

Has financialization hit China's food security?—from the perspective of technological innovation in agricultural enterprises

Guo Zijing

School of Economics and Management, Guangxi Normal University, Guilin, China

Abstract: Currently, global food security is very unstable and risky. An important link to ensure food security is agriculture. However, there is a general tendency to financialization in entities. This article examines the possibility of the impact of financialization on food security from the micro-perspective of enterprise innovation. Taking China, a populous and developing country, as an example, the operating data of the listed agricultural companies of Shenzhen-Shanghai shares A from 2010 to 2020 were selected as research samples to test the impact of financialization on the innovation of agricultural enterprises, expand relevant theories, and further analyze the heterogeneity of agricultural companies. The results show that: firstly, there is a trend of financialization in Chinese agricultural enterprises and there is a significant U-shaped relationship between financialization and the input of agricultural enterprises. If the degree of financialization is too high, it will have a negative effect on agricultural enterprises and impact on food security. Second, there is firm heterogeneity in the innovation input of agricultural enterprises caused by financialization. Excessive financialization is more obvious in the "crowding out" of innovation input from state-owned enterprises large-scale enterprises and agricultural manufacturing enterprises, indicating that excessive financialization has a greater impact on food security of these three types of agricultural enterprises. Final, this document presents corresponding policy suggestions for the financial development of Chinese agricultural enterprises to promote agricultural innovation and ensure food security.

Keywords: Agricultural enterprises; Financialization; Enterprise innovation; Inverted U-shaped relation; Heterogeneity

1. Introduction

Food security is a fundamental issue that concerns the survival of humanity. In recent years, it has been difficult to guarantee global food security in the face of multiple crises such as global climate change, economic antiglobalization and trade blockages caused by war ^[1-2]. In particular, food security in developing countries with large populations such as China and India needs further consideration. The Chinese government has always given great importance to the issue of food security in China. For example, "No. 1 central document" for 2023 focused on 'agriculture, rural areas, and farmers'. Leadership of agricultural enterprises is crucial in various ways to ensure food security, because they can promote the development of the agricultural economy, advance the progress of agricultural technology, and thus improve the ability of agriculture to resist risks ^[3]. The Chinese government has made it clear on many occasions that it will focus on ensuring food security and the supply of important agricultural products and making the seed industry self-reliant and self-controlled in science and technology. The science and technological innovation of agricultural enterprises is a key link to achieve a stable increase in grain ^[4]. The impacts of financialization on food security are more at the level of agricultural enterprises, mainly through the impact of agricultural enterprises and then impact on food security.

In recent years, China's economic growth has slowed and the contradiction of overcapacity is prominent. Companies at the bottom of the industrial value chain have invested innovative funds in the financial industry, leading to increasingly active financial asset investment activities of companies ^[5]. In 2018, the total amount of financial assets held by China's listed non-financial companies of A shares reached 685 billion yuan, about 7 times that of 2007, and the trend of financialization of entity companies was gradually generalized ^[6]. The characteristics of high liquidity and high profitability of financial assets attract many investors to perform speculative arbitrage. Agricultural entities are no exception. Among the 445 agriculture-related companies on the A Share and the New Third Board in

2019, 173 Chinese agricultural companies have allocated financial assets excluding cash [7]. When implementing the high-quality development strategy, agricultural companies transfer a large amount of capital to the financialized sector for reasons such as economic benefits [8]. A large number of studies have shown that the excessive shift of asset allocation to financialization will crowd out real investment and investment in innovation, and thus hinder the development of the real economy. The 20th National Congress of the Communist Party of China (CPC) pointed out in the high-quality development section that modern financial regulation should be improved, and the agricultural support and protection system should be strengthened. The leading advantage of the agricultural economy in international competition is increasingly dependent on innovation, and the high-quality development of the agricultural economy cannot be achieved without the promotion of the level of technological innovation of agricultural enterprises [4]. At present, in the context of the increasing prevalence of food security and financialization of nonfinancial enterprises, with science and technology as the main driving force of economic growth, do Chinese agricultural enterprises have a tendency to financialization? How does financialization affect the innovation of Chinese agricultural enterprises and thus impact China's food. However, there is a lack of research on such a literature in the current academic circle.

