Green Insurance and Total Factor Productivity of Enterprises

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Abstract. Based on the data of China listed companies from 2012 to 2023, this study empirically examines the impact of green insurance on total factor productivity (TFP) of enterprises. The research finds that green insurance can significantly enhance TFP of enterprises, and this finding has been robustly tested through a series of robustness checks. Mechanism tests indicate that green insurance can further improve TFP by increasing the green strategic orientation of enterprises. Heterogeneity tests show that for private enterprises and those located in eastern and central regions, the impact of green insurance on TFP is significantly positive, whereas for state-owned enterprises and those in western regions, this impact is not significant.

Keywords: green insurance,total factor productivity of enterprises, green strategy orientation

1 Introduction

As a key component of green finance, green insurance has expanded from environmental pollution liability insurance to include products such as agricultural green insurance, carbon sink insurance, and green building insurance, shifting its function from post-incident compensation to pre-incident prevention and green incentives. Yet its actual effects remain complex: while green insurance can mitigate transition risks and enhance total factor productivity (TFP) (Liu and Qiao, 2021),[1] it may also weaken environmental governance incentives and even encourage greenwashing due to moral hazard and adverse selection (Wen et al., 2021).[2] Thus, whether green insurance genuinely promotes corporate TFP hinges not only on policy effectiveness but also on the interplay among institutional design, market mechanisms, and corporate behavior. This study investigates the impact of green insurance on TFP using data from Chinese A-share listed firms. Its marginal contributions are threefold: first, it extends the green finance literature by focusing on green insurance; second, it examines the mediating role of corporate green strategic orientation; and third, it offers targeted policy implications.

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2 Literature Review

Green insurance has evolved alongside the expansion of green finance, becoming a crucial instrument in facilitating the green transition of the socio-economy (Wang and Sun, 2025).[3] As a financial innovation, it embeds green development principles into insurance products and services to pursue both socio-economic progress and low-carbon development (Wang and Jia, 2023).[4] Research on system construction has explored the green insurance framework and its indicator system, identifying challenges and improvement strategies from both macro and micro perspectives (Liu and Huang, 2023).[5] Case studies, such as in Fujian Province, highlight the role of supply-side reforms and service system development in fostering a green economy (Liang, 2025),[6] while other studies discuss classification standards and practice pathways, distinguishing core, basic, and quasi-green insurance (Zhang and Xie, 2022).[7] Empirical evidence on the impact of green finance on total factor productivity (TFP) remains mixed. Some studies show that green finance significantly enhances energy efficiency and green TFP through energy structure optimization and technological innovation (Wang et al., 2025;[8] Meng et al., 2024[9]), yet others find that green finance policies may constrain TFP in heavily polluting enterprises due to intensified financing constraints and R&D crowding-out effects (Zhao et al., 2023).[10]

3 Research Design

(1) Model Specification.

This study establishes the following model:

$$TFP_{it} = \alpha_0 + \beta_0 GI_{it} + \gamma_k Control_{it} + Year_t + Firm_i + \varepsilon_{it} \quad (1)$$

TFP, GI, $Control$, $Year$, $Firm$ respectively represent the total factor productivity of the enterprise, green insurance, a series of control variables, time fixed effects, individual fixed effects, and error terms.

(2) Definition of Variables.

Regarding the dependent variable, the measurement of total factor productivity (TFP) of enterprises, this study employs the LP method to calculate and analyze TFP. As shown in Fig. 1, the average TFP of sample enterprises presents an overall upward trend during the sample period.

For the core explanatory variable, the measurement of green insurance, this study examines the proportion of environmental pollution liability insurance revenue in total premium income. As illustrated in Fig. 2, the average level of green insurance shows a steady growth trend over the sample years.

As for the mediating variable, green strategic orientation (GSO), the study measures it by aggregating seven indicators extracted from annual reports and social responsibility reports of listed companies. These seven indicators include: whether the enterprise has environmental protection concepts, objectives, and institutional systems; whether it has obtained ISO14000 certification; whether it conducts environmental

education and training; whether it organizes special environmental activities; and whether it implements the "three simultaneous" system (simultaneous planning, construction, and operation of environmental protection facilities). As presented in Fig. 3, the average green strategic orientation of enterprises maintains a continuous upward tendency.

