

Research on Impact of Enterprise Innovation Capability on Corporate Social Responsibility in Era of Big Data

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Abstract: The healthy development of an enterprise promotes the development of the whole society. At the same time, innovation ability is one of the important factors for enterprises to obtain core competitiveness. In the long-term and stable development of enterprises and society, the innovation ability of enterprises and the fulfillment of social responsibilities play a crucial role. First of all, on the basis of understanding the background and current situation of corporate social responsibility management in the era of big data, this paper focuses on government subsidy policies in the era of big data to study the relationship between improving corporate innovation ability and strengthening corporate social responsibility performance. Secondly, this paper makes use of the data of 500 enterprises from 2016 to 2020 by quantitative analysis and empirical analysis. The results show that there is a positive correlation between innovation capability and Corporate social responsibility, and government subsidies positively regulate the impact of innovation capability on corporate social responsibility. Finally, based on the above conclusions, this paper puts forward the following suggestions for economic development: First, enterprises should realize that R&D investment and economic benefits should be equal, and both are the top priority of economic development. Second, companies must actively maintain investment in research and development, using digital technologies such as the Internet, the Internet of Things and big data for front-end and back-end development. Third, to further stimulate the internal vitality of enterprises, the government needs to maintain tax reduction and exemption policies for high-tech enterprises, especially small and medium-sized enterprises.

Keywords: Big Data, Innovation, Corporate Social Responsibility, Government Subsidy

1. Introduction

With the in-depth development of the information technology revolution, big data is used broadly to bring convenience to people's lives and provide a new direction for enterprise management. From macro government management to micro enterprise management, big data has promoted a qualitative change in management. In order to use information technology, the government has introduced policies on tax and fee reduction for high-tech companies. The emergence and rapid development of big data technology make it more possible for the production and operation of enterprises to be presented on multiple platforms through information channels. Stakeholders of enterprises

easily excavate, refine and apply the potential data records. Enterprises cannot reverse the trend of development, but need to take the initiative to adapt to the new living environment by using big data technology to improve the core competitiveness of enterprises. Using big data technology strengthens the innovation ability, and accurate analysis of corporate social responsibility information for enterprises to regulate and control the social impact. Businesses through the data analysis improve corporate social responsibility fulfillment degree has great influence.

In recent years, the research on the relationship between corporate innovation and social responsibility has attracted the attention of scholars. For the research of innovation ability and social responsibility fulfillment, scholars have different measurement standards for innovation ability. Many

scholars believe that there is an inverted U-shaped relationship between R&D investment and social responsibility. When government subsidies are included as a moderating variable, few scholars study the relationship between them. This paper will focus on these variables to carry out research, such research will be helpful to explore the ways and means of enterprises to better play their social responsibilities in the era of big data. We can also further explore the role and use of government subsidies for the economic development of enterprises.

2. Literature Review

2.1. Research on Enterprise Innovation Ability and Social Responsibility

Scholars have studied the relationship between R&D investment and corporate social responsibility from both theoretical and empirical perspectives. Scholars believe that increasing R&D investment and other innovative activities have a positive impact on corporate social responsibility. More scholars emphasize that entrepreneurs must take technological innovation as their social responsibility. That is, social responsibility needs to be integrated into technological innovation. Carlotto [1] found that enterprises reduce material loss and improve the efficiency of resource use through technological innovation, thus reducing environmental pollution and increasing corporate social responsibility. Zhang [2] points out that enterprises increase R&D investment to achieve a different strategy in fulfilling social responsibility. For example, cost-effective products or services promote the quality of enterprises' social behaviors. Scholars have also empirically studied the relationship between different levels of social responsibility and R&D investment and defined the three levels of social responsibility: monetary capital layer, human capital layer, and social capital layer. All have a positive impact on R&D investment. Zhu [3] believes that social responsibility and R&D investment are mutually mediating, and this benign relationship is beneficial to enterprises to improve their long-term performance. Love J H, Ganotakis P [4] conducted a regression analysis on the panel data of more than 1,000 enterprises in the past 10 years and showed that R&D investment had a more significant impact on CSR in the manufacturing industry. In the manufacturing industry, high-risk enterprises showed a more significant conclusion. Zhang [5] took more than 3000 American listed companies from 2001 to 2011 as samples and found that enterprise innovation would promote the fulfillment of corporate social responsibility. Liang [6] showed that there is a certain positive relationship between R&D intensity and social performance, and this relationship is more obvious in private enterprises than state-owned enterprises based on 1132 groups of observational data from 493 listed companies in China. Another point of view in domestic research is that the fulfillment of corporate social responsibility positively affects the innovation activities of enterprises, which are also reflected in the R&D expenditure of enterprises. Wang and

