	0.2856	0.0145	1	490
G	0.5472	0.2939	0.0130	1	490

To supplement and more directly observe the difference among the three rating systems, we calculate the medians of their total ESG scores and sub-scores across the 10 CSI sectors.

Table 4.5: ESG scores' medians of the three rating systems in the 10 CSI sectors

	CSI				Wind				SynTao GF			
	ESG	E	S	G	ESG	E	S	G	ESG	E	S	G
Financials and Real Estate	0.53	0.53	0.51	0.52	6.68	**3.11**	5.07	**7.49**	49.8	49.2	54.8	46.7
Industrials	0.51	0.50	0.50	0.48	6.60	1.27	6.16	7.16	49.3	48.7	54.6	45.7
Materials	0.49	0.56	0.56	0.52	6.34	2.76	5.51	6.93	49.3	48.7	53.4	47.8
Communication Services	**0.57**	**0.73**	0.55	0.55	6.41	0.00	4.80	6.99	49.3	49.3	55.9	43.8
Consumer Discretionary	0.51	0.50	0.54	0.54	6.65	0.00	4.90	7.18	47.6	47.8	52.7	45.2
Information Technology	0.49	0.67	0.49	0.51	**6.82**	0.00	5.52	7.07	49.0	49.0	52.7	44.0
Health Care	0.53	0.53	0.47	0.50	6.77	1.91	5.39	6.50	48.9	**50.4**	52.3	44.0
Consumer Staples	0.52	0.50	0.55	0.55	6.01	1.55	4.11	7.43	48.4	43.4	53.7	47.8
Energy	0.52	0.58	**0.58**	**0.58**	6.36	2.17	**6.25**	7.11	48.7	46.6	50.2	50.2
Utilities	0.53	0.56	0.56	0.56	6.45	2.05	6.14	7.43	**51.0**	45.4	**56.8**	**53.4**

1) CSI. Table 4.5 shows the distribution of the CSI's 2020 ESG/E/S/G-score medians based on the 10 CSI sectors. The sector with the higher total ESG score is communication services (0.57), while the lowest total ESG scores are found in the materials (0.49) and information technology (0.49) sectors.

Most of the sectors' CSI E-scores have high medians, with the highest being from the communication services sector (0.73). The sector with the highest S-score is energy (0.58), and the sectors with the lowest S-scores are health care (0.47) and information technology (0.49). The sector with the

highest G-score is energy (0.58), and the sector with the lowest G-score is industrials (0.48).

In summary, compared with other pillars, the medians of the CSI's E-scores are higher for most of the sectors, with the highest median being from the communication services sector (E-score: 0.73); the lowest median is from the health care sector (S-score: 0.47).

2) Wind. Examining Wind's 2020 ESG/E/S/G-score medians for the 10 CSI sectors, we find the sector with the highest total ESG score to be information technology (6.82) and that with the lowest total ESG score to be consumer staples (6.01).

The sector with the highest E-scores is the financials and real estate (3.11) sector. Those with the lowest E-scores are the communication services, information technology, and consumer discretionary sectors, which all have a value of 0. The sector with the highest S-score is energy (6.25), whereas the consumer staples (4.11) sector has the lowest S-score. The sectors with the highest G-scores are the financials and real estate (7.49), utilities (7.43), and consumer staples (7.43) sectors, whereas that with the lowest G-score is the health care sector (6.50).

Overall, Wind's G-score medians for all 10 CSI sectors are higher than its ESG/E/S-score medians. The financials and real estate sector demonstrates the highest median (G-score: 7.49), whereas the communication services, information technology, and consumer discretionary sectors demonstrate the lowest median value (E-score: 0).

3) SynTao Green Finance. Concerning the ESG/E/S/G-score medians of SynTao Green Finance for the 10 CSI sectors, the sector with the highest total

ESG score is the utilities (51.0). The sectors with the lowest total ESG scores have similar medians (around 48).

The sector with the highest E-score is health care (50.4), and that with the lowest E-score is consumer staples (43.4). Regarding the S-score, most of the medians are similar in value (above 52); the lowest is for the energy sector (50.2). For the major sectors, the median G-scores are relatively similar, with the highest demonstrated by the utilities sector (53.35).

In summary, the distribution of the SynTao Green Finance ESG/E/G-score medians for the 10 CSI sectors is relatively balanced. Among them, the utilities sector has the highest value (S-score: 56.8) and the communication services sector has the lowest value (G-score: 43.8).

4.3.3 Cor elation results

We also perform a correlation analysis among the ESG ratings provided by the CSI, Wind, and SynTao Green Finance.

According to the correlation matrix for the ESG/E/S/G-scores, the coefficients among all three ESG ratings are significantly low. That is, there is a significant difference in the ESG rating mechanism across the different rating providers. For example, the correlation coefficient between the total CSI ESG score and the total Wind ESG score is only 0.19, which is significant at the 99% confidence level, thus revealing the great divergence of these two raters.

This indicates that the three rating systems are weakly correlated during the period of analysis, which aligns with empirical evidence from research on rating differences (see Berg et al., 2022).

Table 4.6: Correlation matrix of the ESG scores across the three rating systems (2021)

a: ESG score

	CSI	Wind	SynTao GF
CSI	1		
Wind	0.1864***	1	
SynTao GF	0.2114***	0.5960***	1

b: E-score

	CSI	Wind	SynTao GF
CSI	1		
Wind	0.2196***	1	
SynTao GF	0.2551***	0.5358***	1

c: S-score

	CSI	Wind	SynTao GF
CSI	1		
Wind	0.1528***	1	
SynTao GF	0.0976***	0.4040***	1

d: G-score

	CSI	Wind	SynTao GF
CSI	1		
Wind	0.2439***	1	
SynTao GF	0.1594***	0.3031***	1

Notes: *, **, and *** indicate significance at the 10%, 5%, and 1% levels.

Chapter 5 Research Methodology

5.1 Technical route

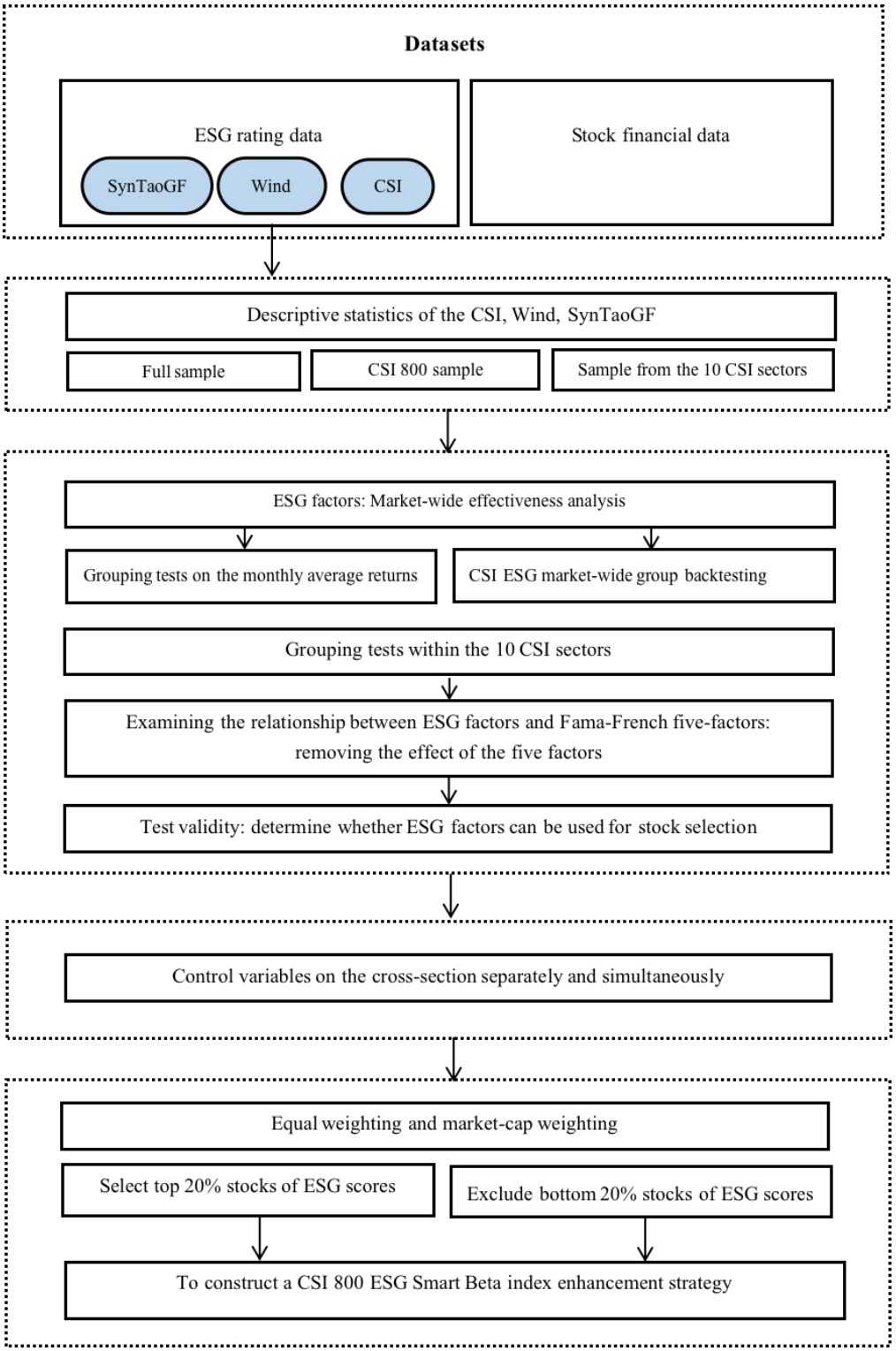

Figure 5.1: Technical route of this study

5.2 Variable selection

5.2.1 ESG ratings

We primarily use the ESG ratings from the ESG rating system to measure ESG performance. In Chapter 3.2, we present an overview of the ESG ratings of the CSI, Wind, and SynTao Green Finance. These ratings are given in the form of AAA, AA, etc., and have corresponding rating scores. In this study, we directly utilize the ESG rating scores (numbers) from all three data providers (the CSI, Wind, and SynTao Green Finance), measuring the ESG performance of different companies.

5.2.2 Control variables

Evidence suggests that ESG ratings are correlated with firm size, profitability, and valuation (see Chapter 2.2.3). In this regard, we use Fama–French asset pricing factors as control variables to analyze the sources of ESG returns. These variables include the market factor (MKT), the size factor (SMB), the value factor (HML), the profitability factor (RMW), and the investment factor (CMA). Among them, the market factor is equal to the market return minus the risk-free rate (i.e., $R_{Mt} - R_{Ft}$), thus reflecting the market risk premium.

For comparability between different factor returns, we mainly refer to Zhang's (2018) factor construction method, which divides stocks into $2 \times 3 = 6$ portfolios along two factor dimensions. One of the factors is fixed as *Size* and divided into two tiers according to the median, and the other is book-to-market equity ratio (B/M), operating profitability (OP), or investment (Inv), divided

into three tiers according to the 30% and 70% quantiles. The specific construction steps are as follows:

(1) Divide all stocks into two *Size* groups, namely small size (S) and big size (B), according to the median market value of the stocks.

(2) Divide the sample into high (H), neutral (N), and low (L) groups according to the 30% and 70% quantiles of the book-to-market ratio.

(3) Across the two indicators above, the full sample can be divided into SH, SN, SL, BH, BN, and BL, for a total of six combinations.

(4) Using the same method, operating profitability and investment style are used. Divide the sample into robust (R), neutral (N), and weak (W) groups; conservative (C), neutral (N), and aggressive (A) groups, according to the 30% and 70% quantiles of the operating profitability and investment style, respectively.

(5) Calculate the market value weighted average return for each period of each portfolio, and construct four factors, namely SMB_t, HML_t, RMW_t, and CMA_t, using the difference between the returns of the different portfolios. The specific calculation formulas are shown in Table 5.1.

Table 5.1: Factor construction

Factor name	Calculation method
Size factor (SMB)	$SMB_{B/M} = (SH + SN + SL)/3 - (BH + BN + BL)/3$ $SMB_{OP} = (SR + SN + SW)/3 - (BR + BN + BW)/3$ $SMB_{INV} = (SC + SN + SA)/3 - (BC + BN + BA)/3$ $SMB_t = (SMB_{B/M} + SMB_{OP} + SMB_{Inv})/3$
Value factor (HML)	$HML_t = (BH + SH)/2 - (BL + SL)/2$
Profitability factor (RMW)	$RMW_t = (BR + SR)/2 - (BW + SW)/2$
Investment factor (CMA)	$CMA_t = (BC + SC)/2 - (BA + SA)/2$

5.3 Empirical methods

5.3.1 Constructing ESG portfolios and single factor test

As illustrated in the empirical literature, constructing ESG portfolios is one of the most common approaches to investigating the relationship between companies' social and financial performance (Halbritter & Dorfleitner, 2015). Based on ESG ratings, this method easily aggregates large panel datasets into a single time-series dimension for better statistical examination.

At each year time point *t* from 2015 to 2021, we rank the CSI 800 constituents based on their ESG rating scores in year *t*-1 and equally divide them into five groups. For each group of stocks, we construct an equally weighted portfolio and a market capitalization-weighted portfolio, respectively. We also construct an ESG long-short portfolio, and the performance of the long-short portfolio represents the excess return of the stock portfolio with the highest ESG score relative to the portfolio with the lowest ESG score.

Similarly, we construct the corresponding portfolios for the individual E-, S-, and G-scores. This is done to examine portfolio performance for individual scores.

We further examine the monthly average returns of the constructed portfolios to assess the ability of the total ESG score and its sub-scores to influence stock returns.

5.3.2 Analysis of the return source of the ESG long-short portfolio

The Fama–French five-factor model is used to regress the constructed long-short portfolios, as a way to assess the source of excess returns of the

high-low groups. The R_{ESG} of the ESG long-short portfolio is expressed as follows:

$$R_{ESG,t} = \alpha_t + \beta_{1,t}MKT_t + \beta_{2,t}SMB_t + \beta_{3,t}HML_t + \beta_{4,t}RMW_t + \beta_{5,t}CMA_t + \varepsilon_t$$

For illustration, in the above regression equation, α represents the part of the ESG long-short portfolio that cannot be explained by the Fama–French model. If it is significantly greater than 0, it indicates some idiosyncratic excess returns.

5.3.3 ESG portfolio analysis after controlling for key variables

After analyzing the return sources of the ESG long-short portfolio, the portfolio analysis of ESG and its sub-scores is reconducted, this time controlling the most influential factors.

We mainly use the grouping method to control for the impact of variables on portfolio returns. For example, when controlling for the market value factor, based on the total market values of the stocks, the stocks are sorted and divided equally into five groups. Within each corresponding market value group, the stocks in the group are then divided equally into five groups based on the ESG rating scores, yielding 25 constructed portfolios. Finally, we examine the monthly average returns of each portfolio to assess the influence of ESG and its sub-scores on stock returns after controlling for the market value factor.

Chapter 6 Empirical Results

6.1 Single factor test

6.1.1 CSI ESG-scores' grouping test in the CSI 800

In the single-factor test section, we first explore the monthly average returns of the CSI ESG ratings on the CSI 800 by group testing. Table 6.1 shows the monthly average returns of each subgroup of ESG ratings. None of the subgroup's returns (from the high-score group to the low-score group) are significantly greater than 0, even at the 90% confidence level.

Compared with the other ESG factors, the equally weighted long-short portfolio (high minus low) of the G factor performs relatively well, with a monthly average return of 0.61%, significant at the 90% confidence level, thus exceeding the other portfolios.

Table 6.1: Grouping test of CSI ESG scores in the CSI 800

		High	Group 2	Group 3	Group 4	Low	High-Low
A: Equally weighted							
ESG	Monthly average return	0.11%	0.36%	0.38%	0.08%	0.09%	0.06%
	t-value	0.17	0.53	0.53	0.11	0.11	0.18
E	Monthly average return	0.23%	-0.04%	0.39%	0.18%	0.29%	-0.04%
	t-value	0.34	-0.05	0.55	0.23	0.38	-0.19
S	Monthly average return	0.14%	0.31%	0.29%	0.26%	0.04%	0.11%
	t-value	0.20	0.45	0.42	0.33	0.05	0.32
G	Monthly average return	0.35%	0.30%	0.32%	0.26%	-0.21%	0.61%
	t-value	0.51	0.46	0.43	0.36	-0.26	1.78

B: Market capitalization-weighted							
ESG	Monthly average return	0.23%	0.05%	0.47%	0.29%	0.37%	-0.13%
	t-value	0.36	0.09	0.68	0.42	0.51	-0.28
E	Monthly average return	0.25%	-0.08%	0.32%	0.25%	0.41%	-0.16%
	t-value	0.39	-0.14	0.51	0.33	0.53	-0.40
S	Monthly average return	0.21%	0.41%	0.28%	0.27%	0.07%	0.11%
	t-value	0.31	0.63	0.46	0.40	0.10	0.23
G	Monthly average return	0.25%	0.22%	0.36%	0.44%	0.11%	0.20%
	t-value	0.37	0.36	0.53	0.73	0.14	0.41

After the grouping test of the ESG-scores' monthly average returns, we find that only the G-score performs relatively well among all of the ESG rating scores. Next, for the equally weighted grouping backtest of the CSI ESG-scores in the CSI 800, the indicators of its corresponding performance also show that only the G factor demonstrates better monotonicity in terms of annualized returns and maximum drawdown.

