Thesis for the Degree of Master of Management of Technology

The Effect of Innovation and ESG on Corporate Financial Performance: Considering both Evaluation Grade and Balanced Score Perspectives

by

Dannah Ruth Galdonez

Graduate School of Management of Technology

Pukyong National University

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(혁신과 ESG가 기업 재무 성과에 미치는 영향: 평가등급 및 균형 점수를 고려하여)

Advisor: Prof. Dong Phil Chun

by

Dannah Ruth Galdonez

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Dannah Ruth Galdonez

Approved by:

(Chaiman) Prof. Ho Sung Son

(Member) Prof. Min Kyu Lee

(Member) Prof. Dong Phil Chun

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Dannah Ruth Galdonez

Graduate School of Management of Technology

Pukyong National University

Abstract

The environmental, social, and governance (ESG) framework is becoming a key component for companies to integrate into their operations, as it may enhance financial performance. While innovation enables companies to generate profits and distinguish themselves from their competitors, ESG practices attract investors and stakeholders. Companies may achieve competitive advantages and generate value by aligning their ESG goals with innovation. Research studies on the impact of ESG on CFP have produced mixed results. Whereas individual ESG activities and innovation significantly influence CFP, potentially enhancing a company's success. On the other hand, research considering both ESG grade and balanced score and their influence on innovation and CFP remains unexplored. We argue that by generating balanced ESG scores, firms will greatly enhance their value and have better financial returns. Thus, the purpose of this study is to examine how ESG performance affects the relationship between innovation and CFP. The study examines 336 Korean manufacturing companies from the KOSPI and KOSDAQ stock markets during 2020–2022. Financial data is collected from FN-Dataguide5, and ESG scores are gathered from the Korea Corporate Governance Service (KCGS). Using hierarchical regression analysis, the moderating effect of ESG on the relationship was explored. The results indicate that ESG performance can significantly moderate the relationship. The study's findings contribute to existing literature by emphasizing the need to balance E, S, and G scores instead of relying solely on the ESG grade from rating agencies. This balance is important for organizations aiming to enhance financial performance by integrating ESG practices into innovation activities.

Keywords: ESG grade, balance, innovation, financial performance

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혁신과 ESG가 기업 재무 성과에 미치는 영향: 평가등급 및 균형 점수를 고려하여

다나 루스 갈도네즈

기술경영전문대학원

부경대학교

초록

ESG(환경, 사회, 지배구조) 프레임워크는 기업 운영에 있어서 재무성과를 향상시킬 수 있는 핵심 요소로 자리 잡고 있다. 기업은 혁신을 통해 수익을 창출하고 경쟁력을 갖출 수 있으며, ESG 활동은 투자자와 이해관계자의 관심을 받을 수 있다. 또한 기업은 ESG 목표를 혁신과 연계하여 경쟁우위를 확보하고 가치를 창출할 수 있다. 기존 선행연구들은 ESG가 CFP에 미치는 영향에 대해 혼재된 결과가 나타났다. 반면에 개별 ESG 활동과 혁신은 CFP에 유의한 영향을 미쳐 잠재적으로 기업성과를 높이는 것으로 나타났다. 그러나 ESG 등급과 ESG 밸런스를 고려한 연구와 이들이 혁신 및 CFP에 미치는 영향력에 대해 살펴본 연구는 아직까지 많이 부족한 상태다. 기업은 균형잡힌 ESG 점수를 가지게 되면, 기업의 가치가 크게 향상되고 재무성과 개선에 도움이 될 것으로 보인다. 따라서, 본 연구는 2020~2022년 코스피 코스닥 주식시장의 336개의 한국 제조업 기업을 대상으로 ESG 성과가 혁신과 CFP에 어떠한 영향을 미치는지 살펴보고자 한다. 본 연구의 재무정보는 FN-Dataguide5에서 수집하였으며, ESG 점수는 한국기업지배구조원(KCGS)에서 수집하였고, 위계적 회귀분석을 이용하여 ESG의 조절효과를 살펴보았다. 그 결과, ESG 성과는 유의한 조절효과를 가짐을 확인하였다. 해당 연구는 ESG 평가기관의 ESG 등급에만 의존하지 않고, E, S, G 점수의 균형을 맞출 필요성을 강조함으로써 기존 연구와의 차별성을 가진다. 이러한 ESG 밸런스는 ESG와 혁신 활동을 통해 재무성과를 개선하고자 하는 기업에 도움이 될 것으로 보인다.

키워드: ESG 평가등급, 균형 점수, 혁신, 재무 성과

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1. Introduction

Research on the impact of innovation and environmental, social, and governance (ESG) on corporate financial performance is expanding globally (Broadstock et al., 2020; Tan and Zhu, 2022). Most studies agree that innovation is a crucial factor in generating profit and acquiring long-lasting competitive advantages (Coluccia et al., 2020; Zhang et al., 2020). However, measuring innovation remains a significant challenge due to the existence of various indicators. Some researchers utilize patents and patent citations (Qiang et al., 2023; Tan and Zhu, 2022), while others primarily rely on the most prominent indicator, research and development (Artz et al., 2010; Li et al., 2023). Research indicates that increasing research and development (R&D) investment and intensity can have a significant positive effect on a company's financial performance (Hand, 2001; Lin et al., 2006; Di Simone et al., 2022). This impact is observed in developing countries, where higher R&D intensity is associated with improved corporate financial performance (CFP). In developed nations, the positive relationship between R&D intensity and CFP is apparent across all levels of competition (Gupta et al., 2017). Additionally, R&D investment is found to have a positive influence on corporate social responsibility (CSR), particularly within the manufacturing sector (Padget and Galan, 2010). By investing in R&D, companies are able to enhance their technological capabilities, foster innovation, and increase productivity, thereby gaining a competitive advantage.

Similarly, there has been progressive growth in the implementation of ESG initiatives across various industries and academic disciplines. These initiatives were initially introduced in a report called 'Who Cares Win' by the United Nations' Principles

for Responsible Investing (PRI) in 2004. The driving force behind this growth is the potential financial benefits associated with ESG. ESG initiatives are likely to attract investors and increase stakeholders' interests, ultimately resulting in the increasing significance of ESG for companies worldwide (Cho, 2022; Chouaibi et al., 2022). Firms around the world are striving to enhance their sustainability in response to increasing pressure to "do good" (DasGupta, 2022; Kim et al., 2022; Tan and Zhu, 2022). The reason behind this is that in today's world, global investors and stakeholders are seeking profitable, diverse, and eco-friendly operations (dos Santos and Pereira, 2022) due to increasing concerns about climate change and other social and global issues.

In 2022, the KPMG Survey of Sustainability Reporting estimated that approximately 96% of large and midsize corporations worldwide are disclosing ESG activities. This is due to their recognition of the increasing concern regarding ESG as a potential risk to their business. Meanwhile, a concentration of environmental risks was observed in the ESG reporting of companies belonging to the N100 and G250 groups. In Korea, the demand for ESG is increasing, prompting government agencies and Korean companies to implement ESG practices (Do and Kim, 2020; Jin and Kim, 2022). In a survey conducted by the Federation of Korean Industries on '2023 ESG Trends', 93% of the leading 500 companies in Korea, out of a total of 100 respondents, expressed their commitment to upholding the scale of their ESG management. Korean companies are following the global trend by disclosing climate information according to the TCFD guidelines (Lee, 2023). For instance, domestic conglomerates like Samsung, SK, Hyundai, and POSCO are actively adopting ESG management as their strategy for survival (Koh et al., 2022). In addition, the Korean stock market is enhancing corporate

governance reporting for companies with over 2 billion assets, and it intends to expand and mandate sustainable management reports through improved corporate disclosure systems (Baek and Lee, 2023). However, Lee and Shin (2010) suggested that Korean consumers fail to sufficiently recognize corporate environmental initiatives. This is because in societies like South Korea, where collective values are prioritized, the significance of environmental factors may be relatively lower compared to cultures that emphasize individualism. The environmental aspects have the most significant issues among the three pillars, accounting for 82% of the overall issues. Meanwhile, social and governance aspects were both accounted for at 9% each (Industry News, 2023).

According to the United Nations, the manufacturing industry is considered to be one of the major contributors to greenhouse gas emissions on a global scale. The increasing environmental problems associated with manufacturing companies have become a subject of escalating global concern among researchers and practitioners (Kabongo, 2018). The manufacturing industry is accountable for more than 20% of the total emissions of greenhouse gases, and it is projected that this figure will rise significantly to approximately 28% by the year 2050 (Kazakova and Lee, 2022). As of the year 2019, the quantity of domestic net emissions in Korea reached a total of 660 million metric tons of carbon dioxide equivalent (CO_2-eq), whereby emissions originating from the manufacturing industry accounted for 380 million metric tons of CO_2-eq which is equivalent to 57.9% of the entire emissions inventory (Korea Development Institute Policy Forum, 2022).

