



A Comparative Study on the Current Development of Digital Agriculture in China and the United States

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Abstract.Based on the historical data and existing research of China and the United States, this paper introduces the basic agricultural development process of the two countries. Secondly, this paper further looks at digital agriculture, a high-level and high-efficiency agricultural goal, and summarizes the reasons, technical definitions, supporting policies, practical results and impacts of China's transformation. The development history, existing technology and future goals of the United States are introduced. Finally, based on the existing technology and development environment of digital agriculture in the two countries, this paper compares the advantages and disadvantages and puts forward targeted development forecasts and suggestions.

Keywords: agriculture, digital transformation, agricultural development, current status of agriculture

1 Introduction

It has been reported that in 2021, international food prices will fluctuate significantly due to multiple factors, causing an increase in uneven global food supply pressure and a steep increase in food security risks. Even so, "China's Agricultural Industry Development Paper" points out that China's total grain production this year will exceed that of last year, cotton, oil, sugar, fruit and vegetable production is steady to good, and the supply of livestock products and aquatic products is stable. China's glorious journey from the early days of its founding more than 70 years ago when it was unable to ensure food and clothing for its people to the present is there for all to see, but it still has many food security problems to be solved and there are multiple difficulties in achieving further agricultural breakthroughs. It is therefore important to actively explore the experiences of other countries that have successfully established healthy and developed agricultural systems to learn from and improve their problems. On the other side of the ocean, another high-profile world power, the United States, with its huge grain reserves and the world's largest carryover stock of grains, which in recent years has been roughly one-third of the world's total. Since the arrival of immigrants to the American continent,

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1 Introduction

Nowadays, China's digital economy continued to grow rapidly, with the size of the digital economy increasing by 410 million yuan, a compound annual growth rate of 14.2 percent. A growing number of countries and enterprises are placing emphasis on the growth of the digital economy, many scholars have undertaken intensive discussions and research on the implications of the digital economy.

Baily and Lawrence stated that the digital economy offers a favourable boost to productivity and IT industry [1], and there are also regional "digital economy gaps" and polarization phenomena within China's digital economy development [2]. Most of the existing literature describes corporate profits and economic development in terms of mass entrepreneurship [3], technological progress [4], enterprise innovation performance [5], corporate financial performance [6], enterprise human capital structure, production efficiency, income distribution [7] and other aspects reflect the influence of the digital economy. Regarding the social effects of the digital economy, the literature has found that the digital economy affects corporate governance perceptions and innovative models of corporate governance [8].

Corporate social responsibility, as an emerging governance model, is a way to enhance corporate reputation [9], and is a major concern for enterprises today. As early as 1976, Fitch proposed that enterprises help solve social problems from the perspective of profit incentives to achieve corporate social responsibility [10]. There are many literature discussions on CSR, ranging from investor activities [11], stock price fluctuations [12], policy factors[13,14], shareholding structure [15], financial performance[16-17] and other angles.

Xiao et al. demonstrated that enterprise digitalization has obvious enabling effects on CSR and can significantly improve CSR performance [18]. Unfortunately, there is currently no literature that precisely links "the development of digital economy in different regions - corporate social responsibility". The main value of this paper resides in exploring the connection between the growth of digital economy in various regions and corporate social responsibility, while examining the underlying correlation. With the rise of the digital economy, enterprises are increasingly embracing social responsibility as a crucial aspect for future success. It is important to understand how the development of digital technologies can impact both businesses and society, fostering mutual growth.

2 Data and Method

Figures of listed Chinese A-share companies in 2010-2021 are selected as the initial research sample in this paper, and the data are treated as follows. First, financial enterprises are excluded. Second, samples with ST and period delisting are excluded. Third, for the purpose of reducing the impact of outliers, this paper applies 1 percent and 99 percent shrinkage to all continuous variables at the micro level. The data are all from Chinese Research Data Services and China Stock Market & Accounting Research Database.

To enhance the reliability of the regression results, this paper also implements the following basic treatments: Firstly, since corporate social responsibility requires a certain time lag to affect corporate financial performance, this paper introduces a one-year lag for the core explanatory variables, which takes into account the time-consuming transfer of variables in practice and also minimizes the endogenous interference of reverse causality. Secondly, we control both time and individual dummy variables to control for fixed effects when possible.

