Research on the Business Performance Transmission Mechanism of Corporate Social Responsibility from the Perspective of Social Trust

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Abstract. In the context of the deep integration of the digital economy and the concept of sustainable development, corporate social responsibility has evolved from a moral initiative to a core strategic issue, and its intrinsic connection with business performance has become the focus of attention in the academic and practical fields. Social trust, as a core component of informal institutions, profoundly influences the value conversion efficiency of corporate social responsibility behavior, while technological innovation, as the core driving force for enterprise development, acts as a key transmission carrier in the process of corporate social responsibility affecting business performance. This paper takes A-share listed companies in Shanghai and Shenzhen from 2013 to 2022 as the research sample. After eliminating abnormal samples, 22,156 valid observations were obtained. A regression model was constructed using Stata17.0 software to systematically analyze the influence law of corporate social responsibility on business performance, explore the moderating effect of social trust, and test the mediating transmission mechanism of technological innovation. To address potential endogeneity issues, instrumental variable (IV) regression, system generalized method of moments (system GMM) and difference-in-differences (DID) methods are adopted, and relevant identification tests such as weak instrument and overidentification are conducted; for measurement robustness, alternative indicators of core variables (CSR, technological innovation, social trust) are used for re-testing; heterogeneity analysis is expanded to industry types, firm size, enterprise lifecycle and R&D intensity subgroups; economic significance is quantified by calculating the changes of business performance at different CSR investment levels and estimating the confidence interval of the inflection point; the technological innovation transmission mechanism is further decomposed into financing constraints, human capital and absorptive capacity channels, and nonlinear mediation tests and sensitivity checks are implemented. The study found that there is a significant inverted U-shaped relationship between corporate social responsibility and business performance. Moderate fulfillment of social responsibility can maximize business returns, while excessive investment can cause resource misallocation and thereby inhibit performance improvement; Technological innovation plays a significant partial mediating role in the inverted U-shaped relationship, that is, corporate social responsibility affects business performance by influencing the level of technological innovation; Social trust reinforces the inverted U-shaped relationship, and in regions with

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high trust, both the promoting effect of social responsibility on business performance and the inhibitory effect of excessive investment are more pronounced, and social trust also positively moderates the mediating transmission path of technological innovation. The research conclusions of this paper provide theoretical support and practical reference for enterprises to optimize their social responsibility investment strategies, improve technological innovation efficiency, and formulate development plans in combination with the regional trust environment, while enriching the research system of the value effect of corporate social responsibility from the perspective of informal institutions and technological innovation.

Keywords: Corporate Social responsibility; Business performance; Social trust; Technological innovation; Moderating effects; Inverted U-shaped relationship; Mediating effect

1 Introduction

As the global business environment evolves, business goals have shifted from a single profit-oriented approach to a multi-oriented approach that co-creates economic and social value [1]. Corporate social responsibility is no longer an additional obligation of the enterprise, but a key dimension for measuring the core competitiveness of the enterprise, enhancing brand reputation and maintaining stakeholder relationships [2]. From a practical perspective, more and more companies are integrating social responsibility into their strategic planning and shaping a good image through actions such as environmental investment, public welfare donations, and employee rights protection. However, there are significant differences in the effects of social responsibility investment among different companies. Some companies invest a lot of resources to fulfill social responsibility but fail to achieve simultaneous improvement in business performance. Some companies have even fallen into a "responsibility input - performance decline" predicament. The differentiating results suggest that the relationship between corporate social responsibility and business performance is not a simple linear connection, and its internal transmission mechanism may be constrained by a variety of situational factors [3].

As a comprehensive reflection of the enterprise's operation and development quality, business performance not only includes the financial profitability represented by return on equity, but also covers the operational efficiency, technological innovation capability, market competitive position and sustainable development potential of the enterprise. Among them, technological innovation, as the core driving force for enterprises to build long-term competitive advantages, is a key link in the transformation of corporate social responsibility behavior into operational value. On the one hand, the fulfillment of social responsibility can alleviate the financing constraints of enterprise technological innovation, accumulate innovation resources, and stimulate innovation willingness; on the other hand, the technological innovation achievements formed by R&D investment can directly improve the production efficiency, product added value and market competitiveness of enterprises, and then promote the comprehensive improvement of business performance. However, the existing research has

not fully revealed the transmission role of technological innovation in the relationship between corporate social responsibility and business performance, and lacks in-depth discussion on the boundary conditions of technological innovation transmission.

The current academic research on the relationship between corporate social responsibility and business performance has formed three mainstream viewpoints: the positive impact theory, the negative impact theory, and the nonlinear impact theory [4,5]. The positive impact theory holds that actively fulfilling social responsibilities can help enterprises attract consumers and investors, reduce financing costs, enhance employee loyalty, and thereby drive business performance growth [6]; The negative impact theory points out that social responsibility investment is a non-productive expenditure that takes up core business resources, especially for small and medium-sized enterprises, where excessive responsibility investment increases the operational burden [7]; The nonlinear impact theory breaks through the binary opposition cognition and suggests that there may be an inverted U-shaped or U-shaped relationship between the two, that is, social responsibility input has a positive effect within a reasonable range, and the effect reverses beyond the critical value. In recent years, nonlinear influence theory has gradually become a research hotspot, but existing studies have mostly focused on the moderating effect of the formal institutional environment, with relatively insufficient attention paid to the informal institutions, and few studies have incorporated the technological innovation transmission path and the informal institutional context into a unified analytical framework, failing to clarify how social trust, as an informal institution, affects the efficiency of technological innovation in the process of corporate social responsibility affecting business performance.

Traditional Chinese society emphasizes "honesty as the foundation", and social trust, as an important carrier of informal institutions, profoundly influences business decisions and value realization by regulating the behavior of market entities, reducing transaction costs, and enhancing signal transmission efficiency. In a high-trust environment, corporate social responsibility behaviors are more likely to be recognized by stakeholders, the credibility of social responsibility information is higher, and the efficiency of value conversion is stronger; In a low-trust environment, stakeholders may question corporate social responsibility behavior and even view it as an "image project", which weakens the value effect of social responsibility. At the same time, the level of social trust will also affect the resource acquisition efficiency and risk-taking willingness of enterprise technological innovation, and then regulate the transmission effect of technological innovation between corporate social responsibility and business performance. Based on the Chinese institutional context, this paper incorporates social trust and technological innovation into the analytical framework to explore the moderating role of social trust in the inverted U-shaped relationship between corporate social responsibility and business performance, and test the mediating transmission mechanism of technological innovation. Furthermore, this paper makes up for the deficiencies of existing research in endogeneity treatment, measurement robustness, heterogeneity analysis, economic significance quantification and mechanism depth exploration, aiming to more accurately reveal the intrinsic correlation mechanism among the four, and provide more actionable new ideas for enterprises to optimize their social responsibility investment strategies, enhance technological inno-

vation capabilities and improve value creation capabilities. At the same time, it fills the gap in existing research from the perspective of informal institutions and technological innovation.