Prior studies have yielded mixed results when examining the impact of ESG on corporate financial performance (Nirino et al., 2021; Lee et al., 2023). As per the findings of Friede et al. (2015), around 90% of 2200 individual studies demonstrated a

positive or 'non-negative' outcome (Nollet et al., 2016; Alkaraan et al., 2022; Chang and Lee, 2022). In some studies, a negative impact (Xie et al., 2018) or no statistically significant effect has been observed (Collucia et al., 2020). In addition, numerous studies have shown how individual E, S, and G activities have a distinct impact on a company's financial performance compared to its overall ESG performance (Cohen, 2023; Lee et al., 2023; Cheng et al., 2023). To put it in simpler terms, the financial performance of a company relies on the individual activities related to ESG activities. The outcome of these activities can vary depending on the company's environment, industry structure, and national characteristics (Baek and Lee, 2023). In the meantime, a multitude of studies have highlighted the substantial impact of innovation and ESG on financial performance. These studies consistently demonstrate that innovation and ESG initiatives have the potential to enhance firm performance (Alkaraan et al., 2022; Chouaibi et al., 2022; Zhang et al., 2020).

Generally, the impact of ESG, considering both the grade and balanced score perspective, and its influence on innovation and corporate financial performance have yet to be explored. Lee et al. (2023) argued that the existing research that utilizes combined ESG scores does not critically examine the assigned weightings for E, S, and G by rating agencies. Nevertheless, in firms that are ambidextrous, adaptive systems should aim for equally distributed weightings across E, S, and G activities to achieve consistent firm performance. Therefore, it is crucial to acknowledge that proportional expansion of the E, S, and G pillars has the potential to enhance firm value, particularly those with lower ESG efficiency (Cheng et al., 2023). Additionally, by aggregating the three pillars into more balanced ESG scores, they contribute value in terms of performance and risk. Thus, the purpose of this paper is to analyze how the ESG grade

and balanced scores affect firm performance (Giese et al., 2021).

In essence, this study contributes to the existing literature by determining the gap in the E, S, and G scores of a company to generate ESG-balanced scores. Specifically, it focuses on the distinction between the ESG grade by rating agency and the calculated E, S, and G balance, which offers a new perspective as a reference for future studies. The findings provide insight into the effect of ESG grades and balanced scores on the relationship between innovation and corporate financial performance. Firstly, there is a notable correlation between R&D intensity and financial performance. Secondly, the findings reveal that the ESG grade does not provide a significant influence on a firm's growth. However, if the score is balanced across all three dimensions, it has the potential to improve the financial performance of the firm by understanding the gaps between the three pillars. Lastly, the analysis reveals that the most significant factor among the three pillars of ESG is GOV, while ENV and SOC have a negative impact on the company's financial performance.

The subsequent five chapters are arranged as follows:

Chapter 2 explores the relevant related literature to formulate the hypotheses. The literature reviewed includes the relationship between innovation and corporate finance performance. In addition, existing literature about the effect of ESG performance and ESG ratings provided by the rating agency on firm performance was also presented.

Chapter 3 presents the sample and data, variable sources from previous studies, the ESG balance calculation method and formula, and the empirical models used based on existing literature.

Chapter 4 presents the empirical results of the analysis. Descriptive statistics, correlation analysis, and regression analysis results were given and analyzed to further understand the relationship.

Chapter 5 discusses the conclusion, summary of the research, implications, and limitations, as well as directions for future work.

2. Literature Review

This study explores the relationship between R&D intensity and corporate financial performance. The moderating effect of ESG performance is assessed by considering both the ESG grade by the rating agency and the calculated E, S, and G balance score. Furthermore, a thorough examination will be carried out to assess the specific impact of the individual ESG pillars.

2.1. Innovation and corporate financial performance linkage

The existing relevant literature pertaining to the linkage between corporate financial performance and innovation has yielded positive results. For instance, the study conducted by Chouaibi et al. (2022) reveals that companies that prioritize green innovation can enhance their overall financial performance. In the service industry, specifically in the context of hotels and casinos, Yoo et al. (2022) suggest that innovation can positively mediate the relationship between corporate social responsibility and corporate financial performance. Similarly, Farza et al. (2021) argue that environmental innovation can sustain the financial performance of large German enterprises, thereby creating a competitive advantage while also driving cost efficiency, especially during the Fourth Industrial Revolution.

Scholars have explored various proxies to measure innovation, with R&D intensity being a prominent one (Lin et al., 2006; Franzen et al., 2007; Padgett and Galan, 2010; Gupta et al., 2017). R&D intensity measurement is commonly utilized as an indicator of innovation, as it allows for the creation of new products and technologies, which is a vital aspect for all companies striving to compete in the global

market (Rodrigues et al., 2020; Baek and Lee, 2023). The metrics include R&D input and output (Li et al., 2022) and R&D elasticity (Collucia et al., 2020).

The effect of R&D on CFP varies greatly and tends to differ for each individual company (Coad and Grassano, 2019). Nevertheless, most research studies imply that increasing R&D intensity could greatly improve a company's financial performance (Hand, 2001; Lin et al., 2006; Padget and Galan, 2010; Gupta et al., 2017; Di Simone et al., 2022). In a study conducted on 258 technology companies located in the United States from 1985 to 1999, sales, in relation to commercialization, and R&D intensity strengthened each other (Lin et al., 2006). A study conducted by Gupta et al. (2017) on 75 countries from 2004 to 2013 found that R&D intensity positively impacts the CFP in developing nations, especially in less competitive industries, while in developed countries, it is evident across all competition levels. According to Padget and Galan (2010), there is a positive relationship between R&D investment and CSR, particularly in the manufacturing industries. Hand (2001) finds strong positive correlations between R&D intensity and market-to-ratio, indicating that R&D expenses impact growth opportunities. Di Simone et al.'s (2022) findings imply that a company's decision to combine growth opportunities with financial investment in R&D helps to increase economic sustainability.

It is widely acknowledged that innovation is crucial for the survival of any organization (Collucia et al., 2020; Coad and Rao, 2008). Specifically, R&D expenditure is often seen as an investment in intangible assets that can effectively enhance future cash flows (Chauvin and Hirschey, 1993). Furthermore, R&D investments contribute to technology capabilities, innovation, and productivity, thereby

providing a competitive advantage (Baek and Lee, 2023).

Hypothesis 1a: The relationship between innovation and ROA is significant

Hypothesis 1b: The relationship between innovation and growth significant

2.2. The moderating effect of ESG performance on the innovation-CFP link

2.2.1. ESG Grade

Most empirical studies focus on the relationship between ESG and CFP. However, these studies offer contradictory results.

As stated by Noller et al. (2016), the ESG grade is a useful tool to measure corporations' practices and their impact on the environment, society, and the business world. However, empirical studies on ESG and CFP provide mixed findings (Alkaraan et al., 2022; Chang and Lee, 2022; Broadstock et al., 2020; Giannopoulos et al., 2022; Lee and Baek, 2023; Xie et al., 2018; Collucia et al., 2020).

Earlier studies found that ESG practices strengthened the link between corporate transformation, Industry 4.0 disclosure, and financial performance (Alkaraan et al., 2022). In a high-growth industry like South Korea, ESG initiatives have been proven to have a positive impact on firm value (Chang and Lee, 2022). Likewise, adoption of CSR and ESG policies improves firms' ability to execute innovative activities, which eventually improves value creation and the company's financial performance

(Broadstock et al., 2020).

At low and high levels of disclosure, the total ESG score has a negative influence on a company's efficiency (Xie et al., 2018). In the case of Norwegian-listed companies from 2010 to 2019, there is a negative correlation between ESG scores and profitability (ROA) (Giannopoulos et al., 2022). Furthermore, Lee and Baek (2023) stated that the comprehensive ESG score has a negative effect on ROA. They mentioned that one possible explanation for this finding is the possibility of overlooking ESG management efficiency.

On the other hand, no statistically significant effect is observed when ESG integrates with Tobin's Q (Collucia et al., 2020). Avramov et al. (2022) expressed increasing concern about the different metrics and standards provided by different rating agencies. Investors are less likely to make ESG investments and actively engage with corporate ESG concerns because of rating uncertainty. For instance, ESG ratings from one agency may not replicate those of another, as interpretation remains difficult and various rating agencies have different criteria for ESG rating methodology (Berg et al., 2022). Moreover, ESG rating agencies' evaluation frameworks are primarily oriented toward the short-term effect on financial performance (Muñoz-Torres et al., 2019). Thus, it is important to note that the relationship between ESG and CFP is complex.

In terms of ESG and R&D, Lee and Baek (2023) stated that due to the limited resources within a company, there is often a trade-off between R&D investment and ESG activities, as both require substantial time and financial investment. Despite the possibility of conflicting results in numerous research studies, it is crucial to emphasize

that a high ESG grade remains important and will continue to be so in the coming years.

Hypothesis 2a: ESG grade can significantly moderate the innovation-ROA.

Hypothesis 2b: ESG grade can significantly moderate the innovation-growth.

