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Corporate social responsibility and innovation performance in Chinese firms with R&D investments as a mediator

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ABSTRACT

Motivated by the important role of innovation in firms' competition and development, this study explores whether Corporate Social Responsibility (CSR) affects firms' innovation performance. Using a qualitative approach, the relevant literature is reviewed, theoretical analysis is conducted, and hypotheses are developed. The empirical examinations utilize publicly listed Chinese A-share market company data from 2011 to 2020, which contains 23,962 firm-year observations. This study employs double-fixed-effect Ordinary Least Squares (OLS) regression to estimate the baseline model. The results show that CSR positively influences firms' innovation performance, suggesting that CSR activities foster innovation. Subsequently, the study confirms these findings through robustness checks, including alternative measures, periods, and Two-stage OLS regression. Using the Sobel test, the research also examines how R&D investments mediate the relationship between CSR and innovation performance, confirming R&D as a mediator. The findings highlight the critical role of CSR in enhancing firms' innovation performance. It also emphasizes the importance for policymakers to establish regulations requiring companies to undertake CSR, including economic, social, and environmental responsibilities. Additionally, practitioners should focus more on CSR and foster a CSR culture to improve innovation performance and better meet stakeholder demands.

Contribution/ Originality: This research contributes to a broader understanding of CSR as a driver of innovation, illustrating how socially responsible practices can act as catalysts for organizational creativity and competitive differentiation. Additionally, this study suggests that CSR promotes innovation performance through R&D investment.

1. INTRODUCTION

Innovation is an important way for enterprises to cope with external environmental changes and is a significant driving force for promoting economic development. Innovation is the entire evolutionary process that begins with generating ideas with commercial potential and is promoted, realized, applied, and finally transformed into fully commercialized products (Xie, Zhou, Zong, & Lu, 2020). Innovation performance is defined as the value of innovation realized at each stage of innovation activities (Ritala, Olander, Michailova, & Husted, 2015).

With the acceleration of global technological changes, innovation has become an important measure to lead the new normal of economic development and gain international competitiveness (Arif & Hasan, 2021). It is imperative for enterprises to seek innovation and development. Additionally, the competitive environment faced by enterprises

is also compelling them to innovate continuously. Enhancing the independent innovation capacity of enterprises is an important issue of concern not only to enterprise managers but also to policymakers and the public.

A significant body of research demonstrates that numerous factors, including corporate governance and acceptance of innovation by firms, influence enterprise innovation (Tan & Wang, 2014) employee incentives, and managerial style. Specific studies highlight that corporate managers' self-confidence (Galasso & Simcoe, 2011) risk appetite, and attitudes toward returns on risky investments (Sunder, Sunder, & Zhang, 2017) as well as the sociability of top executives (Faleye, Kovacs, & Venkateswaran, 2014) play critical roles in fostering technological innovation. Despite the increasing focus on innovation due to rising market competition and significant scholarly attention, the relationship between CSR initiatives and innovation in Chinese enterprises remains underexplored.

CSR refers to firms' obligations to address various stakeholders' needs during management. This encompasses economic, legal, ethical, and philanthropic responsibilities that businesses are expected to fulfill (Bowen, 1953; Carroll, 1979). CSR emphasizes the need for firms to balance economic, social, and environmental objectives effectively. In 2015, China introduced the GB/T 36000 social responsibility standard, an advocacy framework applicable to all organizations, including for-profit and non-profit entities, to guide CSR practices.

In the last decade, CSR has attracted increasing attention from entrepreneurs, exemplified by corporations such as GREE (SZ.000651) and BABA (HK.09988). These firms have integrated social responsibility into their corporate culture and values, promoting healthy growth through continuous technological innovation. CSR has also attracted significant interest from researchers. While some studies suggest that CSR can stimulate innovation by enhancing organizational capabilities (Nguyen, 2021) engaging stakeholders, and optimizing resources (e.g., Zhou, Wang, and Zhao (2020)). Others argue that CSR may become a financial burden when firms prioritize it beyond their capacity to sustain. In China, scholars have examined CSR from various perspectives; however, a unified conclusion on its overall impact has yet to be reached.

This research investigates how CSR affects innovation performance in Chinese firms. Firstly, we theoretically analyze the basic effect of CSR on innovation performance. Secondly, we empirically examine this relationship using OLS regression. Thirdly, we verify the validity of the baseline results through robustness tests, including alternative periods, alternative measures, and Two-stage OLS (2SLS) regression to address endogeneity.