China's listed agricultural enterprises are basically national or local leading agricultural enterprises with large scale and great influence, which is very representative. Therefore, this study selects all China's listed A-share agricultural enterprises from 2010 to 2020 as a research object and constructs a theoretical model to test the impact of agricultural enterprise financialization on innovation investment. Major innovations and contributions include: (1) focus on issues related to agricultural enterprises' financialization. Although the issue of the financialization of enterprises has been a hot topic in recent years, the existing literature on the study of the financialization of enterprises pays more attention to the manufacturing enterprises, while few researchers pay attention to the financialization of agricultural enterprises' financialization. However, we cannot ignore the important value of agricultural enterprises and the problem of their deepening financialization. (2) Expand the relevant theory. Most of the existing literature believes that the relationship between enterprise financialization and enterprise innovation is linear. This study verifies the inverted U-shaped relationship between enterprise financialization and agricultural enterprise innovation through theoretical and empirical analysis. (3) From the perspective of heterogeneity of the firm itself, the differences of the inverted U-shaped relationship between financialization and innovative firms of different nature are investigated.

2. Literature review and research hypothesis

"Financialization" refers to the financialization of the corporate governance structure and behavior caused by factors such as the decline in the profit rate of industrial investment and the continuous expansion of the financial sector, which is specifically manifested by the expansion of financial investment, the share of financial profits and the financial expenditure of non-financial enterprises [9-10]. At present, China's financial market is still in the development stage. Financial instruments are not rich enough, the financial system is not perfect, and the process of "financialization" has not yet been completed. In the context of China's current financial system, it is more accurate to describe the investment behavior of the financial assets of enterprises as "expanding financialization activities" [6].

In theory, according to endogenous growth theory, technological progress is the decisive factor to ensure the sustainable economic growth of enterprises. Innovation in agricultural enterprises is very important for their sustainable development, and its sustainable development is the guarantee of stable food security [4]. Financialization may not only produce the "reservoir effect" to increase the liquidity of the assets of the enterprises and promote investment in innovation, but also produce the "crowding effect" and have a negative impact on investment in innovation. Currently, a small number of scholars have studied the relationship between different degrees of financialization and investment in innovation in enterprises. One is moderate financialization. There is a significant positive correlation between the amount of corporate financial assets and corporate performance [11]. When the business performance of enterprises is poor, the financial investment will "crowd out" the innovation investment of the enterprises, and when the business performance is good, it will promote the innovation investment of enterprises [12]. However, moderate financialization can promote enterprise innovation by easing cash flow constraints [13]. The second is excessive financialization. Excessive financial development will lead to enterprises' separation from the function of serving the real economy and increase their dependence on financial channels for profit, thus excessively pursuing financial investment and ultimately hindering enterprise innovation [13]. In addition, the loose monetary policy will intensify the "crowding out effect" on the innovation of the enterprise [14]. Existing studies have shown that there is

an inverted U-shaped relationship between the influence of financialization on enterprise innovation investment, that is, moderate financialization can promote the maximization of enterprise innovation investment and minimize the "crowding out effect" ^[15]. However, some scholars have come to a completely opposite conclusion ^[16], and its non-linear relationship is still controversial. Most studies focus on manufacturing enterprises, agricultural enterprises has not been discussed by scholars. Therefore, this study proposes hypothesis based on theoretical analysis and other research of enterprises.

Hypothesis 1: The influence of financialization on innovation investment has a reasonable horizontal fluctuation range, that is, the relationship between financialization of agricultural enterprises and enterprise innovation is inverted U-shaped.

In order to more truly and accurately depict the actual situation of the capital market, this study further analyzes the heterogeneity from three aspects: the nature of the enterprise ownership, the scale and the nature of the industry. The first is the own nature of enterprises. The difference in production between state-owned and non-state-owned enterprises is reflected mainly in the following aspects. State-owned enterprises have a serious "soft budget constraint" problem, but are protected by government support and policies, and most of these enterprises control the lifeblood of the national economy and have certain monopoly power ^[17]. The market for non-state-owned enterprises is an almost perfect competition market, following the natural law of "survival of the fittest". Entrepreneurs in non-state-owned enterprises are closely related to the interests of the enterprise, and have more incentive to choose to take the risk of continuous innovation, to gain long-term development advantages. Due to the "soft budget" phenomenon of state-owned enterprises, and the inherent advantages of state-owned enterprises lead to less competitive pressure and thus lack of innovation and research and development motivation, so it is more likely to obtain the main income through financial investment than non-state-owned enterprises. However, when state-owned enterprises rely too much on financial assets and gradually break away from industry, they will step into the zone of excessive financialization, which will further inhibit their innovation and development.

Hypothesis 2a: Excess financialization has a greater negative impact on state-owned companies.