2.2.2. Balance of ESG

Most of the research studies primarily concentrate on the relationship between the evaluation grade of ESG and corporate financial performance. The credibility of ESG ratings, however, is compromised due to the utilization of different methodologies and the absence of specific criteria to adhere to. This leads to uncertainty and limited alignment, ultimately affecting managers, investors, and researchers (Chatterji et al., 2016; Lee et al., 2023). Berg et al. (2022) found that the disparity in ESG ratings is linked to a fundamental dispute about the underlying data rather than differing definitions. This suggests that different rating agencies hold different perspectives on the crucial aspects of ESG assessment. Therefore, this controversy presents challenges when it comes to assessing ESG performance. As a result, this gives rise to less favorable conditions for advancing ESG principles in the market.

In order to resolve this matter, it is necessary to establish a balance between the E, S, and G activities (Lee et al., 2023). The concept of ESG balance is a recent development that demands comprehensive analysis from both the academic and business sectors. A significant gap becomes apparent when comparing the ESG grade of rating agencies to the balanced ESG score and their overall effects on financial

performance.

Koh et al. (2022) revealed that not all ESG activities result in the same levels of effectiveness. The primary conflict in ESG policies is the discordance between the "G" and the "E" and "S," as reported in a Harvard Business Review article (Strine et al., 2022). A balance among the three dimensions must be established, even if there are any potential conflicts that may arise between them (Hansmann et al., 2012).

According to Giese et al. (2021), a more balanced and industry-specific weight allocation of E, S, and G showed greater long-term significance. They contended that governance metrics had an immediate impact on financial outcomes, whereas environmental and social factors had a gradual yet lasting effect. Nonetheless, achieving sustainable success for a firm demands the balance of these three integral components. This denotes that firms must strive to attain financial success while also taking into account the social and environmental consequences of their operations (Edgeman and Eskildsen, 2014).

Cheng et al. (2023) propose that companies can enhance their ESG performance by adjusting the values of the sub-pillars within the ESG framework. This can be attained by enhancing certain indicators while reducing others or by strengthening all pillars equally. Overall, ESG performance has a considerable influence on a company's perception, reputation, stakeholder interests, and capacity to attain sustainable financial success (Chouabi et al., 2020; Nirino et al., 2021; Tan and Zhu, 2022).

A recent study by Lee et al. (2023) explored the connection between ESG grade by a third-party rating agency and balanced weighted ESG scores in regards to firm

performance. The findings of the study suggest that engaging in balanced E, S, and G activities is linked to the highest level of firm performance. In addition, it was concluded that the negative impact on company performance is derived from the percentage difference between the ESG rating agency's grade and the balanced ESG scores.

Hypothesis 2c: ESG balanced scores can significantly moderate the innovation-ROA.

Hypothesis 2d: ESG balanced scores can significantly moderate the innovation-growth.

2.3. The moderating effect of ESG sub-pillars on the innovation-CFP link

Presently, the majority of research studies include the effect of individual ESG sub-pillars on financial performance. These studies analyze how individual ESG scores influence the value creation of a firm.

In order to fully comprehend the influence of the three pillars on a company's ESG performance, it is essential to understand their individual significance. The Porter hypothesis (1991) suggests that environmentally damaging businesses can benefit from environmental policies. The hypothesis suggests that strict environmental regulations might serve as a catalyst for innovation. This, in turn, could lead to an improvement in the efficiency or quality of products for end users (Leeuwen and Mohnen, 2017). In reference to social activities, good corporate social conduct that entails corporate donations is likely to lead to advantageous financial outcomes in the long term

(Brammer and Millington, 2008). Moreover, multiple studies demonstrated positive correlations between corporate governance and CFP, including independent directors (Zhu et al., 2016) and board gender diversity (Terjesen et al., 2016).

Among the three ESG pillars, corporate governance is widely regarded as having a more favorable influence on innovative performance (Zhang et al., 2020). Furthermore, it provides the most efficient predictions for future fundamentals. Thereby, it attracts a larger group of investors (Pedersen et al., 2021) and acts as the main mechanism by which CSR commitment leads to increased CFP (Nollet et al., 2016). Cheng et al. (2023) expounded that governance (G) is a well-established concept, in contrast to environmental (E) and social (S), which are relatively new concepts. They added that firms with a long-standing tradition of good corporate governance may consider reallocating some resources from G to E and S. This will enhance the likelihood of enhancing their overall ESG performance.

Although most studies indicate that strong governance plays a crucial role in determining a firm's financial success, we must not overlook the significant impact that environmental and social factors have on achieving sustainable value for the firm.

Hypothesis 3a: Environmental dimension can significantly moderate the innovation-ROA.

Hypothesis 3b: Environmental dimension can significantly moderate the innovation-growth.

Hypothesis 3c: Social dimension can significantly moderate the innovation-ROA.

Hypothesis 3d: Social dimension can significantly moderate the innovation-growth.

Hypothesis 3e: Governance dimension can significantly moderate the innovation-ROA.

Hypothesis 3f: Governance dimension can significantly moderate the innovation-growth.

Figure 2.1 provides an overview of the research model and the hypotheses proposed in the study.

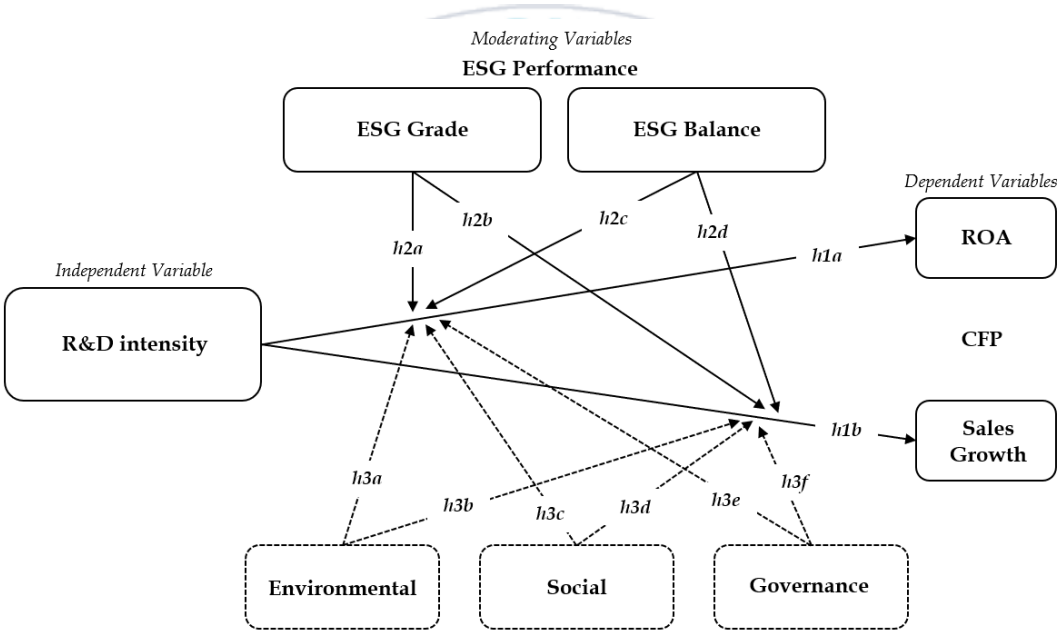

Figure 2.1. Research model and hypotheses

3. Methodology

3.1. Sample and Data

The sole institution that publishes the ESG code of best practices in South Korea is Korea Institute of Corporate Governance and Sustainability (KCGS), from which the ESG data were obtained. The KCGS provides relevant, verifiable, and systematic ESG metrics and data to institutional and professional investors in Korea (Lee et al., 2016). The KCGS rating methodology incorporates a standard evaluation process that seeks to minimize ESG risks. Additionally, if there is any ESG-related issue that may potentially diminish corporate value, an in-depth analysis is conducted. Standard evaluation has a total of 24 major categories and 323 evaluation items for ESG rating models, while in-depth analysis has 57 evaluation items. Figure 3.2 shows the KCGS ESG rating models.

ESG Rating Models

Category	Environmental (E)	Social (S)	Governance (G)	Governance for FIs (FG)
Standard Evaluation	4 major categories, 103 evaluation items - leadership & governance - risk management - operation & performance - stakeholder communication	9 major categories, 53 evaluation items - labor practice - workplace safety & health - human rights - fair operation practice - sustainable consumption - information & privacy protection - local community engagement and development - stakeholder communication	4 major categories, 70 evaluation items - board leadership - shareholder rights protection - auditing - stakeholder communication	7 major categories, 97 evaluation items - board - shareholder rights protection - CEO - remuneration - risk management - auditing body & internal control - stakeholder communication
In-Depth Analysis	10 evaluation items - violation of environmental laws - climate change risk - environmental accidents, etc.	10 evaluation items - unethical labor practice - frequent workplace accidents - unfair trade - violation of consumer rights, etc.	19 evaluation items - violation of governance laws - inappropriate agenda for shareholders' meetings - performance-irrelevant pay raises - controversial related-party transactions, etc.	18 evaluation items - violation of accounting rules - sanctions from financial authorities - designation as unfaithful disclosure corporation - negative auditor opinion, etc.

