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ESG and Environmental Regulations

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01

A Study on the Advancement of ESG Practices and the Enhancement of Environmental Regulation Efficiency in Korea (I)

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HIGHLIGHTS

- ESG practices are essential for a green economic transition and achieving sustainable development goals. This necessitates policy and institutional frameworks that ensure coherent disclosure, measurable impacts, transparency of ESG performance, and alignment of environmental regulations with ESG practices.
- Companies face complex disclosure options related to materiality concepts, international and domestic frameworks, and thematic coverage. Aligning these frameworks with sustainable development goals is particularly important.
- Korea's legally adopted thematic impact assessment frameworks cover 11 out of the 17 SDG categories, offering a structured approach to evaluating the impacts of economic activities on sustainable development. These frameworks can be utilized to develop methodologies for measuring the impact of ESG practices.
- To ensure credibility, mechanisms such as external reviews for green bonds, external assurance for sustainability reporting, and sustainable finance disclosure regulations have been established. Ongoing research addresses concerns about misrepresented sustainability information by clarifying financial sector interrelationships and exploring the public sector's role in enhancing transparency and reliability.
- Emerging ESG disclosure standards, both domestically and internationally, are expected to significantly impact Korea's environmental regulations. As Korea prepares to introduce its Sustainability Disclosure Standards in 2024, analyzing the relationship between these standards and current regulations is crucial for guiding regulatory reform.

ARTICLE INFORMATION

Keywords

- Sustainable Finance
- ESG Disclosure
- Greenwashing
- Impact Measurement
- Environmental Regulations

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I Background and Aims of Research

Background

- As sustainable finance gains popularity, integrating sustainability into the decision-making processes of investors and financial institutions is vital for promoting sustainable economic activities, projects, and companies.
- ESG factors, initially key for responsible or ESG investing, now serve as essential metrics in sustainability reporting, integrating sustainability-related risks into mainstream financial practices and assessing various aspects of sustainable finance.
- With the expanding influence and importance of business practices guided by ESG factors, managing these practices at the national level is vital for effective sustainable development policy.

Need

- ESG practices, driven by sustainable finance and green consumerism, play a critical role in facilitating a green economic transition and achieving sustainable development goals.
- Recently, many countries, including the EU, have developed institutional frameworks for sustainable finance. The Korean government is considering a range of measures to provide the necessary institutional elements for sustainable finance to function effectively.
- There is a need for efforts to support policy and institutional frameworks that maximize the benefits of integrating ESG factors into business practices, thereby enhancing sustainable development.

Objective

- To advance ESG practices in business, it is necessary to ensure coherent disclosure aligned with the economy's sustainable development goals, measure the impacts of ESG practices, enhance the transparency of ESG performance information, and reshape existing environmental regulations that were not initially designed with ESG considerations in mind.
- This three-year project aims to address these issues by strengthening the policy and institutional framework to enhance ESG practices in Korea. The first year's research focuses on analyzing international and domestic issues and establishing a foundational framework for subsequent studies.

II Ensuring Coherent Disclosure Aligned with Sustainable Development Goals

| 1 | Introduction

ESG disclosure and sustainable development

- The goal of this pillar is to align ESG disclosure practices with both global and national sustainable development goals by adhering to international disclosure frameworks, such as GRI and IFRS Sustainability Disclosure Standards (IFRS SDS). In the first year, the research reviewed the newly released ISSB standards and TNFD guidelines and conducted a mapping exercise to compare various international and domestic ESG disclosure frameworks with global SDGs and national sustainable development goals.
- Early sustainability reporting focused on the transparency of a company's impact on sustainable development. The focus has now shifted to identifying information on sustainability-related financial risks and opportunities that companies face.
- The purpose of enhancing disclosure is to boost national sustainable development by aligning corporate sustainability reporting, sustainable finance benchmarks, and sustainable development goals.
- ESG information provided by companies through financial disclosures, governance disclosures, and sustainability reporting follows certain standards and reporting frameworks.

International trends

- Two new sustainability disclosure frameworks have been released: the IFRS Sustainability Disclosure Standards (IFRS SDS), covering all areas of sustainability, and the Taskforce on Nature-related Financial Disclosures (TNFD), focused on nature-related thematic disclosures.
- The EU established the European Sustainability Reporting Standards (ESRS) in collaboration with international organizations such as the International Sustainability Standards Board (ISSB) and the Global Reporting Initiative (GRI).
- The USA Securities and Exchange Commission has implemented climate disclosure rules, while the UK aims to align business activities with sustainability goals through the Sustainability Disclosure Standard.
- The G20 Sustainable Finance Report 2023 was released in September 2023.

| 2 | IFRS Sustainability Disclosure Standards

IFRS SDS and key features

- The IFRS Sustainability Disclosure Standards (IFRS SDS) were introduced and finalized in June 2023.
- The ISSB standards consist of IFRS S1, a general sustainability standard, and IFRS S2, a climate change-specific standard, along with industry-specific guidelines to help companies apply IFRS S2.
  - IFRS S1 divides the required disclosures into four categories: governance, strategy, risk management, and metrics and targets.
- IFRS S1 includes general requirements for disclosures about sustainability-related financial information, applicable to reporting on sustainability-related financial risks and opportunities for all sustainability issues.
- IFRS S2 includes climate-related disclosures, applicable to reporting on climate-related financial risks and opportunities.
  - IFRS S2 builds on existing reporting frameworks such as the Task Force on Climate-related Financial Disclosures (TCFD) and is designed to be compatible with International Financial Reporting Standards (IFRS).

| 3 | TNFD

TNFD designed to identify a company's impact and dependency on nature

- In response to the need for a consistent framework for risk management and disclosure of nature-related risks and opportunities, the Task Force on Nature-related Financial Disclosures (TNFD) was established in 2021.
- The purpose of the TNFD is to develop a reporting framework for companies to disclose nature-related financial information, helping to identify a company's impact and dependency on nature.

| 4 | Chapter takeaways

- Companies face complex disclosure options regarding different materiality concepts, the choice between international and domestic frameworks, and thematic coverage.
- Recently, frameworks emphasizing financial materiality, such as IFRS SDS and TNFD, have been developed and are gaining market attention, compared to current ESG disclosures in Korea, which are primarily based on impact materiality.
- In this context, aligning these disclosure frameworks with sustainable development goals is particularly important. In Chapter 2, we conducted a mapping exercise linking major disclosure frameworks with both global and national sustainable development goals.

III Measuring the Impacts of ESG Practices

| 1 | Introduction

Impacts of ESG practices on sustainable development

- The purpose of sustainable finance, with ESG integration at its core, is to ensure that economic activities align with society's sustainable development efforts by considering their impacts on sustainable development in financial decisions.
- Measuring the impact of ESG practices is crucial to ensure they support sustainable development. This has been a central concern since the inception of the Principles for Responsible Investment (PRI), which developed a five-part framework to help investors understand and manage the real-world outcomes of their investments in line with the Sustainable Development Goals (SDGs).