The scale of an enterprise determines its production capacity and profitability. The scale of large enterprises means that enterprises have resource advantages such as human capital and production technology, investment and financing ability and resource richness ^[18], and can better coordinate and allocate various production factors ^[19]. However, large enterprises may be limited to the existing technology dividend due to the rigidity of knowledge and organizational structure ^[20], resulting in a weak awareness of technological innovation. According to the theory of diminishing marginal efficiency of technological innovation, it can be predicted that the degree of financialization of large-scale enterprises is higher than that of small-scale enterprises. In other words, the level of innovation of large-scale enterprises is higher than that of small-scale enterprises in general. When they reach the level of innovation within the appropriate range of financialization, their technology is more difficult to innovate compared to small-scale enterprises. To obtain higher profits, they invest more assets in the financial sector, and when the amount of financial assets reaches a certain amount, enterprise innovation will be inhibited. However, due to the limitation of their own technical conditions, the level of productivity of small-scale enterprises is often low. From a long-term perspective, small companies pay more attention to their own innovation.

Hypothesis 2b: Excessive financialization has a greater negative impact on large enterprises.

In recent years, in the context of ensuring food security, China has introduced a large number of policies to support the operation of pure agricultural enterprises, which is reflected mainly in the modernization of the planting industry, the improvement of soil fertility, agricultural insurance, subsidies for leading companies, etc. At present, the mode of economic growth of China's agricultural manufacturing industry is based mainly on the expansion of production factors ^[21]. Compared to pure agricultural enterprises, China's agricultural manufacturing industry is still in the stage of insufficient independent innovation level and efficiency, which is closely related to backward technology and equipment, the lack of technical innovation talent, and the imperfect innovation environment of China's current agricultural manufacturing industry ^[22]. However, in view of the current policy trend, the government pays more attention to the construction of pure agricultural enterprises. The lack of independent innovation ability of agricultural manufacturing enterprises and the characteristics of long cycle of production and operation returns contradict the short-term economic effects pursued by entrepreneurs. This may lead to agricultural manufacturing enterprises being more likely than pure agricultural enterprises to prefer financial investment and obtain more additional income.

Hypothesis 2c: Excessive financialization has a greater negative impact on agri-manufacturing firms.

3. Research Design

3.1. Data, samples and variables

3.1.1. Data are derived from sample selection

In this study, A-share agricultural enterprises listed in China's Shenzhen and Shanghai from 2010 to 2020 were selected as research samples, and the financial data and innovation data involved in the research process were from the annual reports of listed companies and the CSMAR database. Referring to the research of Fu et al.^[23], the agricultural enterprises defined in this study are agricultural enterprises related to agriculture in a strict sense, mainly including traditional agricultural enterprises in the primary industry and agricultural product processing enterprises in the secondary industry. According to the results of the industry classification of listed companies by the China Securities Regulatory Commission in 2012, this study includes agriculture, forest, animal husbandry and fishery, agricultural and sideline food processing industry, food manufacturing industry and wine, beverage and refined tea manufacturing industry, as well as wood processing and wood, bamboo, rattan, brown, grass products industry and other manufacturing enterprises in the category of agricultural enterprises. To enhance the reliability of the empirical results, the research data of this article excludes enterprises with serious lack of financial data, enterprises with serious lack of innovation data, and data with continuous data less than 5 years and ST, *ST and PT companies.

3.1.2. Variable specification

Table 1: Variable names, definitions and descriptive statistics

Variable	symbol	algorithm	Mean	S.D	min	max	N
Innovation input	<i>Innova1</i>	Logarithm of R&D investment	16.791	1.643	9.635	20.758	1238
	<i>Innova2</i>	Logarithm of intangible assets	18.883	1.221	11.472	22.295	1238
Financialization	<i>Fin1</i>	Financial assets/total assets	0.309	0.157	0.022	0.859	1238
	<i>Fin2</i>	(Financial assets - monetary funds)/total assets	0.110	0.113	0.000	0.727	1238
Operating profit	<i>Profit</i>	Operating profit	0.964	4.000	-4.050	66.600	1238
Tax	<i>Tax</i>	Tax payable/net profit	0.353	2.816	-18.598	86.257	1238
Cash flow	<i>Cash</i>	Money funds/total assets	0.199	0.146	0.008	0.857	1238
Net profit rate on total assets	<i>Roa</i>	Net profit/total assets	0.050	0.103	-1.880	0.526	1238
Financial leverage	<i>Lev</i>	(Net profit + income tax expense + finance expense)/(Net profit + income tax expense)	1.203	2.039	-36.314	33.156	1238
Enterprise scale	<i>Size</i>	Logarithm of assets	0.512	0.500	0.000	1.000	1238
Ownership concentration	<i>Top1</i>	Shareholding ratio of the largest shareholder (%)	0.370	0.146	0.041	0.960	1238
Enterprise age	<i>Age</i>	Year - Time of establishment + 1	2.869	0.348	0.693	3.611	1238
Enterprise Nature	<i>Soe</i>	State-owned = 1, Non-state-owned = 0	0.381	0.486	0.000	1.000	1238
Enterprise area	<i>Area</i>	Enterprise Province	-	-	-	-	1238

