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# The Effect of Corporate Social Responsibility Information Disclosure on Total Factor Productivity

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**Abstract:** This study examines the impact mechanism of corporate social responsibility (CSR) information disclosure quality on total factor productivity (TFP) using data from Chinese A-share listed companies during 2010–2023. Employing a dual-pathway framework of resource aggregation and supervisory governance, we measure TFP via the LP and OP methods and analyze 39,844 firm-year observations through a mediation effect model. Results indicate that CSR disclosure quality significantly enhances firm-level TFP, with amplified effects in state-owned enterprises and firms audited by the Big Four. Mechanism tests demonstrate that CSR disclosure operates through four channels: alleviating financing constraints, optimizing human capital structure, intensifying media attention, and improving internal control quality. By integrating TFP into the analytical framework of CSR economic consequences, this research extends stakeholder and signaling theories, elucidating the micro-mechanisms through which sustainable development practices affect productivity. The conclusions provide empirical evidence for enterprises to optimize CSR strategies for productivity gains and for policymakers to refine disclosure regulatory systems, with implications for fostering high-quality development.

**Keywords:** Corporate Social Responsibility Disclosure; Total Factor Productivity; Resource Aggregation Effect; Supervisory Governance Effect

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## 1.Introduce

### 1.1 Research Background and Importance

In the contemporary global economy, the pursuit of sustainable development has become a central tenet for corporations worldwide. Stakeholders, including investors, regulators, and consumers, are increasingly demanding transparency regarding corporate performance beyond financial metrics, particularly in environmental, social, and governance (ESG) dimensions. Against this backdrop, Corporate Social Responsibility (CSR) disclosure has emerged as a critical non-financial communication tool, enabling firms to signal their commitment to long-term value creation and sustainable practices.

Concurrently, enhancing Total Factor Productivity (TFP) is universally recognized as the core driver of high-quality and sustainable economic growth, representing the efficiency with which all inputs are converted into output. While existing literature has extensively explored the impact of CSR disclosure on financial performance, its influence on firms' intrinsic operational efficiency—proxied by TFP—remains underexplored. This gap is significant, as understanding whether and how transparent sustainability reporting contributes to productive efficiency is crucial for both corporate strategy and academic

inquiry.

Most prior research focuses on the direct financial outcomes of CSR, such as firm value or cost of capital. However, scant attention has been paid to its effect on TFP, a more fundamental indicator of a firm's technological advancement and resource allocation efficiency. This study, therefore, seeks to bridge this gap by investigating the causal relationship between CSR disclosure quality and firm-level TFP. We propose a dual-pathway framework, hypothesizing that CSR disclosure influences TFP through both a resource-attraction effect (e.g., alleviating financing constraints, optimizing human capital) and a supervisory-governance effect (e.g., enhancing media monitoring, strengthening internal controls).

By empirically testing this framework using a large sample of Chinese listed firms, this research aims to provide robust, international evidence on the economic value of CSR disclosure. The findings will offer valuable insights for global managers seeking to leverage sustainability reporting for competitive advantage and for policymakers designing disclosure regulations to foster sustainable economic development.

### 1.2 Research Objectives

This study aims to systematically examine the impact mechanism and pathways through which Corporate Social Responsibility (CSR) information disclosure influences Total Factor Productivity (TFP). The core objectives are to empirically validate the direct promoting effect of CSR disclosure on TFP and to delve into its underlying transmission mechanisms, with a focus on the dual pathways of the "resource aggregation effect" (e.g., alleviating financing constraints and optimizing human capital) and the "supervisory governance effect" (e.g., enhancing media attention and strengthening internal control). Furthermore, the research explores the heterogeneous effects arising from contextual factors such as equity nature and audit quality, while ensuring the robustness of findings through methods including variable substitution and extended observation windows.

The research seeks to deepen the theoretical understanding of the economic consequences of CSR by transcending the traditional financial performance framework and revealing the value-creation mechanism of CSR practices from a productivity perspective. On a practical level, it aims to provide empirical evidence for enterprises to optimize information disclosure strategies and enhance TFP, as well as to offer insights for policymakers in designing disclosure regulatory systems that promote high-quality development.

## 2.Review of the literature

Although research on the economic consequences of corporate social responsibility (CSR) disclosure is already extensive, literature directly examining its impact on firm total factor productivity remains in a nascent stage. Scholars both domestically and internationally are gradually shifting their focus from traditional financial performance to efficiency indicators that better represent long-term competitiveness and high-quality development.

Foreign scholars have earlier explored the potential link between CSR disclosure and production efficiency from a theoretical perspective. Based on stakeholder theory and the resource-based view, firms build trust with key groups such as investors, employees, customers, and communities through CSR disclosure. The accumulation of this "social capital" helps firms access scarce resources (Sen, 2001), thereby providing support for production efficiency and innovation activities. For instance, empirical research by Mao (2022) found that firms consistently committed to sustainable development and actively disclosing related information, while not necessarily leading in stock performance and market valuation in the short term, demonstrated greater robustness in operational efficiency, innovation capability, and risk control. This indirectly suggests an enhancement in total factor productivity.

High-quality CSR disclosure is regarded as a positive signal that can effectively alleviate information asymmetry, reduce external investors' risk perception, and consequently help firms obtain capital at a lower cost (Margolis et al., 2009). The alleviation of financing constraints enables firms to allocate more resources to R&D, advanced equipment, and technological upgrades, directly promoting the improvement of total factor productivity (Meseguer-Sánchez et al., 2021). Firms with strong CSR performance are more likely to attract and retain high-quality talent (Tunio et al., 2021). Simultaneously, disclosure related to employee welfare and training reflects the firm's investment in human capital. This can stimulate employee innovation and enhance internal process efficiency, serving as a core micro-foundation for driving growth in total factor

productivity (Mukhuty et al., 2022). CSR disclosure requires firms to establish more robust internal management and data collection systems, which inherently strengthens internal controls (Lozano et al., 2009). Sound internal controls can reduce agency costs and inefficient investments, optimizing resource allocation. Furthermore, disclosing environmental and social risk information helps firms identify and mitigate operational risks (e.g., environmental incidents, supply chain disputes) that could disrupt production, thereby safeguarding the stability of production processes (Liang et al., 2022).

It is noteworthy that some studies point to potential negative or complex relationships. For example, excessive or unrealistic CSR investments may divert productive resources, increase management costs, and negatively impact efficiency in the short term (Li, 2022). Additionally, this relationship is significantly influenced by the institutional environment. The productivity effect of CSR disclosure tends to be more pronounced in regions with stronger investor protection and more developed market mechanisms (Hawn, 2016).

# 3.Research methodology

## 3.1 Research hypotheses

Against the backdrop of global sustainable development and the rise of ESG investing, corporate social responsibility (CSR) information disclosure has become a vital component of strategic corporate management. As China's economy transitions towards high-quality development, enhancing total factor productivity (TFP) stands as a core pathway for optimizing economic structure. Investigating the impact of CSR disclosure on TFP therefore holds significant theoretical and policy implications(Li, 2022).

Grounded in signaling theory, CSR disclosure serves a crucial signaling function in markets characterized by information asymmetry. Systematically disclosed sustainability reports convey positive information about sound corporate governance and long-term potential to stakeholders, thereby enhancing market trust and improving the business operating environment. From the perspective of stakeholder theory, CSR disclosure facilitates the establishment of constructive, long-term relationships with investors, employees, customers, and other parties, creating favorable conditions for TFP improvement(Ni, 2019).

