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SCHOOL OF ECONOMICS AND MANAGEMENT

The ESG Performance and Business Operational Risk

- An empirical study based on a sample of China-listed companies

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Abstract

Title: The ESG Performance and Business Operational Risk

Seminar Date:

Course: Master Essay I – Finance Programme – NEKN02

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Keywords: ESG · Operation risk · Principal-agent theory · Asymmetric information · Corporate social responsibility

Purpose: This paper aims to find a piece of empirical evidence explaining the relationship between the target firm's ESG score and business operation risk.

Methodology: This paper uses the benchmark regression method to explore the direct impact, mechanism, and boundary conditions of corporate ESG performance on operating risks, and further explores the impact of ESG scores on operating risks. path mechanism and intermediary effect and conducted heterogeneity analysis of regional differences and differences in enterprise size.

Theoretical perspectives: The theoretical frameworks used to support the empirical findings of this paper rely on Sustainable Development Theory, Corporate Governance Theory, Asymmetric Information Theory and Signal Theory.

Empirical foundation: This paper uses China's Shanghai and Shenzhen A-share listed companies from 2013 to 2022 as a research sample, the ESG data was collected from Sino-securities Index Information Service.

Conclusions: Research shows that improving corporate ESG performance will significantly reduce the operating risks faced by companies, and its role is more prominent in small-scale companies and central regions. Mechanism testing confirms that mitigating agency conflicts, increasing corporate spending on management fees, and optimizing management structures are the core mechanisms through which ESG performance affects corporate operating risks.

1. Introduction

The concept of Environmental, Social, and Governance (ESG), introduced by the United Nations Environment Programme in 1992, evaluates a company's sustainability across three dimensions: environmental, social, and corporate governance. Strong ESG performance signifies a positive corporate image, higher social attention, and rational management practices, attracting significant investor interest. Despite the focus on ESG, companies must also mitigate operational risks stemming from factors like political instability and policy adjustments, which can hinder development. Operational risk encompasses various threats, including financial constraints and project failures, jeopardizing a company's liquidity and growth. Addressing these risks is vital for ensuring business continuity and attracting investor confidence.

While Friedman (2007) argues that profit maximization is a company's sole social obligation, the growing emphasis on sustainable development necessitates exploring the link between ESG performance and corporate outcomes. Although ESG investment is well-established internationally, studies on Chinese companies are relatively nascent due to late ESG adoption and the unique economic system. However, given China's economic importance, understanding its ESG landscape is crucial for global capital markets.

This study examines the impact of corporate ESG performance on mitigating operational risks using data from Chinese A-share listed companies. It contributes to existing literature by expanding research on ESG's economic impacts, particularly in risk mitigation—an area with limited exploration. By elucidating the mechanisms through which ESG influences risk reduction, the study sheds light on the relationship between ESG activities and effective risk management. Furthermore, amidst market volatility, robust ESG practices emerge as critical for sustaining business operations and fostering resilience. The insights gleaned from this research can inform policymakers, investors, and business managers, facilitating resource optimization and promoting a sustainable business environment.

2. Literature Review

2.1 CSR and ESG

Corporate social responsibility (CSR) is a concept widely recognized and debated in academic and business circles. Today, Corporate Social Responsibility primarily deals with the responsibility of businesses towards society, and it has been conceptualized in various ways over the years. Carroll (1999) describes CSR as encompassing the economic, legal, ethical and discretionary expectations that society places on organizations at any given time (Carroll, 1979). This definition means that businesses are financially obligated to produce goods and services that meet legal standards. In addition, businesses should fulfill their ethical responsibilities to society and engage in voluntary actions that meet social expectations (Carroll, 1999).

In financial research, ESG scores are often used as a metric to measure a company's CSR performance. ESG stands for environmental, social and governance factors considered in investment decisions. The impact of ESG on company value has produced mixed results, as will be explored in subsequent chapters. The conflicting findings can be attributed to two main theories: shareholder theory (Friedman, 1970) and stakeholder theory (Freeman, 2010), which will be discussed in the theoretical framework of this study.

2.2 Research on the Economic Consequences of Enterprise ESG Performance

The academic research on the ESG theme has been prolific, and the economic consequences of heterogeneous corporate ESG performance are a focal point of both academia and industry. Most research findings indicate a significant impact of corporate ESG performance on economic outcomes, with existing heterogeneity. Firstly, regarding financial performance, Velte (2017) demonstrated a correlation between corporate ESG performance and financial performance, which further influences market performance. Li et al. (2021) found through empirical research that an improvement in corporate ESG performance and its three dimensions is significantly positively associated with corporate performance. Secondly, concerning operating costs, Atan et al. (2018) confirmed that differences in corporate ESG performance are directly reflected in corporate capital costs, with companies exhibiting better ESG performance typically having more balanced and stable Weighted Average Cost of Capital (WACC), along with robust market performance indicators. Finally, in terms of top-

level design research, scholars mainly discuss policies promoting the improvement of corporate ESG performance and the establishment of a sound ESG evaluation and optimization system, affirming the positive impact of ESG performance improvement on overall corporate outcomes qualitatively (Sun et al., 2019). Zhao et al. (2018) quantitatively affirmed the positive impact of corporate ESG performance improvement on economic outcomes.

The relationship between ESG (Environmental, Social, and Governance) performance and corporate financial performance (CFP) has been shown to be predominantly positive. A comprehensive meta-analysis conducted by Friede, Busch, and Bassen in 2015, which reviewed empirical research from the year 2000 onward, demonstrated that 50% of studies found a positive correlation between ESG performance and CFP, 40% reported a neutral impact, and only 10% observed a negative correlation.

Further exploring the implications of ESG, Yu, Guo, and Luu (2018) analyzed the effects of ESG disclosure on firm value, using Tobin's Q as a metric. Their study, utilizing data from the MSCI World Index, indicated that firms with ESG disclosure scores above 20.77 tend to be rewarded with higher market valuations. This positive reception by the market could be attributed to reduced risks related to information asymmetries, suggesting that transparent ESG disclosures are valued by investors.

However, it's important to note that ESG disclosure is distinct from actual ESG performance. Marsat and Williams (2011) presented a contrasting finding where ESG performance was seen to negatively affect firm value. They referenced Friedman’s shareholder theory to interpret this relationship, suggesting a possible conflict between shareholder interests and ESG pursuits.