Figure 3.2. KCGS ESG rating models

The financial data were extracted from FN-Dataguide5, and the sample selection consists of 336 manufacturing firms in South Korea, 284 firms from KOSPI, and 98 firms from the KOSDAQ stock market for the period of 2020–2022. KOSPI operates as the stock market for major corporations operating in various sectors, while KOSDAQ primarily serves technology enterprises. A hierarchical regression model was used to investigate the impact of innovation, ESG comprehensive and individual scores, and balanced ESG scores on financial performance, specifically in terms of profitability (return on assets) and growth (sales growth). Table 3.1 provides a summary of the demographic information pertaining to manufacturing companies listed on KOSPI and KOSDAQ with ESG ratings.

Table 3.1. Demographic information of KOSPI and KOSDAQ-listed manufacturing companies with ESG ratings

한국표준산업분류10차 (중분류)	Korean Standard Industrial Classification	Company Count	Percentage
1차 금속 제조업	Primary metal manufacturing	20	6%
가구 제조업	Furniture manufacturing	4	1%
가죽, 가방 및 신발 제조업	Leather, bag and shoe manufacturing	4	1%
고무 및 플라스틱제품 제조업	Rubber and plastic products manufacturing	16	5%
금속가공제품 제조업; 기계 및 가구 제외	Fabricated metal products manufacturing; excluding machinery and furniture	6	2%
기타 기계 및 장비 제조업	Other machinery and equipment manufacturing	28	8%
기타 운송장비 제조업	Other transportation equipment manufacturing	8	2%
기타 제품 제조업	Other product manufacturing	1	0%
목재 및 나무제품 제조업; 가구 제외	Wood products manufacturing; excluding furniture	4	1%

비금속 광물제품 제조업	Non-metallic mineral products manufacturing	17	5%
섬유제품 제조업; 의복제외	Textile product manufacturing; except apparel	4	1%
식료품 제조업	Food manufacturing	17	5%
의료, 정밀, 광학기기 및 시계 제조업	Medical, precision, optical and watchmaking manufacturing	8	2%
의료용 물질 및 의약품 제조업	Medical substance and drug manufacturing	60	18%
의복, 의복 액세서리 및 모피제품 제조업	Clothing, clothing accessories and fur products manufacturing	6	2%
자동차 및 트레일러 제조업	Automobile and trailer manufacturing	25	7%
전기장비 제조업	Electrical equipment manufacturing	9	3%
전자부품, 컴퓨터, 영상, 음향 및 통신장비 제조업	Electronics, computer, video, audio, and telecommunications equipment manufacturing	40	12
코크스, 연탄 및 석유정제품 제조업	Coke, briquettes and petroleum refinery manufacturing	1	0%
펄프, 종이 및 종이제품 제조업	Pulp, paper and paper products manufacturing	7	2%
화학물질 및 화학제품 제조업; 의약품 제외	Chemicals and chemical product manufacturing; excluding pharmaceuticals	51	15%
TOTAL		**336**	

3.2. Variables

According to Zhou et al. (2022), the evaluation of financial performance is categorized into indices of profitability, operating ability, and growth ability. This study focuses on the dependent variables of return on assets (ROA), which is a measure of profitability, and sales growth, which reflects the growth ability index. Return on Assets (ROA) is commonly employed as an accounting measure of performance (Waddock

and Graves, 1997; Farza et al., 2021), as it is considered more reliable and stable compared to the return on sales (Xie et al., 2019). Similarly, Sales Growth (GROWTH) is a growth index determined by an annual percentage change in total sales (Filatotchev and Piesse, 2009).

The main independent variable in this study is the level of investment in research and development, referred to as R&D intensity (R&D int). This measurement is calculated by dividing the expenses incurred on research and development by the total assets of the company (Lin et al., 2006; Franzen et al., 2007; Padgett and Galan, 2010; Gupta et al., 2017).

The moderating variable is ESG performance, which is divided into two components: [1] ESG grade and [2] ESG balance. Environmental, social, and governance (ESG) factors play a crucial role in creating long-term value. Therefore, we argue that achieving a balance among the sub-pillars of ESG holds great significance. Additionally, we take into account the moderating effect of the three individual components of ESG (i.e., ENV, SOC, and GOV). The KCGS assigns ESG grades with letter marks using a descending seven-point scale (S, A+, A, B+, B, C, and D). Figure 3.3 displays the KCGS ESG rating grades.

Figure 3.3. KCGS ESG rating grades

Subsequently, we convert these letter markings into numerical scores on a scale ranging from 7 (S) as the highest score, representing exceptional ESG performance, to 1 (D) as the lowest. Table 3.2 illustrates the conversion of ESG ratings into numerical scores.

Table 3.2. ESG rating to numerical score

ESG Rating	Score Equivalent
S	7
A+	6
A	5
B+	4
B	3
C	2
D	1

Following the conversion of the scores into numerical values, we obtained the ESG dummy variables represented by the values of 1 and 0. In the case of ESGT, ENV, SOC, and GOV variables, if the score surpasses the average score, the dummy variable will be assigned a value of 1; otherwise, it will be assigned a value of 0 (Score>Average = 1; 0).

On the contrary, the ESG balance dummy variable adopts a different approach. Rather than relying on the average score, we opted to employ the median as a means to identify the central value. A score surpassing the median suggests a considerable gap among the scores and a low level of balance, thereby necessitating a value of 0. Conversely, a low gap signifies a high level of balance, resulting in a value of 1. In summary, 1 denotes a low gap with high level of balance, while 0 signifies a high gap with low level of balance (Score>Median = 0; 1).

The controls are firm size (SIZE), which is the natural logarithm of net sales; firm age (AGE), the current year minus the year of incorporation; leverage ratio (LEV), total debt over total assets; liquidity (LIQ), the natural logarithm of cash and cash equivalents; and finally, total asset turnover (TAT). These variables were selected based on previous studies on the link between innovation and corporate financial performance. SIZE is expected to positively impact the CFP and R&D link, as larger firms have more resources for social and environmental initiatives and are more sensitive to financial performance improvement through corporate governance (DasGupta, 2022; Zhou et al., 2022). AGE is expected to have a negative effect, as older firms may be less adaptable to new market conditions and stakeholder demands, leading to lower growth rates (Coad et al., 2016; DasGupta, 2022). LEV also negatively impacts firms' financial and risk-taking abilities due to higher debt levels (Chouaibi et al., 2022; Godfrey et al., 2009; Zhou et al., 2022). LIQ positively impacts firms' liquidity levels, indicating better financial performance (DasGupta et al., 2023; Li et al., 2012). Total Asset Turnover (TAT) also has a positive influence on the relationship between innovation and CFP. This is due to a higher TAT reflects increased operational efficiency and productivity (Qiang et al., 2023; Zhou et al., 2022).

Table 3.3 provides an overview of the variables, organized by year, description, and sources.

Table 3.3. Summary of variables and data sources

	Variable	Year	Description	Data sources
Independent Variable	**R&D Intensity**	2020	R&D expenses to total assets	Lin et al., 2006; Franzen et al., 2007; Padgett and Galan, 2010; Gupta et al., 2017
Dependent Variable	**Profitability (ROA)**	**2022**	Net income to total assets	Waddock and Graves, 1997; Farza et al., 2021; Xie et al., 2019
Dependent Variable	**Growth (Sales Growth)**	**2022**	Annual percentage change in total sales	Filatotchev and Piesse, 2009
Moderator	**ESGT**	2021	ESG Grade dummy (Score>Ave=1, 0)	Nollet et al., 2016
Moderator	**ESGBal**	2021	Calculated ESG Balance score dummy (Score>Med=0, 1)	Cheng et al., 2023; Lee et al., 2023
Moderator	**ENV**	2021	ENV Score dummy (Score>Ave=1, 0)	Leeuwen and Mohnen, 2017
Moderator	**SOC**	2021	SOC Score dummy (Score>Ave=1, 0)	Brammer and Millington, 2008
Moderator	**GOV**	2021	GOV Score dummy (Score>Ave=1, 0)	Zhu et al., 2016; Terjersen et al., 2016
Control Variable	**Firm Size (SIZE)**	2022	Natural logarithm of total assets	DasGupta, 2022; Zhou et al., 2022
Control Variable	**Firm Age (AGE)**	2022	Current year minus year of incorporation	Coad et al., 2016; DasGupta, 2022
Control Variable	**Leverage Ratio (LEV)**	2022	Total debt to total asset	Godfrey et al., 2009; Chouaibi et al., 2022; Zhou et al., 2022
Control Variable	**Liquidity (LIQ)**	2022	Natural logarithm of cash and cash equivalents	Li et al., 2012; DasGupta et al., 2023
Control Variable	**Total Asset Turnover (TAT)**	2022	Total Asset Turnover	Zhou et al., 2022, Qiang et al.,2023

3.3. Calculation of ESG balance

The ESG balance is determined by calculating the highest numerical score of the three pillars and subtracting it from the lowest score, just as shown in equation 1. The primary reason for using this methodology is because our main objective is to determine the gaps or discrepancies in individual ESG scores. This derives from our contention that the larger the gap between the E, S, and G scores of a company, the less balanced the distribution of resources for ESG activities. We consider that the difference between the highest and lowest scores will indicate the gap between the individual scores. Hence, this methodology will help determine the balanced distribution among the three ESG pillars.

