Intellectual capital and its impact on cost of debt capital of agricultural listed companies in China

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Abstract

Intellectual capital (IC) as an important strategic resource drives firms' competitiveness and performance. The objective of this paper is to investigate the impact of IC on cost of debt capital based on the data from 35 Chinese agricultural listed companies over the period 2014-2020. Value Added Intellectual Coefficient (VAIC) model is employed as a measurement of IC, and cost of debt capital is measured by dividing interest expenses by average short-term and long-term debt. The empirical results show that IC has no significant impact on cost of debt capital. Regarding IC components, human capital (HC) negatively and significantly affects cost of debt capital, while physical and structural capitals have no significant impact. In addition, for agricultural companies with low levels of IC, there is a negative relationship between HC and cost of debt capital. This paper might provide some insights for corporate managers to improve firm performance and lower the cost of capital in the market by efficient management of IC resources.

Keywords: Intellectual capital. Cost of debt capital. Agricultural listed companies.

1. Introduction

Capital is the basis of corporate development, and different types of capital play different roles in the development of social production. With the improvement of productivity, the society will inevitably change from capital-driven to knowledge-driven. In the era of knowledge economy, intellectual capital (IC) as an important competitive resource is of great significance to the comprehensive strength of a country, a region, or an enterprise (Xu and Wang, 2018; Vidyarthi and Tiwari, 2019; Xu and Li, 2019; Zeng *et al*., 2021; Vo and Tran, 2022). IC plays a more and more important role in the process of value creation (Zéghal and Maaloul, 2011).

Firms' financial activities begin with the financing behaviors (Su, 2017). Cost of debt capital is crucial to corporate performance and sustainable development (Fonseka *et al*., 2020). The external financing of Chinese listed companies is dominated by debt financing, especially bank borrowings (Xie *et al*., 2019). Higher cost of debt capital leads to a reduction in financing efficiency and operating profit, thus affecting the long-term development of companies (Yazdanfar and Öhman, 2021). The study on how companies can obtain debt at a lower cost has been the focus of scholars and practitioners.

Agriculture is a capital-intensive industry, and capital structure has a great impact on its sustainable development (Liu *et al*., 2020; Xu *et al*., 2021). This sector is considered as a strategic sector because it fulfills economic, social and environmental functions (Xu and Wang, 2019; Hornungová, 2022). It is evidenced that IC investment in China's agricultural sector is not sufficient (Xu and Wang, 2020; Zhang *et al*., 2021). In addition, IC research in agribusiness attracts little attention except Scafarto *et al*. (2016), Kozera-Kowalska and Baum (2018), Xu and Wang (2019, 2020), Kozera-Kowalska (2020), Xu *et al*. (2020), Ivanovic *et al*. (2021), Ovechkin *et al*. (2021), Xu and Zhang (2021), Jin and Xu (2022), and Balaji and Mamilla (2023). Although most studies on IC have investigated how IC improves firm performance (Xu and Li, 2019; Xu and Liu, 2021), what is less clear is the impact of IC on cost of debt capital. Therefore, understanding this relationship is of great significance for corporate managers to lower firms' cost of debt with the utilization of IC resources.

This study aims to investigate the relationship between IC and cost of debt capital of Chinese agricultural listed companies. We address two issues in this study. First, we aim to test whether IC and its components impact cost of debt capital. Second, we investigate whether the level of IC influences this relationship. Pulic (2000)'s Value Added Intellectual Coefficient (VAIC) model is used as a measurement of IC, and cost of debt capital is measured by dividing interest expenses by average short-term and long-term debt.

The contributions of this study are as follows. First, little has been done on the value of IC from the perspective of cost of capital, and this study makes a first attempt to fill this gap. Second, it will help managers to make rational investment strategies by managing IC resources in order to realize the minimum rate of return required by investors and maintain a sustainable source of funds for corporate development. Finally, it can contribute to help investors increase their attention to corporate IC to reasonably assess their investment risks and promote the improvement of capital allocation efficiency.

The remainder of this paper is as follows. Section 2 presents the literature review and hypotheses development. Section 3 presents the research methodology, and Section 4 reports

the empirical results. Finally, Section 5 concludes the paper with some policy implications.

2. Literature Review and Hypotheses Development

2.1. IC definition and measurement

Although the field of IC continues to grow, its definition is still inconsistent (Dzenopoljac *et al*., 2017). Following Edvinsson and Sullivan (1997), IC is viewed as knowledge that has the potential to be converted into company value. Stewart (1997) defined it as the sum of everything everybody in a company knows that brings a competitive edge.