1) **In terms of annualized returns, under the equal weighting method, the high-score group of the CSI G-score performs relatively better.**

We can observe that the CSI G-score's high-score group performs better, with an annualized return of 5.05%, and shows decreasing monotonicity from the high to the low group (i.e., 5.05%, 4.39%, 4.17%, 3.88%, and -0.64%).

Comparatively, neither the total ESG score nor the E-score or S-score reflect a linear relationship in terms of annualized returns, but the second and third groups in the medium place perform better (ESG score, Group 3: 5.04%; E-score, Group 3: 4.76%; S-score, Group 2: 4.49%). This finding is similar to

the empirical findings of Barnett & Salomon (2006) and Chen & Lee (2016) that the impact of ESG scores on earnings shows a non-linear relationship and that the ESG factors positively affect firm performance only when a certain threshold is needed.

2) **Regarding the maximum drawdown, the equally weighted high-score group of the CSI G-score demonstrates the best performance.**

The G-scores' equally weighted groups present better monotonicity, from the high-score group to the low-score group, with maximum drawdown rates of 32.54%, 34.07%, 35.29%, 35.72%, and 43.40%, respectively. However, the other scores do not show such a pattern.

To sum up, the CSI G-score demonstrates the best overall performance in terms of annualized returns and maximum drawdown. Therefore, we next focus on exploring the possible sources of returns for the equally weighted long-short portfolio constructed by the G factor. Meanwhile, regardless of the total ESG score, E-score, S-score, and G-score, all of the subgroups with low scores perform worse in terms of annualized returns and maximum drawdown. This is consistent with the results of the current empirical report (CSI, 2021c); that is, the low-score group demonstrates worse performance compared with high-score group.

Table 6.2: CSI ESG-score equally weighted group backtest indicators

Group	Annualized return rate	Volatility	Sharpe ratio	Maximum drawdown	Calma ratio
High	2.79%	16.98%	0.1643	33.88%	0.0823
Group 2	4.90%	16.90%	0.2901	34.51%	0.1421
Group 3	5.04%	17.09%	0.2949	34.01%	0.1481
Group 4	2.15%	17.87%	0.1201	36.50%	0.0588

Low	1.97%	18.26%	0.1079	42.03%	0.0469
High-Low	0.40%	5.82%	0.0695	16.04%	0.0252
With scores	3.41%	17.22%	0.1983	36.13%	0.0945
Without scores	4.99%	14.12%	0.3535	25.22%	0.1978
With-without scores	-1.24%	6.76%	-0.1840	19.01%	-0.0654

Table 6.3: CSI E-score equally weighted group backtest indicators

Group	Annualized return rate	Volatility	Sharpe ratio	Maximum drawdown	Calma ratio
High	3.85%	17.07%	0.2259	34.69%	0.1111
Group 2	1.23%	17.33%	0.0710	37.69%	0.0327
Group 3	4.76%	17.04%	0.2792	35.91%	0.1325
Group 4	3.45%	18.13%	0.1903	35.60%	0.0969
Low	3.79%	17.47%	0.2171	37.33%	0.1016
High-Low	-0.10%	4.15%	-0.0233	12.29%	-0.0079
With scores	3.41%	17.22%	0.1983	36.13%	0.0945
Without scores	4.99%	14.12%	0.3535	25.22%	0.1978
With-without scores	-1.24%	6.76%	-0.1840	19.01%	-0.0654

Table 6.4: CSI S-score equally weighted group backtest indicators

Group	Annualized return rate	Volatility	Sharpe ratio	Maximum drawdown	Calma ratio
High	3.07%	16.72%	0.1836	35.16%	0.0873
Group 2	4.49%	16.73%	0.2685	33.71%	0.1332
Group 3	4.04%	17.41%	0.2322	34.14%	0.1184
Group 4	3.69%	17.99%	0.2048	38.58%	0.0955
Low	1.60%	18.44%	0.0866	40.14%	0.0398
High-Low	0.92%	6.55%	0.1407	13.24%	0.0696
With scores	3.41%	17.22%	0.1983	36.13%	0.0945
Without scores	4.99%	14.12%	0.3535	25.22%	0.1978
With-without	-1.24%	6.76%	-0.1840	19.01%	-0.0654

scores

Table 6.5: CSI G-score equally weighted group backtest indicators

Group	Annualized return rate	Volatility	Sharpe ratio	Maximum drawdown	Calma ratio
High	5.05%	17.34%	0.2915	32.54%	0.1553
Group 2	4.39%	16.87%	0.2601	34.07%	0.1287
Group 3	4.17%	17.68%	0.2356	35.29%	0.1180
Group 4	3.88%	17.33%	0.2236	35.72%	0.1085
Low	-0.64%	17.92%	-0.0354	43.40%	-0.0146
High-Low	5.44%	5.76%	0.9434	14.50%	0.3750
With scores	3.41%	17.22%	0.1983	36.13%	0.0945
Without scores	4.99%	14.12%	0.3535	25.22%	0.1978
With-without scores	-1.24%	6.76%	-0.1840	19.01%	-0.0654

6.1.2 CSI ESG-scores' grouping test within different CSI sectors

The results of the grouping tests on the monthly average returns of ESG-score portfolios indicate that the G factor is more effective for portfolio construction than the other scoring factors and can be further investigated.

To examine the effectiveness of the ESG factors on excess returns in different sectors, we conduct grouping tests for each of the 10 CSI sectors (for 2020). The specific performance of the ESG factors' long-short portfolio (high minus low) among the 10 CSI sectors is described below (see Appendix 3):

1) **Within the communication services sector**, under the equal weighting method, only the total CSI ESG score demonstrates positive excess returns (return: 0.64%). In contrast, the CSI E-, S-, and G-scores do not have such returns (E: -1.39%; S: -0.49%; G: -0.62%). Similarly, the market capitalization-weighted portfolio indicates that in the communication services

sector, the total CSI ESG-score performs best.

2) **Within the industrials sector**, under the equal weighting method, the CSI's total ESG score, S-score, and G-score can all generate excess returns (ESG: 0.21%; S: 0.23%; G: 0.57%). Among the three factors, the best performer is the G factor, with a monthly average return of 0.57% (t = 1.53). However, in terms of the market capitalization-weighted portfolio, almost all of the CSI's ESG factors are ineffective in yielding excess returns.

3) **Within the utilities sector**, under the equal weighting method, compared with other scores, the CSI's S- and G-scores are able to generate some positive excess returns (S: 0.90%; G: 0.23%). Between them, the S factor is the better performer, with higher returns. Similarly, the market capitalization-weighted portfolio also shows that the CSI's S factor performs best, with an excess return of 1.02% (t = 1.82).

4) **Within the financials and real estate sector**, under the equal weighting method, all of the CSI's ESG scores can generate excess returns (ESG: 0.38%; E: 0.91%; S: 0.70%; G: 0.21%). Among them, the E factor is the top performer, with a return of 0.91% (t = 1.70). The market capitalization weighting method delivers a similar outcome, with the E factor performing best in this sector (return: 1.25%, t = 1.70).

5) **Within the consumer discretionary sector**, under the equal weighting method, the E-, S-, and G-scores are all able to generate positive excess returns (E: 0.54%; S: 0.35%; G: 1.21%). Among them, the G factor is the most effective, with the highest return (t = 1.84). Similar results are observed when using the market capitalization weighting method; that is, the G factor outperforms the other factors in this sector (return: 1.59%, t = 1.62).

6) **Within the energy sector**, under the equal weighting method, only the CSI S-score has a return of 0.34%; the CSI's total ESG score, E-score, and G-score are ineffective in generating positive excess returns (ESG: -0.50%; E: -1.10%; G: -0.94%). According to the market capitalization weighting approach, the CSI's S factor demonstrates the best performance, with a return of 0.57%. Furthermore, the ESG factor is able to generate a positive excess return of 0.47%.

7) **Within the information technology sector**, the equally weighted CSI G-score's long-short portfolio has an excess return of 2.67% (t = 4.05), demonstrating the best performance, followed by the CSI's ESG score (return: 1.06%, t = 1.76). The market capitalization weighting method yields a similar result, with the G factor demonstrating the best outcome (return: 1.58%, t = 2.23).

8) **Within the health care sector**, under the equal weighting approach, the CSI ESG score, E-score, and S-score are all ineffective in generating positive excess returns (ESG: -0.40%; E: -0.43%; S: -0.57%), with the CSI G-score being the only one that positively generates excess returns (0.89%). Similarly, the CSI G factor is the top performer in yielding excess returns (1.46%) using the market capitalization weighting method.

9) **Within the materials sector**, none of the four CSI ESG factors are able to generate positive excess returns (ESG: -0.48%; E: -0.26%; S: -0.52%; G: -0.43%), regardless of the weighting method.

10) **Within the consumer staples sectors**, under the equal weighting approach, the CSI's total ESG score, S-score, and G-score are all more effective in terms of generating positive excess returns (ESG: 0.62%; S: 0.39%; G:

0.87%) than the CSI E-score, with the G factor showing the best performance. In the market capitalization-weighted portfolio, the G factor is no longer effective in generating positive returns (-0.20%), but the ESG score and S-score remain effective.

6.1.3 Summary: CSI ESG factors' performance across sectors

1) Of the 10 CSI sectors in 2020, the CSI total ESG score can generate positive excess returns in five, namely the communication services, industrials, financials and real estate, information technology, and consumer staples sectors. However, its effectiveness in the rest of the sectors is almost non-existent.

2) Compared with the other three scoring factors (ESG/E/S), the CSI G factor demonstrates the best performance in obtaining positive excess returns in five of the ten sectors (i.e., industrials, consumer discretionary, information technology, health care, and consumer staples). To some extent, this reflects the efficacy and significance of corporate governance components for these five sectors. As a result, higher corporate governance ratings, such as on having a reliable management system and an open evaluation process, may assist businesses in the related industries in generating excess returns.

3) It is worth noting that the CSI G factor can significantly affect excess returns in the information technology sector, demonstrating the best performance (return: 2.67%, t = 4.05). Compared with the means of the CSI ESG scores across different sectors, the mean of the G-score in the information technology sector is the lowest (0.52), as shown in Table 4.4 (G-score mean in communication services: 0.61). However, inconsistent with the increasing influence of the information technology industry, most information technology

companies have relatively low ESG ratings and are also not currently ESG leaders (Egorova et al., 2022), with much space for advancement. Thus, improving the corresponding corporate governance level and developing their ESG practices may affect the excess return performance of companies in this sector to a greater extent.

Following this examination of the excess returns of the ESG factors across various sectors, we address which return variables (or asset pricing factors) are more connected with the ESG factors. Furthermore, we explore which factors may influence the excess return source of the ESG factors.

6.2 Long-short portfolio analysis of ESG factors

In the previous section, we mainly examine ESG and its sub-scores as single factors, without considering the impact of factors such as firm size and profitability on ESG scores. Larger and more profitable companies typically have more money to invest in aspects of environmental and social responsibility, in addition to having stronger corporate governance. On this basis, it is necessary to control for these potential variables and further observe the relationship between ESG scores and stock returns.

The return of the long-short portfolio for ESG factors is taken as the dependent variable. The ESG portfolio return is regressed by the five factors of Fama and French (2015), to explore these factors' explanatory power. The intercept of the model represents the fraction of the ESG portfolio return that cannot be explained by the Fama–French five factors.

Table 6.6: Fama–French five-factor regression on the ESG long-short portfolio's

returns

		Alpha	MKT	SMB	HML	RMW	CMA	Adj R^2
A: Equally weighted long-short portfolio								
ESG	Coeff.	0.002	-0.123	-0.205	-0.119	0.577	0.435	0.49
	t-value	0.59	-1.97	-2.32	-0.92	3.13	1.59	
E	Coeff.	0.000	-0.100	-0.204	-0.087	0.040	0.086	0.31
	t-value	0.05	-2.31	-3.33	-0.97	0.31	0.45	
S	Coeff.	0.000	-0.038	-0.161	0.012	0.668	0.029	0.61
	t-value	-0.01	-0.71	-2.12	0.11	4.19	0.12	
G	Coeff.	0.006	-0.093	-0.187	-0.163	0.532	0.355	0.31
	t-value	2.08	-1.24	-1.75	-1.04	2.38	1.07	
B: Market capitalization-weighted long-short portfolio								
ESG	Coeff.	-0.001	0.039	-0.233	0.071	0.878	0.209	0.50
	t-value	-0.40	0.46	-1.93	0.40	3.48	0.56	
E	Coeff.	0.000	-0.070	-0.133	0.101	0.570	0.362	0.37
	t-value	0.11	-0.87	-1.16	0.60	2.38	1.02	
S	Coeff.	0.001	0.104	-0.250	0.153	0.985	0.144	0.66
	t-value	0.19	1.45	-2.47	1.03	4.65	0.46	
G	Coeff.	0.002	-0.038	-0.273	-0.229	0.861	0.529	0.38
	t-value	0.50	-0.38	-1.95	-1.12	2.94	1.22	

1) The Fama–French five factors only offer weak explanations for the returns of the G-score's equally weighted long-short portfolio; however, alpha (intercept) is significant.

Regarding the G factor's equally weighted long-short portfolio, the Fama–French five factors can only explain a small fraction of its return ($R^2 = 0.31$). It is also worth noting that only the G factor's equally weighted long-short portfolio has a significant and positive excess return (alpha = 0.006, t = 2.08).

In other words, the long-short portfolio constructed by the G factor has some information that simply cannot be explained by the Fama–French five

factors. This means that the return of the long-short portfolio built by the CSI G-score may be influenced by variables other than the classical asset pricing factors. Therefore, we consider the possibility of the CSI G-score bringing additional information to the investment portfolio. It may be suitable to use governance as a key factor for stock selection.

2) The size factor (i.e., SMB) significantly and negatively influences the returns of the equally weighted long-short portfolios of the ESG, E, and S factors.

In the time series, SMB significantly and negatively affects the monthly average returns of the equally weighted long-short portfolios for the ESG factor, E factor, and S factor (coefficient: ESG: -0.205, t = -2.33; E: -0.204, t = -3.33; S: -0.161, t = -2.12).

This finding suggests that larger companies (e.g., large-cap stocks) have correspondingly higher total ESG scores, E-scores, and S-scores than smaller companies.

3) The profitability factor (i.e., RMW) significantly and positively influences the returns of the equally weighted long-short portfolios of the ESG, S, and G factors.

In the time series, the equally weighted long-short portfolios' monthly average returns for the ESG, S, and G factors are significantly and positively affected by RMW (coefficient: ESG: 0.577, t = 3.13; S: 0.668, t = 4.19; G: 0.532, t = 2.38). In other words, RMW greatly and positively explains part of the variations in the returns of the equally weighted long-short portfolios for the ESG, S, and G factors.

This finding makes it clear that the more profitable a company is, the better

performing its total ESG score, S-score, and G-score may be.

4) In terms of the market capitalization weighting approach, no significant excess return for the ESG factors' long-short portfolio is found.

At the same time, utilizing the market capitalization weighting method, which is equivalent to reducing the influence of small-cap stocks, we do not observe any significant excess returns for any of the ESG factors' long-short portfolio. Thus, market value can be considered a factor that may affect the excess returns of the ESG factors' long-short portfolio.

5) MKT, HML, and CMA have no significant effect on the returns of most ESG factors' long-short portfolios, regardless of the weighting method.

Specifically, MKT only has a significant and negative influence on the monthly average returns of the equally weighted long-short portfolios for the ESG and E factors (coefficient: ESG: -0.123, t = -1.97; E: -0.100, t = -2.31).

6.3 ESG factors' grouping test after controlling variables

In the time series, after exploring the long-short portfolios above, we find that SMB (i.e., the size factor) and RMW (i.e., the profitability factor) have significant effects on the monthly average returns generated by the ESG factors' portfolio.

Therefore, on a cross-sectional basis, we further conduct grouping tests on ESG factors after controlling for the market value and ROE. Two weighting strategies are utilized, namely equal weighting and market capitalization weighting.

6.3.1 Controlling for marketvalue

1) **First, using the equal weighting approach and controlling for market value, we discover that the G and S factors perform better than the ESG and E factors.**

G factor. Among the subgroups with small market value, the monthly average returns of the G-score groups show better monotonicity. Specifically, in the small market value group (Group 1), the G-score's monthly average returns from the low-score group to the high-score group are -0.63%, -0.21%, -0.06%, 0.37%, and 1.45%, respectively. However, in the subset with large market value (Group 5), the monthly average returns of the G-score's low to high subgroups do not show monotonicity.

