Does biological assets affect the firms' cost of debt Capital? evidence from chinese listed agriculture firms

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Abstract

The Accounting Standard for biological assets was firstly issued by the Ministry of Finance of China (MOF) in February 2006 and implemented in Chinese listed companies in January 2007. This standard has become clear accounting guidelines for biological assets for Chinese listed companies. This paper examines the effect of biological assets, an agricultural characteristic asset on cost of debt capital for Chinese listed agricultural firms over the period 2007～2016. We find that biological assets have significant positive effect on cost of debt capital. The impact is mainly caused by the consumable biological assets, other than the effect of other inventory asset on cost of debt capital. The above conclusions are still valid after adopting cost of debt capital replacement metrics, the lag of the independent variable, and the two-stage regression method. Furthermore, we find that the more biological assets, the higher the cost of debt capital especially in non-state-owned enterprises with low market-oriented area. Our findings suggest that listed agricultural firms should change their business model to reduce the proportion of biological assets, set aside consumable biological assets from other inventory assets.

Keywords: Listed agricultural firm. Biological assets. Cost of debt capital.

1. Introduction

In China, agriculture is now at the critical stage of industrial transformation and upgrading. As an important microscopic entity in the agricultural economy, agricultural

companies are the main undertakers and promoters in this process. Listed agricultural companies are the leading enterprises in agricultural enterprises, and they play a leading role in the transformation and upgrading of Chinese agricultural enterprises. It has an important mission to drive farmers to increase production and income, promote the adjustment of agricultural industrial structure and promote the process of agricultural industrialization (Fan et al., 2012). Therefore, the development of listed agricultural companies has great practical significance for solving the problems of China's current agricultural industry development and farmers' poverty alleviation.

Business growth needs funds' support. However, the lack of funds' support has always been the bottleneck in Chinese agricultural development (Yao and Liu, 2011; Xu and Zhang, 2012), how to meet the funding needs of agricultural enterprises has become a key issue affecting its development. Corporate financing is mainly from equity financing and debt financing. Due to the high threshold and long process of equity financing, debt financing is an important way for Chinese companies to conduct regular financing（Wang et al., 2016；Daly and Skaife, 2016）. According to WIND database statistics, the total amount of debt financing for Chinese listed agricultural companies accounted for 41.33% in 2016. In the same period, the debt financing of all listed companies in China accounted for 52.48%. The ratio of debt financing for listed agricultural companies is low. Chinese agricultural enterprises have difficulties in financing (Zhang, 2014; Fang and Li, 2011; Wang, 2003). Then, a very important question would be what factors affect the supply of creditors' funds to listed agricultural companies. The economic theory believes that price is the decisive factor influencing supply and demand. As the price of creditor funds used by listed agricultural companies, what are the factors that affect the cost of debt capital? Whether the characteristics of listed agricultural companies affected the cost of creditors' debt financing or debt financing? Regarding the issue of debt financing of Chinese agricultural companies, some studies mainly discussed the influencing factors of debt financing and debt financing structure of agricultural companies from the combination of production and finance (Tan and Fan, 2016), agricultural value chain (Zhang, 2014), financing structure and investment scale (Yao and Liu, 2011), financing efficiency (Tian, 2009), and default risk (Xia, 2009). However, few studies concern about the factors that affect the cost of debt capital of listed agricultural companies.

Studies have shown that in debt financing activities, accounting information is the basis for contracting parties to conclude a debt contract (Smith C. and Warner J., 1979; Chen

et al., 2010). In February 2006, MOF issued firstly "Accounting Standards for Business Enterprises No. 5 - Biological Assets" (CAS5), which was implemented in Chinese listed companies in January 2007, biological assets have been recognized as an independent asset in balance sheet. Then, will biological assets, as an industry-specific asset possessed by listed agricultural company, affect the judgment of creditors on the repayment risk of agricultural companies, and in turn affect the cost of debt capital of listed agricultural companies?

Therefore, the paper empirically examines the impact of biological assets, an agricultural characteristic asset, on the company's cos of debt capital. our sample is composed of the listed companies with biological assets in China after the implementation of CAS5 over the period 2007~ 2016. Compared with existing research, this study makes several significant contributions. Firstly, we confirm the role of biological asset information in the debt contract, reflect the economic consequences of biological asset information, expand the research in biological assets, and provide some empirical evidence for Chinese biological assets standard guidelines improvement. Secondly, the study supplements the research on the debt financing of Chinese agricultural companies from the financing costs perspective and provides ideas for solving the difficulties of financing of agricultural companies.

2. Literature Review

As for listed agricultural firms, biological assets are not only an important part of their total assets, but also their most industry-specific asset. Biological assets are the resource base for agricultural operations. Inconsistent with the importance of biological assets, accounting theorists and authorities have not paid enough attention to accounting of agricultural specific biological assets for a long time (Herbohn.K and Herbohn.J，2006；Argilés and Slof, 2001). Agricultural accounting standards has been delayed. This situation has changed since 2000. The International Accounting Standards Committee firstly published specifically for agricultural accounting of IAS41 in 2000, which has been accepted by most countries in the world. In February 2006, based on IAS41, MOF firstly published CAS5, which was implemented in the listed agricultural companies on January 1st, 2007 in China. CAS5 considers biological assets as "living animals and plants related to agricultural production" including consumable biological assets, bearer biological assets, and public welfare biological assets. The consumable biological assets are current assets. Bearer biological assets and public welfare biological assets are non-current assets. The implementation of CAS5 has

become clear accounting guidelines for biological assets for Chinese listed companies (Qin and Zhang, 2006). It helps to reflect the real financial performance of listed agriculture companies' operation. In China, more and more listed companies have biological assets and engage in agricultural operation. The number of these companies are increasing from 80 in 2007 to 210 in 2016. The accounting information of biological assets have been attended increasingly by the interests of the capital market. At the same time, the research on biological assets in china has gradually aroused more and more interest (Meng, 2002;Qin, 2004; Tian et al, 2005; Qin and Zhang, 2006; Li and Wang, 2007;Liu and Wen, 2009; Wang and Zhu, 2012; Xie et al., 2014).