The mechanisms through which CSR disclosure influences TFP are manifested in the following pathways: First, it reduces financing costs through a signaling effect, providing capital support for technological innovation(Clarkson, 2008). Second, it attracts high-caliber talent via a reputation mechanism, optimizing the structure of human capital. Third, it strengthens internal controls, thereby improving the efficiency of resource allocation. Fourth, it introduces external supervision, which helps constrain managerial conduct. Finally, it enhances operational stability through process optimization. Together, these pathways constitute a multi-channel transmission framework through which CSR affects TFP(David, 2016).

Based on the foregoing analysis, this paper proposes the following research hypothesis:

H1: Corporate social responsibility disclosure has a significant positive impact on enterprise total factor productivity.

Against the backdrop of growing ESG adoption, corporate social responsibility (CSR) disclosure has emerged as a significant mechanism influencing investor decisions, mitigating financing constraints, and ultimately enhancing total factor productivity (TFP)(Sheldon, 1924). Grounded in information asymmetry theory and signaling theory, proactive and high-quality CSR disclosure conveys positive signals to the market regarding sound corporate governance, lower risk profiles, and long-term value, thereby distinguishing firms from lower-quality peers and strengthening trust among external investors and creditors. Stakeholder theory further suggests that such disclosure helps shape a responsible corporate image, improves commercial credit and debt financing conditions, and significantly reduces the risk perception and financing costs imposed by external capital providers(Bowen, 1984).

The alleviation of financing constraints enables firms to concretize investments in long-term R&D, technological upgrades, and advanced equipment, reducing underinvestment and resource misallocation caused by capital shortages(Davis , 1960). Consequently, management is better positioned to support innovation initiatives and technological transformation projects that, despite longer cycles, contribute to fundamental efficiency gains, thereby directly promoting TFP growth(Carroll , 1991).

Based on the logic of the "resource attraction effect," this paper proposes the following hypothesis:

H2: Corporate social responsibility disclosure positively affects enterprise total factor productivity by alleviating financing

constraints.

Impact through Optimizing Human Capital Structure (Resource Attraction Effect)

In today's sustainability-oriented business environment, CSR disclosure serves as a strategic tool for attracting, motivating, and retaining high-quality talent( Siegel, 2001). From a human capital theory perspective, CSR disclosure essentially constitutes an investment in human capital. By shaping a favorable employer brand, it reduces recruitment and training costs, enhances the quality of the talent structure, and thereby strengthens the firm's knowledge accumulation and innovation capabilities, providing an intellectual foundation for TFP improvement(Fama, 1971).

Social identity theory further elucidates that firms actively fulfilling social responsibilities enhance employees' sense of belonging, identification, and pride, which translates into higher work engagement and organizational loyalty, improving overall operational efficiency(Cheng, 2014). According to signaling theory, given the information asymmetry in the labor market, CSR disclosure sends positive signals to potential and current employees regarding employee care, cultural atmosphere, and ethical standards, helping firms establish a competitive advantage in talent attraction—particularly among value-driven, younger knowledge workers(Hemingway, 2004).

Through these mechanisms, CSR disclosure optimizes the structure and quality of human capital. A highly competent and identified workforce not only drives technological innovation but also enhances organizational learning, adaptability, and continuous improvement capabilities, thereby pushing the production technology frontier outward and supporting long-term TFP growth (Ackerberg, 2010).

Based on the above analysis, this paper proposes the following hypothesis:

H3: Corporate social responsibility disclosure positively affects enterprise total factor productivity by optimizing the human capital structure.

Impact through Enhancing Media Attention (Supervisory Governance Effect)

Media attention, as an important external governance mechanism, plays a key transmitting and reinforcing role in the process through which CSR disclosure affects TFP(Ackerberg, 2010). Corporate disclosure of social responsibility information conveys positive non-financial signals to the market, easily triggering media coverage and focus, thereby forming effective external supervision (Ackerberg, 2010).

According to agenda-setting theory, media guides public attention by selecting and emphasizing specific issues. Detailed CSR reports provide positive material for media, turning corporate social performance into a public issue and attracting sustained attention (Caggese, 2013). This scrutiny places corporate behavior under broad public supervision, compensating to some extent for deficiencies in internal corporate governance and alleviating principal-agent problems.

From a reputation mechanism perspective, media attention is directly linked to corporate and managerial reputation. Positive coverage builds reputational capital and enhances stakeholder trust, while negative exposure may trigger reputational risks, increasing financing costs and legal pressures (Midrigan, 2014). To protect their reputation, management is motivated to improve operational transparency, increase innovation investment, optimize resource allocation, and commit to long-term value creation, thereby avoiding market penalties associated with short-term opportunistic behavior (Restuccia, 2008).

Furthermore, media scrutiny reduces information asymmetry between the firm and external parties, helps bolster market confidence, alleviates financing constraints, and provides more stable funding support for technological upgrades (Gopinath, 2017). Under media attention, management is also more inclined to direct resources towards more efficient production activities and innovation, thereby improving resource allocation efficiency and laying the groundwork for sustained TFP growth (Bond, 2017).

In summary, this paper proposes the following hypothesis:

H4: Corporate social responsibility disclosure positively affects enterprise total factor productivity by enhancing media attention.

Impact through Improving Internal Control Quality (Supervisory Governance Effect)

Internal control, as a core mechanism of internal corporate governance, reveals an important pathway through which CSR disclosure affects TFP. CSR disclosure is not only a means of external communication but also a significant process for

internal management optimization (Bloom, 2007). Based on principal-agent theory, mandatory and voluntary disclosure requirements compel management to regularly report social and environmental performance to stakeholders (Bloom, 2014). This transparency mechanism curbs managerial opportunistic behavior and promotes systematic improvement of the internal control system (Bender, 2018).

To fulfill disclosure commitments, firms must establish standardized mechanisms for information collection, processing, and reporting, achieving standardization of management processes (Fleisher, 2010). This includes setting up data monitoring and evaluation systems for key areas such as environmental management, employee rights, and supply chain responsibility, which directly enhances the overall quality of internal controls (Chiang, 2007).

The improvement of the internal control system further directly benefits TFP by standardizing business processes, reducing operational risks, and enhancing resource utilization efficiency (Tian, 2011). Simultaneously, sound internal controls optimize corporate decision-making mechanisms, increase investment, reduce inefficient investment, and strengthen constraints and incentives for management, encouraging a focus on long-term value creation and thereby improving overall operational efficiency (Min, 2014).

Based on the aforementioned "supervisory governance effect" pathway, this paper proposes the following hypothesis:

H5: Corporate social responsibility disclosure positively affects enterprise total factor productivity by improving internal control quality.

## 3.2 Model specification

### 3.2.1 Baseline regression model

To examine the impact of corporate social responsibility (CSR) disclosure on total factor productivity (TFP) (Hypothesis H1), the following baseline regression model is constructed:

$$TFP_{i,t} = \beta_0 + \beta_1 CSR_{i,t} + \beta Controls_{i,t} + \delta_i + \theta_t + \varepsilon_{i,t} \qquad (3-1)$$

TFP{i,t}is the dependent variable, representing the total factor productivity. TFP is measured using both the LP method (TFP_LP) and the OP method (TFP_OP).CSR{i,t}is the core explanatory variable, representing the quality of CSR disclosure (CSR1).Controls{i,t}is a vector of control variables, which includes firm size (Size), profitability (Roa), financial leverage (Lev), cash flow (Cash), growth (Growth), board size (Board), the proportion of independent directors (Indep), ownership concentration (Top1), institutional investor shareholding (Inst), and firm age (Age).δi and θt denote industry and year fixed effects, respectively.ε{i,t}is the random error term.