Related global initiatives

- There are frameworks designed to guide investments toward sustainable development goals. Two key examples are the UNEP FI Impact Protocol, targeting financial institutions, and the OECD-UNDP Impact Standards for Financing Sustainable Development (IS-FSD), designed for stakeholders involved in development finance.

| 2 | Frameworks for measuring sustainability impacts

UNEP FI Impact Radar

- UNEP FI (2018) defines "impact" on sustainable development as the dependent variable of sustainable finance and undertakes various efforts to promote its alignment with the global Sustainable Development Goals (SDGs) by 2030.
- The Impact Radar offers a holistic approach to sustainability, considering the three pillars of sustainable development—economic, social, and environmental—through an assessment of both positive and negative impacts.
- The Impact Radar compiles various impact areas and topics under these three pillars and serves as the basis for the UNEP FI Impact Analysis Tool, which consists of open-source tools designed for banks, investors, corporate clients, and investee companies.

UNDP SDG Impact Standard

- The UNDP's SDG Impact Standard is designed to help companies and investors embed sustainability and the SDGs into their internal management and decision-making processes.
- The "OECD-UNDP Impact Standards for Financing Sustainable Development" report provides targeted SDG impact standards and action indicators to guide organizations in aligning their practices with the SDGs.

| 3 | Sustainable finance impact in practice

Impact across industries and sectors

- Our study highlighted the application of sustainable finance across different industries and sectors. For example, in the energy sector, indicators such as renewable energy capacity and carbon emissions avoided are prevalent.
- In contrast, the healthcare sector focuses on metrics like healthcare costs saved and improved health outcomes. Each sector has unique indicators that reflect its specific contributions to sustainable development.

Impact reporting case studies

- We examined several case studies to illustrate the practical application of impact measurement in sustainable finance.

- Sovereign and Sub-Sovereign Issuers: For example, Uzbekistan's issuance of a sovereign SDG bond illustrated how national-level initiatives can align with SDG goals and generate significant impact in areas such as education, health, and clean energy.
- Financial Institutions: We analyzed how financial institutions, like green bond issuers, report on their contributions to sustainable development through detailed metrics that align with international standards like the ICMA Green Bond Principles.
- Corporate Issuers: Corporations such as the Amplify Capital provided detailed impact reports that focus on specific SDG targets and included both quantitative and qualitative metrics to measure their contributions.
- Impact Funds: Funds like the Deetken Impact Fund showcased their sector-specific impacts in areas like financial inclusion and renewable energy, using standardized metrics to report their achievements.

| 4 | Chapter takeaways

- Several Korean financial institutions, including the Korea Credit Guarantee Fund and the Industrial Bank of Korea, have implemented measures to assess environmental and social impacts.
- Korea has adopted thematic impact measurement and assessment frameworks by law, covering 11 out of the 17 SDG categories. These frameworks offer a structured approach to evaluating the impacts of economic activities on sustainable development goals.
- The case studies and measurement frameworks discussed in this chapter can be effectively utilized for assessing the impacts of ESG practices. By leveraging these frameworks, businesses and financial institutions in Korea can align their ESG activities with both national and global sustainability objectives.

IV Enhancing ESG Performance Transparency

| 1 | Introduction

The public sector's role in ensuring reliable ESG data

- When companies effectively integrate ESG practices into their operations, they become key drivers in achieving sustainable development goals. Accurate measurement and transparent disclosure of their contributions are foundational to the success of sustainable finance. Reliable ESG performance information empowers investors, stakeholders, and the public to make informed decisions and hold companies accountable for their sustainability claims.
- To ensure the credibility of this information, several robust mechanisms have been established, including external reviews for green bonds, external assurance for sustainability reporting, and sustainable finance disclosure regulations for financial institutions and investors.
- However, misrepresented or misleading sustainability performance information remains a concern. To address this, ongoing research focuses on clarifying the complex interrelationships between corporate entities, projects, activities, products, technologies, and the financial sector's sustainability performance. This research also explores the potential role of the public sector in further enhancing the transparency and reliability of ESG information.

Credibility of sustainability information and greenwashing issues

- Greenwashing can occur unintentionally, but it is often used intentionally to appeal to the public and consumers to increase product sales and enhance a company's image.
- Recently, the definition of greenwashing has expanded beyond merely communicating misinformation. It now includes companies' failures to announce, implement, or report on their ESG goals and visions. This broader interpretation of greenwashing highlights the lack of international consensus on the term's usage.

| 2 | ESG performance reviews: corporate and project levels

Corporate sustainability assurance

- Independent assurance of corporate sustainability reporting is increasingly common, utilizing frameworks like the AA1000 series and ISAE 3000. The draft ISSA 5000 standard, currently under review, seeks to establish a comprehensive, independent verification process for all sustainability information.

Green bond frameworks

- Green bond frameworks ensure the proper allocation of funds to environmentally sustainable projects. These frameworks often involve external review institutions to verify adherence to established standards. The EU's recently adopted Regulation on European Green Bonds aims to standardize green bond requirements and align them with the EU taxonomy for sustainable activities.

| 3 | ESG performance review in finance

EU SFDR

- The EU Sustainable Finance Disclosure Regulation (SFDR) requires financial market participants and advisors to comprehensively disclose sustainability-related information. By promoting transparency and mitigating greenwashing risks, the SFDR empowers investors to make informed decisions. EU supervisory authorities oversee and monitor compliance.

National implementation: Germany and France

- Germany's BaFin and France's AMF, as national financial regulators, actively interpret and enforce the SFDR. They provide guidance on key implementation challenges, aiming for consistent application of the regulation. Both regulators are committed to fully integrating sustainability considerations into their respective financial systems.

| 4 | Chapter takeaways

ESG Transparency in Korea

- In response to growing demand, Korea is bolstering its monitoring of ESG information to combat greenwashing. The Ministry of Environment and the Financial Supervisory Service have developed guidelines and standards aligned with international best practices to ensure the transparency and reliability of ESG certifications and evaluations.

ESG Integration in Korean Finance

- A study of 26 Korean financial institutions revealed a diverse range of ESG activities, including green loans, investments, and bonds. These institutions also adhered to green finance declarations and principles, demonstrating a commitment to incorporating sustainability into their operations.

V Optimizing Environmental Regulations

| 1 | Introduction

Corporate ESG practices and environmental regulations

- Historically, corporate sustainability practices were driven by government-mandated environmental regulations. However, recent ESG practices are now primarily influenced by financial incentives, green consumer demand, and international regulatory frameworks, often intersecting with regulatory requirements.
- The fourth pillar of this study, 'Optimizing Environmental Regulations,' aims to analyze the interaction between ESG practices and the effectiveness of existing environmental policies. By examining this interaction, the study seeks to identify opportunities to enhance regulatory frameworks, ensuring they remain effective in an environment increasingly shaped by voluntary ESG commitments.

| 2 | Optimizing environmental regulations through alignment with ESG practices

State of environmental regulations

- Korea maintains a comprehensive system of environmental regulations encompassing obligations and restrictions, entry controls, location-specific rules, and standards for environmental technology and evaluation. These regulations often entail specific actions, financial charges, and compliance with established criteria and labels.