Zhang [7] concluded that the negative fulfillment of corporate social responsibility has an inhibiting effect on the innovation of pharmaceutical companies.

2.2. Research on Government Subsidies

Government subsidy refers to the behavior that the government and other departments transfer free economic benefits to specific objects through certain channels in order to achieve specific goals, and its core feature is non-compensation. On the basis of consulting relevant literature, it is found that many scholars have analyzed government subsidies and divided them into direct subsidies and indirect subsidies according to the different ways of subsidies [8].

Government subsidies play a moderating role in the correlation between enterprise innovation and its development. However, scholars have not conducted in-depth studies on this issue, focusing on the relationship between government R&D subsidies and R&D input. According to the research views of Li and Cui [9], there are two kinds of effects of government subsidies on enterprise R&D investment. The first effect is incentive effect, and the second effect is crowding out effect. On the basis of in-depth research, it is pointed out that subsidies by the government are conducive to improving the enthusiasm of enterprises' R&D investment, which has a positive effect on the increase of enterprises' R&D investment, and can significantly alleviate the problem of insufficient funds in R&D, so as to improve the technological innovation ability of enterprises and provide effective guarantee for the development of enterprises. However, Lv Jiuqin [10] and other scholars emphasized that government subsidies would have a certain crowding out effect on enterprises' R&D investment. Some local officials lack a correct understanding of the law of enterprise innovation and provide R&D subsidies only to meet relevant indicators, which leads to rent-seeking behaviors of enterprises and investment of government subsidies in short and quick projects. However, some scholars have proposed that the relationship between government R&D subsidies and enterprise R&D input is nonlinear and has an inverted U-shaped feature. By establishing and improving the government subsidy mechanism and formulating clear assessment requirements for enterprises, enterprises can continuously improve the R&D process and management mechanism, reasonably integrate and utilize R&D resources, and meet the requirements for high-quality development of enterprises. In order to ensure the proper use of government subsidy funds, the government will play a role in the R&D decisions of enterprises, which will have a negative impact on resource allocation and thus trigger whole social changes. At the same time, there is no definitive conclusion at this stage on whether government subsidies are helpful to the improvement of CSR. Sheng Liying [11] found that there is an inverted U-shaped relationship between government subsidies and CSR, that is, increasing government subsidies can promote the fulfillment of heavy polluting enterprises'

social responsibilities. When government subsidies meet certain standards, Whether the restriction effect of government subsidies on CSR fulfillment is significant.

3. Theory and Hypotheses

3.1. Corporate Innovation Capability and Corporate Social Responsibility

In the era of big data, the performance of corporate social responsibility depends on the level of enterprise development. The key to the rapid development of enterprises lies in innovation ability and innovation quality. Innovation ability is also a powerful tool for many high-tech enterprises relying on big data technology. From the internal point of view, the realization of technological progress through R&D expenditure relieves employees' work pressure, improves work efficiency, and reduces production costs and the occurrence of accidents in special industries. Technology also improves the competitiveness and brand awareness of enterprises in the same industry and increases stock returns and operating profits so that the interests of shareholders are guaranteed. Externally, for consumers, technological progress is conducive to improving product quality and realizing product differentiation to meet consumers' different preferences. For the environment, technological progress optimizes the efficiency of resource use and reduces the environmental pollution caused by economic development. For society, technological progress improves the comprehensive strength of a country and brings convenience to people's life. Corporate social responsibility is divided into internal responsibility and external responsibility. Internal responsibility contains economic responsibility and legal responsibility [12]. Innovation-driven enterprises effectively improve the technical level of enterprises and the total factor productivity and innovation quality of enterprises. This transformation provides a foundation for enterprises to better fulfill their social responsibility. Enterprises improve product quality through R&D and innovation. Products and services are available to all consumers, but the quality must be guaranteed. Enterprises better fulfill their economic responsibilities which refer to environmental responsibility and charitable responsibility. Enterprises need to reduce their negative externalities in production and decouple their business expansion from environmental pollution, namely environmental responsibility. Charitable responsibility refers to the enterprise's profit returning to society and enhancing its reputation. Therefore, we propose hypothesis 1.