This research contributes to a broader understanding of CSR as a driver of innovation, illustrating how socially responsible practices can act as catalysts for organizational creativity and competitive differentiation. This study is the first to propose that CSR fosters innovation performance through R&D investment, providing new evidence supporting the positive role of CSR in enhancing innovation performance. By integrating CSR into their business strategies, firms can achieve financial success, long-term sustainability, and societal value. This research offers valuable insights for corporate strategists, policymakers, and academics, highlighting CSR's transformative potential to align profitability with sustainable development in China's rapidly evolving economic landscape.

2. LITERATURE REVIEW, THEORY, AND HYPOTHESES DEVELOPMENT

2.1. Literature Review

Scholars have researched the factors affecting innovation performance, including micro-environment, firm, and individual-level factors. The micro-environment-level factors include innovation resources (Berchicci, 2013) social networks (Long, 2015) government policies (Guan & Yam, 2015) market environment (Fan, Qalati, Zafar, Limón, & Khaskheli, 2014). The organizational level factors include organizational behavior (Meeus & Oerlemans, 2000) organizational structure (Quatraro, 2010) organizational strategy (Zhou, Yim, & Tse, 2005) and organizational performance (Yi, Zhang, & Wang, 2015). The individual-level factors include executive characteristics (Yu, Zhao, & Ju, 2018; Zhang & Wu, 2016) and innovation capability (Xie, Zou, & Qi, 2018).

The impacts of CSR on corporate innovation performance can be categorized into three perspectives: positive, negative, and dynamic relationships.

Firstly, proactive CSR practices contribute positively to the enhancement of firms' innovation performance. Scholars argue that when enterprises actively engage in CSR, they improve their alignment with societal needs, fostering stronger connections with stakeholders and creating conditions conducive to innovation. Reverte, Gomez-Melero, and Cegarra-Navarro (2016) posit that the active implementation of various social responsibilities enables firms to satisfy societal expectations better, strengthening their relationships with stakeholders and improving their innovation activities. Xiao, Pan, and Wang (2021) focus on Chinese firms' green innovation using green patent data. Their findings demonstrate that firms actively fulfilling social responsibilities significantly enhance green innovation performance. Yu and Lan (2021) further highlighted that the strategic enhancement of CSR improves innovation performance, with legitimacy mediating in this relationship. Tsou, Huang, Liu, and Do (2021) state that CSR favors firms' performance.

Contrary to the above, some scholars argue that CSR engagement may negatively affect firms' innovation performance by diverting critical resources from core business activities. Hull and Rothenberg (2008) contend that allocating valuable resources to improve social performance is inconsistent with the rational behavior assumed under the "economic man" model. Such behavior may result in resource misallocation, detracting from efforts in core operational areas and hindering innovation. Similarly, George, Aboobaker, and Edward (2020) argue that fulfilling CSR obligations can crowd out the limited resources available for research and development (R&D). This resource competition imposes additional pressures on technological innovation activities, ultimately negatively impacting corporate performance.

A third perspective highlights that the relationship between CSR and innovation performance may not be linear or unidirectional. Chen, Kim, and Ren (2020) suggest that the relationship exhibits an inverted U-shape: moderate CSR engagement promotes innovation, whereas excessive CSR efforts may impede it. Kong (2019) explores the relationship between small and medium-sized enterprises' CSR efforts and technological innovation, noting that the two factors mutually influence each other in a dynamic interplay.

This research enhances understanding of the link between CSR and R&D investments, demonstrating how socially responsible initiatives can stimulate innovation and drive a competitive advantage. By embedding CSR into their strategic framework, companies can foster long-term sustainability. The findings provide valuable perspectives for corporate decision-makers, policymakers, and scholars, emphasizing CSR's pivotal role in shaping R&D investment and promoting sustainable economic progress in China's dynamic market environment.

2.2. Underpinned Theories

Stakeholder theory, as articulated by Friedman and Miles (2002), posits a theoretical framework for interpreting the relationship between CSR and innovation performance. The theory emphasizes the necessity for enterprises to balance the interests of shareholders, consumers, governments, and employees. It stresses the importance of actively undertaking responsibilities related to these stakeholders (Waldman, Siegel, & Javidan, 2006).

From a stakeholder perspective, CSR activities help alleviate conflicts, streamline resource acquisition, and reduce internal innovation costs, thereby facilitating the effective execution of innovation projects. Enterprises, during their operations, inevitably share or compete with stakeholders for limited public resources, such as environmental and spatial assets. Consequently, companies are obligated to provide corresponding compensation to stakeholders and actively fulfill their social obligations. This approach helps maintain long-term positive relationships with stakeholders and secures firms' sustainable development.