Mapping Korea's environmental regulations to ESG disclosure frameworks

- This study initiated a mapping exercise aligning Korea's environmental regulations with ESG disclosure frameworks, primarily focusing on the widely-used Global Reporting Initiative (GRI) Standards. In 2024, a more in-depth analysis is planned to further refine the correlation between these two frameworks.

| 3 | Enhancing environmental policy through information-based instruments

The role of ESG disclosure and eco-labels

- The OECD (2007) recommended combining information-based instruments, such as eco-labels, with direct environmental measures for increased effectiveness. Eco-labels provide decision-makers with essential product sustainability information, addressing market failures related to information asymmetry. For businesses, obtaining eco-labels is a key ESG practice that mitigates risks related to product sustainability.
- The increasing emphasis on ESG disclosure can drive the adoption and expansion of eco-labeling programs, enhancing consumer awareness and informed decision-making, and further reducing information asymmetry in the market.

Consumer awareness and perceptions of eco-labeling schemes in Korea

- A survey was conducted to evaluate consumer awareness and the influence of environmental performance on purchasing decisions regarding current eco-labeling schemes in Korea.
- Awareness of eco-labeling
  - The survey showed high awareness among consumers for various eco-labels. The "Energy Efficiency

Label" had the highest recognition at 99.1%, followed by the "Environmental Label Certification" at 93.4%.

- Understanding of the differences between labels
  - Despite high awareness, only 38.3% of respondents felt confident in distinguishing between different eco-friendly labels.
- Trust in eco-labels
  - Overall, 85.1% of respondents indicated some degree of trust in eco-labels, with the highest trust among the 20s age group at 93.3%.
- Suggestions for improvement
  - Survey participants suggested several improvements for eco-labeling schemes, including better promotion and information provision (59.8%) and the integration of similar labels (42.3%).
- Environmental issues for certification reform
  - Respondents identified key environmental issues for certification reform, such as resource circulation and the circular economy (51.8%), greenhouse gas reduction (50.1%), and climate change adaptation (47.7%).

| 4 | Chapter takeaways

ESG disclosure to improve environmental regulation and policy

- Emerging ESG disclosure standards, both domestically and internationally, are poised to significantly influence Korea's environmental regulations. As Korea prepares to introduce its Sustainability Disclosure Standards in 2024, it is crucial to analyze the relationship between these standards and current environmental regulations to guide regulatory reform.

Strengthening information-based environmental policies

- Existing sustainability criteria for activities, businesses, and corporations (e.g., Green Classification System, Green Bond Guidelines, Corporate Sustainability Reporting) are closely linked to product sustainability information. This connection underscores the potential for eco-friendly certifications to act as information-based policy tools, supporting environmental regulation and the green transition of industries.

VI Policy Recommendations

Development of domestic sustainability reporting standards aligned with policies

- The EU has mandated sustainability reporting through the Corporate Sustainability Reporting Directive (CSRD) and developed the European Sustainability Reporting Standards (ESRS) to support it. The ESRS is designed to encourage companies to contribute to the achievement of EU's sustainable development goals, including carbon neutrality.
- With mandatory sustainability disclosures expected after 2026, Korea also needs to develop its own sustainability reporting standards. These standards should be aligned with national and regional sustainable development policies to effectively promote sustainability practices among Korean businesses.

Establishing a framework for measuring impact centered on sustainable development

- Despite the active use of the K-Taxonomy and Green Bond Guidelines in Korea, a systematic measurement and evaluation of the actual impact of activities or projects classified as sustainable under these guidelines are lacking.
- It is necessary to develop international-level impact measurement guidelines based on methodologies established by major international organizations. These guidelines can then be utilized to evaluate the ESG performance of activities, projects, and companies in the context of sustainable finance.

The need for institutional mechanisms to enhance ESG information reliability

- ESG factors have evolved beyond responsible investment and become a systematic framework for sustainability reporting. Recently, ESG factors have expanded from being a measure of corporate and financial activities and performance to a criterion for assessing the sustainability of activities and projects.
- The EU Taxonomy, introduced by the EU to promote sustainable finance, serves as a standard for classifying sustainable finance-related activities. Its scope is expanding as it is linked to the European Green Bond (EuGB), a sustainability standard for projects.
- The EU Taxonomy has already influenced Korea, leading to the development of the Green Classification System. It is expected that EuGB will also significantly impact the revision of Korea's Green Bond Guidelines. The key characteristic of these changes is the expansion of the scope of sustainability information and its interconnectedness with ESG factors. In this process, the "reliability of ESG information" (the so-called "greenwashing") emerges as a critical issue.

The necessity of managing product sustainability information

- The EU is expanding its efforts to enhance the reliability of sustainability information to include products and services. The proposed Green Claims Directive aims to prevent greenwashing and is expected to lead to a comprehensive overhaul of existing product certification systems.
- While standards for sustainable activities, projects, and companies have been recently developed and revised due to the growth of sustainable finance, the environmental criteria for products, which have been in operation for a long time, have received relatively less attention.
- Sustainability standards for activities (Green Classification System), projects (Green Bond Guidelines), and companies (sustainability reporting) focus on the sustainability of the production process. In contrast, green certifications (environmental certifications) focus on the sustainability of the product itself. It is necessary to develop and align the various certifications for existing products with the ESG standards developed in the sustainable finance sector.

Sustainable finance disclosure

- In Korea, the focus of ESG information disclosure has been primarily on corporate sustainability reporting. However, the EU also emphasizes disclosingf information on the performance of sustainable finance.
- While the impact and performance of corporate ESG activities are measured individually, assessing the ESG performance of the financial sector is more challenging due to its aggregated nature. To address this, the EU's Sustainable Finance Disclosure Regulation (SFDR) mandates financial institutions to disclose how they incorporate ESG factors into their investment decisions (EU Benchmarks' disclosure).
- ESG disclosure by financial institutions not only enhances transparency in sustainable finance but also effectively signals the importance of ESG integration to companies. It is worth considering introducing mandatory ESG disclosure for financial institutions alongside corporations.

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02

Developing Plans for Environmental Regulation Reform that Address Domestic and International Environmental Changes

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HIGHLIGHTS

- Environmental regulations, influenced by market demand, production costs, and environmental externalities, are likely to strengthen due to the increasing national interest in environmental concerns, rising production costs, and worsening environmental indicators.
- The evolving industrial landscape, driven by emerging technologies such as information and communications technology, is reshaping business structures and management methods. This underlines the necessity for strategies utilizing digital technologies for energy efficiency and carbon emission reduction to bolster domestic competitiveness in response to the Fourth Industrial Revolution.
- The expansion of corporate voluntary improvement efforts, exemplified by participation in initiatives like RE100, enhances company image and product/service reliability. However, achieving targets may necessitate governmental and institutional support to facilitate the use of renewable energy sources domestically.
- The dissemination of the digital economy underlines the need to ensure compatibility with sustainability goals and maintain high consumer protection standards across Europe. Korea exhibits a world-class digital environment, ranking high in digital competitiveness indexes.
- Proposed mid- to long-term reforms include expanding market-based policy instruments and voluntary approaches to encourage environmental improvements, enhancing regulatory tools supported by technology for a responsible digital economy, engaging in international regulatory cooperation, improving regulatory agency governance through a risk-based approach and stakeholder participation, and instituting ex-post regulatory assessments to systematically monitor the effectiveness of regulations.