Hypothesis 1: In the era of big data, an enterprise's innovation ability is positively correlated with its social responsibility, the stronger the innovation ability of a big data enterprise is, the more corporate responsibility it will assume.

3.2. Moderating Role of Government Subsidies

More high-tech enterprises enjoy the preferential policy of taxes and fees. There are additional tax credits and other policies for small and medium-sized high-tech companies. In

addition, enterprises establish or maintain political connections to obtain a favorable environment or conditions for loans, tax rates, licenses to operate in government-controlled industries, and even financial subsidies. In the innovation of enterprises, government subsidies reduce a lot of pressure on enterprises in the capital. In general, the profit ability of enterprise in the process of corporate social responsibility has strong maneuverability and selectivity. However, profitability is weakened, and even operating losses of the current period in the face of the enterprise bear the social responsibility. Its primary responsibility is to "turn the deficit into profit", rather than bear the excessive social burden reluctantly [13]. In addition, to improve the competitiveness of regional enterprises and the political performance of local governments, the government also provides financial subsidies to enterprises with losses, rather than interfering in the business activities of enterprises and blindly encouraging enterprises to undertake social tasks. In favorable circumstances, government subsidies help enterprises save costs and focus on production with the important links of enterprises. In the unfavorable situation of enterprises, government subsidies help enterprises bear the social burden when necessary. Therefore, we propose hypothesis 2:

Hypothesis 2: In the era of big data, government subsidies are positively regulating enterprises' innovation ability and corporate social responsibility.

4. Empirical Estimation

4.1. Data and Methodology

In this study, a-share listed companies in Shanghai and Shenzhen were included. Global social responsibility rating and released corporate social responsibility reports from 2016 to 2020 were selected for collecting samples. Panel data were used to test the relationship between enterprise innovation capability, corporate social responsibility, and the moderating effect of government subsidies. In order to ensure the reliability of the data and the credibility of the results, the data were processed as follows. The companies were selected with "science and technology" in the enterprise name. Companies with incomplete samples or abnormal data were excluded. The data of 500 companies in five years (2016–2020) were obtained after excluding the data of ST, *ST, and other companies under abnormal trading conditions. Excel 2013 and Stata 14.0 were used for the analysis. Then descriptive statistics were carried out to understand the situation of the data studied in this paper. The relationship between variables was initially understood through correlation analysis, and the multicollinearity test by VIF test was conducted to verify whether there was a high degree of multicollinearity between variables. Finally, the model was estimated, the relationship between variables was verified, and the interaction item analysis was carried out. To understand the regulatory role of government subsidies, and finally get the research conclusion of this paper.

4.2. Variable Definitions

4.2.1. Corporate Social Responsibility

We selected the total score of the "Social responsibility of listed Companies" rating system of the Hexun network from 2010 to 2020. The social responsibility index of the rating system is divided into five first-level indicators: shareholder responsibility, customer and consumer responsibility, supplier and employee responsibility, environmental responsibility, and social responsibility. In order to ensure the scientific and integrity of the measurement of social responsibility of all A-share listed companies in Shanghai and Shenzhen, the first-level indicators are divided into second-level and third-level indicators. The second-level indicators contain 13 questions, and the third-level indicators contain 37 questions. This index system is recognized and used by many domestic scholars [14]. Therefore, we used this data for the measurement index of CSR.