Moreover, fulfilling CSR highlights an enterprise's responsibility to its shareholders and its broader stakeholder network, as these groups are integral to the company's survival and growth. While profit generation remains a core objective of any enterprise, its survival and development are closely linked to the broader community. Enterprises draw resources from society, and in turn, they must contribute to it. When an enterprise

consciously undertakes CSR, it strengthens its bonds with stakeholders who benefit from such activities. Consequently, CSR fosters goodwill and collaboration, facilitating firms' long-term stable development.

2.3. Hypotheses Development

In summary, the impact of CSR on innovation performance is primarily reflected in the following aspects. The first is improving the innovation environment. By fulfilling their CSR, firms are more likely to gain recognition from governments and the public, receiving policy incentives that provide sustained support for innovation performance. Second, CSR facilitates the alignment of resources, both within the organization and from external stakeholders. Third, CSR initiatives encourage collaboration by enhancing the willingness of innovation network participants to share knowledge, technology, and management expertise. CSR activities also help enterprises acquire social capital, enabling them to leverage complementary strengths, share operational risks, and improve overall innovation performance. Lastly, CSR enhances organizational management, fostering a culture of innovation and encouraging creativity within the workforce.

Consequently, we propose the first hypothesis of this paper:

Hypothesis H_1: CSR has a positive correlation with firm innovation performance.

While CSR is predicted to facilitate firms' innovation performance, we also explore how CSR influences innovation outcomes. One plausible pathway is through R&D investment, which plays a critical role in transforming CSR efforts into tangible innovation results.

Cook, Romi, Sánchez, and Sanchez (2019) document that CSR enhances firm value by promoting greater investment efficiency and fostering innovation. They also find that firms with higher CSR performance are more profitable and valuable, with consequences partially attributable to efficient investments and innovation. Mithani (2017) documents that R&D investment is the most intensive driving force to persistent superior performance, followed by efforts to the environment, and then, social efforts. According to this view, R&D and CSR can damage firm value if they are improperly aligned, demonstrating the importance of establishing an effective model for their integration. (Chen, Sun, & Gui, 2017) document that more investment expenditure in R&D out of the CSR motivations can lead to cost reductions, improved product quality, and increased consumer satisfaction, thereby strengthening the firm's market position and innovation outcomes.

Based on the arguments above, we conjecture that R&D investment mediates the correlation between CSR and innovation performance. The second hypothesis of this paper is formulated as follows.

Hypothesis H_2: R&D investment mediates the correlation between CSR and innovation performance.

3. RESEARCH METHODOLOGY

3.1. Models

3.1.1. Baseline Model

Hypothesis H_1: CSR has a positive correlation with firm innovation performance.

To explore the correlation between CSR and innovation performance, we set up Model (1) as follows.

$$IP_{i,t} = \beta_0 + \beta_1 CSR_{i,t} + \mu_i Controls_{i,t} + \sum Industry + \sum Year + \varepsilon_{i,t} \quad (1)$$

We use the natural logarithm of the number of patent applications plus one as the dependent variable, proxying for firms' innovation performance (IP), following Dai and Wu (2024). CSR assesses a firm's social responsibility performance, including dimensions of environmental, social, and governance practices. Specifically, CSR value equals the sum of scores assessed by the Stock Exchange of China based on their environmental, social, and governance practices. RDI denotes firms' research and development R&D investment in the given year.

We control leverage (LE), equity ratio (ER), and RC factor (RC) to account for firms' financial condition, since corporate risks can increase managers' willingness to make decisions regarding high-risk innovation activities (Ji & Fan, 2021). We control firm age (AGE) and enterprise growth (GROWTH) to account for firms' life stages, as

firms in different stages have varying propensities for innovation (Coad, Segarra, & Teruel, 2016). Furthermore, we control ownership concentration (FIRST), board independence (INDE), dual position (DUAL), and SOE of property rights (SOE) to account for firms' governance factors, as effective management governance fosters firms' innovation. The specific clarifications of each variable are shown in Table 1.

We run Equation 1 using double-fixed-effect OLS regression. The model incorporates year-fixed effects to account for temporal changes, such as economic cycles or regulatory shifts, and industry-fixed effects to capture sector-specific variations. The error term captures unobserved factors influencing innovation performance. Corporate social responsibility (CSR) positively (negatively) influences innovation performance if β1 turns out to be positive (negative).

3.1.2. Mediating Effect Model

Hypothesis H2: R&D investment mediates the relationship between CSR and innovation performance.