ARTICLE INFORMATION

Keywords

- Environmental Regulation
- Regulatory Reform
- Bundled Regulation
- Voluntary Approach
- Digital Economy

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I Introduction

| 1 | Necessity and objective of the study

To keep up with the government's push for regulatory innovation, it is critical to act swiftly, including analyzing current issues in the field of environment, preparing regulatory improvements, and proposing study projects for the future.

- The purpose of this study is to examine the economic, social, and environmental impacts of the new government's regulatory innovation framework and propose improvements for future environmental regulations.
- The research content to be reviewed in this study is largely divided into five areas, and the main research content of each area is as follows:
  - Discussion on the reorganization of existing environmental regulations
  - Industrial environmental regulation demands and government responses
  - Foreign cases and international recommendations
  - Collection of opinions from domestic stakeholders through expert forums
  - Development of a domestic environmental regulation reorganization plan

II Theoretical Background of Environmental Regulations

The theoretical system of environmental regulations

- Environmental regulation refers to government intervention to correct negative external effects of environmental pollution, which includes imposing sanctions on individuals or companies that cause pollution.
  - The OECD (2008) presents an integrated perspective to find the right balance between complex and conflicting environmental, economic, and social goals.

Environmental regulatory measures

- Environmental regulatory means can be largely divided into three categories: direct regulation centered on orders, market-based economic incentives, and voluntary regulation.
  - Direct regulation is the most widely used means of environmental regulation, but in terms of economic efficiency, market-based economic incentives are much more effective, and autonomous environmental regulation is the most ideal in terms of inducing voluntary environmental improvement efforts by regulated parties.

Domestic environmental regulation operation status

- More than 70% of environmental regulations in Korea are comprised of direct regulations.
  - Since the 1990s, many market-based economic incentive systems have been introduced, including the volume-based waste rate system, various levy systems, and the emission trading system.
  - More recently, there has been a growing interest in voluntary environmental regulations, such as the activation of ESG information disclosure and corporate participation in 'RE100', both domestically and internationally.

III Discussion on Environmental Regulation Reforms

| 1. | History of environmental regulations introduced in Korea

Key environmental regulations by period

- 1970s~1980s: Established the environmental regulation framework, legislated the Environmental Conservation Act, and created the Environment Agency
- 1990s~2000s: Advanced the environmental regulation framework, introduced six major environmental acts, and transformed the Environment Agency into the Ministry of Environment
- 2010s: Made the environmental regulation framework more efficient, overhauled the scheme for fine dust management and hazardous chemicals, enforced the Act on Registration and Evaluation of Chemical Substances and the Chemical Substances Control Act, introduced the integrated environmental

management system, and consolidated water management

- 2020s: Enacted the Framework Act on Low Carbon, Green Growth, enforced the Special Act on the Reduction and Management of Fine Dust, and enacted the Framework Act on Water Management

Directions in key environmental regulation reforms by year

- Identified the same key points suggested in the Ministry of Environment's annual basic directions for regulatory innovation since 2014
  - Transition to comprehensive negative regulatory system('prohibited in principle' to 'permitted in principle')
  - Field-oriented customized regulation improvement
  - Rationalization of chemical substance regulations based on the size and circumstances of companies
  - Improving regulations that make people and livelihoods inconvenient

| 2 | Regulatory innovation strategy by the current government

The government has sought regulatory reforms through the Regulatory Reform Committee and the Office for Government Policy Coordination, focused on reviewing new and stricter regulations, establishing a regulatory innovation platform for new industries, and addressing regulatory difficulties on the ground.

- The impact of bundled regulations, which greatly affect business activities, is not felt on the ground, as there is a lack of proactive efforts by those subject to the regulations to improve them.
- The Directions for Regulatory Innovation by the New Government (announced on June 14, 2022) aims to overcome these limitations and drive economic resurgence and sustainable growth through robust regulatory innovation.
  - The government has developed the following solutions to tasks related to regulatory reform: establishment of the Regulatory Innovation Strategy Council under the President as the highest decision-making body for regulatory innovation, operation of the Regulatory Innovation Task Force to reform bundled regulations, introduction of a regulation review system, strengthening of the regulatory sandbox, and reinforcement of regulatory quality control.

In this context, the Ministry of Environment has operated the Environmental Regulation Field Response Task Force dedicated to regulatory reforms since May 30, 2022, and announced the

Environmental Regulation Innovation Plan. Some of the key points of the plan are outlined below:

- From closed regulations to open regulations: Applying innovative technologies to convert waste into recycled products
- From uniform regulations to differentiated regulations: Improving compliance through differentiated chemical regulations according to risk
- From command-type regulations to communication-type regulations: Reducing procedures and strengthening transparency by expanding environmental assessment communication
- Regulations that facilitate the transition to a green society: Prioritize innovation in regulations related to carbon neutrality and the circular economy

| 3 | Requests by industries to overhaul environmental regulations

The Federation of Korean Industries, the Korea Chamber of Commerce and Industry, and the Korea Federation of SMEs have also identified and submitted environmental regulation innovation tasks to the government.

- The Federation of Korean Industries submitted 26 tasks related to carbon reduction and chemicals, the Korea Chamber of Commerce and Industry submitted ten tasks, including simplifying the registration of substances for research and development and preparing specifications for waste plastic pyrolysis oil products, and the Korea Federation of SMEs submitted 12 tasks, including alleviating the mandatory recycling rate for LED lights.

Previously, industries have made the following requests for environmental regulations:

- The Federation of Korean Industries requested that the government increase tax incentives for companies investing in safety and environmental measures as well as consult with companies to gather input before introducing new regulations.
- The Korea Chamber of Commerce and Industry identified 'investment costs to respond to regulations' as the top challenge in terms of environmental regulations, followed by 'excessive administrative procedures and documentation requirements,' and 'a lack of appropriate technology.'
- In addition, in the 2022 survey on environmental issues, the majority of respondents suggested that voluntary compliance should be encouraged through incentives based on fulfilling obligations, rather than relying on stricter regulations.
- The Korea Enterprises Federation identified 'strengthening feedback and social management when companies request that regulatory difficulties be addressed' as a policy task to improve the effectiveness of the current regulatory improvement scheme.

IV Changing Conditions in Environmental Regulations

| 1 | Regulatory conditions from the perspective of optimal environmental regulations

From the perspective of optimal environmental regulations, the level of an environmental regulation is determined by market demand, production cost, and the externality caused by environmental pollution.