4.2.2. Innovation Ability

It is difficult to find an index that fully reflects the

technological innovation of enterprises. The commonly used indicators represent the R&D expenses of innovation input and the ratio of R&D expenditure to operating income, the number of patent applications/authorizations, and the sales revenue of new products. This research does not involve innovation efficiency. For the protection of the enterprise, we used "R&D spending/operating income" as a variable measure standard [15]. The more R&D investment, the stronger the technological innovation capability of the enterprise.

4.2.3. Government Subsidies

Government subsidies data was collected from the financial statements of listed companies. The information on government subsidies of listed companies is disclosed under the item of "non-operating income" in the annual reports of listed companies. The sources and types of government subsidies are disclosed in detail every year. We determined each subsidy obtained by enterprises in the current year through the screening of subsidy items in the annual financial report.

Table 1. Variable definition.

Variable types	Variable name	symbol	Variable definitions
The dependent variable	Corporate social responsibility	Csr	Total score of hexun.com
The independent variables	innovation ability	Ct	Ln (Annual R&D Expenditure)
moderator variable	government subsidies	Trea	Corporate financial statements
	enterprise scale	Size	Ln (Total assets of the Company)
Control Variables	Enterprise age	Age	The number of years an enterprise has been listed
	Ownership structure	Soe	State-owned enterprises =1, otherwise =0

4.3. Measures

Table 2 lists the statistical characteristics and correlation coefficients of all variables in this study. The results show that the standard deviations of all variables are obvious, indicating significant heterogeneity among variables. In the sample data used, the minimum value of CSR is -12.74, and the maximum value is 80.32. The score span is large with a mean value of 24.03. The standard deviation is only 15.32, indicating that the CSR fulfillment degree of the 500 high-tech enterprises is generally not high. The average CT value is 18.18 and the standard deviation is 18.33, indicating that the innovation ability of the sample enterprises is generally low.

Table 2. Descriptive statistics.

variables	N	mean	sd	min	max
csr	2499	24.03	15.32	-12.74	80.32
ct	2499	18.18	1.770	7.720	23.42
size	2500	22.65	1.340	11.56	27.33
age	2500	16.67	5.990	0	30
soe	2500	0.300	0.460	0	1
trea	2500	0.180	0.390	0	1

Table 3 lists the correlation statistical analysis of the research variables. The results show that CT is positively correlated with the explained variables at the 1% level ($P < 0.01$), which preliminarily supports hypothesis 1. The

adjustment variable is positively correlated with the explained variable at the level of 1% ($P < 0.01$), and the correlation coefficients of other control variables are less than 0.5, indicating that there is no obvious multicollinearity problem between variables.

Table 3. Collinearity analysis.

	Csr	Ct	Size	Age	Soe	Trea
Csr	1					
Ct	0.277***	1				
Size	0.394***	0.600***	1			
Age	0.004	-0.0150	0.117***	1		
Soe	0.108***	0.0100	0.165***	0.206***	1	
Trea	0.104***	0.066***	0.076***	0.052***	0.495**	1

Note: *, ** and *** are statistically significant at 10%, 5% and 1%, respectively.

The regression results are shown in Table 4. Taking corporate social responsibility as the dependent variable, model M1 tests the innovation ability as the independent variable and the enterprise size, operation years, and ownership structure as control variables. The regression results show that after the introduction of control variables, innovation ability has a significant positive impact on corporate social responsibility ($\beta = 0.497$, $P < 0.01$), indicating that the level of corporate social responsibility continuously improves with the continuous improvement of the innovation ability of high-tech enterprises. This

verifies H1. This is because the higher the innovation ability of enterprises, especially high-tech companies, the more they pay attention to and use various high-tech products with big data to better serve the public, and the higher the degree of social responsibility. The improvement of innovation ability can create more products and services that meet the needs of consumers in the international market. In the process of responding to the standardization of global social responsibility, the improvement of innovation ability also enables enterprises to further expand overseas markets and improve the rights and interests of more stakeholders, thus enhancing the level of corporate social responsibility.