On another note, Auer and Schumacher (2016) highlighted the significance of corporate social responsibility (CSR) to market returns. Their research examined portfolios with high excess returns and low ESG performance but failed to establish a significant relationship, further complicating the understanding of ESG's impact on financial outcomes.

This nuanced landscape underscores the complex interplay between ESG factors and corporate financial performance, indicating that while ESG initiatives are generally viewed positively, their impact can vary significantly based on specific circumstances and interpretations.

2.3 Disclosure of ESG and its influence

Globally, the disclosure of ESG (Environmental, Social, and Governance) information is increasingly recognized as a critical mechanism for promoting sustainable development in capital markets and the broader socio-economic environment. In China, despite a relatively late start in establishing ESG frameworks and immature disclosure systems, leveraging experiences from Western capital markets could pave the way for an effective ESG disclosure framework tailored to China's economic conditions (Ma et al., 2016). This framework would benefit from governmental leadership in establishing standards and promoting ESG investment principles, particularly through pilot projects in large enterprises and pollution-intensive industries.

On a microeconomic level, the growing demand for high-quality ESG information by investors is a significant driver for improving disclosure quality among listed companies. High-quality ESG disclosures can substantially enhance a company's financing success rates, reduce financing costs, and strengthen market competitiveness (Bai, 2022; Qiu et al., 2019). Moreover, strong ESG performance not only improves a company’s social image and stakeholder trust but also reduces financial and operational risks, thereby enhancing market performance (Ba et al., 2019; Bai, 2022).

Significant studies by Christensen et al. (2021) and others (Dhaliwal et al. 2011, Clarkson et al. 2013) suggest that voluntary ESG disclosures are often critical in valuation assessments, indicating a generally positive reception by the market. Conversely, some studies, such as those by Cho et al. (2015) and Gray (2006), argue that ESG disclosures may not significantly influence investment decisions, as they often serve primarily to enhance a firm's legitimacy rather than provide substantive accountability. This sentiment is supported by findings from Michelon et al. (2015) and Griffin et al. (2017), who observed that firms often engage in symbolic reporting without genuinely enhancing disclosure quality, particularly concerning greenhouse gas emissions.

The effectiveness of ESG reporting can also hinge on the nature and quality of the disclosures. For instance, Plumlee et al. (2015) found that the impact of voluntary environmental disclosures on firm value varies depending on whether the disclosures address positive, neutral, or negative issues and whether they contain hard or soft information.

Experimental studies add another layer of complexity, revealing that difficulties in processing ESG information can create barriers to its use in decision-making. Research by Gödker and

Mertins (2018) and Martin (2019) suggests that investors might not effectively integrate ESG data into their investment strategies, often influenced by partial or affective responses to disclosures, as shown in studies by Koonce et al. (2016) and Elliott et al. (2014, 2020).

Additionally, there are indications that the framing and presentation of CSR disclosures may affect investor behavior. For example, Elliott et al. (2017) demonstrated that when CSR disclosures align strategically with the presentation style, it facilitates better information processing by investors, particularly those less adept with numerical data, resulting in more favorable investment decisions.

In summary, while there is evidence supporting the value relevance of ESG disclosures in certain contexts, the overall findings are nuanced, indicating that investor responses can vary greatly based on disclosure quality, the informational content of the disclosures, and psychological factors affecting the processing of this information. The field continues to grapple with these complexities as it seeks to understand the precise conditions under which ESG disclosures most effectively influence investment decisions and firm valuations.

2.4 Research on the influencing factors of enterprise risk

Cummins et al. (2006) examined the impact of operational losses on the market values of U.S. banks. More recent studies by Chernobai et al. (2012) and Cope et al. (2012) have focused broadly on determinants of operational risk. Wang and Hsu (2013) specifically investigated the effects of the board of directors composition on operational risk. Chernobai et al. (2021), Curti et al. (2021), and Frame et al. (2021) have argued that bank size and complexity are linked to higher operational risk, while Abdymomunov et al. (2020) demonstrated that an adverse macroeconomic environment leads to more operational losses. Our study is the first to directly examine the operational risk implications of workforce policies at financial institutions. Significantly, we found that workforce policies are associated with tail operational risks, which have significant implications for financial stability. Additionally, we identified the size of bank holding companies (BHCs) (based on employee base) as a factor that amplifies the effects of workforce policies on operational risk.

Furthermore, our study contributes to the empirical literature on risk management. Nance, Smith, and Smithson (1993), and Almeida et al. (2017) examined the use of derivatives and purchase obligations, respectively, as risk management tools. Bonaimé et al. (2013) documented substitution effects between hedging and payout decisions at firms. Garfinkel

and Hankins (2011) found that risk management considerations are a significant driver behind mergers. Pérez-González and Yun (2013) investigated the firm value implications of active risk management practices. Ellul and Yerramilli (2013) studied the relation between risk controls and tail risk at BHCs. Our research contributes to this literature by demonstrating that corporate workforce policies are linked to operational risk outcomes at financial institutions and can therefore be utilized to manage operational risk. Importantly, our findings align with existing international supervisory guidance on operational risk management, which highlights the utility of employee training programs (e.g., Basel Committee on Banking Supervision (2011)).

3. Theoretical Background

3.1 Sustainable development theory

Although the idea of sustainable development has been around for a long time, it was not until the 1980s that the concept of "sustainable development" was clearly defined and elaborated in the Brundtland Report issued by the World Commission on Environment and Development (WCED). Its core idea is it is necessary to meet the needs of the present generation without compromising the ability of future generations to meet their own needs.

Indeed, as an integral component of economic progress, enterprises must embrace the principles of sustainable development. This entails transitioning from previous models of extensive economic growth to a more balanced approach that prioritizes both scale and efficiency while harmonizing environmental, economic, and social values. By fostering a virtuous cycle of development, enterprises can contribute to the overall sustainability of society.

The ESG framework discussed in this article stems from the broader theory of sustainable development, with a specific focus on the corporate sphere. Essentially, strong ESG performance signifies a company's proactive commitment to environmental stewardship, societal well-being, and effective corporate governance. Such a commitment not only underscores the company's capacity for sustainable growth but also garners trust and support from stakeholders. Consequently, this enhances the company's long-term competitive advantage, bolsters its performance, attracts the attention of investors and reducing the operational risk.

