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Independent Study Progress Report
ESG Investing and Strategies

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ESG Investing and Sustainable Finance - A Review of Literature

Abstract

ESG (environment, social and governance) investing, an investing strategy combining both fundamental analysis and ESG performance, is growing exponentially as more investors and issuers utilize ESG and climate data as tools to support their portfolio selection. The perceived threat to economic, cultural and social activities has gradually risen people's awareness of sustainable financing strategies.

Consistent with the value investing principles forwarded by Warren Buffet, ESG investing and strategies have served as the focus for many scholars from home and abroad. In this report, I will review the basic literature on corporate social responsibility, sustainable finance, ESG ratings, impact investing, ESG investing strategies, DJSI 2020 sustainability assessment and ESG applications in fixed income investment.

Keywords: *ESG investing, sustainable finance, corporate social responsibility, value investing, DJSI 2020, fixed income investment, impact investing*

1 Corporate Social Responsibility

1.1 Definitions & Scopes

CSR (Corporate Social Responsibility) refers to the incorporation of ESG (environment, social and governance) factors into portfolio decisions, management, decision making, etc. ESG measures a multifaceted performance of a company's social responsibility by three dimensions:

- The Environment (E) dimension measures a company's impact on the natural ecosystem. It comprises a company's emission (e.g., harmful gases), pollution and waste (e.g., oil spills), efficiency in the usage of natural resources (e.g., water, coal, energy, materials), etc.
- The Social (S) dimension measures a company's relationship with its workforce, customers and society. Components including company's effort to maintain loyal workers (e.g., provide training and development, health care, safety measures), company's service to customers (e.g., produce satisfactory goods and services) and company's citizenship will all be taken into account.
- The Governance (G) dimension focuses on both wealth maximization of long-term shareholders (e.g., a well-functioning board, well-designed compensation policies) and protection of the rights of minorities (e.g., gender diversity, race, sexual orientation).

CSR, generally considered as a voluntary behavior, is beyond compliance (Vogel, 2005) and serves as a way of self-regulation (Calveras et al., 2007). To understand CSR with sufficient theoretical depth, we now look at the objectives of a firm.

1.2 The Objective of the firm

Do we care about firms' ESG performance simply because of the perceived threat from the environment to the economy and firm value? Is CSR consistent with firms' objective functions? The neoclassical economic paradigm considers CSR as unnecessary and inconsistent with profit maximization (e.g., Friedman (1970)). Friedman (1970) once argued that the only objective of the firm was profit maximization and firms should not be expected to voluntarily act in responsible for the society or environment. This division of corporate and government responsibility demonstrates the core opinion of the "classical dichotomy": market controls corporations and investors to pursue efficiency while the government corrects market failures and externalities that harm efficiency (Benabou & Tirole, 2012).

However, the most widely accepted view today states that corporations should be managed to maximize shareholder interest. Shareholders are residual claimants of a company's cash flows and care most about the value of the company (Fama & Jensen, 1983). Marquez (2015) also suggests that management can also give due regard to the interests of stakeholder groups, for stakeholders play an essential role in the company's whole supply chain.

CSR principles expect socially responsible firms to internalize the externalities they create. Consistent with the value investing principles forwarded by Warren Buffet, most scholars still consider CSR to be in accordance with value maximization rather than to sacrifice profits for

non-pecuniary preferences.

1.3 Different Views towards CSR

As ESG preoccupations become more and more ubiquitous in the money management industry, scholars turn to investigate how CSR affects the economy, shareholder wealth and stakeholder welfare. There are three different views towards CSR:

- Mutually beneficial situation
- Delegated philanthropy
- Insider-initiated corporate philanthropy

The most popular view held by the scholars describes a mutually beneficial situation for the company's shareholders, other stakeholders and the whole society, namely, "doing well by doing good". Companies can achieve superior financial performance by engaging in ESG strategies. Even though considering ESG may come at a cost in the short run, it is eventually a long-term investment that leads to long-term value maximization. For instance, a firm can develop costly environmental R&D (sacrificing short-term benefits) which can build up its reputation, attract socially conscious customers and avoid potential penalties in the future (promote long-term benefits). However, since CSR is generally beyond the scope of fundamental analysis, only well-performing firms can afford to invest in CSR (Kubik et al., 2012).

The second view takes CSR as a delegated exercise of prosocial behavior on behalf of stakeholders (Benabou & Tirole, 2010). Some stakeholders are willing to sacrifice money to achieve future social goals, for corporations can create positive externalities to an extent that stakeholders cannot achieve on their own as a result of coordination problems (Hart & Zingales, 2017).

The third view regards CSR as a manifestation of agency problems and other corporate governance issues. Corporate prosocial behavior at least partially reflects corporate insiders' desires to engage in philanthropy rather than stakeholders' willingness to sacrifice money for a good cause.

Based on the three views towards CSR, scholars have classified CSR into "strategic CSR", "pure altruistic CSR" and "CSR resulting from agency problems". For firm managers and institutional investors, their main focus lies in the financial performance (e.g., investment return and social value) of ESG investing. Whether outstanding ESG performance can effectively bring long-term significant return arouses people's interest.

1.4 Financial Performance

Orlitzky et al. (2003) reveal a positive correlation between CSP (corporate social performance) and CFP (corporate financial performance). Endrikat et al. (2014) compile 149 studies and conclude that CFP and CEP are generally positively linked (bidirectionally causal). Moreover, a meta-analysis of 60 review studies that combine more than 2200 unique primary studies conducted by Friede et al. (2015) documents that over 90% of academic studies indicate

a non-negative relationship between ESG and financial performance. The latest research conducted by Whelan et al. (2021) compiles 1000 studies published from 2000 to 2015 (245 corporate studies in total) which assess the link between ESG and financial performance. The results report positive (58%), neutral (13%) and mixed (21%) correlations that dominate the literature.

Since a large proportion of previous studies documents a positive correlation between ESG and financial performance, in what aspects can CSR achieve long-term value maximization? Conceptually, CSR engagement can enhance firm value through the following different channels:

1. Lower the weighted average cost of capital (Goss & Roberts, 2011; Koskinen et al., 2019; Tsang et al., 2011; Hoepner et al., 2016).
2. Lower the idiosyncratic risk and the probability of financial distress (Lee & Faff, 2009).
3. Generate a halo effect that may have an impact on valuation (Hong & Liskovich, 2016).
4. Build up social capital and trust and will be more resilient to potential market volatility (e.g., financial crisis) by controlling the downside risk (Servaes et al., 2017).
5. Insure the firm against rare environmental disasters or social malfunctioning (Wang et al., 2014).
6. Motivate employees leading to employee satisfaction (Edmans, 2012).
7. Gain reputation and obtain support from stakeholders (Deng et al., 2013).

After reviewing the financial performance of ESG investing, now we move to another important question, namely, how ESG performance is rated by different agencies?

2 ESG Measurements and Ratings

Various rating agencies have collected and integrated information of a company's ESG performance based on its own social responsibility reports, news items, third-party reports, interviews and questionnaires, etc. They use the information and design indicator systems which can yield an overall ESG score, as well as scores for individual components (E, S, G). Since different industries share different features over the behavior on environmental, social and governance dimensions, the ratings are generally adjusted for different industries.

There are currently some widely used ratings, including KLD (cover more than 3000 US companies), Dow Jones Sustainability Index (RobecoSAM), Bloomberg, S&P ESG Index and Trucost, MSCI Intangible Value Assessment, etc.

2.1 The Bias of ESG Ratings

Different companies within the same business sector generally have different ESG ratings. However, the measure of ESG performance of a given company may be biased (inconsistent with its actual performance). Three main reasons for the bias are given as follows:

- Industry: normalizing ESG ratings by industry can lead to oversimplifications.
- Size of the company: generally large corporations may receive better ESG reviews because they dedicate more resources and capital to develop ESG strategies and prepare ESG disclosures.
- Geography: different regions require different ESG disclosures, which may affect the ratings. Besides, firms in common law countries are proved to have much lower ESG scores than firms in civil law countries (Liang & Renneboog, 2017).
- Backward-looking: the ESG ratings are based on historical performance which may not reflect the company's current effort to improve its sustainability record.

2.2 Inconsistencies in ESG Ratings

Although many famous rating agencies listed above have developed their mature ESG rating systems, their rating results show inconsistencies in many aspects. The ESG scores for the same company can differ significantly with different ESG databases. The correlation of ESG ratings between Moody and S&P is around 0.99. However, the overall correlation between ESG ratings across different providers is only 0.3, raising wide concerns on the validity of ratings. The lack of a common definition of social responsibility and the lack of agreement on measuring metrics are the main reasons (Durand et al., 2016).

By decomposing ESG rating disagreement into measurement, scope and weights, the "measurement" divergence, scope divergence and weights divergence explain 53%, 44% and 3% of the total divergence separately (Rigobon et al., 2019). This surprising result indicates that only a small amount of rating disagreement results from different weights across different dimensions. How the agencies measure the details of ESG performance actually matters. Besides, the average correlation between six prominent ESG scores providers is less than 0.5 (Schmidt et al., 2019). Civil-law-based ESG data providers have different focuses on ESG scope measurements. For instance, they care more about social issues and protection while providers in common-law-based countries focus more on shareholders' rights.

In general, the current ESG measurements are potentially biased by country regulations, laws, industries, size, etc. Striking inconsistencies exist among ESG scores provided by different agencies. ESG characteristics need to be measured more accurately by focusing on real ESG investments and the agreements on measuring metrics among different agencies.

