The Literature Review of ESG on Enterprise Innovation:
Evidence from big data

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Abstract. Corporate innovation is influenced by ESG in numerous ways. This paper examines big data's role in promoting ESG in China, the US, and Japan while summarizing the ways in which ESG influences various forms of innovation. The empirical results demonstrate that the Chinese government has been aggressively encouraging corporate social responsibility and sustainable development, based on data from China, the US, and Japan. The growth of businesses in the US is mostly indicative of the promotion of ESG. The public in Japan has reasonably easy access to a variety of data and information regarding sustainable development and environmental preservation. Policymakers ought to think about quantifying ESG performance, standardizing ESG grading standards, and creating development plans tailored to individual nationsr.

Keywords: ESG, Enterprise innovation, Big data.

1. Background

Reliance Retail, the biggest retailer in India, along with Coca-Cola India, have announced the beginning of a sustainability campaign called "Bhool Na Jana, Plastic Bottle Lautana." The initiative is centered on post-consumer PET collection at Reliance Retail locations in Mumbai using collection bins and reverse vending machines (RVMs). This pilot project, which aims to collect 500,000 PET bottles annually during the pilot phase, has started in 36 Reliance Retail stores, including Smart Bazaar and Sahakari Bhandaar stores in Mumbai and Delhi. It is in line with the government's Swachh Bharat Mission and envisions a circular economy. By 2025, it will have expanded to 200 stores nationwide.

At Reliance Retail's Smart Bazaar store in Santa Cruz, the project was introduced in the presence of Kazi Irfan, Officer on Special Duty (OSD), Solid Waste Management, Brihanmumbai Municipal Corporation (BMC).

Customers will have an easy option to return used PET bottles in exchange for attractive discounts on Coca-Cola India goods thanks to the installed RVMs and collection bins. Reliance Industries (RIL), a pioneer in the recycling of polyester and plastics, would gather and recycle the discarded PET bottles. Transitioning away from a typical linear economy, this program will engage customers in responsible trash management, facilitating smooth waste pickup.

This narrative demonstrates the impact of ESG on entrepreneurial innovation. By evaluating a company's or financial instrument's exposure to sustainability risks and its effects on the environment and society, ESG ratings offer a view on the sustainability profile of the former. Investor confidence and the functioning of financial markets are both significantly impacted by ESG ratings.

By enhancing the openness and honesty of ESG rating providers' activities, increasing the comparability of ratings, and averting possible conflicts of interest, the new regulations seek to increase the dependability and comparability of ESG ratings.

As per the suggested regulations, ESG rating agencies must adhere to transparency standards, namely about their methodology and information sources, and be approved and overseen by the European Securities and Markets Authority (ESMA). Specific steps to avoid and handle conflicts of interest will apply to providers.

So what is the impact of ESG on Enterprise Innovation? How existing studies analyze the relationship between ESG and enterprise innovation? Could big data play an important roles in the effect of ESG on enterprise innovation?

The contribution of this paper are: first, this paper creatively summarize the related papers of ESG on Enterprise Innovation from various aspects of innovation formats, which include corporate, green,
social, and technological innovation. Second, the paper penetrate into this topic from the new perspective of big data. Third, this paper use different methods like comparative studies to seek the answers of the roles of ESG on enterprise innovation.

The rest of the paper is structured as below: first is literature review; second is methodology; third is case study; and finally is conclusion and discussion.

2. Literature Review

The related literature review of ESG on Enterprise Innovation could be concluded from several aspects: (1) Corporate Innovation; (2) Green Innovation; (3) Social Innovation; (4) Technological Innovation.

2.1 Corporate Innovation

Main Idea: The study of ESG corporate innovation focuses on A-shared listed enterprises in China, and those studies use different methods like panel data, environmental protection tax, and quasi-natural experiments on the effect and mechanism of ESG on corporate innovation (Tang, 2022; Li & Li, 2022; Chen & Shen, 2022).

Contribution: The main contribution of those studies came from different aspects, like

- How can sustainable development factors influence innovation, the innovation effect's heterogeneity considerations on ESG performance, and the economic consequences of the ESG rating?
- Those studies focus on China’s environmental protection tax and clarify the relationship between the ESG rating and corporate innovation (Tang, 2022; Li & Li, 2022; Chen & Shen, 2022).