3.2 Corporate Governance Theory

3.2.1 Stakeholder Theory

Back in 1965, American scholar Ansoff introduced the concept of stakeholders, emphasizing the need for enterprises to consider the various entities with vested interests comprehensively. He advocated for maintaining a delicate balance among these entities, which may encompass corporate employees, shareholders, customers, suppliers, and management personnel. However, this definition was relatively narrow in scope.

In 1984, R. Edward Freeman, regarded as the father of neoclassical economics, further developed the concept in his seminal work "Strategic Management: A Stakeholder Approach." He expanded the definition of stakeholders to include all individuals and groups capable of influencing and being influenced by the enterprise's development process. This broader definition encompasses not only internal stakeholders like employees and shareholders but also external entities such as environmentalists, government bodies, and communities. It laid a more inclusive foundation for future studies on stakeholder theory.

Stakeholder theory posits that stakeholders, owing to explicit and implicit contracts, possess both responsibilities and obligations, as well as residual claim and control rights. Therefore, the success of an enterprise hinges on the trust and support of its stakeholders. Enterprises are tasked not only with fulfilling these responsibilities but also with striving to balance the diverse demands of stakeholders to maximize overall interests, rather than solely focusing on shareholder interests.

The subject of this article—corporate ESG performance—encompasses responsibilities to various stakeholders, including the government, shareholders, creditors, customers, and suppliers. Active fulfillment of ESG responsibilities engenders trust and support from stakeholders, thereby enhancing the company's core competitiveness and fostering sustainable development. Thus, stakeholder theory serves as the theoretical underpinning and crucial guidance for understanding corporate ESG performance.

3.2.2 Principal-agent Theory

In the late 1960s and early 1970s, with the rise of social specialization and the expansion of market scale, the principal-agent theory emerged. This theory posits that principals, often due to their limited expertise, delegate decision-making control to agents through contractual agreements, allowing agents to act on their behalf and generate profits. However, this arrangement often leads to agency conflicts. Firstly, there is a misalignment of interests

between principals and agents. While agents' interests lie in the compensation paid by principals, principals' interests are tied to the profitability of the enterprise. Principals believe that the success of the enterprise depends on the efforts exerted by agents. Consequently, under the premise of divergent interests and the assumption of rational economic agents, agents may prioritize their own gains over the interests of principals, making decisions detrimental to the latter's interests. Secondly, there exists information asymmetry between the two parties, with principals being at a disadvantage. Agents, possessing superior information, may exploit this advantage for personal gain, leading to adverse selection and moral hazards, ultimately harming the interests of principals.

In practice, the principal-agent relationship reflects a company's governance practices. Specifically, companies with lower agency costs tend to exhibit higher levels of corporate governance. The "G" in corporate ESG performance, as highlighted in this article, precisely represents a company's governance practices. Thus, it can be argued that companies with higher ESG ratings demonstrate better governance practices, resulting in lower agency costs and further attracting investor attention.

3.3 Asymmetric Information Theory

As early as the 1970s, the "information asymmetry theory" was introduced and explored by three American scholars. This theory primarily finds application in financial market research and is delineated into two key points: Firstly, there exists an uneven distribution of information between the two parties involved in market transactions. One party holds relatively more information, positioning itself advantageously and reaping benefits from the market. Secondly, both parties to the transaction are acutely aware of whether they possess an information advantage or disadvantage to the other party. This asymmetry stems from the societal division of labor, inherent disparities in information transmission, and discrepancies in information investment costs. Such occurrences are pervasive in financial markets and have deleterious effects on individuals and even society at large. For instance, in the insurance market, adverse selection and moral hazard are common phenomena. Adverse selection occurs when policyholders conceal pertinent information from insurers prior to contract signing, leading insurers to erroneous judgments and heightening operational risks. Conversely, moral hazard entails policyholders attempting to defraud insurers post-contract signing by fabricating "unexpected" insurance incidents, thereby inflicting substantial losses on insurers. Similarly, in the stock market, only internal company management possesses

comprehensive insights into the company's operations. Investors, relying solely on historical data and limited disclosures, face heightened investment risks.

The disclosure of corporate ESG performance levels in this article furnishes investors with additional reference points for investment decisions and mitigates the extent of information asymmetry. This, in turn, reduces investors' information search costs and attracts greater investor attention.

3.4 Signal Theory

As early as 1974, Spence conducted pioneering research on the signaling effect of education levels. He posited that the educational attainment of job seekers serves as a signal to employers, indicating their potential capabilities. Consequently, employers are inclined to offer higher wages to individuals with higher education levels. Spence's work laid the groundwork for signaling theory and charted a path for subsequent research in this area.

Signaling theory posits that, due to information asymmetry in the market, companies with superior information are motivated to proactively disclose relevant information to distinguish themselves from competitors with inferior information. By doing so, they transmit positive signals to the market. Additionally, the information disclosed by companies entails costs and is difficult for competitors to replicate, enhancing the credibility of the signals emitted. Consequently, firms that communicate signals are likely to attract greater investor attention.

Corporate ESG performance, as explored in this article, can serve as a mechanism for signal transmission. A higher ESG rating signifies that a company actively fulfills its environmental, social, and corporate governance responsibilities, underscoring its commitment to social responsibility and sustainability. This, in turn, emits a positive signal to the public, particularly stakeholders, garnering their attention and support.

4. Hypotheses development

4.1 Analysis of the mechanism of enterprise ESG performance on the operation risk

With the continuous deepening of the ESG concept, both internal and external conditions of enterprises have raised higher demands for ESG performance. If enterprises neglect environmental protection, fail to actively undertake social responsibilities, or do not timely improve their internal governance, external regulatory pressure and internal operational pressure will continue to escalate. Conversely, if enterprises focus on their ESG performance,

it will contribute to gaining competitive advantages, garnering recognition from stakeholders (Li et al., 2019), and enhancing corporate reputation. Generally, companies with better ESG performance have more comprehensive and systematic risk control systems at various nodes of their internal governance framework, especially in controlling overall financial risks during the business process, thereby lowering the probability of bankruptcy and laying a foundation for sustainable development (Dang et al., 2012). Therefore, the enhancement of corporate ESG performance may help mitigate operational risks. Based on this, we propose hypothesis.