In this case, rather than employing the average or mean score, we opt for the median score, as it is a more fitting choice in the presence of outliers, as the median enables us to ascertain the central value in a data set. When the score exceeds the median, the disparity is accordingly larger, thus resulting in a lower balance. Conversely, when the score is below the median, the gap decreases, indicating a higher balance.

$$ESGBalance = max_m - min_m \quad (1)$$

Herein, max refers to the maximum value among the three ESG pillars, while min is the minimum value. The m is the representation of e, s, and g. Therefore, the calculation of ESG balance can be seen from the expression (maximum value of E/S/G score) minus (minimum value of E/S/G score).

3.4. Empirical Model

We conducted an empirical examination of the proposed hypotheses pertaining to the relationship between R&D intensity and CFP. We also investigate the potential moderating influence of ESG performance. This was accomplished through the utilization of a hierarchical regression analysis (Zhang et al., 2020; Khoury et al., 2022). A hierarchical regression analysis is conducted to analyze the effect of independent variables on dependent variables while considering the influence of moderating variables. CFP was separated into profitability (ROA) and growth (sales growth).

The estimation model included a one-year lag for moderating variables and a two-year lag for the main independent variable. A lag in the estimation model is essential for effectively assessing the relationship between variables (Velte, P., 2017; Guenther, E.M., and Hoppe, 2014). Meanwhile, the hierarchical regression analysis, a commonly utilized statistical method, was conducted using SPSS 27. To test the hypotheses, the following regression equations apply:

CFP – **ROA**

Model 1 examines the direct relationship between the dependent variable ROA for firm i and time t, and the independent variable R&D intensity for firm i at time t-2. The model also includes a number of control variables that can influence the direct relationship between the variables, as depicted in Equation 2.

$$ROA_{i,t} = \beta_0 + \beta_1 R\&Dint_{i,t-2} + \beta_2 CONTROLS_{i,t} + \varepsilon_{i,t} \quad (2)$$

In Model 2, the moderating variables ESGT and ESGBal for firm i at time t-1 were introduced into the analysis (Equation 3). On the other hand, in a separate analysis, moderating variables ENV, SOC, and GOV were also introduced (Equation 4).

$$ROA_{i,t} = \beta_0 + \beta_1 R\&Dint_{i,t-2} + \beta_2 CONTROLS_{i,t} + \beta_3 ESGT_{i,t-1} + \beta_4 ESGBal_{i,t-1} + \varepsilon_{i,t} \quad (3)$$

$$ROA_{i,t} = \beta_0 + \beta_1 R\&Dint_{i,t-2} + \beta_2 CONTROLS_{i,t} + \beta_3 ENV_{i,t-1} + \beta_4 SOC_{i,t-1} + \beta_5 GOV_{i,t-1} + \varepsilon_{i,t} \quad (4)$$

In Model 3, the interactive terms between independent and moderating variables (Equations 5 and 6) were added to the analysis to test the hypotheses.

$$ROA_{i,t} = \beta_0 + \beta_1 R\&Dint_{i,t-2} + \beta_2 CONTROLS_{i,t} + \beta_3 ESGT_{i,t-1} + \beta_4 ESGBal_{i,t-1} + \beta_5 R\&Dint_{i,t-2} * ESGT_{i,t-1} + \beta_6 R\&Dint_{i,t-2} * ESGBal_{i,t-1} + \varepsilon_{i,t} \quad (5)$$

$$ROA_{i,t} = \beta_0 + \beta_1 R\&Dint_{i,t-2} + \beta_2 CONTROLS_{i,t} + \beta_3 ENV_{i,t-1} + \beta_4 SOC_{i,t-1} + \beta_5 GOV_{i,t-1} + \beta_6 R\&Dint_{i,t-2} * ENV_{i,t-1} + \beta_7 R\&Dint_{i,t-2} * SOC_{i,t-1} + \beta_8 R\&Dint_{i,t-2} * GOV_{i,t-1} + \varepsilon_{i,t} \quad (6)$$

CFP – **GROWTH**

Model 1 investigates the direct correlation between the dependent variable growth for firm i and time t, and the independent variable R&D intensity for firm i at time t-2.

The model also incorporates various control variables (Equation 7).

$$GROWTH_{i,t} = \beta_0 + \beta_1 R\&Dint_{i,t-2} + \beta_2 CONTROLS_{i,t} + \varepsilon_{i,t} \quad (7)$$

In Model 2, the analysis introduced the moderating variables ESGT and ESGBal (Equation 8) for firm i at time t-1. Additionally, in a separate analysis, ENV, SOC, and GOV were added (Equation 9).

$$GROWTH_{i,t} = \beta_0 + \beta_1 R\&Dint_{i,t-2} + \beta_2 CONTROLS_{i,t} + \beta_3 ESGT_{i,t-1} + \beta_4 ESGBal_{i,t-1} + \varepsilon_{i,t} \quad (8)$$

$$GROWTH_{i,t} = \beta_0 + \beta_1 R\&Dint_{i,t-2} + \beta_2 CONTROLS_{i,t} + \beta_3 ENV_{i,t-1} + \beta_4 SOC_{i,t-1} + \beta_5 GOV_{i,t-1} + \varepsilon_{i,t} \quad (9)$$

In Model 3, we included the analysis of Equations 10 and 11, which consist of the interactive terms between independent and moderating variables, to examine the hypotheses.

$$GROWTH_{i,t} = \beta_0 + \beta_1 R\&Dint_{i,t-2} + \beta_2 CONTROLS_{i,t} + \beta_3 ESGT_{i,t-1} + \beta_4 ESGBal_{i,t-1} + \beta_5 R\&Dint_{i,t-2} * ESGT_{i,t-1} + \beta_6 R\&Dint_{i,t-2} * ESGBal_{i,t-1} + \varepsilon_{i,t} \quad (10)$$

$$GROWTH_{i,t} = \beta_0 + \beta_1 R\&Dint_{i,t-2} + \beta_2 CONTROLS_{i,t} + \beta_3 ENV_{i,t-1} + \beta_4 SOC_{i,t-1} + \beta_5 GOV_{i,t-1} + \beta_6 R\&Dint_{i,t-2} * ENV_{i,t-1} + \beta_7 R\&Dint_{i,t-2} * SOC_{i,t-1} + \beta_8 R\&Dint_{i,t-2} * GOV_{i,t-1} + \varepsilon_{i,t} \quad (11)$$

Where *i* refers to the firm and *t* to time.

$CFP_{i,t}$ signify the corporate financial performance (ROA and GROWTH) of firm *i* in year *t*.

$R\&Dint_{i,t-2}$ denotes the R&D intensity of firm *i* in year *t-2*.

$ESGT_{i,t-1}$ represents the ESG grade dummy, having a value of 1 for the ESG score greater than the average total score and 0 otherwise for firm *i* in year *t-1*.

$ESGBal_{i,t-1}$ is calculated ESG Balance and converted into a dummy variable, having a value of 0 if the score greater than the median score and 1 otherwise for firm *i* in year *t-1*.

$ENV_{i,t-1}$, $SOC_{i,t-1}$, and $GOV_{i,t-1}$ indicate the individual E, S, and G dummy scores of 1 greater than the average score, otherwise 0 for firm *i* in year *t-1*.

Controls include firm size (*SIZE*), firm age (*AGE*), leverage (*LEV*), liquidity (*LIQ*), and total asset turnover (*TAT*) firm *i* in year *t*.

β for beta. $\beta 1$ is the slope coefficient of R&D intensity, and $\beta 2$ is the coefficient of control variables. $\beta 3$–$\beta 5$ refers to the coefficients of moderators ESGT, ESGBal, and individual ENV, SOC, and GOV. $\beta 6$–$\beta 8$ is the coefficient of interactive variables.

$\varepsilon_{i,t}$ is the error term of the firm *i* in year *t*.

3.5. Comparison of ESGT and ESGBal

Figure 3.4 depicts the comparison in percentage between ESGT and ESGBal scores. In the context of ESGT, out of a sample of 336 manufacturing firms, only 1% possess an evaluation grade of A+ (6), while 17% attain an evaluation grade of A (5). Furthermore, 18% of the firms received a B+ grade (4), while 31% achieved a B grade (3). The remaining 33% of the firms obtained a C grade (2), with only 1% being awarded a D grade (1).

In comparison, using our calculation method for ESGBal to determine the gaps in score in individual firms, 9% have a balanced score (0 gap), indicating that there is no gap between the scores. Additionally, 37% is well balanced (1 score gap), and 38% is fairly balanced (2 score gaps). Furthermore, 15% is poorly balanced (3 score gaps), while only 1% is not balanced, with 4 gaps in score.