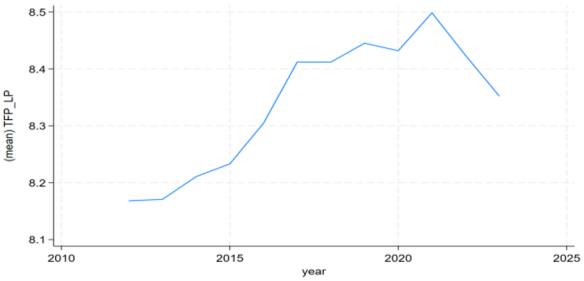

Fig. 1. Trend chart of average TFP

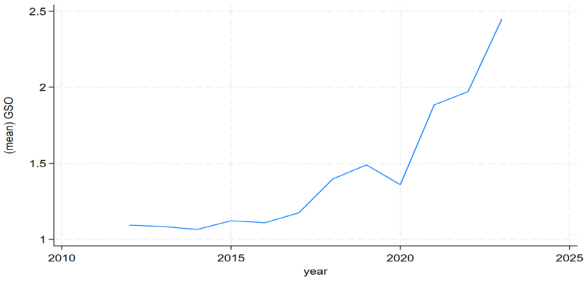

Fig. 2. Trend chart of average green insurance

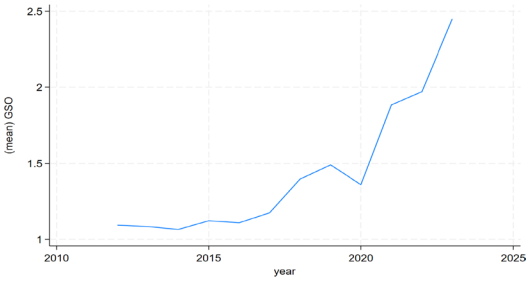

Fig. 3. Trend chart of average GSO

Regarding control variables, this study selects a series of variables from both corporate and macro levels, specifically including: (1) Corporate-level variables: enterprise size, profitability, debt repayment capacity, liquidity level, age, board size, executive compensation, and equity concentration; (2) Macro-level variables: regional economic development level, regional industrial structure status, and regional environmental protection policies.The level of financial development in the district.

(3) Data Sources and Descriptive Statistics.

This paper selects A-share listed companies in Shanghai and Shenzhen from 2012 to 2023 as the research sample and samples with a large amount of missing data are removed. In terms of data sources, green insurance data comes from the "China Statistical Yearbook" and "Statistical Yearbooks of Various Provinces and Cities", other enterprise-level data from the Guotai An Database (CSMAR), and macro-level data from the Wind Database. The descriptive statistics of each variable are detailed in Table 1.

Table 1. Descriptive Statistics

VarName	Obs	Mean	SD	Min	Max
TFP_LP	37214	8.358	0.977	6.778	10.364
GI	40564	0.028	0.007	0.015	0.041
Size	41628	3.096	0.053	3.012	3.206
ROA	41627	0.038	0.049	-0.080	0.129
Leverage	36173	1.227	0.466	0.800	2.721
Liquidity	41591	0.677	1.293	-1.964	3.907
Board	30545	8.379	1.366	6.000	11.000
Salary	30483	0.268	0.281	0.013	1.065
Age	41625	9.673	7.886	0.000	25.000
PE	34853	63.560	67.785	9.560	276.043
Top5	41383	0.487	0.183	0.241	0.856

4 Empirical Analysis

(1) Basic Regression Analysis

The regression results are presented in the Table 2 below. As can be seen, the impact of green insurance on total factor productivity (TFP) remains significantly positive with the inclusion of both enterprise-level and macro-level control variables, indicating that green insurance enhances corporate TFP.

