Impact of ESG Implementation on Total Factor Productivity under the Context of Carbon Peak and Neutral Target

Jiayu Luo *

NewHuadu Business School, Minjiang University, Fuzhou, 350108, China

* Corresponding author: China3211702122@stu.mju.edu.cn

Abstract. The focus of this essay is the relationship between environmental, social, and corporate governance (ESG) performance and total factor productivity (TFP) under the Dual Carbon Target. Through the technology innovation effect and allocation effect of resources, the research examines and explores how ESG affects TFP. Between them, the technology innovation effect releases the innovation potential of enterprises from three dimensions: innovation efficiency, innovation quality, and innovation output (the increase of green invention patents), meanwhile, the resource allocation effect improves investment efficiency as well as reduces financing constraints, increasing green investment opportunities. There has been a preliminary discussion in existing literature on the impact of ESG advantages on corporate innovation output, but no literature has yet addressed how ESG expands green investment opportunities via firm innovation. Hence, the article provides a new insight into green investment opportunities to reveal the intrinsic mechanisms of the impact of ESG performance on enterprise TFP, expanding the research perspective of relevant literature. The findings in this paper demonstrate that ESG advantages can effectively enhance corporate TFP, and offer valuable implications for governments to strengthen environmental assessment mechanisms to better incentivize companies to unleash innovative potential, thereby promoting comprehensive green transformation and economic development.

Keywords: ESG Performance, Total Factor Productivity, Digital Transformation, Green Finance.

1. Introduction

In 2021, “Carbon Peak” and “Carbon Neutral” was first written into the Chinese government work report, low carbon green growth has become the main theme of economic and social development. With high-quality development as the theme of the economy and society, innovation will become the first driving force, green will become the universal form, and green and innovation will become two important factors driving economic transformation and upgrading. While in the past, manufacturing enterprises only focus on innovation without taking environmental protection into account, so that most of the companies in China are in the “non-green innovation” situation [1]. As a country relying on heavy industry economy, to achieve high-quality development led by the green economy, the key is on the combination of economic and ecological civilization construction. Therefore, in the process of accelerating the green transformation and upgrading of the economy and improving the quality of firms, enterprises confront with the dual tasks of improving total factor productivity (TFP) and fulfilling their environmental, social, and corporate governance (ESG) responsibilities [2].

ESG includes three dimensions of environment, society and corporate governance, originating from socially responsible investment and ethical investment, integrating the concepts of sustainable development and green development, giving full play to the role of stakeholders, relying on market-driven mechanisms, and advocating that enterprises internalize their environmental friendliness and social responsibility into their corporate governance, so as to ensure the fulfillment of environmental responsibility and social responsibility by enterprises through standardized and high-level corporate governance. ESG is highly in line with the overall layout of the "Five-in-One" and the new development concept, emphasizing the need for enterprises to focus on ecological environmental protection, fulfill their social responsibilities, and improve their governance level, which promotes the change of the enterprise's business philosophy, and points out a new path for the enterprise to improve quality and efficiency, and for the high-quality development of the economy and society,

both for the enterprise's own value creation and for the macro-economic development of the economy. Both the enterprise's own value creation and macroeconomic growth are of great significance.

2. Mediating Effect

ESG plays a moderating role in digital transformation. Digital technology innovation can enhance ESG performance through dynamic capabilities such as green innovation, social responsibility, and operational management, thereby affecting TFP [3-5].

Li et al. found that digital transformation (DT) helps corporates collect and process information efficiently, expand their scale efficiency, and achieve data-driven intelligent and efficient production [6]. Furthermore, Li et al. shows that DT reduces barriers to technical cooperation (TC) and reshapes the way value creation between corporates and other organizations. Corporate TC is an effective measure to improve TFP [6].

Additionally, ESG also has a moderating effect on corporate DT. ESG enables corporates to maintain good relationships with multiple stakeholders and reduce information asymmetries. It helps corporates create a good reputation and gain the technology partner’s trust. At the same time, ESG can alleviate principal-agent problems and reduce environmental violation costs and financing constraints. It further supports the positive effects of DT on TC and TFP.

ESG considerations are increasingly becoming a cornerstone of corporate strategy, particularly in the context of digital transformation. Green innovation, as a dynamic capability, plays a crucial role in enhancing ESG performance. It involves the development and implementation of environmentally friendly technologies and processes that reduce ecological footprints and promote sustainability. In the financial sector, green innovation is not just about compliance with environmental regulations; it’s about seizing opportunities that arise from the transition to a low-carbon economy. Financial institutions that invest in green technologies, such as blockchain for carbon credit trading or AI for energy-efficient portfolio management, can achieve superior TFP. This is because green innovation can lead to cost reductions, open new markets, and improve investor relations by aligning with the values of socially conscious investors.

