Corporate social responsibility and corporate innovation efficiency: evidence from China

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Abstract

Purpose – This study aims to analyse the impact of corporate social responsibility (CSR) on corporate innovation efficiency and the mechanism underlying this effect.

Design/methodology/approach – Data of non-financial listed companies operating in China from 2010 to 2019 were employed. Dual fixed-effects and dynamic panel models were used to explore the relationship between CSR and corporate innovation efficiency, and analyse its heterogeneity.

Findings – The researchers found that CSR reduces innovation efficiency in China. Further, (1) when enterprises conduct CSR to obtain excess returns, it is easy to form excess goodwill; (2) under the pressure of the government and society, enterprises passively assume CSR, thereby crowding out R&D funds; and (3) regardless of whether companies in the high-tech industry actively or passively assume social responsibilities, CSR will not have a significant impact on their innovation efficiency.

Research limitations/implications – The sample of this research is limited to Chinese A-share listed companies and lacks consideration for small and medium-sized enterprises. Therefore, whether the conclusions of this article are applicable to small and medium-sized enterprises or family enterprises needs further verification.

Practical implications – The research explores the intrinsic motivation and possible consequences of CSR from the dual perspectives of corporate active and passive.

Social implications – The ultimate goal of a firm is to make a profit. In practice, few enterprises pay without any return. Perhaps some companies actively assume social responsibilities in order to obtain greater benefits, while passively assume social responsibilities due to oppression.

Originality/value – This study analyses the impact of CSR on corporate innovation efficiency from both active and passive perspectives. The results have important implications for government officials and entrepreneurs.

Keywords Corporate social responsibility, Corporate innovation, Innovation efficiency

Paper type Research paper

1. Introduction

In 2019, China was ranked 14th in the Global Innovation Index (GII) (World Intellectual Property Organization, 2019) and fifth in the Innovation Outputs Sub-Index, with the report clearly stating that "China performs better in Innovation Outputs than Inputs". China's total investment in research and development (R&D) that same year was 2.21 trillion yuan (excluding Hong Kong and Macau; roughly 289.3 billion euros), ranking second worldwide (OECD, 2021); enterprises accounted for 76.4% of this value (National Bureau of Statistics of China, 2019). Even as a developing country, China has already adopted innovation-driven development as a national strategy.

In October 2020, the fifth plenary session of the 19th central committee of the Communist Party of China stated that the main goal of social and economic development in the 14th Five-Year Plan period is to achieve sustained and healthy economic development through significant improvements in quality, efficiency and innovation capabilities. As one of the main engines of long-term economic growth, innovation plays a vital role in the development of a nation (Solow, 1957; Asunka et al., 2021). While China's economy has entered a stage of high-quality development, its existing innovation capabilities no longer meet its development needs (Wu et al., 2020). Given the requirements of high-quality economic development, China's future innovations should pay more attention to efficiency.

Corporate innovation efficiency refers to the input–output ratio of innovation activities an enterprise engages in to meet its development needs (Asimakopoulos et al., 2020; Liu et al., 2020). As is well known, innovation is a high-risk and high-yield activity. If it fails, a large amount of early-stage investments will become sunk costs, incurring large losses to the innovation entity. Many scholars believe that increasing the tolerance of enterprises to failure (Manso, 2011; Tian and Wang, 2014) and broadening financing channels (Li et al., 2018) can stimulate enterprise innovation. However, even if innovation is successful, enterprises must still pay a high price for the persistence of managers and injection of funds. As such, ensuring that innovation starts from the source could effectively improve its efficiency, reduce the burden on the enterprise and help the enterprise enter the positive energy cycle of sustained and healthy development.

The World Business Council for Sustainable Development (WBCSD) believes that corporate social responsibility (CSR) represents a company's commitment to sustainable development. This definition is consistent with the main theme of sustainable and healthy economic development in China, and even worldwide. Nevertheless, scholars do not have a unified view regarding the impact of CSR on corporate innovation. On the one hand, some scholars proposed that the fulfilment of various social responsibilities by companies can contribute to corporate innovation by improving employees' sense of occupational security, maintaining stakeholder relationships and obtaining more social capital (Fang et al., 2014; Tian and Wang, 2014). Additionally, several researchers have confirmed the role of CSR in promoting corporate innovation from the perspectives of corporate types, CSR practices and corporate investment (Zhou et al., 2020; Garcia-Piqueres and Garcia-Ramos, 2020; Cook et al., 2019). On the other hand, a few studies have confirmed that if companies actively or passively fulfil their social responsibilities, they will reduce their R&D capital, which will in turn have a negative impact on the scale of corporate innovation (Gallego-Álvarez et al., 2011; Halkos and Skouloudis, 2018). Mithani (2017) proposed that companies' attention towards innovation may be weakened by emphasising CSR.

The two competing views mainly stem from the relationship between CSR and corporate innovation being a direct cause and effect, and not considering the psychological activities of corporate entrepreneurs, such as close political-business relationships or the formation of excess goodwill. Additionally, some scholars considered that there is no significant relationship between CSR and corporate innovation in developing countries (Ullah and Sun, 2021); they only discussed the impact of CSR on corporate innovation and did not consider corporate innovation efficiency. As China advocates for innovation as the core driving force of its economic development, the efficiency of corporate innovation should be emphasised in research. Therefore, this study first examines the impact of CSR on corporate innovation efficiency, then explores the influencing mechanism from the perspective of entrepreneurs' active and passive fulfilment of social responsibilities.