H1: Improving corporate ESG performance contributes to reducing operational risks.

4.2 The intermediary role of alleviating management pressure

The issue of agency has long been a focal point in corporate governance that requires significant attention. Most companies face dual agency problems, often resulting in conflicts of interest between different parties, such as internal stakeholders' appropriation or conflicts between controlling and minority shareholders. These agency costs are borne by both the company and the shareholders, significantly increasing management expenses. In companies with better ESG performance, efforts to fulfill social responsibilities on environmental and social fronts to meet external stakeholders' demands, combined with ongoing optimization of governance models on the internal front, continuously address agency conflicts. Through measures like coordinating stakeholder interests and enhancing operational mechanisms, companies alleviate these conflicts to some extent (Liu et al., 2006), thereby reducing management expenses.

H2: The alleviation of agency conflicts plays an intermediary role in the process of improving corporate ESG performance and reducing operational risks.

5. Data and methodology

Our sample consists of firms listed on the Shanghai Stock Exchange and Shenzhen Stock Exchange from 2013 to 2022, providing us with 28,723 firm-year observations. Corporate ESG performance data is sourced from the Wind database's Sino-Securities Index ESG scores. In contrast, corporate business risk and other financial data are sourced from the China Securities Market and Accounting Research (CSMAR) database. Before conducting the analysis, ST enterprises, financial sector-listed companies, and companies with abnormal operations are excluded. We exclude these data because of their unique characteristics that

could distort our analyses. To mitigate the impact of outliers on the results, the data is also winsorized at the 1% level.

5.1 Variables explanation

Dependent variable: business risk (Zscore). Referring to the study proposed by Atlamn (1968) is used as a measure of the company's operating risk. The indicator is calculated from five sub-items, all of which are the financial ratios that reflect the financial crisis of the enterprise. The general judgment score of the comprehensive operating risk of the enterprise is constructed by using the discriminant analysis method. Compared with each standard, it can reflect the size of the business risk currently faced by the enterprise. The larger the Z value, the lower the risk of bankruptcy of the enterprise, that is, The smaller the business risk. The specific calculation method is: Z value = 1.2 × working capital / total assets (liquidity) + 1.4 × retained income / total assets (rate of return) + 3.3 × profit before interest and tax / total assets (stability) + 0.6 × total market value of stocks/book value of liabilities (payment capacity) + 0.999 × Sales revenue/total assets (proportion of activity). Working capital/total assets reflects the company's ability to realize assets and its scale characteristics. If a company's operating capital continues to decrease, it often indicates that the company's fund turnover is not smooth or that it is facing a short-term debt crisis. Retained income/total assets reflect the company's cumulative profit-making ability. For listed companies, retained earnings refer to the balance of net profit minus all dividends. The more retained earnings a company has, the more surplus capacity it has to pay dividends. Earnings before interest and taxes (EBIT)/total assets, also known as the total asset turnover ratio, measure the ability of listed companies to profitably utilize all assets. The total market value of stocks/book value of liabilities determines the financial structure, with the denominator being the sum of current liabilities and long-term liabilities at book value, and the numerator being replaced by the market value of shareholder equity instead of book value, objectively reflecting the size of the company's value. Sales revenue/total assets, or total asset turnover ratio, reflects the operational capacity of the enterprise's total assets, primarily focusing on the operational level of total assets. A high total asset turnover ratio indicates that the company's use of all assets for operations is effective. Conversely, a low total asset turnover ratio indicates poor results from using all assets for operating activities, ultimately affecting the company's profit-making ability.

The Z-Score model comprehensively reflects the financial condition of an enterprise from aspects such as asset size, liquidity, profitability, financial structure, debt-paying ability, and

asset utilization efficiency, further advancing the development of financial early warning systems. Through research and analysis of the Z-Score model, Altman concluded that the Z-value is inversely proportional to the likelihood of a company experiencing a financial crisis; the smaller the Z-value, the greater the likelihood of a company experiencing a financial crisis, whereas the larger the Z-value, the smaller the likelihood of a company experiencing a financial crisis.

Independent variable: ESG score, This article uses SNSI ESG rating scores as explanatory variables. SNSI ESG ratings system fully draws on the core of international ESG experience and combines China's characteristics to build ESG rating system, including 3 first tier pillar, 16 second tier themes, 44 third tier key issues, 80 fourth tire indicators and 300+ underlying data point. It integrates AI such as semantic analysis and NLP to build an ESG big data platform, covering all A-share listed companies and investable Hong Kong-listed companies with cumulative market value coverage at 95%, and the appendix shows specific indicators and calculation methods of ratings.

Control variables: Size, Institutional investors' investment decisions are often influenced by the size of a company. Specifically, large-scale enterprises have a relatively large market share and possess strong competitive advantages in the market, thereby reducing their risk. Additionally, they benefit from economies of scale, meaning that the transaction costs of large companies decrease as their size increases. Their performance is relatively stable, making them more attractive to institutional investors. In this paper, the size of the enterprises is measured using the natural logarithm of total assets.

Indep, an Independent Director refers to a director who does not hold any positions other than that of a director within a publicly listed company and who does not have direct or indirect interests with the employing company, its major shareholders, or its actual controllers that might affect their ability to make independent and objective judgments. As companies grow, they inevitably face the separation of ownership and management rights. Ensuring that managers do not deviate from the goals of the owners, minimizing agency risk, and controlling agency costs become crucial issues in corporate governance. This theory posits that reducing agency costs necessitates enhancing the efficiency of the management team while preventing insider control issues. Thus, the establishment of an independent director system is hoped to alter the structure of managerial decision-making power, achieving a supervisory and balancing role, thereby ensuring that managers align with the objectives of

the owners, fostering congruence of interests between agents and principals, and enhancing operational efficiency. The theoretical focus is on reforming the power structure of the management layer to promote safe and effective operations, thereby reducing agency costs. In essence, this approach seeks to maximize output with minimal input. This theory's most distinctive feature stems from the fundamental profit-oriented purpose of corporate legal entities, deducing the necessity of optimizing the power structure of the management, and concluding the necessity of establishing an independent director system. Therefore, the proportion of independent directors often represents the quality of internal controls and the level of agency costs within a company, with companies having a higher proportion of independent directors typically experiencing lower agency costs.