### 3.2.2 Mechanism test models

To test the mediating mechanisms of the resource attraction effect (financing constraints and human capital structure) and the supervisory governance effect (media attention and internal control quality), and to validate Hypotheses H2a, H2b, H3a, and H3b, we follow the mediation effect test procedure proposed by Wen et al. (2004) and construct the following models:

$$M_{i,t} = \alpha_0 + \alpha_1 CSR_{i,t} + \alpha Controls_{i,t} + \delta_i + \theta_t + \varepsilon_{i,t} \qquad (3-2)$$

$$TFP_{i,t} = \gamma_0 + \gamma_1 CSR_{i,t} + \gamma_2 M_{i,t} + \gamma Controls_{i,t} + \delta_i + \theta_t + \varepsilon_{i,t} \qquad (3-3)$$

Here, M{i,t}represents the mediating variable. For the resource attraction effect path, M{i,t}denotes financing constraints (SA_abs, where a larger value indicates more severe constraints) and human capital structure (RL, the proportion of employees with a bachelor's degree or higher). For the supervisory governance effect path, M{i,t}denotes media attention (Media, the natural logarithm of one plus the number of media reports) and internal control quality (IC, the natural logarithm of the DIB index).

First, Equation (2) examines the effect of the explanatory variable CSR on the mediating variable M(coefficient α1). Subsequently, Equation (3) incorporates the mediating variable M into the baseline regression to test the direct effect of CSR on TFP(coefficient γ1) and the effect of the mediating variable Mon TFP(coefficient γ2). A significant α1and γ2together indicate the presence of a mediating effect.

## 3.3 Data

### 3.3.1 Samples

This study selects data from A-share listed companies on the Shanghai and Shenzhen stock exchanges for the period 2010–2023 as the initial sample. The data were processed as follows. First, ST and *ST companies were excluded. Second, because the financial data of financial firms differ significantly from those of non-financial firms, listed financial companies were removed. Third, observations with missing or abnormal data were excluded. Finally, all continuous variables were winsorized at the 1% and 99% levels. After the above screening, a final sample of 39,844 firm-year observations was obtained.

The data sources are as follows: basic financial data were sourced from the CSMAR database, corporate social responsibility information was obtained from the Social Responsibility Research Database within CSMAR, and media attention data were collected from the CNRDS database, among other sources. Data processing was conducted using Excel and Stata 18.

### 3.3.2 Measurement of the explained variables

Total Factor Productivity (TFP) serves as a core comprehensive indicator for measuring the efficiency with which firms translate given factor inputs into output. Its accurate measurement is crucial for ensuring the reliability of empirical findings. Traditional Ordinary Least Squares (OLS) estimation of production functions suffers from simultaneity bias—where firms adjust input levels in response to observed productivity shocks—and sample selection bias arising from firms' entry and exit decisions based on productivity. To address these endogeneity concerns, this study employs more rigorous semi-parametric estimation methods.

Specifically, we concurrently apply the OP method proposed by Olley and Pakes (1992) and the LP method developed by Levinsohn and Petrin (2003). Both approaches control for unobservable productivity shocks by introducing proxy variables, yet they differ in their mechanisms and applicability:

The OP method uses firm investment as the proxy variable. However, investment can be influenced by external factors such as financing constraints, potentially failing to fully capture genuine productivity changes. Moreover, this method suffers from sample loss due to zero-investment observations.

The LP method, in contrast, employs intermediate input as the proxy. Intermediate input typically responds more sensitively to productivity variations and effectively avoids sample attrition caused by zero investment. Nevertheless, it may also be affected by non-productivity factors, such as supply chain fluctuations.

To enhance the robustness of our conclusions and following the approach of Tian (2011), this paper calculates TFP using both methods, enabling cross-validation and comparative analysis.

### 3.2.3 Measurement of explanatory variables

The core explanatory variable of this study is the quality of corporate social responsibility (CSR) information disclosure. Drawing on the research of Dhaliwal (2012), this variable is measured along two dimensions: disclosure behavior and disclosure quality. Specifically, disclosure behavior is represented by a dummy variable, which takes a value of 1 if the company publishes a CSR report or relevant information in that year, and 0 otherwise. Disclosure quality is assessed based on stakeholder theory, following the approach of Clarkson (1995). This involves a comprehensive evaluation based on 12 key aspects covered in CSR reports from the CSMAR database. A binary scoring method is applied to each aspect, and the total scores are summed. The final CSR disclosure quality index is then standardized to a range of 0 to 1, with higher values indicating better quality of CSR information disclosure.

*Table 1.Core conceptual definitions*

| Variable type classification | Variable naming principles | Symbol design specifications | Measurement method description framework |
|---|---|---|---|
| Dependent variable | Total factor productivity | TFP_ LP | Total factor productivity of the firm in the current year measured using the LP method |
| | | TFP_OP | Total factor productivity of the firm in the current year measured using the OP method |
| Explanatory variable | Corporate social responsibility disclosure quality | CSR1 | Score obtained based on relevant indicators of social responsibility information disclosure in the CSMAR Social Responsibility Database, standardized |

| Variable type classification | Variable naming principles | Symbol design specifications | Measurement method description framework |
|---|---|---|---|
| Mediating variable | Financing constraints | SA_abs | Absolute value of the SA index |
| | Human capital structure | RL | Number of employees with a bachelor's degree or higher / Total number of employees |
| | Media attention | Media | Natural logarithm of (number of media reports + 1) |
| | Internal control | IC | Natural logarithm of the DIB index |
| Control variable | Firm size | Size | Natural logarithm of total assets at year-end |
| | Return on assets | Roa | Net profit / Total assets |
| | Asset-liability ratio | Lev | Total liabilities at year-end / Total assets at year-end |
| | Cash flow ratio | Cash | Net cash flow from operating activities / Total assets |
| | Operating revenue growth rate | Growth | (Operating revenue of the current year / Operating revenue of the previous year) – 1 |
| | Board size | Board | Natural logarithm of the number of board members |
| | Proportion of independent directors | Indep | Number of independent directors / Total number of board members |
| | Shareholding ratio of the largest shareholder | Top1 | Number of shares held by the largest shareholder / Total number of shares |
| | Proportion of institutional investors' shareholding | Inst | Number of shares held by institutional investors / Total number of shares |
| | Firm age | Age | Natural logarithm of (current year – firm founding year + 1) |

# 4.An empirical analysis

## 4.1 Descriptive statistics

The full sample comprises 39,844 firm-year observations, with no missing values for any variables. Under the two measurement approaches for the core dependent variable, total factor productivity (TFP), the mean values are 8.956 (LP method) and 6.612 (OP method), respectively, with significant variation across firms (standard deviations of 1.098 and 0.881, respectively). The core explanatory variable, corporate social responsibility information disclosure (CSR1), has a mean of 0.457 and a median of 0.583, indicating a slightly left-skewed distribution, with the majority of firms exhibiting disclosure levels above the mean. The relatively high standard deviation of CSR1 reflects substantial variation in disclosure quality across firms, which provides a basis for investigating the heterogeneous effects of CSR. Regarding the control variables, the distributional characteristics of firm size (Size), profitability (Roa), financial leverage (Lev), and others are consistent with existing literature and align with the general patterns observed in Chinese listed companies. It is particularly noteworthy that the standard deviation of firm growth (Growth) is relatively high (1.111), indicating that the sample includes firms at different growth stages, thereby enhancing the representativeness of the sample.