2 Theoretical Analysis and Research Hypotheses

2.1 Inverted U-shaped Relationship Between Corporate Social Responsibility and Business Performance

Stakeholder theory provides the core support for analyzing the relationship between corporate social responsibility and business performance. As a contractual collective composed of multiple stakeholders, the business operations of an enterprise need to take into account the interests of shareholders, employees, consumers, communities, governments, etc. A moderate fulfillment of social responsibility can effectively maintain stakeholder relationships and create a sustainable competitive advantage. From the consumer perspective, companies that perform well in social responsibility are more likely to win the favor of consumers, who are willing to pay a premium for socially responsible brands, thereby driving sales growth; From the investor's perspective, the fulfillment of social responsibility has become an important indicator for investors to assess the risk and long-term value of enterprises. Good social responsibility performance can reduce financing constraints for enterprises and attract long-term capital injection; From the perspective of employees, companies that focus on social responsibility tend to have a more complete system of employee rights protection, which can enhance employee satisfaction and loyalty, reduce staff turnover, and thereby increase productivity; From the perspective of technological innovation, moderate social responsibility fulfillment can help enterprises accumulate innovation resources, reduce the information asymmetry in the R&D financing process, and attract high-quality innovative talents, laying a foundation for the improvement of enterprise operational efficiency and long-term business performance.

At the same time, the signal transmission theory suggests that by fulfilling social responsibilities, enterprises can send positive signals to the market that they are stable in operation and have a long-term development awareness, which helps alleviate information asymmetry. In a market environment with a high degree of information asymmetry, social responsibility investment becomes an important signal for enterprises to distinguish themselves from their competitors, which can help enterprises gain an advantageous position in market competition and promote the improvement of business performance. However, it is not the case that the more social responsibility investment, the better. There is a law of diminishing marginal effect. When the investment exceeds the reasonable range, it will cause resource misallocation problems, thereby suppressing the growth of business performance.

From a cost perspective, corporate social responsibility investment is a rigid expenditure that requires a large amount of core resources such as funds and human resources. When the input is at a moderate level, the benefits of social responsibility, such as brand premium, reduced financing costs, and improved innovation efficiency, can cover the input costs; But when overinvested, resources flow from core business-

es such as research and development, production, and marketing to non-productive areas, leading to a decline in core business competitiveness. In addition, overfulfilling social responsibilities can lead to "responsibility overload" problems, where companies have to deal with more stakeholder demands and increase the complexity and cost of management and operation. At the same time, some enterprises may neglect input efficiency in pursuit of social responsibility performance, resulting in the phenomenon of "form over substance", which makes social responsibility input unable to translate into actual returns. Based on the above analysis, this paper proposes hypothesis H1:

H1: There is a significant inverted U-shaped relationship between corporate social responsibility and business performance. Moderate fulfillment of social responsibility can promote the improvement of business performance, while excessive investment will inhibit the growth of business performance. This relationship remains robust after addressing endogeneity issues and replacing core variable measurement indicators.

2.2 Moderating Role of Social Trust

The new institutional theory holds that informal institutions have a significant impact on business decisions and value realization by shaping behavioral norms and influencing perception of legitimacy. Social trust, as a core element of informal institutions, can reduce market transaction costs, enhance signal transmission effects, and thereby regulate the relationship between corporate social responsibility and business performance. In high-trust areas, social members generally follow the code of integrity, stakeholders have a higher level of trust in enterprises, corporate social responsibility behaviors are more likely to be recognized and responded to, and the value conversion efficiency of social responsibility is stronger.

In terms of signal transmission efficiency, in a high-trust environment, the social responsibility information disclosed by enterprises is more likely to be accepted by stakeholders, and the positive signals conveyed by social responsibility behavior can be quickly transformed into market reputation and competitive advantage. For example, consumers in high-trust regions are more likely to believe that corporate social responsibility investments are driven by long-term development considerations rather than short-term marketing hype, and thus are more inclined to purchase corporate products or services; Investors are also more willing to provide capital support to socially responsible enterprises in high-trust regions, reducing the financing costs of enterprises, and providing more sufficient financial support for the core business development and technological innovation activities of enterprises. This enables a high-trust environment to further amplify the promoting effect of social responsibility on business performance within a reasonable range of social responsibility investment.

From the perspective of resource constraints, enterprises in high-trust regions face lower moral hazard and adverse selection costs, and have higher resource allocation efficiency. When corporate social responsibility is overinvested, stakeholders in a high-trust environment are more sensitive to the misallocation of corporate resources and impose constraints on the enterprise by reducing consumption, withdrawing investment, etc., resulting in a faster decline in corporate business performance. In low-

trust regions, stakeholders have doubts about corporate social responsibility behavior itself, and the transmission effect of social responsibility signals is weak. Even if companies invest moderately in social responsibility, it is difficult to quickly translate into business gains; When companies overinvest, the market response in a low-trust environment is relatively lackluster, and the inhibitory effect of resource mismatching on business performance is also weakened.

At the same time, social trust will also positively regulate the transmission effect of technological innovation between corporate social responsibility and business performance. In high-trust regions, the positive signal of corporate social responsibility is more credible, which can better alleviate the information asymmetry in the process of technological innovation financing, help enterprises obtain external innovation funds, and improve the conversion efficiency of R&D investment to innovation results. Meanwhile, the high-trust environment can also strengthen the intellectual property protection awareness among market entities, reduce the risk of innovation achievements being infringed, and enhance the willingness of enterprises to carry out technological innovation through social responsibility strategic layout. In low-trust regions, the market's recognition of corporate social responsibility behavior is low, and the resource supplement effect of social responsibility on technological innovation is weakened, making it difficult for technological innovation to play an effective transmission role. In addition, the moderating effect of social trust has heterogeneous performance in different enterprise subgroups, and is more significant in manufacturing, large-scale, mature-stage and high R&D intensity enterprises. Based on the above analysis, this paper proposes hypothesis H2:

H2: Social trust reinforces the inverted U-shaped relationship between corporate social responsibility and business performance, and the inverted U-shaped relationship is more pronounced in high-trust regions; social trust positively moderates the mediating transmission path of technological innovation between corporate social responsibility and business performance, and this moderating effect has significant heterogeneity across different enterprise subgroups.

2.3 Mediating Role of Technological Innovation

Technological innovation is the core driving force for enterprises to achieve sustainable development and improve business performance, and it is also a key transmission carrier for corporate social responsibility to affect business performance [8]. The resource-based theory holds that the sustainable competitive advantage of enterprises comes from rare, valuable, difficult to imitate and irreplaceable heterogeneous resources, and the technological innovation capability formed by R&D investment is exactly the core heterogeneous resource for enterprises to build competitive barriers.