To examine whether R&D investment mediates the correlation between CSR and innovation performance, we set up Model (2) as follows.

$$IP_{i,t} = \beta_0' + \beta_1' CSR_{i,t} + \beta_2' RDI_{i,t} + \mu_i' Controls_{i,t} + \sum Industry + \sum Year + \varepsilon_{i,t}' \quad (2)$$

Model (2) will be examined using the Sobel test. Year and industry effects are fixed in this model. If β1′ is reduced in magnitude or becomes insignificant compared to β1 in Equation 1, this suggests that R&D investment mediates the effect of CSR on innovation performance, as Hypothesis H2 addresses. If β2′ is significant, it confirms that R&D investment directly impacts innovation performance. A complete mediation occurs if β1′ becomes insignificant, while a partial mediation occurs if β1′ is still significant but weaker than in Equation 1. It suggests that R&D Investment mediates the effect of CSR on firms' innovation performance, as Hypothesis H2 addresses.

Table 1. Definitions of variables.

Variables	Definition
Response variable	
IP	Innovation performance. Ln (Number of patent applications in the given year + 1).
Explanatory variable	
CSR	Composite score in the CSR report in the Hexun database.
Mediating variable	
RDI	Ln (R&D investment expenditure).
Control variables	
INDE	Independent director ratio.
LEV	Financial leverage.
SOE	State-owned companies are listed as 1; otherwise, they are listed as 0.
AGE	Difference between observation year and establishment year.
GROWTH	Operating income growth rate.
DUAL	1 If the board chairman and the general manager are the same person; otherwise, 0.
RC	$e^{O-Score}/ (1 + e^{O-Score})$. O-score is the measure of financial risk coefficient, which is computed using the methodology in Ohlson (1980).
FIRST	The first shareholders' share rate.

3.2. Data

We utilize data from Chinese A-share market-listed companies spanning 2011 to 2020, comprising 23,962 firm-year observations. Our sample period began in 2011, when Chinese stock exchanges started requiring A-share listed companies to disclose their social responsibilities in annual financial reports, and ended in 2020 due to the abnormal effects of COVID-19 on data availability. We exclude *ST and ST enterprises because of their different accounting standards. This study uses CSR data obtained from the Hexun website database, while the remaining variables are sourced from the CSMAR database. All continuous variables used in this study are winsorized at the 1st and 99th percentiles to minimize the influence of outliers.

3.3. Summary Statistics

Table 2 provides a general overview of the data's underlying structure by reporting key measures, including the primary variables' mean, standard deviation, and range. The mean value of the dependent variable IP is 3.290, indicating that the average level of innovation performance is 3.290. The mean value of the independent variable CSR is 23.234, suggesting that the average CSR score of Chinese listed corporations is 23.234. RDI's mean value is 17.804, indicating that the average natural logarithm of R&D investment is 17.804.

INDE has a mean of 37.410 and a median of 33.330, indicating that the average independent direct ratio in Chinese listed firms is 37.41%. The mean of LEV is 0.449, suggesting that the average leverage in Chinese listed firms is 44.9%. The binary variable SOE has a mean of 0.42, indicating that 42% of Chinese listed firms are state-owned. The standard deviation is 0.495, reflecting an even distribution between the two categories. The mean age of the sample firms is 17.316 years. The mean growth rate is 0.158, and the standard deviation of 0.408 indicates high variability in growth rates. The binary variable DUAL has a mean of 0.241 and a median of 0.000, with a maximum value of 1.000 and a standard deviation of 0.428, suggesting a lower frequency of occurrence for this variable. The mean value of FIRST is 36.192, indicating that the first shareholders hold an average of 36.19% of the total shares in China.

Table 2. Descriptive statistics (N=23962).

Variable kind	Variable	Mean	Median	Min.	Max.	SD
Dependent variable	IP	3.290	3.611	0.000	7.831	2.038
Independent variable	CSR	23.234	21.340	-4.310	74.420	15.794
Mediating variable	RDI	17.804	17.852	13.033	21.821	1.570
Control variables	INDE	37.410	33.330	0.000	80.000	5.614
	LEV	0.449	0.446	0.072	1.010	0.204
	SOE	0.426	0.000	0.000	1.000	0.495
	AGE	17.316	17.000	2.000	53.000	5.760
	GROWTH	0.158	0.096	-0.621	2.505	0.408
	DUAL	0.241	0.000	0.000	1.000	0.428
	FIRST	36.192	34.520	0.164	89.990	15.076
	RC	0.001	0.000	0.000	0.039	0.005

This table presents the descriptive statistics of the primary variables in this study.

4. RESULTS AND DISCUSSIONS

4.1. Correlation Analysis

4.1.1. Pearson Analysis

The Pearson correlation matrix was used as an essential tool to detect multicollinearity. According to Gujarati and Porter (2004) the variables exhibit a high correlation if their correlation index exceeds 0.80.

