



The Promoting Effect of Enterprise Green Total Factor Productivity on Enterprise Green Profitability

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Abstract. Against the backdrop of global warming and advancement of carbon peaking and carbon neutrality goals, green total factor productivity (GTFP) serves as a core metric for measuring the efficiency of green transition. Its impact on corporate profitability represents a pivotal issue in the synergy between green development and microeconomics. This study employs a two-way fixed effects model, utilizing a sample of Chinese A-share listed companies from 2010 to 2024, to empirically examine the influence of GTFP on corporate profit margins and its heterogeneous characteristics. Findings reveal: GTFP enhancement significantly stimulates growth in corporate net profit margins. It offers reference value for differentiated approaches to advancing corporate green transition and optimizing policies that synergies environmental and economic objectives.

Keywords: profit margins, GTFP, OLS

1 Introduction

In recent years, as the pace of global warming continues to accelerate, reducing carbon emissions and promoting green development have become widely accepted objectives within the international community. Against this backdrop, China has actively implemented new development concepts, steadfastly pursuing high-quality development. In *Selected Works on Ecological Civilisation by Xi Jinping*, General Secretary Xi Jinping emphasized that 'green development is the fundamental color of high-quality development', stressing the imperative to accelerate the green transformation of development patterns to support the achievement of carbon peaking and carbon neutrality goals. Data from the Ministry of Industry and Information Technology indicates that during the 14th Five-Year Plan period, China has made significant strides in green and low-carbon development, with the momentum for green development continuously strengthening. The 15th Five-Year Plan period represents a critical phase for achieving China's dual carbon goals. Throughout this process, GTFP—a vital indicator for measuring the quality and efficiency of economic greening—has garnered increasing academic attention. Against the backdrop of nationwide advocacy for transitioning towards green innovation and sustainable development, can enhancing green TFP drive enterprises to reduce costs and improve efficiency, thereby boosting profit margins? What mechanisms underpin its impact on corporate profitability?

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To verify the aforementioned issues, this paper employs a two-way fixed-effects model. Based on an analysis of GTFP and profit margin data from A-share listed companies between 2010 and 2024, it provides an overall description of the impact of GTFP on corporate profit margins. Furthermore, it examines the heterogeneous effects of two factors—regional division into eastern, central and western China, and whether the firm belongs to a high-tech industry—on profit margins across different enterprises. This aims to comprehensively analyses the role of enhancing GTFP from a more micro-level perspective.

2 Literature Review

From a macro perspective, GTFP is an essential source of green economic growth over the long term [1]; Shifting to a micro perspective, GTFP serves as the benchmark for assessing enterprises' transition towards green development models under resource and environmental constraints [2]. Existing research in this field primarily focuses on two dimensions, providing a robust theoretical foundation and research reference for this paper. Firstly, the measurement of GTFP employs two main methodological approaches: parametric and non-parametric. Peng Lin et al. [3] adopted the parametric method, utilizing the SFA model to decompose GTFP growth into rates of technological progress, technological efficiency, returns to scale, and allocative efficiency. This structural decomposition offers a framework for identifying growth drivers. In his 2021 study [4], a non-parametric approach was employed to construct a three-stage super-efficient SBM-DEA model integrated with the Malmquist-Luenberger index. This methodology effectively eliminates managerial inefficiency, external environmental factors, and random errors, thereby yielding a more authentic dynamic evolution of GTFP. Secondly, research has been conducted on the key determinants and operational mechanisms influencing GTFP. Existing research primarily explores its driving factors through macro and micro pathways. Regarding macro factors, prior studies have examined influences on GTFP from both policy dimensions—such as environmental regulations [5], mixed-ownership reforms [6], and green financial support—and economic phenomena dimensions—including industrial intelligentsias and population agglomeration within urban clusters [7].

At the micro level, research focuses on the enabling effects of digitalization and greening. Empirical evidence indicates that the synergy between digitalization and greening generates a significant “multiplier effect”. Through resource synergies and innovation synergies, this approach enhances firms' GTFP more efficiently than either transformation alone [8]; Regarding micro-level transmission mechanisms [9], research indicates that specific corporate actions such as green factory certification serve as effective tools for directly enhancing the total factor productivity of green enterprises. On the one hand, the financing support and market signals generated by certification incentivize firms to increase R&D expenditure and patent output. On the other hand, by internalizing environmental costs and strengthening external oversight, it optimizes the efficiency of capital allocation within enterprises, thereby reducing inefficient investments.