Taking corporate social responsibility as the dependent variable, model M2 tests the independent variable and control variables. The results show that the government subsidy positively regulates innovation ability and corporate social responsibility. When the control variable is certain, the innovation ability of enterprises has a greater impact on corporate social responsibility with government subsidies. This is because government subsidies reduce the financial pressure on enterprises. High-tech enterprises with strong profitability fulfill their social responsibilities. For enterprises with weak profitability, government subsidies help them minimize losses. Government subsidies play an incentive effect at a certain time. Meanwhile, the assessment requirements of enterprises accompanied by government subsidies will encourage enterprises to continuously optimize their internal R&D and management processes and meet the government requirements by improving R&D investment capacity, production and operation capacity and business performance. In this process, enterprises will constantly improve their mechanisms from all aspects. Thus, the level of corporate social responsibility is enhanced, and economic development is promoted to a certain extent.

Table 4. Regression analysis.

M1		M2	
variables	csr	variables	csr
ct	0.534*** (2.81)	ct	0.469** (2.45)
size	4.469*** (17.47)	size	4.483*** (17.56)
age	-0.100** (-2.10)	age	-0.093* (-1.96)
soe	2.029*** (3.25)	soe	0.904 (1.26)
Constant	-85.887*** (-18.09)	m	0.142*** (3.20)
Observations	2,494	Constant	-85.278*** (-17.98)
R-squared	0.193	Observations	2,494
		R-squared	0.196

Note: *** p<0.01, ** p<0.05, * p<0.1

5. Conclusion

First, using the panel data of 500 listed high-tech companies from 2016 to 2020, this paper analyzes the

relationship between R&D investment, government subsidies and corporate social responsibility of high-tech companies in the era of big data. For high-tech enterprises, their innovation ability is affecting the fulfillment and further development of corporate social responsibility. The innovation ability of high-tech enterprises is mainly reflected in the research and development investment of new technologies and the use of big data algorithms. The improvement of innovation ability reflects the enterprise's investment in research and development, which is conducive to improving the recognition and loyalty of customers, and also conducive to the development of overseas markets, establishing long-term competitive advantages, so as to facilitate the enterprise to establish a foothold in the market and find a suitable market position for the enterprise. Despite the complex market and political environment in international trade, the company can still produce products and services with better quality based on its research and development ability. It can not only gain achievements inside the company, but also gain more attention and favor from stakeholders outside. Thus, the level of corporate social responsibility will be further improved and the development of the whole economy.

Second, the moderating effect of government subsidies has also been tested. For enterprises with government subsidies, their innovation ability has a greater impact on CSR. That is, government subsidies have a positive moderating effect on enterprises' innovation ability and social responsibility fulfillment. For enterprises, government subsidies are not only a side affirmation of enterprise reliability, but also a subsidy and support for enterprise performance and technology. Enterprises also have financial support to better cope with the difficulties and problems in economic development, so as to better protect the interests of internal and external stakeholders in order to better enhance the level of corporate social responsibility.

6. Discussion

The above conclusions have the following implications for improving the management and economic development of high-tech companies. First, in this era of big data, high-tech companies focus on corporate performance and corporate social responsibility. Enterprises should realize that R&D investment and economic benefits should be equal, and both are the top priority of economic development. Second, companies must realize that fulfilling their social responsibilities is not futile. Companies must actively maintain investment in research and development, and utilize digital technologies such as the Internet, the Internet of Things and big data for front-end and back-end development. This will help enterprises maintain their technological advantages in domestic and foreign markets. Third, to further stimulate the internal vitality of enterprises, the government needs to maintain tax reduction and exemption policies for high-tech enterprises, especially small and medium-sized enterprises.

7. Research Limitations and Future Directions

The conclusion of this study has certain implications for the economic development of enterprises and government subsidy measures in the era of big data. However, this study also has certain limitations on the measurement of enterprise innovation ability in the era of big data. In terms of innovation capability variables, future studies can be supplemented from the number of patents applied by enterprises and the number of R&D personnel. At the same time, in the research on innovation capability and CSR, there may be other mediating variables besides government subsidies. The operation mechanism is also relatively complex, and these problems are still worth further study and exploration.

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