- National interest and demand regarding the environment are increasing, particularly among the MZ generation.
- The production costs in the manufacturing industry are continuously increasing, and if we look at the environmental status as a proxy for externalities, the emissions of air pollutants, greenhouse gases, wastewater, and waste are also showing an increasing trend.
- Considering the above, it is highly likely that environmental regulations will be strengthened rather than weakened.

| 2 | Emerging future technologies and changing industrial structure

Changes and impacts

- Today's industries and technologies are evolving towards creating new added value based on information and communications technology, disrupting the business structure and management methods in industries and resulting in major changes in corporate behaviors.
- The environmental impacts related to digital transformation presented in the European Green Deal announced in 2019 are as follows:
  - Positive impact: Promote circular economy, alleviate environmental pressure on the ecosystem, reduce pollutant emissions through smart agriculture, predict and monitor pollution levels, promote environmental innovation through the spread of environmental information, and effectively implement environmental regulations through environmental data management.
  - Negative impact: Impact on resources due to mining/extraction of raw materials, environmental impact caused by the process of extracting raw materials, and greenhouse gas emissions resulting from the use of electricity.

- In order to enhance the competitiveness of domestic companies in the global environment, strategies using digital technologies for energy efficiency and carbon emission reduction are expected to become more important.

Domestic issues

- The government, which took office in 2022, is promoting the response to the Fourth Industrial Revolution and digital transformation as a national policy task and supporting digital transformation across all industrial sectors.
- The private sector, especially among large companies, is seeing an emerging movement to respond to the changing industrial structure by combining and integrating information and communications technology (ICT) and artificial intelligence (AI).

| 3 | Expansion of corporate voluntary improvement efforts

Changes and impacts

- As of March 2023, 28 large domestic companies have joined RE100 and are practicing it.
  - Consumers are not only paying attention to the outstanding quality and price competitiveness of products and services, but also to the ESG-related movements of companies.
  - The voluntary interest and efforts in environmental protection by companies participating in RE100 not only improve the image of the company, but also greatly enhance the reliability of their products and services.

Domestic issues

- In fact, it is not easy to achieve the RE100 target within a given period without institutional support from the government to expand and facilitate the use of renewable energy sources in domestic power production and infrastructure.

| 4 | Dissemination of the digital economy

Changes and impacts

- With the growth of e-commerce in the EU as compared to traditional retail, it is becoming important to ensure that e-commerce is compatible with the EU's sustainability goals and a high level of consumer protection is maintained across Europe.

Domestic issues

- According to the Korea Economic Research Institute's analysis of digital competitiveness comparison data from major overseas institutions, it was found that Korea has a world-class digital environment.
  - Korea is ranked 12th out of 64 countries in the digital competitiveness ranking announced by IMD, 11th out of 120 countries in the EIU's Inclusive Internet Index, and eighth out of 141 countries in the CISCO Digital Readiness Index.

| 5 | International environmental policy

In 2021, as part of the European Green Deal, the EU announced Fit for 55, which aims to reduce net greenhouse gas emissions by 55% or more from 1990 levels by 2030.

- The EU's Fit for 55 initiative has expanded the sectors subject to the existing EU emissions trading scheme, adding aviation, maritime transport, road transport, and buildings to the original list that included electricity and regional aviation.
- Efforts are being made to introduce the Carbon Border Adjustment Mechanism (CBAM) as one of the key policies to tackle climate change.
  - Steel and steel products, one of the sectors subject to the scheme, account for 95% of Korea's exports to the EU, which means the Korean steel industry is expected to be affected by this regulatory development.

EU Directive on Corporate Sustainability Due Diligence

- In 2022, the EU Commission announced the Directive on Corporate Sustainability Due Dilligence.
  - The EU member states are moving towards enhancing corporate accountability for negative environmental impact and tightening legal obligations regarding due diligence in order to ensure that companies take into account human rights and environmental impacts when making decisions.

V Forums on Environmental Regulations

Two forums were held, including an expert forum and an industry forum, to gather opinions from diverse stakeholders on environmental regulations.

- Overview of key points from the expert forum
  - Shift the nature of regulations towards technology-oriented
  - Consolidate redundant regulatory systems
  - Examine whether it is possible to shift some of the existing regulatory policies to market-based ones
  - Consider an outlook in industries to introduce regulatory reforms in the field of environment
    - As mentioned in the *Recommendation of the Council for Agile Regulatory Governance to Harness Innovation* (OECD, 2021), it is recommended that a series of regulatory improvements through learning is needed to ensure regulatory policies appropriately respond to a changing technological landscape.
  - In terms of the regulatory reform framework, it is necessary to shift from a regulatory policy centered on the executive branch towards a whole-of-government regulatory policy governance that encompasses legislative and judicial branches in regulatory policies.
    - It means regulatory reforms should be pursued considering the entire process, including regulatory legislation, regulatory enforcement, compliance management, and post-regulation evaluation. To do so, principle-based regulations, technological innovation, and a regulatory legislation model need to be developed and promoted.
- Overview of key points from the industry forum
  - Gradually tighten regulations in line with circumstances, industries, and company sizes in Korea
  - Gather feedback from industries about tax-related policies, including environmental taxes
  - Prepare sufficient support policies, clear standards, and a stepwise approach to introduce the corporate disclosure system
  - Streamline complex and excessive administrative procedures and tackle overlapping regulations
    - Currently, it is difficult to implement regulations on the ground, as the opinions of companies are not sufficiently reflected during review and discussion of new or stronger environmental regulations.
  - As behavioral changes among government officials are also an important factor, it is necessary to prepare support measures at the level of the Ministry of Environment.

VI Proposed Mid- to Long-Term Reforms

| 1 | Expand market-based policy instruments

- The OECD suggests market-based policies as the most efficient tool to reduce the externality related to the environment.
  - These policy instruments are considered more economically efficient, since the instruments encourage companies to find the most efficient way to improve the environment and drive innovation through incentives.
  - Market-based instruments provide incentives for companies to actively introduce new technologies such as green technology, which can lead to voluntary investment.

| 2 | Expand the use of a Voluntary Approach (VA)

- Recently, with the rapid spread of ESG information disclosure, interest in voluntary approaches is increasing.
  - The use of a voluntary approach can reduce administrative cost for regulatory operations and allow companies to tailor their environmental efforts to their individual circumstances, thereby reducing their costs in responding to ESG.
  - It is crucial to provide incentives or introduce administrative support to encourage companies to participate.

- Although there are concerns about ensuring compliance with a voluntary approach, it can be more effective when combined with other policy measures.

| 3 | Strengthening a responsible digital economy

- The OECD (2021) notes that a risk-based regulatory approach can be more effective with improved digital technologies and available data.

- According to the Environmental Policy Stringency (EPS) Index, it is necessary to expand the use of regulatory tools supported by technologies in Korea.
  - It will make regulations more optimized, tailored, and agile, reflecting the diversity of those subject to regulations, improving the effectiveness of regulations, and reducing compliance cost for those subject to regulations.

| 4 | Proactively respond to and engage in international regulatory cooperation

- The OECD (2021) presents a systematic approach that takes into account international recommendations when establishing new domestic regulations to facilitate multilateral regulatory cooperation.
  - It is necessary to introduce environmental regulations in a sequential manner, taking into consideration of the competitiveness of the Korean industry and international trends.

| 5 | Improving regulatory agency governance

- Regulatory recommendations from the OECD (2021) and EPA (2021) highlight the importance of a risk-based approach.
  - During the design of a regulation, potential risks and trade-offs should be analyzed, and this process should be based on the latest evidence and scientific facts.