The contributions of this study are twofold. Theoretically, the literature has mostly focused on the impact of CSR on the scale of corporate innovation. A discussion on corporate innovation efficiency, especially in terms of its negative influence, is still lacking. Practically, this study identifies for the first time the internal reasons why companies actively or

passively assume social responsibility, and verifies the two mechanisms by which CSR inhibits corporate innovation efficiency: (1) generating excess goodwill and (2) reducing cash holdings to suppress corporate innovation efficiency.

The remainder of this article is organised as follows. Section 2 reviews the relevant literature and develops the research hypotheses. Section 3 presents the research design. Section 4 details the empirical analysis and testing. Section 5 presents the mechanism analysis, while Section 6 provides the heterogeneity analysis. Section 7 concludes the paper.

2. Literature review and hypotheses development

2.1 Corporate social responsibility

Hitherto, the literature has focused on the positive impact of CSR based on the stakeholder theory, including providing better premiums to target shareholders (Cho *et al.*, 2021), building a good reputation for the company (Zhou and Wang, 2020), creating risk management benefits (Kim *et al.*, 2021), improving corporate profitability (Mughal *et al.*, 2021) and increasing the possibility of obtaining trade credit (Zhang *et al.*, 2020). These studies unanimously believe that CSR can increase corporate profits in various ways, thereby effectively alleviating corporate financing constraints.

Additionally, according to the signalling theory, fulfilling CSRs can also strengthen the CEO's ability to take risks (Dunbar *et al.*, 2020), curb insider trading among executives (Cui *et al.*, 2015) and reduce consumers' retaliation for product failure (Kim and Park, 2020). Therefore, the extant studies imply that CSR has a positive impact on future development, whether at an organisational or individual level. Further, compared with non-family companies, the managers of family companies are more likely to pay attention to CSR, which can significantly benefit family companies (Fehre and Weber, 2019; Nekhili *et al.*, 2017) and elicit a more positive response from the market (Sekerci *et al.*, 2021). Nevertheless, some scholars have pointed out that many companies do not fulfil their social responsibilities as per their original intentions (Lee, 2020). Entrepreneurs with higher social status in China are more likely to assume social responsibilities (Liu *et al.*, 2021a). To further explore the influence of CSR on enterprises, this study uses data on China's A-share listed companies as a sample.

2.2 Corporate social responsibility and corporate innovation efficiency

Current research on CSR and corporate innovation mostly focuses on the scale of corporate innovation, but lacks a discussion on corporate innovation efficiency and the internal psychological activities of entrepreneurs in fulfilling their social responsibilities. The importance of innovation efficiency for the survival and development of enterprises is self-evident for the home country. Many scholars have analysed this issue from multiple aspects, which can be divided into macroscopic and microscopic levels. The existing macro-level research has focused on government subsidies (Hou *et al.*, 2019; Lin and Luan, 2020), the opening of high-speed rails (Huang and Wang, 2020), environmental regulations (Zhang *et al.*, 2021) and other aspects of innovation efficiency. Additionally, many scholars have studied national (Kontolaimou *et al.*, 2016), regional (Faria *et al.*, 2020; Min *et al.*, 2020) and industrial innovation efficiency (Lin and Luan, 2020; Lin *et al.*, 2021). The micro analyses focused on aspects such as employee creativity (Stojcic *et al.*, 2018), gender diversity in R&D teams (Xie *et al.*, 2020), pay gap (Pan *et al.*, 2020) and P2P (peer-to-peer) supply chain financing (Pan *et al.*, 2021a).

Owing to different research subjects and directions, academic circles have different opinions on the measurement of corporate innovation efficiency from the macro and micro levels. Similarly, extant research has not yet provided clear results on whether and how CSR can affect corporate innovation efficiency. Some researchers confirmed that CSR can

significantly promote technological innovation (Bocquet *et al.*, 2017; Ko *et al.*, 2020) and companies with higher CSR performance will generate more patents and patent citations, thereby having a positive impact on the efficiency of corporate innovation (Cook *et al.*, 2019). For example, banks are a type of enterprise whose CSR practices can promote the improvement of technical efficiency (Shahwan and Habib, 2021). This effect is particularly significant in developed countries or those with high levels of investor protection (Belasri *et al.*, 2020). CSR is also an important driving mechanism for enterprises to improve innovation (Martinez-Conesa *et al.*, 2017). As a corporate strategy, CSR can enhance the company's ability to pursue innovative activities in the initial stage of implementation (Broadstock *et al.*, 2020). However, this positive effect is not so evident in emerging countries (Chkir *et al.*, 2021), similar to the view of Belasri *et al.* (2020). Several studies have also shown that companies with higher CSR performance have higher investment efficiency than those with lower CSR performance (Shahzad *et al.*, 2018; Benlemlih and Bitar, 2018).

Considering innovation as a large-scale investment, CSR can also improve enterprise innovation efficiency. Simultaneously, the signal transmission theory believes that effective charitable donation activities can transmit the signal of good financial operations to the outside world, and thereby prevent a company's stock price from being affected by negative events, which will in turn help the enterprise avail future loans and reduce the financing constraints on its innovation activities (Jia *et al.*, 2020). The theory of social capital also holds that assuming part of the social responsibilities of stakeholders can expand the social capital of an enterprise, thereby enhancing its risk-bearing ability and adding guarantees for it to carry out innovation activities. Therefore, we posit the following:

H1. CSR and corporate innovation efficiency are positively correlated.