S factor. Among the groups with relatively large market value, the monthly average returns of the S-score subgroups demonstrate some monotonicity. Specifically, for the relatively large market value group (Group 4), the monthly average returns from the S-score's low-score group to Group 3 are -0.02%, 0.20%, and 0.83%, respectively. However, this kind of monotonicity on monthly average returns is not shown in the subgroups with small market value.

ESG and E factors. The monthly average returns of the ESG-score and E-score subgroups do not demonstrate monotonicity under the equal weighting strategy.

Table 6.7: ESG factors' grouping test by controlling for market value (equally weighted)

Panel A: ESG groups

		Small market value	2	3	4	Large market value
Low	Monthly	-0.06%	0.35%	0.12%	0.05%	1.14%

	average return					
	t-value	-0.07	0.37	0.14	0.05	1.24
2	Monthly average return	-0.43%	0.12%	-0.30%	0.51%	0.51%
	t-value	-0.47	0.13	-0.39	0.73	0.67
3	Monthly average return	0.00%	0.52%	0.02%	0.78%	0.50%
	t-value	0.00	0.64	0.02	1.05	0.69
4	Monthly average return	0.29%	0.90%	0.11%	0.33%	0.35%
	t-value	0.34	1.08	0.14	0.43	0.53
High	Monthly average return	0.15%	0.03%	0.15%	0.11%	0.18%
	t-value	0.19	0.04	0.20	0.15	0.28

Panel B: E groups

		Small market value	2	3	4	Large market value
Low	Monthly average return	0.21%	0.40%	-0.10%	0.45%	0.73%
	t-value	0.23	0.44	-0.14	0.57	0.75
2	Monthly average return	0.23%	0.32%	0.22%	0.31%	1.03%
	t-value	0.24	0.35	0.29	0.41	1.56
3	Monthly average return	-0.15%	0.37%	0.24%	0.48%	-0.07%
	t-value	-0.17	0.50	0.30	0.63	-0.10
4	Monthly average return	-0.50%	0.44%	-0.16%	0.10%	-0.07%
	t-value	-0.64	0.54	-0.19	0.13	-0.11
High	Monthly average return	-0.16%	0.35%	-0.04%	0.34%	0.64%
	t-value	-0.18	0.42	-0.05	0.50	0.94

Panel C: S groups

		Small market value	2	3	4	Large market value
Low	Monthly average return	-0.33%	0.50%	-0.25%	-0.02%	0.19%

	t-value	-0.34	0.53	-0.32	-0.02	0.23
2	Monthly average return	0.28%	0.21%	-0.31%	0.20%	0.69%
	t-value	0.30	0.24	-0.36	0.27	0.96
3	Monthly average return	0.07%	0.68%	0.24%	0.83%	0.16%
	t-value	0.09	0.85	0.30	1.14	0.23
4	Monthly average return	-0.26%	0.30%	0.05%	0.46%	0.65%
	t-value	-0.32	0.37	0.07	0.66	0.95
High	Monthly average return	-0.09%	0.28%	0.29%	0.31%	0.24%
	t-value	-0.11	0.33	0.43	0.39	0.37

Panel D: G groups

		Small market value	2	3	4	Large market value
Low	Monthly average return	-0.63%	-0.09%	-0.53%	0.25%	0.54%
	t-value	-0.64	-0.11	-0.66	0.29	0.61
2	Monthly average return	-0.21%	0.86%	0.21%	0.01%	0.93%
	t-value	-0.25	0.98	0.27	0.01	1.26
3	Monthly average return	-0.06%	0.54%	-0.15%	0.67%	0.17%
	t-value	-0.08	0.60	-0.19	0.87	0.26
4	Monthly average return	0.37%	0.23%	-0.05%	0.69%	0.36%
	t-value	0.47	0.28	-0.06	0.95	0.58
High	Monthly average return	1.45%	0.50%	0.44%	0.20%	0.28%
	t-value	1.61	0.66	0.63	0.29	0.39

2) **Second, under the market capitalization weighting method, we discover that the G and S factors perform better when market value is controlled.**

By controlling for market value and observing the monthly average returns of the ESG subgroups under the market capitalization weighting strategy, we

find similar results to the equal weighting approach. Among the four ESG factors, the G factor and the S factor perform the best.

G factor. Among the groups with small market value, the monthly average returns of the G-score subgroups exhibit better monotonicity. Specifically, in the small market value group (Group 1), the returns of the G factor's low-score to high-score groups are -0.60%, -0.10%, -0.02%, 0.38%, and 1.49%, respectively. However, the monthly average returns of the G-score groups do not show monotonicity in the subset with large market value.

S factor. The S-score groups' monthly average returns exhibit better monotonicity among the groups with large market value. The returns of the S-score's low to high groups are -0.04%, -0.04%, 0.04%, 0.36%, and 0.39%, respectively, in the large market value group (Group 5). However, in the small market value groups, the returns of the S-score's low to high groups are not monotonic enough.

ESG and E factors. The ESG-score and E-score subgroups' monthly average returns do not demonstrate much monotonicity.

3) **In summary, after controlling for market value**, the S and G factors continue to demonstrate effective influences on the monthly average returns of their scoring groups. Correspondingly, higher S- and G-scores may be conducive to improving the returns of investment portfolios.

Table 6.8: ESG factors' grouping test by controlling for market value (market capitalization-weighted)

Panel A: ESG groups

		Small market value	2	3	4	Large market value
Low	Monthly average return	0.10%	0.34%	0.17%	-0.01%	0.93%

	t-value	0.11	0.36	0.20	-0.01	1.19
2	Monthly average return	-0.44%	0.07%	-0.30%	0.57%	0.39%
	t-value	-0.48	0.08	-0.38	0.80	0.54
3	Monthly average return	0.17%	0.56%	0.05%	0.83%	0.56%
	t-value	0.21	0.68	0.06	1.12	0.76
4	Monthly average return	0.34%	0.93%	0.11%	0.26%	-0.12%
	t-value	0.39	1.11	0.15	0.34	-0.18
High	Monthly average return	0.08%	-0.05%	0.14%	0.09%	0.32%
	t-value	0.10	-0.07	0.19	0.13	0.47

Panel B: E groups

		Small market value	2	3	4	Large market value
Low	Monthly average return	0.43%	0.37%	-0.08%	0.46%	0.53%
	t-value	0.45	0.41	-0.11	0.59	0.59
2	Monthly average return	0.19%	0.31%	0.25%	0.33%	0.82%
	t-value	0.19	0.35	0.33	0.42	1.10
3	Monthly average return	-0.13%	0.37%	0.24%	0.43%	-0.23%
	t-value	-0.14	0.49	0.29	0.57	-0.33
4	Monthly average return	-0.39%	0.49%	-0.12%	0.12%	-0.03%
	t-value	-0.49	0.59	-0.15	0.15	-0.04
High	Monthly average return	-0.19%	0.28%	-0.01%	0.34%	0.30%
	t-value	-0.21	0.34	-0.01	0.50	0.44

Panel C: S groups

		Small market value	2	3	4	Large market value
Low	Monthly average return	-0.20%	0.52%	-0.27%	-0.06%	-0.04%
	t-value	-0.21	0.56	-0.35	-0.07	-0.05

2	Monthly average return	0.41%	0.18%	-0.28%	0.18%	-0.04%
	t-value	0.43	0.21	-0.33	0.25	-0.07
3	Monthly average return	0.12%	0.65%	0.28%	0.93%	0.04%
	t-value	0.15	0.81	0.36	1.24	0.06
4	Monthly average return	-0.38%	0.32%	0.08%	0.42%	0.36%
	t-value	-0.46	0.39	0.11	0.61	0.55
High	Monthly average return	0.04%	0.27%	0.30%	0.24%	0.39%
	t-value	0.05	0.32	0.43	0.29	0.57

Panel D: G groups

		Small market value	2	3	4	Large market value
Low	Monthly average return	-0.60%	-0.07%	-0.47%	0.30%	0.22%
	t-value	-0.59	-0.09	-0.57	0.33	0.26
2	Monthly average return	-0.10%	0.88%	0.21%	0.01%	0.74%
	t-value	-0.12	1.01	0.27	0.01	1.14
3	Monthly average return	-0.02%	0.58%	-0.11%	0.70%	0.25%
	t-value	-0.03	0.64	-0.14	0.90	0.37
4	Monthly average return	0.38%	0.18%	-0.02%	0.61%	0.23%
	t-value	0.47	0.22	-0.02	0.84	0.35
High	Monthly average return	1.49%	0.42%	0.41%	0.22%	0.19%
	t-value	1.64	0.56	0.60	0.30	0.27

6.3.2 Controlling for return on equity

The grouping test of the ESG factors' monthly average returns is performed by controlling for ROE and by using the two strategies of equal weighting and market capitalization weighting.

1) **First, under the equal weighting strategy, the G and S factors perform relatively better when controlling for ROE.**

G factor. The monthly average returns of the G-score groups demonstrate greater monotonicity in both subgroups of low and high ROE. In particular, in ROE Group 2, the monthly average returns of the G factor's low-score to high-score groups are -0.51%, -0.03%, 0.01%, 0.19%, and 0.74%, respectively. In addition, in ROE Group 5, the returns of the groups with low to medium G-scores are 0.13%, 0.51%, and 0.68%, respectively.

S factor. The monthly average returns of the S-score groups exhibit a better degree of monotonicity in both the low and high ROE groups. For example, in the low ROE group, the monthly average returns of the S factor's groups with medium to high scores are -0.15%, 0.57%, 0.72%, and 1.17%, respectively. Similarly, in the high ROE group, the returns of the S factor's low- to medium-score groups are 0.32%, 0.35%, 0.40%, and 0.95%, respectively.

ESG and E factors. The monthly average returns of the ESG and E-score groups lack monotonicity.

Table 6.9: ESG factors' grouping test by controlling for ROE (equally weighted)

Panel A: ESG groups

		Low ROE	2	3	4	High ROE
Low	Monthly average return	0.01%	-0.15%	0.38%	0.24%	0.51%
	t-value	0.01	-0.17	0.50	0.27	0.66
2	Monthly average return	-0.17%	0.01%	-0.05%	0.21%	0.15%
	t-value	-0.20	0.02	-0.07	0.26	0.19
3	Monthly average return	0.42%	0.42%	0.11%	0.09%	0.62%
	t-value	0.48	0.49	0.15	0.13	0.83
4	Monthly average return	0.46%	0.01%	0.73%	0.36%	0.55%

	t-value	0.55	0.01	1.00	0.54	0.73
High	Monthly average return	0.49%	0.21%	-0.17%	-0.10%	0.26%
	t-value	0.63	0.26	-0.25	-0.16	0.34

Panel B: E groups

		Low ROE	2	3	4	High ROE
Low	Monthly average return	0.60%	0.34%	0.38%	-0.57%	0.29%
	t-value	0.60	0.45	0.45	-0.71	0.36
2	Monthly average return	-0.02%	-0.08%	0.28%	0.92%	0.47%
	t-value	-0.02	-0.09	0.37	1.15	0.67
3	Monthly average return	-0.28%	0.06%	0.06%	0.17%	0.61%
	t-value	-0.36	0.07	0.09	0.22	0.83
4	Monthly average return	-0.19%	0.07%	-0.14%	0.21%	-0.21%
	t-value	-0.20	0.08	-0.21	0.31	-0.26
High	Monthly average return	0.62%	0.01%	0.08%	-0.06%	0.82%
	t-value	0.75	0.02	0.11	-0.10	0.93

Panel C: S groups

		Low ROE	2	3	4	High ROE
Low	Monthly average return	0.03%	-0.16%	-0.23%	0.36%	0.32%
	t-value	0.04	-0.18	-0.30	0.40	0.33
2	Monthly average return	-0.15%	0.15%	0.27%	0.57%	0.35%
	t-value	-0.16	0.19	0.35	0.68	0.48
3	Monthly average return	0.57%	0.28%	0.56%	0.22%	0.40%
	t-value	0.64	0.36	0.73	0.30	0.52
4	Monthly average return	0.72%	-0.16%	-0.18%	0.10%	0.95%
	t-value	0.77	-0.20	-0.26	0.14	1.32
High	Monthly average return	1.17%	0.44%	0.19%	0.02%	0.23%
	t-value	1.17	0.56	0.27	0.04	0.28

Panel D: G groups

		Low ROE	2	3	4	High ROE
Low	Monthly average return	-0.35%	-0.51%	-0.53%	-0.05%	0.13%
	t-value	-0.35	-0.60	-0.66	-0.06	0.15
2	Monthly average return	0.22%	-0.03%	0.85%	0.30%	0.51%
	t-value	0.24	-0.03	1.21	0.39	0.61
3	Monthly average return	0.24%	0.01%	0.18%	-0.01%	0.68%
	t-value	0.27	0.01	0.22	-0.01	0.83
4	Monthly average return	0.03%	0.19%	0.25%	0.33%	0.67%
	t-value	0.04	0.24	0.37	0.48	0.91
High	Monthly average return	1.18%	0.74%	-0.03%	0.32%	0.18%
	t-value	1.49	0.87	-0.04	0.50	0.25

2) **Second, under the market capitalization weighting strategy, the G and S factors perform relatively better when controlling for ROE.**

Next, by controlling for ROE, we find that the market capitalization weighting strategy produces results that are similar to those of the equal weighting approach. That is, among the four scoring factors, the G and S factors perform the best in terms of monthly average returns.

G factor. Among the groups with low ROE, the monthly average returns of the G-score groups show better monotonicity. For example, in the low ROE group (Group 1), the monthly average returns of the G factor's medium- to high-score groups are 0.07%, 0.03%, and 1.14%, respectively. However, in the high ROE group, not enough monotonicity is shown in the returns of the G-score subgroups.

S factor. Mirroring the G factor's results, the monthly average returns of

the S-score groups exhibit good monotonicity in the low ROE groups. The monthly average returns of the S factor's groups with medium to high scores are specifically -0.15%, 0.70%, 1.04%, and 1.63% in the low ROE group (Group 1); however, there is no monotonicity revealed in the high ROE groups.

ESG and E factors. There is no monotonicity shown in the monthly average returns of the ESG and E-score groups when controlling for ROE.

3) **In summary, aftercontrolling forthe ROE factor**, the G and S factors still have some effects on the monthly average returns to an extent; this kind of effect is more pronounced in the subgroup with low ROE.

Table 6.10: ESG factors' grouping test by controlling for ROE (market capitalization-weighted)

Panel A: ESG groups

		Low ROE	2	3	4	High ROE
Low	Monthly average return	0.27%	0.01%	-0.03%	0.77%	0.66%
	t-value	0.27	0.01	-0.04	0.94	0.76
2	Monthly average return	-0.12%	0.33%	-0.28%	-0.13%	1.05%
	t-value	-0.14	0.41	-0.41	-0.19	1.07
3	Monthly average return	0.60%	0.80%	-0.14%	0.29%	1.09%
	t-value	0.75	0.92	-0.22	0.36	1.29
4	Monthly average return	-0.07%	-0.35%	-0.18%	-0.15%	0.83%
	t-value	-0.11	-0.42	-0.31	-0.25	0.91
High	Monthly average return	0.21%	0.07%	-0.10%	0.14%	0.45%
	t-value	0.28	0.07	-0.17	0.22	0.53

Panel B: E groups

		Low ROE	2	3	4	High ROE
Low	Monthly average return	0.94%	0.90%	-0.10%	-0.20%	0.81%
	t-value	0.96	1.05	-0.12	-0.23	0.82

2	Monthly average return	0.37%	0.17%	0.00%	1.22%	0.89%
	t-value	0.41	0.20	0.01	1.57	0.98
3	Monthly average return	-0.37%	0.10%	-0.16%	-0.33%	0.40%
	t-value	-0.62	0.12	-0.25	-0.44	0.48
4	Monthly average return	0.00%	-0.02%	-0.23%	0.20%	0.25%
	t-value	0.00	-0.03	-0.48	0.34	0.29
High	Monthly average return	0.22%	0.09%	-0.07%	0.12%	0.60%
	t-value	0.28	0.11	-0.10	0.17	0.67

Panel C: S groups

		Low ROE	2	3	4	High ROE
Low	Monthly average return	0.00%	-0.14%	-0.49%	1.12%	0.66%
	t-value	0.00	-0.16	-0.69	1.33	0.61
2	Monthly average return	-0.15%	0.24%	-0.42%	0.97%	0.32%
	t-value	-0.19	0.33	-0.73	1.22	0.39
3	Monthly average return	0.70%	0.39%	0.19%	-0.12%	0.63%
	t-value	0.79	0.49	0.25	-0.16	0.76
4	Monthly average return	1.04%	-0.08%	-0.42%	-0.06%	1.43%
	t-value	1.01	-0.09	-0.65	-0.09	1.73
High	Monthly average return	1.63%	0.24%	0.21%	0.24%	0.62%
	t-value	1.66	0.26	0.36	0.38	0.69

Panel D: G groups

		Low ROE	2	3	4	High ROE
Low	Monthly average return	-0.31%	-0.46%	0.03%	-0.17%	0.65%
	t-value	-0.31	-0.62	0.03	-0.18	0.66
2	Monthly average return	0.34%	0.44%	0.20%	0.38%	1.19%
	t-value	0.42	0.47	0.32	0.60	1.35
3	Monthly	0.07%	0.11%	-0.12%	-0.11%	1.08%

	average return					
	t-value	0.07	0.13	-0.20	-0.15	1.11
4	Monthly average return	0.03%	0.57%	-0.18%	0.20%	1.04%
	t-value	0.04	0.69	-0.33	0.34	1.14
High	Monthly average return	1.14%	0.28%	-0.37%	0.36%	0.22%
	t-value	1.51	0.31	-0.51	0.50	0.28

6.3.3 Controlling for both market value and ROE

In the following step, we conduct the grouping test on the monthly average returns of the ESG factors, this time controlling for both market value and ROE.