Since IAS41 prefers fair value measurement for biological assets, the existing research focuses more on fair value measurement related issues for biological assets. Elad (2004) believes that the implementation of IAS41 will have a greater impact on the profit of agricultural companies due to the measurement of biological assets by fair value. In addition, many theoretical problems such as the separation of biological assets and land are not solved. Therefore, it is not suitable for less developed countries. When measuring biological assets using fair value, the uncertainty of fair value leads to the instability of financial performance of agricultural enterprises (Herbohn.K and Herbohn.J, 2006; Herbohn.K, 2006；Silva.F et al.,2015). A study by Dowling and Godfrey (2001) on the measurement of biological assets in listed Australian companies finds that historical cost is more popular. In addition, studies have shown that measuring biological assets at fair value is likely to lead to tax increases (Elad, 2004), pressure to distribute dividends (Herbohn. K, 2006), management's profit manipulation (Herbohn.K, 2006; Silva.R et al., 2015), weaken the comparability of accounting information (Cairns et al., 2011), cause an increase in the cost of debt capital of related companies (Daly and Skaife, 2016), and other adverse effects. Empirical studies based on Brazilian listed companies have found that biological asset information measured by fair value is not relevant to information users (Silva Filho et al., 2013). There are more restrictions on fair value measurement (Brito et al., 2014). However, some studies have a more positive view on fair value measurement of biological assets. For example, based Spanish companies data ,Argilés et al. (2011) tests indicate that historical cost measurement and fair value measurement have no significant difference in predicting future cash flows of biological assets. However, the fair value measurement of biological assets is more predictive of future earnings.

Some studies believe that the choice of biological asset measurement attributes should be matched with the intention of asset usage. For example, Huffman (2018) believes that

based on the way in which the biological assets realize value (exchange/use) according to the corresponding measurement method (fair value/historical cost) can improve the value of relevance accounting information. In contrast with IAS41, CAS5 prefers historical cost for biological assets. The research of CAS5 mainly focuses on the formulation of biological assets accounting standards and its comparison with IAS41 (Qin, 2004; Qin and Zhang, 2006), biological assets accounting confirmation and measurement method selection (Meng, 2002; Tian et al, 2005; Liu and Wen, 2009), analysis of the quality requirements of biological asset disclosure, the status of information disclosure of listed companies' Bioassets (Wang and Zhu, 2012; Xie et al., 2014), and the impact of the implementation of CAS5 on the income of agricultural enterprises (Li and Wang, 2007; Wang and Qin, 2010; Wu et al, 2014). The above theoretical research helps to deepen the understanding of the specificity of biological assets and the impact of this particularity on biological asset accounting information. However, the existing research is more normative research, limited to the theoretical discussion of biological assets; the research on the disclosure of biological assets of Chinese agricultural listed companies is mostly a descriptive analysis of the status quo of disclosure, and the relevant research results lack rigorous empirical evidence. In addition, none of these studies have discussed the impact of biological assets on Chinese corporate debt financing.

3. Materials and Methods

3.1. Hypotheses development

Unlike companies in western developed countries, which rely on equity financing, Chinese companies rely primarily on debt financing to meet their funding requirements (Allen et al, 2005; Yu and Pan, 2008; Xu et al, 2017). Debt cost of capital is the price paid by companies for debt financing and depends mainly on the creditor's judgment of on the level of credit risk exposure, especially the default risk (Fisher, 1959). Asymmetric information exists in credit markets. Debtor has information advantage. However, creditor needs to acquire relevant information about debtor from multiple channels during the conclusion of the debt contract in order to evaluate and judge so as to determine the solvency and performance risk of the debtor, the level of the risk exposure, and the final decision on whether to issue the loan and the cost of debt capital. Compared with low risk exposure companies, creditor will require higher returns for high risk exposure companies, thus increasing the cost of debt capital. The creditor evaluates the debtor's solvency and performance risk and determines the

level of the risk exposure mainly through accounting information (Kothari et al, 2010). As the main carrier of accounting information, the financial reports can provide creditors with reliable and relevant information (Barth et al, 2001). Research shows that accounting information about assets is a major factor affecting the cost of debt capital. For example, Xu et al. (2017) find that the recognition of mergers and acquisitions of goodwill assets will lead to a decrease in the cost of debt based on the samples of Chinese listed companies. Cui and Liu (2013) state that asset attributes may affect Chinese companies' debt pricing. Chung et al. (1993) also find that oil and gas asset reserves in the oil and gas industry are the information that creditors focus on. This is because assets are the resource base for companies to engage in business activities. They have In-exchange value and In-use value (Littleton.A.,1935), which can bring expected economic benefits to companies. The impact of the expected economic benefits from assets on the cost of debt capital has two dimensions: On the one hand, the expected economic benefits from the assets can provide a reasonable guarantee for value realization of creditor's rights and reduce the credit risk of the creditors, thus could reduce the company debt financing cost, on the other hand, different assets have different ways and means to realize expected economic benefits. Assets with high risk in the realization of expected economic benefits, the confirmation of assets will increase the overall risk level of corporate assets, thus could increase companies' debt financing cost.