*Table 2.Descriptive statistics*

| Variable | N | Mean | Med | SD | Min | Max |
|---|---|---|---|---|---|---|
| TFP_LP | 39844 | 8.956 | 8.851 | 1.098 | 5.919 | 12.065 |
| TFP_OP | 39844 | 6.612 | 6.509 | 0.881 | 4.387 | 9.225 |
| CSR1 | 39844 | 0.457 | 0.583 | 0.260 | 0.000 | 1.000 |
| Size | 39844 | 7.652 | 7.573 | 1.254 | 4.060 | 11.181 |
| Roa | 39844 | 0.033 | 0.034 | 0.067 | -0.556 | 0.222 |

| Variable | N | Mean | Med | SD | Min | Max |
|---|---|---|---|---|---|---|
| Lev | 39844 | 0.429 | 0.422 | 0.205 | 0.028 | 0.908 |
| Cash | 39844 | 0.046 | 0.045 | 0.069 | -0.222 | 0.267 |
| Growth | 39844 | 0.369 | 0.120 | 1.111 | -0.928 | 17.107 |
| Board | 39844 | 2.117 | 2.197 | 0.198 | 1.609 | 2.708 |
| Indep | 39844 | 0.377 | 0.364 | 0.054 | 0.286 | 0.600 |
| Top1 | 39844 | 0.340 | 0.317 | 0.147 | 0.078 | 0.758 |
| Inst | 39844 | 0.437 | 0.451 | 0.245 | 0.001 | 0.923 |
| Age | 39844 | 2.957 | 2.996 | 0.328 | 1.099 | 3.689 |

## 4.2 Baseline regression analysis

This study employs total factor productivity (TFP) calculated using both the LP and OP methods as the core dependent variable. The regression results for the LP method (TFP_LP) are presented in Table 3.

Model (1) is a simple regression containing only the CSR1 variable. Its coefficient is 1.105 (t=54.173), which is significantly positive at the 1% level. After including year and industry fixed effects in Model (2), the coefficient of CSR1 slightly decreases to 1.084 (t=53.277) while retaining its significance. This indicates that the positive effect of CSR1 on TFP_LP remains robust after controlling for time trends and industry heterogeneity. Model (3) further incorporates control variables. The coefficient of CSR1 decreases to 0.409 (t=27.686) but remains significant at the 1% level, suggesting that the positive impact of corporate social responsibility (CSR) information disclosure quality on TFP is partially mediated through firm characteristics. Model (4) represents the full model, including both control variables and fixed effects. The coefficient of CSR1 is 0.282 (t=19.529) and significantly positive, confirming that improvements in CSR disclosure quality effectively enhance firm-level TFP.

Regarding the control variables, the coefficient for firm size (Size) is 0.437 (t=129.188) and significantly positive, indicating that economies of scale contribute to improved production efficiency. The coefficient for profitability (Roa) is 3.081 (t=52.536) and highly significant, suggesting that firms with stronger profitability can more easily accumulate resources for productivity enhancement. The coefficient for financial leverage (Lev) is 1.393 (t=66.468) and significantly positive, implying that moderate debt may promote productivity growth through tax shield effects and investment expansion. Corporate governance variables, including board size (Board), the proportion of independent directors (Indep), ownership concentration (Top1), and institutional investor shareholding (Inst), are all significantly positive, confirming the positive role of sound corporate governance in enhancing TFP.

*Table 3.LP method baseline regression analysis table*

| Variable name | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | TFP_LP | TFP_LP | TFP_LP | TFP_LP |
| CSR1 | 1.105*** | 1.084*** | 0.409*** | 0.282*** |
| | (54.173) | (53.277) | (27.686) | (19.529) |
| Size | | | 0.407*** | 0.437*** |
| | | | (114.563) | (129.188) |
| Roa | | | 3.149*** | 3.081*** |
| | | | (49.548) | (52.536) |
| Lev | | | 1.755*** | 1.393*** |
| | | | (82.987) | (66.468) |

| Variable name | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | TFP_LP | TFP_LP | TFP_LP | TFP_LP |
| Cash | | | -0.212*** | 0.009 |
| | | | (-3.623) | (0.167) |
| Growth | | | 0.005 | -0.005 |
| | | | (1.549) | (-1.434) |
| Board | | | 0.008 | 0.111*** |
| | | | (0.328) | (5.187) |
| Indep | | | 0.436*** | 0.445*** |
| | | | (5.336) | (6.001) |
| Top1 | | | 0.175*** | 0.079*** |
| | | | (5.968) | (2.927) |
| Inst | | | 0.456*** | 0.416*** |
| | | | (24.383) | (23.961) |
| Age | | | 0.283*** | 0.021* |
| | | | (24.531) | (1.726) |
| _cons | 8.451*** | 8.089*** | 3.532*** | 3.499*** |
| | (787.812) | (165.557) | (45.423) | (44.581) |
| Ind | NO | YES | NO | YES |
| Year | NO | YES | NO | YES |
| N | 39844 | 39844 | 39844 | 39844 |
| Adj $R^2$ | 0.069 | 0.234 | 0.563 | 0.645 |
| F | 2934.696 | 203.296 | 4668.601 | 1036.088 |

To verify the robustness of the results, this study also conducted regression analysis using total factor productivity measured by the OP method (TFP_OP) as the dependent variable, as shown in Table 4. In the simple regression of Model (1), the coefficient of CSR1 is 0.722 (t=43.572), which is significant at the 1% level. After including fixed effects in Model (2), the coefficient becomes 0.650 (t=40.669) while retaining its significance. In Model (3), which incorporates control variables, the coefficient of CSR1 is 0.432 (t=29.585), and in the full Model (4), the coefficient is 0.293 (t=20.498), both of which remain significantly positive. These results are consistent with the findings obtained using the LP method, further confirming that the quality of corporate social responsibility information disclosure has a significantly positive impact on firm-level total factor productivity.

*Table 4.OP method baseline regression analysis table*

| Variable name | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | TFP_OP | TFP_OP | TFP_OP | TFP_OP |
| CSR1 | 0.722*** | 0.650*** | 0.432*** | 0.293*** |
| | (43.572) | (40.669) | (29.585) | (20.498) |
| Size | | | 0.078*** | 0.108*** |
| | | | (22.248) | (32.318) |

| Variable name | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | TFP_OP | TFP_OP | TFP_OP | TFP_OP |
| Roa | | | 3.089*** | 3.024*** |
| | | | (49.165) | (52.068) |
| Lev | | | 1.773*** | 1.406*** |
| | | | (84.808) | (67.717) |
| Cash | | | -0.107* | 0.065 |
| | | | (-1.858) | (1.213) |
| Growth | | | 0.001 | -0.006* |
| | | | (0.209) | (-1.914) |
| Board | | | 0.048** | 0.139*** |
| | | | (2.074) | (6.540) |
| Indep | | | 0.506*** | 0.518*** |
| | | | (6.265) | (7.052) |
| Top1 | | | 0.177*** | 0.066** |
| | | | (6.106) | (2.449) |
| Inst | | | 0.479*** | 0.432*** |
| | | | (25.891) | (25.116) |
| Age | | | 0.289*** | 0.021* |
| | | | (25.329) | (1.756) |
| _cons | 6.282*** | 5.859*** | 3.545*** | 3.573*** |
| | (721.165) | (152.698) | (46.131) | (45.973) |
| Ind | NO | YES | NO | YES |
| Year | NO | YES | NO | YES |
| N | 39844 | 39844 | 39844 | 39844 |
| Adj $R^2$ | 0.045 | 0.265 | 0.337 | 0.459 |
| F | 1898.477 | 240.923 | 1838.228 | 484.459 |

The baseline regression results consistently show that the quality of corporate social responsibility information disclosure (CSR1) has a significant positive effect on corporate total factor productivity (both TFP_LP and TFP_OP), supporting the research hypothesis and indicating that the research conclusions are robust to different measurement methods of total factor productivity.