1) **Under the equal weighting strategy, the G, E, and S factors perform relatively better when controlling for both market value and ROE.**

The results show that the monthly average returns of the G, E, and S factors show relatively good monotonicity in the subgroups with small market value and low ROE.

G factor. Specifically, for Group 2 under small market value and low ROE, the monthly average returns of the G factor's low- to high-score groups are -0.38%, 0.04%, 0.10%, and 0.99%, respectively.

E factor. For Group 1 under small market value and low ROE, the monthly average returns of the E factor's medium- to high-score groups are -0.53%, -0.49%, and 0.59%, respectively.

S factor. Similar to the results above, for Group 1 under small market value and low ROE, the returns of the S factor's medium- to high-score groups are -0.26%, -0.07%, and 0.83%, respectively.

In addition, the groups with large market value and high ROE do not demonstrate corresponding monotonicity in the monthly average returns of the

G-score, E-score, and S-score groups.

Table 6.11: ESG factors' grouping test by controlling for both market value and ROE (equally weighted)

Panel A: ESG groups

		Small market value				Large market value			
		Low ROE	2	3	High ROE	Low ROE	2	3	High ROE
Low	Monthly average return	-0.32%	0.10%	0.44%	0.33%	0.15%	0.28%	0.75%	0.46%
	t-value	-0.31	0.11	0.52	0.38	0.17	0.38	0.82	0.52
2	Monthly average return	-0.01%	0.13%	-0.51%	-0.07%	0.27%	0.01%	0.39%	0.73%
	t-value	-0.01	0.14	-0.59	-0.08	0.35	0.01	0.50	0.95
3	Monthly average return	-0.03%	0.24%	0.45%	0.14%	0.44%	0.30%	0.39%	0.61%
	t-value	-0.03	0.25	0.60	0.20	0.61	0.42	0.60	0.74
High	Monthly average return	0.69%	0.41%	0.46%	-0.09%	-0.12%	-0.12%	0.12%	0.45%
	t-value	0.70	0.52	0.56	-0.12	-0.15	-0.19	0.21	0.54

Panel B: E groups

		Small market value				Large market value			
		Low ROE	2	3	High ROE	Low ROE	2	3	High ROE
Low	Monthly average return	0.36%	0.50%	0.46%	-0.37%	0.67%	0.49%	0.18%	0.87%
	t-value	0.34	0.60	0.55	-0.45	0.86	0.64	0.21	1.07
2	Monthly average return	-0.53%	0.43%	0.25%	0.72%	-0.05%	-0.07%	0.35%	0.14%
	t-value	-0.55	0.43	0.30	0.88	-0.06	-0.09	0.45	0.19
3	Monthly average return	-0.49%	0.11%	0.25%	0.26%	-0.11%	-0.12%	0.37%	0.14%
	t-value	-0.54	0.13	0.31	0.36	-0.13	-0.19	0.56	0.18
High	Monthly average return	0.59%	0.05%	-0.06%	-0.57%	0.09%	0.06%	0.49%	1.17%
	t-value	0.59	0.06	-0.08	-0.74	0.12	0.10	0.74	1.30

Panel C: S groups

		Small market value				Large market value			
		Low ROE	2	3	High ROE	Low ROE	2	3	High ROE
Low	Monthly average return	0.02%	0.18%	-0.66%	0.24%	-0.13%	-0.05%	1.61%	0.74%

	t-value	0.02	0.18	-0.78	0.24	-0.16	-0.07	1.83	0.81
2	Monthly average return	-0.26%	0.33%	0.72%	0.15%	0.73%	0.06%	-0.14%	0.28%
	t-value	-0.27	0.42	0.82	0.19	0.93	0.09	-0.18	0.36
3	Monthly average return	-0.07%	0.14%	0.16%	0.25%	0.07%	0.21%	0.38%	1.07%
	t-value	-0.08	0.15	0.21	0.33	0.09	0.29	0.54	1.38
High	Monthly average return	0.83%	0.29%	0.15%	-0.19%	0.52%	0.14%	0.17%	0.28%
	t-value	0.89	0.37	0.19	-0.26	0.60	0.22	0.27	0.34

Panel D: G groups

		Small market value				Large market value			
		Low ROE	2	3	High ROE	Low ROE	2	3	High ROE
Low	Monthly average return	-0.62%	-0.38%	-0.63%	-0.05%	0.05%	-0.13%	0.36%	0.52%
	t-value	-0.58	-0.38	-0.69	-0.06	0.06	-0.19	0.39	0.59
2	Monthly average return	0.25%	0.04%	0.80%	-0.09%	-0.06%	0.38%	0.34%	1.10%
	t-value	0.26	0.05	1.00	-0.10	-0.07	0.49	0.48	1.23
3	Monthly average return	0.04%	0.10%	0.23%	0.26%	0.43%	0.20%	0.13%	0.54%
	t-value	0.05	0.13	0.27	0.36	0.55	0.32	0.20	0.71
High	Monthly average return	0.88%	0.99%	0.14%	0.13%	0.53%	-0.22%	0.69%	0.17%
	t-value	0.98	1.10	0.18	0.18	0.68	-0.30	1.03	0.23

2) **Under the market capitalization weighting strategy, unlike the results using the equal weighting approach, the ESG, E, and S factors perform poorly when controlling for both market value and ROE; only the G factor groups show some monotonicity.**

Furthermore, under the market capitalization weighting strategy, the results show that the ESG, E, and S factors show poor monotonicity from the low- to high-score groups.

G factor. Group 4 under small market value and high ROE and Group 1 under large market value and low ROE both show some monotonicity. For

instance, for Group 4 under small market value and high ROE, the monthly average returns of the G factor's low- to high-score groups are -0.13%, -0.05%, 0.14%, and 0.16%, respectively.

3) **In summary,** based on the aforementioned outcomes, we suggest that stocks with simultaneously low ESG scores, low E-scores, low S-scores, small market value, and low ROE can be excluded when building an index enhancement strategy for the CSI 800, while ideally utilizing the equal weighting strategy to do so.

Table 6.12: ESG factors' grouping test by controlling for both market value and ROE (market capitalization-weighted)

Panel A: ESG groups

		Small market value				Large market value			
		Low ROE	2	3	High ROE	Low ROE	2	3	High ROE
Low	Monthly average return	-0.16%	0.13%	0.66%	0.14%	0.20%	-0.16%	1.19%	1.23%
	t-value	-0.16	0.13	0.76	0.16	0.22	-0.23	1.47	1.22
2	Monthly average return	0.16%	0.21%	-0.44%	-0.09%	0.48%	-0.07%	0.32%	0.93%
	t-value	0.19	0.23	-0.52	-0.11	0.58	-0.09	0.44	1.03
3	Monthly average return	-0.08%	0.40%	0.55%	0.09%	-0.34%	-0.19%	-0.18%	1.06%
	t-value	-0.09	0.42	0.70	0.12	-0.50	-0.31	-0.29	1.14
High	Monthly average return	0.79%	0.39%	0.36%	-0.01%	0.23%	0.00%	0.01%	0.52%
	t-value	0.79	0.49	0.43	-0.01	0.27	0.00	0.01	0.61

Panel B: E groups

		Small market value				Large market value			
		Low ROE	2	3	High ROE	Low ROE	2	3	High ROE
Low	Monthly average return	0.53%	0.69%	0.42%	-0.40%	0.91%	0.04%	0.32%	1.46%
	t-value	0.50	0.80	0.50	-0.52	1.07	0.06	0.35	1.44
2	Monthly average return	-0.41%	0.39%	0.37%	0.50%	0.02%	0.09%	0.39%	0.35%
	t-value	-0.45	0.40	0.42	0.63	0.02	0.12	0.50	0.39

3	Monthly average return	-0.43%	0.28%	0.42%	0.44%	-0.41%	-0.20%	0.00%	0.17%
	t-value	-0.49	0.32	0.49	0.58	-0.52	-0.35	-0.01	0.22
High	Monthly average return	0.61%	0.09%	-0.02%	-0.62%	0.20%	-0.08%	-0.05%	0.81%
	t-value	0.64	0.11	-0.03	-0.80	0.25	-0.13	-0.08	0.89

Panel C: S groups

		Small market value				Large market value			
		Low ROE	2	3	High ROE	Low ROE	2	3	High ROE
Low	Monthly average return	0.19%	0.33%	-0.49%	0.31%	-0.06%	-0.36%	2.33%	0.73%
	t-value	0.20	0.31	-0.54	0.29	-0.07	-0.51	2.55	0.77
2	Monthly average return	-0.28%	0.24%	0.74%	-0.08%	0.23%	-0.15%	-0.27%	0.37%
	t-value	-0.30	0.31	0.84	-0.11	0.34	-0.23	-0.35	0.42
3	Monthly average return	0.05%	0.26%	0.17%	0.19%	0.11%	-0.12%	-0.11%	1.46%
	t-value	0.06	0.28	0.22	0.25	0.13	-0.18	-0.18	1.65
High	Monthly average return	0.72%	0.47%	0.19%	-0.14%	-0.05%	0.34%	0.22%	0.72%
	t-value	0.80	0.61	0.23	-0.19	-0.06	0.56	0.34	0.79

Panel D: G groups

		Small market value				Large market value			
		Low ROE	2	3	High ROE	Low ROE	2	3	High ROE
Low	Monthly average return	-0.54%	-0.24%	-0.51%	-0.13%	-0.20%	-0.07%	0.62%	1.03%
	t-value	-0.54	-0.24	-0.55	-0.17	-0.25	-0.10	0.93	1.10
2	Monthly average return	0.38%	0.14%	1.05%	-0.05%	-0.17%	0.23%	0.21%	1.40%
	t-value	0.41	0.16	1.28	-0.06	-0.19	0.35	0.30	1.39
3	Monthly average return	0.07%	0.02%	0.28%	0.14%	0.44%	-0.22%	-0.12%	0.60%
	t-value	0.07	0.03	0.32	0.19	0.57	-0.39	-0.20	0.66
High	Monthly average return	0.86%	0.97%	-0.06%	0.16%	0.52%	-0.34%	0.38%	0.55%
	t-value	0.98	1.09	-0.09	0.23	0.61	-0.43	0.54	0.66

6.3.4 CSI G factor's overall performance

Controlling for market value and ROE at the same time, and testing the

monthly average returns of the ESG factors in groups, we find that overall, the G factor performs relatively better.

1) For the CSI G factor, the monthly average returns of the low- to high-score groups show relatively good monotonicity.

2) In terms of the equal weighting strategy, for Group 2 under small market value and medium ROE, the CSI G factor's monthly average returns from the low- to high-score groups are -0.38%, 0.04%, 0.10%, and 0.99% (see Table 6.11), respectively, presenting some monotonicity.

3) According to the market capitalization weighting strategy, for Group 4 under small market value and high ROE and for Group 1 under large market value and low ROE, some monotonicity is shown in the monthly average returns of the G-score's groups.

4) The monotonicity presented by the monthly average returns of the G-score groups is poor only within the groups of both large market value and high ROE.

To sum up, the financial market will value relatively smaller and less profitable companies with comparatively good corporate governance at a higher price.

Chapter 7 Application of ESG factors

7.1 Exploring the construction of the CSI 800 ESG Smart Beta index enhancement strategy

Currently, most empirical studies have argued that ESG factors themselves are unable to capture significant Smart Beta returns. However, is it possible to consider and execute ESG investments without reducing the returns of investors?

We use the CSI 800 Index as the performance benchmark, mainly using the CSI 800 constituents as the sample, and compare the performance of portfolios that select the top 20% stocks of ESG scores and exclude the bottom 20% stocks of ESG scores. The equal weighting and market capitalization weighting methods are used to construct the index enhancement strategy, respectively.

7.1.1 Grouping test of the CSI ESG index enhancement strategy in the CSI 800

For the CSI ESG index enhancement strategy, the results of the grouping test (see Table 7.1) reveal that only the enhancement strategy constructed by excluding the bottom 20% stocks of the G-score has better effects than the other ESG factors in the equal weighting approach, with a significant positive excess return of 0.12% (t = 2.33). This indicates that the index enhancement strategy constructed by the CSI G-score can generate excess returns relatively more consistently, yielding better performance.

Table 7.1: CSI ESG index enhancement strategy: Return test

	Select top 20%	Exclude bottom 20%	CSI 800 benchmark	Select top 20%	Exclude bottom 20%

					excess return	excess return
A: Equally weighted groups						
ESG	Monthly average return	0.10%	0.22%	0.21%	-0.11%	0.01%
	t-value	0.15	0.32	0.29	-0.56	0.39
E	Monthly average return	0.25%	0.19%	0.21%	0.05%	-0.01%
	t-value	0.37	0.28	0.29	0.54	-0.28
S	Monthly average return	0.22%	0.26%	0.21%	0.01%	0.06%
	t-value	0.32	0.38	0.29	0.23	1.30
G	Monthly average return	0.41%	0.32%	0.21%	0.21%	0.12%
	t-value	0.62	0.47	0.29	1.59	2.33
B: Market capitalization-weighted groups						
ESG	Monthly average return	0.26%	0.23%	0.24%	0.02%	-0.01%
	t-value	0.40	0.37	0.38	0.38	-0.33
E	Monthly average return	0.25%	0.21%	0.24%	0.01%	-0.03%
	t-value	0.38	0.35	0.38	0.37	-0.36
S	Monthly average return	0.35%	0.27%	0.24%	0.12%	0.03%
	t-value	0.53	0.44	0.38	1.04	1.13
G	Monthly average return	0.21%	0.28%	0.24%	-0.02%	0.04%
	t-value	0.32	0.45	0.38	-0.38	1.17

7.1.2 CSI ESG index enhancement strategy: group backtesting

The results of group backtesting on the CSI ESG index enhancement strategy also indicate that the CSI G-score index enhancement strategy has relatively better performance.

1) The CSI 800 index enhancement strategy constructed by the total CSI ESG score is less effective.

The annualized returns of the portfolio constructed by the equal weighting strategy, screening the top 20% stocks of the ESG score (2.66%), are lower than

those of the equally weighted benchmark CSI 800 (3.41%). However, the portfolio constructed by equal weighting, excluding the bottom 20% stocks of the total ESG score, yields higher annualized returns (3.65%), lower volatility, and lower maximum drawdown than the equally weighted benchmark CSI 800.

Table 7.2: CSI ESG score: Equally weighted group backtest indicators

	Annualized return	Volatility	Sharpe ratio	Maximum drawdown	Calma ratio	Information ratio	Tracking error
Select top 20%	2.66%	16.94%	0.1569	34.18%	0.0777	-0.2598	3.01%
Exclude bottom 20%	3.65%	17.02%	0.2145	34.54%	0.1057	0.2139	0.91%
Equally weighted CSI 800	3.41%	17.22%	0.1983	36.13%	0.0945		

Table 7.3: CSI ESG score: Market capitalization-weighted group backtest indicators

	Annualized return	Volatility	Sharpe ratio	Maximum drawdown	Calma ratio	Information ratio	Tracking error
Select top 20%	4.64%	16.19%	0.2866	26.93%	0.1723	0.0261	2.89%
Exclude bottom 20%	4.19%	15.43%	0.2713	29.49%	0.1420	0.6427	0.83%
CSI 800	4.17%	15.48%	0.2693	29.83%	0.1397		

2) The CSI 800 index enhancement strategy constructed by the CSI E-score is not effective enough.

Regardless of the weighting methods, the annualized returns of the portfolio constructed by excluding the bottom 20% stocks of the CSI E-score

are lower than those of the benchmark CSI 800. However, under the equal weighting strategy, the portfolio constructed by screening the top 20% stocks of the CSI E-score results in higher annualized returns (4.06%), lower volatility, and lower maximum drawdown than the equally weighted benchmark CSI 800.