With respect to biological assets, since the country firstly issued CAS5 in 2006 and implemented it to listed companies in Shanghai and Shenzhen Stock Exchange, biological assets have been recognized as an independent asset in balance sheet and become an important part of the assets of agricultural companies. Biological assets are the types of assets with significant agricultural characteristics. Unlike ordinary inventory and fixed assets, biological assets have special natural value-added attributes. They can bring agricultural products or other biological products through specific biological transformation processes such as growth and reproduction to achieve the expected economic benefits. However, due to the characteristics of agricultural economic activities and biotransformation processes, the process of realizing the expected economic benefits of biological assets has greater uncertainty. On the one hand, from the in-exchange value of biological assets perspective, biological assets can realize their expected economic benefits through transfer, sale, etc., to provide creditors with reasonable guarantees. However, due to the current biological assets imperfections in China such as value assessment, property rights definition, and asset collateral, it is difficult to convert biological assets into cash (Meng,2004), thus exposes

greater risks to creditors. On the other hand, in terms of the in-use value of biological assets, biological assets can produce agricultural products or other biological assets through agricultural production activities, thus can bring cash flows and realize expected economic benefits. However, agricultural activities are naturally weak and integrate natural reproduction with economic reproduction, the influence of natural factors is more sensitive and serious than other industries (Liu, 2008). Therefore, the realization of the expected economic benefits of biological assets is greatly affected by uncontrollable natural factors. It is easy to use creditors to bear larger risks, which will increase the cost of capital. In summary, this paper proposes the following hypothesis H1:

H1: Under the same conditions, biological assets are positively related to the cost of debt capital of the listed agricultural companies.

3.2. Sample selection

Biological assets were formally appeared in the Balance Sheet after CAS5 was formally implemented in Chinese listed companies on January 1, 2007. In the Balance Sheet, consumable biological assets are classified as inventory items, and bearer biological assets and public welfare biological assets are separately listed or listed as other long-term assets. Therefore, this paper selects annual reports of Chinese listed companies with biological assets disclosure over the period 2007-2016 as the initial observations.

We then collect consumable biological assets, bearer biological assets, and public welfare biological assets based on inventory details, bearer biological assets, public welfare biological assets, and other long-term asset details from the CSMAR database. In the end, a total of 1,431 company annual reports with biological assets are obtained and cross-reference with the WIND database. After eliminating annual reports with missing relevant variables, our final sample includes 1301 company annual reports. The relevant research data is based on the CSMAR database except for the basic loan interest rate that comes from the WIND database. All continuous variables are processed in Winsorize on 1% and 99% quantiles.

3.3. Research variables

The explained variable is cost of debt capital (*COD*). Following prior research (Pittman and Fortin ,2004;Jiang,2009）, Cost of Debt Capital (*COD*) is equal to total interest

expenses divided by average of long-term and short-term debt. Among them, total interest expenses include interest expenses and capitalized interest. Short-term liabilities include short-term loans and long-term loans due within one-year. Long-term liabilities include long-term loans, bonds payable, long-term payables, and other long-term liabilities.

The explanatory variable is biological asset (*Bio*). Biological Asset (*Bio*) is equal to biological assets at the end of current period divided by total assets at the end of the current period.

In order to better separate the impact of the biological asset on the company's cost of debt capital, this paper controls other factors that may affect the company's cost of debt capital. Following prior research (Pittman and Fortin,2004; Jiang, 2009; Xu et al., 2017), this paper controls the following variables: Current year refinancing (*Offer*); Profitability (*ROA*); Company Size (*Size*); Growth (*Growth*); Asset-liability ratio (*Lev*); proportion of tangible assets (*Tang*); proportion of independent board directors (*IDP*); two-in-one (*Dual*); executive compensation (*Wage*); Shareholding ratio of the largest shareholder (*Top1*); Type of audit opinion (*Opinion*); Nature of equity (*SOE*); Base loan interest rate (*Rate*); In addition, we also control annual and industry fixed effects.

3.4. Model

To test hypothesis, this paper constructs a multiple linear regression model as follows:

$$COD_{i.t} = \beta_0 + \beta_1 * Bio_{i,t} + \beta_i * Controls_{i,t} + Fixedeffects + \varepsilon_{i,t} \quad (1)$$

Among them, *COD* is cost of debt capital, *Bio* is the Proportion of biological assets, and the remaining variables are related to relevant control variables. The specific definition of variables is shown in Table 1. Controls represent related control variables. *Fixedeffects* represent fixed effects of the year and industry. If β_1 in the model (1) is significantly positive, it indicates that the biological asset is positively related to cost of debt capital. Hypothesis is verified.