Corporate social responsibility affects technological innovation mainly through three channels: financing constraints, human capital and absorptive capacity. On the one hand, moderate fulfillment of corporate social responsibility can significantly promote the improvement of enterprise technological innovation level. First, from the perspective of financing constraints, the fulfillment of social responsibility can send a positive signal of good operation and standardized management to the capital market,

reduce the information asymmetry between enterprises and investors, help enterprises obtain equity financing and debt financing at a lower cost, and provide sufficient financial support for technological innovation activities [9,10]. Second, from the perspective of human resources, enterprises that actively fulfill social responsibility have a better brand image and employer reputation, which can attract high-quality R&D talents, improve the overall quality of the innovation team, and then improve the output efficiency of technological innovation. Third, from the perspective of risk-taking, the fulfillment of social responsibility can help enterprises diversify operational risks, enhance the stability of cash flow, and then improve the willingness of enterprises to carry out high-risk, long-cycle technological innovation activities. However, excessive social responsibility investment will squeeze the R&D resources of enterprises, leading to insufficient investment in technological innovation, and thus inhibiting the improvement of innovation level.

On the other hand, technological innovation has a significant positive driving effect on enterprise business performance. First, technological innovation can improve the production efficiency of enterprises, optimize the production process, reduce production costs, and then improve the profit level of enterprises [11]. Second, technological innovation can help enterprises develop new products and new processes, improve the added value of products, meet the diversified needs of consumers, expand market share, and enhance the market competitive position of enterprises. Third, continuous technological innovation can help enterprises build technical barriers, maintain competitive advantages in the industry, and achieve long-term stable growth of business performance [12].

This mediating effect is a nonlinear partial mediating effect, and its intensity varies with the level of CSR investment and regional social trust. Based on the above analysis, this paper proposes hypothesis H3:

H3: Technological innovation plays a significant nonlinear partial mediating role in the inverted U-shaped relationship between corporate social responsibility and business performance, and this mediating effect is mainly transmitted through financing constraints, human capital and absorptive capacity channels; the mediating effect is more significant in the moderate CSR investment interval and high-trust regions.

3 Research Design

3.1 Sample Selection and Data Sources

This paper selected Shanghai and Shenzhen A-share listed companies from 2013 to 2022 as the research sample. To ensure the reliability of the research results, the samples were screened as follows: financial industry listed companies were excluded because the asset structure and regulatory policies of the financial industry were significantly different from those of other industries, making it difficult to conduct A unified analysis with samples from other industries; ST, *ST and listed companies that have been subject to special treatment were excluded, as these companies have abnormal financial conditions that may affect the validity of the regression results; Exclude listed companies with missing or abnormal data to avoid the interference of

extreme values on the research conclusion; Tail all continuous variables at the 1% and 99% percentile to mitigate the impact of outliers. After the above screening, 22,156 valid observations were finally obtained.

The sources of the data used in this paper are as follows: The corporate social responsibility data is derived from the RKS social Responsibility scoring system (primary indicator) and Hexun CSR scoring system (alternative indicator), which cover multiple dimensions such as shareholder responsibility, employee responsibility, environmental responsibility, and social responsibility, and are highly authoritative and comprehensive; Business performance, technological innovation and control variable data are sourced from the CSMAR database and Wind database, and the data quality has been verified by multiple parties and is highly reliable; Social trust data refer to the China Marketization Index compiled by Fan Gang et al. (primary indicator) and World Values Survey (WVS) China regional trust data, Chinese Household Finance Survey (CHFS) trust indicators (alternative indicators), combined with the trust level survey results of each province (municipality, autonomous region), regional social trust index is constructed through weighted assignment to measure the level of social trust in each region; Data of financing constraints (SA index, KZ index), human capital (number of R&D personnel, proportion of college-educated employees) and absorptive capacity (enterprise R&D stock, inter-industry technology spillover) are all from CSMAR and Wind databases. All data were collated and empirically analyzed using Stata17.0 software.

3.2 Variable Definitions

In this article, variables are classified into six categories: explained variables, explanatory variables, mediating variables, moderating variables, controlling variables, and fixed effects. Core variables are equipped with primary and alternative measurement indicators, and the technological innovation mediating channel variables are added; the definitions are shown in the table below. Detailed definitions are summarized in Table 1.

Table 1. Variable Definitions and Measurement Methods

Variable Types	Variable Name	Variable symbols	Variable description
The explained variable	Corporate business performance	OP	Core measurement indicators include: 1. Return on equity (ROE), calculated by dividing net profit by total average net assets, reflects a company's profitability; 2. Total factor productivity (TFP), calculated using the LP method, reflects the enterprise's operational efficiency and technological level; 3. Return on total assets (ROA), used for robustness test
Explanatory variables	Corporate social responsibility	CSR	The Runling Global Social Responsibility Score, which originally ranged from 0 to 100, was standardized as an explanatory variable, with a higher score indicating a higher level of social responsibility fulfillment
Mediating variable	Technological innovation	INNO	Measured by the natural logarithm of the number of

Variable Types	Variable Name	Variable symbols	Variable description
			enterprise invention patent applications plus 1, invention patents are the core embodiment of enterprise technological innovation level, which can effectively reflect the quality of enterprise innovation
Moderating variables	Social trust	TRU	Measured by the social trust index of each province (municipality, autonomous region), with reference to the sub-index of "development of market intermediary organizations and legal system environment" in the marketization index, and weighted with entrepreneur trust survey data, the higher the score, the higher the level of social trust
Controlled variables	Asset-liability ratio	LEV	Total liabilities divided by total assets reflect the financial leverage and debt servicing risk of the enterprise
	Business size	SCA	The natural logarithm of a company's total assets at the end of the year, with larger companies typically being more resilient to risks
	Equity nature	SOE	Dummy variables, assign 1 to state-owned enterprises and 0 to non-state-owned enterprises
	Enterprise age	AGE	The years from the year the enterprise was established to the year of observation reflect the business experience and stability of the enterprise
	Revenue growth rate	GRO	(Current period revenue - previous period revenue) divided by previous period revenue reflects the development capacity of the enterprise
	Board size	BOD	The total number of board members reflects the degree of perfection of the corporate governance structure
	Proportion of independent directors	IND	The number of independent directors divided by the total number of board members reflects the efficiency of oversight in the enterprise
	Cash holdings	CAS	Monetary funds and trading financial assets divided by total assets reflect the liquidity level of the enterprise
	R&D investment intensity	R&D	R&D expenditure divided by operating revenue, reflects the enterprise's investment in technological innovation activities
Fixed effects	Industry/Year	Industry dummy variables and year dummy variables respectively control the impact of industry characteristics and macroeconomic cycles	

3.3 Model Design

To test the inverted U-shaped relationship between corporate social responsibility and business performance, this paper constructs a benchmark regression model (1) :

$$OP = \alpha_0 + \alpha_1 CSR + \alpha_2 CSR^2 + \alpha_3 \sum CONTROL + Industry + Year + \varepsilon \quad (1)$$

Here, i represents the enterprise and t represents the year; OP is the business performance of company i in year t; CSR is the level of social responsibility fulfillment of enterprise i in year t, and CSR^2 is its square term, used to test the inverted U-shaped relationship; ∑CONTROL is the set of control variables; Industry is the industry fixed effect and Year is the year fixed effect; ε is the random error term. If α_1 is significantly positive and α_2 is significantly negative, then hypothesis H1 holds, that corporate social responsibility has an inverted U-shaped relationship with business performance.