The target variables are corporate social responsibility and digital economy development level. If the company discloses CSR in that year, it takes 1, and if it does not, it is 0. Digital economy development level data draws on the research indicators of digital economy by Zhang and Jiao [19]. The explanatory variables in this paper are profit and credit availability ratios. In this paper, the bank credit ratio and interest expense ratio are used to measure the credit availability ratio. The bank credit ratio measures the proportion of bank credit in corporate borrowings. This is because the total liabilities of the enterprise include accounts payable and liabilities arising from the enterprise's borrowing from banks. Therefore, after subtracting accounts payable, liabilities arising from corporate borrowings from banks account for the majority of total liabilities [20]. Its formula is as follows, where i , t indicates the company and time respectively:

$$\text{bankloan ratio}_{it} = \frac{\text{total debt}_{it} - \text{account payable}_{it}}{\text{total debt}_{it}} \quad (1)$$

$$\text{interestpayment ratio}_{it} = \frac{\text{interest payable}_{it}}{\text{sales revenue}_{it}} \quad (2)$$

To control for the effects of other variables on corporate social responsibility, this paper includes a list of control variables in the model, such as company size, asset-liability ratio, return on equity, operating cash flow ratio, property rights, book-to-market ratio, and total asset turnover.

This paper utilizes the asset benefit ratio and the corporate credit ratio to measure the effectiveness of CSR on its financial metrics and proposes the following assumption H_1 and model:

H_1 : Taking on CSR benefits a company's profits as well as its borrowing costs.

$$y_{i,j,t+1} = \beta_1 CSR_{j,i,t} + X_{j,i,t} \Gamma + i_t + i_{industry} + i_{city} + \varepsilon_{i,t} \quad (3)$$

Just as mentioned above, there is also a regional digital economy gap and polarization in China's digital economy development. We postulate that profits and loan cost benefits brought by corporate social responsibility will differ based on the different digital economy development in the geographical areas where businesses operate. So we propose the following assumption H_2 and model :

H_2 : Profit of CSR to business as well as the cost of lending will be better with the level of digital economy development in the city where the business is located.

$$y_{i,j,t+1} = \beta_1 CSR_{j,i,t} \times D_{j,t} + \beta_2 CSR_{j,i,t} + D_{j,t} + X_{i,j,t} \Gamma + i_t + i_{industry} + i_{city} + \varepsilon_{i,t} \quad (4)$$

Xu and Liu propose that CSR is more prominent in companies with more valuable political relationships, particularly non-state firms, small companies and corporations located in less marketized cities [21]. Therefore, we expect that with the economic development, different regions present different levels of digital economy, for different equity nature of the enterprise in the digital economy additive, its commitment to social responsibility on the enterprise's impact is different. Of these, the effects on non-state-owned enterprises are stronger than those on state-owned enterprises. Therefore, following assumption H_3 and model are proposed.

H_3 : The CSR added in the digital economy is more pronounced in the private sector in terms of profits for businesses and the cost of loans.

$$y_{i,j,t+1} = \gamma_1 CSR_{i,j,t} \times D_{i,t} \times Private_{i,j,t} + CSR + D_{i,t} + Private + CSR \times D_{j,t} + D_{i,t} \times Private + CSR \times Private + i_t + i_{industry} + i_{city} + \varepsilon_{i,t} \quad (5)$$

The variable subscripts i, j and t in the three models represent company, region and time respectively. The explained variables $y_{i,j,t+1}$ are the profits and loan costs of the enterprise in the previous year. In model 1, the core explanatory variables $CSR_{j,i,t}$

represent the performance of the social responsibility of the enterprise i in the current period. From Model 2, the co-resident explained variables $CSR_{i,j,t} \times D_{j,t}$ indicates the performance of enterprise its social responsibility under the domestic digital economy development in its location. To Model 3, the core explaining variable $CSR_{i,j,t} \times D_{i,t} \times Private_{i,j,t}$ expresses the performance of social responsibilities of enterprises i with different equity properties under digital economy development in their locality. In addition, we control for a range of fixed effects in the model, i_t , $i_{industry}$, i_{city} representing time fixed effects, industry fixed effects, and region fixed effects.

3 Results

The total amount of data shown in Table 1 is 16816. The average digital development level is 0.244, with a variance of 0.192, then the minimum value is 0.002, with a maximum value of 0.865 indicates significant differences in the development level of digital economy in different regions. The mean value of corporate social responsibility is 0.278, and the variance is 0.448, showing that the performance of listed companies in disclosing their social responsibility varies.

Table 1. Descriptive Statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
CSR	16816	.278	.448	0	1
dig	16816	.244	.192	.002	.865
Size	16816	22.253	1.293	19.57	26.452
Lev	16816	.441	.206	.027	.927
ROA	16816	.04	.061	-.382	.255
ROE	16816	.064	.129	-.962	.406
ATO	16816	.66	.455	.055	2.907
Cashflow	16816	.042	.068	-.224	.256
BM	16816	1.062	1.154	.052	10.089
SOE	16816	.386	.487	0	1
Bank-loan ratio	16816	.928	.149	-5.715	1
Interest-payment ratio	16816	.005	.055	-.191	5.105

3.1 Time Effect

Based on the findings in Table 2, the performance of corporate social responsibility has no significant correlation between its current return on assets, bank credit ratio and profit expenditure. Corporate social responsibility in the current year does not affect its profit and loan costs.