3 ESG Investing & Strategies

3.1 Development

The Global Sustainable Investment Review (2018) reports that over 30 trillion dollars were managed according to responsible investment criteria across the world in 2018. The Principles of Responsible Investing (PRI), the largest global network of institutional investors committed to considering ESG issues in their investment processes, had more than 2500 signatories with over 85 trillion dollars in AUM at the end of 2019, as shown in figure 1 below:

Figure 1. PRI Signature Institutions (source: 2020 ESG status report)

3.2 Sustainable, Responsible and Impact Investing

Institutional investors care the most about how ESG and sustainable finance affect asset prices and portfolio returns. The most common ESG investing strategies are:

- Negative screening: exclude "sin" stocks in the portfolio. Investors tend to avoid investing in firms that sell products such as tobacco, alcohol, weaponry, pornography.
- Positive screening: select companies that are meet above-average standards in ESG measurements, such as environment protection, human rights promotion or investment sustainability.
- "Transversal" screening: an active strategy that combines bost negative and positive screening (Roth et al., 2019).
- ESG integration: asset management companies should use a clear and systematic method to integrate ESG characteristics into traditional financial analysis or investment analysis.
- Direct engagement: shareholders actively participate in ESG activism through proxy voting and direct engagement.
- Sustainable investing and impact investing

Figure 2 below shows the investment scale with respect to different ESG strategies from 2012 to 2018:

Figure 2. ESG Strategies Scale (source: 2020 ESG status report)

	负面排除	ESG整合	股东参与策略	规范筛选	正面筛选	可持续主题投资	影响力投资
2012	8274	6176	4689	3038	1013	83	89
2014	12046	7527	5919	4385	890	137	101
2016	15023	10369	8365	6210	1030	331	248
2018	19771	17544	9835	4679	1842	1018	444

On the one hand, SRI fund creates a binding constraint on portfolio construction. Therefore we expect that the reduction in diversification will reduce the portfolio return. Besides, "sin" stocks generally can generate high returns if the low demand causes under-pricing (Hong & Kacperczyk, 2009). Investing in these stocks is considered riskier by investors so that a high return is expected to compensate for the risk. On the other hand, SRI fund may generate higher returns if market underestimates the impact of corporate ESG policies.

Renneboog et al. (2008) conclude that SRI funds do not generate higher expected returns (the alpha in asset pricing model is close to 0 or even negative). Several other studies also show that SRI funds returns do not differ significantly from that of conventional bonds. However, Wagner et al. (2019) conclude that even facing disappointing returns, investors in SRI funds do not withdraw their investments. In addition to financial returns, they receive "moral" or ethical dividends. Many investors value the sustainability criteria and are willing to forgo financial performance in order to invest in accordance with their social preferences.

3.3 ESG Factor Investing

While mach literature in corporate finance documents that specific aspects of CSR can generate value, literature in asset pricing has been less convinced about the ability to generating positive returns with ESG investing strategies. Hamilton et al. (1993) show that the performance of SRI funds is not significantly different from non-SRI funds. However, Renneboog et al. (2008) demonstrate that the market, size, value and momentum factors implied by the Fama-French factor model are not strongly correlated with the positive/negative screens. The Fama-French three factor model is shown below.

$$\hat{R}_{i,t} = \tilde{r}_{f,t} + \hat{\beta}_{j,m} \cdot \tilde{r}_{M,t} + \hat{\beta}_{j,s} \cdot \tilde{r}_{SMB,t} + \hat{\beta}_{j,h} \cdot \tilde{r}_{HML,t} \quad (1)$$

Therefore, an additional factor, namely, the ESG factor, should be added in the pricing model, which is indicated in formula (2).

$$\hat{R}_{i,t} = \tilde{r}_{f,t} + \hat{\beta}_{j,m} \cdot \tilde{r}_{M,t} + \hat{\beta}_{j,s} \cdot \tilde{r}_{SMB,t} + \hat{\beta}_{j,h} \cdot \tilde{r}_{HML,t} + \hat{\beta}_{j,E} \cdot \tilde{r}_{ESG,t} \quad (2)$$

Currently, there is still no consensus about ESG-based investing helps or hurt financial performance.

4 DJSI & CSA 2020 Corporate Sustainability Assessment

4.1 Background

S&P Global has purchased the asset management company RobecoSAM in Switzerland, indicating that S&P Global will take over the annual sustainability development research held by RobecoSAM. In 1999, S&P index department created the DJSI (The Dow Jones Sustainability Indices). The DJSI & CSA corporate sustainability assessment was therefore designed and covered more than 4700 listed companies. Serving as the main source of data that reports the sustainability performance of listed companies, DJSI uses questionnaires as the dominant way to collect ESG information from target companies and introduce professional third-party to do the verification.

The latest questionnaire was released on 2020.4.1. Target companies had four months to finish the assessment form and handed it in before 2020.7.30. S&P then used authentic media, temporary reports and direct interviews to do intersectional confirmation. The assessment result is updated **annually** based on the analysis and cross-validations. In this report, we briefly summarize how DJSI measures a company's ESG performance.

4.2 "E" Dimension Measurements

We first introduce the measurements with respect to the environmental dimension. All the questions below require specifying where this information is publicly available in the public reporting or corporate websites.

1) Environmental Reporting:
   - What is the coverage of your company's environmental indicators? (>75% or <50%)
   - What type of external assurance your company has received in relation to the reporting? (e.g., external audit, certain national rule)
2) Environmental Policy & Management System:
   - Is your company's environmental management policy publicly available?
   - How your environmental system (EMS) is certified/audited/verified?
   - Has your company paid significant fines or penalties to the ecology in the past periods?
3) Operational Eco-Efficiency:

- Provide your company's total direct gas emissions (DGHG scope1) from operations.
- Provide your company's total indirect gas emissions (DGHG scope2) from energy purchased and consumed.
- Complete the table for total energy consumption (non-renewable fuels, electricity purchased, steam/heating/cooling, etc)
- Provide company's total net freshwater extraction and consumption.
- Provide company's total solid waste disposed (not recycled, reused).
- Provide the data for direct emissions of NOx, SOx, SF6, dust, direct mercury, hazardous waste, ash and gypsum waste from operations.

4) Biodiversity:
   - Does the company have a publicly available commitment to maintaining biodiversity?
   - Has your company assessed its sites to determine what level of biodiversity importance exists on the land that is under your responsibility?
5) Climate Strategy:
   - Does the company provide incentives for the management of climate change issues?
   - How is your organizations' process for identifying, assessing and managing climate related issues into your overall risk management?
   - Have you identified any climate change risks or opportunities that have potential to generate substantial change in your business operations?
   - Does your organization use climate-related scenario analysis to inform your strategy?
   - Does your company has corporate-level climate-related targets?
   - ...

4.3 "S" Dimension Measurements

We now introduce the measurements with respect to the social dimension. All the questions below require specifying where this information is publicly available in the public reporting or corporate websites.

1) Social Reporting:
   - Is the coverage of your company's publicly available social reporting clearly indicated in the report or in the online domain?
   - What type of external assurance your company has received in relation to the reporting? (e.g., external audit, certain national rule)
2) Labor Practice Indicators:
   - What percent of your total employees are represented by an independent trade union?
   - What indicators do you use relating to equal enumeration?

3) Human Rights:
   - Do you have a publicly available policy in place for your commitment to respect human rights in accordance with the UN Guiding Principles?
   - Has your company developed a due diligence process to proactively identify potential impacts respecting human rights?
   - Has your company conducted an assessment of potential human rights issues?
   - Does your company publicly disclose its commitments and status of human rights?
4) Human Capital Development:
   - Provide the data related to training, development and internal mobility for the last fiscal year.
   - Provide two examples of employee development programs that have been developed to upgrade and improve employee skills.
   - Does your company have a metric to quantitatively measure the benefits from its investments linked to a specific employee development program?
5) Talent Attraction & Retention:
   - Provide the company's total and voluntary turnover rates for the last four years.
   - What is the percentage of actively engaged employees?
   - Does your company provide long-term incentives for employees below the senior management level?
6) Corporate Citizenship and Philanthropy:
   - What is the type of philanthropy activities your company has participated in?
   - Estimate the total monetary value (at cost) of your company's citizenship/philanthropy contributions.
   - Does your company have a group-wide strategy that provides guidance to your corporate citizenship/philanthropy activities?
7) Stakeholder Engagement

4.4 "G" Dimension Measurements

In the end, we introduce the measurements with respect to the social dimension. According to the literature, governance measurements contribute more than 60% to the overall ESG scores of the companies. All the questions below require specifying where this information is publicly available in the public reporting or corporate websites.

1) Corporate Governance:
   - Indicate the number of executive and non-executive directors on the board of directors.

- Is the board of directors headed by a non-executive and independent chairman or independent lead director?
- Does your company has a formal, publicly available board diversity that clearly requires diversity factors such as gender, race, nationality or cultural background?
- Indicate the number of women on your company's board of directors/supervisory board.
- How does your company ensure the effectiveness of your board of directors/supervisory board?
- Indicate the average tenure of board members on your company's board of directors.
- Does your company has predefined financial returns or financial metrics relevant to the CEO's variable compensation?
- Do your company's CEO and other executive members hold company shares?
- ...

2) Materiality:
   - Has your company conducted a materiality analysis to identify the most important material issues?
   - Does your company publicly disclose details of the materiality analysis?
3) Risk &Crisis Management:
   - Indicate which departments are responsible for enterprise risk management.
   - Does your company perform sensitivity analysis and stress testing on a group level?
   - Indicate two long-term emerging risks that your company identifies as having the most significant impact on the business in the future.
   - What strategies does your company pursue in order to promote effective risk culture?
4) Codes of Business Conduct:
   - Which of the following conducts (corruption, discrimination, whistleblowing, etc.) are covered by your codes of conduct at a group level?
   - Which of the following aspects are covered by your anti-corruption and bribery policy?
   - What mechanisms are in place to assure effective implementation of your company's codes of conduct?
   - Indicate the number of substantiated cases of corruption and bribery in the past four fiscal years.
5) Customer Relationship Management:
   - Does your company monitor and set quantitative targets to improve customer satisfaction?
6) Policy Influence:

- Indicate the annual total monetary contributions spending for political campaigns, organizations, trade associations, etc.