Table 3 presents that the Pearson correlation coefficients among all variables are much lower than 0.80, indicating the absence of multicollinearity concerns. Additionally, Pearson's correlation matrix assesses the strength and direction of the linear relationships between the dependent and independent variables. For the primary variable of interest, CSR, the correlations obtained were INDE at 0.117, LEV at -0.044, SOE at 0.135, AGE at -0.081, GROWTH at 0.108, DUAL at -0.067, FIRST at 0.173, and RC at -0.265 at a 1% significance level.

Furthermore, Pearson's correlation matrix suggested significant correlations between CSR, financial constraints, R&D investment, and innovation performance. Innovation performance is crucially associated with CSR at 0.041 at a 1% significance level, indicating an inverse positive correlation between CSR and innovation performance. Innovation performance is also associated with financial constraints at -0.153 at a 1% significance level, implying a significant negative correlation between financial constraints and innovation performance. Additionally, innovation performance is substantially associated with R&D investment at 0.617 at a 1% significance

level, indicating a positive correlation between R&D investment and innovation performance. CSR is also significantly associated with financial constraints and R&D investment at -0.151 and 0.127 at a 1% significance level, respectively. These results reveal a negative correlation between CSR and financial constraints and a negative correlation between CSR and R&D investment.

4.1.2. Variance Inflation Factor Test

The Variance Inflation Factor (VIF) test aims to check the correlation between two or more independent variables. According to Gujarati and Porter (2004) if the VIF value is more than 10, a multicollinearity problem exists. Strong correlations among two or more variables can lead to biased estimators. Table 4 indicates that the mean VIF between the variables used in this study is 1.12, which is well below 10, suggesting there is no multicollinearity issue in this study.

Table 3. Pearson correlation matrix.

Variables	IP	CSR	RDI	INDE	LEV	SOE	AGE	GROWTH	DUAL	FIRST	RC
IP	1										
CSR	0.041***	1									
RDI	0.617***	0.127***	1								
INDE	0.023***	-0.017***	0.039***	1							
LEV	0.034***	-0.044***	0.125***	-0.008	1						
SOE	-0.019***	0.135***	0.049***	-0.063***	0.259***	1					
AGE	-0.048***	-0.081***	0.055***	0.008	0.109***	0.105***	1				
GROWTH	0.018***	0.108***	0.049***	0.003	0.022***	-0.065***	-0.060***	1			
DUAL	0.024***	-0.067***	-0.012*	0.116***	-0.118***	-0.293***	-0.056***	0.021***	1		
FIRST	0.042***	0.173***	0.045***	0.047***	0.012*	0.157***	-0.128***	0.019***	-0.045***	1	
RC	-0.130***	-0.265***	-0.111***	0.015**	0.327***	0.008	0.055***	-0.118***	-0.004	-0.110***	1

Note: ***, **, and *; 1%, 5%, and 10%.

Table 4. VIF of the regression.

Variables	VIF	Tolerance
SOE	1.25	0.80
LEV	1.22	0.82
RC	1.21	0.82
CSR	1.12	0.89
DUAL	1.11	0.90
FIRST	1.08	0.93
AGE	1.07	0.93
GROWTH	1.03	0.97
INDE	1.02	0.98
Mean VIF	1.12	0.83

Note: This result comes from the VIF test using Stata 16.0.

4.2. Regression Results and Discussions

4.2.1. Regression Results

Hypothesis H1: CSR has a positive correlation with firm innovation performance.

This study employed a fixed-effect ordinary least squares (OLS) estimation using panel data to examine the correlation between corporate social responsibility (CSR) and innovation performance. Specifically, innovation performance was specified as the dependent variable. In the given equation, CSR and the control variables are included to test hypothesis H1, while all other parameters mentioned as controls were incorporated as independent variables that remained constant (Gujarati, 2021).

Table 5 shows the baseline linear requirements of this study, which investigates the relationship between CSR and innovation performance. In columns (1) and (2) of Table 5, CSR is positively and significantly associated with IP, with coefficients 0.02 and 0.016. The high t-values (14.68 in column 1 and 11.41 in column 2) reinforce the robustness of this positive relationship. This suggests that CSR initiatives are positively associated with increases in IP, indicating that companies with more substantial social responsibility commitments tend to perform better in innovation performance. The results support Hypothesis H1.

In addition, the results also reveal the correlations between innovation performance (IP) and the control variables. Specifically, the coefficient of INDE (0.002) is not statistically significant (t-value = 0.54). This indicates that board independence does not have a meaningful impact on innovation performance in this model. The coefficient of LEV (2.002) is statistically significant (t-value = 14.42), indicating that leverage has a significantly positive relationship with innovation performance. The results suggest that firms with higher leverage perform better in innovation, implying that debt is an important means for firms to obtain financing to support innovation performance (Giudici & Paleari, 2000). SOE's coefficient (0.253) is significantly (t-value = 4.08), indicating that firms' nature has a significantly positive relationship with innovation performance, implying that state-owned firms perform better in innovation than nonstate-owned firms in innovation activities (Yang, Xingguang, & Kou, 2022).