We perform further analysis by employing a paired t-test to determine the mean difference between ESGT and ESGBal. A paired t-test determines whether the two sets of data are unrelated or if the observations from one set are linked to specific observations from the other set, establishing their paired nature (Sherwood and Pollard, 2018; Paradis and Schiehll, 2021).

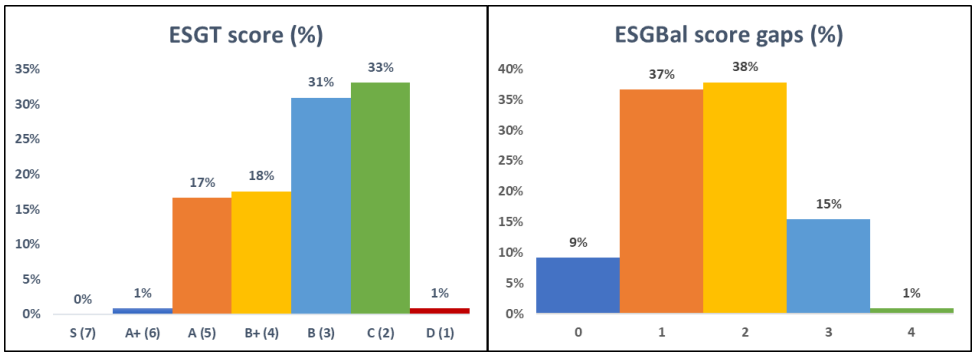

Figure 3.4. ESGT and ESGBal scores comparison

Figure 3.5 represents the research framework of this study. The main objective is to comprehend the direct influence of ESG performance on the relationship between innovation (R&D intensity) and corporate financial performance.

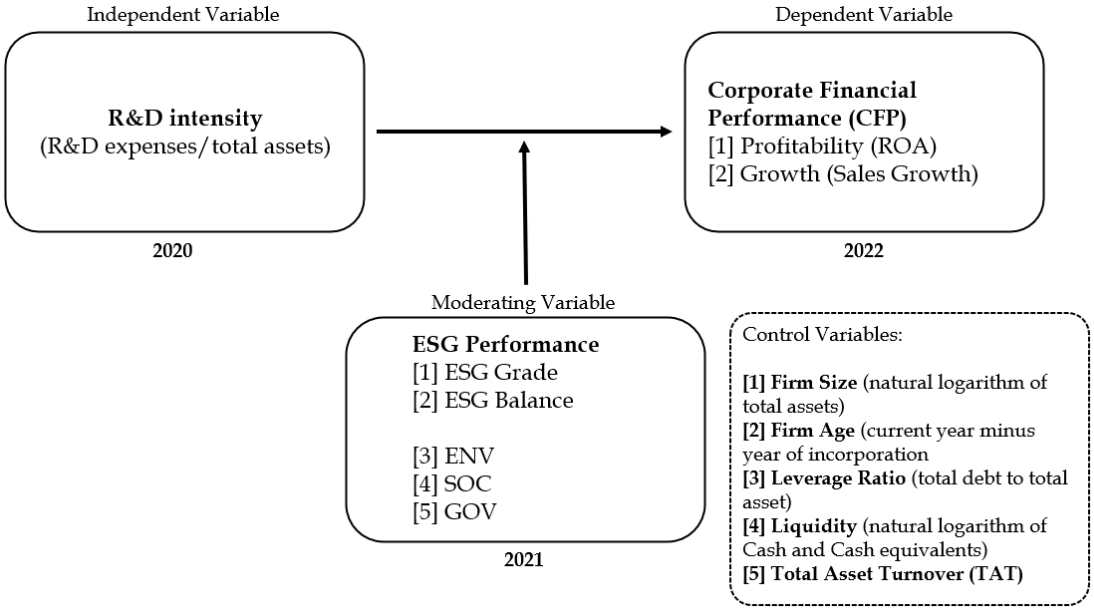

Figure 3.5. Research Framework

4. Empirical Results

4.1. Descriptive Statistics

4.1.1. Descriptive statistics of variables

Table 4.4 presents the descriptive statistics for the R&D intensity, CFP, ESG, and control variables. The dependent variable, ROA (profitability), exhibits a mean value of 2.28, with a minimum value of -34.085 and a maximum value of 30.43. In terms of growth, the mean value is 19.25, with a minimum value of -52.21 and a maximum value of 1168.19.

The mean value of R&D intensity is 0.02, with a minimum of 0.00 and a maximum of 0.53. Comparatively, the mean value of ESGBal, amounting to 0.84, surpasses the mean value of ESGT, which stands at 0.35. Among all the indicators of ESG performance, ESGT demonstrates the lowest value. This finding implies that companies with well-balanced ESG scores tend to have the highest level of performance (Lee et al., 2023).

Table 4.4 further illustrates the significant difference in the sub-pillars of Environmental, Social, and Governance (ESG). By examining the performance indicators of ESG, it becomes evident that the sub-pillar of Governance (GOV) exhibits the highest average mean of 0.64, while the sub-pillar of Social (SOC) demonstrates the lowest average mean of 0.38. The sub-pillar of Environment (ENV) has an average mean value of 0.49. These findings align with the research conducted by Nollet et al. (2016) and Giese et al. (2021).

Table 4.4. Descriptive statistics of variables

	N	Minimum	Maximum	Mean	Std. Dev.
Panel A: Financial Performance					
ROA	336	-34.08	30.43	2.28	8.60
GROWTH	336	-52.21	1162.19	19.25	68.33
Panel B: Market-Perceived Innovation					
R&D intensity	336	0.00	0.53	0.02	0.04
Panel C: ESG Performance					
ESGT	336	0.00	1.00	0.35	0.48
ESGBal	336	0.00	1.00	0.84	0.37
ENV	336	0.00	1.00	0.49	0.50
SOC	336	0.00	1.00	0.38	0.49
GOV	336	0.00	1.00	0.64	0.48
Panel D: Control Variables					
SIZE	336	17.00	27.00	20.39	1.48
AGE	336	2.00	124.00	38.38	21.34
LEV	336	0.00	76.71	23.83	16.40
LIQ	336	13.00	24.00	17.62	1.82
TAT	336	0.00	12.04	0.89	0.45

4.1.2. Descriptive statistics of firm characteristics

Table 4.5 illustrates the descriptive statistics on the basic firm characteristics of the sample of 336 manufacturing firms. The mean values for total assets, equity, and liabilities are 43.13 billion won, 25.59 billion won, and 17.52 billion won, respectively. Additionally, the average total sales amount to 34.95 billion won. Finally, the average operating income for the observed period is 2.70 billion won.

The mean values of total assets and total sales are the highest, while the operating income is the lowest. This suggests that manufacturing companies are making significant investments in fixed assets such as machinery and equipment in order to enhance their production capacity. As a result, the company's total assets will increase,

and there is a possibility of long-term sales growth. However, this also leads to higher depreciation expenses and a decrease in operating income in the short term.

Table 4.5. Descriptive statistics on the basic firm characteristics of the sample manufacturing companies (in billion won)

	N	Minimum	Maximum	Mean	Std. Dev.
Total Assets	336	0.32	4,484.25	43.13	263.72
Total Equity	336	0.04	3,547.50	25.59	200.44
Total Liabilities	336	0.03	936.75	17.52	71.24
Total Sales	336	0.05	3,022.31	34.95	188.83
Operating Income	336	-20.85	433.77	2.70	24.57

4.1.3. Paired t-test result

Table 4.6 displays the results of paired t-tests that compare the means of ESGT and ESGBal. The findings indicate that there was a significant difference in the ESGT (M = 0.3512, SD = 0.47805) and the ESGBal (M = 0.8363, SD = 0.37055) conditions. The *t-value* was -16.618, with 335 *degrees of freedom (df)* and a *p-value* of 0.000.

Table 4.6. Paired t-test of ESGT and ESGBal

	Mean	N	Std. Deviation	t	df	Sig
ESGT	0.3512	336	0.47805	-16.618	335	0.000
ESGBal	0.8363	336	0.37055			

4.2. Correlation Analysis

The findings of the correlation analysis suggest that there is significant evidence of a relationship between the independent and dependent variable. This can be observed

in Table 4.7. The R&D intensity exhibits a positive correlation with growth, with a coefficient of 0.552 ($p < 0.01$). However, there is no apparent correlation between ROA and R&D intensity.

The control variables SIZE, LEV, and TAT exhibit a positive correlation with ROA (0.205, 0.229, 0.180; $p < 0.01$, respectively). On the contrary, the company's leverage (LEV) shows a notable negative correlation with profitability (-0.286, $p < 0.01$). It can be attributed to the company's higher debt level, which does not generate any financial profits. This outcome aligns with previous findings (Chouaibi et al., 2022; Godfrey et al., 2009; Zhou et al., 2022).

Lastly, there is a notable correlation between R&D intensity and ESGBal (-.124, $p < .05$), hence in a negative direction. Among all the ESG performances, only the GOV is associated with sales growth (.109, $p < .05$). This implies that companies with enhanced governance practices may have a higher potential for growth, in line with the findings of several previous studies (Nollet et al., 2016; Zhang et al., 2020; Pedersen et al., 2021). Nevertheless, it is worth highlighting that the majority of the indicators of ESG performance are positively linked to one another.