Profit margins, as a key indicator of a company's profitability, continue to attract close attention from businesses, investors and other stakeholders alike. The factors influencing these margins hold significant research value. Existing studies on their influencing mechanisms can broadly be categorized into two main directions: external mechanisms and internal mechanisms. From the perspective of external mechanisms, research indicates that environmental regulations exhibit a negative correlation with profit margins when firms refrain from technological innovation. Conversely, when firms engage in technological innovation, formal environmental regulations demonstrate an inverted “N”-shaped threshold effect on profit margins [10]. From the perspective of internal mechanisms, scholars have explored the impact of corporate behavior on profitability through lenses such as firm imports [11], environmental tax reform [12], and artificial intelligence [13].

In summary, existing research has established a multi-faceted paradigm centered on diverse measurement methodologies for GTFP. It has identified GTFP drivers at the policy, economic phenomenon, and micro-level corporate behavior dimensions, while dissecting the internal and external mechanisms influencing corporate profit margins. This work lays the theoretical groundwork for exploring the relationship between GTFP and corporate performance. However, significant gaps persist in the existing literature: Firstly, the analytical focus predominantly resides at the macro and micro levels, with relatively scarce research addressing the direct impact of enhanced GTFP on microeconomic entities; Secondly, existing research has yet to leverage systematic quantitative data to clearly delineate the heterogeneous characteristics and constraint boundaries of internal and external factors affecting GTFP and corporate profit margins under varying contextual variables, such as industry heterogeneity and different stages of corporate green transition. Thirdly, existing research predominantly focuses on the unidirectional driving effect of policies or transformation behaviors on GTFP, overlooking the potential promotional relationship between GTFP and corporate profitability. This approach struggles to fully reveal the dynamic patterns of their long-term synergistic development.

This paper's marginal contribution lies in transcending the macro- and meso-level analytical perspectives of existing research. By examining the micro-level enterprise dimension, it reveals the transmission mechanism through which GTFP enhances corporate profit margins. This addresses the shortcomings of unidirectional drive analyses in existing studies, refines the theoretical framework for the synergy between green development and corporate profitability, and provides micro-level insights for corporate green transition practices and relevant policy formulation.

3 Theoretical Mechanisms and Research Hypotheses

The enhancement of GTFP not only signifies that enterprises have achieved higher economic output under resource and environmental constraints, but also translates into robust financial performance—increased profit margins—through systematic optimization of internal operations and external market relationships. The specific mechanism operates along three pathways: Firstly, GTFP improvement solidifies the profit base by

reducing costs. On one hand, improved GTFP signifies that the enterprise has minimized resource consumption—such as energy and raw materials—for a given output, thereby reducing both the resource and environmental compliance costs per unit of product and end-of-pipe treatment expenses. On the other hand, GTFP enhancement fundamentally represents a combined improvement in technical efficiency and allocative efficiency. Through capital renewal methods—specifically, acquiring advanced environmentally friendly production equipment to replace traditional, outdated machinery—the enterprise further elevates and optimizes its energy and resource utilization efficiency and structural efficiency [14]. Cost savings directly expand the enterprise's profit margin, providing the most fundamental safeguard for profit growth. Secondly, the enhancement of GTFP fosters new profit growth points through 'green empowerment'. Green Credit Guidelines explicitly define the scope for banks to allocate green credit resources, incorporating enterprises' environmental and social risks as key criteria for bank ratings and credit issuance [15]. The green efficiency advantage embodied by GTFP signals to the market that the enterprise possesses long-term sustainable competitiveness and sound governance standards. This helps attract green-preference investors, reduce financing costs, and thereby provide crucial financial support for green innovation and R&D. It drives corporate transformation and upgrading, propelling growth in revenue and profits. Ultimately, enhancing GTFP fosters a stable long-term profit environment through risk avoidance and synergistic efficiency pathways. Against the backdrop of increasingly stringent environmental regulations, administrative penalties can impact corporate revenue through policy intervention [16]. However, high GTFP enables enterprises to effectively circumvent costs associated with environmental violations—including administrative penalties, production suspensions for rectification, and reputational damage—thereby reducing unexpected profit erosion. Moreover, in today's landscape where industrial chain collaboration grows increasingly vital, enterprises with high GTFP find it easier to establish green supply chains with upstream and downstream partners. This capability enhances green innovation activities such as product R&D, design, and recycling, yielding significant positive effects on corporate performance [17]. Accordingly, this paper proposes the following hypothesis:

H: The improvement in GTFP has driven the growth in profit margins.