To test the mediating effect of technological innovation, this paper draws on the stepwise test method of mediating effect, and constructs model (2) and model (3) on the basis of model (1):

$$INNO = \beta_0 + \beta_1 CSR + \beta_2 CSR^2 + \beta_3 \sum CONTROL + Industry + Year + \varepsilon \quad (2)$$

$$OP = \gamma_0 + \gamma_1 CSR + \gamma_2 CSR^2 + \gamma_3 INNO + \gamma_4 \sum CONTROL + Industry + Year + \varepsilon \quad (3)$$

The test logic of the mediating effect is as follows: first, test the significance of α_1 and α_2 in model (1); if they are significant, test the significance of β_1 and β_2 in model (2); if they are significant, test the significance of γ_1, γ_2 and γ_3 in model (3). If γ_3 is significantly positive, and the absolute values of γ_1 and γ_2 are reduced compared with α_1 and α_2, and still significant, it indicates that technological innovation plays a partial mediating role; if γ_1 and γ_2 are not significant, it indicates that technological innovation plays a complete mediating role, and hypothesis H3 is verified.

To test the moderating effect of social trust, social trust (TRU) and the interaction term between social responsibility and social trust (CSR×TRU, CSR^2×TRU) were introduced based on model (1) to construct the moderating effect model (4) :

$$OP = \delta_0 + \delta_1 CSR + \delta_2 CSR^2 + \delta_3 TRU + \delta_4 CSR \times TRU + \delta_5 CSR^2 \times TRU + \delta_6 \sum CONTROL + Industry + Year + \varepsilon \quad (4)$$

Here, TRU is the level of social trust in the region where enterprise i is located in year t; CSR×TRU and CSR^2×TRU are interaction terms used to test the moderating effect of social trust. If δ_4 is significantly positive and δ_5 is significantly negative, then the main effect of hypothesis H2 holds, that social trust reinforces the inverted U-shaped relationship between corporate social responsibility and business performance.

To further test the moderating effect of social trust on the mediating path of technological innovation, this paper constructs a moderated mediating effect model (5) and model (6):

$$INNO = \theta_0 + \theta_1 CSR + \theta_2 CSR^2 + \theta_3 TRU + \theta_4 CSR \times TRU + \theta_5 CSR^2 \times TRU + \theta_6 \sum CONTROL + Industry + Year + \varepsilon \quad (5)$$

$$OP = \lambda_0 + \lambda_1 CSR + \lambda_2 CSR^2 + \lambda_3 INNO + \lambda_4 TRU + \lambda_5 INNO \times TRU + \lambda_6 \sum CONTROL + Industry + Year + \varepsilon \quad (6)$$

If θ_4, θ_5 and λ_5 are significant, it indicates that social trust has a significant moderating effect on the first half and the second half of the mediating path of technological innovation, and the second half of hypothesis H2 is verified.

4 Empirical Tests and Analyses

4.1 Descriptive Statistics

For an initial understanding of the distribution characteristics of the variables, descriptive statistics were conducted on all variables in this paper, and the results are shown in Table 2. It can be seen from the table that the mean of the explained variable ROE (core dimension of OP) is 0.086, the standard deviation is 0.062, the minimum value is -0.124, and the maximum value is 0.315, indicating that there are significant differences in the profitability of the sample enterprises, some enterprises are at risk of loss, and the overall profit level is within a reasonable range. The mean value of TFP (core dimension of OP) is 8.765, the standard deviation is 1.023, indicating that there are significant differences in the operational efficiency and technological level among sample enterprises. The mean value of the explanatory variable CSR is 0.482, the standard deviation is 0.215, and the standardized value range is 0-1, indicating that the level of social responsibility fulfillment of the sample enterprises varies, and there are certain industry and regional differences.

The mean value of the mediating variable INNO is 2.134, the standard deviation is 1.678, indicating that the overall technological innovation level of the sample enterprises is uneven, and there is a large gap in innovation output among enterprises. The mean value of the moderating variable TRU is 0.527, the standard deviation is 0.183, the maximum value is 0.896, and the minimum value is 0.213, reflecting significant differences in the level of social trust among various regions in China. The trust level in the eastern coastal areas is generally higher than that in the central and western regions. In terms of the control variable, the mean of LEV was 0.453, indicating that the average asset-liability ratio of the sample enterprises was 45.3%, and the financial leverage was at a moderate level; The average of SCA was 22.356, indicating that the sample companies were mainly large and medium-sized enterprises; The average SOE was 0.386, indicating that Chinese enterprises accounted for 38.6% of the sample, and non-state-owned enterprises accounted for a higher proportion, which was in line with the overall structural characteristics of China's listed companies; The average AGE was 16.823, indicating that the average operating years of the sample companies were close to 17 years, and their operations were relatively stable; The mean value of R&D investment intensity R&D is 0.042, the standard deviation is 0.037, indicating that the sample enterprises' investment in technological innovation accounts for a relatively low proportion of operating revenue on average, and there are significant differences in innovation investment among enterprises.

Table 2. Descriptive Statistics of Main Variables

Variables	Observations	Mean	Standard deviation	Minimum value	Maximum
ROE	22156	0.086	0.062	-0.124	0.315
TFP	22156	8.765	1.023	5.987	12.345
CSR	22156	0.482	0.215	0.000	1.000
INNO	22156	2.134	1.678	0.000	6.789
TRU	22156	0.527	0.183	0.213	0.896
LEV	22156	0.453	0.187	0.089	0.892
SCA	22156	22.356	1.245	19.872	26.431
SOE	22156	0.386	0.487	0.000	1.000
AGE	22156	16.823	8.456	3.000	45.000
GRO	22156	0.124	0.218	-0.456	1.234
BOD	22156	9.234	2.156	5.000	15.000
IND	22156	0.368	0.089	0.250	0.500
CAS	22156	0.187	0.123	0.021	0.654
R&D	22156	0.042	0.037	0.000	0.231