7) Supply Chain Management:
   - Does your company have a supplier code of conduct and is it publicly available?
   - Does your company have a formalized process in place to identify potential sustainability risks in the supply chain?
8) Information Security/Cybersecurity:
   - Are the board of directors and executive management engaged in the information security/cybersecurity strategy and review process?
   - ...
9) Innovation Management
10) Market Opportunities
11) Privacy Protection

5 ESG Applications in Fixed Income & Equity Investment

In this part, we will review the "fixed income investor's guide" and "equity investor's guide" published by the UN PRI. The two reports give sufficient suggestions on how to pursue sustainable investing in the fixed income field as well as the equity investing field. We first list the six principles forwarded by UN PRI:

- Incorporate ESG issues into investment analysis and decision-making process
- Integrate ESG issues into ownership policies and practices
- Require investment institutions to appropriately disclose ESG information
- Promote the acceptance and implementation of PRI principles by the investment industry
- Establish a cooperation mechanism to improve the effectiveness of the implementation of PRI principles
- Report the activities and progress of the implementation results

5.1 ESG in Fixed Income Investment

Fixed income investors are typically represented as asset owners, such as pension funds, insurance companies and fixed income asset management companies. For fixed income investors, the first, second, third and the last principle above are most important. This type of investor focuses more on long-term stable profits rather than short-term returns. How to effectively control the downside risk and protect their principal amount are the major concerns. Financial crises are the largest threats to the bondholders.

Therefore, instead of worrying about the variations in stock price, they care more about economic situations, macroscopic policies and long-term effects. As reviewed in the previous section, ESG investing strategies can eventually lead to long-term value maximization even with some costs at the beginning. Hence, fixed income investors should actively integrate ESG strategies into their decision-making process. The following figure shows some features of fixed income investing and the corresponding responsible investing strategies.

Figure 3. PRI Fixed Income Investment (source: fixed income user's guide)

固定收益投资的特征	责任型投资行动
潜在的下行风险比获利机会更为重要——与增长机遇相比，要更关注风险、低波动性和资本保值。	要关注 ESG 因素对财务下行风险的贡献，尤其是可能影响发行人信用的重大事件风险和系统性风险。其中最突出的问题应该是治理问题。
贷款人与借款人之间属于契约关系；他们并不是所有者。债务持有人不会在年度股东大会上投票，与管理层的接触并不频繁。	- 要管理风险，请利用任何机会就关注的 ESG 因素与发行人沟通（例如处于发行前的准备阶段）。 - 与其它债券持有人展开合作，以便进行更加有效的参与。 - 在债务重组大会上对治理议题进行投票。
多层分析（例如收益率差价和收益曲线分析）。	制定强大而精简的流程，帮助分析师高效识别并管理 ESG 风险。
多种发行人类型（如企业、政府、金融行业和多国组织）。	针对不同发行人采用不同的ESG 分析；指标、加权标准和参与方式会有所不同。并没有放之四海而皆准的标准。
多工具（如结构性产品和 ABS）。	分析与 ESG 相关的发行人信用风险和低偿资产集合和发起人风险。
- 作为公共或私人工具发行的债务。 - 作为投资级别或高收益证券发行的债务。	RI 方案会根据 ESG 信息、参与机会、投资者影响和与管理层的接触而改变。私人/高收益证券可能会存在较高的风险，但提供了参与和做出超凡业绩的机会。
不同的资本结构水平 — 高级、次级、混合式等。	相比于优先债持有人，次级债持有人会更早面临财务下行风险，使得他们对 ESG 风险的影响更加敏感。
债务工具有固定的期限，有效期各不相同。	考虑不同的有效期是否会影响 ESG 对信用的重要性（例如碳排放立法对三年期和十年期债券的影响是否一样？）。

First of all, incorporate ESG into issuers' analysis. ESG information helps asset owners to analyze the credit of issuers other than some fundamental analysis. For different types of issuers, the analytical process is different.

(1) For government bond issuers, asset owners need to conduct sovereign bond analysis. In this case, the measuring scope for environment, social and governance is broad (including water shortage, natural disasters, human rights, corruption, etc.).

Figure 4. Sovereign Bond Analysis (source: fixed income user's guide)

环境	社会	治理
碳强度	人口统计学	机构监管力度
水资源紧缺	教育和人力资本	贪污腐败
能源资源和管理	健康水平	政权稳定性
自然灾害	政治和新闻自由	法治
生态承载力和生态系统质量	人权	财务报表
污染	劳动标准	监管效力
生物多样性	社会排斥	遵守公约
农业	收入不平等	国际关系

For these issuers, the difficulty lies in how to measure these macroscopic dimensions accurately. Neuberger Berman (2013) conducted sovereign bond analysis and reached the following result. In a simplified version of the evaluation system (one environmental indicator, five social indicators and nine governance indicators), the scores are as follows.

Figure 5. Neuverger Berman's Ratings (source: fixed income user's guide)

		环境	社会					治理								
								法律			政治	经济				
	ESC 得分	能源强度	政府效率	监管质量	政治稳定性和安全性	公民话语权与问责机制	法治	贪污腐败	人类发展	经商容易度	政治和选举日程	资金来源	银行业风险评估	银行业资产质量	市场估值	贸易开放程度
香港	85.7	100	84	87.5	66	86.6	60.3	80.7	77	98.9	100	100	80	94.5	99.5	90.9
新加坡	84.9	86.1	93.1	86.5	70.2	85	46.3	83.9	87	99.4	80	100	80	89.5	99.1	90.9
智利	76.3	96.4	73.5	80.8	59.3	74.2	71.2	77.4	72	81.7	80	85	70	77.8	90.1	59.7
台湾	75.3	99.7	73.4	73.3	64.9	86.8	67.5	70.8	61	86.1	90	70	60	96.9	99	84.9
韩国	71.3	42.8	74.6	69.1	53.9	86.9	64.2	70.2	56	95	100	70	70	83.4	94.8	74.4
卡塔尔	68.5	47.6	66.7	58.8	70.2	76.2	30.8	65.5	68	77.8	70	100	60	82.4	82.5	67.8
马来西亚	67.9	45.9	70	63.2	52.6	67	41.1	60.4	49	92.2	100	90	60	79.4	99.1	89.2
以色列	67.5	87.6	74.1	77	28.4	85.7	63	69.6	60	80	80	60	60	73.6	82.9	50.7

The results indicate that Turkey is a country with good economical fundamentals, but a declining performance in ESG. Argentina is having a high level of inflation by its ESG behavior.

(2) For local government bond issuers, the scope on different dimensions is much narrower. In this case, the measuring scope typically covers the unemployment rate, social median income, education level of voters, and public infrastructure in some places.

(3) For multinational bond issuers, the focus lies in the return, for the risk is generally low.

(4) For corporate bond issuers, the governance factor of an enterprise is directly related to its credit capacity. Scandals such as fraud and bribery will directly lead to bankruptcy and affect the company's liability. For different industries, the measuring scope for ESG is different. For instance, water resources are only crucial to certain industries and airline companies are more concerned about fuel efficiency and low carbon emissions.

The second focus is to apply ESG screening for different issuers. Below are some typical standards used for applying screening process when conducting the issuers' analysis.

Figure 5. ESG Screening (source: fixed income user's guide)

筛选方法	企业标准	政府标准	金融行业标准
道德/声誉筛选	收入源自： - 烟草 - 有争议的 武器 - 核能 - 色情文学 - 武器 - 博彩 - 酒精 - 动物测试	- 遵守关于 人权和 环境议题的 国际标准 （参见下文） -资金使用 惩罚	- 在企业标准（左侧） 下，列出了 融资业务或 所有权活动 - 在企业标准（左侧） 下，列出了 ABS融资业务活动的发起 - 掠夺性贷款 - 激进避税 计划或 咨询工作
规范、标准和国际法律	- 非法活动 - 出口控制 - 国际 劳工组织 公约 - 联合国全球契约 标准 [14]	- 贸易禁令 - 美国、欧盟、联合国 制裁 - ILO 公约 - 人权 公约 - 蒙特利尔议定书 - 京都议定书 - 世界治理 指标 - 渥太华条约 （禁止杀伤人类地雷） - 集束弹药公约 (CCM)	- 出口控制 - 揭发者政策 - 合规 - 社区 再投资法案（美国） - IFC 绩效 标准 - 赤道原则 - 国际 制裁

Overall, fixed income investors are encouraged to use ESG screening (positive/negative) and impact investing strategies to integrate ESG consideration in the decision-making process. Since the relationship between the lender and the borrower is merely a contractual relationship, bondholders tend not to use active strategies such as ESG integration or direct participation.

5.2 ESG in Equity Investment

For equity investors, the main work is to incorporate ESG factors into the stock analysis. Fund managers and institutional investors need to know how to apply ESG integration. The buy-side needs to know how ESG factors are priced while the sell-side needs to use ESG analysis to satisfy the need from the buy-side.

To apply ESG strategy into equity investment, there are four steps in total:

- ✓ Qualitative analysis
- ✓ Quantitative analysis
- ✓ Decision making (increase, decrease or hold the principal)
- ✓ Ownership evaluation (communication and voting, use additional information to guide future investment)

We focus on how to transform financial indicators from financial statements, investment information platforms and other information (step 1) into different investing strategies (step 2).