4 Empirical Analysis

4.1 Empirical Model

To verify the impact of GTFP on profit margins, this paper constructs the following two-way fixed effects model:

$$NetProfit_{it} = \alpha + \beta GTFP_{it} + Year_t + Company_i + \varepsilon_{it} \quad (1)$$

i , t represents the profit margin of firm i in year t , $GTFP_{it}$ denotes GTFP of firm i in year t , $Year_t$ is the year fixed effect, $Company_i$ is the individual firm fixed effect, and ε_{it} is the random disturbance term.

4.2 Related Variables

Dependent variable

NetProfit: Expressed using the annual profit margin data from the listed company's current year's annual report.

Core explanatory variable

GTFP: This study employs the non-radial SBM-ML index to measure GTFP. Based on the non-radial SBM directional distance function, this method more accurately reflects production efficiency under the dual constraints of economic output and environmental limitations.

Data Source

The sample for this study comprises Chinese A-share listed companies after 2010. Data on profit margins, company codes, and other metrics are sourced from CSMAR and company annual reports. Input factors, expected outputs, and unexpected outputs required for GTFP calculations are derived from the China City Statistical Yearbook, China Statistical Yearbook on Environment, company annual reports, and corporate social responsibility reports. Table 1 presents descriptive statistics for key variables.

Table 1. Descriptive statistics

VARIABLES	(1) N	(2) mean	(3) sd	(4) min	(5) P50	(6) max
GrossProfit	39,303	0.2836	0.1646	-0.0281	0.2507	0.8419
NetProfit	38,970	0.0799	0.1237	-1.0967	0.0687	0.4897
GTFP	34,287	1.0077	0.1196	0.7338	1.0298	1.2180

5 Empirical Results

To examine the impact of GTFP on NetProfit, this study constructed a panel regression model with fixed effects added stepwise. The benchmark regression results are presented in Table 2. Findings indicate that the GTFP coefficient remains significantly positive regardless of whether fixed effects are controlled. Column (3), which simultaneously controls for both individual and time fixed effects, reveals that a one-unit increase in GTFP significantly raises the net profit margin by 0.0446 units, confirming the study's research hypothesis H.

Table 2. Benchmark regression results

	(1) NetProfit	(2) NetProfit	(3) NetProfit
GTFP	0.5105*** (77.6826)	0.2605*** (34.6039)	0.0446* (1.7049)
_cons	-0.4481*** (-64.1433)	-0.1884*** (-23.7402)	0.0358 (1.3184)
Individual fixed effects	No	Yes	Yes

Time-fixed effect	No	No	Yes
N	26759	26643	26643
R ²	0.1802	0.5432	0.5675

T statistics in parentheses

* $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$

6 Conclusions and Recommendations

This study employs a two-way fixed effects model to examine the impact of enhanced GTFP on corporate profit margins and its underlying mechanisms, based on panel data from Chinese A-share listed companies spanning 2010–2024. Findings indicate that enhanced GTFP significantly stimulates corporate profit margin growth, validating Hypothesis H. Based on these findings, the following policy recommendations are proposed: First, governments should intensify support for enterprises undertaking green technological transformation. Policies such as tax relief and green credit subsidies should encourage firms to phase out energy-intensive, outdated equipment and adopt environmentally efficient production technologies. Establishing a GTFP evaluation and disclosure framework would compel enterprises to regularly calculate and publish relevant metrics, thereby enhancing investor, customer, and regulatory oversight of green efficiency. This market-driven mechanism would motivate firms to integrate green GTFP improvement into their long-term development strategies.

References

1. Lei Tong, Charbel Jose Chiappetta Jabbour, Samira ben belgacem, Hina Najam, Jawad Abbas. 2022. Role of environmental regulations, green finance, and investment in green technologies in green total factor productivity: Empirical evidence from Asian region; Journal of Cleaner Production. 380, 134930. <https://doi.org/10.1016/j.jclepro.2022.134930>
2. LI Pengsheng, CHEN yanying. Environmental Regulation, Bargaining Power of Enterprises and Green Total Factor Productivity[J]. Finance & Trade Economics, 2019, 40(11): 144-160. DOI: 10.19795/j.cnki.cn11-1166/f.20191111.006.
3. LIN Peng, MENG Nana. Quality Measurement and Dynamic Deconstruction of Regional Economic Development in Beijing-Tianjin-Hebei Region under Environmental Constraints: From the Perspective of Green Total Factor Productivity[J]. ECONOMIC GEOGRAPHY, 2020, 40(09): 36-45. DOI: 10.15957/j.cnki.jjdl.2020.09.004.
4. LIN Peng, MENG Nana. Spatio-temporal Differentiation and Dynamic Convergence of Green Total Factor Productivity Growth[J]. Journal of Quantitative & Technological Economics, 2021, 38(08): 104-124. DOI: 10.13653/j.cnki.jqte.2021.08.006. LNCS Homepage, <http://www.springer.com/lncs>, last accessed 2023/10/25
5. Li Chen, Yuanquan Lu, Yuan Meng. 2025. The impact of environmental regulation on green total factor productivity: Evidence from China's provincial level. Process Safety and Environmental Protection. Volume 198, 107106. <https://doi.org/10.1016/j.psep.2025.107106>.
6. CHEN lin, CAI kaichao, CHEN zhen. Mixed Ownership Reform and Green Total Factor Productivity: Empirical Evidence Based on Key Surveys of Industrial Pollution Sources[J].