Table 1: Definitions of major research variables

Variable type	variable name	Definition
Explained	COD	Cost of debt capital equal to the total interest expense divided by the

variable		average of long- and short-term debt
Explanatory variables	Bio	Biological asset equal to biological assets at the end of current period divided by the total assets at the end of the period
	Offer	Refinancing equal to one if there is additional issuance or allotment in the year, zero otherwise
	ROA	Profitability equal to operating profit divided by total assets at the end of the period
	Size	The size of the company equal to the natural logarithm of the total assets at the end of the period
	Growth	Growth equal to operating income growth ratio
	Lev	Asset-liability ratio equal to total liabilities divided by total assets at the end of period
	Tang	Proportion of tangible assets equal to the total of inventory and fixed assets divided by total assets at the end of the period
Control variable	IDP	The proportion of independent board directors equal to the proportion of independent board directors to the total number of board directors
	Dual	Combination of the two positions. If the chairman and the general manager are the same person, equal to one, zero otherwise
	Wage	Executive compensation equal to the natural logarithm of top three executives' total compensation
	Top1	Shareholding ratio of the largest shareholder
	Opinion	Type of audit opinion. If it is a standard unreserved opinion for the current year, equal to one, zero otherwise
	SOE	The nature of equity. If it is a state-owned company, equal to one, zero otherwise
	Rate	Basic loan interest rate equal to 1 to 3 years central bank base interest rate

3.5. Descriptive statistics

The descriptive statistics of the relevant variables in this paper are shown in Table 2. The mean and median of *COD* are 0.059 and 0.0578 respectively. This indicates that the average cost of debt capital was 5.9% in this sample, which is basically consistent with the findings of Jiang (2009). A standard deviation of 0.0397 for *COD* indicates that the indicator does not have large differences in the sample. The minimum and maximum values of *COD* are 0 and 0.273 respectively. This suggests that some companies have a relatively high cost of debt capital, reaching 27.3%.

The mean and median of *Bio* (biological assets) are 0.0442 and 0.0071 respectively. This suggests that the ratio of biological assets to total assets of the company is generally low. The minimum and maximum values of *Bio* are 0 and 0.457 respectively. This suggests that the proportion of biological assets compared with the total assets for some companies is very small, which is almost 0 and some companies are as high as 45.7%. Different companies have great different *Bio*. The average value of the *Offer* (refinancing) is 0.122, which indicates that 12.2% of companies have additional issuance or allotment in current year. The data of indicators such as *ROA*, *Size*, *Growth*, *Lev*, *Tang*, *IDP*, *Dual*, and *Wage* shows little difference

within the sample. The average value of *Top1* (shareholding ratio of the largest shareholder) is 35.77 and the standard deviation is 14.97.

This indicates that there is a certain difference in shareholder ratio of the largest shareholder. The average value of *Opinion* (audit opinion type) is 95.5%. This indicates that the vast majority of companies received standard unqualified audit opinions. The average value of *SOE* (equity property) is 43.8%. This suggests that most of the sample companies were non-state-owned enterprises. The average of the *Rate* (base loan interest rate) is 5.976 with a standard deviation of 0.738. This suggests that the indicator does not have large differences in the sample.

Table 2: Descriptive statistics of major variables

variable name	n	Mean	Std	Min	Q1	Median	Q3	Max
COD	1301	0.0590	0.0397	0	0.0413	0.0578	0.0709	0.273
Bio	1301	0.0442	0.0868	0	0.0009	0.0071	0.0375	0.457
Offer	1301	0.122	0.328	0	0	0	0	1
ROA	1301	0.0404	0.0689	-0.221	0.0098	0.0332	0.0707	0.269
Size	1301	22.08	1.186	19.50	21.21	22.00	22.83	25.26
Growth	1301	0.237	0.672	-0.554	0.0009	0.120	0.263	5.034
Lev	1301	0.484	0.217	0.0774	0.320	0.481	0.630	1.136
Tang	1301	0.462	0.171	0.0754	0.337	0.457	0.586	0.854
IDP	1301	0.371	0.0550	0.273	0.333	0.333	0.400	0.571
Dual	1301	0.228	0.419	0	0	0	0	1
Wage	1301	14.00	0.835	12.28	13.36	13.99	14.56	15.98
Top1	1301	35.77	14.97	8.440	24.03	34.39	46.78	71.62
Opinion	1301	0.955	0.206	0	1	1	1	1
SOE	1301	0.438	0.496	0	0	0	1	1
Rate	1301	5.976	0.738	4.750	5.366	6.245	6.511	7.368

4. Results

4.1. Main Tests

Table 3 presents the regression results of the impact of biological assets on cost of debt capital. Column (1) presents regression results with no controlling year and industry fixed effects; Column (2) presents the regression results of control year and industry fixed effects; Column (3) presents the regression results after distinguishing between current biological assets and non-current biological assets. As CAS5 combines consumable biological assets with other inventory items in the inventory item in the balance sheet, column (4) further presents the regression results of the different impact of consumable biological assets and other inventory items on the cost of debt capital.