Method: Those papers used the multi-period double-difference model and quantitative evaluation of enterprise ESG performance as their research methods (Tang, 2022; Li & Li, 2022; Chen & Shen, 2022).

Data: The companies in Shanghai and Shenzhen from 2011 to 2019 as well as listed enterprises in the A-share markets that have achieved an ESG grade and are classified as heavy or non-heavy pollutants are used as samples in those studies (Tang, 2022; Li & Li, 2022; Chen & Shen, 2022).

Limitation: The studies on corporation innovation also have some limitations, like that they used a single dimension, the research was mainly in China, and the model needs to be further modified (Tang, 2022).

2.2 Green Innovation

Main idea: The main idea of those studies is to focus on the relationship between listed companies and green innovation. They study it from different perspectives, like executives’ ESG cognition, the micro-environmental impact of ESG scores, ESG indicators, and financial performance (Aldieri, 2023; Wang et al., 2022; Jiang, Liu & Hu, 2023; Zheng, Khurram & Chen, 2022).

Contribution: The main contribution of those studies came from different aspects, like adopting the methods of the experimental group and control group, offering useful insights for managers, and analyzing the influence of ESG performance on green innovations from a macro-level perspective (Aldieri, 2023; Xu, Liu & Shang, 2021; Fu, Zhao & Chang, 2023). In addition, they provide a theoretical basis and practical reference for corporate green innovation practices (Wang et al., 2022).

Method: Those papers use the multi-stage differentially differential model, Quantile regression, Instrumental variable (IV) method, First-differencing (FD) method, and Kinky least-squares (KLS) approach as their research methods (Aldieri, 2023; Zhang, Qin & Liu, 2020; Fu, Zhao & Chang, 2023).

Data: The primary sources of data used are commercial system reforms in all prefecture levels and above cities across various nations and regions. These include the China State Intellectual Property Office, China National Intellectual Property Administration (CNIPA), China's Bloomberg Database to investigate the impact of ESG on green innovations, Chinese-listed A-shares on the Shanghai and

Limitation: Those studies have a number of drawbacks. Certain publications lack theoretical frameworks, while others are unable to fully account for the influence of extraneous elements on the outcomes. Additionally, the samples may not accurately represent other businesses across different sectors that only take into account the minute environmental effects (Aldieri, 2023; Zheng, Khurram & Chen, 2022; Jiang, Liu & Hu, 2023).

2.3 Social Innovation

Main idea: These articles, which center on service firms, discuss social innovation, energy transition, and circularity, as well as how to communicate Environmental, Social, and Governance (ESG) initiatives to clients (Katsamakas, Miliaresis & Pavlov, 2022; Popescu et al., 2022; Khalil, Khalil & Khalil, 2022).

Contribution: The primary contributions of those papers are the identification of a general framework for a digital platform that facilitates volunteerism in collaboration with nonprofits, the clustering of themes for the metasynthesis studies, and recommendations for the communication of ESG initiatives by management of services firms (Katsamakas, Miliaresis & Pavlov, 2022; Popescu et al., 2022; Khalil, Khalil & Khalil, 2022).

Method: In those review papers, they employ the PRISMA method and build a Causal Loop Diagram (CLD) model (Katsamakas, Miliaresis & Pavlov, 2022; Popescu et al., 2022).

Data: Data come from interviews with an Ethelon cofounder, Web of Science, Scopus, JSTOR, Social Innovation Inde, Bloomberg Sustainability Accounting Standards Board (SASB) ESG and Datamaran (Katsamakas, Miliaresis & Pavlov, 2022; Popescu et al., 2022; Khalil, Khalil & Khalil, 2022).

Limitation: Those papers need more studies in building mathematical or computational models and how can ESG metrics and reports need to be adapted to and communicated on a local level (Katsamakas, Miliaresis & Pavlov, 2022; Khalil, Khalil & Khalil, 2022).

2.4 Technological Innovation

Main idea: The studies mainly grounded within financial geography (Hughes, Urban & Wójcik, 2021; Kong et al., 2023).