Social Responsibility: In tandem with green innovation, social responsibility is another dynamic capability that significantly influences ESG performance in the digital era. It encompasses a broad range of activities, from ethical business practices to community engagement and employee welfare. For financial institutions, social responsibility means going beyond the bottom line to consider the broader impact of their operations on society. By leveraging digital platforms for transparent communication, promoting financial inclusion through technology, and supporting social enterprises via impact investing, financial firms can enhance their reputation and build trust with stakeholders. Moreover, socially responsible practices can lead to a more engaged and productive workforce, which is a key driver of TFP in the service-oriented finance industry.

Operational Management: Operational management, the third pillar of dynamic capabilities in the ESG framework, is about optimizing business processes and resource utilization. In the digital age, this often involves the adoption of cutting-edge technologies to streamline operations, reduce costs, and improve service delivery. For the finance sector, operational management can be revolutionized through digital transformation initiatives like automating routine tasks with Robotic Process Automation (RPA), employing big data analytics for risk management, and utilizing cloud computing for scalability and agility. These innovations not only contribute to a leaner and more efficient operation but also support sustainability by minimizing waste and energy consumption. As a result, operational management through digital innovation can have a direct positive impact on TFP, reflecting the enhanced productivity and operational excellence of financial firms.

3. Technology Innovation Effect

Technology innovation mechanism demonstrates that there is a positive relationship between ESG performance and TFP by unleashing corporate innovation effectiveness [7]. This effect manifests across three dimensions:

In terms of innovation efficiency, ESG-focused companies tend to allocate resources more efficiently, fostering a conducive environment for innovation. By integrating sustainability principles into their operations, firms streamline processes, reduce waste, and optimize resource utilization, thereby enhancing TFP. For innovation quality, ESG considerations incentivize companies to prioritize research and development (R&D) efforts aimed at developing high-quality, innovative solutions. Investments in sustainable technologies not only address environmental challenges but also spur breakthroughs in product design, enhancing competitiveness and market positioning. Regarding innovation output, a notable outcome of heightened ESG performance is the proliferation of green invention patents. Companies committed to sustainability are more likely to develop and commercialize environmentally-friendly technologies, contributing to a greener economy while simultaneously boosting TFP through the creation of intellectual property. In addition, Sun et al. found that this beneficial effect tends to be stronger for state-owned enterprises (SOEs), heavily polluting industries, and environments with a low degree of marketization [8].

First, the state-owned firms are more engaged in environmental and social issues than other non-state-owned firms. Given the public ownership feature of SOEs, there is a heightened level of scrutiny on their operations, especially concerning their environmental and social impacts. The implementation of ESG practices in SOEs can lead to improved operational efficiencies and innovation, as these enterprises are typically more susceptible to public and governmental pressure to adhere to sustainable practices. Meanwhile, ESG has a positive influence on financial performance of SOEs, which may benefit from government support in the form of subsidies or preferential policies when they align with national ESG goals, thereby directly influencing their TFP.

Second, heavy pollution industries, such as mining, chemicals, and power generation, are under increasing pressure from regulators, investors, and the public to strengthen the disclosure of ESG information. The adoption of ESG practices in these sectors often promotes to the evolution of cleaner technology, which can reduce waste and increase efficiency. Moreover, as consumers become more environmentally conscious, companies in polluting industries that adopt ESG principles may gain a competitive edge to have better market positioning and higher TFP.

Third, in regions where market forces are less prevalent, ESG factors can play a vital role in shaping corporate behavior. Companies operating in such context may find that ESG compliance is a requirement for accessing capital or participating in certain markets, potentially attracting green investment and partnerships that can boost TFP.

4. Allocation Effect of Resources

Allocation effect of resources illustrates that corporations' high scores on ESG are related to fewer financial constraints, higher investment efficiency and more green investment opportunities. This leads to the firm's output growth and high productivity [9].

To be specific, ESG ratings function through reducing market financing constraints and obtaining government grants. Firstly, improved ESG ratings help ease market financing constraints, enhancing financial performance, increasing investments in productive capital, and securing funds for R&D, thereby raising TFP. Secondly, higher ESG ratings aid in acquiring more government grants, which improve free cash flow, augment green investment opportunities, and reduce research risks, further elevating TFP [10].

The allocation effect of resources is a concept that highlights the impact of a firm’s ESG performance on its financial and operational outcomes. Firms with high ESG scores tend to experience fewer financial constraints, which implies that they have better access to capital at lower

costs. This is because investors and lenders often perceive such firms as lower risk, given their responsible business practices.

Moreover, high ESG scores are associated with higher investment efficiency. This means that firms are better at allocating capital to projects that yield the highest returns relative to their risk. They avoid over- or under-investing in assets, thus optimizing their investment portfolio. This efficient capital allocation is partly due to the stringent governance practices that reduce the likelihood of managerial overreach and ensure that investments are made in projects that align with the firm's long-term strategy and stakeholder interests.