Table 3: Biological Assets and Cost of Debt Capital

Dependent variable	(1) *COD*	(2) *COD*	(3) *COD*	(4) *COD*
Bio	0.0283**	0.0274**		
	(2.40)	(2.11)		
LBio			0.0399***	0.0493***
			(2.72)	(2.98)
NBio			-0.0000	-0.0000
			(-1.50)	(-1.61)
CInventory				-0.0467***
				(-4.36)
Fixed				-0.0286***
				(-2.82)
Tang	-0.0414***	-0.0327***	-0.0366***	
	(-5.46)	(-4.07)	(-4.33)	
Offer	0.0059*	0.0034	0.0034	0.0033
	(1.87)	(1.02)	(1.03)	(1.02)
ROA	-0.0196	0.0012	-0.0026	-0.0007
	(-0.81)	(0.05)	(-0.11)	(-0.03)
Size	-0.0021	-0.0048***	-0.0050***	-0.0050***
	(-1.46)	(-3.15)	(-3.23)	(-3.24)
Opinion	-0.0186**	-0.0182**	-0.0180**	-0.0183**
	(-2.17)	(-2.17)	(-2.16)	(-2.19)
Growth	0.0035	0.0042	0.0043	0.0044
	(1.22)	(1.53)	(1.56)	(1.58)
Lev	0.0255***	0.0359***	0.0345***	0.0341***
	(2.63)	(3.66)	(3.55)	(3.52)
SOE	-0.0051**	-0.0040	-0.0030	-0.0029
	(-2.12)	(-1.60)	(-1.22)	(-1.17)
IDP	-0.0179	-0.0096	-0.0110	-0.0133
	(-1.06)	(-0.60)	(-0.68)	(-0.80)
Dual	0.0001	-0.0004	-0.0003	-0.0007
	(0.03)	(-0.15)	(-0.13)	(-0.27)
Wage	-0.0027	-0.0038**	-0.0037**	-0.0039**
	(-1.60)	(-2.17)	(-2.13)	(-2.23)
Top1	-0.0002***	-0.0002***	-0.0002***	-0.0002**
	(-3.39)	(-2.98)	(-2.76)	(-2.52)
Rate	0.0015	-0.0048	-0.0046	-0.0048
	(0.83)	(-1.55)	(-1.49)	(-1.55)
Intercept Item	0.1756***	0.2636***	0.2674***	0.2710***
	(5.24)	(6.43)	(6.52)	(6.54)
Annual fixed effect	Uncontrolled	control	control	control
Industry fixed effect	Uncontrolled	control	control	control
Observations	1,301	1,301	1,301	1,301
R-squared	0.100	0.172	0.176	0.178

Note: *** is 1% significance level; ** means 5% significance level; * means 10% significance level. The same hereinafter.

The results in column (1) show that the estimated coefficient of *Bio* (biological assets) is 0.0283 and is significant at the 5% level; In the regression result of column (2), the estimated coefficient of *Bio* (biological assets) is 0.0274 and is also significant at the 5% level. This indicates that the biological asset information has a certain debt contract governance function. For every one percentage point increase in the of biological assets, the cost of debt capital cost will increase 0.0274 percentage points. Hypothesis is initially

verified. In the regression results of column (3), the estimated coefficient of *LBio* (current biological assets) is 0.0399 and is significant at the 1% level, while *NBio* (non-current biological assets) is negatively correlated with the cost of debt capital but not significant.

These findings indicate that the impact of biological assets on debt capital costs is mainly due to current biological assets. In the regression results in column (4), the estimated coefficient of *LBio* (current biological assets, or consumable biological assets) is significantly positive at the 1% level. Other inventory items and tangible assets after deducting the consumption of biological assets, the estimated coefficients are all significantly negative at the 1% level. This indicates that the general assets of listed agricultural companies, such as non-biological assets inventory, fixed assets and other tangible assets, have played a positive effect on the cost of debt capital and reduced the cost of debt financing.

The biological assets (mainly consumable biological assets) have a negative effect on the cost of debt capital and increase the cost of debt financing. Thus, the consumable biological assets and other inventories have a heterogeneous impact on cost of debt capital and have different meanings for Creditors. Therefore, it is not appropriate to list biological assets with other inventories together in the existing CAS5. From usefulness of accounting information for decision-making perspective, the next step should be to separate these two assets in the revision of CAS5. In addition, from the test results of the relevant control variables, if the estimated coefficient of size (corporate size) is significantly negative, it indicates that the larger scale of the company, the lower the cost of its debt capital; If the coefficient of estimation of Lev (asset-liability ratio) is significantly positive, it indicates that the higher the degree of corporate debt, the higher the cost of debt capital; If the estimated coefficient of Opinion (audit opinion type) is significantly negative, it indicates that the lower the cost of debt capital when the company is issued a standard unreserved report. These results are in line with our expectations and are consistent with previous research.

4.2. Robustness test

4.2.1. Replace metrics for cost of debt capital

As there are currently many measurement methods for cost of debt capital in China, this paper uses Zou and Adams (2008)'s measurement methods to measure cost of debt capital. *COD1* (Cost of Debt Capital) equal to the total interest expense (interest expense plus capitalized interest) divided by the average of the total liabilities at the end of the year and at

the beginning of the year. It is tested. Table 4 presents the regression results after changing cost of debt capital metrics. The above study found no substantial changes.

Table 4: Robustness test: replacement of debt capital cost metrics

Dependent variable	(1) *COD1*	(2) *COD1*	(3) *COD1*
Bio	0.0144**		
	(2.29)		
LBio		0.0167**	0.0275***
		(2.35)	(3.50)
NBio		0.0000	0.0000
		(0.26)	(0.04)
CInventory			-0.0124***
			(-2.90)
Fixed			0.0088**
			(2.23)
Tang	-0.0003	-0.0009	
	(-0.08)	(-0.28)	
Offer	0.0026*	0.0025*	0.0025*
	(1.92)	(1.91)	(1.92)
ROA	-0.0492***	-0.0498***	-0.0473***
	(-5.38)	(-5.39)	(-5.16)
Size	0.0009	0.0009	0.0009
	(1.57)	(1.56)	(1.63)
Opinion	0.0021	0.0022	0.0018
	(0.78)	(0.79)	(0.64)
Growth	0.0015*	0.0015*	0.0016*
	(1.85)	(1.86)	(1.93)
Lev	0.0210***	0.0207***	0.0202***
	(6.86)	(6.76)	(6.59)
SOE	-0.0066***	-0.0065***	-0.0064***
	(-6.44)	(-6.27)	(-6.20)
IDP	0.0001	-0.0002	-0.0030
	(0.02)	(-0.02)	(-0.41)
Dual	0.0022**	0.0022**	0.0018*
	(1.98)	(1.99)	(1.66)
Wage	-0.0038***	-0.0038***	-0.0040***
	(-4.88)	(-4.87)	(-5.23)
Top1	-0.0001*	-0.0000	-0.0000
	(-1.74)	(-1.61)	(-1.18)
Rate	-0.0008	-0.0008	-0.0011
	(-0.71)	(-0.68)	(-0.96)
Intercept Item	0.0587***	0.0591***	0.0636***
	(3.90)	(3.92)	(4.29)
Industry fixed effect	control	control	control
Annual fixed effect	control	control	control
Observations	1,301	1,301	1,301
R-squared	0.298	0.298	0.311