4.3 Regression Analysis Results

4.3.1. ESG Performance

The empirical analysis has revealed a correlation between the financial performance of corporations, specifically their return on assets (ROA) and growth, and

R&D intensity. This correlation is illustrated in Table 4.8. Furthermore, this analysis takes into consideration the moderating influence of the ESG grade by the rating agency (ESGT) and the balanced ESG score (ESGBal). These variables are examined to test hypotheses 1 and 2.

The findings show that R&D intensity does not have a significant impact on profitability, specifically the return on assets (ROA). In contrast, with regards to sales growth, the R&D intensity demonstrates a noteworthy and favorable impact. This is evident in models 1, 2, and 3 at the 1% level of significance ($\beta = 879.451$, $p < 0.01$; $\beta = 878.663$, $p < 0.01$; and $\beta = 2043.255$, $p < 0.01$). Therefore, it can be deduced that hypothesis 1 is partly supported.

Table 4.8 exhibits supplementary evidence pertaining to the relationship between R&D intensity, ESGT, and ESGBal on CFP. Within the framework of profitability (ROA), the findings indicate that ESGT has a detrimental influence ($\beta = -3.100$, $p < 0.1$). Moreover, the interaction coefficient between R&Dint and ESGT is positive ($\beta = 56.982$, $p < 0.05$), whereas R&Dint and ESGBal display a negative moderating effect ($\beta = -44.803$, $p < 0.05$). This observation is reflected in Model 3. On the contrary, in terms of the growth index, ESGBal exhibits a favorable impact ($\beta = 34.504$, $p < 0.01$). Meanwhile, no statistical significance is observed in the interaction terms of R&Dint and ESGT. However, the interactive coefficient between R&Dint and ESGBal is negative ($\beta = -1992.831$, $p < 0.01$). Hence, hypothesis 2 is partially supported.

Table 4.7. Correlation analysis

	ROA	GROWTH	R&Dint	ESGT	ESGBal	ENV	SOC	GOV	SIZE	AGE	LEV	LIQ	TAT
ROA	1												
GROWTH	.102	1											
R&Dint	-.081	**.552****	1										
ESGT	.060	.036	.003	1									
ESGBal	.001	-.107	**-.124***	**.283****	1								
ENV	.079	-.018	-.073	**.845****	**.583****	1							
SOC	.039	.018	.047	**.888****	**.206****	**.757****	1						
GOV	.071	**.109***	.038	**.738****	-.102	**.502****	**.588****	1					
SIZE	**.205****	-.034	**-.051**	**.630****	**.163****	**.608****	**.652****	**.434****	1				
AGE	-.040	-.089	**-.131***	**-.126****	.011	-.094	**-.161****	**-.142****	-.093	1			
LEV	**-.286****	-.036	-.104	**.132***	**.171****	**.174****	.066	.045	.081	.040	1		
LIQ	**.229****	.037	.004	**.533****	**.119***	**.504****	**.544****	**.374****	**.849****	**-.118***	-.067	1	
TAT	**.180****	.054	**-.123***	**.145****	**.129***	**.198****	**.117***	**.137***	.059	-.042	**.137***	-.012	1

*N = 336; *p<.05; **p<0.01*

4.3.2. Individual E, S, and G pillars

Table 4.9 reflects the empirical results of individual pillars of ESG. In the case of ROA, Model 3 reveals that both R&D intensity ($\beta = -53.682$, $p < 0.01$) and SOC ($\beta = -2.692$, $p < 0.1$) have a negative impact. Among the sub-pillars of ESG, only GOV shows a positive and significant interaction with R&D intensity ($\beta = 51.001$, $p < 0.05$). The implication that can be derived from these results is that the separate scores assigned to environmental and social activities do not have a significant influence on a company's profitability level.

In terms of sales growth, the significance of all three ESG pillars is evident. The impact of ENV is positive ($\beta = 11.829$, $p < 0.1$), while GOV has a detrimental effect ($\beta = -25.526$, $p < 0.01$), as demonstrated in Model 3. The interaction between R&D intensity and ENV is found to be negative ($\beta = -542.887$, $p < 0.1$). Additionally, SOC has a moderating influence on R&D intensity and growth, which is also negative ($\beta = -1202.908$, $p < 0.01$). This implies that the efforts made in the context of environmental and social activities do not result in any additional benefits for a company's firm performance (Koo et al., 2023; Melloni et al., 2017). On the other hand, GOV has a positive moderating effect ($\beta = 1623.083$, $p < 0.01$). It can be inferred that corporate governance serves as a reliable indicator of strong future prospects, while the predictive abilities of E and S are limited. This observation aligns with the conclusions reached by Pedersen et al. (2021). Therefore, hypothesis 3 is partially supported.

Table 4.8. Regression analysis of R&D-CFP link with ESGT and ESGBal as moderators

n=336	ROA			GROWTH		
Variables	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**
R&Dint	-16.047	-15.397	-.152	**879.451*** **	**878.663*** **	**2043.255*** **
	(-9.780)	(-9.786)	(-14.670)	(70.647)	(70.506)	(62.861)
SIZE	.764	1.145*	**1.151***	2.527	4.729	**4.813***
	(.569)	(.607)	(.603)	(4.108)	(4.374)	(2.583)
AGE	-.002	-.003	-.009	-.023	-.048	-.087
	(-.020)	(-.020)	(-.020)	(-.147)	(-.147)	(-.087)
LEV	**-.171*** **	**-.167*** **	**-.166*** **	.317	.355	.142
	(-.027)	(-.027)	(-.027)	(.197)	(.197)	(.117)
LIQ	.460	.464	.469	-.213	-.315	-1.119
	(.463)	(.462)	(.459)	(-3.341)	(-3.326)	(-1.965)
TAT	**3.965*** **	**4.182*** **	**3.960*** **	**16.826** **	**19.178** **	**16.347*** **
	(.970)	(.978)	(.976)	(7.010)	(7.048)	(4.181)
ESGT		-1.925	**-3.100***		-9.624	-.430
		(-1.173)	(-1.309)		(-8.454)	(5.609)
ESGBal		-.748	.264		**-15.027***	**34.504*** **
		(-1.202)	(-1.295)		(-8.662)	(5.548)
R&Dint x ESGT			**56.982** **			-166.247
			(27.034)			(-115.842)
R&Dint x ESGBal			**-44.803** **			**-1992.831*** **
			(20.880)			(-89.474)
Constant	**-20.407*** **	**-27.118*** **	**-27.500*** **	-66.955	**-99.277***	**-110.760*** **
	(-6.306)	(-7.671)	(-7.620)	(-45.677)	(-55.307)	(-32.675)
R-squared	.187	.196	.212	.329	.340	.771
Adjusted R-squared	.172	.176	.188	.316	.323	.764
F-statistics	**12.601*** **	**9.960*** **	**8.733*** **	**23.854*** **	**21.023*** **	**109.428*** **

*Note: Standard errors in parentheses (*** p < 0.01, ** p < 0.05, * p < 0.1).*

Table 4.9. Regression analysis of R&D-CFP link with ENV, SOC and GOV as moderators

n=336	ROA			GROWTH		
Variables	**(1)**	**(2)**	**(3)**	**(1)**	**(2)**	**(3)**
R&Dint	-16.047	-14.811	**-53.682*** **	**879.451*** **	**891.490*** **	126.906
	(-9.780)	(-9.833)	(-16.877)	(70.647)	(70.718)	(88.735)
SIZE	.764	**1.111***	**1.200***	2.527	5.347	**6.927** **
	(.569)	(.617)	(.612)	(4.108)	(4.435)	(3.217)
AGE	-.002	-.005	-.009	-.023	-.050	-.001
	(-.020)	(-.021)	(-.021)	(-.147)	(-.148)	(-.108)
LEV	**-.171*** **	**-.170*** **	**-.167*** **	.317	.314	.164
	(-.027)	(-.028)	(-.027)	(.197)	(.199)	(.144)
LIQ	.460	.431	**.411**	-.213	-.671	-2.155
	(.463)	(.464)	(.460)	(3.341)	(-3.338)	(-2.420)
TAT	**3.965*** **	**4.158*** **	**4.017*** **	**16.826** **	**17.978** **	**15.924*** **
	(.970)	(.985)	(.982)	(7.010)	(7.087)	(5.163)
ENV		-.083	.127		1.972	**11.829***
		(-1.102)	(1.349)		(7.927)	(7.091)
SOC		-1.716	**-2.692***		**-18.358** **	11.794
		(-1.220)	(-1.517)		(-8.773)	(7.975)
GOV		.182	-.905		7.915	**-25.526*** **
		(.965)	(-1.053)		(6.944)	(-5.539)
R&Dint x ENV			-28.730			**-542.887***
			(-59.086)			(-310.657)
R&Dint x SOC			52.022			**-1202.908*** **
			(59.765)			(-314.226)
R&Dint x GOV			**51.001** **			**1623.083*** **
			(21.102)			(110.950)
Constant	**-20.407*** **	**-26.505*** **	**-26.863*** **	-68.895	**-117.493** **	**-105.307*** **
	(-6.306)	(-7.603)	(-7.538)	(-45.547)	(54.685)	(-39.633)
R-squared	.187	.193	.215	.329	.339	.657
Adjusted R-squared	.172	.171	.186	.316	.321	.644
F-statistics	**12.601*** **	**8.659*** **	**7.361*** **	**26.854*** **	**18.616*** **	**51.457*** **

*Note: Standard errors in parentheses (*** p < 0.01, ** p < 0.05, * p < 0.1).*

The statistical test results for each hypothesis are displayed in Table 4.10. Additionally, the table shows whether the hypotheses were supported or rejected based on the regression analysis.