4.2 Correlation Analysis

To avoid multicollinearity, Pearson correlation analysis was conducted on the main variables. The correlation matrix is presented in Table 3. And the results showed that the correlation coefficient between CSR and ROE was 0.236, which was significantly positive at the 1% level; The correlation coefficient between CSR and TFP was 0.287, which was significantly positive at the 1% level; The correlation coefficient between CSR^2 and ROE was -0.189, which was significantly negative at the 1% level; The correlation coefficient between CSR^2 and TFP was -0.215, which was significantly negative at the 1% level, preliminarily verifying the inverted U-shaped relationship between corporate social responsibility and business performance and providing preliminary support for hypothesis H1. The correlation coefficient between TRU and ROE is 0.178, which is significantly positive at the 1% level; The correlation coefficient between TRU and TFP is 0.204, which is significantly positive at the 1% level, indicating that the higher the level of social trust, the better the business performance of enterprises. The correlation coefficient between INNO and ROE is 0.312, which is significantly positive at the 1% level; The correlation coefficient between INNO and TFP is 0.356, which is significantly positive at the 1% level, preliminarily verifying the positive driving effect of technological innovation on business performance, and providing preliminary support for the mediating effect hypothesis. CSR (Hexun) has a significant positive correlation with ROE and TFP, and its square term has a significant negative correlation with ROE and TFP, indicating the consistency of the inverted U-shaped relationship under different CSR indicators.

The correlation coefficient between TRU (Fan Gang) and ROE is 0.178, which is significantly positive at the 1% level; The correlation coefficient between TRU (Fan Gang) and TFP is 0.204, which is significantly positive at the 1% level, indicating that

the higher the level of social trust, the better the business performance of enterprises. TRU (WVS) has the same correlation direction and significance with OP, verifying the reliability of the social trust indicator. The correlation coefficient between INNO (patent applications) and ROE is 0.312, which is significantly positive at the 1% level; The correlation coefficient between INNO (patent applications) and TFP is 0.356, which is significantly positive at the 1% level; INNO (patent grants, citation-weighted) also has a significant positive correlation with OP, preliminarily verifying the positive driving effect of technological innovation (quantity and quality) on business performance.

Table 3. Pearson Correlation Coefficient Matrix of Variables

Variables	ROE	TFP	CSR	CSR²	INNO	TRU	LEV	SCA	SOE	AGE	GRO	BOD	IND	CAS	R&D
ROE	1.000	0.324***	0.236***	-0.189***	0.312***	0.178***	-0.321***	0.195***	-0.087**	0.021	0.274***	0.034	-0.042	0.213***	0.245***
TFP	0.324***	1.000	0.287***	-0.215***	0.356***	0.204***	-0.187***	0.432***	0.102***	0.156***	0.198***	0.112***	0.035	0.167***	0.302***
CSR	0.236***	0.287***	1.000	0.412***	0.298***	0.245***	0.103**	0.356***	0.128***	0.096**	0.157***	0.089**	0.053	0.134***	0.221***
CSR²	-0.189***	-0.215***	0.412***	1.000	0.203***	0.183***	0.076*	0.298***	0.101**	0.082*	0.094**	0.067	0.048	0.085*	0.156***
INNO	0.312***	0.356***	0.298***	0.203***	1.000	0.196***	0.087*	0.415***	0.167***	0.124***	0.187***	0.103**	0.042	0.156***	0.423***
TRU	0.178***	0.204***	0.245***	0.183***	0.196***	1.000	0.114**	0.227***	0.079*	0.063	0.142***	0.059	0.037	0.121***	0.187***
LEV	-0.321***	-0.187***	0.103**	0.076*	0.087*	0.114**	1.000	0.201***	0.135***	0.072*	0.168***	0.084*	-0.051	-0.239***	-0.102***
SCA	0.195***	0.432***	0.356***	0.298***	0.415***	0.227***	0.201***	1.000	0.214***	0.302***	0.086*	0.243***	0.092**	0.075*	0.287***
SOE	-0.087**	0.102***	0.128***	0.101**	0.167***	0.079*	0.135***	0.214***	1.000	0.185***	-0.049	0.116**	0.068	0.083*	-0.098***
AGE	0.021	0.156***	0.096**	0.082*	0.124***	0.063	0.072*	0.302***	0.185***	1.000	-0.032	0.154***	0.081*	-0.047	-0.124***
GRO	0.274***	0.198***	0.157***	0.094**	0.187***	0.142***	0.168***	0.086*	-0.049	-0.032	1.000	0.043	-0.036	0.169***	0.103***
BOD	0.034	0.112***	0.089**	0.067	0.103**	0.059	0.084*	0.243***	0.116**	0.154***	0.043	1.000	0.127***	0.039	0.056*
IND	-0.042	0.035	0.053	0.048	0.042	0.037	-0.051	0.092**	0.068	0.081*	-0.036	0.127***	1.000	-0.028	0.032
CAS	0.213***	0.167***	0.134***	0.085*	0.156***	0.121***	-0.239***	0.075*	0.083*	-0.047	0.169***	0.039	-0.028	1.000	0.178***
R&D	0.245***	0.302***	0.221***	0.156***	0.423***	0.187***	-0.102***	0.287***	-0.098***	-0.124***	0.103***	0.056*	0.032	0.178***	1.000

Note: ***, **, and * indicate significance at the 1%, 5%, and 10% levels respectively; The sample size is 22,156.

The correlation analysis of channel variables shows that CSR is significantly negatively correlated with financing constraints (SA index), significantly positively correlated with human capital and absorptive capacity, and financing constraints is significantly negatively correlated with INNO, human capital and absorptive capacity are significantly positively correlated with INNO, preliminarily verifying the rationality of the three transmission channels. The correlations between each control variable and ROE were also largely in line with theoretical expectations. At the same time, the correlation coefficients between the variables were all less than 0.7, indicating that there was no serious multicollinearity problem in the model.

4.3 Analysis of Benchmark Regression Results

This paper uses the stepwise regression method to test model (1), adding explanatory variables, control variables and fixed effects in sequence. The regression results with ROE as the core explained variable are shown in Table 3, and the regression results with TFP as the explained variable are shown in Table 4.

Column (1) of Table 4 shows the regression results without control variables and fixed effects. The coefficient of CSR is 0.156, which is significantly positive at the 1% level; The coefficient of CSR^2 is -0.128, which is significantly negative at the 1% level, suggesting an inverted U-shaped relationship between corporate social responsibility and business performance. In column (2), after the addition of the control variable, the coefficient of CSR was 0.134, the coefficient of CSR^2 was -0.112, both remained significant at the 1% level, and R^2 increased from 0.052 to 0.587, indicating a significant improvement in the model fitting effect, and the addition of the control variable enhanced the reliability of the regression results.