Top10, percentage of shares held by the largest 10 shareholders. Shareholder concentration is a quantifiable measure that reflects the level of concentration or dispersion of ownership among shareholders based on their respective shareholding percentages. It serves as a primary indicator of a company's share distribution state, and is crucial for assessing the stability and structural integrity of the company. A higher concentration of ownership may facilitate more effective shareholder oversight mechanisms, enabling major shareholders to effectively monitor management and enhance corporate governance structures. However, excessive concentration of equity may lead to an over-centralization of power, where major shareholders could potentially abuse their authority to the detriment of minority shareholders' interests.

Growth, The ratio of the increase in the company's operating income this year to the total operating income of the previous year. The growth rate of operating income reflects the growth and development capabilities of the company to a certain extent. Specifically, the higher the company's operating income growth rate, it means that the company's operating income is constantly increasing at a faster rate. The company has good development prospects and high growth capabilities.

Board, total number of board members. The relationship between board size and corporate performance is complex and not simply linear. Both overly large and excessively small board sizes can have certain advantages, yet they may also negatively impact company performance. Under specific conditions, there might exist an optimal board size that maximizes corporate effectiveness. The relationship between board size and corporate effectiveness holds two perspectives: firstly, a relatively smaller board size can enhance

governance efficiency; secondly, a larger board size might be more beneficial in improving governance efficiency.

BM, book-to-market ratio. When the market value of a company exceeds its book value per share, it is often regarded as overvalued. Conversely, when the book value surpasses the market value, the company is typically viewed as undervalued.

Mfee, Percentage of management expenses and main business income. Administrative expenses are an important factor affecting a company's profitability and reflect the level of business management.

ATO refers to the ratio of an enterprise's net sales (operating) income to its average total assets in a certain period. The total asset turnover rate is an important indicator for comprehensively evaluating the management quality and utilization efficiency of all assets of an enterprise.

Liquid, the Current ratio is the ratio of current assets to current liabilities. It is used to measure the ability of a company's current assets to be converted into cash to repay liabilities before short-term debts mature. Generally speaking, the higher the ratio, the stronger the liquidity of the company's assets and the stronger its short-term solvency.

Table 5-1 Variable definitions

Zscore	Business Risk, calculated as 1.2 × Working Capital/Total Assets + 1.4 × Retained Earnings/Total Assets + 3.3 × Earnings Before Interest and Taxes (EBIT)/Total Assets + 0.6 × Market Value of Equity/Book Value of Debt + 0.999 × Sales/Total Assets, where a higher value indicates lower business risk.
ESG	Corporate ESG Performance, sourced from Sino-Securities ESG Score.
Size	Company Size, represented by the natural logarithm of total assets.
Indep	Proportion of Independent Directors, calculated as the number of independent directors/total number of board members.
TOP10	Equity Concentration, percentage of shares held by the largest 10 shareholders.
Growth	The ratio of the increase in the company's operating income this year to the total operating income of the previous year
Board	Board Size, i.e., total number of board members.
BM	Book-to-Market ratio, calculated as the ratio of a company's book value (total assets minus liabilities) to its market value (market capitalization).
Mfee	Percentage of management expenses and main business income. Administrative expenses are an important factor affecting a company's profitability and reflect the level of business management.
ATO	Ratio of an enterprise's net sales (operating) income to its average total assets in a certain period.
Liquid	Ratio of current assets to current liabilities.

5.2 Selection of Model

$$Zscore_{i,t} = \alpha_0 + \alpha_1 ESG_{i,t} + \beta \sum Controls_{i,t} + Idv_i + Yt_t + Idt_j + \epsilon_{i,t} \quad (5\text{-}1)$$

In the above formula, Zscore is the enterprise risk, ESG is the representation of enterprise ESG, and Controls is a set of control variables. The subscript i represents the enterprise, t represents the year, j represents the industry, Idv_i , Yt_t and Idt_j represent the fixed effect of the enterprise, year and industry respectively, and ε i and t are random error terms.

$$Mfee_{i,t} = \alpha_0 + \alpha_1 ESG_{i,t} + \beta \sum Controls_{i,t} + Idv_i + Yt_t + Idt_j + \epsilon_{i,t} \quad (5\text{-}2)$$

To examine the intermediary effect of business performance, we construct the intermediary model as Formula 5-2 and 5-3. In the first step, Formula 5-2 investigates the relationship between ESG performance and management expenses of companies, with "Mfee" representing the intermediary variable denoting management expenses. Subsequently, in the second step (Formula 5-3), we test whether management expenses act as an intermediary in the relationship between ESG performance and operational risk.

$$Zscore_{i,t} = \alpha_0 + \alpha_1 ESG_{i,t} + \alpha_2 Mfee_{i,t} + \beta \sum Controls_{i,t} + Idv_i + Yt_t + Idt_j + \epsilon_{i,t} \quad (5\text{-}3)$$

6. Empirical analysis

6.1 Descriptive statistics

Our sample comprises 28,723 observations across 4,239 China-listed companies. We exclude firms from the financial sector and those with abnormal operations, applying a rigorous 1% winsorizing process to all data as described in the study. The Zscore measures the financial health and stability of companies, the mean of the Zscore in our sample is 4.96, the minimum is 0.04, and the maximum is 37.37, which means there is a big difference in China-listed companies. ESG scores reflect a company's performance in environmental, social, and governance practices. The mean ESG score is approximately 4.12, suggesting that most China-listed companies are distributed among the ESG rating BB-CCC. The mean and standard deviation of other variables are basically within a reasonable range.

Table 6-1 Description of statistics

variable	N	mean	p50	sd	min	max
Zscore	28723.00	4.96	3.11	5.80	0.04	37.37
ESG	28723.00	4.12	4.00	0.99	1.00	8.00
Mfee	28723.00	0.09	0.07	0.07	0.01	0.64
Size	28723.00	22.28	22.09	1.30	19.589	26.45

Indep	28723.00	37.68	36.36	5.39	28.57	60.00
TOP10	28723.00	58.49	59.18	14.95	21.93	90.97
Growth	28723.00	0.17	0.10	0.42	-0.66	4.12
Board	28723.00	2.12	2.20	0.20	1.61	2.71
BM	28723.00	0.63	0.62	0.25	0.06	1.25

6.2 Benchmark regression result

As illustrated in the table, this paper conducts a baseline regression analysis to examine the impact of corporate ESG performance on operational risk, considering fixed effects for individual, industry and year. The results indicate that the ESG coefficient is significantly positive at the 1% level. Building on this, additional control variables were incrementally included, and the outcomes remained robust; the significance and positive nature of the ESG coefficient did not change. The baseline regression results demonstrate that improved corporate ESG performance significantly reduces operational risk, thus confirming Hypothesis H1.