4.2.2. The independent variable lags behind by one period

When creditors obtain company information, there is a certain lag and it is difficult to obtain timely data in the current period. Therefore, when making investment decisions, they

often use prior period-end financial statements for risk assessment. For this reason, we use the lag of one-period independent variables for regression. Table 5 presents the regression results of all independent variable lags. The main study found no change.

Table 5: Robustness test: the lag of the independent variable

Dependent variable	(1) *COD*	(2) *COD*	(3) *COD*
L.Bio	0.0207*		
	(1.84)		
L.LBio		0.0313**	0.0420***
		(2.44)	(3.05)
L.NBio		-0.0000*	-0.0000*
		(-1.69)	(-1.79)
L.CInventory			-0.0414***
			(-3.67)
L.Fixed			-0.0205**
			(-2.36)
L.Tang	-0.0254***	-0.0299***	
	(-3.25)	(-3.65)	
L.Offer	0.0082**	0.0080**	0.0081**
	(2.37)	(2.34)	(2.35)
L.ROA	-0.0485*	-0.0536**	-0.0508*
	(-1.86)	(-2.05)	(-1.94)
L.Size	-0.0047***	-0.0048***	-0.0049***
	(-3.09)	(-3.16)	(-3.20)
L.Opinion	-0.0126	-0.0123	-0.0126
	(-1.55)	(-1.53)	(-1.57)
L.Growth	0.0003	0.0004	0.0005
	(0.16)	(0.25)	(0.31)
L.Lev	0.0281***	0.0265***	0.0259**
	(2.73)	(2.59)	(2.53)
L.SOE	-0.0053**	-0.0044*	-0.0041*
	(-2.24)	(-1.85)	(-1.73)
L.IDP	-0.0131	-0.0145	-0.0177
	(-0.82)	(-0.91)	(-1.10)
L.Dual	0.0030	0.0029	0.0026
	(1.07)	(1.06)	(0.96)
L.Wage	-0.0024	-0.0024	-0.0027*
	(-1.64)	(-1.64)	(-1.79)
L.Top1	-0.0001	-0.0001	-0.0001
	(-1.39)	(-1.17)	(-0.92)
Rate	0.0007	0.0009	0.0006
	(0.28)	(0.34)	(0.22)
Intercept Item	0.2041***	0.2090***	0.2147***
	(5.70)	(5.83)	(5.85)
Industry fixed effect	control	control	control
Annual fixed effect	control	control	control
Observations	990	990	990
R-squared	0.184	0.188	0.192

4.2.3. Endogenous problems

The above findings may have endogenous problems. For example, study show that the

performance of the listed agricultural companies in China is poor and unstable (Fan et al., 2012). The increase in cost of debt capital of the listed agricultural companies may be due to their poor performance and cause "pseudo-correlation". In order to correct this endogenous bias, this paper uses two-stage least squares method to verify. In this paper, *Bio_Mean* (industry average biological assets) is used as a tool variable because biological assets usually need to occupy a certain amount of land resources and the total amount of land resources that can be used for agricultural production in a given period of time is limited.

The more land resources occupied by a certain company, the less the land resources that can be used for other companies to manage agricultural production. Therefore, the industry average biological assets will affect a company's biological assets but the impact on cost of debt capital is very small. It can be used as a better instrumental variable. For the same reason, *LBio_mean* (Industrial Average Consumable biological assets) is selected as a tool variable in the inspection of current biological assets (or consumable biological assets). The first stage of the instrumental variable method returns the following model:

$$Bio_{i.t} = \beta_0 + \beta_1 * Bio\_Mean_{i,t} + \beta_i * Controls_{i,t} + Fixedeffects + \varepsilon_{i,t} \quad (2)$$

$$Bio_{i.t} = \beta_0 + \beta_1 * LBio\_Mean_{i,t} + \beta_i * Controls_{i,t} + Fixedeffects + \varepsilon_{i,t} \quad (3)$$

Table 6 presents the regression results of instrumental variables. Columns (4)-(6) show the results of the first phase of regression. F statistics are all greater than 10, suggesting that the selection of instrumental variables is reliable and there is no problem with weak instrumental variables. The estimated coefficients of *Bio_Mean* (industry average biological assets) and *LBio_mean* (industry average consumable biological assets) are significantly negative at the 1% level, suggesting that when other companies' biological assets in the industry rise, the company's biological assets will decline due to the limited nature of agricultural land resources. Columns (1)-(3) present the regression results for the second stage of instrumental variables. In the regression results for column (1), the estimated coefficient for Bio (biological assets) is significantly positive, indicating that the biological assets are positively related to cost of debt capital; In the regression results for columns (2) and (3), the estimated coefficients of *LBio* (consumable biological assets) are all significantly positive at the 1% level, suggesting that the consumptive biological assets are positively related to cost of debt capital.