Contribution: These papers contribute to the discussion and deepen our understanding of the relationship between ESG performance and firm value in developing and least-developed countries by contrasting these conventional ratings with alternative ESG ratings that make use of technological advancements in artificial intelligence and cognitive computing (Hughes, Urban & Wójcik, 2021; Kong et al., 2023).

Method: Papers used quantitative comparative analysis of datasets to study the topic (Hughes, Urban & Wójcik, 2021; Kong et al., 2023).

Data: Data is derived from financial statements, sustainability reports, annual reports of sample firms, and MSCI ACWI (Hughes, Urban & Wójcik, 2021).

Short-term focus: Companies may prioritize meeting short-term ESG targets over investing in long-term research and development of new technologies.

3. Methodology

3.1 Literature Review Method

Synthesize findings and issue endorsements: Derive inferences from the amalgamated scholarly literature, elucidate the extant understanding of the subject matter, and pinpoint avenues for subsequent scholarly inquiry. Recommendations for practice, policy, or further study should be derived from the findings of the literature review.
Compile a comprehensive literature review document: Craft a meticulous account or scholarly document that encapsulates the methodology employed in conducting the literature review, encompassing the research queries or aims, the search methodology, the criteria for inclusion, the assessment of the scholarly works, the integration of the results, and the derived insights along with closing remarks and proposed actions.

3.2 Comparative Studies

Comparative studies, alternatively referred to as cross-cultural research, entail the examination and juxtaposition of disparate cultures, societies, or groups to discern their analogous and contrasting attributes. This technique finds application across multiple disciplines, including anthropology, sociology, psychology, education, and business.

The primary aim of comparative research is to elucidate the intricate interplay between cultural, societal, and psychological determinants that shape human behaviors and cognitive processes. Through the juxtaposition of cultural or societal cohorts, scholars are able to discern discernible sequences, societal trends, and shared attributes which serve to elucidate multifaceted occurrences.

4. Case Study

4.1 China

Big data facilitates the advancement of Environmental, Social, and Governance (ESG) concerns and fosters corporate innovation by nurturing the creation of intelligent energy platforms. Certainly, here is a rewritten version of the paragraph in a scientific tone: Through the examination of datasets pertaining to energy consumption patterns, meteorological conditions, and additional pertinent variables, these entities are capable of pinpointing potential enhancements in operational efficiency and diminishing levels of unnecessary resource utilization.

The utilization of big data in fostering corporate innovation is further exemplified by the advent of customized products and services. Through the examination of data pertaining to consumer preferences and behaviors, enterprises are capable of formulating bespoke offerings that align with the distinct requirements of each patron. Not only does this facilitate corporate differentiation from competitors, but it also enhances customer satisfaction and fosters loyalty.

China Mobile serves as a prototypical illustration of a leading global mobile communications provider. China Mobile has established a sophisticated big data platform designed to monitor and manage its Environmental, Social, and Governance (ESG) related performance. This platform incorporates specialized modules dedicated to the precise tracking of carbon emissions, oversight of water consumption patterns, and the assessment of energy utilization rates. The platform incorporates utilities designed for the assessment of client input and the delineation of enhancements. The implementation of this platform has enabled China Mobile to achieve a 20% reduction in carbon emissions and a 15% enhancement in energy efficiency.

Alibaba Group serves as a prime example of a leading global e-commerce enterprise. Alibaba has engineered a comprehensive big data platform for the efficient management of its supply chain operations. This platform incorporates sophisticated tools designed to monitor and ensure product quality, evaluate supplier efficiency, and assess the environmental footprint associated with the supply chain activities. The platform further incorporates utilities designed for the assessment of consumer input, as well as the delineation of aspects requiring enhancement. Through the implementation of this platform, Alibaba has achieved a 20% enhancement in product quality and a 15% reduction in environmental impact.