First of all, for **fundamental analysis**, we can adjust indicators (revenue, cost, book value, capital expenditure) or pricing models (DCF, DDM, APV) according to ESG impact. ESG factors can be quantitatively incorporated into the valuation model. Beta and discount rates can also be adjusted according to ESG performance.

Second, for **quantitative strategies**, quantitative fund managers can take ESG factors into consideration together with factors such as value, size, momentum, growth, and volatility. They

can improve stock selection strategies, take the correlation between ESG ratings and returns into account and strengthen the predictive risk models. There are two commonly used strategies to use the ESG factor: 1. Reduce the weight of stocks with poor ESG performance. 2. Adjust the weight of each stock in the portfolio based on the statistical correlation between the ESG and other factors.

Third, for **smart beta strategies**, adjust the weights of the portfolio based on ESG scores, strengthen the combined ESG risk response capabilities and reduce downside risks.

Fourth, for **index enhancing strategies**, track an ESG-adjusted index portfolio or integrate the ESG factor into other active components.

Statistical Analysis on ESG Ratings

Abstract

Many rating agencies in China have designed their unique ESG indicator systems. Hua Zheng ESG ratings, covering all A-share listed companies, will be the focus of this report. Besides, Harvest Fund provides a comprehensive ESG ranking for over 95% of A-share listed companies. This report will display the statistical results of the distributions of the ratings. Comparison between Hua Zheng and Harvest Fund will be made based on the distributions and correlations.

The discrete ESG rankings (from “AAA” to “C”) provided by Hua Zheng do not follow an approximately normal distribution, while the continuous ESG ratings by Harvest Fund tend to be normally distributed. Both rankings show a positive correlation with the market value factor (total/circulate). Hua Zheng ESG ratings also display a positive correlation with earnings ratio (e.g., EPS).

However, Hua Zheng ESG ratings display a significant correlation (>0.3) within the environmental, social and governance dimensions, raising the concern of information overlap. Harvest Fund ratings, on the other hand, do not display a significant correlation within the three dimensions, indicating relatively good complementarity for ESG measurements. The two ratings also show discordance regarding the same industry. Which rating agency can provide the most convincing ESG rankings still remains obscure.

Keywords: *ESG investing, sustainable finance, Hua Zheng ESG ratings, Harvest Fund ESG ratings, statistical analysis*

6 Statistical Analysis of ESG Ratings

6.1 Hua Zheng ESG Ratings

6.1.1 Background

Aiming to objectively measure the positive externalities produced by firms, Hua Zheng ESG ratings use the comprehensive rating methodologies from S&P Trucost for reference and construct a modified version considering the features of the Chinese stock market.

Serving as the only rating agency that covers the ESG performance of all A-share listed companies (more than 4000 listed companies), Hua Zheng has provided the ESG ranking of the target firms for 12 years. The rankings are updated **quarterly** based on new information from social responsibility reports (23%), authentic media (12%), regular or temporary reports (55%) and supervision department (10%). Hua Zheng rating agency treats different industries with different ESG rating systems and combines the unique features of each industry with its ESG indicator system.

6.1.2 Indicator System

Hua Zheng ESG ratings use a comprehensive indicator system with 3 first-level indicators, 14 second-level indicators, 26 third-level indicators and over 70 bottom-level indicators. Some of the second-level indicators are listed as below:

- Environment: internal management system, operational purposes, green products, external authentication, historical defaults
- Social: institutional system, operating activities, social contributions, external verification
- Governance: institutional system, governance structure, operating activities, operational risks, external risks

With a modified weighted average calculation system, Hua Zheng ESG ratings have been documented as an effective indicator for factor returns, risk warning and downside risk aversion.

6.2 Data Processing

6.2.1 Sample data

The data of Hua Zheng ESG ratings are selected from Wind Terminal. The ratings cover a range from grade C to AAA (nine grades in total) based on a company's evaluated governance, environmental and social performance. To analyze the statistical distributions, the ratings are

replaced by digits 1-9, with 9 representing the highest rank “AAA” and 1 representing the lowest rank “C”.

6.2.2 Data Manipulations

Although Hua Zheng ESG ratings cover more than 4000 A-share listed companies, many historical rankings for different companies are missing due to ineffective ESG disclosure in the Chinese stock market. Many small and medium-sized companies do not actively disclose their social responsibility reports. Much ESG information has not been updated for several evaluation periods. Therefore, this report only focuses on the distribution of the latest ESG ratings (i.e., 2021.1.31). After filtering all the data with missing values, there are 4167 stocks remaining with available ESG ratings, “E” ratings, “S” ratings, “G” ratings and other basic indices including total market value, circulation market value, PE, EPS, SPS and CPS.

7 Statistical Analysis

7.1 Total Distributions

The following figures display the statistical distributions of ESG scores, E scores, S scores and G scores of all A-share companies (4167 stocks after cleaning) in the Chinese stock market:

Figure 6. Distribution of total ESG Scores

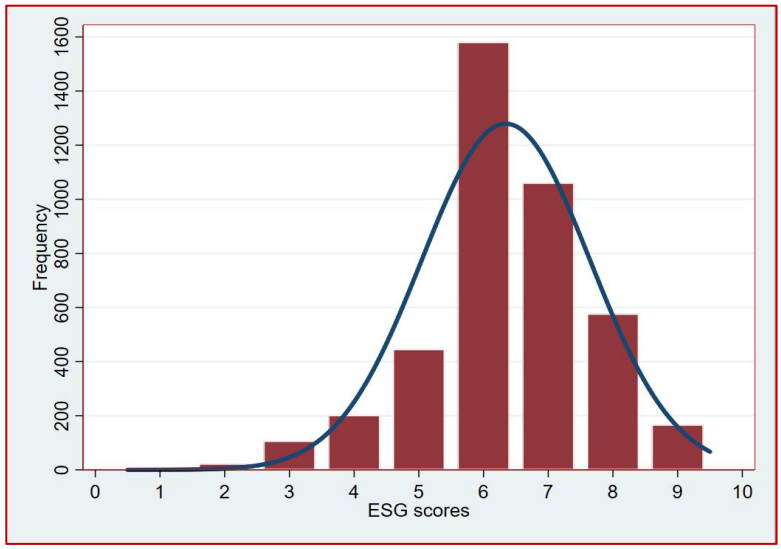
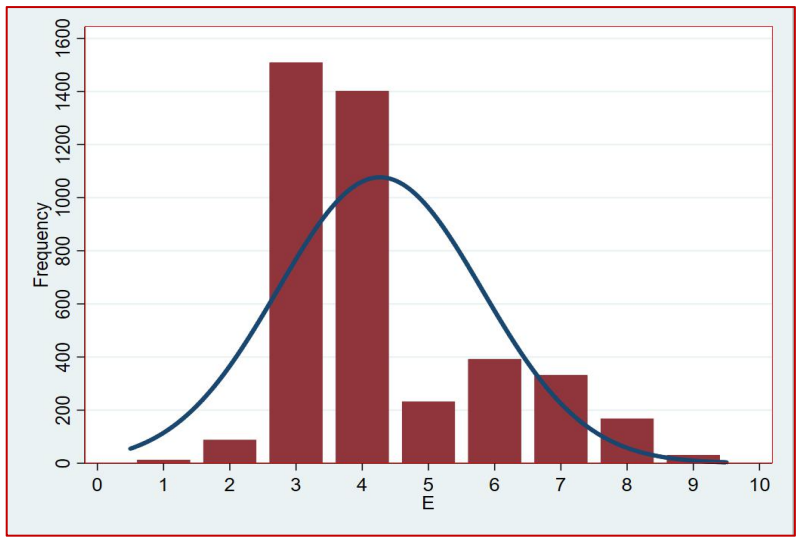


Figure 1 describes the distribution of ESG scores of all 4167 target stocks. The blue line is the fitting normal kernel density line implemented by Stata. As revealed in the graph, the overall distribution for ESG score is left-skewed. Most A-share listed companies get an overall ranking of “A” and “BBB”. The mean score is around 6.345. Therefore, we hypothesize that the overall

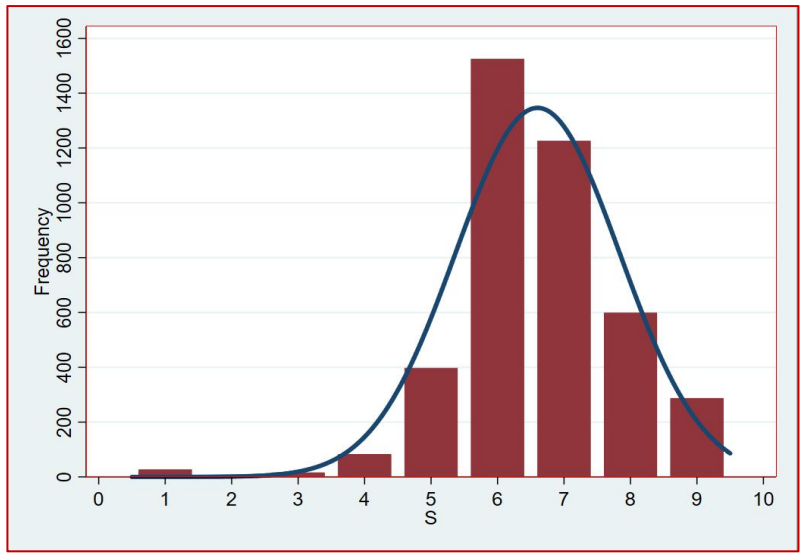
ESG scores of the listed companies do not follow an approximately normal distribution.