Additionally, firms with strong ESG credentials are more likely to identify and capitalize on green investment opportunities. These opportunities not only contribute to sustainable development but also open new markets and revenue streams for the firm. By investing in green technologies and practices, firms can differentiate themselves from competitors and establish a reputation as industry leaders in sustainability.

The culmination of these factors—fewer financial constraints, higher investment efficiency, and more green investment opportunities—leads to output growth and high productivity for the firm. Output growth refers to the increase in the quantity of goods or services produced by the firm, while productivity is a measure of how efficiently these outputs are generated relative to inputs.

In essence, the allocation effect of resources suggests that ESG is not just a matter of corporate responsibility but also a strategic imperative that can drive financial performance. Firms that excel in ESG are likely to be more innovative, resilient, and competitive, which ultimately translates into growth and productivity gains. This relationship between ESG performance and financial outcomes has significant implications for investors, managers, and policymakers. Investors can use ESG scores as a criterion for portfolio selection, managers can leverage ESG to enhance corporate value, and policymakers can promote ESG standards to foster a more sustainable and efficient economy. In conclusion, the allocation effect of resources underscores the importance of ESG in the contemporary business landscape. As firms increasingly recognize the value of ESG, it can be expected a shift towards more sustainable business practices that not only benefit the environment and society but also contribute to the firm's financial success.

From a general perspective, an overall good ESG performance of enterprises can benefit the climate stability, and in turn, furtherly reduces firms' carbon emissions.

In the context of finance, the ESG performance of enterprises is increasingly seen as a critical factor in promoting climate stability. A strong ESG record reflects a company's commitment to environmental stewardship, social responsibility, and sound governance practices. Such a commitment can led to a reduction in carbon emissions, which is essential for mitigating the adverse effects of climate change. Financially, companies with good ESG performance often have better risk management strategies, are more resilient to market volatility, and are more likely to attract investment. Investors and stakeholders are increasingly using ESG criteria to screen potential investments, recognizing that companies with sustainable practices are more likely to succeed in the long term. Moreover, good ESG performance can enhance a company's reputation, leading to increased customer loyalty and potentially higher profits. In the finance sector, there is a growing understanding that sustainable business practices are not just good for the planet but also beneficial for a company's bottom line. As such, there is a clear financial incentive for companies to improve their ESG performance. This, in turn, contributes to the broader goal of climate stability, creating a virtuous cycle where financial health and environmental sustainability reinforce each other. In summary, from a general perspective, a good ESG performance is not only beneficial for the climate but also advantageous for firms in the financial arena, as it can lead to a reduction in carbon emissions and promote overall corporate sustainability. This alignment of environmental and financial objectives is crucial for the development of a stable and sustainable global economy.

5. Conclusion

Corporate ESG implementation has a positive impact on total factor productivity and realizes a "win-win" situation for both company and social benefits by easing financing constraints and enhancing technological innovation. At the same time, I also found that ESG has a more significant impact on TFP for SOEs and heavy pollution enterprises.

This research emphasizes the importance of digital transformation to the TFP of enterprises and shows that increasing the R&D investment of listed companies in ESG is conducive to promoting green invention patents outputs. Based on my research, I propose the following three suggestions. Firstly, under the ESG system, in order to greatly improve total factor productivity, enterprises need to effectively enhance core technologies, concentrate on overcoming difficulties, increase technological innovation and investment in advanced equipment, and gradually improve the carrying, digesting and absorbing capacity of technological innovation inputs, so as to realize the goal of soundly improving the total factor productivity of enterprises through technological innovation and reform. Secondly, all parties should make efforts to broaden diversified financing channels and alleviate the problem of corporate financing constraints. The government should actively promote innovation by financial institutions, develop new green financial products, broaden the credit scope of ESG investment, lower the loan interest rate for enterprises with good ESG performance, improve the ESG ecosystem financing system, and give enterprises the greatest support. Meanwhile, enterprises should eliminate the waste of resources, focus on improving the efficiency of resource allocation, exchange less input for higher output, optimize the investment structure, realize cost reduction and efficiency improvement, and lay the foundation for high-quality development. Finally, the whole nation should introduce policies and regulations that promote the application of digital technology, guide enterprises in pursuing the Sustainable Development Goals strategy, and gradually incorporate ESG indicators into performance assessments. The government needs to provide special funding to support enterprises' technological R&D and help them incorporate digital technology in their production and management processes to improve their innovations and operational efficiency.

ESG criteria are increasingly recognized as significant drivers of a company's long-term success. The positive impact of ESG on TFP can be attributed to efficient resource utilization, innovation, and enhanced operational performance. Conversely, high TFP indicates effective management and operational efficiency, which can lead to improved ESG performance through better resource allocation and strategic investments in sustainable practices. This symbiotic relationship suggests that companies focusing on ESG factors are likely to achieve superior productivity, thereby creating a virtuous cycle that promotes financial sustainability and responsible corporate citizenship.

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