Table 7.4: CSI E-score: Equally weighted group backtest indicators

	Annualized return	Volatility	Sharpe ratio	Maximum drawdown	Calma ratio	Information ratio	Tracking error
Select top 20%	4.06%	17.02%	0.2387	34.40%	0.1181	0.2503	2.36%
Exclude bottom 20%	3.36%	17.03%	0.1972	35.32%	0.0951	-0.1071	0.80%
Equally weighted CSI 800	3.41%	17.22%	0.1983	36.13%	0.0945		

Table 7.5: CSI E-score: Market capitalization-weighted group backtest indicators

	Annualized return	Volatility	Sharpe ratio	Maximum drawdown	Calma ratio	Information ratio	Tracking error
Select top 20%	4.46%	15.71%	0.2841	27.46%	0.1625	0.0872	3.64%
Exclude bottom 20%	4.04%	15.31%	0.2637	28.94%	0.1395	-0.1845	0.83%
CSI 800	4.17%	15.48%	0.2693	29.83%	0.1397		

3) Similar to the results above, the CSI 800 index enhancement strategy constructed by the CSI S-score has relatively less effectiveness.

Under the equal weighting strategy, screening the top 20% stocks and excluding the bottom 20% stocks of the CSI S-score both result in higher

annualized returns (equally weighted CSI 800: 3.41%; screening top 20%: 3.85%; excluding bottom 20%: 3.99%), lower volatility, and lower maximum drawdown. However, the difference with the corresponding indicators of the equally weighted benchmark CSI 800 is not obvious, and thus the enhancement effect is not strong enough. Similar results are obtained when utilizing the market capitalization weighting method.

Table 7.6: CSI E-score: Equally weighted group backtest indicators

	Annualized return	Volatility	Sharpe ratio	Maximum drawdown	Calma ratio	Information ratio	Tracking error
Select top 20%	3.85%	16.79%	0.2294	34.44%	0.1118	0.1019	3.42%
Exclude bottom 20%	3.99%	17.01%	0.2345	34.96%	0.1141	0.5468	0.95%
Equally weighted CSI 800	3.41%	17.22%	0.1983	36.13%	0.0945		

Table 7.7: CSI E-score: Market capitalization-weighted group backtest indicators

	Annualized return	Volatility	Sharpe ratio	Maximum drawdown	Calma ratio	Information ratio	Tracking error
Select top 20%	5.72%	16.37%	0.3492	29.25%	0.1954	0.4153	3.90%
Exclude bottom 20%	4.54%	15.43%	0.2943	29.34%	0.1548	0.4209	0.83%
CSI 800	4.17%	15.48%	0.2693	29.83%	0.1397		

4) The CSI 800 index enhancement strategy constructed by the CSI G-score demonstrates the best performance overall.

The CSI 800 index enhancement strategy constructed with the equal

weighting of the CSI G-score performs better. Specifically, under the equal weighting strategy, screening the top 20% stocks and excluding the bottom 20% stocks of the CSI G-score both result in higher annualized returns (equally weighted CSI 800: 3.41%; screening top 20%: 5.58%; excluding bottom 20%: 4.52%) and lower maximum drawdown.

Among them, it is worth noting that the CSI 800 index enhancement strategy constructed by the equally weighted exclusion of the bottom 20% stocks has an information ratio of 1.22 and a smaller tracking error, which presents a comparatively good result.

In summary, we conclude that the equally weighted CSI 800 enhancement strategy constructed by the CSI G-score demonstrates better return performance. Under equal weighting, we also find that the enhancement strategy constructed by excluding the bottom 20% stocks of the G-score has a smaller difference in each indicator compared with the benchmark CSI 800 and may generate some excess returns. This result indicates that the use of the negative screening strategy does not worsen returns, but instead has a relatively positive enhancement effect.

Meanwhile, enlightened by the above findings that the G factor is more effective for portfolio construction when conducting grouping tests, we further investigate the underlying indicators of the G-score, to understand what elements of the G factor can effectively enhance return performance.

Table 7.8: CSI G-score: Equally weighted group backtest indicators

	Annualized return	Volatility	Sharpe ratio	Maximum drawdown	Calma ratio	Information ratio	Tracking error
Select top 20%	5.58%	17.32%	0.3219	31.70%	0.1759	0.7220	2.89%

Exclude bottom 20%	4.52%	17.13%	0.2635	34.37%	0.1314	1.2168	0.86%
Equally weighted CSI 800	3.41%	17.22%	0.1983	36.13%	0.0945		

Table 7.9: CSI G-score: Market capitalization-weighted group backtest indicators

	Annualized return	Volatility	Sharpe ratio	Maximum drawdown	Calma ratio	Information ratio	Tracking error
Select top 20%	4.54%	17.38%	0.2612	30.76%	0.1476	0.1656	4.03%
Exclude bottom 20%	4.59%	15.46%	0.2967	28.49%	0.1611	0.5806	0.69%
CSI 800	4.17%	15.48%	0.2693	29.83%	0.1397		

7.2 Exploration of the underlying indicators of the CSI G-score

7.2.1 CSI G-score: information on its underlying indicators

The underlying indicators of the CSI G-score are shown in Table 7.10. Specifically, the CSI G-score has 21 indicators. All data for the underlying indicators of the CSI G-score used in this study are from the open database and data services of Wind.[1]

Table 7.10: CSI G-score: Information on its underlying indicators

CSI G-score's underlying indicators	**Code**
Percentage of independent directors: Number of independent directors/total number of directors	G111

[1] See the Wind database for details: https://www.wind.com.cn/portal/en/WDS/database.html.

Whether there is no objection (1 is no objection)	G122
Whether the financial report is released in a timely manner	G211
Whether the type of audit opinion on the annual financial report is a “standard unqualified opinion”	G212
Whether there is no material change in the report (1 is no material change)	G213
Exchange’s scoring of information disclosure of listed companies	G214
Concentration of shareholding 1 (percentage of shares held by the largest shareholder) (%)	G311
Concentration of shareholding 2 (percentage of shares held by the top 10 shareholders) (%)	G312
Whether no dividend has been paid continuously in the past 3 years	G313
Current ratio (solvency)	G411
Debt-to-asset ratio (capital structure)	G412
ACCRUAL	G421
Pledge ratio 1	G422
Pledge ratio 2	G423
Goodwill to net assets ratio	G424
Monetary capital with interest property debt ratio	G425
R&D capitalization ratio	G426
Executive compensation incentive	G511
Whether the company has been publicly condemned by the exchange, publicly identified, or investigated and administratively punished by the SFC in the past year	G611
Penalty amount for violation in the past year as a percentage of operating revenue	G612
Debt default	G613

Next, we conduct a full-history descriptive statistical analysis of the CSI G-score’s underlying indicators, providing a basis for further analysis.

Table 7.11: Descriptive statistics: CSI G-score's underlying indicators

Indicator detail	Code	Data type	Mean	SD	Coefficient of variation	Max	Min	Median
Percentage of independent directors: Number of independent directors/total number of directors	G111	num	0.3784	0.0583	0.1540	0.8000	0.0000	0.3636
Whether there is no objection (1 is no objection)	G122	bool	0.8659	-	-	1.0000	0.0000	1.0000
Whether the financial report is released in a timely manner	G211	bool	0.8659	-	-	1.0000	0.0000	1.0000
Whether the type of audit opinion on the annual financial report is a "standard unqualified opinion"	G212	bool	0.8298	-	-	1.0000	0.0000	1.0000
Whether there is no material change in the report (1 is no material change)	G213	bool	0.7922	-	-	1.0000	0.0000	1.0000
Exchange's scoring of information disclosure of listed companies	G214	num	0.6279	0.3504	0.5580	1.0000	-0.5000	0.5000
Concentration of shareholding 1 (percentage of shares held by the largest shareholder) (%)	G311	num	36.8111	16.4557	0.4470	100.0000	0.0000	35.8100
Concentration of shareholding 2 (percentage of shares held by the top 10 shareholders) (%)	G312	num	62.8459	16.2191	0.2581	100.0100	0.0000	63.2200
Whether no dividend has been paid continuously in the past 3 years	G313	bool	0.0572	-	-	1.0000	0.0000	0.0000

Current ratio (solvency)	G411	num	1.5884	1.9068	1.2004	54.5600	0.0000	1.2940
Debt-to-asset ratio (capital structure)	G412	num	50.1831	20.9535	0.4175	94.9429	1.0744	51.1177
ACCRUAL	G421	num	0.0491	0.0404	0.8222	0.7620	0.0000	0.0399
Pledge ratio 1	G422	num	21.3731	32.7768	1.5336	100.0000	0.0000	0.0000
Pledge ratio 2	G423	num	12.0551	16.0633	1.3325	77.9600	0.0000	3.7100
Goodwill to net assets ratio	G424	num	0.0728	0.1567	2.1529	3.0233	0.0000	0.0046
Monetary capital with interest property debt ratio	G425	num	65.2647	1,341.0128	20.5473	59,130.4656	0.0000	0.5049
R&D capitalization ratio	G426	num	0.1950	0.3322	1.7033	1.0000	-0.0410	0.0000
Executive compensation incentive	G511	num	2,221,948.3608	3,491,613.0225	1.5714	43,810,000.0000	0.0000	1,151,800.0000
Whether the company has been publicly condemned by the exchange, publicly identified, or investigated and administratively punished by the SFC in the past year	G611	bool	0.0127	-	-	1.0000	0.0000	0.0000

Penalty amount for violation in the past year as a percentage of operating revenue	G612	num	0.0000	0.0005	26.5439	0.0324	0.0000	0.0000
Debt default	G613	bool	0.0006	-	-	1.0000	0.0000	0.0000

7.2.2 CSI G-score's underlying indicators: grouping test

To verify the effectiveness of the CSI G-score's underlying metrics, each indicator's monthly average returns are examined using both equally weighted and market capitalization-weighted grouping tests.

Based on the monthly average returns and significance levels from the long-short portfolio constructed by each factor, the bottom indicators that are considered relatively effective are as follows: debt default, whether no dividend has been paid continuously in the past 3 years, ACCRUAL, the exchange's scoring of the information disclosure of listed companies, and pledge ratio 2. The long-short portfolio constructed by debt default (return: -6.57%, t = -3.80), whether no dividend has been paid continuously in the past 3 years (return: -0.68%, t = -1.68), and ACCRUAL (return: -0.25%, t = -1.78) negatively affect monthly average returns. Conversely, the long-short portfolio constructed by the exchange's scoring of information disclosure of listed companies (return: 0.43%, t = 1.70) positively affects monthly average returns.

Meanwhile, among the long-short portfolios constructed by market capitalization weighting (see Appendix 4), only the debt default factor is relatively effective, significantly and negatively impacting its portfolio's excess returns (return: -6.45%, t = -3.60).

Table 7.12: CSI G-score's underlying indicators: Equally weighted grouping test

	Code		Low	High	High-Low
Exchange's scoring of information disclosure of listed companies	G214	Monthly average return	0.12%	0.53%	0.43%
		t-value	0.15	0.80	1.70
Current ratio (solvency)	G411	Monthly average return	0.15%	0.49%	0.36%
		t-value	0.20	0.66	1.04
Whether there is no material change in the report (1 is no material change)	G213	Monthly average return	-0.32%	0.21%	0.43%
		t-value	-0.29	0.30	0.51
Monetary capital with interest property debt ratio	G425	Monthly average return	0.08%	0.27%	0.20%
		t-value	0.11	0.38	0.74
R&D capitalization ratio	G426	Monthly average return	0.08%	0.22%	0.16%
		t-value	0.11	0.28	0.59
Concentration of shareholding 1 (percentage of shares held by the largest shareholder) (%)	G311	Monthly average return	0.16%	0.40%	0.24%
		t-value	0.21	0.58	0.99
Percentage of independent directors: Number of independent directors/total number of directors	G111	Monthly average return	0.22%	0.35%	0.13%
		t-value	0.31	0.49	1.12
Concentration of shareholding 2 (percentage of shares held by the top 10 shareholders) (%)	G312	Monthly average return	0.18%	0.37%	0.18%
		t-value	0.23	0.55	0.67
Executive compensation incentive	G511	Monthly average return	0.19%	0.09%	-0.10%
		t-value	0.26	0.13	-0.41
ACCRUAL	G421	Monthly average return	0.40%	0.15%	-0.25%

		t-value	0.57	0.20	-1.78
Goodwill to net assets ratio	G424	Monthly average return	0.43%	0.13%	-0.30%
		t-value	0.62	0.17	-1.21
Debt-to-asset ratio (capital structure)	G412	Monthly average return	0.42%	0.16%	-0.25%
		t-value	0.57	0.22	-0.83
Pledge ratio 1	G422	Monthly average return	0.31%	-0.06%	-0.38%
		t-value	0.46	-0.07	-1.26
Pledge ratio 2	G423	Monthly average return	0.38%	-0.02%	-0.41%
		t-value	0.58	-0.02	-1.50
Whether there is no objection (1 is no objection)	G122	Monthly average return	0.32%	0.17%	-0.14%
		t-value	1.58	0.24	-0.20
Whether the financial report is released in a timely manner	G211	Monthly average return	0.32%	0.17%	-0.14%
		t-value	1.58	0.24	-0.20
Whether the type of audit opinion on the annual financial report is a "standard unqualified opinion"	G212	Monthly average return	1.41%	0.50%	-0.96%
		t-value	1.17	0.61	-1.06
Whether no dividend has been paid continuously in the past 3 years	G313	Monthly average return	0.32%	-0.35%	-0.68%
		t-value	0.45	-0.40	-1.68
Whether the company has been publicly condemned by the exchange, publicly identified, or investigated and administratively punished by the SFC in the past year	G611	Monthly average return	0.18%	-0.75%	-0.90%
		t-value	0.25	-0.68	-1.11

Debt default	G613	Monthly average return	0.18%	-6.33%	-6.57%
		t-value	0.25	-3.28	-3.80

To clearly select the more effective underlying indicators of the CSI G-score, the absolute values of the monthly average returns and the t-value of its equally weighted long-short portfolio are ranked. While prioritizing monthly average returns, the magnitude of the t-value is also taken into consideration. Based on this, we define the relatively effective factors under the CSI G-score as follows:

(1) Debt default

(2) Whether the type of audit opinion on the annual financial report is a "standard unqualified opinion"

(3) Whether the company has been publicly condemned by the exchange, publicly identified, or investigated and administratively punished by the SFC in the past year

(4) Pledge ratio 2

(5) Whether no dividend has been paid continuously for the past 3 years

(6) The exchange's scoring of the information disclosure of listed companies

(7) Current ratio (solvency)

Among them, only the last two underlying factors listed above positively affect stock returns; the other five factors negatively affect stock returns.

Table 7.13: Long-short portfolios of the CSI G-score's underlying indicators: Absolute value of monthly average returns

CSI G-score's underlying indicator (equally weighted long-short portfolio)	Absolute value of monthly average

	returns
Debt default	6.57%
Whether the type of audit opinion on the annual financial report is a "standard unqualified opinion" (1 is yes)	0.96%
Whether the company has been publicly condemned by the exchange, publicly identified, or investigated and administratively punished by the SFC in the past year	0.90%
Whether no dividend has been paid continuously in the past 3 years	0.68%
Exchange's scoring of information disclosure of listed companies	0.43%
Whether there is no material change in the report (1 is no material change)	0.43%
Pledge ratio 2	0.41%
Pledge ratio 1	0.38%
Current ratio (solvency)	0.36%
Goodwill to net assets ratio	0.30%
Debt-to-asset ratio (capital structure)	0.25%
ACCRUAL	0.25%
Concentration of shareholding 1 (percentage of shares held by the largest shareholder) (%)	0.24%
Monetary capital with interest property debt ratio	0.20%
Concentration of shareholding 2 (percentage of shares held by the top 10 shareholders) (%)	0.18%
R&D capitalization ratio	0.16%
Whether there is no objection (1 is no objection)	0.14%
Whether the financial report is released in a timely manner	0.14%
Percentage of independent directors: Number of independent directors/total number of directors	0.13%
Executive compensation incentive	0.10%

Table 7.14: Long-short portfolios of the CSI G-score's underlying indicators: Absolute value of the t-value

CSI G-score's underlying indicator (equally weighted long-short portfolio)	Absolute value of t-value
Debt default	3.80
ACCRUAL	1.78
Exchange's scoring of information disclosure of listed companies	1.70
Whether no dividend has been paid continuously in the past 3 years	1.68
Pledge ratio 2	1.50
Pledge ratio 1	1.26
Goodwill to net assets ratio	1.21
Percentage of independent directors: Number of independent	1.12

directors/total number of directors	
Whether the company has been publicly condemned by the exchange, publicly identified, or investigated and administratively punished by the SFC in the past year	1.11
Whether the type of audit opinion on the annual financial report is a "standard unqualified opinion" (1 is yes)	1.06
Current ratio (solvency)	1.04
Concentration of shareholding 1 (percentage of shares held by the largest shareholder) (%)	0.99
Debt-to-asset ratio (capital structure)	0.83
Monetary capital with interest property debt ratio	0.74
Concentration of shareholding 2 (percentage of shares held by the top 10 shareholders) (%)	0.67
R&D capitalization ratio	0.59
Whether there is no material change in the report (1 is no material change)	0.51
Executive compensation incentive	0.41
Whether there is no objection (1 is no objection)	0.20
Whether the financial report is released in a timely manner	0.20

7.3 Based on the CSI G-score's underlying indicators: exploring the construction of the CSI 800 ESG index enhancement strategy

Based on testing the effectiveness of the G-score's underlying indicators, we consider using the seven G-score bottom factors that are more effective in obtaining excess returns—namely (1) debt default, (2) whether the type of audit opinion on the annual financial report is a "standard unqualified opinion," (3) whether the company has been publicly condemned by the exchange, publicly identified, or investigated and administratively punished by the SFC in the past year, (4) pledge ratio 2, (5) whether no dividend has been paid continuously for the past 3 years, (6) the exchange's scoring of the information disclosure of listed companies, and (7) current ratio (solvency)—to construct a new CSI G-score (G plus-score).