- It is crucial to include individuals and companies from the early stages of policy design, such as preliminary assessment, and participation from stakeholders is very important to enhance transparency and regulatory compliance.

- It is needed to prepare more flexible and resilient regulatory practices to encourage innovation and improve responsiveness and resilience, and to reduce the burden and compliance cost for those subject to regulations.

| 6 | Introducing ex-post regulatory assessment

- Ex-post regulatory assessment consists of compliance evaluation (qualitative), which is achieved through the process of collecting opinions from stakeholders related to environmental regulation, and environmental regulation effectiveness and ripple effect analysis (quantitative), which can be confirmed by verifying the significance of changes in indicators before and after regulation.

- It is necessary to institutionalize post-regulation impact assessments to regularly and systematically monitor whether regulations are achieving their original goals after they are established.

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03

Optimal Environmental Regulation in the Presence of Sustainable Finance

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HIGHLIGHTS

- This study examines the interaction between sustainable finance and optimal environmental regulation, focusing on how firms' profit-maximizing decisions are influenced by sustainable finance.
- It develops a theoretical model to analyze how sustainable finance affects firms' production decisions and environmental emissions, highlighting conditions under which sustainable finance can complement or replace traditional environmental regulation.
- The findings reveal that sustainable finance can increase emissions for greener firms due to financial incentives and lower costs, while less-green firms tend to reduce emissions due to higher costs.
- The study also finds that voluntary abatement can occur without regulation and that a synergistic relationship exists between market preferences for greener firms and the adjustment factor based on a firm's relative greenness.
- Data analysis shows a heterogeneous distribution of emissions-intensive firms across different industrial sectors and a skewed GHG intensity among companies, with a small number of firms responsible for a large portion of emissions.

ARTICLE INFORMATION

Keywords

- Optimal Environmental Regulation
- Sustainable Finance
- Sustainable Finance Benchmark
- Sustainable Development
- Climate Change

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I Introduction

Background

- Environmental economics, fundamental to modern environmental policy, categorizes environmental issues as externalities. Externalities are defined as costs or benefits impacting social welfare but not factored into the decision-making of consumers or producers. In this framework, a firm might produce pollution, a negative externality, resulting in external costs not borne by the firm. This leads to an economically inefficient overproduction of pollution.
- The concept of the optimal emission level is central to environmental economics. It refers to the amount of pollution that would maximize social welfare, taking into account both the benefits of economic activity and the costs of environmental damage. Optimal environmental regulation aims to achieve this level of pollution through government intervention, using policy instruments like pollution taxes, cap-and-trade systems, or direct regulations. The goal is to make polluters internalize the costs of their pollution, resulting in a more efficient use of resources.

Sustainable finance as a new theoretical issue

- The emergence of sustainable finance has added a new dimension to the economics of environmental regulation. Investors are increasingly considering environmental performance in their capital allocation decisions, thereby incentivizing firms to voluntarily enhance their environmental practices. Green consumerism has also emerged in many countries, encouraging firms to enhance their environmental performance.
- This shift in firm behavior has significant implications for environmental regulation, and may influence the effectiveness of traditional regulatory tools. The growing interest in the relationship between firms' behavior and sustainable finance is driven by the impact of green investments on environmental outcomes and the new constraints and incentives introduced by sustainable finance.

Methodological approach

- Literature review: An examination of existing literature on optimal environmental regulation with a focus on second-best settings and environmental taxes.
- Theoretical analysis: An analysis of how sustainable finance impacts firm behavior, examining how it influences firms' decisions to optimize production and emissions for profit maximization.

II Optimal Environmental Regulation

Externalities and optimal environmental regulation

- Concept of externalities: Externalities are costs or benefits that affect social welfare but are not included in producers' or consumers' decision-making. Pollution, a negative externality, leads to overproduction because firms do not bear the external costs.
- Addressing inefficiencies: Optimal environmental regulation seeks to internalize external costs through government intervention, achieving an emission level that maximizes social welfare. Policy instruments like pollution taxes, cap-and-trade systems, and direct regulations are used to incentivize firms to reduce emissions.
- Theoretical foundation: The theoretical basis lies in Arthur Pigou's concept of the Pigouvian tax, set at the marginal external cost of pollution at the optimal emission level, aligning private costs with social costs.

Second-best settings

- Translating the theoretical model of optimal environmental regulation into effective policies presents several challenges, including dealing with asymmetric information, interactions with existing taxes, and ensuring compliance. Consequently, real-world applications often require second-best solutions—optimal compromises given existing constraints.
- Interaction with existing taxes: Environmental taxes interact with existing taxes (e.g., labor, consumption), creating or exacerbating market distortions. The "double dividend" hypothesis suggests these taxes can reduce pollution and generate revenue to offset other taxes, improving economic efficiency.
- Imperfect competition: Market power (monopolies, oligopolies) influences the design and effectiveness of environmental policies. A monopolist's output reduction due to market power can lower pollution, affecting the optimal pollution tax rate.
- Asymmetric information and uncertainty: Information asymmetry between regulators and firms about pollution control costs and emissions can lead to suboptimal tax rates and regulations. Firms may act strategically to evade regulations.
- Incomplete compliance: High compliance costs and perceived low risk of detection can lead to incomplete adherence to regulations. Enhanced enforcement, stricter penalties, and financial assistance can improve compliance.
- Technological change: Technological advancement, whether driven by market forces or government policies, significantly impacts the optimal level of environmental regulation.

III Sustainable Finance

Sustainability-related risks

- Sustainability-related risks refer to the financial risks arising from a company's environmental, social, or governance (ESG) performance. These risks, if realized, could negatively impact a financial institution's business model, strategy, and ability to achieve goals.
- Traditionally, financial institutions have focused on credit, liquidity, and market risks, but now face a new category of environment-related financial risks. Sustainable finance integrates these risks into investment decisions, to promote sustainable development and responsible business practices.

Awareness of sustainability-related risks by the financial sector

- Increasing awareness of sustainability-related risks is transforming the financial sector's asset preferences. Financial markets are shifting towards greener assets, seen as less risky and more socially responsible.
  - This shift mitigates financial instability, supports sustainable development goals, and aligns with initiatives like the UN Principles for Responsible Investment, which promote integrating ESG factors into investment decisions.
- Investing in greener assets reduces sustainability risks due to several advantages. It enhances a company's reputation, attracts consumers, ensures regulatory compliance, and leads to cost savings in energy and waste management. It also fosters innovation and long-term growth through investments in sustainable technologies.
- This shift in investor sentiment is marked by a growing preference for greener assets, particularly investments in companies committed to environmental stewardship and greener technologies.
  - These companies often have substantial reputational capital, making them more appealing to stakeholders.
  - Investment portfolios are now assessed on both financial performance and sustainability attributes, reflecting the belief that companies prioritizing sustainability are less susceptible to various risks and better positioned for long-term financial success.