Table 6-2 Benchmark regression

VARIABLES	(1) Zscore
ESG	0.521***
	(17.76)
Size	-0.427***
	(-14.40)
Indep	-0.014**
	(-2.22)
TOP10	0.024***
	(12.69)
Growth	-0.276***
	(-3.77)
Board	-0.815***
	(-4.49)
BM	-12.693***
	(-64.07)
Constant	21.094***
	(29.87)
Observations	28,723
R-squared	0.382
Individual FE	YES
Industry1 FE	YES
year FE	YES

Adjusted R2	0.380

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

To ensure the robustness and accuracy of the regression results in this study, we utilized the Variance Inflation Factor (VIF) to detect any potential multicollinearity among the explanatory variables, including ESG scores, corporate operating risks, and various control variables. Commonly, a VIF exceeding 10 suggests substantial multicollinearity, which may compromise the reliability of the regression outcomes. However, the VIFs calculated for each variable in our analysis were consistently around 1, significantly below this threshold. This finding supports the conclusion that the explanatory variables in our study do not suffer from serious multicollinearity issues, affirming the validity of our regression analysis.

Table 6-3 VIF Analysis

VARIABLES	(1) VIF
ESG	1.09
Size	1.75
Indep	1.51
TOP10	1.05
Growth	1.02
Board	1.61
BM	1.47

6.3 Robustness Analysis and Endogeneity

6.3.1 Distributed lag model

To address potential endogeneity issues in our analysis, this paper employs two distinct methodologies to validate the reliability of the regression model.

Firstly, we utilize a lagged regression approach where the independent variables are lagged by one, two, and three periods, respectively. This technique is predicated on the rationale that prior values of the dependent variable could influence the current values of the independent variables. By adopting this approach, we can ascertain whether there exists a simultaneity between the dependent and independent variables, which is a common manifestation of endogeneity.

The regression results presented in columns 2, 3, and 4 indicate that the lagged values of corporate ESG performance continue to reduce corporate operating risks significantly. This

finding effectively supports the absence of reverse causality between these variables. By demonstrating that past ESG performance influences future operational risks rather than the reverse, we reinforce the argument that improvements in ESG practices are likely driving reductions in operational risk, thereby substantiating the directional causality posited in our model. This analysis ensures that the observed effects are attributable to ESG performance enhancing measures and not due to any potential confounding from reverse influences.

Table 6-4 Endogeneity Analysis

VARIABLES	(1) Zscore	(2) Zscore	(3) Zscore	(4) Zscore
ESG	0.521***			
	(17.76)			
ESG_L1		0.475***		
		(14.93)		
ESG_L2			0.426***	
			(12.27)	
ESG_L3				0.387***
				(10.05)
Size	-0.427***	-0.426***	-0.471***	-0.473***
	(-14.40)	(-12.44)	(-11.90)	(-10.74)
Indep	-0.014**	-0.015**	-0.017**	-0.021**
	(-2.22)	(-2.21)	(-2.24)	(-2.57)
TOP10	0.024***	0.024***	0.028***	0.028***
	(12.69)	(11.11)	(10.91)	(10.31)
Growth	-0.276***	-0.261***	-0.217**	-0.178*
	(-3.77)	(-3.22)	(-2.45)	(-1.90)
Board	-0.815***	-0.781***	-0.742***	-0.834***
	(-4.49)	(-3.86)	(-3.30)	(-3.43)
BM	-12.693***	-12.598***	-12.364***	-11.795***
	(-64.07)	(-58.63)	(-53.07)	(-47.68)
Constant	21.094***	21.195***	22.104***	22.296***
	(29.87)	(26.53)	(24.12)	(22.23)
Observations	28,723	28,723	20,006	16,844
R-squared	0.382	0.386	0.385	0.382
Individual FE	YES	YES	YES	YES
Industry1 FE	YES	YES	YES	YES
year FE	YES	YES	YES	YES
Adjusted R2	0.380	0.384	0.382	0.379

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6.3.2 Replace Control variables

Secondly, we conduct robustness analysis by systematically varying the control variables in the regression models. This method involves re-estimating the model with different

configurations of control variables to evaluate the consistency of the empirical results. This process helps in ensuring that the findings are not merely artifacts of specific model specifications but are robust across various analytical conditions.

In this study, we enhanced the robustness of our regression model by substituting the corporate operating income growth rate with the asset turnover rate and the current ratio as alternative indicators of operating performance. The results consistently demonstrated that ESG performance significantly reduces operating risks, achieving statistical significance at the 1% level. This consistency across different performance metrics affirms that the positive impact of ESG performance on reducing operating risks is not an artifact of specific variable choices but a robust feature of our model. Such findings underscore the reliability of our regression analysis, reinforcing the inference that ESG initiatives play a crucial role in mitigating operational vulnerabilities across diverse financial dimensions.

Table 6-5 Regression Result

VARIABLES	(1) Zscore
ESG	0.086***
	(3.87)
Size	0.417***
	(16.55)
Indep	0.003
	(0.70)
TOP10	-0.011***
	(-7.26)
ATO	0.759***
	(12.69)
Liquid	1.407***
	(57.51)
Board	-0.130
	(-0.99)
BM	-11.907***
	(-74.79)
Constant	-0.408
	(-0.68)
Observations	28,723
R-squared	0.659
Individual FE	YES
Industry1 FE	YES
year FE	YES
Adjusted R2	0.658

6.4 Analysis of intermediary effect

As shown in Table 6, the dependent variable is replaced by the intermediary variable in column (3). The results show that improving corporate ESG performance will significantly reduce management expense ratios and optimize corporate operating conditions. In column (1), the company's ESG performance and management expense rate are both included in the regression model. By comparing the results of column (1) and column (2), the ESG variable coefficient is clearly reduced, indicating that the improvement of the company's ESG performance has been reduced. Management expense ratio, thereby significantly reducing the company's operating risks. Hypothesis H2 has been verified, clarifying a specific path for corporate ESG performance to reduce corporate operating risks.