In addition, when exploring the construction of the CSI 800 ESG index

enhancement strategy (see Chapter 7.1), we find that the equal weighting enhancement strategy of the CSI G-score has better return performance. The corresponding results also show that the negative screening strategy does not cause a loss of return to investors, and it even has a certain positive enhancement effect. Therefore, with respect to these results, we continue to explore the methods of constructing CSI 800 ESG index enhancement strategies through a self-constructed CSI G-score (G plus-score).

7.3.1 Based on the CSI G plus-score's portfolios: return test

Based on the self-constructed G plus-score, we use the CSI 800 Index as the performance benchmark, comparing the performance of portfolios that select the top 20% stocks and exclude the bottom 20% stocks of the G plus-score.

Under the two methods of equal weighting and market capitalization weighting, the tests of the monthly average returns indicate that both portfolios of the G plus-score can generate some excess returns compared with the benchmark CSI 800 (see Table 7.15). Among them, the market capitalization-weighted portfolios demonstrate relatively better outcomes in terms of excess returns (select top 20%: 0.13%; exclude bottom 20%: 0.14%), both higher than the equally weighted portfolios (select top 20%: 0.05%; exclude bottom 20%: 0.05%).

Table 7.15: Self-constructed CSI G plus-score's portfolios: Return test

		Select top 20%	Exclude bottom 20%	CSI 800 benchmark	Select top 20% excess return	Exclude bottom 20% excess return
Equally weighted	Monthly average return	0.92%	0.92%	0.87%	0.05%	0.05%

portfolios	t-value	1.53	1.58	1.53	0.48	1.24
Market capitalization-weighted portfolios	Monthly average return	0.60%	0.60%	0.46%	0.13%	0.14%
	t-value	1.09	1.13	0.99	0.49	0.83

7.3.2 CSI G plus-score index enhancement strategy: performance indicators

With respect to the performance indicators of the G plus-score index enhancement strategies (see Table 7.16), under both weighting methods, both the strategies of selecting the top 20% and excluding the bottom 20% stocks of the G plus-score yield higher annualized returns than the benchmark CSI 800. Furthermore, the positive screening strategy yields higher returns than the negative screening strategy.

It should be noted that under the market capitalization weighting method, the portfolios constructed by the G plus-score demonstrate better enhancement effects, where the annualized returns are obviously higher than the benchmark (CSI 800: 3.17%; select top 20%: 6.29%; exclude bottom 20%: 5.67%).

Similar to the results of the index enhancement strategy constructed by the CSI G-score (overall indicators), with the equal weighting method, the negative screening strategy of the G plus-score (constructed by the seven underlying factors of the CSI G-score) yields little difference in each performance indicator compared with the benchmark CSI 800, and it may also produce some excess returns. This once again strengthens the finding that using a negative screening strategy does not worsen returns, but rather has a positive enhancement effect.

Table 7.16: G plus-score: Equally weighted portfolio's performance indicators

	Annualized return	Volatility	Sharpe ratio	Maximum drawdown	Calma ratio	Information ratio	Tracking error
Select top 20%	9.77%	29.90%	0.3269	70.72%	0.1382	0.2243	4.16%
Exclude bottom 20%	9.60%	29.66%	0.3237	71.73%	0.1338	0.4699	1.50%
Equally weighted CSI 800	8.96%	29.26%	0.3062	71.59%	0.1252		

Table 7.17: G plus-score: Market capitalization-weighted portfolio's performance indicators

	Annualized return	Volatility	Sharpe ratio	Maximum drawdown	Calma ratio	Information ratio	Tracking error
Select top 20%	6.29%	28.02%	0.2246	70.78%	0.0889	0.3335	11.48%
Exclude bottom 20%	5.67%	27.54%	0.2060	72.17%	0.0786	0.3752	8.29%
CSI 800	3.17%	24.88%	0.1273	70.06%	0.0452		

Chapter 8 Conclusion

To echo the increasingly important trend of ESG investment and social responsibility, we focus on the Chinese A-share market, especially on the CSI 800 stocks, and conduct a comparison analysis of the mainstream ESG rating agencies. From a more comprehensive perspective, we primarily compare the logical frameworks and rating methodologies of the different raters.

We assess whether ESG scores are effective in stock selection through grouping tests of their portfolios in the whole market and within different sectors. Furthermore, we investigate the impact of ESG scores on corporate investment returns and risks. From a practical perspective, we also explore the construction of the CSI 800 ESG Smart Beta index enhancement strategy on the basis of variable control. These empirical attempts may serve as important references for future ESG investment in the Chinese market.

8.1 Research conclusions

1) **Comparatively, there are significant differences between the three Chinese ESG rating providers.**

We compare the similarities and differences of the logical frameworks of international and local rating agencies, and compare the underlying indicators of domestic rating agencies. In addition, we conduct a correlation analysis of the ESG ratings of the three major domestic agencies (the CSI, Wind, and SynTao Green Finance). We find that the correlation coefficients among them are significantly small, thus indicating that the rating systems and methods are significantly different.

2) **For the CSI ESG ratings, the CSI G-score demonstrates the best**

performance on the grouping test of the monthly average returns in the CSI 800.

Compared with the other ESG factors, the equally weighted long-short portfolio of the G factor performs relatively well, with a monthly average return of 0.61%, significant at the 90% confidence level.

The results of the equally weighted group backtest also show that the CSI G-score has the best overall performance. In terms of annualized returns and maximum drawdown, the CSI G-score shows good monotonicity from its low- to high-score groups. In contrast, the groups of the other ESG scores show less monotonicity, presenting comparatively poor performance.

Meanwhile, for the total ESG score, E-score, S-score, and G-score, all of their low-score groups perform worse in terms of annualized returns and maximum drawdown. Therefore, we deem a relatively high G-score as able to improve returns, and consider it to be more effective in generating excess returns when constructing portfolios using a single factor. Further analysis is required to confirm this.

3) **For the top 10 CSI sectors, the G-score is the top performer on the grouping tests in terms of delivering excess returns across five sectors.**

Compared with the other three factors, the CSI G factor demonstrates better excess return performance in five sectors (i.e., industrials, consumer discretionary, information technology, health care, and consumer staples). To some extent, this reflects the effectiveness and importance of corporate governance elements for these five sectors. Accordingly, higher corporate governance scores, such as on having a sound management system and a transparent evaluation system, may help companies in these sectors generate

excess returns.

It is worth noting that the CSI G factor can significantly affect the excess returns of the information technology sector, showing the best performance among all (return of G: 2.67%, t = 4.05). Given that the majority of information technology companies have relatively low ESG ratings and are still not ESG leaders in the industry (Egorova et al., 2022), there is much space for improvement.

4) **When exploring the revenue sources of ESG factors' long-short portfolios, the Fama–French five-factor model demonstrates a poor ability to explain the return of the G-score's long-short portfolio. This means that its excess return may be affected by other variables than the classical asset pricing factors. It is also found that SMB and RMW are significantly associated with the long-short portfolios' monthly average returns.**

The corresponding results demonstrates that the Fama–French five-factor model can only explain a small part of the return of the equally weighted CSI G factor's long-short portfolio ($R^2 = 0.31$). After removing the five factors from the time series, the CSI G-score remains effective, and only at this point is there a significant and positive excess return (alpha = 0.006, t = 2.08). This finding indicates that the G factor's long-short portfolio has some additional information that cannot be explained by the Fama–French five factors, compared with other factors. In this vein, the excess return of the G factor's long-short portfolio may be influenced by factors other than the classical asset pricing factors.

Nagy et al. (2016) made similar findings, indicating that a large portion of the excess returns of two strategies constructed from the MSCI's ESG data (i.e.,

the ESG tilt strategy and the ESG momentum strategy) cannot be explained by style factors and thus may be attributable to ESG factors.

In addition, the returns of the equally weighted long-short portfolios of the E, S, and ESG factors are significantly and negatively affected by SMB (i.e., the size factor), and RMW (i.e., the profitability factor) significantly and positively influences the returns of the ESG, S, and G factors' equally weighted long-short portfolios. This suggests that larger and more profitable firms, especially for the E and S factors, have correspondingly higher ESG scores, compared with smaller and less profitable comapnies. This is also shown by Melas et al. (2017), who found that larger firms, with more profits and more stable revenues, tend to have relatively better ESG scores.

5) **Based on the results of the Fama–French model regression, after controlling for market value and ROE separately and simultaneously, the G factor demonstrates relatively better performance.**

Under the equal weighting and market capitalization weighting methods, after controlling for market value, the G-score's low- to high-score groups show some monotonicity in terms of monthly average returns, especially in the small market value groups. After controlling for ROE, the monthly average returns of the G factor's groups still show some monotonicity; this effect is more obvious in the low ROE groups.

When controlling for both market value and ROE, the monthly average returns of the G-score groups generally exhibit poor monotonicity only in the groups with both high ROE and large market value. In other words, the financial market will value relatively smaller and less profitable enterprises with solid corporate governance at a higher price. These companies are expected to have

much potential to grow.

At the same time, under the market capitalization weighting method, some monotonicity in the ESG, E, and S factors' low- to high-score groups disappears when market value is small and ROE is low. Therefore, we suggest excluding stocks with low ESG-, E-, and S-scores, small market value, and low ROE simultaneously, to construct corresponding ESG investment portfolios.

6) **In the application of ESG factors, using equal weighting and market capitalization weighting to construct the CSI 800 ESG index enhancement strategy, the G-score demonstrates the best performance.**

In the CSI 800 ESG index enhancement strategy constructed by equal weighting, the CSI G-score's portfolio shows the best return performance. Only the equally weighted enhancement strategy constructed by excluding the bottom 20% stocks of the G-score generates significant and positive excess returns (return: 0.12%, t = 2.33), which indicates that the CSI G-score can generate excess returns in a relatively consistent way. Additionally, under the equal weighting strategy, portfolios screening the top 20% stocks and excluding the bottom 20% stocks of the CSI G-score both result in higher annualized returns and lower maximum drawdown compared with the benchmark CSI 800.

More importantly, we find a relatively small difference between the performance indicators in the enhancement strategy constructed through the equally weighted exclusion of the bottom 20% stocks of the G-score and the equally weighted CSI 800. This shows that the use of a negative screening strategy does not worsen returns, but instead has a certain positive enhancement effect.

Hill (2022) made a similar argument regarding negative screening in his

book *ESG in practice: From theoretical elements to sustainable portfolio construction*, reporting that 88% of studies offer neutral or uncertain results on actual fund returns, and that most of these funds use negative screening. While fund managers have been trying to generate better performance across a wide range of socially responsible investing (SRI) strategies, "they at least haven't lost money in the attempt" (Hill, 2022). Although this book focuses on the research field of funds, it also provides relevant insight, namely that negative screening strategies may have the advantage of not causing loss to investors to a certain degree.

To further validate these findings on negative screening strategies, we plan to extend the current ESG study to the Chinese fund market.

7) **Exploring the G-score's underlying indicators, we discover that seven factors are more effective in affecting stock returns. Using the seven underlying factors of the G-score (G plus-score), we then construct new CSI 800 index enhancement strategies. The results show that the portfolio screening the top 20% stocks performs better. The negative screening strategy also comes with an advantage: it does not increase investment costs.**

Combined with the above findings, the CSI G factor has better effects on the generation of excess returns and portfolio construction. Therefore, by further examining the data and underlying indicators of the CSI G factor, we find that seven bottom factors are more effective in influencing stock returns:

(1) Debt default

(2) Whether the type of audit opinion on the annual financial report is a "standard unqualified opinion"

(3) Whether the company has been publicly condemned by the exchange, publicly identified, or investigated and administratively punished by the SFC in the past year

(4) Pledge ratio 2

(5) Whether no dividend has been paid continuously for the past 3 years

(6) The exchange's scoring of the information disclosure of listed companies

(7) Current ratio (solvency)

Among them, only the last two indicators listed above positively affect stock returns; the other five factors negatively affect stock returns.

In the following step, by utilizing the seven underlying indicators, we construct the G plus-score. Under both weighting methods, we find that the portfolios screening the top 20% stocks and excluding the bottom 20% stocks of the G plus-score both lead to higher annualized returns compared with the benchmark CSI 800. Furthermore, the portfolio selecting the top 20% stocks of the G plus-score outperforms that excluding the bottom 20% stocks.

It is also worth noting that the difference between the performance metrics of excluding the bottom 20% stocks of the G plus-score and the benchmark CSI 800 is relatively small. This result again reflects that the negative screening strategy does not increase investors' costs and instead brings them some enhanced returns while satisfying their ESG preferences.

Based on the above findings, we can summarize the answers to the four research questions of this study:

(1) Based on the empirical results of the grouping tests, there is no significant positive impact of the CSI's total ESG score, E-score, or S-score on

stock returns; only the portfolio constructed by the CSI G-score can generate positive returns, although the significance level is limited.

(2) Therefore, we pay much attention to the G-score. By constructing the CSI G-score index enhancement strategy, we find that the negative screening strategy has a certain effect leading to significant and positive excess returns. In addition, the small differences between the indicators of its portfolio backtest and the benchmark CSI 800 suggest that this strategy does not worsen returns, but rather enhances overall returns.

(3) As analyzed by the Fama–French five-factor model, the impact of the CSI ESG ratings on stock returns is found to be mostly explained by the asset pricing factors. The Fama–French five factors only offer weak explanations for the returns of the G-score's equally weighted long-short portfolio; however, alpha (intercept) is significant.

(4) Similar to the results of the index enhancement strategies constructed by the CSI G-score, the findings of the self-constructed G plus-score (based on the seven underlying indicators) also indicate that both positive and negative screening strategies have positive effects on stock returns. Although the positive screening strategy has better return performance, the negative screening strategy also proves its advantage of not increasing investment costs.

8.2 Research implications

1) From a business perspective, we provide practical value. According to the empirical results, we find that although ESG scores do not generate significant and stable alpha, the individual G factor does have some value and negative screening strategies do not weaken returns. Thus, when we actually

select investable stocks, it is possible to exclude companies with poor ESG score or G-score performance, while overlaying other stock selection strategies to provide clients with products that can meet their ESG investment needs without affecting returns.

2) We enrich empirical ESG research on the Chinese market. In this study, we focus on the CSI 800 stocks, expand the sample size compared with current ESG research on the A-share stock market, increase the observation of industry sectors. At the same time, we break through the traditional ESG classification, directly using G-score underlying indicators, build a more focused and effective G-score portfolio strategy, and verify the impact of ESG ratings on A-shares (CSI 800), thus providing rich data and empirical results for further ESG research on the Chinese market.

8.3 Research outlook

8.3.1 Outlook for future investment in the Chinese market

1) ESG is closely linked to portfolio return risk.

In today's investment market, the ultimate investment objective is simplified to enhance returns and reduce risk. In reality, however, investors have always held value-based investment goals, such as avoiding companies that violate the law, commit financial fraud, or pollute the environment. From this point of view, ESG investment can reflect to some extent investors' pursuit of values that go beyond enhancing returns and reducing risk, through which investors can demonstrate support for the values of sustainable development and their belief in the benefits of ESG (CSI, 2021b). At the same time, the impact of risk will continue to grow, and ESG will be more closely linked to

portfolio return risk. The findings of the CSI's "Global ESG Investment Development Report in 2020" highlight the combined impact of ESG factors on listed companies through return and risk mechanisms, in which top ESG performers not only demonstrate better performance but also lower risk and higher market valuation (CSI, 2021a).

As a result, the value of ESG investments will steadily rise as the relationship between ESG factors and portfolio return risk becomes more evident, which will encourage more investors in the Chinese capital market to utilize the ESG strategy.

2) Increased interest in ESG investment among individual investors.

Today, institutional investors continue to focus on ESG investments; in addition, individual investors are becoming more focused on ESG. According to a report from the Morgan Stanley Sustainability Institute, 75% of individual investors and 86% of millennial investors show great interest in sustainable investing, maintaining these high proportions since 2015. Furthermore, the percentage of millennial investors who are "very interested" in sustainable investment has increased from 28% to 38% (Morgan Stanley, 2017).

Capturing the attention of young people and individual investors will undoubtedly lay the foundation for the continued development of sustainable investment in this era, and the importance of ESG investment as an investment direction will continue to increase as more and more young individuals participate in investment.