Figure 7. Distribution of "Environment" Scores



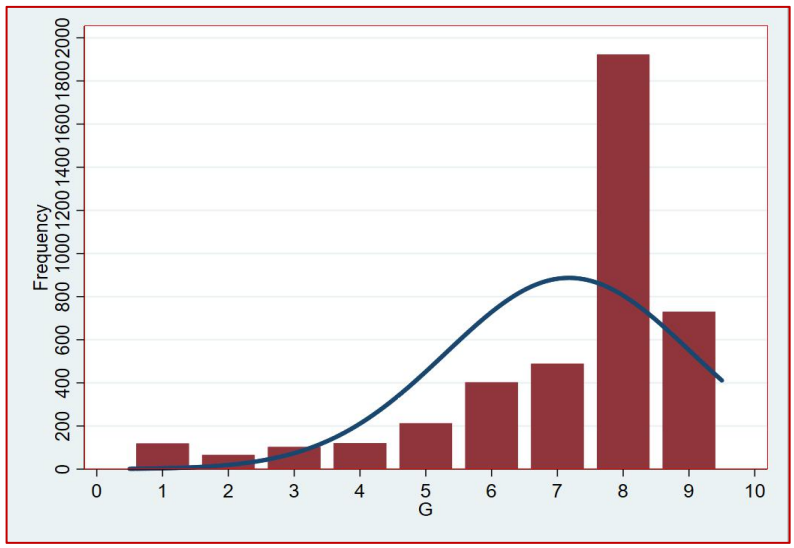
The majority of target companies obtain a low score in the environment dimension. Over 2500 listed A-share companies only get a ranking of "B" and "CCC". The mean score is only 4.268.

Figure 8. Distribution of "Social" Scores



The mean score of the social dimension is around 6.60, indicating that most companies perform relatively well in institutional systems, donations, poverty alleviation, etc.

Figure 9. Distribution of "Governance" Scores



Over 2000 listed companies have achieved a ranking of "AA" and above in the governance dimension. The kernel density function shows a kurtosis much larger than standard normal distributions (kurtosis = 5.419).

The descriptive statistics of ESG, E, S, G rankings are displayed in the following table:

Table 1. Descriptive Statistics of E, S, G and total scores

Variables	Obs	Mean	Std. Dev.	Min	Max	p1	p99	Skew.	Kurt.
rank	4167	6.345	1.3	1	9	3	9	-.445	3.742
E	4167	4.268	1.544	1	9	2	8	1.066	3.294
S	4167	6.603	1.235	1	9	3	9	-.503	5.253
G	4167	7.176	1.875	1	9	1	9	-1.674	5.419

7.2 Tests for Normality

The next step is to rigorously verify the hypothesis that the overall ESG, E, S, G scores do not follow an approximately normal distribution. Using the implemented Shapiro-Wilk W Test and Skewness/Kurtosis Test in Stata, the results are given as follows:

Table 2. Shapiro-Wilk W Test for Normal Data

Variable	Obs	W	V	z	Prob>z
ESG scores	4,167	0.988	28.037	8.696	0.000
E	4,167	0.926	169.323	13.388	0.000
S	4,167	0.972	63.439	10.827	0.000
G	4,167	0.868	304.828	14.922	0.000

Table 3. Skewness/Kurtosis Tests for Normality

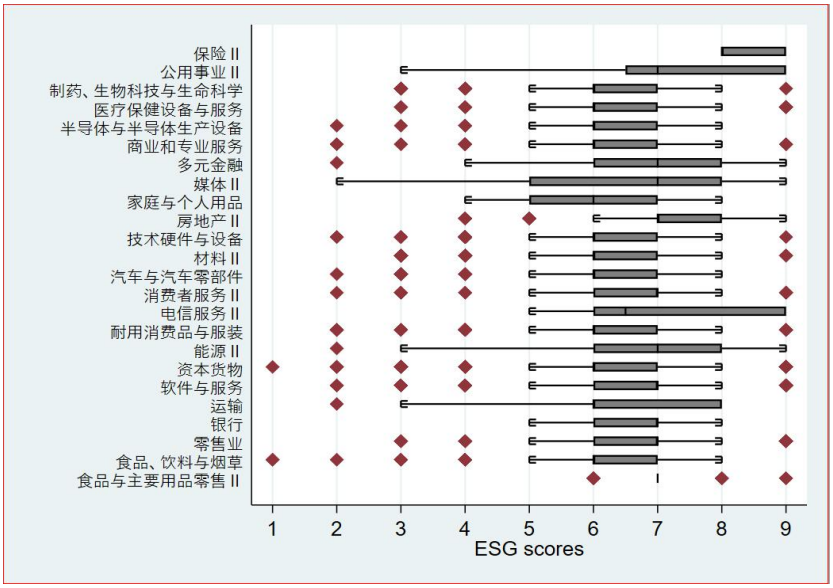
Variable	Obs	Pr(Skewness)	Pr(Kurtosis)	adj_chi2(2)	Prob>chi2
rank	4,167	0.000	0.000	.	0.000
E	4,167	0.000	0.001	.	0.000
S	4,167	0.000	0.000	.	0.000
G	4,167	0.000	0.000	.	0.000

Hence, the null hypothesis that the overall ratings follow an approximately normal distribution is rejected at a 1% significance level since the P-values given by both tests are smaller than 0.001.

7.3 Industry Distribution

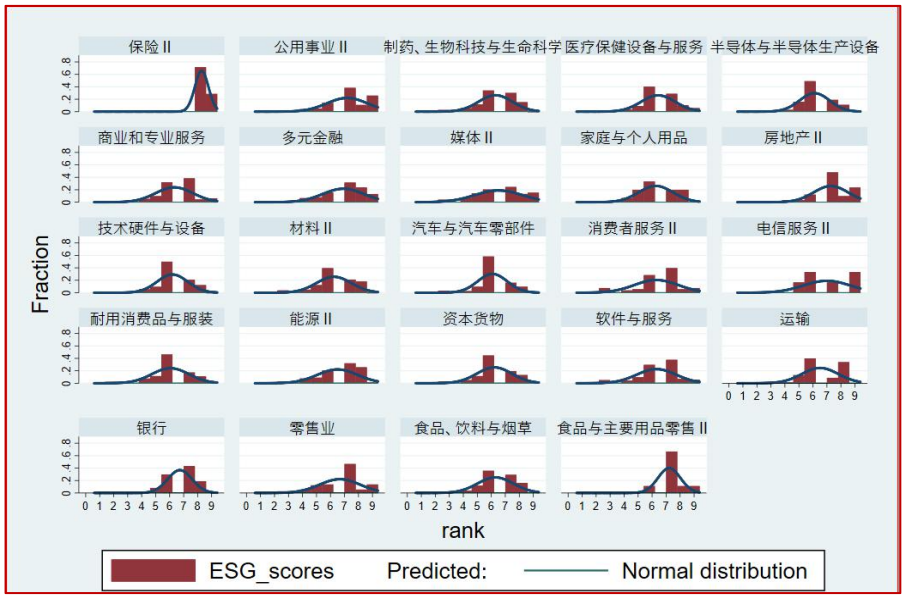
Since Hua Zheng rating agency designs different indicator systems for different industries, the next focus will be the ESG ratings classified by industries. Wind Terminal provides 24 kinds of industries in total to classify all the A-share listed stocks. To study the behavior of the outliers, we first construct the box plot of overall ESG scores in different industries (the independent E, S, G scores box plots are attached in the appendices):

Figure 10. Industry ESG Scores Box Plot



Most of the industries have outliers (extreme points) that affect the overall industry ESG performance. However, insurance, banking, public services industries have relatively balanced ESG scores without the existence of extreme points. To gain insights into whether the overall ESG scores within the same industry follow an approximately normal distribution, histograms corresponding to different industries are constructed as figure 6:

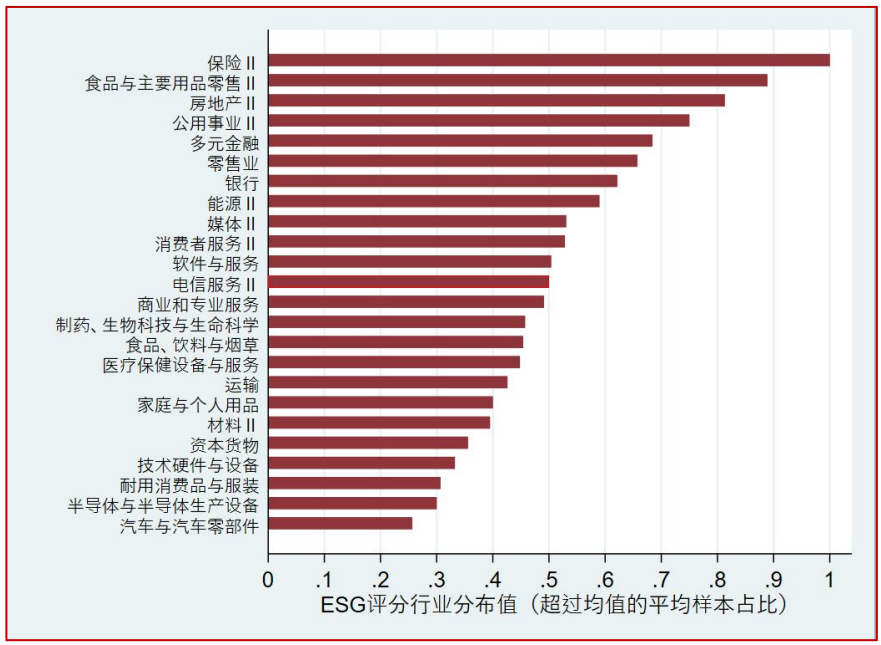
Figure 11. Industry ESG Scores Histograms



As expected, the overall ESG scores for 24 industries do not follow approximately normal distributions. By the visualization results, a possible guess is that the insurance industry behaves the best among all other industries, for all the companies in the insurance industry have achieved a rating of "AA" and above).