Table 6: Robustness test: Endogenous issues

Dependent variable	*(1)*	(2)	(3)	(4)	(5)	(6)
	Second stage return			*First-phase regression*		
	COD	*COD*	*COD*	*Bio*	*LBio*	*LBio*
Bio	0.1337*					
	(1.83)					
LBio		0.1467***	0.1670***			
		(2.61)	(2.69)			
Bio_mean				-1.0847***		
				(-6.11)		
LBio_mean					-1.4639***	-1.3183***
					(-6.01)	(-6.06)
NBio		-0.0000	-0.0000		-0.0000***	-0.0000***
		(-0.32)	(-0.51)		(-6.66)	(-6.37)
CInventory			-0.0680***			0.2123***
			(-3.94)			(9.57)
Fixed			-0.0309***			0.0338**
			(-2.88)			(2.32)
Tang	-0.0413***	-0.0478***		0.1104***	0.1294***	
	(-3.46)	(-4.14)		(8.70)	(8.31)	
Offer	0.0039	0.0039	0.0038	-0.0031	-0.0025	-0.0019
	(1.19)	(1.18)	(1.16)	(-0.51)	(-0.51)	(-0.40)
ROA	0.0084	0.0005	0.0045	-0.0076	0.0222	0.0006
	(0.34)	(0.02)	(0.18)	(-0.21)	(0.54)	(0.01)
Size	-0.0028	-0.0031*	-0.0031*	-0.0120***	-0.0104***	-0.0096***
	(-1.61)	(-1.93)	(-1.90)	(-5.04)	(-5.11)	(-4.98)
Opinion	-0.0164*	-0.0165*	-0.0168*	-0.0353***	-0.0316*	-0.0268
	(-1.73)	(-1.79)	(-1.83)	(-3.37)	(-1.92)	(-1.63)
Growth	0.0038	0.0040	0.0041	0.0057*	0.0044	0.0035
	(1.35)	(1.43)	(1.46)	(1.90)	(1.09)	(0.99)
Lev	0.0330***	0.0304***	0.0292***	0.0241*	0.0349**	0.0374**
	(3.19)	(2.91)	(2.77)	(1.93)	(2.30)	(2.55)
SOE	-0.0049*	-0.0030	-0.0026	0.0023	-0.0070*	-0.0081**
	(-1.96)	(-1.19)	(-1.03)	(0.52)	(-1.79)	(-2.14)
IDP	-0.0086	-0.0115	-0.0170	0.0208	0.0350	0.0585
	(-0.53)	(-0.70)	(-0.99)	(0.57)	(0.83)	(1.53)
Dual	-0.0003	-0.0002	-0.0009	-0.0042	-0.0052	-0.0012
	(-0.10)	(-0.06)	(-0.33)	(-0.86)	(-1.12)	(-0.28)
Wage	-0.0034*	-0.0034*	-0.0038**	-0.0051	-0.0045	-0.0020
	(-1.90)	(-1.94)	(-2.18)	(-1.62)	(-1.49)	(-0.69)
Top1	-0.0002***	-0.0002**	-0.0002**	-0.0001	-0.0002*	-0.0003***
	(-3.02)	(-2.52)	(-2.09)	(-0.40)	(-1.86)	(-2.86)
Rate	-0.0029	-0.0027	-0.0032	-0.0195***	-0.0230***	-0.0182***
	(-0.78)	(-0.78)	(-0.93)	(-4.05)	(-4.62)	(-3.90)
Intercept Item	0.1945***	0.2065***	0.2140***	0.6831***	0.6229***	0.5257***
	(3.22)	(4.14)	(4.36)	(10.27)	(8.02)	(7.64)
Annual fixed effect	control	control	control	control	control	control
Industry fixed effect	control	control	control	control	control	control
Observations	*1,271*	*1,271*	*1,271*	*1,271*	*1,271*	*1,271*
R-squared	0.174	0.177	0.177	0.398	0.394	0.447
F	-	-	-	19.9575	36.13	36.7236

From the test results of instrumental variables, the conclusions of this paper have not changed after considering endogenous problems and are still robust.

4.3. Further analysis

4.3.1. Influence of the nature of equity

Compared with non-state-owned enterprises, Chinese state-owned enterprises received better treatment when they apply for a loan. It is easier for them to obtain the required loans. The government will favor state-owned enterprises in many resource allocations, which is equivalent to providing invisible guarantees for state-owned enterprises. Therefore, it is easier for them to obtain various kinds of subsidies and access to loans (Sun et al., 2006).

Non-state-owned enterprises undertake higher debt financing costs (Li and Liu, 2009). Even when the currency contracted, credit funds are still tilted toward state-owned enterprises (Ye and Zhu, 2009), which virtually increased the pressure on external financing for non-state-owned enterprises. Therefore, it is expected that the creditors of state-owned enterprises will be less sensitive to biological assets than non-state-owned enterprises. In order to test the above assumptions, this paper shows the regression results of listed companies into the two sub-samples: state-owned and non-state-owned enterprises according to the nature of the equity. Columns (1) and (2) in Table 7 show the results of grouped regressions for state-owned and non-state-owned companies, respectively. It finds that the estimated coefficient for Bio (biological assets) in column (1) is 0.0128, but not significant.

The estimated coefficient is significantly positive in column (2). It suggests that the impact of biological assets on cost of debt capital is more prominent in non-state-owned enterprises and is consistent with expectations.

4.3.2. Influence of marketization

The external institutional environment can affect firms' cost of debt financing. Due to the differences in resource endowments, geographic locations, and national policies, the degree of marketization in various regions in China is quite different. The level of marketization has a significant impact on firms' cost of debt financing (Sun et al., 2005). In areas with a low degree of marketization, the greater constraints on firms' cost of debt financing, the more difficulty, and the more expensive of financing are prominent (Yu and Pan, 2008).