3) Further improvement in the applicability of the ESG rating system in the Chinese context.

With regulators promoting the construction of a "green financial system"

and support from the rapid development of China's ESG investment market, much remains to be explored in terms of more profound combinations of ESG rating systems and Chinese-specific characteristics. Such work could also facilitate the continued growth of ESG in the Chinese market.

As mentioned in Ping An's (2020) report "*ESG Investment in China,*" inconsistencies in ESG terminology remain, along with unclear references and incorrect disclosures, leading to the phenomenon of "greenwashing" (CFA Institute, 2021). Thus, necessary next steps include enhancing ESG data coverage, better unifying ESG industry terminology and measurement standards, and aligning with international market standards.

8.3.2 Robustness tests and extensions for future studies

1) Study limitations

We mainly focus on data from the A-share market over a relatively short period of data collection, which may negatively affect the validity of the results. According to Hvidkjær's (2017) literature review, many studies have based their inferences on a very short period, during which the results of measuring the returns have a weak statistical function. Specifically, some studies have used a period of less than 10 years; in shorter periods, the relevant results are associated with particular time points, such as the rise in oil prices and economic expansion.

2) Robustness tests for future studies

a. **Adjusting the sample size.** From the Chinese market, the sample size of the CSI 800 stocks, which is the focus of this study, could be replaced with two sample pools, namely the CSI 300 and CSI 500, while using the same grouping

test and examination methods based on the CSI ESG evaluation data beginning in 2017. The CSI 300 and CSI 500 datasets would accordingly provide validation results from different sample sizes, thus making the empirical results more robust.

b. **Adjusting the sample period.** By adjusting the sample period of the data and utilizing the same grouping test and examination methods, a new empirical study for the CSI ESG data could be started from 2018 to explore whether similar and robust results can be obtained.

3) Extensions for future research

a. **Breaking through the traditional classification of ESG and constructing a portfolio strategy based on the most effective underlying factors in ESG.** In this study, we mainly build G-score portfolio strategies based on the most effective G-score's underlying indicators. In the further step, we aims to challenge the traditional ESG classification and find the most effective underlying indicators among all ESG factors, to build ESG Smart Beta index enhancement strategies, thus positively improving investment performance and risk management capabilities.

b. **Focusing more on environmental factors (E).** We mainly focus on the impact of corporate governance factor (G) on corporate returns. Considering the ongoing green investment policies and positive international attention to the environment and climate, future research could focus more on the specific impact of environmental factors on the Chinese stock market, as done by Zhang et al. (2021), who emphasized the importance of research on environmental factors.

c. **Extending the study to the mutual fund market.** ESG research could be

extended to the mutual fund market. The characteristics of ESG funds could be illustrated to explore whether funds with better ESG practices can reduce the related downside risk.

d. **Focusing on ESG momentum factors.** As mentioned in some studies, ESG momentum factors may have a positive impact on corporate financial performance (Shanaev & Ghimire, 2022). We argue that ESG momentum can also be involved in portfolio construction in future research. Giese et al. (2019) also emphasized the financial value of ESG momentum. In addition, the integration of traditional factors (e.g., momentum and low volatility) with ESG can lead to both short-term performance benefits and fulfill the potential of ESG ratings to reduce medium- to long-term risk, which may facilitate further exploration of index enhancement strategies.

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Appendix 1

Comparison of the G-score's underlying indicators across raters

Major categories	**Subcategories**	**AMAC**	**CSI**	**Wind**	**SynTao GF**	**MSCI**	**Rayliant**
The SEC scope	Shareholder rights	(See financial indicators)	(See financial indicators)	(See financial indicators)		Shareholder	
	Directors and board of directors	1) Corporate strategy: ESG strategy concept, ESG strategy management, business strategy impact, and risk management strategy	Percentage of independent directors: number of independent directors, number of directors, and whether there is no objection	ESG committee; average tenure of board members (years), proportion of independent directors (%), percentage of female directors (%), number of board meetings (times), standard deviation of the age of directors and supervisors (years), number of audit committee meetings (times), number of meetings of the Remuneration Committee (times), number of meetings of the Nomination Committee (times), and average tenure of board members (years)	1) Independence of the board of directors 2) Board diversity	Board of directors	
		2) Board governance: Board structure, percentage of non-executive directors, percentage of independent directors, role of independent directors, and role of the board of directors					

Major categories	Subcategories	AMAC	CSI	Wind	SynTao GF	MSCI	Rayliant
	Supervisors and supervisory board	Role of the supervisory board		Number of supervisory board meetings (times)			
	Senior management and corporate incentives	1) Executive realizations (combined number of additions and reductions) 2) Executive turnover rate	Executive compensation incentives	Percentage of female executives (%) and shareholding of executives (%)	Executive compensation		
	Controlling shareholders, their related parties, and the listed company	1) Connected transactions (proportion of revenue and cost of connected transactions of major shareholders; examine conflict of interest) 2) Change of control	Whether there is no significant change, equity concentration (shareholding ratio of the largest shareholder) (%), and equity concentration (percentage of shares held by the top 10 shareholders) (%).	Total shareholding of the top 10 shareholders (%)			

Major categories	Subcategories	AMAC	CSI	Wind	SynTao GF	MSCI	Rayliant
	Stakeholder environmental protection and social responsibility	(See corporate disclosure)	(See corporate disclosure)				
Corporate information disclosure	Corporate governance report	Corporate governance disclosure quality, fair competition system, and behavior	Exchange's scoring of listed companies' disclosure	1) Corruption management systems and institutions 2) Whistleblower protection mechanisms 3) Training on corruption and bribery policies, etc. 4) Anti-corruption and bribery supervision of business partners 5) Anti-monopoly and fair competition management system 6) Business continuity management	1) Anti-corruption and bribery 2) Whistleblowing system	1) Business ethics 2) Corruption and instability 3) Anti-competitive behavior	1) Regulatory action 2) Monopoly avoidance
	Financial reports	1) Annual report audit opinion 2) Whether the annual report contains a detailed description of	1) Whether the financial report is published in a timely manner, the type of audit opinion on the annual financial report,	1) (Audit) "Standard unqualified opinion" 2) Change of accounting firm 3) "Standard unqualified opinion" on internal audit; 4) Change of internal audit	1) Tax transparency clarity 2) Information transparency	Accounting and auditing	Honesty in auditing and accounting

Major categories	Subcategories	AMAC	CSI	Wind	SynTao GF	MSCI	Rayliant
		the information disclosed and whether the report examines truthfulness, completeness, and timeliness	and whether it is a "standard unqualified opinion" 2) Exchange's scoring of information disclosure of listed companies	accounting firm			
	ESG report	Voluntary disclosure: social responsibility reports, ESG, and completeness of disclosure	1) Whether to disclose the social responsibility report 2) Performance: The company has disclosed the basis for the preparation of its social responsibility report or the reference standard for its preparation 3) Exchange's scoring of information		Information transparency		

Major categories	Subcategories	AMAC	CSI	Wind	SynTao GF	MSCI	Rayliant
			disclosure of listed companies				
Reflected effectiveness	Financial performance	1) Corporate governance exceptions: cash dividend rate (including free cash dividend rate), return on invested capital (ROIC), interest coverage multiple, non-recurring profit, and loss ratio 2) Shareholder returns: major shareholder liquidation (combined number of increase and decrease in holdings), shareholder return, and	1) Capital structure: current ratio (solvency) and gearing ratio (capital structure) 2) Financial quality: ACCRUAL, pledge ratio, goodwill to net assets ratio, money capital interest-bearing debt ratio, and R&D capitalization ratio 3) Shareholders: whether there are no	1) Related parties: amount of sales of products to related parties (RMB million); size of sales of products to related parties per million yuan of revenue (RMB million); amount of purchases of products from related parties (RMB million); size of products purchased from related parties per million yuan of revenue (RMB million); amount of funds provided to related parties incurred (RMB million); incidence of funds provided to related parties per million yuan (RMB million); scale of funds provided by related parties to listed companies (RMB million);		1) Salaries, dividends, benefits, etc. 2) Financial system instability 3) Tax transparency	1) Peers: less investment in "very high variable rate companies" (monopoly pricing) 2) Too much sales hype (large retail trade flows) 3) Too much leverage

Major categories	Subcategories	AMAC	CSI	Wind	SynTao GF	MSCI	Rayliant
		returns of small and medium shareholders 3) Upstream and downstream/debt: corporate credit relationship (accounts receivable/payable and turnover ratio) 4) Financial risk: debt ratio, pledge ratio of listed companies' equity, and goodwill value 5) Economic transformation: R&D investment	consecutive dividends in the past 3 years	and scale of funds provided by related parties to listed companies per million yuan (RMB million) 2) Shareholders: share pledge ratio (%)			

Major categories	Subcategories	AMAC	CSI	Wind	SynTao GF	MSCI	Rayliant
	Regulatory penalties	Whether penalized for disclosure, debt, and contract defaults	1) Whether they were publicly condemned by the exchange in the past year, whether they were publicly identified, and whether they were investigated and administratively punished by the SFC 2) The ratio of penalty amount for violation to business revenue in the past year				
	Controversial events	Violations	Debt default	1) News and opinions 2) Regulatory penalties 3) Lawsuits	1) Controversial business ethics events 2) Negative corporate governance events		

Appendix 2

Descriptive statistics of the Wind ESG ratings in the CSI sectors[1]

Wind	Mean	SD	Min	Max	Observations
Communication Services					
ESG	6.9500	1.2898	3.7100	9.5700	268
E	3.6157	3.6460	0.0000	10.0000	268
S	5.1771	2.4782	0.0000	10.0000	268
G	7.4019	1.1148	2.4500	9.6000	268
Industrials					
ESG	7.0184	0.9851	4.5000	9.8200	2,541
E	2.8303	2.9804	0.0000	10.0000	2,541
S	6.3774	1.8990	0.7200	10.0000	2,541
G	7.3789	0.8147	4.4800	9.6000	2,541
Utilities					
ESG	6.7503	1.0530	4.3800	9.2900	436
E	2.8293	2.5332	0.0000	9.2000	436
S	6.0637	2.4165	0.0000	10.0000	436
G	7.5711	0.8961	3.2400	9.3100	436
Financials and Real Estate					
ESG	6.7628	1.0507	3.2600	9.6900	1,860
E	3.8113	3.1044	0.0000	10.0000	1,860
S	5.1155	2.3554	0.0000	10.0000	1,860
G	7.6134	0.8820	2.7600	9.7300	1,860
Consumer Discretionary					
ESG	6.6711	0.8548	3.5900	9.6400	1,748
E	1.8936	2.4695	0.0000	10.0000	1,748
S	5.1753	1.8687	0.0000	10.0000	1,748
G	7.2539	0.9257	3.1900	9.6900	1,748
Energy					
ESG	7.2017	1.2394	5.0200	9.3900	332

[1] The samples for the top 10 CSI sectors are based on the overall historical records of the Wind.

E	4.2179	2.7839	0.0000	9.0100	332
S	6.8199	2.0816	1.6500	10.0000	332
G	7.5574	1.0641	4.6600	9.9400	332
Information Technology					
ESG	6.8529	0.8785	3.9000	9.5300	1,760
E	2.0635	2.4005	0.0000	10.0000	1,760
S	5.4519	1.9304	0.0000	10.0000	1,760
G	7.1720	0.8005	3.0000	9.5900	1,760
Health Care					
ESG	6.8879	0.8815	4.0300	9.3500	1,082
E	3.0179	2.8636	0.0000	10.0000	1,082
S	5.4629	1.6252	0.3200	9.8600	1,082
G	6.6999	0.9312	2.9400	9.3800	1,082
Materials					
ESG	6.6596	1.0726	3.5600	9.6700	1,886
E	3.2450	2.4845	0.0000	10.0000	1,886
S	5.5608	2.5255	0.0000	10.0000	1,886
G	7.2141	0.7602	2.7800	9.6800	1,886
Consumer Staples					
ESG	6.5026	1.1272	4.1400	9.3500	876
E	2.7562	2.7186	0.0000	10.0000	876
S	4.4771	2.4282	0.0000	9.8000	876
G	7.6006	0.8370	3.4100	9.7500	876

Descriptive statistics of the SynTao GF ESG ratings in the top 10 CSI sectors[1]

SynTao GF	Mean	SD	Min	Max	Observations
Communication Services					
ESG	55.0800	7.0711	47.2500	66.2500	151
E	54.5700	9.5952	44.7400	69.3700	151
S	62.2400	7.1184	51.5200	76.5200	151
G	47.7900	9.3969	37.0700	65.5200	151

[1] The samples for the top 10 CSI sectors are based on the overall historical records of the SynTao GF.

Industrials						
	ESG	49.0700	4.4506	36.8800	64.75	1,440
	E	47.9100	6.1229	34.9400	69.48	1,440
	S	53.0800	6.5073	23.9000	67.06	1,440
	G	45.6200	6.2427	32.5400	62.07	1,440
Utilities						
	ESG	50.8700	4.4955	43.0000	60.3800	243
	E	45.7500	5.7905	33.3300	56.1700	243
	S	57.0500	4.8901	51.5900	67.4600	243
	G	51.3100	5.3596	42.4100	62.5000	243
Financials and Real Estate						
	ESG	50.0100	5.9764	34.2500	61.88	1,037
	E	50.4200	8.1140	33.1200	67.86	1,037
	S	54.6800	7.3714	37.5000	72.79	1,037
	G	45.1400	6.0202	32.3800	65.58	1,037
Consumer Discretionary						
	ESG	48.4300	4.5072	40.1200	64.3800	995
	E	48.3800	6.8578	33.9700	71.1000	995
	S	52.3700	5.6095	40.4400	70.4500	995
	G	44.4300	6.4223	31.7500	67.8600	995
Energy						
	ESG	45.5000	5.7605	38.2500	52.7500	188
	E	39.7200	8.4885	29.3800	49.0500	188
	S	50.5100	4.6229	43.2800	57.9400	188
	G	48.1000	8.7007	34.9100	59.8200	188
Information Technology						
	ESG	50.5300	5.0899	40.0000	64.2500	997
	E	51.7900	7.5589	41.1400	78.8700	997
	S	55.1500	5.6842	43.9400	73.8600	997
	G	44.0000	5.8326	30.1600	54.7400	997
Health Care						
	ESG	50.4200	5.8259	41.8800	68.7500	605

	E	52.7400	8.1540	40.5100	82.3900	605
	S	53.6300	5.8882	38.2100	70.5200	605
	G	44.3500	6.8048	32.7600	59.6800	605
Materials						
	ESG	50.1900	6.1165	41.0000	71.0000	1,046
	E	49.3900	9.4214	33.1200	78.5700	1,046
	S	53.8800	5.9701	41.1800	70.1500	1,046
	G	47.0200	7.0213	31.7000	65.1800	1,046
Consumer Staples						
	ESG	40.2500	4.1606	40.2500	40.2500	490
	E	48.3000	8.3668	31.5800	31.5800	490
	S	52.2300	5.0872	40.1500	63.6400	490
	G	46.6800	6.6365	26.3400	57.1400	490

Appendix 3

CSI: Grouping test in communication services sector

		High	Group2	Group3	Group4	Low	High-Low
A: Equally weighted							
ESG-score	Monthly average return	-0.66%	-0.31%	-1.11%	0.23%	-1.35%	0.64%
	t-value	-0.66	-0.29	-0.84	0.16	-1.09	0.64
E-score	Monthly average return	-0.77%	0.10%	-0.36%	-1.33%	0.61%	-1.39%
	t-value	-0.68	0.10	-0.30	-0.97	0.43	-1.23
S-score	Monthly average return	-0.89%	-1.10%	0.63%	-0.58%	-0.55%	-0.49%
	t-value	-0.72	-0.89	0.53	-0.56	-0.42	-0.50
G-score	Monthly average return	-0.92%	-0.53%	-0.08%	-0.99%	-0.04%	-0.62%
	t-value	-0.86	-0.54	-0.07	-0.78	-0.02	-0.49
B: Market capitalization weighted							
ESG-score	Monthly average return	-0.61%	0.16%	-1.11%	0.93%	-1.02%	0.41%
	t-value	-0.56	0.14	-0.67	0.65	-0.72	0.32
E-score	Monthly average return	-0.49%	-0.06%	-0.51%	-1.09%	0.43%	-0.84%
	t-value	-0.35	-0.07	-0.38	-0.72	0.27	-0.55
S-score	Monthly average return	-1.01%	-1.05%	0.37%	-0.06%	-0.59%	-0.56%
	t-value	-0.77	-0.66	0.33	-0.06	-0.49	-0.52
G-score	Monthly average return	-0.82%	-0.33%	-0.43%	-0.17%	0.53%	-0.68%
	t-value	-0.74	-0.35	-0.35	-0.12	0.30	-0.35