Table 2. Implications of corporate social responsibility on current corporate profits and loan costs

	(1)	(2)	(3)
VARIABLES	ROA	Bank-loan ratio	Interest-payment ratio
CSR	0.000	0.003	-0.000
Constant	0.037***	0.720***	-0.019
Observations	16,816	16,816	16,816
Number of Stkcd	2,829	2,829	2,829
R ²	0.835	0.129	0.015

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

According to Table 3, return on assets is directly proportional to corporate social responsibility at the 5% level, that means fulfilling CSR significantly increases the return on capital in the following year. It can be inferred that the main reason is that enterprises obtain a positive brand image and a good reputation in society through social responsibility, thus consumers tend to purchase the goods and services of the company in the next year.

At the same time, the bank-loan ratio is positively correlated with corporate social responsibility at the level of 10%, suggesting that performing CSR improves a firm's lending limit for the following year. The main reason is that enterprises have increased the trust of banks in enterprises and increased their loan limits through good information transmitted to society. However, the interest-payment ratio is not significantly correlated with corporate social responsibility. This shows that the performance of corporate social responsibility can increase the return on assets and increase the loan limit. Hypothesis 1 holds.

Table 3. Influence of corporate social responsibility on profits and loan costs with a one-year lag

	(1)	(2)	(3)
VARIABLES	ROA	Bank-loan ratio	Interest-payment ratio
CSR _{t-1}	0.005**	0.008*	0.000
Constant	0.404***	0.818***	0.818***
Observations	13,001	13,001	13,001
Number of Stkcd	2,541	2,541	2,541
R ²	0.119	0.122	0.122

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

Based on Table 4, corporate social responsibility is directly proportional to the return on assets at the 1% level, but not significantly correlated with the proportion of bank credit and interest income. The main reason is that with the continuous improvement of the reputation of enterprises in society, consumers will be more inclined to buy enterprises with good reputation in society when purchasing products and services of the same nature, so the improvement of the return on assets with a lag of 2 periods will be more efficient than the improvement of lagging 1 period.

Table 4. The effects of corporate social responsibility on profits and loan costs lagged by 2 years

	(1)	(2)	(3)
VARIABLES	ROA	Bank-loan ratio	Interest-payment ratio
CSR _{t-2}	0.007**	0.006	-0.001
Constant	0.731***	0.811***	-0.181***
Observations	10,641	10,641	10,641
Number of Stkcd	2,351	2,351	2,351
R ²	0.089	0.076	0.008

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

3.2 The Impact of Regional Digital Economy

Do a one-year extension on all variables. According to Table 5, the return on capital is significantly correlated with CSR*dig at 5%, and has no significant correlation with the credit availability ratio and interest expense, indicating that the return on assets

can be increased with higher developed regional digital economy, but the loan cost will not be affected. Hypothesis 2 doesn't quite pass the test.

As shown in the control variables, return on equity is significantly positively correlated with return on assets, not significantly correlated with bank credit ratio, and negatively correlated with interest expense, indicating that enterprises with high profitability are more inclined to meet the demand for funds through internal retained earnings, and avoid bank loans, so as to improve the internal asset structure of enterprises. The cashflow ratio is positively correlated with the return on capital and the bank credit ratio, and negatively correlated with the interest expense ratio, indicating that enterprises with strong liquidity ability can increase the return on capital, expand the loan limit of banks, but reduce the loan interest, and stabilize the cash flow and loan cost of enterprises.

Table 5. Digital economy development influence on one-year profit deferral and loan costs when firms perform social responsibility.

	(1)	(2)	(3)
VARIABLES	ROA	Bank-loan ratio	Interest-payment ratio
CSR*dig _{t-1}	0.015**	-0.003	-0.003
Size _{t-1}	-0.016***	-0.000	0.005***
Lev _{t-1}	-0.015***	0.164***	0.004
ROE _{t-1}	0.075***	-0.002	-0.024***
ATO _{t-1}	0.016***	-0.021***	-0.003
Cashflow _{t-1}	0.074***	0.051***	-0.018*
BM _{t-1}	-0.006***	-0.005***	0.002*
SOE _{t-1}	-0.009**	0.009	0.012**
Constant	0.401***	0.803***	-0.102***
Observations	13,001	13,001	13,001
Number of Stkcd	2,541	2,541	2,541
R ²	0.119	0.122	0.008

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

3.3 Nature of Enterprise

Model ROA_A is the rate of return on assets for state-owned firms, while Model ROA_B shows return on assets of non-state-owned firms. According to Table 6, non-state-owned firms' return on assets is highly related to CSR*dig at the 5% level and not with state-owned corporations' return on assets, demonstrating that with the growth of regional digital economy, the Return on assets for non-SOEs can be improved, but there is no impact on SOEs. Hypothesis 3 is true.