Moreover, according to the stakeholder theory, in the process of fulfilling social responsibilities, enterprises must not only be responsible for shareholders, employees, suppliers and consumers, but also for the environment and society. The environment is a dimension of CSR. In the case of low environmental commitments, CSR inhibits the improvement of sustainable innovation (Pan *et al.*, 2021b). CSR actions are themselves subject to public scepticism because of increased public awareness in greenwashing and scandalous corporate behaviours (Panwar *et al.*, 2014).

According to the signal transmission theory, companies will participate in charity donations and environmental protection to send positive signals to the public, thereby improving the public's perception of the company. Good CSR performance cannot reduce the financial risks faced by the company. On the contrary, if the company only adopts imitative innovation at this time, it will cause higher financial risks (Liu *et al.*, 2021b). Eventually, some companies with poor financial performance may have had to reduce their investment in R&D because they were forced to assume social responsibilities, which directly affected their innovation input. The decrease in innovation input will inevitably lead to a decrease in innovation output, but the degree of change between the two is affected by multiple factors, which makes it difficult – but not impossible – to maintain consistency. Therefore, a reduction in innovation input will affect corporate innovation efficiency in some way.

Further, the social capital theory states that companies may also use the "big, long-term rewards" strategy as an initiative to assume a little social responsibility to impress the government and society and elicit a positive reaction from them (Lim and Pope, 2021). Kaul and Luo (2018) also pointed out that companies that engage in CSR actions usually receive social support and rewards, such as additional profits. However, this type of company must be a high-performance one and its CSR activities need to be related to its core business; otherwise, the negative impact on the company and society will be negative. The speculative behaviours of some companies not only decrease R&D resources, but also weaken the

company's emphasis on innovation activities, thereby reducing innovation efficiency. Therefore, we posit the following:

H2. CSR and corporate innovation efficiency are negatively correlated.

Table 1 compares the literature on the direct or indirect impacts of CSR on corporate innovation efficiency.

3. Research design

3.1 Sample selection and data sources
Our research sample consists of companies listed on the Shanghai Stock Exchange and the Shenzhen Stock Exchange during 2010–2019. Due to the different nature of financial companies (e.g. banks' debt ratios are extremely high, but their means of profit-making is through loans), we performed further processing on the sample to prevent the research results from being affected by extreme values. We first excluded observations from the finance and insurance industries, as well as observations with several missing values. Next, to reduce the influence of extreme values, we reduced the continuous variables by 1% in both directions in order to reflect the overall situation of the data and improve robustness. Based on this, the unbalanced panel data included 16,913 valid observations.

The data on CSR were obtained from the Hexun CSR report and Rankins CSR ratings (RKS). Considering the integrity of the data, this study used the more complete Hexun data as a benchmark, while the RKS were used for the robustness tests. Other financial, R&D and patent data came from the China Stock Market and Accounting Research (CSMAR) Database, Wind database and the China Research Data Platform (CNRDS).

3.2 Model construction and variable measurement
Based on existing research (Li *et al.*, 2020; Nanda and Rhodes-Kropf, 2013), this study examines the impact of CSR on corporate innovation efficiency using the following model:

$$Inveff_{i,t+1} = \alpha + \beta CSR_{i,t} + \gamma CV_{i,t} + \delta_i + \theta_{j,t} + \varepsilon_{i,t} \tag{1}$$

where *Inveff*$_{i,t+1}$ is an enterprise's innovation efficiency. Since it takes one year before a patent application is finally approved, the method of lagging one period was adopted. Presently, the measurement of innovation in the mainstream literature can be divided into innovation input and innovation output. Innovation input is concentrated on human and capital input (Hall *et al.*, 2008), while innovation output considers enterprise patent applications and authorisation (Tong *et al.*, 2014).

This study combines innovation input and output, which can more reasonably measure corporate innovation efficiency (Kontolaimou *et al.*, 2016; Shen and Zhang, 2018). Additionally, many studies have shown that among the three existing patent types, invention patents are the most innovative. Further, considering that the values of granting a

Type of impact	Extant studies
Indirect or direct positive influence	Zhou *et al.* (2020), Garcia-Piqueres *et al.* (2020), Bocquet *et al.* (2017), Ko *et al.* (2020), Cook *et al.* (2019), Shahwan and Habib (2021), Belasri *et al.* (2020), Shahzad *et al.* (2018), Benlemlih and Bitar (2018), Jia *et al.* (2020)
Indirect or direct negative influence	Mithani (2017), Gallego-Álvarez *et al.* (2011), Halkos and Skouloudis (2018), Panwar *et al.* (2014), Lim and Pope (2021), Kaul and Luo (2018), Pan *et al.* (2021b), Liu *et al.* (2021b)

patent and the R&D investment data of many companies are 0, 1 was added to the original data. After taking the logarithm, the ratio of the logarithmic value $Ln(1+Inv_{t+1})$ of the number of invention patent applications and the number of patents granted to the logarithmic value $Ln(1+RD_t)$ of the company's R&D investment was measured, and expressed as follows: $Inoeff\_Inv_{i,t+1} = Ln(1+Inv_{i,t+1})/Ln(1+RD_{i,t})$. Generally, the higher the efficiency of a company's invention and innovation, the higher the unit cost of R&D converted into invention patents. Further, the sum of the three types of patent applications was used to measure innovation scale, expressed as $Ln(1+Pat_{i,t+1})$; these methods will continue to be used on this basis to measure the overall innovation efficiency of the company as, $Inoeff\_Pat_{i,t+1} = Ln(1+Pat_{i,t+1})/Ln(1+RD_{i,t})$.