After visualizing the distributions, the next focus is the industry distribution index which is defined as the proportion of each industry that exceeds the overall average performance. The industry distribution indices of ESG scores are displayed as follows:

Figure 12. Industry ESG Scores Ranking



The insurance industry holds the first place as expected, for each company in insurance industry obtains an overall score of "AA" and above, which is beyond the average level. Other industries including food and supplies retail, real estate and diversified finance have relatively high industry distribution indices than over industries. However, less than 40% of the companies in auto parts, semiconductor, durable consumer goods and technique hardware industry exceed the average ESG performance.

The following figures are industry distribution indices for components E, S, G, scores respectively.

Figure 13. Industry Environment Scores Ranking

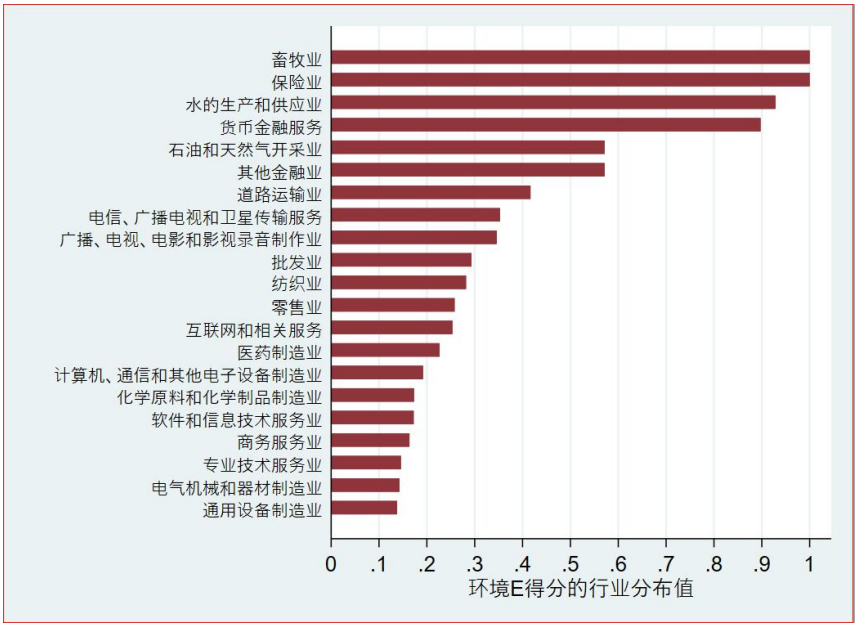


Figure 14. Industry Social Scores Ranking

Figure 15. Industry Governance Scores Ranking

Animal husbandry, insurance, water supply and monetary finance industry perform well in environment dimension, while information technology, business service and electricity industry perform the worst among 24 industries by Wind.

Retailing, insurance, wholesale and monetary finance industry perform well in social dimension, while animal husbandry, broadcasting and electricity industry perform the worst among 24 industries.

Textile, insurance, professional skills and water supply industry perform well in governance dimension, while monetary finance, animal husbandry and internet industry perform the worst among 24 industries.

Therefore, we conclude that insurance industries have an overall best performance in ESG among all other industries.

7.4 Correlation with other Factors

Market values (total or circulation market value), price-earnings ratio, earnings per share are all important factors that investors care the most about when conducting the fundamental analysis. To calculate the correlation between ESG rating indices and these factors, we first calculate the Spearman correlation coefficients between these factors in each cross-section. Then use the arithmetic average of all cross-sections to get the average value as output.

The results are given in Table 4 below. OPS and NPS represent operating income per share and net cash flows from operating activities per share. We use the trailing twelve months value for measuring EPS and PE.

Table 4. Spearman's Rank Correlation Coefficients

Variables	E	S	G	ESG	Tol	Cir	PE	EPS	OPS	NPS
E score	1.000									
S score	0.480	1.000								
G score	0.359	0.287	1.000							
ESG score	0.592	0.613	0.794	1.000						
Total_mar	0.301	0.292	0.291	0.374	1.000					
Cir_mar	0.299	0.291	0.288	0.371	0.998	1.000				
PE	-0.094	-0.064	0.125	0.065	0.089	0.089	1.000			
EPS	0.069	0.095	0.331	0.309	0.424	0.426	0.145	1.000		
OPS	0.004	0.154	0.266	0.245	0.270	0.270	0.011	0.556	1.000	
NPS	0.063	0.105	0.236	0.234	0.331	0.332	0.036	0.526	0.473	1.000

The correlation between ESG scores and E, S, G scores are high (>0.59), for overall ESG scores reflect weighted average performance of the environmental, social and governance dimensions. Besides, there exists a certain positive correlation (coefficients>0.28) between ESG, E, S or G scores and market value (total/circulate), as indicated in the table. This result is consistent with the common sense that the larger the firm value, the more the firm invests in ESG strategies, the better ESG performance the firm will have. ESG scores also show some correlations with EPS, OPS and NPS, indicating that the earnings may have positive effects on ESG performance. Moreover, there is no significant correlation between ESG scores and PE ratio.

However, we notice that the correlation among environmental, social and governance scores are high (generally higher than 0.3). It raises the concern that there may exist information overlap within the measures of the three different dimensions. The three indices may not have satisfactorily high complementarity as expected. Since the ratings provided by Hua Zheng only cover 9 discrete different numbers, the boundary between different ranks may be obscure. The rankings may also be less effective than continuous ratings designed by S&P Trucost.

8 Harvest Fund ESG Ratings

8.1 Background

As one of the leading mutual funds devoting to integrating ESG strategies into the Chinese stock market, Harvest Fund signed the contract of UN PRI in 2020. Harvest Fund got an A+ rating in “strategy and governance” in the evaluation report released by UN PRI. Similar to Hua Zheng, Harvest Fund has developed a mature ESG rating system for Chinese stock market.

Unlike the discrete ratings provided by Hua Zheng, Harvest Fund offers a continuous ranking with grades from 0 to 100, covering around 97% of all A-share listed companies (over 4000 companies). The rankings are updated based on new information from social responsibility reports, authentic media, regular or temporary reports, supervision department and other industrial associations. Harvest Fund uses machine learning and natural language processing to crawl data, conducting data manipulations and update the ESG ratings on a **monthly** basis.

Harvest Fund ESG ratings use a comprehensive indicator system with 3 first-level indicators, 8 second-level indicators, 23 third-level indicators and over 110 bottom-level indicators. Some of the indicators are shown in the following figure:

Figure 16. Harvest Fund ESG Indicators

表 1：嘉实 ESG 评分指标体系

3 个主题	8 个议题	23 个事项
环境	环境风险暴露	地理环境风险暴露、业务环境风险暴露
	污染治理	气候变化、污染物排放、环境违规事件
	自然资源和生态保护	自然资源利用、循环和绿色经济
社会	人力资本	员工管理和福利、员工健康和安全、人才培养和发展、员工相关争议事件
	产品和服务质量	产品安全和质量、商业创新、客户隐私和数据安全、产品相关争议事件
	社区建设和贡献	社区建设、供应链责任
治理	治理结构	股权结构和股东权益、董事会结构和监督、审计政策和披露、高管薪酬和激励
	治理行为	商业道德和反腐败、治理相关争议事件

资料来源：Wind、招商证券

8.2 Comparison with Hua Zheng ESG Ratings

Unlike Hua Zheng ESG Ratings, Harvest Fund ESG data follows an approximately normal distribution. Despite the existence of left skewness in governance score, environmental and social scores both follow an approximately normal distribution.

Figure 17. Harvest Fund E, S Scores Distribution

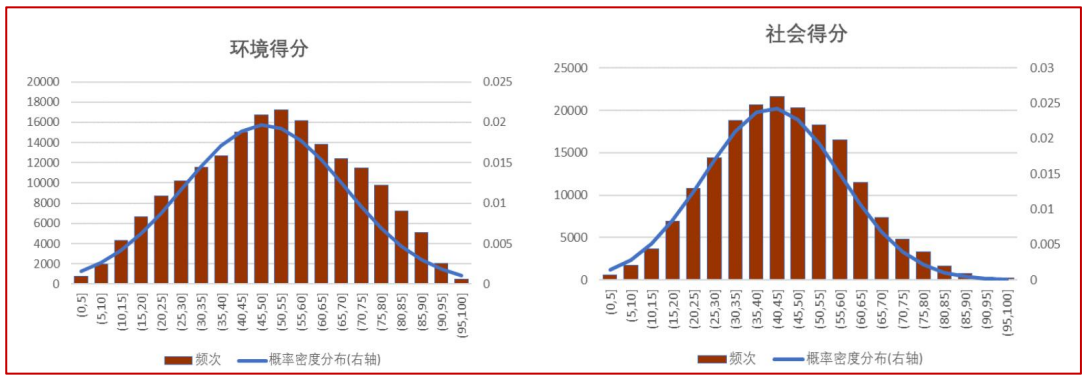
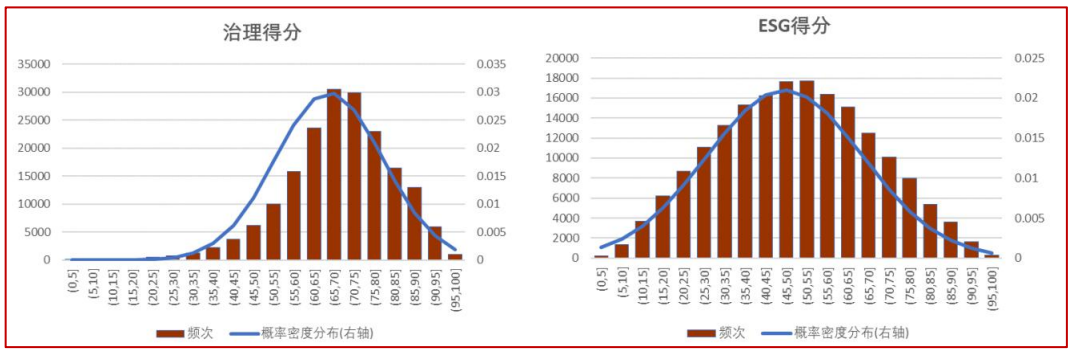


Figure 18. Harvest Fund G, ESG Scores Distribution



The following figures show the industry distribution indices calculated by Harvest Fund ESG ratings, using an industry classification from China Securities Regulatory Commission.