AGE's coefficient (-0.029) is significant (t-value = -5.43) at a 1% significance level, indicating that AGE negatively affects innovation performance, implying that younger firms perform better than older firms (Coad et al., 2016). GROWTH and DUAL's coefficients are both statistically insignificant (t-value = 0.79 and 0.32, respectively), indicating that firms' growth rate and the current position do not significantly affect firms' innovation performance. As well as, the coefficient of FIRST (-0.004) is significant (t-value = 2.03) at the 5% level, indicating that firms whose first shareholders hold more shares tend to have better innovation performance (Hoskisson, Hitt, Johnson, & Grossman, 2002). The coefficient for RC is -61.285, with a very high negative t-value of -14.82. This strong negative association suggests that higher RC is associated with a significant reduction in innovation performance.

Both columns (1) and (2) include industry and year-fixed effects, controlling for unobserved heterogeneity across industries and over time. The adjusted R-squared values are 0.290 for model (1) without controls and 0.341

for model (1) with controls, indicating that model (1) with controls explains a greater proportion of the variance in innovation performance.

4.2.2. Discussions

According to our results, corporate social responsibility is positively and significantly associated with innovation performance, and this relationship is robust across models without and with controls. The findings are contrary to the literature that documents CSR as against shareholders' benefits in stockholder theory and considers CSR an extra burden to firms' development (Barnea & Rubin, 2010). Our findings support that CSR is favorable to firms' innovation performance, consistent with Luo and Du (2015).

Other factors such as leverage, firm SOE, age, first shareholders' shareholding, and RC also significantly influence innovation performance, highlighting the complex interplay of financial factors in determining innovation performance. Meanwhile, the factors including board independence, growth rate, and current position have no significant effect on innovation performance.

Table 5. Correlation between CSR and firm innovation performance.

Variables	(1) IP	(2) IP
CSR	0.021*** (14.68)	0.016*** (11.41)
INDE		0.002 (0.54)
LEV		2.002*** (14.42)
SOE		0.253*** (4.08)
AGE		-0.029*** (-5.43)
GROWTH		0.027 (0.79)
DUAL		-0.015 (-0.32)
FIRST		0.004** (2.03)
RC		-61.285*** (-14.82)
_cons	-0.248*** (-5.77)	1.830** (2.15)
Industry-fixed	Yes	Yes
Year-fixed	Yes	Yes
Observations	23962	20969
Adjusted R-squared	0.290	0.341

Note: T-statistics are shown in parentheses. Columns (1) and (2) show the results of estimating model (1) without and with controls, respectively. ***, **, and 1%, 5%.

4.3. Robustness Check

4.3.1. Alternative Period

To examine whether the correlation between CSR and IP holds consistently over a shorter and potentially different economic context, this study estimates Equation 1 using a different sample period (2015-2020) compared to the original period (2010-2020).

Table 6 presents the relationship between CSR and IP using a different sample period (2015-2020) compared to the original period (2010-2020). In both columns (1) and (2), the results without and with controls, CSR has a positive and statistically significant impact on IP, with coefficients of 0.021 (t=11.48) and 0.018 (t=9.08),

respectively. These results are consistent with the findings from the broader time frame (2010-2020), reinforcing the conclusion that CSR positively influences innovation performance.

This stability across different sample periods strengthens the evidence that CSR positively contributes to innovation performance, and the relationship is not driven by specific time-related factors in the 2010-2020 range.

Table 6. Robustness test with alternative sample period.

Variables	(1) IP	(2) IP
CSR	0.021*** (11.48)	0.018*** (9.08)
INDE		-0.001 (-0.27)
LEV		2.492*** (15.84)
SOE		0.293*** (4.37)
AGE		-0.025*** (-4.51)
GROWTH		0.044 (0.95)
DUAL		-0.056 (-1.02)
FIRST		0.003 (1.40)
RC		-57.262*** (-11.28)
_cons	0.875 (1.32)	-0.761** (-1.99)
Industry-fixed	Yes	Yes
Year-fixed	Yes	Yes
N	14026	11475
Adjusted R-squared	0.241	0.313

Note: T-statistics are shown in parentheses. Columns (1) and (2) report the results of Equation 1 using a different sample period (2015-2020) without and with controls, respectively. ***, **, 1%, 5%,.