The core explanatory variable, $CSR_{i,t}$, refers to CSR, which was mainly taken from a report generated by Hexun.com, which scores the CSR of listed companies according to certain index weights every year. This index can examine the comprehensive performance of a company in fulfilling its social responsibilities and adjust it according to the industry to which the company belongs. For example, in terms of environmental responsibility, which is a first-level indicator, the manufacturing and service industries are set to 30% and 10%, respectively, which is consistent with reality. As is well known, environmental pollution caused by the manufacturing industry is more serious than that caused by the service industry, so it needs to bear a higher level of social responsibility. The evaluation indicators include shareholder responsibilities, employee responsibilities, supplier responsibilities and consumer rights responsibilities, and further consist of two or three levels under the first-level indicators to cover the production and operating activities of a company.

Additionally, according to previous studies (Lee, 2020; Martinez-Alonso et al., 2019), we set the following control variables around the innovation efficiency of enterprises: logarithm of enterprise size (Size), logarithm of operating income (Sale), net profit margin of total assets (net profit/average balance of total assets, RoA), corporate growth (growth rate of total assets at the end of the year, Growth), asset–liability ratio (debt at the end of the year/total assets at the end of the year, Lev), ratio of independent directors (number of independent directors/total number of directors, Indep), the largest shareholder's shareholding ratio (Fshare), urban economic scale (logarithm of regional economic production, GDP) and urban population size (logarithm of the city's population at the end of the year, Popu). Considering that the regional fixed effects of a company's location are likely to be reflected in the company's individual fixed effects, individual fixed effects (δ_i) were also added to the model. Further, $\theta_{j,t}$ is the fixed effect of industry j in year t, thereby controlling for the unobservable factors that change over time at the industry level. The descriptive statistical results for the above variables are presented in Table 2.

4. Empirical analysis and robustness testing

4.1 Impact of CSR on the scale and efficiency of corporate innovation

This study discusses the impact of CSR on the scale of corporate innovation, and then discusses its impact on corporate innovation efficiency. Following the method used in the literature, we used the sum of the three types of patent applications of enterprises to measure the scale of innovation. As some companies have no patent values in a certain year, they cannot be processed logarithmically; therefore, they were represented by $Ln(1 + Pat)$. Innovation efficiency was measured by the ratio of the logarithmic summation of invention patents applied for and granted in $t+1$ year ($Ln(1 + Inv)$ and the three types of patents ($Ln(1+Pat)$) to the logarithm of R&D investment in T-year ($Ln(1 + RD)$).

Table 3 shows the regression results for CSR under the firm's innovation scale and efficiency fixed-effects model. In each column, control variables at the firm and city level were added and year × industry fixed effects were controlled for. The empirical results show that

Variable	Obs.	Mean	Std. dev.	5% ile	95% ile	Min	Max
Dependent variables							
Inoeff_Inv	16,913	0.071	0.065	0.000	0.191	0.000	0.354
Inoeff_Pat	16,913	0.141	0.083	0.000	0.268	0.000	0.454
Ln(*1 + Pat*)	16,913	2.541	1.575	0.000	5.049	0.000	8.75
Independent variable							
CSR	16,913	24.397	16.67	1.678	64.790	−18.45	90.87
Control variables							
Size	16,913	22.08	1.266	20.372	24.452	19.032	27.303
Sale	16,913	21.433	1.453	19.381	24.094	15.932	28.693
Lev	16,913	0.415	0.205	0.103	0.766	0.027	1.025
Roa	16,913	0.042	0.063	−0.050	0.135	−0.517	0.252
Growth	16,913	0.209	0.519	−0.243	0.834	−0.631	7.781
Indep	16,913	0.374	0.053	0.333	0.455	0.286	0.571
Fshare	16,913	0.343	0.146	0.136	0.613	0.083	0.755
GDP	16,913	17.521	1.387	15.108	19.451	12.968	19.605
Popu	16,913	6.393	0.666	5.252	7.274	2.944	8.133

Table 2.
Descriptive statistics

	(1) Measure the scale of corporate innovation by Ln (1 + *Pat*)	(2) Measure corporate innovation efficiency by *Inoeff_Inv*	(3) Measure corporate innovation efficiency by *Inoeff_Pat*
CSR	−0.1889*** (−2.80)	−0.0090*** (−3.11)	−0.0081** (−2.13)
Size	0.2666*** (5.13)	0.0117*** (5.30)	0.0112*** (3.90)
Sale	0.2096*** (5.74)	0.0047** (2.27)	0.0083*** (3.83)
Lev	−0.1201 (−1.08)	−0.0090** (−2.13)	−0.0041 (−0.65)
Roa	0.4252** (2.01)	−0.0063 (−0.69)	0.0236** (1.97)
Growth	−0.0523*** (−3.31)	−0.0019*** (−2.71)	−0.0019** (−2.13)
Indep	−0.2928 (−1.17)	−0.0024 (−0.23)	−0.0161 (−1.13)
Fshare	0.1469 (0.66)	0.0161 (1.63)	0.0070 (0.59)
GDP	−0.0421 (−0.63)	−0.0003 (−0.10)	−0.0027 (−0.69)
Popu	0.2109* (1.79)	−0.0124 (1.48)	0.0108 (1.65)
Individual	Yes	Yes	Yes
Year × Industry	Yes	Yes	Yes
Obs.	16,913	16,913	16,913
Within-R^2	0.1946	0.1498	0.1264