## 4.3 Mediating effect test

Based on the research hypotheses and baseline regression results, corporate social responsibility (CSR) information disclosure significantly promotes corporate total factor productivity. To delve deeper into the underlying pathways, this study further conducts mechanism tests from the theoretical dimensions of the "resource aggregation effect" and the "supervision and governance effect." Specifically, it examines the roles of four mediating variables: financing constraints (SA_abs), human capital structure (RL), media attention (Media), and internal control (IC). To enhance the robustness of the conclusions, this study sequentially employs the Baron & Kenny three-step method for preliminary path verification. It is supplemented with the Sobel test and the Bootstrap sampling method (500 repetitions) to strictly assess the statistical significance of the mediating effects.

### 4.3.1 Mediating mechanism test of the resource aggregation effect

Columns (1)-(3) in Table 5 show that the coefficient of corporate social responsibility information disclosure (CSR1) on financing constraints (SA_abs) is -0.022, which is significantly negative at the 1% level (t = -8.714). This indicates that a higher level of CSR disclosure is associated with lower corporate financing constraints. After controlling for the financing constraints variable, the coefficients of CSR1 on TFP_LP and TFP_OP remain significantly positive (0.272 and 0.282, respectively), and financing constraints themselves have a significantly negative impact on TFP (coefficients of -0.445 and -0.490, respectively). The Sobel test Z-values are 7.598 (TFP_LP) and 7.778 (TFP_OP), far exceeding the critical value of 1.96. The 95% confidence intervals from Bootstrap sampling are [0.008, 0.012] for TFP_LP and [0.008, 0.013] for TFP_OP, both of which do not contain zero, confirming the robustness of the results. This suggests that CSR information disclosure promotes total factor productivity by alleviating external financing constraints, thereby providing more stable financial support for the enterprise. Hypothesis H2 is supported.

Columns (4)-(6) indicate that the coefficient of CSR information disclosure (CSR1) on human capital structure (RL) is 0.044, which is significant at the 1% level (t = 11.152). This suggests that CSR disclosure helps attract and retain highly educated talent, thereby optimizing the firm's human capital. After introducing the RL variable, the coefficients of CSR1 on TFP_LP and TFP_OP remain significantly positive (0.216 and 0.228, respectively), and RL itself has a significant positive effect on TFP (coefficients of 1.328 and 1.310, respectively). The Sobel Z-value is 10.96, and the Bootstrap confidence interval does not contain zero, confirming the significant mediating effect of human capital structure. This implies that by disclosing CSR information, firms shape a positive employer image, attract high-quality talent, provide intellectual support for technological innovation and efficiency improvements, and ultimately drive total factor productivity growth. Hypothesis H3 is validated.

*Table 5.The three-step mechanism test*

| Variable name | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | SA_abs | TFP_LP | TFP_OP | RL | TFP_LP | TFP_OP |
| CSR1 | -0.022*** | 0.272*** | 0.282*** | 0.044*** | 0.216*** | 0.228*** |
| | (-8.714) | (18.891) | (19.802) | (11.152) | (13.851) | (14.819) |
| SA_abs | | -0.445*** | -0.490*** | | | |
| | | (-15.521) | (-17.248) | | | |
| RL | | | | | 1.328*** | 1.310*** |
| | | | | | (59.093) | (58.927) |
| Size | -0.013*** | 0.431*** | 0.102*** | -0.039*** | 0.498*** | 0.169*** |
| | (-22.547) | (127.013) | (30.295) | (-41.207) | (132.563) | (45.480) |
| Roa | 0.080*** | 3.117*** | 3.064*** | 0.228*** | 2.565*** | 2.510*** |
| | (7.859) | (53.265) | (52.901) | (14.472) | (41.542) | (41.106) |
| Lev | 0.000 | 1.393*** | 1.406*** | 0.063*** | 1.296*** | 1.312*** |
| | (0.098) | (66.676) | (67.977) | (10.843) | (57.002) | (58.338) |
| Cash | -0.005 | 0.007 | 0.063 | -0.120*** | 0.270*** | 0.326*** |
| | (-0.485) | (0.130) | (1.176) | (-8.061) | (4.637) | (5.647) |
| Growth | -0.001* | -0.005 | -0.007** | 0.016*** | -0.022*** | -0.024*** |
| | (-1.743) | (-1.574) | (-2.071) | (17.474) | (-6.146) | (-6.641) |
| Board | -0.013*** | 0.106*** | 0.133*** | 0.077*** | 0.010 | 0.039* |
| | (-3.462) | (4.932) | (6.264) | (12.992) | (0.438) | (1.703) |
| Indep | -0.174*** | 0.367*** | 0.433*** | 0.222*** | 0.111 | 0.190** |

| Variable name | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | SA_abs | TFP_LP | TFP_OP | RL | TFP_LP | TFP_OP |
| | (-13.438) | (4.962) | (5.903) | (10.942) | (1.397) | (2.413) |
| Top1 | -0.010** | 0.075*** | 0.061** | -0.047*** | 0.108*** | 0.093*** |
| | (-2.144) | (2.769) | (2.273) | (-6.417) | (3.764) | (3.260) |
| Inst | -0.021*** | 0.407*** | 0.422*** | 0.110*** | 0.235*** | 0.252*** |
| | (-6.927) | (23.480) | (24.595) | (23.339) | (12.596) | (13.684) |
| Age | 0.719*** | 0.341*** | 0.373*** | -0.016*** | 0.030** | 0.031** |
| | (344.369) | (14.299) | (15.809) | (-4.799) | (2.359) | (2.429) |
| _cons | 1.958*** | 4.371*** | 4.532*** | 0.264*** | 4.075*** | 4.118*** |
| | (143.154) | (45.376) | (47.544) | (2.863) | (11.290) | (11.535) |
| Ind | YES | YES | YES | YES | YES | YES |
| Year | YES | YES | YES | YES | YES | YES |
| N | 39844 | 39844 | 39844 | 30384 | 30384 | 30384 |
| Adj $R^2$ | 0.810 | 0.647 | 0.463 | 0.451 | 0.690 | 0.527 |
| F | 2434.801 | 1031.050 | 485.386 | 362.063 | 968.554 | 484.398 |
| Sobel Z | | 7.598 | 7.778 | | 10.96 | 10.96 |
| Bootstrap | | [0.008,0.012] | [0.008,0.013] | | [0.052,0.066] | [0.049,0.067] |

### 4.3.2 Mediating mechanism test of the supervision and governance effect

As shown in column (1) of Table 6, the coefficient of corporate social responsibility information disclosure (CSR1) on media attention (Media) is 0.254, which is significantly positive at the 1% level. This indicates that a higher level of CSR disclosure corresponds to greater media attention received by the firm. Columns (2)-(3) show that after controlling for the media attention variable, the coefficients of CSR1 on TFP_LP and TFP_OP remain significantly positive (0.258 and 0.268, respectively), and media attention itself has a significant positive effect on TFP (coefficients of 0.099 and 0.103, respectively). The Sobel test Z-values are 11.79 (for TFP_LP) and 11.90 (for TFP_OP), far exceeding the critical value of 1.96. The 95% confidence intervals from Bootstrap sampling are [0.021, 0.029] and [0.022, 0.030], respectively, neither of which includes zero, confirming the robustness of the results. This suggests that CSR information disclosure promotes total factor productivity by enhancing media attention, thereby strengthening external supervision and information transparency. Hypothesis H4 is supported.