Definitions of sustainable finance

- UNEP Statement of Commitment by financial institutions for sustainable development: Established after

the Rio Earth Summit in 1992, this statement is the foundation for sustainable finance initiatives. Financial institutions commit to integrating environmental and social considerations into their operations.

- UN Principles for Responsible Investment (UN PRI): Launched in 2006, the UN PRI aims to integrate ESG factors into investment decision-making, promoting long-term returns and sustainable practices. It encourages global investors to adopt six principles that incorporate ESG considerations.
- OECD: The OECD defines sustainable finance as aligning financial flows and products with sustainable development by integrating ESG factors into financial services. Assessment methodologies vary across jurisdictions.
- European Union (EU): The EU defines sustainable finance as economic activities contributing to six environmental objectives, based on the Taxonomy Regulation. "Green finance" refers to financial products with a positive environmental impact.
- United Kingdom (UK): The UK's 2021 roadmap defines sustainability in finance through three ESG factors: Environment, Social, and Governance. It emphasizes global reporting standards and corporate disclosure.

IV The Model

| 1 | Basic framework

- Chapter 4 introduces a theoretical model analyzing how sustainable finance influences a firm's production decisions and environmental emissions within the framework of optimal environmental regulation.
- The model operates in a monopolistic competition environment with a linear demand curve and production function. Firms use a composite input priced at per unit, and the cost function is expressed in terms of output (y) and productivity (θ).

$$P(Y),\ p'(y) < 0 \text{ and } c(y,\ \theta) = \frac{\omega}{\theta} y$$

- The firm aims to maximize profit by choosing an output level where marginal revenue equals marginal cost. The optimal output level is positively correlated with productivity and negatively correlated with input price.

$$y_0 = \frac{\omega - \theta p(y)}{\theta p'(y)}$$

- Emissions are a byproduct of production, and the level is determined by the firm's environmental performance or 'greenness' (g), where a higher g indicates a more environmentally friendly process. The profit-maximizing emission level reflects the emissions associated with profit-maximizing production, considering the firm's greenness.
- Optimal input and emissions levels are influenced by market dynamics, technological efficiency, and environmental considerations. Increased market prices or decreased marginal costs lead to higher input and emissions levels, while improved productivity or a more elastic demand curve results in lower levels. Increasing the firm's greenness factor directly reduces both inputs and emissions.

$$z_0 = \frac{y_0}{\theta} = \frac{(\omega - \theta p)}{\theta^2 p'} \text{ and } e_0 = (1-g)z_0$$

| 2 | Government intervention: Environmental taxation

- This section discusses the impact of an optimal environmental tax (τ^*) on a firm's profit-maximizing output and emissions. The tax aims to internalize the externalities caused by pollution and maximize social welfare.
- With the tax, the firm's cost function includes the tax on emissions, increasing the marginal cost of production and decreasing both output and emissions.

$$c_\tau(y, \theta) = c(y, \theta) + \tau^* e$$

- The profit-maximizing output level under the tax (y^*) is lower than the output level without the tax (y_0). The extent of this decrease depends on the tax rate, the firm's environmental performance (g), and the slope of the demand function. A higher tax rate, lower environmental performance, or a more elastic demand curve leads to a larger decrease in output.

$$y^* = \frac{\omega + \tau^*(1-g) - \theta p(y)}{\theta p'(y)}$$

- The optimal input level under the tax is also lower than the level without the tax. The tax effectively reduces the input level used by the firm, aligning with the policy's objective to internalize environmental externalities. The optimal emission level under the tax is lower than the level without the tax, except for completely "green" firms with zero emissions. For firms with partial greenness, the environmental tax effectively reduces emissions.

$$z^* = \frac{y_0}{\theta} = \frac{\omega + \tau^*(1-g) - \theta p}{\theta^2 p'(y)} \text{ and } e^* = (1-g)z^*$$

| 3 | Sustainable finance

Green consumerism

- Incorporates green consumerism by modifying the demand function to account for the market's preference (γ) for products from environmentally responsible firms.
- The benchmark level of greenness ($\bar{g}$) is introduced as a standard to assess firms' environmental performance. Firms exceeding the benchmark may command a price premium, while those falling short may face a price discount.

$$p(y) + \gamma(g - \bar{g})$$

Sustainable finance and environmental performance

- Integrates sustainable finance by linking the market price of inputs to a firm's environmental performance. This affects both the firm's revenue (market risk) and tax obligations (regulatory risk). The greenness-adjustment parameter (α) quantifies the market's willingness to offer a premium for greener firms or a discount for less green firms.

$$\omega - \alpha(g - \bar{g})$$

- Sustainable finance is defined as the condition where $\alpha < 0$, occurring when there's a market preference for sustainability ($\gamma > 0$) or environmental taxation ($\tau > 0$).

$$\alpha > 0 \text{ if } \gamma > 0 \text{ or } \tau > 0$$

Profit maximization with sustainable finance

- The revenue function is redefined to capture the green consumerism effect, incorporating consumer preferences for environmentally responsible products. The cost function includes the impacts of the optimal environmental tax and the sustainable finance parameter.

$$R_{\gamma,\alpha}(y) = (p(y) + \gamma(g - \bar{g}))y \text{ and } c_{\tau^*,\alpha}(y, \theta) = \frac{\omega - \alpha(g - \bar{g}) + \tau^*(1 - g)}{\theta}$$

- The profit function combines these elements, reflecting the market premium for green products, risk-adjusted input pricing, and the effective tax burden modulated by the firm's greenness. The profit-maximizing output level under sustainable finance and environmental taxation is derived, illustrating the interplay between these factors in the firm's strategic decisions.

$$\pi_{\tau^*,\alpha}(y) = \left(p(y) + \gamma(g - \bar{g}) - \frac{1}{\theta}(\omega - \alpha(g - \bar{g}) + \tau^*(1 - g))\right)y$$

- The impact of sustainable finance on emissions abatement is ambiguous and depends on the firm's greenness relative to the industry benchmark. Greener firms may increase emissions due to financial

incentives and lower costs, leading to higher production. Less-green firms tend to reduce emissions due to higher costs and decreased production.

$$e_1 - e^* = (1-g)\left(\frac{-\alpha(g-\bar{g}) + \theta\gamma(g-\bar{g})}{\theta^2 p'}\right)$$

- For firms where $g > \bar{g}$ (greener than the benchmark): Here, $\alpha(g-\bar{g})$ is positive. Since p' is negative, this leads to an increase in e_1 compared to e^*, as the negative terms in the numerator reduce the absolute value of the fraction. Therefore, $e_1 - e^*$ is positive, indicating an increase in emissions under sustainable finance for greener firms. This increase is due to the greater scale of production and use of inputs incentivized by sustainable finance.
- For firms where $g < \bar{g}$ (less green than the benchmark): Here, $\alpha(g-\bar{g})$ is negative, decreasing the value of e_1 compared to e^*. As a result, $e_1 - e^*$ is negative, indicating a reduction in emissions under sustainable finance for less green firms. This reduction is due to the increased cost burden, leading to reduced production and input use.
- The sign of $e_1 - e^*$ is positive for greener firms ($g > \bar{g}$) and negative for less green firms ($g < \bar{g}$). This outcome highlights the complex impact of sustainable finance on emissions, depending on a firm's environmental performance relative to the industry benchmark.