Therefore, this paper expects that the impact of biological assets on cost of debt

capital will be more pronounced in companies with low degree of marketization. In order to test the above speculations, this paper uses the Wang et al. (2017)'s index of China's marketization process and divides the research sample into two categories: high degree of marketization and low degree of marketization according to the median of the index of marketization process in the region where the listed company is located.

Column (3) and (4) in Table 7 show group regression results with high degree of marketization and low degree of marketization, respectively. It finds that the estimated coefficient of Bio (biological assets) in column (3) is 0.028 and insignificant. However, the estimated coefficient in column (4) is 0.0318 and significant at the level of 5%. It indicates that biological assets increase the cost of debt capital is even more pronounced in companies with low levels of marketization, which is consistent with expectations.

Table 7: Further analysis of the nature of equity and degree of marketization

Dependent variable	(1) State-owned enterprises COD	(2) Non-state-owned enterprises COD	(3) High degree of marketization COD	(4) Low degree of marketization COD
Bio	0.0128	0.0471*	0.0278	0.0318**
	(0.86)	(1.84)	(1.28)	(2.01)
SOE			-0.0009	-0.0043
			(-0.23)	(-1.06)
Offer	0.0044	0.0014	0.0066*	0.0028
	(0.76)	(0.37)	(1.66)	(0.51)
ROA	0.0404	-0.0140	-0.0538	0.0702*
	(1.09)	(-0.42)	(-1.60)	(1.76)
Size	-0.0086***	-0.0023	-0.0024	-0.0069***
	(-3.75)	(-1.04)	(-1.16)	(-2.89)
Opinion	-0.0113	-0.0235*	-0.0336**	-0.0102
	(-1.00)	(-1.81)	(-2.20)	(-1.06)
Growth	-0.0012	0.0072*	0.0053	0.0025
	(-0.44)	(1.96)	(1.09)	(0.86)
Lev	0.0518***	0.0319**	0.0089	0.0611***
	(4.10)	(2.16)	(0.75)	(4.27)
Tang	-0.0555***	-0.0170	-0.0337***	-0.0402***
	(-4.30)	(-1.53)	(-3.02)	(-3.20)
IDP	-0.0168	-0.0030	0.0059	0.0066
	(-0.80)	(-0.11)	(0.31)	(0.25)
Dual	-0.0024	-0.0011	-0.0012	-0.0010
	(-0.42)	(-0.40)	(-0.44)	(-0.21)
Wage	0.0008	-0.0071***	-0.0045**	-0.0041
	(0.26)	(-3.22)	(-2.02)	(-1.35)
Top1	-0.0003**	-0.0002*	-0.0003***	-0.0002
	(-2.22)	(-1.66)	(-2.87)	(-1.52)
Rate	-0.0033	-0.0057	-0.0051	-0.0057
	(-0.73)	(-1.28)	(-1.26)	(-1.40)
Intercept Item	0.2706***	0.2546***	0.2521***	0.2883***
	(4.47)	(4.40)	(4.30)	(4.80)

Annual fixed effect	control	control	control	control
Industry fixed effect	control	control	control	control
Observations	570	731	675	626
R-squared	0.197	0.210	0.183	0.224

5. Conclusion

As an agriculture characteristic asset, does biological assets affect the firms' cost of debt capital? To answers this question, it is of great significance not only for an in-depth understanding of the relationship between agricultural characteristic assets and external financing in the agricultural sector, but also for solving the financing difficulties of agricultural enterprises.

This paper examines the impact of biological assets on the cost of debt capital based on Chinese listed agriculture companies over the period 2007-2016. The study finds that the more biological assets the listed agricultural companies own, the higher the cost of debt financing. This paper further examines the association between the current and noncurrent of two types of biological assets to firms' cost of debt capital and finds that only the consumable biological assets have a significant positive correlation with cost of debt capital. It indicates that creditors in China are mainly concerned about the consumable biological assets of listed agricultural companies.

The CAS5 does not set aside current biological assets from other assets and put them together as inventory items in balance sheet. Based on the above examines, this paper further studies the different impact of current biological assets and other inventory items on firms' cost debt financing. As a result, we find that there is significantly positive correlation with current biological assets and cost of debt financing. However, there is significantly negative correlation with other inventory items and cost of debt financing. It indicates that it is unreasonable for the current CAS5 to combine consumable biological assets with other inventory asset into inventory item in the balance sheet. The above conclusions are still valid after adopting the metrics of cost of debt capital replacement, the lag of the independent variable, and the two-stage regression method. In addition, the paper also finds that the impact of biological assets on cost of debt capital is significant in non-state-owned enterprises and regions with low degree of marketization. It indicates that the effect of biological asset on cost of debt capital is more pronounced in companies with financing difficulties. The research conclusion of this paper shows that the creditor will adjust the credit decision based on the

biological asset. Biological asset is an important information content in debt contract.

The conclusions of this paper have the following two main policy implications: First of all, the listed agricultural companies can change their business models through cooperative changes such as "company + farmer" or "company + cooperative + farmer households" to transfer their biological assets to cooperatives and farmers, thus can reduce the proportion of biological assets they have in their own agricultural operations.

Second, the consumable biological assets and general inventory have different effects on cost of debt capital and the creditors will treat the consumable biological differently from other assets. Therefore, it is unreasonable that China CAS5 combines consumable biological assets with other inventory items as inventory item in the balance sheet and should set aside consumable biological assets from other inventories as assets in the balance sheet.

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