(1) Indicators of innovation of agricultural enterprises. By reference to the analysis and practice of Shi and Yang^[24], so only innovation investment is selected as the variable to measure enterprise innovation. Therefore, the two innovation input indicators in this study are as follows: 1) R&D input (*Innova1*): The logarithm of the R&D input is used to measure; 2) Intangible assets (*Innova1*): The intangible assets logarithm is used to measure the contribution of enterprises to innovation. In order to better measure enterprises' innovation input through intangible assets, land use rights and other intangible assets are excluded. (2) Financialization indicators of agricultural enterprises. Drawing on the practices of Xie. et al.^[25]. According to the accounting balance sheet account, 12 items on the balance

sheet of financial assets (including "trade financial assets", "derivative financial assets", "other receivables", "buy-resale financial assets", "current assets maturing within one year", "other current assets", "loans and advances", "financial assets available for sale", "hold-to-maturity investments", "long-term equity investments", "investment real estate", "Monetary funds") are considered an indicator of financialization (Fin1). With the deepening of studies on financialization, some scholars believe that although monetary funds are also financial assets, operating activities themselves will also generate money, so financial assets do not include monetary funds [26]. To build a more comprehensive financialization index, this study adds financial assets excluding items' monetary funds as a second financialization index (Fin2). (3) Control variables. In this study, the influence of other control variables on enterprise innovation is considered. After referring to the analysis and practice of scholars such as Xie Fusheng et al [5,26], the control variables are selected as follows: Operating profit, which measures the growth capacity of enterprises; Tax, measuring the external environment of enterprises; Cash flow, measuring the level of productive assets held by enterprises; Net profit rate on total assets, a measure of the vitality of a business; Financial leverage, a measure of corporate debt risk; Enterprise Size, measuring the scale of enterprise competition; Ownership concentration, measuring the power of shareholders; The Age of the enterprise measures the years of operation of the enterprise. In addition, the company's ownership nature and the company's area are also included for further control.

3.2. Model Construction

To test the influence of financialization on innovation input of agricultural enterprises, the following econometric model is constructed:

$$Innova_{i,t} = \alpha + \beta_1 Fin_{i,t} + \beta_2 Fin_{i,t}^2 + \beta_3 Control_{i,t} + \varepsilon_{i,t} \quad (1)$$

In the model, $Innova_{i,t}$ is the enterprise innovation index, including $Innova1$ and $Innova2$, which are the variables explained in this study. $Fin_{i,t}$ and quadratic terms ($Fin_{i,t}^2$) are the core explanatory variables for the degree of enterprise financialization, $Control_{i,t}$ and represent a series of control variables.

4. Empirical results and analysis

4.1. Descriptive statistical analysis

Table 1 shows that in the innovation of input from Chinese agricultural enterprises from 2010 to 2020, the mean value of the input from R&D $Innova1$ is 16.791 and the standard deviation is 1.643, while the mean value of the intangible asset $Innova2$ is 18.883 and the standard deviation is 1.221. This indicates that there are significant fluctuations in innovation input between different agricultural enterprises in China and between different years. The mean values of $Fin1$ and $Fin2$ of corporate financialization are 0.309 and 0.110, and the standard deviations are 0.157 and 0.113, respectively. It shows that there are great differences in the level of financialization among different agricultural enterprises in China in different years. Therefore, financialization can be estimated that financialization has a significant impact on the level of innovation input of agricultural enterprises, that is, financialization will have an impact on food security, but the specific impact needs to be further tested.

4.2. Benchmark regression model

Before estimating the model, the Hausman specification test was performed and the result showed that the P-value was greater than 10%, so the random effects model was selected for analysis in this study. Second, the maximum likelihood ratio test (LR) was performed, and the results showed that there was no heteroskedasticity problem. Table 2 reports the results of the influence of the degree of financialization on the contribution of enterprise innovation. The explained variable of models (1) and (2) is the logarithm of R&D input, and the explained variable of models (3) and (4) is the logarithm of intangible assets. The core explanatory variable of models (1) and (3) is financial assets, while the core explanatory variable of models (2) and (4) is financial assets excluding monetary funds. The logic of model setting has the following considerations: First, both R&D funds and intangible assets can be used as key variables in the input of innovation. Second, monetary funds can be used as financial assets of enterprises, but considering that monetary funds are used for the daily operation of enterprises, they may not have financial attributes. To make the research results more robust, the above conditions are incorporated separately into the model.