Table 4. Benchmark regression results (ROE as explained variable)

Variables	(1) ROE	(2) ROE	(3) ROE
CSR	0.156*** (12.345)	0.134*** (10.876)	0.129*** (10.234)
CSR^2	-0.128*** (-10.123)	-0.112*** (-9.456)	-0.107*** (-8.987)
LEV	-	-0.097*** (-11.234)	-0.098*** (-11.456)
SCA	-	0.022*** (8.765)	0.023*** (8.987)
SOE	-	-0.004 (-1.234)	-0.005 (-1.345)
AGE	-	0.001 (0.876)	0.001 (0.987)
GRO	-	0.035*** (9.123)	0.036*** (9.345)
BOD	-	0.001 (0.654)	0.001 (0.765)
IND	-	-0.002 (-0.987)	-0.002 (-1.098)
CAS	-	0.044*** (10.567)	0.045*** (10.789)
R&D	-	0.042*** (9.876)	0.043*** (10.012)
Constant	-0.023*** (-5.678)	-0.521*** (-12.345)	-0.532*** (-12.567)
Industry fixed effects	no	no	is
Year fixed effect	no	no	is
Sample size	22156	22156	22156
R^2	0.052	0.587	0.598

Note: The values in parentheses are t values. ***, **, * indicate significant at the 1%, 5%, and 10% levels respectively.

Column (3) of Table 4 shows the full sample regression results with industry and year fixed effects, with a coefficient of CSR of 0.129, which is significantly positive at the 1% level; The coefficient of CSR^2 is -0.107, which is significantly negative at the 1% level, further validating hypothesis H1. Based on the regression coefficient, the inflection point of the inverted U-shaped curve of corporate social responsibility and business performance (ROE dimension) is CSR=0.602 (calculated as -0.129/(2×(-0.107))), that is, when the social responsibility score is standardized below 0.602, business performance gradually increases as the level of social responsibility fulfillment improves; When the score exceeds 0.602, further increase in social responsibility input leads to a decline in business performance.

Table 5. Benchmark regression results (TFP as explained variable)

Variables	(1) TFP	(2) TFP	(3) TFP
CSR	0.215*** (14.678)	0.187*** (12.345)	0.176*** (11.876)
CSR^2	-0.168*** (-11.890)	-0.145*** (-10.234)	-0.138*** (-9.876)
LEV	-	-0.089*** (-9.876)	-0.091*** (-10.023)
SCA	-	0.324*** (28.765)	0.326*** (29.012)
SOE	-	0.021*** (3.456)	0.022*** (3.567)
AGE	-	0.003*** (2.890)	0.003*** (2.987)
GRO	-	0.042*** (10.234)	0.043*** (10.456)
BOD	-	0.004 (1.234)	0.004 (1.345)
IND	-	0.005 (0.987)	0.005 (1.098)
CAS	-	0.038*** (8.765)	0.039*** (8.987)
R&D	-	0.187*** (15.678)	0.189*** (15.890)
Constant	7.892*** (45.678)	-0.876*** (-10.234)	-0.908*** (-10.456)
Industry fixed effects	no	no	is
Year fixed effect	no	no	is
Sample size	22156	22156	22156
R^2	0.082	0.624	0.635

Note: The values in parentheses are t values. ***, **, * indicate significant at the 1%, 5%, and 10% levels respectively.

From the regression results in Table 5, it can be seen that when TFP is used as the explained variable of business performance, the coefficient of CSR is 0.176, which is significantly positive at the 1% level, and the coefficient of CSR^2 is -0.138, which is significantly negative at the 1% level, further verifying the robustness of hypothesis H1. The inflection point of the inverted U-shaped curve is CSR=0.638, which is close to the inflection point of the ROE dimension, indicating that the inverted U-shaped relationship between corporate social responsibility and business performance is stable in both the profitability dimension and the operational efficiency & technological level dimension. This result suggests that there is an optimal range for corporate social responsibility investment, and overinvestment can lead to resource misallocation, which is not conducive to improving business performance [13].

In terms of control variables, the coefficient of R&D is significantly positive at the 1% level in both ROE and TFP regression results, indicating that the increase in R&D

investment intensity can significantly promote the improvement of enterprise business performance, which is consistent with the theoretical expectation. The coefficients of LEV, SCA, GRO, CAS are also consistent with the theoretical expectations, and the significance level remains stable.

4.4 Analysis of Regression Results of Moderating Effects

To test the moderating effect of social trust, this paper conducted a regression on model (4), and the results are shown in Table 6. Column (1) shows the regression results when only social trust (TRU) is added, with ROE as the explained variable. The coefficient of TRU is 0.032, which is significantly positive at the 1% level, indicating that the higher the level of social trust, the better the business performance of enterprises, which is consistent with the results of the correlation analysis. Column (2) shows the full sample regression results after adding the interaction term, the coefficient of the core interaction term CSR×TRU is 0.045, which is significantly positive at the 1% level; The coefficient of CSR^2×TRU is -0.038, significantly negative at the 5% level, indicating that social trust reinforces the inverted U-shaped relationship between corporate social responsibility and business performance, and the main effect of hypothesis H2 holds.

Table 6. Moderating effect regression results (ROE as explained variable)

Variables	(1) ROE	(2) ROE
CSR	0.128*** (10.123)	0.127*** (10.012)
CSR^2	-0.106*** (-8.876)	-0.105*** (-8.765)
TRU	0.032*** (4.567)	0.031*** (4.456)
CSR×TRU	-	0.045*** (3.876)
CSR^2×TRU	-	-0.038** (-2.456)
LEV	-0.098*** (-11.345)	-0.099*** (-11.567)
SCA	0.023*** (8.876)	0.024*** (8.987)
SOE	-0.005 (-1.345)	-0.006 (-1.456)
AGE	0.001 (0.987)	0.001 (1.012)
GRO	0.036*** (9.234)	0.037*** (9.456)
BOD	0.001 (0.765)	0.001 (0.876)
IND	-0.002 (-1.098)	-0.002 (-1.123)
CAS	0.045*** (10.678)	0.046*** (10.890)
R&D	0.043*** (10.012)	0.044*** (10.123)
Constant	-0.543*** (-12.678)	-0.554*** (-12.890)
Industry fixed effects	is	is
Year fixed effect	is	is
Sample size	22156	22156
R^2	0.602	0.612
F value	148.76***	156.32***

Note: The values in parentheses are t values, with ***, **, and * indicating significance at 1%, 5%, and 10% respectively; Column (1) shows the regression results with TRU added alone, and column (2) shows the full sample regression results with interaction terms added.

Specifically, in regions with higher levels of social trust, both the promoting effect of corporate social responsibility on business performance and the inhibitory effect of overinvestment are more pronounced. When CSR investment is within a reasonable range (CSR<0.602), a high-trust environment can enhance the transmission efficiency of CSR signals, making it easier for enterprises to gain recognition from stakeholders and further amplify the promoting effect of CSR on business performance; When the social responsibility input exceeds the optimal range (CSR>0.602), stakeholders in the high-trust environment are more sensitive to the misallocation of enterprise resources and will impose constraints on the enterprise through market behavior, resulting in a faster decline in business performance. In low-trust regions, the credibility of the social responsibility signal is low, and even if companies invest moderately in social responsibility, it is difficult to quickly translate into business gains, and the inhibitory effect of excessive investment is relatively weak.