V Data Insight on Greenness Distribution

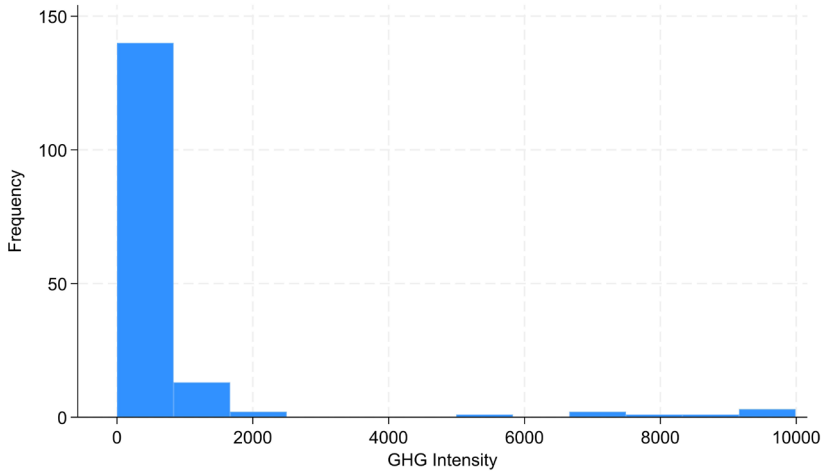
Data description

- Chapter 5 delves into the data-driven analysis of firms' environmental performance, or greenness, across various Korean companies using greenhouse gas (GHG) intensity as a key metric.
  - It begins by detailing the data sources and types used in the study, primarily focusing on GHG emissions and energy use data from the National GHG Management System (NGMS) for companies under the Korea Emissions Trading Scheme (K-ETS) and revenue information from the Data Analysis, Retrieval and Transfer System (DART).
  - The study focuses on 163 companies representing 48 sectors. The variables used in the analysis include company identifier, sector code, GHG emissions, energy use, revenue, cost of goods sold, and SME status.

Results

- GHG intensity distribution
  - The distribution of GHG intensities among companies is highly skewed, with a small number of firms responsible for a disproportionately large share of emissions.
  - This has implications for the effectiveness of sustainable finance mechanisms, as policies targeting high-emission companies might reduce incentives for less-polluting firms to innovate and adopt greener technologies.
- GHG intensity by sector
  - The analysis reveals a heterogeneous distribution of emissions-intensive firms across different industrial sectors. Some sectors have higher median GHG intensities, indicating higher emissions relative to revenue, while others have more moderate intensities. This highlights the potential for targeted environmental regulations in high-intensity sectors to achieve significant emission reductions.

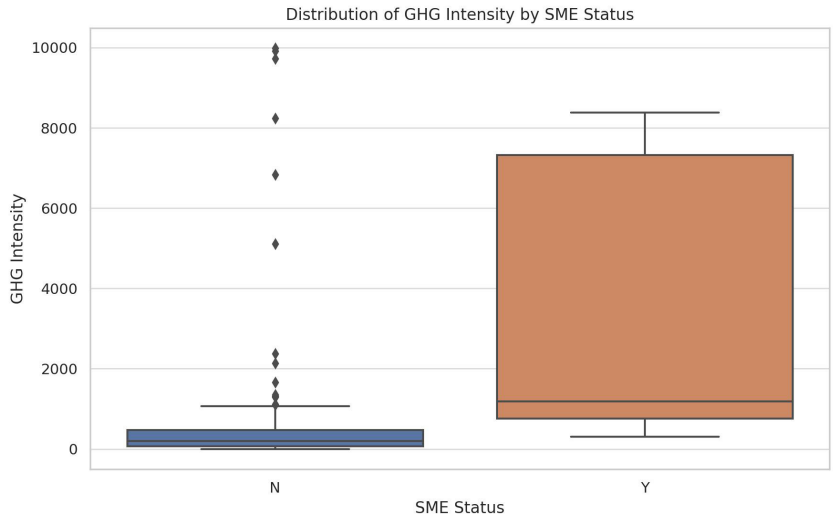
Figure 1. **Distribution of GHG intensity across companies (tCO2/KRW 1 billion)**



Note: GHG intensity in tCO2/ KRW 1 billion.
Source: The author.

- SMEs and GHG intensity
  - Small and medium-sized enterprises (SMEs) tend to have higher GHG intensity than larger firms, likely due to factors like less efficient technologies, smaller operational scales, and limited resources for emission reduction.
  - This finding underscores the need for tailored policy measures to support SMEs in transitioning to greener operations.

Figure 2. GHG intensity distribution by SME status



Note: GHG intensity in tCO2/Billion KRW.
Source: The author.

VI Conclusions

Key findings

- The key findings highlight the complex relationship between sustainable finance and environmental regulation. The theoretical model reveals that the impact of sustainable finance on emissions abatement is not uniform but varies depending on a firm's environmental performance relative to the industry benchmark.
- For firms greener than the industry benchmark, sustainable finance can lead to increased emissions due to financial incentives and lower costs encouraging higher production. Conversely, less green firms tend to reduce emissions under sustainable finance due to the economic pressures and higher costs.
- The study finds that less green firms can achieve emission reductions under sustainable finance without explicit government regulations. This is due to the market mechanisms in sustainable finance that incentivize emission reductions through market-based incentives and cost considerations.
- The study identifies a synergistic relationship between the market's preference for greener firms and

the adjustment factor based on a firm's relative greenness. A higher preference for green firms amplifies the impact of a firm's greenness on its cost structure and market positioning, motivating firms to adopt greener practices.

- The study emphasizes the role of green consumerism in driving voluntary abatement by firms. The market's preference for sustainability can incentivize firms to reduce emissions voluntarily, highlighting the importance of consumer choices in promoting environmental responsibility.

Policy implications

- Chapter 6 emphasizes the need for regulatory authorities to adapt to the evolving landscape of sustainable finance. It highlights the importance of aligning environmental regulation with the impact of sustainable finance by monitoring how firms respond to financial incentives and adjusting regulations accordingly.
- It also stresses the need for greater transparency in sustainable finance benchmarks, ensuring these benchmarks are accurately determined and communicated to stakeholders to guide investment decisions and regulatory compliance.
- It emphasizes the importance of providing tailored support to small and medium-sized enterprises (SMEs) in their transition to sustainability, as they often face unique challenges in adopting greener practices due to limited resources and less efficient technologies.
- Finally, it advocates for sector-specific strategies to harmonize environmental regulation and sustainable finance, recognizing the diverse environmental performance across different industries. It suggests that regulatory frameworks should incorporate sector-specific incentives and benchmarks to encourage sustainable practices.

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