The results show that models (1) and (2) respectively examine the influence of different measures of financialization on the investment in R&D investment of enterprises. The results show that the primary coefficients of Fin1 and Fin2 of financialization degree are positive, being 1.6840 and 1.4602, respectively, and are significant at the 5% level; the secondary coefficients are -1.9601 and -2.7011, respectively, and are significant at the 10% level. This indicates that there is a significant U-shaped relationship between financialization and the new R&D input of enterprises, that is, moderate financialization can promote the R&D input of enterprises, while excessive financial investment will have a negative effect on the R&D input of enterprises. Models (3) and (4) examined the influence of different measures of financialization on the intangible assets of companies. The results show that, similar to the effect of R&D investment, the primary coefficients of Fin1 and Fin2 are 1.2997 and 0.6904, respectively. The primary coefficients of Fin1 are significant at 5%, and the secondary coefficients are negative -2.8583 and -3.2804, respectively, and the significance level is 1%. This shows that there is also an inverted U-shaped relationship between financialization and the input of intangible asset. However, it is worth mentioning that when financial assets that exclude monetary funds measure the degree of financialization of enterprises, the first coefficient of financialization degree (Fin2) is not significant positive, while the second coefficient is significantly negative. This indicates that the inverted U-shaped relationship between financialization and enterprise innovation efficiency is existing but unstable when financial assets excluding monetary funds are used to explain the relationship. In conclusion, the above results show that moderate financialization can promote the improvement of enterprise intangible assets, while excessive financial investment will have a negative effect on enterprise intangible assets, which is consistent with the results of financialization on enterprise R&D investment. It is concluded that there is an inverted U-shaped relationship between financialization and innovation input. In other words, a moderate amount of financialization will stabilize food security, while an excessive amount of financialization will undermine food security. Hypothesis 1 is supported.

Table 2: Results of the baseline regression.

Explanatory variable	(1)	(2)	(3)	(4)
	FIN1	FIN2	FIN1	FIN2
	Innova1	Innova1	Innova2	Innova2
Fin	1.684**	1.460**	1.300**	0.690
	(-0.804)	(-0.738)	(-0.542)	(-0.499)
Fin ²	-1.960*	-2.701*	-2.858***	-3.280***
	(-1.034)	(-1.529)	(-0.697)	(-1.034)
Roa	0.225	0.274	-0.263	-0.196
	(-0.304)	(-0.304)	(-0.205)	(-0.205)
Lev	0.017	0.019	-0.001	0.000
	(-0.012)	(-0.012)	(-0.008)	(-0.008)
Tax	0.000	-0.001	0.002	0.001
	(-0.009)	(-0.009)	(-0.006)	(-0.006)
Profit	0.539***	0.549***	0.321***	0.337***
	(-0.074)	(-0.074)	(-0.050)	(-0.050)
Cash	-0.856***	-0.551**	-1.471***	-2.199***
	(-0.316)	(-0.252)	(-0.213)	(-0.171)
Top1	-0.433***	-0.420***	-0.319***	-0.301***
	(-0.090)	(-0.090)	(-0.061)	(-0.061)
Cons	16.486***	16.601***	19.064***	19.251***
	(-0.176)	(-0.150)	(-0.124)	(-0.107)
R ²	0.076	0.081	0.227	0.237
N	1 238	1 238	1 238	1 238

Note: The "()" below the regression coefficient of each variable is robust standard error; "****", "***" and "**" indicate passing the test at the significance level of 1%, 5% and 10%, respectively (same below).

4.3. Heterogeneity analysis

Table 3: Results of the enterprise heterogeneity

Explanatory variable	(1)	(2)	(3)	(4)	(5)	(6)
	State-owned	Non-state-owned	Large-scale	Small and medium-sized	Pure agricultural	agric-manufacturing
	Innova1	Innova1	Innova1	Innova1	Innova1	Innova1
Fin2	2.834**	1.105	1.932*	-0.153	0.451	1.576**
	(-1.236)	(-0.929)	(-1.023)	(-0.996)	(-1.875)	(-0.787)
Fin2 ²	-8.748***	-1.602	-4.166**	-0.064	0.529	-3.721**
	(-2.687)	(-1.915)	(-2.104)	(-2.134)	(-3.919)	(-1.635)
Roa	-0.437	0.372	0.479	0.208	0.833	0.274
	(-0.891)	(-0.326)	(-0.501)	(-0.360)	(-0.810)	(-0.321)
Lev	0.096***	0.005	0.000	-0.003	-0.010	0.023*
	(-0.023)	(-0.015)	(-0.016)	(-0.019)	(-0.049)	(-0.012)
Tax	-0.004	0.001	-0.011	0.007	0.003	-0.001
	(-0.028)	(-0.009)	(-0.009)	(-0.020)	(-0.078)	(-0.008)
Profit	0.725***	0.494***	0.385***	0.494***	0.169	0.673***
	(-0.133)	(-0.091)	(-0.102)	(-0.108)	(-0.173)	(-0.081)
Cash	-0.179	-0.846***	-0.105	-0.720**	-1.604***	-0.343
	(-0.457)	(-0.301)	(-0.391)	(-0.318)	(-0.617)	(-0.271)
Top1	-0.619***	-0.316***	-0.218*	-0.421***	-1.000***	-0.270***
	(-0.160)	(-0.108)	(-0.119)	(-0.148)	(-0.214)	(-0.097)
Cons	16.247***	16.736***	17.005***	16.179***	16.934***	16.473***
	(-0.258)	(-0.180)	(-0.194)	(-0.190)	(-0.324)	(-0.169)
R ²	0.076	0.130	0.072	0.058	0.193	0.060
N	472	766	634	604	271	967