Table 6. Effects of the digital economy development on the profits of companies with different equity nature when practicing social responsibility.

	(1)	(2)
VARIABLES	ROA _A	ROA _B
CSR*dig _{t-1}	-0.004	0.020**
Size _{t-1}	-0.007***	-0.016***
Lev _{t-1}	-0.001	-0.009
ROE _{t-1}	0.080***	0.054***
ATO _{t-1}	0.004	0.024***
Cashflow _{t-1}	0.075***	0.076***
BM _{t-1}	-0.007***	-0.011***
Constant	0.203***	0.384***
Observations	5,150	7,851
Number of Stkcd	974	1,672
R ²	0.119	0.138

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

4 Discussion

Through discussion, the main conclusions we draw are as follows. First, corporate social responsibility has a time effect. That is to say, fulfilling the current social responsibility of a company has no impact on the current profits and loan costs, and it will only be related after one year, and the profit income will continue to increase over time. Second,the digital economy contributes additively to profits generated by enterprises in fulfilling their social responsibilities, but has no significant impact on

loan costs. That is to say, the higher the digital economy in a city, the greater the benefits of fulfilling social responsibility on corporate profits. Furthermore, companies of varying ownership structures display distinct characteristics in similar circumstances. Particularly noticeable is the significantly greater return on assets observed in privately-owned businesses, in comparison to state-owned enterprises.

The findings from scholarly research align with the derived outcomes. Zhang et al. proposed that the influence of social responsibility on financial performance in the current period is not significant, and that social responsibility with a lag of one year has a positive impact on financial performance [6], which is consistent with the conclusion of this paper. However, in this literature, it is proposed that the impact of social responsibility with a two-year lag on financial performance is not significant, and the return on assets with a two-year lag used in this paper is significantly positively correlated with corporate social responsibility, and the correlation coefficient is greater than that of one year lag. It is speculated that the main reason is that with the development of society, the performance of corporate social responsibility has been spread more rapidly, which is further reflected in the better degree of consumer favor for enterprises, and the positive feedback obtained by enterprises from consumers has increased. Zhu also proposed that the better the CSR performance, the higher the market evaluation, and the higher the information content of accounting surplus [22]. It shows that consumers are more likely to buy companies that already have a good reputation when comparing goods and services. Therefore, if the enterprise itself continues to undertake their social obligations, it will promote the establishment of corporate image and thus increase consumer desire to consume, and the return on capital gained by the enterprise will also increase year after year.

Also, the digital economy has a complementary influence on the return on assets that enterprises increase when fulfilling their social responsibilities, which may be because enterprises located in areas with better digital economy development obtain higher social benefits when fulfilling their social responsibilities, can obtain government support, consumers have strong spending power, and have stronger purchasing power for products and services. Tencent is located in Shenzhen. The company's game business has been criticized in the society, but then Tencent has continuously fulfilled its social responsibilities in public charity, rural revitalization, environmental protection and low carbon, helping social development by donating resources, co-building projects, volunteering, and promoting micro-enterprises, so as to gain the trust of consumers and hedge off some negative social impacts.

Compared to government-owned corporation, non-state enterprise can achieve this bonus effect. It is speculated that the main reason is because state-owned enterprises themselves have social responsibilities to stabilize society, and the masses believe that state-owned enterprises have their obligation to fulfill their social responsibilities; For non-state-owned enterprises, their active fulfillment of social responsibilities can better gain reputation and help enterprises promote business.

For the cost of loan of the explanatory variable, this paper not only discusses the lag period, but also studies the impact of the current period and the two years lag, and finds that the loan limit and cost only have an impact in the next year of fulfilling social responsibility. The main reason is that the enterprise actively fulfills its social responsibilities, on the one hand, it can reflect the performance of the enterprise and has a good reputation, On the other hand, companies that are often financially sound tend to be more inclined to fulfill their social responsibilities.

There are also shortcomings in this article, as long as there are the following points: first, there is some missing data at the time of data collection; Second, the financial indicators used for measurement are mainly short-term indicators. In the future, long-term financial indicators can be considered.

5 Conclusion

In recent years, with the increasing public attention to corporate social responsibility, the rapidly developing digital economy has become an external factor driving corporate social responsibility. With the data of A-share listed companies in China from 2010 to 2021, this study empirically tests the impact of corporate social responsibility on financial performance, as well as the impact of digital economy development in different regions on corporate social responsibility. Corporate social responsibility favors profits and loan costs with a 1-year lag, and profits are time-continuous. The digital economy is additive to the profits raised by corporate social responsibility and notably more for non state-owned firms than for state-owned firms.

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