Figure 19. Harvest Fund Industry Ranking of E, S

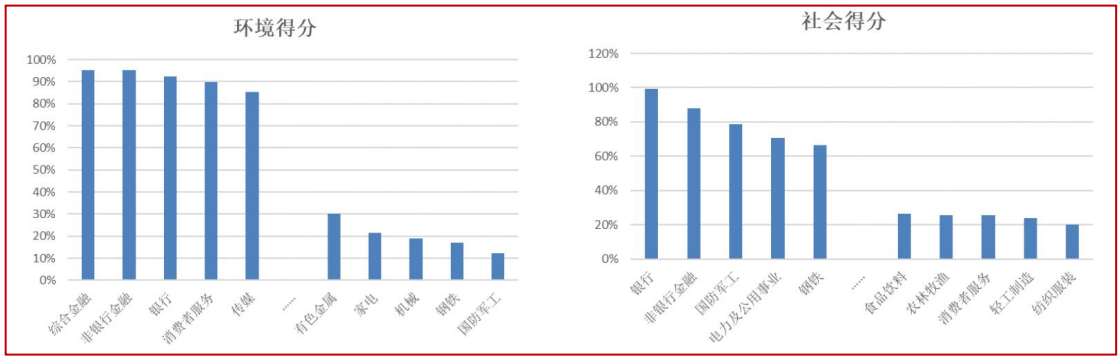
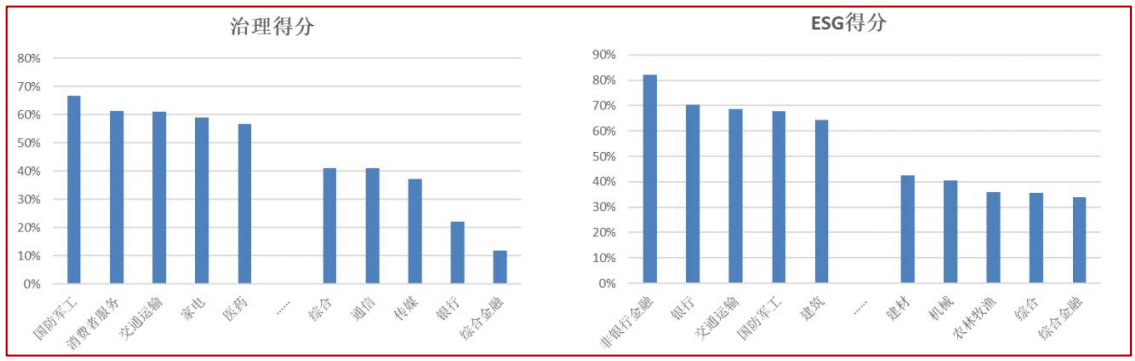


Figure 20. Harvest Fund Industry Ranking of G, ESG



As shown in the figure, comprehensive finance, bank and non-banking finance industry have relatively good performance in environmental dimension. Mechanical industry and military industry behave the worst among all other industries. Overall, the bank and non-banking finance industries have outstanding performance in all dimensions. However, in Hua Zheng ESG ratings, insurance industry dominates other industries with respect to all the ratings. There exist inconsistencies in the ranking between Hua Zheng and Harvest Fund.

The following table displays the Spearman correlation coefficient between the ratings and circulate market value. The calculation methods are exactly the same as the methods introduced previously.

Table 5. Factor Correlation Coefficients for Harvest Fund

Variables	E score	S score	G score	ESG score	Cir_mar
E score	1.000				
S score	0.007	1.000			
G score	0.011	0.162	1.000		
ESG score	0.316	0.620	0.774	1.000	
Cir_mar	0.120	0.345	0.271	0.393	1.000

The correlation between ESG scores and E, S, G scores are high (>0.3), for overall ESG scores reflect weighted average performance of the environmental, social and governance dimensions. Besides, there exists a certain positive correlation (coefficients>0.12) between ESG, E, S or G scores and market value (total/circulate), which is consistent with the results obtained by Hua Zheng ESG ratings.

However, the correlation within ESG, E, S and G scores are low, indicating a good complementarity between the measures of different dimensions. Generally, ESG ratings provided by Harvest Fund display more comprehensive results than Hua Zheng.

Although the ratings offered by Harvest Fund do not cover all A-share listed companies, the rankings are in continuous type and are widely recognized by institutional investors. Harvest Fund still provides comprehensive ESG information with high-frequency updates. Besides, some empirical studies document that the ESG ratings can effectively generate alpha return by integrating into certain quantitative strategies.

Many rating agencies in China have designed their own ESG indicator systems. However, the average correlation between these ratings is lower than 0.2, which means that different rankings show large inconsistencies to each other. Which agency can provide the most convincing ratings still remains obscure. The ESG measurements in China still require a long way ahead.

9 Independent Study Conclusions & Future Work

Throughout this semester, I have gained a multifaceted understanding of ESG development in China and the world. Most of my daily work is reading academic papers, research reports and write personal reflections. Due to space limitation, this report only partially shows what I have done in the past 4 months, including a literature view on ESG and some statistical analysis on ESG rating data. Besides, I have finished weekly reports on AuM Statistics summary, DJSI 2020 corporate sustainability assessment, pension fund and sovereign fund in America, ESG

integration in equity investments and fixed income investments, etc. I have collected data of the ownership structure for all mutual fund companies in China, the data for state-owned mutual fund enterprises in America, social responsibility reports or declarations of mutual fund companies for binary regression (which may contribute to the 2021 status report), etc. If you are interested in checking my weekly reports, feel free to contact me or Dr. Jiang Pingping.

After gaining a broader insight in the ESG development and status, the next step this summer is to focus more on the statistical analysis of ESG performance. Institutional investors and managers all care the most about whether good ESG performance will lead to long-term value maximization (i.e., “doing well by doing good”) as verified in the literature. The first task this summer is to assist Dr. Jiang on the “2021 status report - ESG Investing in China Asset Management Industry”, which is to be finished by September. I can try to help develop some particular questions for mutual fund managers and collect relevant data. The second task this summer is to focus more on empirical tests (e.g., how ESG factor can be implemented into quantitative strategies, how ESG factor performs in generating excess return). I can review some case studies about how to use ESG information to pick stocks, how to control downward risk and do some backtracking. I will focus on my coding skills and modeling skills throughout this summer. Hopefully I can gain more insights into ESG strategies very soon.

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Appendix A: Code (Partially)

Code for analyzing ESG Ratings: (Stata)

```
cd "D:\ESG-Project RA\reading paper"
clear
import excel "D:\ESG-Project RA\reading paper\华证 ESG 评级数据.xlsx", sheet("Sheet1")

drop in 2
rename (A B C D E F G H I J K L M N O P)(code name date rank hist_rank E S G total circulate PE EPS SPS CPS
class1 class2)
egen miss = rowmiss(rank)
drop if miss
gen order = _n //生成一列索引列
codebook rank
codebook E
codebook S
codebook G
replace rank="9" if rank=="AAA"
replace rank="8" if rank=="AA"
replace rank="7" if rank=="A"
replace rank="6" if rank=="BBB"
replace rank="5" if rank=="BB"
replace rank="4" if rank=="B"
replace rank="3" if rank=="CCC"
replace rank="2" if rank=="CC"
replace rank="1" if rank=="C"
replace E="9" if E=="AAA"
replace E="8" if E=="AA"
replace E="7" if E=="A"
replace E="6" if E=="BBB"
replace E="5" if E=="BB"
replace E="4" if E=="B"
replace E="3" if E=="CCC"
replace E="2" if E=="CC"
replace E="1" if E=="C"
replace S="9" if S=="AAA"
replace S="8" if S=="AA"
replace S="7" if S=="A"
replace S="6" if S=="BBB"
replace S="5" if S=="BB"
replace S="4" if S=="B"
```