Note(s): The robust standard error for city-level clustering is used in the model and the t-values are in parentheses; *, ** and *** represent significance at the 10%, 5% and 1% levels, respectively

Table 3.
Impact of CSR on the corporate innovation scale and innovation efficiency

the coefficient on CSR in columns (1)–(3) is significantly negative, indicating that the fulfilment of CSR is significantly negatively correlated with corporate innovation efficiency. Taking column (2) as an example, the average value of *Inoeff_Inv* is 0.071. Economically speaking, every 1% increase in the CSR score will reduce corporate innovation efficiency by 0.064% (−0.0090 × 0.071 × 100% = −0.064%); this is consistent with H2. Additionally, the absolute value of 0.0090 of the CSR coefficient in column (2) is greater than that of 0.0081 in column (3), which also coincides with the more innovative nature of the invention patent.

Furthermore, the coefficients on *Size* and *Sale* are both significantly positive at the 1% level, indicating a positive impact on enterprise innovation activities. However, the high levels of *Lev* and *Growth* are not conducive to the improvement of enterprises' innovation efficiency. It is worth noting that regional economic scale and population will not promote the efficiency of corporate innovation.

4.2 Instrumental variable test

Omitted variables and measurement errors are the main sources of endogeneity (Semykina and Wooldridge, 2010). Problems related to omitted variables and measurement errors are very common. In this study, the number of omitted variables was inherently innumerable and could not be fully defined. Further, there were unavoidable errors in the measurement of variables. For example, ability factors could be considered missing variables because they are difficult to measure. Even if there are scales to measure them, there will be deviations.

To minimise bias caused by measurement errors or missing variables and further reduce endogeneity, this study used instrumental variables. Instrumental variables need to meet the assumptions of exogeneity and correlation at the same time: they are exogenous to the explained variable and related to the explanatory variable.

Based on a comprehensive consideration, this study used the shareholder responsibility score (*sha_csr*) as an instrumental variable. This indicator fully considers the profitability, debt servicing level, return dividends and information disclosure of the company. It passed the weak instrumental variable test, which meets the two conditions for an instrument variable to work: relevance and exogeneity. On the one hand, shareholder responsibility is not directly related to corporate innovation efficiency, which satisfies the exogenous requirements. On the other hand, because this indicator is one of the first-level indicators of the CSR scores, it is closely related to CSR, which satisfies the requirement of relevance.

The regression results for the instrumental variables in Table 4 show that the coefficient of CSR is still negative after considering endogeneity, indicating that CSR can significantly inhibit the innovation efficiency of enterprises, which is consistent with the previous results.

4.3 Robustness tests

To further ensure the robustness of the conclusions, we conducted robustness tests by changing the CSR measurement method and sample.

4.3.1 Changes in the CSR measurement method. The CSR data used previously were obtained from Hexun.com, while the data from the RKS were used to test for robustness. There is a slight difference between the two data sources in terms of CSR ratings; RKS is

	(1) Measure corporate innovation efficiency by *Inoeff_Inv*	(2) Measure corporate innovation efficiency by *Inoeff_Pat*
CSR	−0.0168** (−2.19)	−0.0157* (−1.68)
Size	0.0112*** (5.41)	0.0114*** (4.00)
Sale	0.0049** (2.33)	0.0084*** (3.77)
Lev	−0.0094** (−2.18)	−0.0044 (−0.70)
Roa	−0.0007 (−0.06)	0.0292** (2.08)
Growth	−0.0020*** (−2.75)	−0.0019*** (−2.71)
Indep	−0.0020 (−0.20)	−0.0158 (−1.10)
Fshare	0.0161* (1.64)	0.0071 (0.60)
GDP	−0.0005 (−0.17)	−0.0029 (−0.75)
Popu	0.0126 (1.51)	0.0110* (1.67)
Individual	Yes	Yes
Year × Industry	Yes	Yes
Obs	16,913	16,913
Within-R^2	0.1493	0.1261

Table 4.
Regression results of shareholder responsibility as instrumental variables

Note(s): The *z*-values are in parentheses; *, ** and *** represent significance at the 10%, 5% and 1% levels, respectively. Due to the limitation of the number of words, the following tables only report the regression results for the main variables

based on the social responsibility reports issued by listed companies, while Hexun.com focuses on CSR performance. RKS ranks listed companies' social responsibility reports based on four major aspects: integrity, content, technicality and industry. Among them, there are approximately 80 second-level indicators and 200 third-level indicators, which have certain significance. Considering that the differences in the RKS social responsibility reports is mainly reflected from the industry (*CSR_ind*) aspect, this indicator was adopted as a proxy for CSR.

The regression results are shown in columns (1)–(2) of Table 5. Since most companies did not actively disclose their CSR reports, the sample size dropped sharply to 22.87%. Even in this case, CSR still has a negative impact on corporate innovation efficiency, which is consistent with the previous conclusion.