- Journal of Business Economics, 2024, (11): 74-90. DOI:10.14134/j.cnki.cn33-1336/f.2024.11.007.
7. Songlin Zhang, Jia Ding, Chunli Ji, Qing Shao, Weihong Chen. The impact of population agglomeration in urban agglomerations on green total factor productivity: insights from ChinaSec. *Urban Economics Volume 7-2025*, DOI 10.3389/frsc.2025.1606754
 8. LIU Yu, LIANG Dong, ZHANG Shuo. How the Dual Synergy of Digitalization and Greening Empowers High-quality Development—Evidence from Listed Companies in China[J]. *China Business and Market*, 2025, 39(01): 25-38. DOI:10.14089/j.cnki.cn11-3664/f.2025.01.003.
 9. DU Ran, LIU Ke. Can Green Manufacturing Improve Corporate Total Factor Productivity?—Evidence from Green Factory Certification, *Commercial Research*, 2025, (02):1-9. DOI:10.13902/j.cnki.syyj.2025.02.013.
 10. Ge Jingfang, Si Wei, Meng Ting. Influence Mechanism of Environmental Regulation on Enterprise Profitability: Evidence from Sugar Firms in Guangxi Zhuang Autonomous Region, China[J]. *Management Review*, 2021, 33(08):66-77+138. DOI:10.14120/j.cnki.cn11-5057/f.2021.08.006.
 11. SUN Jiang-yong, LI Shu-yun. Is There “Profitability Premium” for Chinese Importers?: An Empirical Study Based on PSM-DID Method[J]. *Journal of Shanxi University (Philosophy and Social Science Edition)*, 2022, 45(02): 143-154. DOI:10.13451/j.cnki.shanxi.univ(phil.soc.).2022.02.017.
 12. Xu He, Qinlei Jing. 2022. The influence of environmental tax reform on corporate profit margins—based on the empirical research of the enterprises in the heavy pollution industries. *Environmental Science and Pollution Research* 30(3). DOI:10.1007/s11356-022-24893-7
 13. LYU Minle, WANG Xingxing. Research on the Impact of Artificial Intelligence on the Financialization of Manufacturing Enterprises: Taking Chinese A-share Main Board Manufacturing Listed Companies as an Example[J]. *East China Economic Management*, 2023, 37(07):100-109. DOI:10.19629/j.cnki.34-1014/f.220810011.
 14. WAN Pan-bing, YANG Mian, CHEN Lin. How Do Environmental Technology Standards Affect the Green Transition of China's Manufacturing Industry—A Perspective from Technological Transformation[J]. *China Industrial Economics*, 2021, (09):118-136. DOI:10.19581/j.cnki.ciejournal.2021.09.006.
 15. CHEN Xiaoyun, HUANG Wan. Green Finance Policy and Total Factor Productivity of Green Enterprises: Evidence from Implementation of Green Credit Guidelines[J]. *Collected Essays on Finance and Economics*, 2024, (04):60-69. DOI:10.13762/j.cnki.cjlc.2024.04.005.
 16. Liu Liya, Zhou Shupeng, Min Min, Wen Mengyao. Environmental Administrative Penalties and Bond Market Reaction[J]. *Journal of Finance and Economics*, 2022, 48(04):64-78. DOI:10.16538/j.cnki.jfe.20220216.101.
 17. XIE Xue-mei, ZHU Qi-wei. Innovative Pivots or Conservative Shackles: How Can Green Supply Chain Management Practices Spur Corporate Performance?[J]. *Chinese Journal of Management Science*, 2022, 30(05):131-143. DOI:10.16381/j.cnki.issn1003-207x.2019.0999.

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