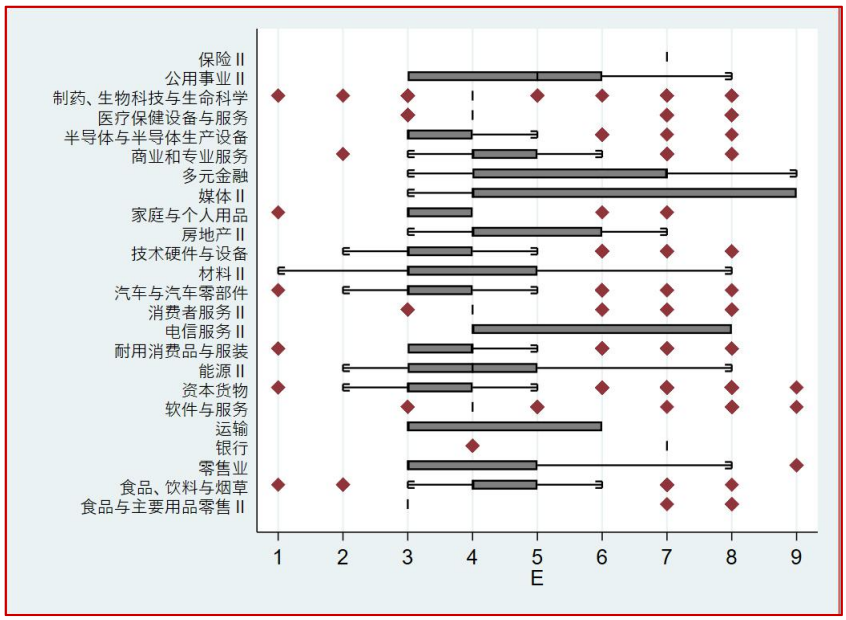
```
replace S="3" if S=="CCC"
replace S="2" if S=="CC"
replace S="1" if S=="C"
replace G="9" if G=="AAA"
replace G="8" if G=="AA"
replace G="7" if G=="A"
replace G="6" if G=="BBB"
replace G="5" if G=="BB"
replace G="4" if G=="B"
replace G="3" if G=="CCC"
replace G="2" if G=="CC"
replace G="1" if G=="C"
destring rank E S G total circulate PE EPS SPS CPS, replace
//analyze total ESG scores
codebook rank
asdoc summarize rank, detail, save(table.doc)
asdoc summarize E, detail, save(table.doc) append
asdoc summarize S, detail, save(table.doc) append
asdoc summarize G, detail, save(table.doc) append
//box plot
graph hbox rank, over(class2) capsize(5)
graph hbox E, over(class2) capsize(5)
graph hbox S, over(class2) capsize(5)
graph hbox G, over(class2) capsize(5)
hist rank, frequency discrete ///
normal ///draw histogram
legend(label(1 "Monthly_return") label(2 "Kernel Density") label(3 "Normal distribution") ///
order(1 - "Predicted:" 2 3) cols(2))
hist E, frequency discrete ///
normal ///draw histogram
legend(label(1 "Monthly_return") label(2 "Kernel Density") label(3 "Normal distribution") ///
order(1 - "Predicted:" 2 3) cols(2))
hist S, frequency discrete ///
normal ///draw histogram
legend(label(1 "Monthly_return") label(2 "Kernel Density") label(3 "Normal distribution") ///
order(1 - "Predicted:" 2 3) cols(2))
hist G, frequency discrete ///
normal ///draw histogram
legend(label(1 "Monthly_return") label(2 "Kernel Density") label(3 "Normal distribution") ///
order(1 - "Predicted:" 2 3) cols(2))
hist rank, fraction by (class2) discrete ylabel(0(0.2)0.8) xlabel(1(1)9) ///
```

```
normal kdensity kdenopts(bwidth(200) color(navy)) width(0.8) vertical color(maroon)    ///draw histogram
legend(label(1 "ESG_scores") label(2 "Normal distribution") ///
order(1 - "Predicted:" 2) rows(1))
asdoc swilk rank, save(table2.doc)
asdoc swilk E, save(table2.doc) append
asdoc swilk S, save(table2.doc) append
asdoc sktest G, save(table2.doc) append
asdoc sktest rank, save(table2.doc) append
asdoc sktest E, save(table2.doc) append
asdoc sktest S, save(table2.doc) append
asdoc sktest G, save(table2.doc) append
asdoc spearman E S G rank total circulate PE EPS SPS CPS, save(table3.doc)
asdoc spearman E S G rank circulate, save(table3.doc) append
gen rank1 = (rank>=7)
gen E1 = (E >= 5)
gen S1 = (S >= 7)
gen G1 = (G >= 8)
bysort class2: egen rank2 = sum(rank1)
bysort class2: egen E2 = sum(E1)
bysort class2: egen S2 = sum(S1)
bysort class2: egen G2 = sum(G1)
bysort class2: egen data = sum(1)
replace rank1 = rank2/data
replace E1 = E2/data
replace S1 = S2/data
replace G1 = G2/data
drop data E2 G2 S2 rank2
graph hbar rank1, bargap(50) over (class2, sort(1) descending)
graph hbar E1, over (class2, sort(1) descending)
graph hbar S1, over (class2, sort(1) descending)
graph hbar G1, over (class2, sort(1) descending)
gen rank3 = (rank>=7)
gen E3 = (E >= 5)
gen S3 = (S >= 7)
gen G3 = (G >= 8)
bysort class1: egen rank2 = sum(rank3)
bysort class1: egen E2 = sum(E3)
bysort class1: egen S2 = sum(S3)
bysort class1: egen G2 = sum(G3)
bysort class1: egen data = sum(1)
replace rank3 = rank2/data
```

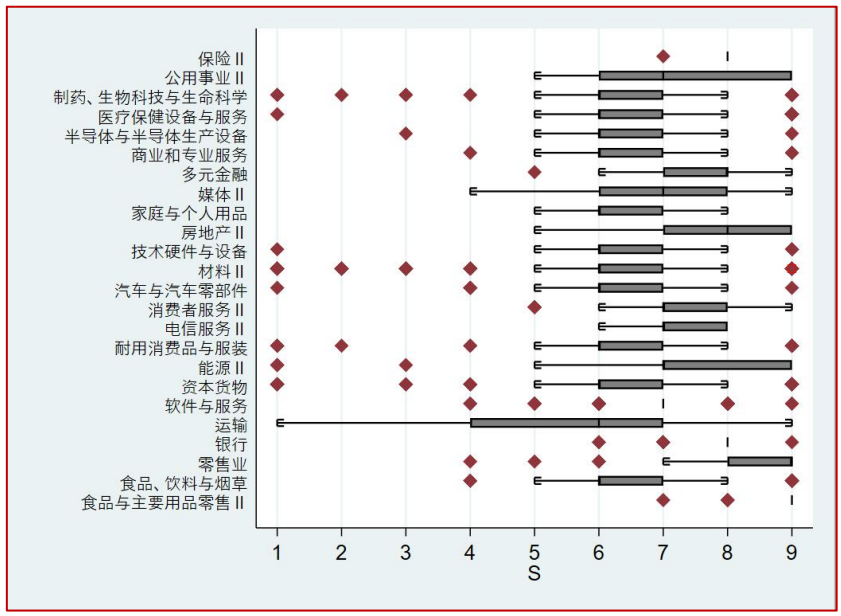
```
replace E3 = E2/data
replace S3 = S2/data
replace G3 = G2/data
drop data E2 G2 S2 rank2
graph hbar rank3, bargap(50) over (class1, sort(1) descending)
graph hbar E3, over (class1, sort(1) descending)
graph hbar S3, over (class1, sort(1) descending)
graph hbar G3, over (class1, sort(1) descending)
gen x1=sort(rank3)
preserve
duplicates list class1
duplicates drop class1 rank3, force
sort rank3, stable
graph hbar rank3, over(class1, sort(1) descending)
list rank3 class2 in 1/5
list rank3 class2 in -5/L
restore
preserve
duplicates list class1
duplicates drop class1 E3, force
sort E3, stable
graph hbar E3, over(class1, sort(1) descending)
list E3 class2 in 1/5
list E3 class2 in -5/L
restore
preserve
duplicates list class1
duplicates drop class1 S3, force
sort S3, stable
graph hbar S3, over(class1, sort(1) descending)
list S3 class2 in 1/5
list S3 class2 in -5/L
restore
preserve
duplicates list class1
duplicates drop class1 G3, force
sort G3, stable
graph hbar G3, over(class1, sort(1) descending)
list G3 class2 in 1/5
list G3 class2 in -5/L
restore
```

Appendix B: Supplementary Figures

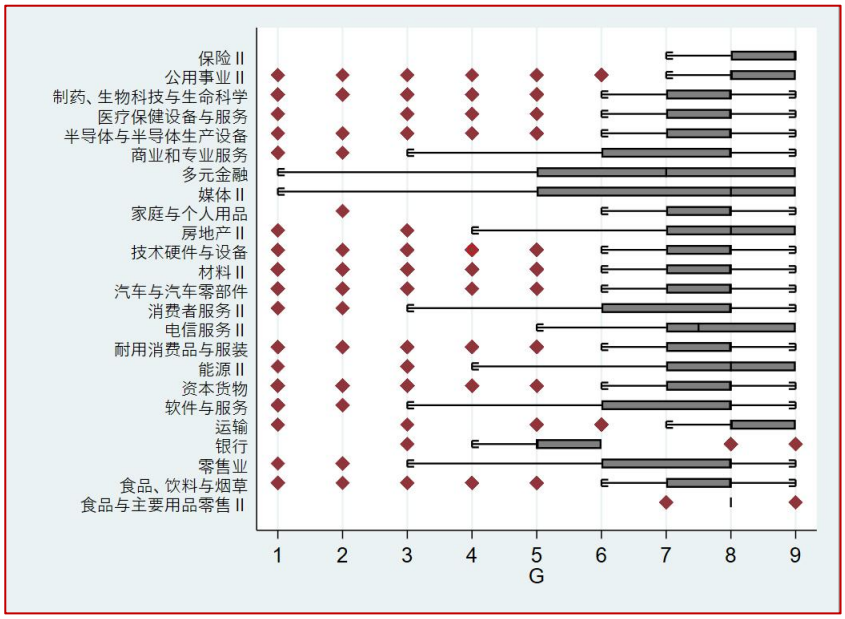
1. Environmental Scores (by Industries) Box Plot:



2. Social Scores Box (by Industries) Plot:



3. Governance Scores Box (by Industries) Plot:


保险 II
公用事业 II
制药、生物科技与生命科学
医疗保健设备与服务
半导体与半导体生产设备
商业和专业服务
多元金融
媒体 II
家庭与个人用品
房地产 II
技术硬件与设备
材料 II
汽车与汽车零部件
消费者服务 II
电信服务 II
耐用消费品与服装
能源 II
资本货物
软件与服务
运输
银行
零售业
食品、饮料与烟草
食品与主要用品零售 II
1
2
3
4
5
6
7
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9
G