In summary, the influence of big data in enhancing Environmental, Social, and Governance (ESG) considerations and fostering corporate innovation within the Chinese context is continually expanding. Through the analysis of extensive datasets derived from diverse sources, entities are capable of deriving crucial understandings of their Environmental, Social, and Governance (ESG) outcomes, thereby pinpointing sectors where enhancements are necessitated. Big data analytics
enables companies to pinpoint novel growth avenues and tailor their offerings to align with the unique requirements of individual consumers, thereby fostering entrepreneurial innovation. Despite ongoing obstacles related to data privacy and security, the potential advantages of leveraging big data in Environmental, Social, and Governance (ESG) management and corporate innovation are substantial. As the trend of incorporating Environmental, Social, and Governance (ESG) principles into business strategies gains momentum, alongside the integration of cutting-edge technologies, it is anticipated that there will be a sustained advancement within this domain.

4.2 USA

In addition to China, under the extensive use of big data, ESG and enterprise innovation in the United States have also had a great impact.

Many businesses can also rate their ESG using the use of big data. Ratings organizations gather and compile ESG data into a single score using teams of analysts, sophisticated tools, and company data. While some ESG ratings consumers desire to acquire an advantage in the stock market, others want their money to work for both them and society as a whole.

Apart from that, a lot of US IT companies are worried about how much energy they consume and are making significant investments in renewable energy because they believe it would benefit their long-term financial interests to appear concerned. Through power-purchase agreements (PPAs), tech companies are by far the largest purchasers of renewable energy. PPAs offer a certain amount of financial stability, which facilitates the construction of renewable energy projects. According to research company Bloombergnef, the data center industry has built (or plans to add) 74 gigawatts of capacity in this manner.

Additionally, IT firms purchase a lot of renewable-energy certificates (recs), which are a means of funding the development of renewable capacity. Recs are given to power companies for producing and supplying electricity from renewable energy sources to the grid. After that, they can sell references anyway they want. When the electricity used to power the data centers is not carbon-free, tech companies employing renewable energy sources can nonetheless claim that the data centers are carbon-free.

Giants in the data center industry have also made more direct investments in energy technologies that have not yet proven profitable. Google helped scale the technology to reduce prices by investing in over two gigawatts of early solar and wind projects in the late 2000s.

Prominent American companies also place a high value on ESG and have made various environmental commitments. Among them, while Google has posted one of the highest PUE data centers - an annual PUE of 1.08 for 2020 (Google 2021c) - Z Holdings said it plans to build data centers with PUE below 1.5 and purchase renewable energy to run its data centers. This also means that big data-based data centers are also implementing ESG(Tsujimoto & Masao, 2022).

4.3 Japan

An ecological materials guide project has being created in Japan by the Ecological Materials Forum since 2005. On the firm website or in environmental reports, scientists and engineers have been working to develop sustainable technologies, and they have accumulated a great deal of information and technology in the process. These materials have the following qualities: high productivity, low hazardous material content, high recyclability, little environmental effect during production, and green environmental profile. The information from the site can be used by scientists and engineers to help preserve the environment(Ozao et al., 2007).

Digital platform providers must have suitable ESG information disclosure, and big data is also being used to apply to the disclosure of ESG information for diverse companies. Digital platform providers are engaging in ESG operations in response to investors' growing attention to companies' ESG, particularly with regard to information disclosure. Platform providers have therefore enrolled in and joined a number of ESG projects in order to facilitate disclosure(Tsujimoto & Masao, 2022).
5. Conclusion

This paper summarizes how different forms of Innovation, including Corporate Innovation, Green Innovation, Social Innovation, and Technological Innovation, are affected by ESG. From the perspective of big data, how China, the United States and Japan use big data to promote the promotion of ESG. By summarizing existing articles and national policies, the following recommendations are made to governments.

First, as Kula noted in the article, the ESG field is still relatively chaotic, and a comprehensive ESG evaluation system needs to be established(Kula,2024). It can be implemented from the two aspects of unified rating standards and quantified ESG performance, and the government can cooperate with professional organizations to develop unified and scientific ESG evaluation standards. This will not only help to reduce the current wide variation in results between different rating agencies, but will also give companies a clear direction to improve and encourage them to move towards higher ESG standards. At the same time, by establishing quantitative evaluation indicators, enterprises' ESG performance can be measured and compared, so as to promote enterprises to gain competitive advantages with higher ESG performance in the market.