4.3.2 Companies with zero innovation efficiency. China's A-share listed companies have a wide range of operations. In addition to manufacturing companies that require higher innovation, there are also companies that need less innovation, such as those in consumer, service and public utility industries. Some companies have never applied for patents or invested in R&D during the sample period. Even if such companies fulfil their social responsibilities, doing so will have no impact on their innovation efficiency. These observations reduce the reliability of the regression results. To eliminate this interference as much as possible, we excluded the enterprises with zero innovation efficiency to ensure robustness.

The regression results are shown in columns (3)–(4) of Table 5. After excluding the companies that have never carried out innovative activities, CSR still has a restraining effect on innovation efficiency, which is consistent with the previous conclusions.

5. Impact mechanism analysis
The study concludes that CSR has a negative impact on corporate innovation efficiency. To further investigate the mechanism of the impact, this study analysed the formation of excess

Based on the rankins CSR ratings	(1) Measure corporate innovation efficiency by *Inoeff_Inv*	(2) Measure corporate innovation efficiency by *Inoeff_Pat*
CSR_ind	−0.0014* (−1.90)	−0.0012* (−1.74)
Control variables	Yes	Yes
Individual	Yes	Yes
Year × Industry	Yes	Yes
Obs	3,869	3,869
Within-R^2	0.1831	0.1570

Excluding companies with zero innovation efficiency	(3) Measure corporate innovation efficiency by *Inoeff_Inv*	(4) Measure corporate innovation efficiency by *Inoeff_Pat*
CSR	−0.0079*** (−2.91)	−0.0054* (−1.69)
Control variables	Yes	Yes
Individual	Yes	Yes
Year × Industry	Yes	Yes
Obs	11,659	11,659
Within-R^2	0.1531	0.1331

Table 5.
Robustness test

goodwill (*excess*) and the reduction in cash holdings (*cash*) from the dual perspective of enterprises' active and passive social responsibility.

5.1 Impact of CSR on excess goodwill

As legal entities whose ultimate goal is to make profit, enterprises carry out various activities around their economic interests, including innovation investment and charity. For innovation investment, the cycle of innovation activities is long and uncertain. However, once the innovation is successful, enterprises can become more competitive, earn excess income and even form a monopoly. As for charity, it is undeniable that the main focus of enterprises is the pursuit of their own goals. Even if a small number of enterprises take the initiative to undertake social responsibility, only a few make truly charitable contributions without any other ulterior motives.

In China, corporate charitable donations are tax-deductible. Enterprises sacrifice their short-term interests in exchange for recognition to benefit from the government's public bidding procurement and the public's daily consumption, gradually improve the social status of entrepreneurs, increase the stock price and indirectly earn income far beyond the previous investment. This explains why entrepreneurs with higher social status are more willing to undertake social responsibility in China. The person in charge or the majority of board members in such enterprises firmly believe that good is rewarded by good. In the long run, enterprises are prone to generating expectations for their own excess profits and gradually form excess goodwill. At this time, regarding the ratio of input to return, enterprises may shift the focus of their operations from R&D to the stock market, which not only results in poor planning and insufficient support for their innovation activities, but also reduces their innovation efficiency.

Based on Wei and Zhu (2019), this study used the difference between actual goodwill and expected reasonable goodwill as a proxy for excess goodwill, which is expressed as follows:

$$Exc\_sca_{i,j,t} = \alpha + \beta Exc\_ave_{i,j,t} + \chi Controls + \delta\mu_j + \phi\nu_t + \varepsilon_{i,j,t} \quad (2)$$

where *Exc_sca* represents the goodwill scale of company i in industry j in year t and *Exc_ave* is the average goodwill scale of industry j except i in year t. Control variables fully consider a series of indicators, such as M&A characteristics, company characteristics, industry goodwill level, and industry and annual dummy variables, while v_t and μ_j are the fixed effects of year and industry, respectively. Excess goodwill is the residual after regressing the level of corporate goodwill. On this basis, excess goodwill (*Excess*) and its interaction with CSR were introduced into the model to further investigate the influence of CSR on corporate innovation efficiency.

The regression results are shown in Table 6. In column (1), the coefficient of CSR is significantly positive, indicating that CSR significantly improves excess corporate goodwill. In columns (2)–(3), the interaction coefficient between CSR and corporate excess goodwill is significantly negative, which indicates that CSR leads to an increase in excess goodwill, which has, in turn, a negative impact on corporate innovation efficiency.

5.2 Impact of CSR on cash holdings

Maintaining innovation activities can be a burden for most firms, while also bear a huge risk of innovation failure. Considering the close relationship between government and business in China, some local governments may require enterprises to participate in various poverty alleviation and charity activities to ease the worries and difficulties of the government and society. Enterprises are forced to fulfil their social responsibilities, which not only crowds out capital that could be used for R&D but also increases the difficulties of

Formation of excess goodwill	(1) Excess	(2) Measure corporate innovation efficiency by *Inoeff_Inv*	(3) Measure corporate innovation efficiency by *Inoeff_Pat*
CSR	0.0071** (1.99)	−0.0137 (0.08)	0.0027 (0.17)
Excess		−0.0084*** (−2.88)	−0.0091** (−2.31)
CSR × Excess		−0.1307* (−1.84)	−0.1123** (−2.15)
Control variables	Yes	Yes	Yes
Individual	Yes	Yes	Yes
Year × Industry	Yes	Yes	Yes
Obs	16,508	16,508	16,508
Within-R^2	0.1629	0.1514	0.1280

Reduction in cash holdings	(4) Cash	(5) Measure corporate innovation efficiency by *Inoeff_Inv*	(6) Measure corporate innovation efficiency by *Inoeff_Pat*
CSR	−0.0177*** (−2.82)	0.0004 (0.08)	−0.0001 (0.05)
Cash		0.0032 (0.49)	−0.0044 (−0.44)
CSR × Cash		−0.0484** (−2.31)	−0.0423* (−1.66)
Individual	Yes	Yes	Yes
Year × Industry	Yes	Yes	Yes
Obs	16,913	16,913	16,913
Within-R^2	0.2413	0.1493	0.1247

Table 6.
Mechanism analysis

enterprises in the "cash is king" era. As a result, enterprises lack funds to carry out innovation activities.