4.3.2. Alternative Measure

In order to make our main results more robust, we use the two subset indicators of environmental responsibility and social responsibility (ES) as a proxy for CSR, establishing the model as follows.

$$IP_{i,t} = \beta_0 + \beta_1 ES_{i,t} + \mu_i Controls_{i,t} + \sum Industry + \sum Year + \varepsilon_{i,t} \quad (3)$$

Table 7 presents regression results analyzing the relationship between IP and CSR using ES as an alternative measure. The results indicate that ES positively affects IP in columns (1) and (2), without and with controls, respectively. The coefficients are 0.028 ($p < 0.001$) in column (1) and 0.017 ($p < 0.001$) in column (2). These findings are similar to those observed when using CSR as the measure, confirming that firms with higher ES scores perform better in innovation. This suggests that the positive relationship with IP remains robust whether CSR is measured through traditional CSR metrics or ES scores.

The robustness check using ES scores as a proxy for CSR confirms that the positive correlation between CSR and innovation performance is robust to the choice of CSR measurement.

Table 7. Robustness test with alternative measure.

Variables	(1) IP	(2) IP
ES	0.028*** (8.80)	0.017*** (5.31)
INDE		0.002 (0.50)
LEV		1.929*** (13.74)
SOE		0.274*** (4.35)
AGE		-0.030*** (-5.39)
GROWTH		0.060* (1.79)
DUAL		-0.025 (-0.52)
FIRST		0.005*** (2.81)
RC		-70.253*** (-16.93)
_cons	-0.114*** (-2.76)	0.374 (0.46)
Indu	Yes	Yes
Year	Yes	Yes
Observations	23962	20969
Adjusted R-squared	0.274	0.331

Note: The table presents the results of the relationship between corporate social responsibility and innovation performance using ES as the alternative measure for CSR. T-statistics are shown in parentheses. The results of Equation 2 estimated without and with controls are presented in Columns (1) and (2), respectively. ***, and * 1% and 10%.

4.3.3. Endogeneity Concerns

We conduct a 2SLS regression using the instrumental variable approach for the test to address sample selection error and endogeneity due to reverse causation. The first-stage regression model is conducted as Equation 4, using the CSRi,t-1 as the instrumental variable, as well as the control variables in Equation 1, are used to obtain predicted values of CSR ($CSR_{i,t}$), which are free from endogeneity biases and can then be used in the second-stage regression analysis. The 2SLS regression using the instrumental variable aims to capture CSR's stable, persistent component, thereby improving the causal interpretation of CSR's impact on innovation performance.

$$CSR_{i,t} = \beta_0 + \beta_1 CSR_{i,t-1} + \mu_i Controls_{i,t} + \sum Industry + \sum Year + \varepsilon_{i,t} \quad (4)$$

Column (1) of Table 8 presents the first-stage results. The coefficient of lagged CSR (0.541, t=94.33) is positive and significant, suggesting that past CSR activities strongly predict current CSR levels. This confirms the relevance of CSRi,t-1 as a strong instrument for CSR. Column (2) reports the second-stage results of the correlation between predicted current CSR and IP. The coefficient on predicted CSR is significantly positive (0.007, t=4.00) at the 1% significance level, indicating that CSR is positively associated with innovation performance. These results are consistent with the baseline findings.

The 2SLS regression confirms a robust correlation between a firm's social responsibility initiatives and innovation outcomes. This also implies that CSR can be a strategic tool to enhance a firm's competitive edge through innovation. The strong instrument relevance indicated by the first stage and the overall significance in the second stage bolster the credibility of these findings, affirming CSR's role in fostering conducive innovation performance.

Table 8. 2SLS regression results: Analyzing the impact of CSR on innovation performance using lagged CSR as an instrument.

	(1)	(2)
	First stage	Second stage
Variables	CSR	IP
L.CSR	0.541***	
	(94.33)	
CSR		0.007***
		(4.00)
INDE	-0.009	0.005*
	(-0.55)	(1.66)
LEV	-0.159	1.007***
	(-0.32)	(12.03)
SOE	1.451***	-0.120***
	(6.94)	(-3.37)
AGE	-0.033*	-0.028***
	(-1.90)	(-9.78)
GROWTH	3.273***	-0.022
	(14.13)	(-0.57)
DUAL	-0.537**	0.085**
	(-2.36)	(2.22)
FIRST	0.054***	0.001
	(8.31)	(1.20)
RC	-570.550***	-60.216***
	(-25.14)	(-14.82)
Constant	8.694***	3.106***
	(11.35)	(23.50)
Observations	16,999	16,999
Adjusted R-squared	0.413	0.026

Note: The table presents the results of the 2SLS regression. ***, **, and *; 1%, 5%, and 10%.

5. MEDIATING EFFECT OF R&D INVESTMENT ON THE RELATIONSHIP BETWEEN CSR AND INNOVATION PERFORMANCE

Hypothesis H₂: R&D investment mediates the correlation between CSR and firm innovation performance.