Table 2. Basic Regression Results

VARIABLES	(1) TFP_LP	(2) TFP_LP	(3) TFP_LP
GI	31.330***	3.761***	3.448***
	(53.28)	(7.98)	(6.03)
Control variables	No	Yes	Yes
Observations	36,909	31,686	23,645
Number of stkcd	4,833	4,706	3,313

z-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1

(2) Robustness Test

To ensure the robustness of the findings, this study conducted variable and regression model substitutions, with the results presented in Table 3. Columns (1) to (4) employ the OP method, OLS method, FE method, and GMM method respectively to calculate firm total factor productivity (TFP). After substituting the original dependent variable, the regression estimates show that green insurance continues to have a sig-

nificantly positive impact on TFP. Column (5) employs a random effects model for re-estimation, with results remaining robust, further confirming the relationship between green insurance and firm TFP.

Table 3. Robustness Testing

VARIABLES	(1) TFP_OP	(2) TFP_OLS	(3) TFP_FE	(4) TFP_GMM	(5) random effect model
GI	5.600***	3.946***	3.729***	5.036***	3.448***
	(9.93)	(7.53)	(7.03)	(8.37)	(6.03)
Control variables	Yes	Yes	Yes	Yes	Yes
Observations	23,645	23,645	23,645	23,645	23,645
Number of stkcd	3,313	3,313	3,313	3,313	3,313

z-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1

(3) Mechanism Testing

As shown in Table 4, the mechanism test results demonstrate that green insurance can enhance total factor productivity (TFP) by positively influencing corporate green strategic orientation (GSO).

Table 4. Mechanism Testing

VARIABLES	(1) GSO	(2) TFP_LP
GSO		0.005***
		(2.80)
GI	41.317***	1.131**
	(26.92)	(2.45)
Control variables	Yes	Yes
Observations	25,476	23,645
Number of stkcd	3,396	3,313

z-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1

(4) Heterogeneity Test

As shown in Table 5, green insurance significantly enhances TFP for private firms and those in eastern and central regions, but shows no such effect for state-owned enterprises (SOEs) or firms in western regions, reflecting clear ownership and regional heterogeneity rooted in differences in resource endowments, environmental constraints, and policy responsiveness.

Table 5. Heterogeneity Test

VARIABLES	(1) state-owned enterprise	(2) Private enterprises	(3) east	(4) central	(5) west
GI	1.662	5.859***	2.179***	3.701**	0.204
	(1.44)	(7.51)	(3.29)	(2.08)	(0.10)
Control variables	Yes	Yes	Yes	Yes	Yes
Observations	6,926	15,112	18,012	3,172	2,371
Number of stkcd	924	2,495	2,597	424	320

z-statistics in parentheses, *** p<0.01, ** p<0.05, * p<0.1

Regarding ownership, private firms face stronger market competition and financing constraints, making risk management critical. Green insurance helps stabilize production inputs by mitigating environmental risks and incentivizes firms to pursue innovation for premium discounts or financing, thereby raising TFP. In contrast, SOEs benefit from government backing, easier financing, and greater risk tolerance, reducing their reliance on green insurance; their operations are often driven more by policy goals than efficiency, limiting its impact.

Regionally, eastern and central areas have higher marketization, stricter environmental enforcement, and better financial infrastructure, allowing green insurance to function effectively. Western regions, however, lag in economic development, regulatory oversight, and insurance market maturity, with weaker corporate awareness and adoption of green finance, which constrains the risk-mitigating role of green insurance and its effect on TFP.

5 Conclusion and Recommendations

Based on the data of China listed companies from 2012 to 2023, this study empirically examines the impact of green insurance on total factor productivity (TFP) of enterprises. The research finds that green insurance can significantly enhance TFP of enterprises, and this finding has been robustly tested through a series of robustness checks. Mechanism tests indicate that green insurance can further improve TFP by increasing the green strategic orientation of enterprises. Heterogeneity tests show that for private enterprises and those located in eastern and central regions, the impact of green insurance on TFP is significantly positive, while for state-owned enterprises and those in western regions, this impact is not significant.

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