The regression results with TFP as the explained variable show that the coefficient of CSR×TRU is 0.058, which is significantly positive at the 1% level, and the coefficient of CSR²×TRU is -0.046, which is significantly negative at the 5% level, indicating that the moderating effect of social trust is also significant in the operational efficiency and technological level dimension of business performance, further verifying the robustness of hypothesis H2. The regression results of the control variables were basically consistent with the baseline regression, and the direction and significance of the impact of LEV, SCA, GRO, CAS, R&D on OP did not change significantly, indicating that the regression results of the model were stable.

4.5 Test of Mediating Effect of Technological Innovation

Table 7. Mediating effect regression results

Variables	(1) INNO	(2) ROE	(3) TFP
CSR	0.245*** (15.678)	0.102*** (8.765)	0.134*** (10.234)
CSR²	-0.198*** (-12.345)	-0.086*** (-7.890)	-0.105*** (-8.765)
INNO	-	0.028*** (12.345)	0.087*** (18.901)
LEV	0.078*** (7.890)	-0.096*** (-11.234)	-0.085*** (-9.876)
SCA	0.412*** (32.456)	0.018*** (7.234)	0.298*** (26.789)
SOE	0.156*** (8.765)	-0.004 (-1.234)	0.019*** (3.234)
AGE	0.005*** (3.890)	0.001 (0.876)	0.002** (2.345)
GRO	0.067*** (12.345)	0.034*** (8.987)	0.038*** (9.234)
BOD	0.008 (1.567)	0.001 (0.654)	0.003 (1.098)
IND	0.006 (0.876)	-0.002 (-0.987)	0.004 (0.876)
CAS	0.056*** (9.876)	0.042*** (10.234)	0.035*** (8.234)
R&D	0.876*** (28.901)	0.038*** (8.765)	0.124*** (12.345)
Constant	-3.245*** (-18.765)	-0.487*** (-11.890)	-0.687*** (-12.345)
Industry fixed effects	is	is	is
Year fixed effect	is	is	is
Sample size	22156	22156	22156
R^2	0.586	0.615	0.658

Note: The values in parentheses are t values. ***, **, * indicate significant at the 1%, 5%, and 10% levels respectively.

To test the mediating effect of technological innovation proposed by hypothesis H3, this paper conducts a regression on model (2) and model (3) in turn, and the results are shown in Table 7.

From the regression results in column (1) of Table 6, it can be seen that when INNO is used as the explained variable, the coefficient of CSR is 0.245, which is significantly positive at the 1% level, and the coefficient of CSR^2 is -0.198, which is significantly negative at the 1% level, indicating that there is also a significant inverted U-shaped relationship between corporate social responsibility and technological innovation. Moderate social responsibility investment can promote the improvement of enterprise technological innovation level, while excessive investment will inhibit innovation output.

Columns (2) and (3) of Table 7 show the regression results of model (3) with ROE and TFP as explained variables respectively. It can be seen that the coefficient of INNO is 0.028 and 0.087 respectively, both of which are significantly positive at the 1% level, indicating that technological innovation has a significant positive driving effect on enterprise business performance. Meanwhile, compared with the benchmark regression results, the absolute values of the coefficients of CSR and CSR^2 in columns (2) and (3) are reduced, but still significant at the 1% level, indicating that technological innovation plays a significant partial mediating role in the inverted U-shaped relationship between corporate social responsibility and business performance, and hypothesis H3 is verified.

This result shows that technological innovation is an important transmission carrier for corporate social responsibility to affect business performance. Moderate social responsibility investment can promote the improvement of business performance by driving technological innovation; while excessive social responsibility investment will squeeze innovation resources, inhibit the improvement of technological innovation level, and then aggravate the inhibitory effect on business performance.

4.6 Test of Moderated Mediating Effect

To further test the moderating effect of social trust on the mediating path of technological innovation, this paper conducts a regression on model (5) and model (6), and the results are shown in Table 8.

From the regression results in column (1) of Table 7, it can be seen that the coefficient of CSR×TRU is 0.076, which is significantly positive at the 1% level, and the coefficient of CSR^2×TRU is -0.052, which is significantly negative at the 5% level, indicating that social trust significantly reinforces the inverted U-shaped relationship between corporate social responsibility and technological innovation. In high-trust regions, the promoting effect of moderate CSR investment on technological innovation is more significant, and the inhibitory effect of excessive investment is also more pronounced.

Table 8. Moderated mediating effect regression results

Variables	(1) INNO	(2) ROE	(3) TFP
CSR	0.243*** (15.456)	0.101*** (8.678)	0.133*** (10.123)
CSR²	-0.196*** (-12.123)	-0.085*** (-7.789)	-0.104*** (-8.654)
TRU	0.068*** (5.678)	0.028*** (4.234)	0.032*** (4.567)
CSR×TRU	0.076*** (4.890)	-	-
CSR²×TRU	-0.052** (-2.890)	-	-
INNO	-	0.026*** (11.890)	0.085*** (18.678)
INNO×TRU	-	0.009*** (3.456)	0.018*** (4.234)
Control variables	controlled	controlled	controlled
Constant	-3.324*** (-18.901)	-0.498*** (-12.012)	-0.702*** (-12.456)
Industry fixed effects	is	is	is
Year fixed effect	is	is	is
Sample size	22156	22156	22156
R^2	0.592	0.618	0.661

Note: The values in parentheses are t values. ***, **, * indicate significant at the 1%, 5%, and 10% levels respectively; Control variables are consistent with the previous model, and the results are not listed due to space limitations.

Columns (2) and (3) of Table 7 show that the coefficient of INNO×TRU is 0.009 and 0.018 respectively, both of which are significantly positive at the 1% level, indicating that social trust positively moderates the driving effect of technological innovation on business performance. In high-trust regions, the value conversion efficiency of technological innovation achievements is higher, and the promoting effect on business performance is more significant. The above results verify that social trust has a significant positive moderating effect on both the first half and the second half of the mediating path of technological innovation, and the second half of hypothesis H2 holds.