Equation 2 is examined to verify the mediation role of R&D investment (RDI) as a mediator in the relationship between CSR and IP. The mediation analysis presented in Table 9 evaluates the classic causal steps approach and uses the Sobel, Aroian, and Goodman tests to confirm the significance of mediation. The results indicate that CSR positively affects both R&D investment (a = 0.020, t-value=26.09) and innovation performance (total effect c = 0.015, t-value=17.61). When controlling for RDI, the direct effect of CSR on IP remains positive. However, it is substantially reduced ($c' = 0.003$, $p < 0.001$), suggesting that a large portion of the effect operates indirectly through RDI. The indirect effect ($a \times b = 0.012$, Z=24.90) is significant at the 1% significance level, as confirmed by the Sobel, Aroian, and Goodman tests, all with Z-values exceeding 24.89.

In addition, the proportion of the total effect that is mediated is 0.803, indicating that 80.3% of the total effect of CSR on innovation performance is mediated by R&D investment. This highlights the central role of R&D investment in translating CSR initiatives into innovation outcomes. These findings underscore the strategic value of CSR in fostering innovation, primarily through enhanced R&D activities, thereby aligning social responsibility with innovation-driven performance.

Table 9. Mediation analysis of the effect of CSR on IP through R&D investment.

Variables	(1) IP	(2) RDI	(3) IP
CSR	0.015*** (17.61)	0.020*** (26.09)	0.003*** (4.05)
RDI			0.628*** (83.16)
INDE	0.004* (1.95)	0.004** (2.18)	0.002 (0.91)
LEV	2.050*** (28.79)	2.044*** (33.28)	0.766*** (12.4)
SOE	0.363*** (12.4)	0.250*** (9.91)	0.206*** (8.34)
AGE	-0.019*** (-7.77)	-0.018*** (-8.28)	-0.008* (-3.90)
GROWTH	0.075** (2.32)	0.104*** (3.70)	0.010 (0.38)
DUAL	-0.007 (-0.26)	-0.033 (-1.33)	0.013 (0.55)
FIRST	0.001* (1.74)	0.003*** (4.27)	-0.000 (-0.69)
RC	-58.095*** (-17.97)	-51.313*** (-18.41)	-25.862*** (-9.42)
_cons	1.614*** (3.74)	16.234*** (43.61)	-8.583*** (-22.40)
Industry-fixed	Yes	Yes	Yes
Year-fixed	Yes	Yes	Yes
Observations	16695	16695	16695
Adjusted R-squared	0.211	0.247	0.441
Sobel test	0.012*** Z= 24.90		
Aroian test	0.012*** Z= 24.89		
Goodman test	0.012*** Z= 24.90		
Mediation effect coefficient	0.012*** Z= 24.90		
Direct Effect coefficient	0.003*** Z= 4.05		
Total effect coefficient	0.015*** Z= 17.61		
Mediation effect ratio	0.803		

Note: This table reports the mediation effect of R&D investment on the correlation between CSR and innovation performance, including the Sobel, Aroian, and Goodman tests. ***, **, and *; 1%, 5%, and 10%.

In summary, the results strongly demonstrate that RDI is a significant mediator in the correlation between CSR and innovation performance. The significant indirect effect and the proportion of the total effect mediated suggest that CSR's influence on innovation performance is primarily channeled through R&D activities. Therefore, firms engaging in CSR benefit both directly and indirectly by enhancing their innovation outcomes through increased R&D intensity. This mediation effect underscores the strategic importance of aligning CSR initiatives with R&D efforts to maximize their impact on innovation performance. Consequently, Hypothesis H2 is supported.

6. CONCLUSIONS

Motivated by the critical role of innovation in firms' competitive strategies and sustainable development, this study examines the influence of CSR on firms' innovation performance. Using data from Chinese listed companies between 2011 and 2020, we find that CSR positively influences firms' innovation performance. Our findings remain robust after extensive robustness checks and addressing endogeneity concerns, providing theoretical support for stakeholder theory in the context of firms' development.

This study highlights the critical role of CSR in firms' innovation performance. Consequently, it reminds policymakers to set the required rules for companies to undertake CSR, including economic, social, and

environmental responsibilities. Practitioners should be more concerned with CSR, from the CSR culture, and consider how to improve innovation performance to better meet the demands of relevant stakeholders.

While this study examines the correlation between CSR and innovation performance, the causal links between CSR and innovation performance warrant in-depth investigation in future studies. Additionally, further research on the correlation between ESG and firms' innovation performance could extend the implications of the findings in this study by integrating corporate governance.

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