Column (4) of Table 5-13 indicates that CSR information disclosure contributes to the improvement of the firm's internal control system. Columns (5) and (6) show that after introducing the IC variable, the coefficients of CSR1 on TFP_LP and TFP_OP remain significantly positive, and IC itself has a significant positive effect on TFP. The Sobel Z-values are far greater than the critical value, and the Bootstrap confidence intervals do not include zero, confirming the significant mediating effect of internal control. This implies that by disclosing CSR information, firms are driven to standardize internal management processes and enhance risk control capabilities, thereby providing institutional safeguards for the growth of total factor productivity. Hypothesis H5 is validated.

*Table 6.The three-step mechanism test*

| Variable name | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | IC | TFP_LP | TFP_OP | Media | TFP_LP | TFP_OP |
| CSR1 | 0.149*** | 0.279*** | 0.291*** | 0.254*** | 0.258*** | 0.268*** |
| | (6.908) | (19.070) | (20.048) | (13.283) | (17.683) | (18.608) |
| IC | | 0.031*** | 0.031*** | | | |
| | | (8.935) | (9.133) | | | |
| Media | | | | | 0.099*** | 0.103*** |
| | | | | | (25.633) | (26.794) |
| Size | 0.065*** | 0.438*** | 0.109*** | 0.254*** | 0.411*** | 0.081*** |
| | (12.852) | (126.805) | (31.978) | (56.591) | (115.827) | (23.186) |
| Roa | 3.717*** | 3.023*** | 2.952*** | 0.954*** | 3.064*** | 2.999*** |
| | (41.300) | (48.531) | (47.851) | (12.118) | (51.168) | (50.600) |
| Lev | -0.294*** | 1.417*** | 1.427*** | 0.378*** | 1.368*** | 1.378*** |
| | (-9.311) | (66.175) | (67.246) | (13.535) | (64.383) | (65.559) |
| Cash | -0.392*** | 0.041 | 0.099* | 0.086 | -0.028 | 0.029 |
| | (-4.777) | (0.745) | (1.804) | (1.195) | (-0.506) | (0.532) |
| Growth | 0.007 | -0.007** | -0.008** | 0.013*** | -0.005* | -0.007** |
| | (1.367) | (-2.099) | (-2.552) | (3.193) | (-1.710) | (-2.251) |
| Board | -0.005 | 0.114*** | 0.142*** | 0.248*** | 0.081*** | 0.108*** |
| | (-0.152) | (5.202) | (6.542) | (8.712) | (3.738) | (5.036) |
| Indep | 0.034 | 0.447*** | 0.526*** | 1.509*** | 0.279*** | 0.347*** |
| | (0.310) | (5.930) | (7.046) | (15.384) | (3.728) | (4.687) |
| Top1 | 0.271*** | 0.074*** | 0.059** | -0.441*** | 0.123*** | 0.111*** |
| | (6.726) | (2.691) | (2.193) | (-12.312) | (4.526) | (4.100) |
| Inst | -0.184*** | 0.404*** | 0.422*** | 0.254*** | 0.396*** | 0.411*** |
| | (-7.123) | (23.027) | (24.319) | (10.982) | (22.513) | (23.644) |
| Age | -0.084*** | 0.024* | 0.024** | -0.211*** | 0.044*** | 0.045*** |
| | (-4.701) | (1.942) | (2.003) | (-13.328) | (3.629) | (3.733) |
| _cons | 6.033*** | 3.276*** | 3.346*** | 2.808*** | 3.225*** | 3.291*** |
| | (51.238) | (39.730) | (40.972) | (27.060) | (40.541) | (41.799) |
| Ind | YES | YES | YES | YES | YES | YES |
| Year | YES | YES | YES | YES | YES | YES |
| N | 37931 | 37931 | 37931 | 38529 | 38529 | 38529 |
| Adj $R^2$ | 0.084 | 0.651 | 0.466 | 0.494 | 0.653 | 0.472 |
| F | 50.386 | 999.087 | 467.293 | 537.724 | 1022.781 | 486.443 |
| Sobel Z | | 5.465 | 5.51 | | 11.79 | 11.9 |
| Bootstrap | | [0.002,0.006] | [0.003,0.007] | | [0.021,0.029] | [0.022,0.030] |

## 4.4 Robustness tests

### 4.4.1 Replacing the explained variable and explanatory variable

In measuring corporate total factor productivity, this paper employs both the LP method and the OP method, and adopts the CSR disclosure quality measurement method CSR1 proposed by Zou Ping. To further verify the robustness of the research conclusions, this paper conducts supplementary tests by replacing variables.

First, this paper uses the total factor productivity measured by the OLS method (TFP_OLS) as the new explained variable for regression analysis. As shown in column (1) of Table 7, the coefficient of the explanatory variable CSR1 is 0.329, which is significantly positive at the 1% level (t = 21.970). This result is entirely consistent with the estimation results using the LP and OP methods in the baseline regression in terms of sign direction and significance level, indicating that regardless of the TFP measurement method used, the quality of corporate social responsibility information disclosure has a significant promoting effect on total factor productivity.

Second, this paper adopts another corporate social responsibility disclosure quality indicator, CSR2 (a count measure constructed based on a company's disclosure performance across eight CSR aspects, where a value closer to 8 indicates better CSR fulfillment), to replace the original explanatory variable. The regression results with TFP_LP and TFP_OP as the explained variables are shown in columns (2) and (3) of Table 7, respectively. When the explained variable is TFP_LP, the coefficient of CSR2 is 0.023, significant at the 1% level (t = 16.084). When the explained variable is TFP_OP, the coefficient of CSR2 is 0.024, also significant at the 1% level (t = 16.869). Although the coefficient values differ from those of CSR1 in the baseline regression, the sign direction and significance level are completely consistent. This suggests that CSR disclosure quality measured in different ways can significantly enhance corporate total factor productivity.

Through the robustness tests involving replacing the explained and explanatory variables described above, this paper finds that regardless of the TFP measurement method (OLS, LP, or OP) or the CSR disclosure quality indicator (CSR1 or CSR2) used, the coefficient of the core explanatory variable remains significantly positive at least at the 1% level. Furthermore, the goodness-of-fit ($R^2$) and F-statistics of each regression model remain at high levels, and the signs and significance of the control variables show no substantial changes. These results indicate that the promoting effect of corporate social responsibility information disclosure quality on total factor productivity is highly robust, confirming the reliability of the research conclusions.

*Table 7.Variable replacement*

| Variable name | (1) | (2) | (3) |
|---|---|---|---|
| | TFP_OLS | TFP_LP | TFP_OP |
| CSR1 | 0.329*** | | |
| | (21.970) | | |
| CSR2 | | 0.023*** | 0.024*** |
| | | (16.084) | (16.869) |
| Size | 0.567*** | 0.440*** | 0.112*** |
| | (161.852) | (130.857) | (33.666) |
| Roa | 2.995*** | 3.090*** | 3.033*** |
| | (49.250) | (52.610) | (52.142) |
| Lev | 1.518*** | 1.391*** | 1.404*** |
| | (69.828) | (66.283) | (67.515) |
| Cash | 0.178*** | 0.011 | 0.067 |
| | (3.181) | (0.211) | (1.258) |
| Growth | -0.012*** | -0.005 | -0.006* |
| | (-3.575) | (-1.463) | (-1.944) |

| Variable name | (1) | (2) | (3) |
|---|---|---|---|
| | TFP_OLS | TFP_LP | TFP_OP |
| Board | 0.205*** | 0.116*** | 0.143*** |
| | (9.201) | (5.375) | (6.735) |
| Indep | 0.675*** | 0.457*** | 0.531*** |
| | (8.787) | (6.164) | (7.221) |
| Top1 | 0.081*** | 0.077*** | 0.063** |
| | (2.887) | (2.841) | (2.359) |
| Inst | 0.489*** | 0.424*** | 0.440*** |
| | (27.164) | (24.378) | (25.549) |
| Age | 0.021* | 0.020 | 0.020* |
| | (1.711) | (1.644) | (1.670) |
| _cons | 3.836*** | 3.465*** | 3.537*** |
| | (47.133) | (44.105) | (45.466) |
| Ind | YES | YES | YES |
| Year | YES | YES | YES |
| N | 39844 | 39844 | 39844 |
| Adj $R^2$ | 0.713 | 0.644 | 0.457 |
| F | 1412.994 | 1031.187 | 480.907 |