Furthermore, the different ownership nature, the size of the company and the industry nature of the agricultural enterprises were tested in groups. The results of the report in Table 3 are as follows. This model measures the degree of financialization of enterprises by financial assets excluding monetary funds and measures innovation investment by R&D investment. Models (1) and (2) are grouped test results of the impact of financialization on innovation input of state-owned enterprises and non-state-owned enterprises, respectively. The results show that there are significant differences in the influence of the financialization level on the innovation input of agricultural enterprises with different ownership properties. The coefficient of the first term between the degree of financialization and the innovation input of state-owned enterprises is 2.8335, which is significant at the statistical level of 5%, indicating that the financialization of state-owned enterprises has a positive effect on their innovation input. For state-owned enterprises, the "reservoir" effect of financialization is obvious, while the second term coefficient is negative -8.7481, which is significant at the statistical level of 1%. It can be shown that the degree of financialization has a significant inverted U-shaped relationship on the innovation input of state-owned enterprises, that is, excessive financialization will significantly inhibit the innovation input of state-owned enterprises. For non-state-owned enterprises, the coefficient of the primary term is positive and the coefficient of the secondary term is negative, but the two coefficients are not significant, indicating that the influence of the degree of financialization on the innovation input of non-state-owned enterprises presents an insignificant inverted U-shaped relationship. That is to say, excessive financialization has an impact on the impact of food security on state-owned agricultural enterprises, but has less impact on non-state-owned agricultural enterprises. Hypothesis 2a is supported. Models (3) and (4) report the impact of financialization on the innovation input of firms of different sizes. The results show that the influence of the financialization level on the innovation input of agricultural enterprises of different sizes is quite different. The primary coefficient of large-scale enterprise financialization on enterprise innovation input is 1.9321, which is statistically significant at 10%, and the secondary coefficient is -4.1656, which is statistically significant at 5%. This indicates that there is a significant inverted U-shaped relationship between large-scale enterprise financialization and enterprise innovation, that is, excessive financialization will significantly inhibit large-scale enterprise innovation input. On the other hand, both the primary and secondary coefficients of SMEs are negative and have no significant influence, which indicates that the financialization of SMEs will inhibit the innovation of enterprises, but the inhibition effect is not significant. That is to say, excessive financialization has a food security impact on large-scale enterprises, while the impact on small and medium-sized enterprises is not so great. Hypothesis 2b is supported. Models (5) and (6) report the impact of financialization on innovation inputs of agricultural firms of different industry nature. The results show that the impact of financialization on innovation input is also significant between these

two types of agricultural enterprises. The coefficients of the primary and secondary terms of financialization of pure agricultural enterprises are both positive and insignificant, indicating that the financialization of pure agricultural enterprises may promote the innovation of enterprises, but the effect is not significant. In agricultural manufacturing enterprises, the coefficients of primary term and secondary term of financialization are 1.5756 and -3.7206, respectively, and both are significant at the 5% level. This indicates that there is a significant inverted U-shaped relationship between financialization and innovation input of agricultural manufacturing enterprises, that is, excessive financialization has a greater negative impact on agricultural manufacturing industry. That is to say, excessive financialization has food security impact on agricultural manufacturing enterprises, but not on pure agricultural enterprises. Hypothesis 2c is supported.