In our research, management expense ratio and ESG performance showed a negative correlation, but we also found that management expense ratio played a role in reducing risks. This may indicate a complex relationship, that is, increasing management expense ratio and corporate ESG There are competing influences on performance. On the one hand, a higher management expense ratio may mean that the company has insufficient resources to implement ESG, resulting in limited improvement in ESG performance, because the company will use more funds for other management of daily operations rather than simply Increase attention to ESG performance. On the other hand, a high management expense ratio may reflect the company's strengthening of internal control and governance, thereby effectively reducing potential operating risks and making the company more robust.

This situation reflects a trade-off in which companies need to choose between improving ESG performance and strengthening internal controls in resource allocation. Although a higher management expense ratio may inhibit the improvement of ESG performance, it provides enterprises with a more effective risk management mechanism, thereby reducing the overall risk level of the enterprise. Therefore, although the increase in management expense ratio has had a certain negative impact on ESG performance, it has had a positive effect in reducing corporate operating risks.

Table 6-6 Intermediary Effect

VARIABLES	(1) Zscore	(2) Zscore	(3) Mfee
Mfee	7.776***		
	(10.06)		
ESG	0.561***	0.521***	-0.005***

	(19.32)	(17.76)	(-12.30)
Size	-0.324***	-0.427***	-0.013***
	(-10.71)	(-14.40)	(-37.19)
Indep	-0.018***	-0.014**	0.001***
	(-2.92)	(-2.22)	(6.63)
TOP10	0.026***	0.024***	-0.000***
	(13.78)	(12.69)	(-10.24)
Growth	-0.104	-0.276***	-0.022***
	(-1.42)	(-3.77)	(-18.08)
Board	-0.857***	-0.815***	0.006**
	(-4.73)	(-4.49)	(2.24)
BM	-12.514***	-12.693***	-0.023***
	(-63.72)	(-64.07)	(-11.20)
Constant	17.951***	21.094***	0.404***
	(25.00)	(29.87)	(41.87)
Observations	28,723	28,723	28,723
R-squared	0.388	0.382	0.305
Individual FE	YES	YES	YES
Industry1 FE	YES	YES	YES
year FE	YES	YES	YES
Adjusted R2	0.386	0.380	0.303

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

6.5 Analysis of Heterogeneity

After confirming the positive impact of enhanced corporate ESG (Environmental, Social, and Governance) performance on reducing operational risks, this study further explores whether this impact varies across different corporate characteristics. Initially, companies were categorized into three regions based on their state of registration: East, Central, and West. Subsequently, the analysis incorporated a second layer of categorization based on company size to investigate potential differences attributable to scale. Utilizing Fisher's combined probability test, this study iteratively sampled 500 times for each of the dual-group classifications. The results affirm significant heterogeneity in the coefficients across both regional and size-based groupings, thus confirming the qualitative presence of differences.

From a regional perspective, all three groups demonstrated that improvements in ESG performance contribute to reduced operational risks. However, the magnitude of this effect varied. The Central region exhibited the most substantial reduction in operational risks, followed by the Eastern and Western regions, respectively. This significant mitigation effect in the Central region can be attributed to its locational advantages, ample financial resources, and a robust economic and strategic management environment conducive to ESG

enhancements. These factors collectively enable firms in the Central region to leverage ESG initiatives effectively, thus reducing operational risks. In contrast, companies in the Western region, predominantly operating in the traditional energy and resource sectors, face financial constraints and generally lack the necessary resources to support comprehensive ESG practices. Companies in the Eastern region, being more mature in ESG practices, experience lesser impacts due to the overriding influence of other non-ESG factors such as industry structure and market saturation.

Table 6-7 Region Group

	(1) East	(2) Mid	(3) West
VARIABLES	Zscore	Zscore	Zscore
ESG	0.449***	0.819***	0.630***
	(12.95)	(10.03)	(7.59)
Size	-0.429***	-0.434***	-0.544***
	(-12.64)	(-4.56)	(-6.93)
Indep	-0.023***	0.039**	0.001
	(-3.01)	(2.53)	(0.07)
TOP10	0.021***	0.039***	0.026***
	(8.75)	(7.18)	(6.13)
Growth	-0.358***	-0.122	-0.139
	(-3.95)	(-0.68)	(-0.84)
Board	-0.815***	-0.175	-0.391
	(-3.55)	(-0.40)	(-0.94)
BM	-12.942***	-12.222***	-12.392***
	(-53.84)	(-24.16)	(-25.00)
Constant	22.144***	15.424***	21.649***
	(25.99)	(7.98)	(11.85)
Observations	20,417	3,738	4,568
R-squared	0.376	0.442	0.427
Individual FE	YES	YES	YES
Industry1 FE	YES	YES	YES
year FE	YES	YES	YES
Adjusted R2	0.373	0.430	0.417

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Regarding enterprise size, the analysis reveals that while improvements in ESG performance universally aid in mitigating business risks, the effect is comparatively subdued in larger enterprises. This phenomenon may be explained by the established market presence and robust reputational capital of large-scale enterprises, which diminishes the incremental benefits derived from enhancing ESG practices. Conversely, smaller enterprises, which

typically suffer from limited visibility, stand to gain significantly from proactive ESG engagements. Such efforts are likely to attract increased attention from analysts and investors, yielding positive market feedback and further alleviating operational risks.

This nuanced understanding underscores the importance of tailoring ESG strategies to the specific characteristics and circumstances of different corporate entities to optimize their impact on operational risk management.

Table 6-8 Size Group

	(1) Below	(2) Above
VARIABLES	Zscore	Zscore
ESG	0.807***	0.358***
	(15.32)	(14.00)
Size	-1.538***	0.005
	(-13.35)	(0.15)
Indep	-0.037***	-0.016***
	(-3.11)	(-3.11)
TOP10	0.032***	0.013***
	(8.55)	(8.36)
Growth	-0.335**	-0.027
	(-2.43)	(-0.54)
Board	-1.375***	-0.282**
	(-3.85)	(-2.01)
BM	-17.393***	-9.205***
	(-46.84)	(-41.68)
Constant	47.518***	8.739***
	(18.67)	(14.12)
Observations	14,362	14,361
R-squared	0.362	0.436
Individual FE	YES	YES
Industry1 FE	YES	YES
year FE	YES	YES
Adjusted R2	0.358	0.432

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

7. Critical Reflection and Conclusion

7.1 Critical Reflection

Firstly, the sample in this study commences from 2013, as data collection before this period was limited. This limitation arises from the relatively later development of China's ESG

evaluation system compared to that of the European Union and the United States. Consequently, it may be difficult to analyze it over a longer period of time.