### 4.4.2 replacing sample periods and adding firm fixed effects

To ensure the reliability and unbiasedness of the baseline regression results, this study conducts robustness checks from two dimensions: sample period adjustment and fixed effects control. First, to exclude the potential influence of extreme external events on the estimation results, samples from the 2015 stock market crash and the COVID-19 pandemic in 2020 are removed. The regression results are presented in columns (1) and (2) of Table 8. The test results show that, after controlling for industry and year fixed effects, the coefficient of Corporate Social Responsibility (CSR1) on Total Factor Productivity (TFP) remains significantly positive at the 1% level, with a value slightly higher than that in the baseline regression. This indicates that the relationship between the core variables is not distorted by specific macroeconomic shocks.

Second, to control for time-invariant firm heterogeneity, this study introduces firm fixed effects, constructing a three-way fixed effects model. The empirical results in columns (3) and (4) show that the coefficient of CSR1 remains significantly positive after accounting for inherent firm characteristics. This confirms that the conclusions of the baseline regression are robust to potential omitted variable bias.

*Table 8.Sample period replacement and addition of firm fixed effects*

| Variable name | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | TFP_LP | TFP_OP | TFP_LP | TFP_OP |
| CSR1 | 0.287*** | 0.298*** | 0.103*** | 0.106*** |
| | (18.509) | (19.398) | (8.740) | (9.112) |
| Size | 0.436*** | 0.107*** | 0.341*** | 0.010** |
| | (119.657) | (29.645) | (75.968) | (2.212) |
| Roa | 3.073*** | 3.016*** | 2.069*** | 2.050*** |
| | (48.229) | (47.752) | (53.558) | (53.821) |

| Variable name | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | TFP_LP | TFP_OP | TFP_LP | TFP_OP |
| Lev | 1.384*** | 1.398*** | 0.754*** | 0.775*** |
| | (61.249) | (62.405) | (37.863) | (39.448) |
| Cash | -0.052 | 0.009 | 0.427*** | 0.440*** |
| | (-0.896) | (0.160) | (12.379) | (12.909) |
| Growth | -0.004 | -0.005 | 0.005** | 0.004** |
| | (-1.189) | (-1.551) | (2.333) | (2.048) |
| Board | 0.114*** | 0.142*** | 0.105*** | 0.109*** |
| | (4.925) | (6.207) | (4.832) | (5.077) |
| Indep | 0.446*** | 0.522*** | 0.253*** | 0.260*** |
| | (5.584) | (6.591) | (3.836) | (4.009) |
| Top1 | 0.087*** | 0.074** | -0.214*** | -0.218*** |
| | (3.001) | (2.570) | (-6.229) | (-6.427) |
| Inst | 0.422*** | 0.438*** | 0.510*** | 0.510*** |
| | (22.582) | (23.674) | (22.632) | (22.984) |
| Age | 0.020 | 0.020 | 0.283*** | 0.297*** |
| | (1.550) | (1.615) | (8.164) | (8.699) |
| _cons | 3.499*** | 3.570*** | 4.181*** | 4.311*** |
| | (41.572) | (42.799) | (31.202) | (32.626) |
| Ind | YES | YES | YES | YES |
| Year | YES | YES | YES | YES |
| ID | NO | NO | YES | YES |
| N | 34137 | 34137 | 39844.000 | 39844.000 |
| Adj $R^2$ | 0.647 | 0.462 | 0.417 | 0.278 |
| F | 921.322 | 431.480 | 477.024 | 289.219 |

### 4.4.3 Extending the observation window

This study tests robustness by extending the observation window through the introduction of lagged terms from 1 to 3 periods. As shown in columns (1) to (3) and columns (4) to (6) of Table 9, the coefficients of the core explanatory variable across multiple lagged periods remain significantly positive at least at the 1% level, confirming the robustness of the conclusions.

*Table 9.Extending the observation period for robustness check*

| Variable name | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | TFP_LP | TFP_LP | TFP_LP | TFP_OP | TFP_OP | TFP_OP |
| L1.CSR1 | 0.257*** | | | 0.269*** | | |
| | (16.830) | | | (17.807) | | |
| L2.CSR1 | | 0.232*** | | | 0.244*** | |

| Variable name | (1) | (2) | (3) | (4) | (5) | (6) |
|---|---|---|---|---|---|---|
| | TFP_LP | TFP_LP | TFP_LP | TFP_OP | TFP_OP | TFP_OP |
| | | (14.265) | | | (15.184) | |
| L3.CSR1 | | | 0.200*** | | | 0.212*** |
| | | | (11.678) | | | (12.554) |
| Size | 0.443*** | 0.450*** | 0.455*** | 0.115*** | 0.123*** | 0.129*** |
| | (121.147) | (113.790) | (107.060) | (31.932) | (31.431) | (30.767) |
| Roa | 2.976*** | 2.898*** | 2.826*** | 2.926*** | 2.851*** | 2.784*** |
| | (48.051) | (44.632) | (41.447) | (47.791) | (44.490) | (41.419) |
| Lev | 1.381*** | 1.354*** | 1.322*** | 1.390*** | 1.359*** | 1.324*** |
| | (60.754) | (55.345) | (50.241) | (61.855) | (56.287) | (51.063) |
| Cash | 0.137** | 0.148** | 0.194*** | 0.187*** | 0.196*** | 0.240*** |
| | (2.313) | (2.308) | (2.806) | (3.189) | (3.096) | (3.515) |
| Growth | -0.003 | -0.001 | 0.001 | -0.004 | -0.002 | 0.000 |
| | (-0.821) | (-0.226) | (0.342) | (-1.157) | (-0.533) | (0.015) |
| Board | 0.096*** | 0.077*** | 0.057** | 0.125*** | 0.105*** | 0.086*** |
| | (4.171) | (3.103) | (2.110) | (5.451) | (4.282) | (3.236) |
| Indep | 0.432*** | 0.424*** | 0.410*** | 0.506*** | 0.501*** | 0.489*** |
| | (5.436) | (4.969) | (4.479) | (6.443) | (5.949) | (5.418) |
| Top1 | 0.049* | 0.035 | 0.036 | 0.035 | 0.019 | 0.020 |
| | (1.678) | (1.070) | (1.006) | (1.185) | (0.593) | (0.578) |
| Inst | 0.440*** | 0.473*** | 0.489*** | 0.456*** | 0.488*** | 0.502*** |
| | (22.886) | (22.109) | (20.488) | (23.982) | (23.112) | (21.360) |
| Age | 0.015 | -0.005 | -0.018 | 0.014 | -0.007 | -0.021 |
| | (1.135) | (-0.298) | (-1.014) | (1.011) | (-0.483) | (-1.198) |
| _cons | 3.602*** | 3.635*** | 3.723*** | 3.677*** | 3.709*** | 3.793*** |
| | (42.246) | (39.127) | (36.757) | (43.623) | (40.456) | (37.990) |
| Ind | YES | YES | YES | YES | YES | YES |
| Year | YES | YES | YES | YES | YES | YES |
| N | 34465 | 29926 | 26038 | 34465 | 29926 | 26038 |
| Adj $R^2$ | 0.647 | 0.647 | 0.645 | 0.463 | 0.464 | 0.461 |
| F | 930.158 | 820.777 | 718.053 | 438.039 | 388.055 | 338.513 |

## 4.5 Heterogeneity analysis

This study examines the heterogeneous effects of corporate social responsibility (CSR) information disclosure on total factor productivity (TFP) from two dimensions: equity nature and audit quality. By constructing interaction term models, we delve into the differential manifestations of the economic consequences of CSR information disclosure under different institutional contexts and market conditions.