Table 4.10. Summary of testing result

Hypothesis	Relationship	Direction	Result
H1a	**R&D intensity - ROA**	Significant (*Negative*)	Supported
H1b	**R&D intensity - growth**	Significant (*Positive*)	Supported
H2a	The moderating role of **ESG Grade** in R&D-ROA	Significant (*Positive*)	Supported
H2b	The moderating role of **ESG Grade** in R&D-growth	Significant	Rejected
H2c	The moderating role of **ESG Balance** in R&D-ROA	Significant (*Negative*)	Supported
H2d	The moderating role of **ESG Balance** in R&D-growth	Significant (*Negative*)	Supported
H3a	The moderating role of **ENV** in R&D-ROA	Significant	Rejected
H3b	The moderating role of **ENV** in R&D-growth	Significant (*Negative*)	Supported
H3c	The moderating role of **SOC** in R&D-ROA	Significant	Rejected
H3d	The moderating role of **SOC** in R&D-growth	Significant (*Negative*)	Supported
H3e	The moderating role of **GOV** in R&D-ROA	Significant (*Positive*)	Supported
H3f	The moderating role of **GOV** in R&D-growth	Significant (*Positive*)	Supported

5. Conclusion

5.1. Summary of the research

This research study explored the impact of innovation and ESG on corporate financial performance. The main objective of this paper is to determine the difference in influence between the ESG ratings provided by the rating agency and the ESG balanced score. Our analysis was conducted using financial data from FNDataguide5 and the KCGS ESG dataset, covering the period from 2020 to 2022. We thoroughly examined a total of 336 manufacturing companies in South Korea. Our examination resulted in three significant findings.

Firstly, R&D intensity has a positive impact on sales growth, which aligns with the findings of Coad and Rao (2008) and Filatotchev and Piesse (2009). According to Cohen and Levinthal (1990), the process of R&D enables an organization to develop the ability to understand and effectively utilize new information and knowledge. Hence, R&D intensity should be regarded as a pivotal factor that contributes to the growth of sales. However, R&D intensity has no significant impact on the company's profitability (ROA). Previous research has demonstrated that it typically takes at least two years, if not longer, for R&D investment to translate into improved firm performance (Tang and Li, 2019). This might suggest that companies demonstrate a hesitancy to allocate funds towards their research and development activities due to the potential negative consequences on their financials and the uncertainty surrounding their success (Symeonidis, 1996).

Our second finding indicates that ESG performance has a moderating effect on the link between R&D intensity and CFP, although the extent of this impact differs. ESGBal has been found to have a negative moderating influence on R&D intensity and CFP. The rationale behind this is that our method of calculating ESG balance differs from that of other researchers. Lee et al. (2023) employed an equal weighting approach on 546 US firms and found that ESG balance has a positive relationship with financial performance. Instead of adopting an equal weighting approach, we opted to determine the gaps in the E, S, and G scores of each company. This is done by subtracting the highest score between E, S, and G from the lowest score. Our argument is that the wider the gap in scores, the lower the level of balance in each ESG activity, which consequently results in lower firm performance. We contend that this approach is more suitable due to the fact that the rating agency's evaluation method of environmental, social, and governance uses distinct evaluation categories and factors. Hence, the utilization of equal weights would not be appropriate since the weights could exhibit variability.

This finding can be primarily attributed to the fact that US and Korean firms have different resources and time availability when it comes to ESG activities. Moreover, in Korea, the concept of ESG is relatively new compared to the United States and other developed nations. Additionally, it is possible that Korean companies focus selectively on a specific aspect of ESG activities, which can significantly impact the allocation of resources for their ESG endeavors. Furthermore, there is still much to be explored in terms of achieving a balanced ESG approach.

Conversely, our method can have a beneficial effect on sales growth when ESG balance is not linked to R&D activities, which is consistent with Lee et al. (2023). In general, the result suggests that a balanced ESG score may have a stronger influence on CFP than the ESG grade from rating agencies. Essentially, this implies that a comprehensive and long-term approach to sustainability, as indicated by a balanced ESG score, leads to improved financial performance for a company.

Finally, we also included the three ESG sub-pillars in the analysis. The findings suggest that when the three pillars of ESG are analyzed individually, each one influences the relationship, especially the growth index. The GOV pillar is particularly notable due to its significant impact on the company's profitability and growth. This aligns with previous research confirming that governance-related activities improve the financial and innovative performance of a firm (Nollet et al., 2016; Zhang et al., 2020). On the contrary, the ENV and SOC pillars negatively affect the growth of the firm. This demonstrates that environmental and social activities do not provide any value to the growth of a company and are not relevant in predicting future profits (Koo and Kim, 2023; Pedersen et al., 2021). Giese et al. (2021) discovered that the impact of individual ESG indicators varies depending on the particular industry to which a company is affiliated. Thus, the explanation for our finding could be that Korean manufacturing firms primarily concentrate on one specific aspect of ESG activities. It is only logical that if a company wishes to incorporate R&D into their innovation activities, they must consider concentrating on only one area of ESG. This might help in determining where they are underperforming in order to attain a balance that will result in enhanced financial value.

5.2. Implications

This research study presents several significant implications. To begin with, this paper will greatly assist researchers in discovering new avenues for further studies on ESG performance. At present, there has been a lack of research considering both the ESG evaluation grade and ESG-balanced score perspectives and their impact on innovation and CFP, particularly in South Korea. This study will serve as a basis for future investigations.

Secondly, business managers and company owners will benefit from this research study. This will enable them to efficiently implement and improve the company's ESG initiatives by ensuring a well-balanced approach to the activities of each ESG pillar. The study conducted by Lee et al. (2023) suggests that there exists a direct link between balanced ESG scores and the performance of companies. However, they note that the ESG scores provided by rating agencies do not demonstrate any significant impact. Thus, this approach will certainly improve firm value instead of solely depending on high ESG ratings given by rating agencies, which ultimately lead to lower firm performance.

Lastly, this research study will also provide benefits for investors. This will enable them to classify and gain a more comprehensive understanding of the fact that not all companies with high ESG ratings have balanced assessments across all aspects of ESG. The rating agencies' criteria may lead to bias in their rating methodologies or intentional manipulation of a company's ESG disclosures and reporting. Accordingly, this research will help investors in their decision-making process when selecting a

company to invest in, especially those individuals who prioritize environmental concerns.

5.3. Limitations

We have acknowledged some limitations in our research. Initially, the covered time frame is limited and does not permit an analysis with a long-term perspective. A longer time frame will capture the long-term effects of some phenomena or interactions that may not be immediately evident or may require time to fully materialize. Nonetheless, the outcomes have proven to be steady and potentially interesting due to their implications.

Another limitation of this study is that our firm sample consists of only 336 firms in the manufacturing industry. It would be beneficial to investigate various industries in order to ascertain whether the findings hold true across all sectors. Moreover, our sample size is not sufficiently large.

5.4. Future research directions

Finally, in order to gain a comprehensive understanding of how our ESG balanced score calculation methodology can enhance firm value, it is essential for future studies to include a longer time frame. This will enable a comprehensive examination of how achieving balance across all areas of ESG is crucial to capturing non-financial risks and opportunities, as well as the company's contribution to

sustainable development.

Moreover, future research should utilize samples from different sectors in order to determine industries, company characteristics, ESG activities, etc. by conducting a thorough investigation of individual E, S, and G ratings. This in-depth analysis will provide valuable insights into areas that require improvement.

Future studies could also explore the use of different measures to assess innovation. This has the potential to generate diverse and possibly superior results. Furthermore, given that the ESG balanced score is still a new concept, scholars might devise a new technique or methodology for calculating ESG balance to fully comprehend the significance of each of the three pillars. The rationale behind this is that, despite our eagerness to expand upon this discourse, there is a scarcity of accessible resources and existing research.

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Industry News. http://www.industrynews.co.kr/news/articleView.html?idxno=48878. 매출액 500대 기업 93%, 경기 악화에도 ESG경영 유지·확대한다.

"The fear of the LORD is the beginning of wisdom, and knowledge of the Holy One is understanding."

"여호와를 경외하는 것이 지혜의 근본이요 거룩하신 자를 아는 것이 명철이니라"

Proverbs (잠인) 9:10

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