CSI: Grouping test in industrials sector

		High	Group2	Group3	Group4	Low	High-Low
A: Equally weighted							
ESG-score	Monthly average return	0.39%	0.38%	0.50%	0.29%	0.20%	0.21%
	t-value	0.52	0.51	0.70	0.35	0.22	0.46
E-score	Monthly average return	0.38%	0.32%	0.16%	0.27%	0.76%	-0.39%
	t-value	0.49	0.45	0.21	0.34	0.80	-0.68
S-score	Monthly average return	0.38%	0.88%	0.35%	0.01%	0.13%	0.23%
	t-value	0.51	1.11	0.47	0.01	0.15	0.62
G-score	Monthly average return	0.40%	0.53%	0.45%	0.58%	-0.15%	0.57%
	t-value	0.58	0.69	0.58	0.68	-0.18	1.53
B: Market capitalization weighted							
ESG-score	Monthly average return	0.07%	0.55%	0.85%	0.48%	0.09%	0.00%
	t-value	0.10	0.75	1.18	0.60	0.10	-0.01
E-score	Monthly average return	0.46%	0.27%	0.22%	0.23%	0.84%	-0.41%
	t-value	0.65	0.35	0.35	0.29	0.84	-0.52
S-score	Monthly average return	0.27%	1.09%	0.29%	0.09%	0.25%	0.01%
	t-value	0.39	1.28	0.40	0.14	0.29	0.02
G-score	Monthly average return	0.21%	0.40%	0.67%	0.57%	0.24%	-0.05%
	t-value	0.26	0.53	0.91	0.72	0.29	-0.11

CSI: Grouping test in utilities sector

		High	Group2	Group3	Group4	Low	High-Low
A: Equally weighted							
ESG-score	Monthly average return	0.48%	0.53%	0.19%	1.08%	0.49%	0.08%
	t-value	0.52	0.42	0.19	0.96	0.38	0.10
E-score	Monthly average return	0.47%	0.53%	0.48%	0.62%	1.04%	-0.50%
	t-value	0.45	0.37	0.49	0.61	0.75	-0.76
S-score	Monthly average return	1.21%	0.78%	0.65%	0.05%	0.19%	0.90%
	t-value	0.98	0.72	0.58	0.04	0.21	1.07
G-score	Monthly average return	0.41%	0.33%	0.56%	1.31%	0.07%	0.23%
	t-value	0.39	0.36	0.49	0.93	0.07	0.31
B: Market capitalization weighted							
ESG-score	Monthly average return	0.95%	0.63%	0.07%	0.83%	0.87%	0.16%
	t-value	0.98	0.51	0.08	0.82	0.61	0.19
E-score	Monthly average return	0.28%	1.02%	0.91%	0.85%	0.82%	-0.45%
	t-value	0.32	0.73	0.86	0.83	0.62	-0.63
S-score	Monthly average return	1.11%	0.48%	0.61%	0.20%	-0.02%	1.02%
	t-value	1.35	0.53	0.57	0.17	-0.02	1.82
G-score	Monthly average return	0.57%	0.66%	0.47%	1.54%	-0.28%	0.77%
	t-value	0.57	0.70	0.48	1.05	-0.40	0.96

CSI: Grouping test in financial and real estate sector

		High	Group2	Group3	Group4	Low	High-Low
A: Equally weighted							
ESG-score	Monthly average return	-0.32%	-0.53%	-0.38%	-0.37%	-0.74%	0.38%
	t-value	-0.41	-0.66	-0.45	-0.39	-0.75	0.70
E-score	Monthly average return	-0.20%	-0.30%	-0.35%	-0.09%	-1.12%	0.91%
	t-value	-0.25	-0.35	-0.38	-0.09	-1.35	1.70
S-score	Monthly average return	-0.24%	-0.63%	-0.53%	0.07%	-0.97%	0.70%
	t-value	-0.31	-0.83	-0.65	0.06	-0.93	0.98
G-score	Monthly average return	-0.50%	-0.40%	-0.28%	-0.45%	-0.71%	0.21%
	t-value	-0.58	-0.50	-0.34	-0.51	-0.77	0.46
B: Market capitalization weighted							
ESG-score	Monthly average return	-0.08%	-0.57%	0.41%	-0.10%	-0.45%	0.32%
	t-value	-0.11	-0.91	0.46	-0.11	-0.58	0.53
E-score	Monthly average return	0.02%	-0.31%	-0.46%	0.19%	-1.26%	1.25%
	t-value	0.02	-0.49	-0.57	0.20	-1.50	1.70
S-score	Monthly average return	0.15%	-0.51%	-0.29%	0.24%	-0.75%	0.81%
	t-value	0.20	-0.71	-0.38	0.23	-0.99	1.19
G-score	Monthly average return	-0.28%	-0.37%	0.15%	-0.22%	-0.35%	0.07%
	t-value	-0.36	-0.52	0.20	-0.31	-0.39	0.13

CSI: Grouping test in consumer discretionary sector

		High	Group2	Group3	Group4	Low	High-Low
A: Equally weighted							
ESG-score	Monthly average return	-0.53%	0.80%	0.37%	-0.33%	-0.54%	0.06%
	t-value	-0.68	0.91	0.39	-0.39	-0.56	0.10
E-score	Monthly average return	0.24%	-0.46%	0.30%	-0.10%	-0.63%	0.54%
	t-value	0.26	-0.58	0.35	-0.12	-0.46	0.42
S-score	Monthly average return	0.02%	-0.44%	0.06%	0.44%	-0.31%	0.35%
	t-value	0.03	-0.52	0.08	0.54	-0.30	0.55
G-score	Monthly average return	0.61%	-0.46%	0.04%	0.19%	-0.54%	1.21%
	t-value	0.73	-0.54	0.05	0.19	-0.55	1.84
B: Market capitalization weighted							
ESG-score	Monthly average return	-0.27%	1.04%	0.41%	-0.09%	-0.42%	0.22%
	t-value	-0.32	1.07	0.38	-0.12	-0.46	0.26
E-score	Monthly average return	0.37%	-0.13%	0.58%	0.28%	-0.88%	1.00%
	t-value	0.40	-0.15	0.63	0.33	-0.61	0.67
S-score	Monthly average return	-0.14%	0.19%	0.55%	0.42%	-0.21%	0.12%
	t-value	-0.15	0.23	0.56	0.44	-0.21	0.14
G-score	Monthly average return	1.31%	-0.32%	-0.02%	0.02%	-0.24%	1.59%
	t-value	1.20	-0.37	-0.02	0.02	-0.27	1.62

CSI: Grouping test in energy sector

		High	Group2	Group3	Group4	Low	High-Low
A: Equally weighted							
ESG-score	Monthly average return	0.71%	0.45%	0.44%	0.13%	1.31%	-0.50%
	t-value	0.64	0.39	0.32	0.13	0.85	-0.42
E-score	Monthly average return	0.25%	0.61%	0.12%	0.65%	1.50%	-1.10%
	t-value	0.23	0.49	0.09	0.56	0.96	-0.91
S-score	Monthly average return	0.23%	0.84%	0.88%	0.88%	-0.19%	0.34%
	t-value	0.21	0.74	0.71	0.71	-0.16	0.55
G-score	Monthly average return	0.60%	0.18%	-0.55%	0.62%	1.71%	-0.94%
	t-value	0.51	0.17	-0.55	0.46	1.20	-0.74
B: Market capitalization weighted							
ESG-score	Monthly average return	1.12%	-0.73%	0.65%	0.31%	0.66%	0.47%
	t-value	1.03	-0.75	0.51	0.34	0.47	0.39
E-score	Monthly average return	-0.35%	0.11%	0.14%	0.09%	0.09%	-0.45%
	t-value	-0.33	0.11	0.12	0.10	0.07	-0.47
S-score	Monthly average return	0.49%	0.73%	0.43%	0.73%	-0.20%	0.57%
	t-value	0.45	0.60	0.42	0.66	-0.17	0.67
G-score	Monthly average return	0.49%	-0.17%	0.18%	0.38%	1.16%	-0.56%
	t-value	0.44	-0.21	0.16	0.28	0.81	-0.51

Grouping test in information technology sector

		High	Group2	Group3	Group4	Low	High-Low
A: Equally weighted							
ESG-score	Monthly average return	0.41%	0.51%	0.90%	0.40%	-0.53%	1.06%
	t-value	0.42	0.55	0.75	0.36	-0.43	1.76
E-score	Monthly average return	0.09%	0.24%	0.53%	0.12%	1.37%	-1.12%
	t-value	0.09	0.22	0.49	0.12	1.01	-1.54
S-score	Monthly average return	-0.04%	0.32%	0.46%	0.95%	0.06%	-0.01%
	t-value	-0.04	0.31	0.44	0.88	0.05	-0.02
G-score	Monthly average return	1.25%	0.95%	0.30%	0.41%	-1.33%	2.67%
	t-value	1.14	1.02	0.27	0.36	-1.12	4.05
B: Market capitalization weighted							
ESG-score	Monthly average return	0.09%	0.74%	1.26%	0.63%	-0.17%	0.33%
	t-value	0.08	0.72	1.06	0.51	-0.13	0.41
E-score	Monthly average return	0.13%	0.05%	0.76%	0.56%	0.86%	-0.57%
	t-value	0.12	0.04	0.64	0.55	0.58	-0.61
S-score	Monthly average return	0.13%	0.39%	0.70%	1.24%	0.41%	-0.28%
	t-value	0.11	0.33	0.62	1.14	0.33	-0.36
G-score	Monthly average return	0.27%	1.68%	0.19%	1.09%	-1.20%	1.58%
	t-value	0.26	1.46	0.16	0.88	-1.02	2.23

Grouping test in health care sector

		High	Group2	Group3	Group4	Low	High-Low
A: Equally weighted							
ESG-score	Monthly average return	0.04%	0.86%	0.54%	-0.45%	0.56%	-0.40%
	t-value	0.04	0.90	0.55	-0.51	0.50	-0.62
E-score	Monthly average return	0.30%	0.54%	0.18%	-0.36%	0.78%	-0.43%
	t-value	0.32	0.57	0.19	-0.41	0.73	-0.76
S-score	Monthly average return	-0.41%	0.76%	0.43%	0.64%	0.13%	-0.57%
	t-value	-0.45	0.76	0.45	0.62	0.14	-1.11
G-score	Monthly average return	0.11%	0.85%	0.46%	0.60%	-0.65%	0.89%
	t-value	0.13	0.98	0.50	0.51	-0.60	1.42
B: Market capitalization weighted							
ESG-score	Monthly average return	0.11%	1.11%	0.72%	-0.37%	0.86%	-0.60%
	t-value	0.11	0.96	0.66	-0.38	0.70	-0.72
E-score	Monthly average return	0.74%	0.52%	-0.21%	0.16%	1.16%	-0.37%
	t-value	0.74	0.48	-0.18	0.17	1.02	-0.54
S-score	Monthly average return	-0.47%	1.01%	1.11%	0.73%	0.44%	-0.97%
	t-value	-0.44	0.95	0.97	0.73	0.44	-1.57
G-score	Monthly average return	0.58%	0.38%	0.82%	1.30%	-0.59%	1.46%
	t-value	0.61	0.39	0.84	0.94	-0.46	1.53

CSI: Group testing in materials sector

		High	Group2	Group3	Group4	Low	High-Low
A: Equally weighted							
ESG-score	Monthly average return	0.32%	0.26%	0.46%	0.79%	0.84%	-0.48%
	t-value	0.34	0.25	0.50	0.75	0.82	-1.06
E-score	Monthly average return	0.28%	0.17%	0.98%	0.76%	0.56%	-0.26%
	t-value	0.30	0.17	0.89	0.76	0.59	-0.77
S-score	Monthly average return	0.30%	0.39%	0.72%	0.33%	0.87%	-0.52%
	t-value	0.31	0.46	0.75	0.28	0.82	-0.79
G-score	Monthly average return	0.48%	0.40%	0.42%	0.41%	1.01%	-0.43%
	t-value	0.50	0.44	0.42	0.44	0.84	-0.68
B: Market capitalization weighted							
ESG-score	Monthly average return	0.44%	0.08%	0.29%	1.08%	1.06%	-0.59%
	t-value	0.45	0.08	0.32	0.96	0.96	-1.12
E-score	Monthly average return	0.32%	0.06%	0.89%	1.01%	0.54%	-0.23%
	t-value	0.32	0.06	0.79	0.99	0.53	-0.44
S-score	Monthly average return	0.20%	0.65%	0.86%	0.36%	0.64%	-0.40%
	t-value	0.20	0.75	0.84	0.30	0.58	-0.52
G-score	Monthly average return	0.71%	0.38%	0.40%	0.38%	1.11%	-0.18%
	t-value	0.71	0.41	0.39	0.39	0.79	-0.22

CSI: Group testing in consumer staples sector

		High	Group2	Group3	Group4	Low	High-Low
A: Equally weighted							
ESG-score	Monthly average return	1.19%	1.13%	1.77%	1.21%	0.58%	0.62%
	t-value	1.12	1.13	1.69	1.06	0.54	0.79
E-score	Monthly average return	0.63%	1.12%	0.67%	2.01%	1.33%	-0.54%
	t-value	0.74	0.97	0.71	1.77	1.09	-0.66
S-score	Monthly average return	1.73%	1.68%	0.76%	0.34%	1.29%	0.39%
	t-value	1.41	1.59	0.68	0.33	1.29	0.39
G-score	Monthly average return	1.41%	0.86%	1.22%	1.99%	0.55%	0.87%
	t-value	1.34	0.82	1.07	2.17	0.49	1.15
B: Market capitalization weighted							
ESG-score	Monthly average return	1.45%	0.82%	2.15%	1.46%	1.41%	0.14%
	t-value	1.21	0.72	1.78	1.11	1.09	0.13
E-score	Monthly average return	1.37%	1.05%	-0.01%	2.37%	2.65%	-1.08%
	t-value	1.25	0.82	-0.01	1.82	1.84	-0.98
S-score	Monthly average return	1.64%	2.42%	1.94%	0.40%	1.05%	0.56%
	t-value	1.17	1.85	1.50	0.36	0.93	0.49
G-score	Monthly average return	1.58%	0.98%	2.26%	2.53%	1.81%	-0.20%
	t-value	1.43	0.77	1.79	2.11	1.38	-0.25

Appendix 4

CSI G-score's underlying indicators: Market capitalization-weighted grouping test

	Code		Low	High	High-Low
Exchange's scoring of information disclosure of listed companies	G214	Monthly average return	0.42%	0.51%	0.09%
		t-value	0.59	0.84	0.25
Current ratio (solvency)	G411	Monthly average return	0.24%	0.95%	0.75%
		t-value	0.36	1.29	1.41
Whether there is no material change in the report (1 is no material change)	G213	Monthly average return	-0.42%	0.48%	0.82%
		t-value	(0.39)	0.73	0.80
Monetary capital with interest property debt ratio	G425	Monthly average return	0.03%	0.40%	0.38%
		t-value	0.05	0.59	1.01
R&D capitalization ratio	G426	Monthly average return	0.11%	0.14%	0.05%
		t-value	0.18	0.20	0.12
Concentration of shareholding 1 (percentage of shares held by the largest shareholder) (%)	G311	Monthly average return	0.42%	0.57%	0.14%
		t-value	0.64	0.93	0.57
Percentage of independent directors: Number of independent directors/total number of directors	G111	Monthly average return	0.36%	0.62%	0.24%
		t-value	0.57	0.99	1.33
Concentration of shareholding 2 (percentage of shares held by the top 10 shareholders) (%)	G312	Monthly average return	0.37%	0.54%	0.14%
		t-value	0.52	0.87	0.35
Executive compensation incentive	G511	Monthly average return	0.29%	0.13%	-0.15%
		t-value	0.42	0.20	-0.33

ACCRUAL	G421	Monthly average return	0.43%	0.58%	0.16%
		t-value	0.74	0.83	0.53
Goodwill to net assets ratio	G424	Monthly average return	0.67%	0.28%	-0.37%
		t-value	1.10	0.42	-1.27
Debt-to-asset ratio (capital structure)	G412	Monthly average return	0.82%	0.32%	-0.50%
		t-value	1.20	0.50	-1.13
Pledge ratio 1	G422	Monthly average return	0.19%	0.11%	-0.04%
		t-value	0.30	0.14	-0.08
Pledge ratio 2	G423	Monthly average return	0.20%	0.19%	0.01%
		t-value	0.34	0.25	0.03
Whether the financial report is released in a timely manner	G211	Monthly average return	0.31%	0.19%	-0.12%
		t-value	1.57	0.31	-0.18
Whether the type of audit opinion on the annual financial report is a “standard unqualified opinion”	G212	Monthly average return	1.82%	0.94%	-1.01%
		t-value	1.50	1.12	-1.00
Whether the company has been publicly condemned by the exchange, publicly identified, or investigated and administratively punished by the SFC in the past year	G611	Monthly average return	0.19%	-1.14%	-1.30%
		t-value	0.31	-1.01	-1.46
Debt default	G613	Monthly average return	0.19%	-6.19%	-6.45%
		t-value	0.31	-3.22	-3.60