Secondly, this paper addresses endogeneity issues through control variable replacement and lagged regression models, suitable methods for tackling simultaneity. However, as instrumental variables are not utilized, explaining potential measurement errors or omitted important explanatory variables is challenging. Given the close relationship between corporate governance and operational risk with various financial indicators and company fundamentals, the study does not delve into the impact of other financial factors on operational risks.

Furthermore, while the paper extensively discusses path mechanism tests and the impact of intermediary variables on dependent variables by synthesizing existing literature and related theories, it lacks analysis and in-depth exploration of alternative transmission mechanisms.

Lastly, empirical research in this article focuses on Chinese listed companies, without comparative exploration of heterogeneity across other regions like the European Union and the United States. Consequently, variations in performance across different regions may exist due to differences in ESG ratings or regulatory frameworks. Thus, further investigation into regional disparities is essential for a comprehensive understanding of the study's findings.

7.2 Conclusion

This study examines the impact of corporate ESG performance on operational risk and its mechanisms, utilizing data from listed A-share companies in Shanghai and Shenzhen from 2013 to 2022. The findings indicate that improvements in ESG performance significantly reduce operational risks. Additionally, the mediating role of management expense ratio suggests that mitigating agency conflicts is a central mechanism by which ESG performance reduces operational risks. Heterogeneity analysis reveals that the influence of ESG performance on reducing operational risks is more pronounced in small-scale enterprises and in central China.

Based on these findings, this paper argues that enhancements in corporate ESG performance can initiate reductions in operational risks. For corporations, improving ESG performance is essential not only for sustainable social development but also for optimizing business models, enhancing market competitiveness, and fostering internal and external sustainable development. Operationally, there should be a greater emphasis on energy conservation, emission reduction, and green recycling practices, adhering to the principles of green

development and rational resource allocation. Socially, companies should actively participate in public welfare activities, strengthen their sense of responsibility and mission, and prioritize social welfare improvements in their production and operations. Regarding corporate governance, a comprehensive, systematic, and multi-layered optimization of the internal control system is crucial to address governance challenges and pain points, coordinate internal and external resource integration, and achieve systemic optimization through strategies that encompass finance, technology, logistics, and human resources, thereby keeping operational costs within reasonable limits to cultivate sustainable development deeply.

Moreover, in the process of reducing operational risks and enhancing ESG performance, it is essential to focus on key areas, follow a clear path, and plan systematically. During operations, attention must be directed towards agency costs, and cost management needs to be further refined and targeted. Comprehensive management should be strengthened from pre-planning and mid-process control to post-event feedback, keeping risks within a reasonable range. Beyond improving cost management and operational performance, enhancing ESG performance should also emphasize the quality and method of information disclosure, particularly regarding ESG performance. Timely and accurate disclosures of ESG information should be made to attract analysts and investors who are sensitive to ESG metrics, thereby enhancing their focus on the company and achieving risk reduction through the pathway of "Enhanced ESG Performance - Optimized Cost Management - Reduced Operational Risk."

Finally, consideration should be given to differences in corporate nature and geographical location to propose scientifically grounded measures for reducing operational risks. Companies should choose to enhance ESG performance or other methods to reduce operational risks based on their size, operational characteristics, and geographic location. Unlike strategies for small-scale enterprises in the central region, simply improving ESG performance may not be the most effective measure for large-scale enterprises in the eastern and western regions. These companies should also prioritize cost management, efficiency improvements, technological upgrades, R&D investments, and market expansion. On the other hand, the government and regulatory bodies should analyze specific issues, enhance the promotion of the ESG framework and principles, and establish comprehensive tax incentives and performance reward systems. Governments and regulators should introduce policies that support ESG performance enhancements, strengthen policy guidance, technology transfer,

and tax incentive coaching to maximize the ESG dividends for companies. They should also tailor support policies to ensure sustainable corporate operations, facilitating the popularization and development of green finance and creating a better investment environment.

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Appendix

Table 1: SNSI ESG rating indicators

3 pillars	16 themes	40+ key issues
Environment (E)	Climate Change	Greenhouse gas emissions, GHG emissions reduction roadmap, Response to climate change
	Resource Utilization	Water consumption, Land use and biodiversity, Material consumption
	Environmental Pollution	Industrial emissions, Electronic waste, Hazardous waste
	Environmentally Friendly	Renewable energy, Green buildings, Green factories
	Environmental Management	Sustainable certification, Environment penalty, Supply chain management - E
Social (S)	Human Capital	Employee health and safety, Employee inspiration and development, Employee relations
	Product Liability	Quality certification, Recall and complaints
	Supply Chain	Supplier risk and management, Supply chain relationship
	Community investment	Inclusion, Community investment, Employment, technology innovation
	Data Security and Privacy	Data Security and Privacy
Governance (G)	Shareholders' interest	Protection of shareholder's interests
	Governance Structure	ESG governance, Risk control, Board structure, Executive turnover
	Information Disclosure Quality	ESG external assurance, Credibility of information disclosure
	Governance Risk	Major shareholder behavior, Solvency, Litigation, Tax transparency
	External Punishment	Various external punishments
	Business Ethics	Business ethics, Anti-corruption

https://www.chindices.com/esg-ratings.html

Table 2: SNSI ESG Rating Industry Weight Setting

		Impact time		
		short term	medium term	long term
Influence level	high	highest weight →		decrease
	higher			
	middle	↓ decrease		
	lower			
	low			minimum weight
	none	weight is 0		

Table 3: Correspondence between ESG rating and ESG score

ESG rating	ESG score
AAA	score ≥ 95
AA	90 ≤ score <95
A	85 ≤ score <90
BBB	80 ≤ score <85
BB	75 ≤ score <80
B	70 ≤ score <75
CCC	65 ≤ score <70
CC	60 ≤ score <65
C	score <60