In China, the operating conditions of most companies are not optimistic, and large cash holdings is their greatest guarantee of survival. On the one hand, CSR reduces the cash holdings of a company, forcing it to reduce R&D investment to ensure normal operations. Although a firm's innovation outputs decrease due to less inputs, it does not necessarily mean that its innovation efficiency also decreases (Xu and Chen, 2020). This situation is more likely to occur in the short term. Due to the hysteresis effect of innovation activities, the reduction in the long-term innovation input of enterprises will inevitably lead to a more serious decline in innovation output, which will in turn have a severe impact on innovation efficiency.

On the other hand, CSR is conducive to building a good reputation and making it easier to obtain finances (Zhou *et al.*, 2020); however, a good reputation requires long-term accumulation and persistence. Companies should thus consider how to survive before they assume social responsibilities. When a company performs CSR recklessly to obtain more financing, it ignores that innovation is the foundation of its survival, leading to a serious reduction in its cash holdings and R&D investment. In general, the innovation output of such enterprises can become more prone to being severely affected, and their innovation efficiency can also fall precipitously. This study used the sum of monetary capital and trading financial assets divided by total assets to measure cash holdings (*cash*), and introduced the interaction between *cash* and *CSR* into the model to further investigate the mechanism underlying the effect of CSR on corporate innovation efficiency.

The regression results are listed in Table 6. In column (4), the coefficient of *CSR* is significantly negative, indicating that CSR significantly reduces corporate cash holdings. In columns (5)–(6), the interaction coefficient between *CSR* and *cash* is significantly negative, which indicates that CSR leads to a reduction in corporate cash holdings, thus inhibiting innovation efficiency.

6. Heterogeneity analysis

6.1 Regional heterogeneity

Considering China's vast territory and uneven distribution of resources, there are huge differences in climate, living habits and cultural customs between the South and North; thus, business environment and behaviour style differ with regional characteristics. More than half of China's 3,000 listed companies are located in the eastern region, while the rest are in the central and western regions.

To determine whether CSR has a heterogeneous effect on enterprises located in different regions, the sample was divided into eastern enterprises and central and western enterprises based on their locations. Columns (1)–(4) of Table 7 show the results for the subsample regression. In columns (1) and (3), regardless of whether innovation efficiency was measured by *Inoeff_Inv* or *Inoeff_Pat*, the estimated coefficient of CSR is significantly negative in the eastern region, but not significant in the central and western regions. This may be because, compared to the central and western regions, the economic prosperity of the eastern region is conducive to speculation by enterprises, meaning enterprises' active performance of social responsibility can thus easily form excess goodwill. By contrast, the relationship between the government and businesses in the prosperous eastern region is more complex; here, enterprises passively assume social responsibility, reducing R&D resources.

Regional heterogeneity	Measure corporate innovation efficiency by *Inoeff_Inv*		Measure corporate innovation efficiency by *Inoeff_Pat*	
	(1) East area	(2) Midwest area	(3) East area	(4) Midwest area
CSR	−0.0078*** (−2.69)	−0.0091 (−1.32)	−0.0092** (−2.00)	−0.0046 (−0.63)
Control variables	Yes	Yes	Yes	Yes
Individual	Yes	Yes	Yes	Yes
Year × Industry	Yes	Yes	Yes	Yes
Obs	12,323	4,590	12,323	4,590
Within-R^2	0.1503	0.1827	0.1399	0.1530

Industrial heterogeneity	(5) High-tech industry	(6) Non-high-tech industry	(7) High-tech industry	(8) Non-high-tech industry
CSR	−0.0021 (−0.36)	−0.0114*** (−3.51)	−0.0062 (−0.98)	−0.0070* (−1.71)
Control variables	Yes	Yes	Yes	Yes
Individual	Yes	Yes	Yes	Yes
Year × Industry	Yes	Yes	Yes	Yes
Obs	5,460	11,453	5,460	11,453
Within-R^2	0.2390	0.1164	0.1853	0.1243

Property rights heterogeneity	(9) State-owned	(10) Non-state-owned	(11) State-owned	(12) Non-state-owned
CSR	−0.0081* (−1.74)	−0.0083** (−2.22)	−0.0040 (−0.62)	−0.0138*** (−3.12)
Control variables	Yes	Yes	Yes	Yes
Individual	Yes	Yes	Yes	Yes
Year × Industry	Yes	Yes	Yes	Yes
Obs	5,541	11,372	5,541	11,372
Within-R^2	0.1770	0.1456	0.1630	0.1240

Table 7.
Analysis of heterogeneity

6.2 Industrial heterogeneity
Compared to wholesale, retail, catering and other traditional industries, the manufacturing industry, especially the high-tech industry, has more stringent requirements for corporate innovation. As the high-tech industry is knowledge- and technology-intensive with fast-evolving products, enterprises cannot survive in a competitive market without focussing on continuous innovation. As such, to further explore the heterogeneous effect of CSR on corporate innovation efficiency in different industries, this study analyses manufacturing enterprises by dividing the equipment manufacturing industry into high-tech and non-high-tech industries.