5. Conclusions and Discussion

5.1. Conclusions

This study explores the impact of financialization on China's food security. Taking the annual data of listed agricultural enterprises in China from 2010 to 2020 as research data, a theoretical model is established to analyze the relationship between financialization and the innovation input of agricultural enterprises and further discusses the heterogeneity of agricultural enterprises. The results show that: (1) there is a tendency to financialization in Chinese agricultural enterprises, and there is a significant U-shaped inverted relationship between financialization and the innovation input of agricultural enterprises. Similar to the research results of Wang Shaohua et al. [12], moderate financialization has a positive effect on the input of enterprise innovation, and financial investment plays the role of a "reservoir". However, excessive financialization will "crowd out" innovation input. (2) The impact of financialization on the innovation input of agricultural enterprises varies greatly due to the heterogeneity of enterprises. The influence of financialization on state-owned enterprises shows a significant inverted U-shaped relationship, while the influence on innovation input of non-state-owned enterprises shows an insignificant inverted U-shaped relationship, that is, excessive financialization has a greater negative impact on state-owned enterprises. The inverted U-shaped relationship between financialization and agribusiness innovation is obvious for large-scale enterprises, but not significant for small-scale enterprises, that is, excessive financialization has a more obvious inhibitory effect on large-scale enterprises. There is a significant inverted U-shaped relationship between financialization and the innovation input of agricultural enterprises in agricultural manufacturing enterprises. Compared to pure agricultural enterprises, excessive financialization has a greater negative impact on the agricultural manufacturing industry.

5.2. Management Enlightenment

The problem of enterprise financialization may have less impact on developed capitalist countries or countries with a small population, but for developing countries, especially China as a populous country, the innovation ability of agricultural enterprises is low, the development level of the agricultural industry is also low, and the contradiction between food supply and population demand is great. If Chinese agricultural enterprises rush to follow financial capital for financial investment, thus crowding out the innovation of agricultural enterprises, it may cause a food crisis for China and similar developing countries. It is necessary to guarantee China's food security and actively promote the reform of the financial market of agricultural enterprises. Currently, although the level of financial assets held by Chinese agricultural enterprises is lower than that of the entire entity enterprises, the financial assets held by Chinese agricultural enterprises have continued to expand over the past ten years, and the proportion of financial assets in total assets is also increasing. Special precautions should be taken against the excessive tendency of financial enterprises. (2) we should build a reasonable restraint mechanism to control the financialization level of agricultural enterprises in a reasonable range. Financial investment has a "reservoir" effect, but excessive financial investment will produce a "crowding out" effect on enterprise innovation input. We should give full play to the exemplary role of state-owned agricultural enterprises and explore reasonable boundaries of financial investment. (3) We should adopt a stricter restraint mechanism for agricultural manufacturing enterprises, large-scale agricultural enterprises and state-owned agricultural enterprises, pay more attention to the financial asset investment behavior of these three types of enterprises, and strengthen correct guidance for their standardized production of the real economy.

5.3. Limitations

This study reveals some important findings, but there are still some limitations. (1) This article takes agricultural enterprises as an example to explore the impact of financialization on China's food security. The research conclusions obtained through the investigation of samples from Chinese agricultural enterprises lack universality and popularity degree. Different national conditions may bring different results. In the future, other forms of countries can be studied as the main body, such as developing countries and capitalist developed countries, countries with large population and countries with small population, and further comparative analysis can be carried out to enrich the research results. (2) Although this article draws certain conclusions from the micro-perspective of agricultural enterprise innovation, in fact, the role of the Chinese government cannot be ignored. Although the essence of enterprise innovation is the subjective behavior of companies and government intervention only plays a secondary role, its influence cannot be ignored. From the perspective of agricultural enterprises, there are many macro and micro factors that affect food security, such as government policies, management background, enterprise internal strategy, enterprise structure, and so on. Currently, these variables are still difficult to obtain from the level of data availability, but will these factors affect the stability of food security? Follow-up studies can be discussed in more depth. (3) Pay attention to the influence of financialization of agricultural enterprises on food security. This article analyzes the impact of the overall financialization of Chinese agricultural enterprises on their innovation, and compares it from three dimensions, such as the different ownership nature, the size of the enterprise and the nature of the industry. Although the two problems of whether there is a trend of financialization in Chinese agricultural enterprises and how financialization affects the innovation of Chinese agricultural enterprises and thus impacts China's food security have been solved, limited by existing research literature and the lack of technology, this article does not further analyze the problem of the degree of financialization in Chinese agricultural enterprises, which can be further discussed in future studies.