Columns (1) and (2) of Table 10 report the regression results grouped by equity nature. The coefficients of the interaction term CSR1SOE are both statistically significant under the two TFP measures (TFP_LP and TFP_OP), indicating that equity nature (whether a firm is state-owned or not) significantly moderates the impact of CSR on TFP, demonstrating significant heterogeneity. The coefficients for CSR1SOE are 0.270 and 0.278 under the two measures, respectively, both significantly positive at the 1% level. This suggests that the enhancing effect of CSR information disclosure on TFP is more pronounced in state-owned enterprises compared to non-state-owned enterprises.

Columns (3) and (4) of Table 10 present the moderating effect of audit quality on the CSR-TFP relationship. The coefficient of the interaction term CSR1×Big4 is significantly positive, indicating that the promoting effect of CSR information disclosure on TFP is stronger for companies audited by international "Big Four" accounting firms.

*Table 10.Heterogeneity analysis*

| Variable name | (1) | (2) | (3) | (4) |
|---|---|---|---|---|
| | TFP_LP | TFP_OP | TFP_LP | TFP_OP |
| CSR1 | 0.180*** | 0.187*** | 0.245*** | 0.255*** |
| | (10.415) | (10.970) | (16.804) | (17.645) |
| SOE | -0.044*** | -0.039*** | | |
| | (-3.026) | (-2.687) | | |
| CSR1*SOE | 0.270*** | 0.278*** | | |
| | (10.192) | (10.595) | | |
| Big4 | | | 0.094** | 0.104*** |
| | | | (2.460) | (2.741) |
| CSR1*Big4 | | | 0.418*** | 0.432*** |
| | | | (6.827) | (7.127) |
| Size | 0.433*** | 0.104*** | 0.422*** | 0.093*** |
| | (128.033) | (31.157) | (123.780) | (27.539) |
| Roa | 3.114*** | 3.061*** | 3.103*** | 3.047*** |
| | (53.165) | (52.777) | (53.279) | (52.878) |
| Lev | 1.387*** | 1.398*** | 1.409*** | 1.422*** |
| | (66.039) | (67.235) | (67.670) | (69.035) |
| Cash | 0.040 | 0.098* | -0.018 | 0.037 |
| | (0.739) | (1.832) | (-0.327) | (0.696) |
| Growth | -0.005 | -0.007** | -0.005 | -0.006* |
| | (-1.638) | (-2.145) | (-1.436) | (-1.917) |
| Board | 0.074*** | 0.098*** | 0.101*** | 0.128*** |
| | (3.420) | (4.576) | (4.729) | (6.067) |
| Indep | 0.368*** | 0.435*** | 0.334*** | 0.401*** |
| | (4.962) | (5.924) | (4.523) | (5.495) |
| Top1 | 0.057** | 0.041 | 0.072*** | 0.058** |
| | (2.109) | (1.551) | (2.699) | (2.203) |
| Inst | 0.374*** | 0.385*** | 0.370*** | 0.384*** |
| | (20.990) | (21.849) | (21.330) | (22.342) |
| Age | 0.001 | -0.001 | 0.028** | 0.029** |
| | (0.121) | (-0.051) | (2.395) | (2.466) |
| _cons | 3.730*** | 3.823*** | 3.674*** | 3.757*** |
| | (46.526) | (48.164) | (46.936) | (48.511) |
| Ind | YES | YES | YES | YES |
| Year | YES | YES | YES | YES |
| N | 39844 | 39844 | 39844 | 39844 |
| Adj $R^2$ | 0.647 | 0.462 | 0.650 | 0.468 |
| F | 1014.735 | 476.696 | 1029.818 | 487.675 |

# 5.Discussion

## 5.1 Summary of key findings

This study empirically examines the impact of corporate social responsibility (CSR) disclosure on total factor productivity (TFP) using a large-sample dataset of Chinese A-share listed companies from 2010 to 2023. The baseline regression results robustly demonstrate that high-quality CSR disclosure significantly enhances TFP, as measured by both the LP and OP methods. Mechanism tests reveal that CSR disclosure improves TFP through dual pathways: the resource aggregation effect (e.g., alleviating financing constraints and optimizing human capital structure) and the supervisory governance effect (e.g., enhancing media attention and internal control quality). Furthermore, heterogeneity analysis indicates that the positive impact of CSR disclosure on TFP is more pronounced in state-owned enterprises and firms audited by Big Four accounting firms.

## 5.2 Theoretical implications

First, this study extends the application of stakeholder theory and signaling theory by integrating TFP as a core indicator of operational efficiency. While prior literature predominantly links CSR to financial performance, our findings highlight that CSR disclosure serves as a critical tool for optimizing resource allocation and productivity, aligning corporate sustainability practices with long-term operational efficiency.

Second, the validated dual-pathway mechanism (resource aggregation and supervisory governance) refines the understanding of how CSR translates into economic value. For instance, the mediation effect of financing constraints underscores the role of CSR in mitigating information asymmetry and reducing capital costs, while the human capital channel emphasizes CSR's function in attracting talent and enhancing innovation capacity. These findings bridge CSR research with productivity theory, offering a micro-foundation for sustainable development strategies.

Third, the heterogeneity results underscore the contextual dependence of CSR's effectiveness. The stronger TFP improvement in state-owned enterprises reflects the synergy between CSR and China's institutional environment, where SOEs face higher expectations for social responsibility fulfillment. Similarly, the moderating role of Big Four audits reinforces the importance of external governance in amplifying CSR's credibility and impact.

## 5.3 Practical and policy implications

For enterprises, our results suggest that proactively disclosing high-quality CSR information is not merely a regulatory compliance task but a strategic investment to boost productivity. Managers should leverage CSR disclosure to strengthen investor confidence, optimize human capital, and improve internal governance systems.

For policymakers, this study supports the enforcement of CSR disclosure mandates as a viable policy tool to promote sustainable economic growth. Regulatory bodies could refine disclosure guidelines to encourage standardized, transparent CSR reporting, particularly for industries with high environmental or social impacts. Additionally, incentives (e.g., tax benefits or credit support) could be designed to reward firms that demonstrate tangible productivity gains through CSR practices.

For investors and stakeholders, the findings provide evidence that CSR disclosure quality can serve as a signal of a firm's operational efficiency and long-term resilience, aiding investment decisions and stakeholder engagement.

## 5.4 Limitations and future research

This study has several limitations. First, the sample focuses on Chinese listed companies, which may limit the generalizability of findings to other economies with distinct institutional contexts. Future research could conduct cross-country comparisons to explore institutional moderators. Second, while we tested four mediation channels, other potential mechanisms (e.g., supply chain collaboration or technological innovation networks) warrant investigation. Third, the study primarily uses structured CSR metrics; qualitative aspects of disclosure (e.g., narrative tone or visual elements) could be examined using natural language processing methods.

Finally, as global attention to ESG (environmental, social, and governance) criteria grows, future work could extend our framework to explore the differential impacts of environmental versus social disclosure on green TFP or analyze how digital transformation moderates the CSR-TFP relationship.

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