Columns (5)–(8) in Table 7 report the results for the subsample regression. In columns (6) and (8), irrespective of whether innovation efficiency was measured by *Inoeff_Inv* or *Inoeff_Pat*, the estimated coefficient of *CSR* is significantly negative in non-high-tech industries, but negative and insignificant in high-tech industries. The reason may be that, compared to non-high-tech industries that can operate sustainably without innovation, high-tech industries rely on unremitting innovation to survive.

Therefore, whether high-tech companies actively assume social responsibilities for the formation of excess goodwill or passively assume them for building a good government-enterprise relationship, these behaviours are less important than the survival of the company. This explains why the impact of CSR on innovation efficiency is not significant in the high-tech industry.

6.3 Heterogeneity of property rights
Owing to the differences in enterprise property rights, there are also significant differences in the mentality of entrepreneurs when they fulfil social responsibilities. Undeniably, state-owned enterprises (SOEs) and the government are inextricably linked—the development of SOEs depends on support from the government. It is thus reasonable that SOEs also need to alleviate government pressure, which is why they undertake social responsibility. However, for private enterprises, foreign-funded enterprises and joint ventures, development mostly depends on the efforts of entrepreneurs. Therefore, in practice, if there are no government or legal requirements, most entrepreneurs may not be willing to fulfil their social responsibilities to avoid increasing operating pressure.

This study divided the entire sample into SOEs and non-SOEs. Columns (9)–(12) of Table 7 show the results for the subsample regression. In columns (10) and (12), the estimated coefficient on *CSR* is significantly negative for non-SOEs, regardless of whether it was measured by *Inoeff_Inv* or *Inoeff_Pat*. While the estimated coefficient of *CSR* in SOEs is negative, its significance level is far lower than that in non-SOEs, indicating that non-state-owned enterprises' social responsibility has a greater negative impact on corporate innovation efficiency.

There are two reasons for this. First, compared to state-owned enterprises, which are strongly supported by the government, most non-state-owned enterprises only obtain finances through entrepreneurial networks and the market prospects of their products; as their connection with the government is weak, the enterprise's own capital must be eroded to undertake additional social responsibilities. The second reason is the mentality of entrepreneurs. State-owned enterprises use government capital to solve government problems, while non-state-owned enterprises use private capital. State-owned enterprises can bear social responsibility at a loss, while non-state-owned enterprises must shoulder the costs on their own.

7. Conclusions and implications
Companies are encouraged to undertake social responsibilities such as charitable donations, green production and labour absorption, because they are beneficial to the government and

the public. While the positive impact of CSR has been confirmed from different perspectives, the original intention of establishing a company is still to earn profit. For most companies, their operating conditions are not ideal, as it is difficult to maintain innovative activities. Further, CSR will put significant pressure on business operations in the short term. Of course, similar to the concept of innovation input, some companies are willing to undertake CSR at the expense of short-term benefits for long-term gains in terms of profit. The difference is that CSR is more beneficial to the government and the public, and successful innovation not only helps the company's own development, but also promotes social progress.

This study considers China as a background, proving that the fulfilment of social responsibilities by enterprises significantly reduces the efficiency of corporate innovation. We found that (1) when an enterprise actively assumes social responsibility to increase profits, it is easy to form excess goodwill, which can weaken the company's emphasis on R&D activities and have a negative impact on innovation efficiency; and (2) being forced to passively take social responsibility under the government and being under social pressure can reduce the company's corporate cash holdings, R&D funds and corporate innovation efficiency. The heterogeneity analysis showed that the effect of CSR on corporate innovation efficiency is more pronounced in enterprises located in China's eastern region, non-high-tech industries and non-state-owned enterprises.

Based on the relationship between CSR and corporate innovation efficiency in China, it can be concluded that CSR can reduce corporate innovation efficiency from both the active and passive perspectives. On the one hand, while the government promotes public interest, social equality and CSR, it also needs to reduce the burden on enterprises by, for example, reducing taxes or government subsidies. Meanwhile, the government should establish the awareness of serving enterprises, as well as strengthen the supervision of officials and formulate targeted measures. For example, SOEs should assume more CSR than non-SOEs. On the other hand, companies must carry out activities related to public welfare and charity according to their original intentions, which are based on their own financial strength. The most practical way to undertake social responsibility is for corporate leaders and directors to establish ethical values and operate with integrity, focussing on their own products and services.

7.1 Contributions and limitations

The contributions of this research are mainly reflected in the following two aspects. Theoretically, this article enriches the relevant literature on CSR and broadens the field of corporate innovation by revealing the mechanism by which CSR inhibits innovation efficiency. Practically, this study identifies the internal reasons why companies actively or passively assume social responsibility, and verifies the two mechanisms by which CSR inhibits corporate innovation efficiency.

Since the sample of this study includes listed companies in China, whether our conclusions are applicable to SMEs or family businesses remains to be further discussed. In addition, our research has not yet paid attention to the non-linear impact of CSR on corporate innovation, which also points out the direction for our future research.

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