References

- [1] Molotoks A., Smith P., & Dawson T. P.(2021). *Impacts of land use, population, and climate change on global food security. Food and Energy Security (1)*, e261.
- [2] Ben Hassen T., & El Bilali H.(2022). *Impacts of the Russia-Ukraine war on global food security: towards more sustainable and resilient food systems? Foods (15)*, 2301.
- [3] Špička J., Boudný J., & Janotová B. (2009). *The role of subsidies in managing the operating risk of agricultural enterprises. Agricultural Economics (4)*, 169-180.
- [4] Sokolova A. P., & Sukhareva O. A.(2020). *Directions and efficiency of innovative development of agricultural enterprises. Complex Systems: Innovation and Sustainability in the Digital Age: Volume 1*, 401-407.
- [5] Sheng Mingquan, Wang Shun, Shang Yuping.(2018). *Financial assets allocation and entity enterprises' total factor productivity: integration of industrial-finance capital or removing reality to virtual. Finance and Trade Research (10)*, 87-97+110.
- [6] Xie Fusheng, Kuang Xiaolu.(2020). *Can manufacturing corporations increase profit rates by expanding financial activities? An example of Chinese a-share listed manufacturing corporations. Journal of Management World (12)*, 13-28.
- [7] Ma Jijie, Huang Jian.(2021). *The trend and influence of international agricultural financialization. China Finance (05)*, 56-57.
- [8] Tan Xiang, Sui Bowen, Ou Xiaoming, Zhou Canfang.(2021). *Important Issues in practicing high quality development of leading agribusinesses: a grounded research based on a single case. Journal of Management Case Studies (02)*, 134-148.
- [9] Krippner G. R. (2005). *The financialization of the American economy. Socio-economic review(2)*, 173-208.
- [10] Stockhammer E. (2004). *Financialisation and the slowdown of accumulation. Cambridge journal of economics (5)*, 719-741.
- [11] Hu Yiming, Wang Xueting, Zhang Jin. (2017).*The motivation for financial asset allocation: reservoir or substitution—evidence from Chinese listed companies. Economic Research Journal(01)*, 181-194.
- [12] Guo Liting, Zhao Sutong.(2020).*Enterprise finance, business performance and innovation investment: based on the empirical research of Chinese manufacturing enterprises listed companies. Journal of Contemporary Financial Research (06)*, 1-11.
- [13] Wang Shaohua, Shangguan Zeming, Wu Qiusheng. (2020). *How does enterprise financialization support innovation? From the perspective of financial moderation. Journal of Shanghai University of*

Finance and Economics(03), 19-34+63

[14] Wang Shaohua, Shangguan Zeming. (2019). *Monetary policy, over-financialization and enterprise innovation. Finance & Economics*(10), 45-58.

[15] Wang Yu, Qiu Yongqin, Suo Shipeng.(2021). *The nonlinear and heterogenous effect of corporate financialization on R&D investment in enterprises. Science Research Management*(12), 116-124.

[16] Zhang Qiushi, Zhang Lifang.(2021).*Financialization of strategic emerging industries and enterprise innovation:based on the moderating effects of internal control effectiveness. Science of Science and Management of S.& T.*(12), 19-34.

[17] Yan Haizhou, Chen Baizhu.(2018).*The Financial assets of industrial listed corporations: the market effect and holding motivation. Economic Research Journal* (07), 152-166.

[18] Ren Haiyun, Nie Jingchun. (2018).*Firm heterogeneity, government subsidy and R&D investment. Science Research Management* (06) ,37-47.

[19] G. E. Halkos, N. G. Tzeremes. *Productivity efficiency and firm size: an empirical analysis of foreign owned companies. International Business Review*, vol. 16, no. 06, pp. 713-731, 2007.

[20] Halkos G. E., & Tzeremes N. G. (2007). *Productivity efficiency and firm size: An empirical analysis of foreign owned companies. International Business Review*(6), 713-731.

[21] Zhu Beizhong.(2015).*Discussing the construction of an innovation-driven system for China's agricultural equipment manufacturing industry. Modern Economic Research*(03), 64-68.

[22] Fang Xianfa, Chen Zhi, Su Wenfeng. (2007).*Research on indigenous innovation strategy of Chinese agricultural equipment industry. Transactions of the Chinese Society for Agricultural Machinery* (05), 69-73.

[23] Fu Wenge, Zhao Nan, Chang Leiqing, Zhao Guodong, Hao Zhijian.(2011). *Investment value evaluation of general agricultural listed companies of a shares. Issues in Agricultural Economy*(12), 97-103+112.

[24] Shi Xuezhi, Yang Zhen.(2021). *Corporate financialization and innovation: a review from the perspective of industrial policies. Science Research Management*(04), 147-157.

[25] Xie Jiazhi, Wang Wentao, Jiang Yuan.(2014). *Manufacturing financialization, government control and technological innovation. Economic Perspectives*(11), 78-88.

[26] Du Yong, Zhang Huan, Chen Jianying.(2017).*The impact of financialization on future development of real enterprises core business: promotion or inhibition. China Industrial Economics* (12), 113-131.