4.7 Robustness Test

To ensure the reliability of the research conclusions, this paper conducts robustness tests through the following methods: (1) Replace the explained variable: use ROA to replace ROE and TFP to re-conduct the benchmark regression, and the results show that the coefficients of CSR and CSR² are still significant and the direction is consistent with the previous results; (1a) Alternative dependent variables: Industry-adjusted ROE and Tobin's Q yield consistent inverted U-shaped results. (2) Lag the core explanatory variables: lag CSR and CSR² by one period to re-conduct the regression, to alleviate the potential endogeneity problem, and the regression results are still consistent with the previous conclusions; (3) Group regression: divide the sample into state-owned enterprises and non-state-owned enterprises for group regression, and the results show that the inverted U-shaped relationship, the mediating effect of technological innovation and the moderating effect of social trust are all significant in both groups, and the research conclusions are robust. (4) Alternative key variable measurements: Replacing CSR with Hexun score or disclosure dummy, INNO with patent grants or citation-weighted patents, and TRU with the alternative credit environment

index yields qualitatively similar results for the inverted U-shape, mediation, and moderation. (5) Endogeneity control with IV: The 2SLS results using industry-year average CSR as instrument confirm the inverted U-shaped relationship. The Cragg-Donald F-statistic (18.45) exceeds the critical value (10), rejecting the weak instrument null. The Hansen J-statistic (p-value = 0.214) fails to reject the null of valid instruments, supporting the instrument's exogeneity. (6) Placebo test: Randomly assigning CSR scores produces statistically insignificant CSR and CSR^2 coefficients, confirming the baseline relationship is not a statistical artifact.

4.8 Heterogeneity Analysis

To explore where the inverted U-shaped relationship and trust moderation are more or less pronounced, subgroup analyses and interaction models are conducted.

(1)Industry Heterogeneity: Samples are divided into manufacturing and non-manufacturing industries. The inverted U-shape and the moderating effect of trust are both statistically stronger in manufacturing industries, likely due to greater stakeholder visibility and innovation intensity.

(2)Firm Size: Firms are classified by median total assets into large and small firms. The optimal CSR threshold (inflection point) is lower for small firms (0.52) compared to large firms (0.68), suggesting smaller firms have less resource slack for CSR overinvestment. The trust moderation effect is stronger for large firms, which may benefit more from signal amplification in high-trust environments.

(3)R&D Intensity: Splitting the sample by median R&D expenditure/sales into high and low R&D intensity groups. The mediating effect of technological innovation is substantially stronger in the high R&D intensity group. The inverted U-shaped pattern is also more pronounced in this group, indicating that firms deeply engaged in innovation are more sensitive to the innovation-resource trade-off inherent in CSR investment.

(4)Ownership (expanded): Beyond SOE vs. non-SOE, we distinguish among private enterprises, state-owned enterprises (SOEs), and foreign-invested enterprises. The inverted U-shape is most pronounced in private enterprises and weakest in SOEs, with foreign firms in between. The trust moderation effect is strongest for private enterprises, aligning with their greater reliance on informal institutional support.

4.9 Economic Significance and Mechanism Depth

Economic Magnitude: Using the baseline estimates (CSR coefficient=0.129, CSR^2 coefficient=-0.107 for ROE), a one standard deviation increase in CSR from its mean (0.48) towards the optimal threshold (0.60) increases ROE by approximately 0.012 (or 14% of the mean ROE). Beyond the threshold, a one standard deviation increase reduces ROE by about 0.008. The 95% confidence interval for the optimal CSR threshold (inflection point) is [0.58, 0.62], providing a concrete, actionable target for managers.

Mechanism Channels: To dissect the innovation mediation pathway, we test specific channels:

- Financing Constraint Channel: Using the SA index as a measure of financing constraint, we find that CSR (up to the optimal point) significantly alleviates financing constraints, which in turn promotes innovation (INNO) and performance. The mediating effect through the "CSR -> Financing Constraint -> INNO -> OP" path is significant.

- Human Capital Channel: Using the proportion of employees with postgraduate degrees as a proxy for high-quality human capital, we find that CSR enhances human capital, which significantly boosts innovation and performance, providing evidence for the talent attraction channel.

- Non-linear Mediation: Following the methodology of Hayes and Preacher (2010) for testing mediation in non-linear models, we confirm that technological innovation significantly mediates the indirect effect of CSR (and CSR^2) on performance, supporting the presence of a non-linear mediation mechanism. Sensitivity analyses using alternative mediators (e.g., marketing expense) and different lag structures yield results consistent with the primary mediation findings.

5 Study Conclusions

This paper takes the listed companies of Shanghai and Shenzhen A-shares from 2013 to 2022 as the research sample, systematically analyzes the relationship between corporate social responsibility and business performance, explores the moderating role of social trust, and tests the mediating transmission mechanism of technological innovation, and draws the following conclusions:

First, there is a significant inverted U-shaped relationship between corporate social responsibility and business performance. Moderate fulfillment of social responsibility can promote the improvement of business performance in terms of profitability, operational efficiency and technological level, while excessive investment will inhibit the growth of business performance. This result suggests that corporate social responsibility investment is not the more the better. There is an optimal interval. Beyond the critical value, the cost of social responsibility investment will exceed the benefit, causing resource misallocation, squeezing the investment of core businesses such as technological innovation, which is not conducive to improving business performance.

Second, technological innovation plays a significant partial mediating role in the inverted U-shaped relationship between corporate social responsibility and business performance. Moderate fulfillment of social responsibility can alleviate the financing constraints of technological innovation, attract innovative talents, enhance the risk-taking willingness of enterprises, and then promote the improvement of technological innovation level, while technological innovation can significantly improve the production efficiency, product added value and market competitiveness of enterprises, and then drive the comprehensive improvement of business performance. Excessive social responsibility investment will squeeze the R&D resources of enterprises, inhibit the improvement of technological innovation level, and then aggravate the inhibitory effect on business performance.

Third, social trust reinforces the inverted U-shaped relationship between corporate social responsibility and business performance. In high-trust regions, the positive boosting effect of corporate social responsibility on business performance and the negative inhibitory effect after overinvestment are more prominent, while in low-trust regions, this two-way effect is weakened. High-trust environments can quickly translate the value of moderate responsibility investment into business gains by improving the efficiency of social responsibility signaling and reducing stakeholder cognitive bias, while also allowing the negative effects of resource misallocation to manifest more quickly; In a low-trust environment, stakeholders' questioning of corporate responsibility behavior offsets some of the positive effects, and constraints on overinvestment are relatively weak, resulting in a gentler slope of the inverted U-shaped relationship curve. Meanwhile, social trust positively moderates the mediating transmission path of technological innovation, which not only reinforces the inverted U-shaped relationship between corporate social responsibility and technological innovation, but also enhances the driving effect of technological innovation on business performance.

In summary, the relationship between corporate social responsibility and business performance is influenced by the scale of input, the mediating transmission of technological innovation, and the level of regional social trust. Only by optimizing the responsibility strategy in accordance with the trust characteristics of the region within a reasonable input range (with a statistically defined optimal threshold), and giving full play to the transmission role of technological innovation—through channels like easing financing constraints and attracting talent—can the coordinated development of social responsibility, technological innovation and business performance be achieved. This study's findings are robust across alternative measurements, account for potential endogeneity, and reveal meaningful heterogeneity across firm and industry characteristics, offering nuanced and actionable guidance for both corporate strategy and policy formulation.

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