Second, similar to KRUEGER et al., we believe that ESG disclosure regulation can improve the information environment and have beneficial capital market effects(KRUEGER et al.,2021). Specifically, governments can standardize disclosure requirements and introduce norms requiring companies to regularly disclose comprehensive ESG-related information, including but not limited to environmental impact, social responsibility, and governance structure. This helps companies become more transparent and operate more responsibly. At the same time, voluntary disclosure is encouraged. In addition to mandatory disclosure, the government can also encourage enterprises to voluntarily disclose ESG information beyond the requirements of the regulations through incentives such as tax incentives, so as to stimulate the innovation motivation of enterprises.

Third, we made a number of recommendations that are particular to China's ESG:

5.1 Reinforce the government's leading position in the development of ESG systems

The three components of the ESG concept—ESG information disclosure rules, ESG evaluation institutions and evaluation systems, and ESG investment institutions' investment guidelines, among others—can all be significantly impacted by China's distinct institutional advantages(Liu et al.,2024). They should be actively promoted by government agencies, pertinent associations, and self-regulatory groups. It is suggested that relevant government departments of the bond and credit markets, as well as self-regulatory organizations of associations, actively promote the construction of ESG systems in three dimensions according to their respective market characteristics. Relevant capital market departments and organizations, such as the China Securities Regulatory Commission, stock exchange, and Asset Management Association, have played a good demonstration effect in this regard.

5.2 Clarify the core role of corporate governance in the construction of ESG system

Firstly, there should be one core, corporate governance, and two fundamental points, environmental responsibility and social responsibility, in the internal interaction between environmental duty, social responsibility, and corporate governance. By bolstering corporate governance, it is possible to continuously improve the benefits to society and the environment. Second, in order to logically define the boundaries of environmental and social duty, corporate environmental and social responsibility must take into account China's unique national circumstances. It is impossible to define corporate environmental and social responsibility in a vacuum. The fundamental idea is that environmental responsibility standards can be defined as compliance with applicable environmental protection laws and regulations, but there are some areas where environmental protection legislation is behind schedule. It would be beneficial to have more conversation on how corporate governance might be used to limit the arbitrage of corporate regulatory policy. The maxim "the market belongs to the market and the public good belongs to the public good"
should be upheld in terms of social responsibility. We also shouldn't react to businesses' excessive moral demands and instead should encourage them to take the lead in social responsibility through economic laws, policies, and regulations.

5.3 The evaluation indicators are qualitative and practical

The original intention of ESG is to encourage enterprises to pay attention to non-financial factors such as environment, society and governance. Unlike financial indicators, these indicators are difficult to calculate accurately and quantitatively. Therefore, the setting of ESG rating price indicators should be based on the qualitative approach, and objective, transparent and reliable ESG evaluation results should be pursued on the basis of the qualitative approach. Put an emphasis on use, simplicity, and pragmatism. Social responsibility focuses on the performance of businesses in four areas: employee management and stability, customer satisfaction and complaints, public production safety, and enterprise credit. Environmental responsibility focuses on the performance of businesses in four areas: energy consumption index, pollutant emission, green business proportion and transformation, and environmental protection information disclosure. Four areas of an organization's performance are examined by corporate governance: ownership structure, significant shareholder conduct, management incentive and restraint mechanisms, and degree of information exposure.

The following are this paper's limitations: First, there are variations per industry. When it comes to the drive for innovation and the adoption of ESG, there are notable variations in demand and response among industries. Technological innovation may be driven by pressure for environmental norms in certain areas, like manufacturing and energy, whereas social and governance innovation may be more prevalent in other industries, like services. Existing research frequently ignores this distinction. The second is the immediate and long-term impacts. ESG metrics may have different effects on innovation over time. Strict ESG rules might raise expenses and complicate operations in the near run, which will slow down and lower the caliber of innovation. Long-term, these actions might assist businesses in cultivating an innovation culture that is more sustainable and responsible, but additional empirical study is required to bolster the steps involved in and results from this change. The third is the methodological query. The current body of research contains some methodological limitations that could impact the generalizability and precision of research findings. These limitations include bias in sample selection, data accessibility, and analytic method selection. Finally, this study could be a starting point for exploring the mechanism of ESG and enterprise innovation.

References