Because of its intangible nature, it is quite difficult to categorize, define or measure IC. Among IC measurement methods, the VAIC model proposed by Pulic (2000) is widely accepted and used by Su (2016), Xu and Wang (2019), Xu *et al*. (2019), Petković *et al*. (2020), Pavlović *et al*. (2021), Gul *et al*. (2022), Nguyen (2023), and Skhvediani *et al*. (2023). The VAIC is estimated based on three elements, including capital employed efficiency (CEE), human capital efficiency (HCE), and structural capital efficiency (SCE). The sum of HCE and SCE is IC efficiency (ICE). The application of this method is simple, which allows comparison across firms and countries (Firer and Williams, 2003). The data used can be obtained from the audited financial statements, which can be verifiable. It distinguishes the sources of the value added of IC and examines the value of IC from the perspective of investment efficiency. However, the VAIC method is also affected by the choice of accounting policies (such as depreciation choices).

2.2. Hypotheses development

IC can provide firms with a competitive advantage and generate more profits (Xu and Wang, 2018; Petković *et al*., 2020; Lu *et al*., 2021). Competitive firms can capture market opportunities and reduce financing constraints and transaction costs. IC cannot be completely reflected in the traditional financial statements (Firer and Williams, 2003). In essence, IC as an intangible asset is an economic resource controlled by the firm. In order to avoid risks, fund providers increasingly favor asset-based financing (Sun, 2012). Therefore, IC and traditional physical capital can be used as a guarantee for investors' required return. It also has financing functions, which can enhance investors' confidence and affect the cost of capital including cost of equity capital and cost of debt capital. Based on the above arguments, we come to the following hypothesis:

H1: The aggregate IC can reduce the cost of debt capital.

ICE and CEE reflect the ability of enterprises to create value by using IC and physical capital, respectively, and their summation reflects the overall level of firms' IC. The inherent characteristics of IC and physical capital might lead to significant differences in the value creation ability. Specifically, the unimitability of IC such as management capabilities and technical secrets can enable firms to maintain their competitive advantage for a long time. On the contrary, physical capital has an easy-to-imitate feature, and its value is usually decreased over time.

Some empirical studies showed that the value creation efficiency of IC is higher than that of physical capital. For example, Ma and Chen (2014) pointed out that the impact of HC on economic growth is greater than that of physical capital in China's cultural industry. Nguyen (2023) found that HC as an IC element has the strongest positive impact on financial performance of service firms. These provide evidence for the significant difference between the value-added efficiency of IC and physical capital. Investors usually have more confidence in firms with a high level of IC over a longer period of time, and are willing to lower their minimum required rate of return (Su, 2017). Based on the above arguments, we come to the following hypothesis:

H2: ICE and CEE have an impact on the cost of debt capital. Compared with physical capital, the impact of ICE on the cost of debt capital is stronger.

HC and SC are corporate internal IC resources. HC is closely related to employees' knowledge, experience, and ability (Firer and Williams, 2003), and employees' personal characteristics have an important impact on corporate financing decision-making. Firms with a high level of HC investment tend to have stronger bargaining power in the financing process, thus reducing the cost of capital. The findings of Zhang and Li (2014) showed that entrepreneurs' good reputation can reduce their debt financing constraints. The level of HC directly affects investors' judgment about the future performance of enterprises, which in turn affects the required rate of return of investors. Su (2016) reported a negative relationship between HCE and cost of debt capital. Therefore, we propose the third hypothesis:

H3: HCE can reduce the cost of debt capital.

SC consists of the codified knowledge embedded within information systems and organizational processes (Inkinen, 2015). SC is the solid foundation and guarantee for the effectiveness of HC. Based on the resource dependence theory, in order to reduce the dependence on external environment, firms can rely on managers with rich social networks to obtain the required resources in the process of enterprise development. For Chinese private firms, You and Liu (2011) pointed out that social capital owned by the entrepreneurs can significantly reduce the cost of equity capital, especially in areas lacking legal protection. There is lack of evidence on how SC influences the cost of debt capital. Therefore, the fourth hypothesis is stated as follows:

H4: SCE can reduce the cost of debt capital.

3. Methodology

3.1. Sample selection

The sample consists of 54 agricultural companies listed on the Shanghai and Shenzhen stock exchanges from 2014 to 2020. We exclude companies with missing information, companies issuing other kinds of shares, delisted companies, and special treatment (ST) companies. The final sample includes 35 agricultural listed companies with 187 observations. The data are sourced from the China Stock Market & Accounting Research (CSMAR) database. Stata 16 is used for analysis.

3.2. Variables

(1) Dependent variable. Guided by Pittman and Fortin (2004), Minnis (2011), Ahn (2017), Su (2017), Xie *et al*. (2019), Fonseka *et al*. (2020), and Kuo *et al*. (2021), we use the ratio of interest expenses to average short-term and long-term debt to estimate cost of debt capital (COD).

(2) Independent variables. Pulic (2000)'s VAIC model is used to measure IC. Su (2017) argued that cost of capital has a lagged effect. Therefore, one-year lagged effect of IC and its components is analyzed. VAIC is the sum of CEE, HCE, and SCE. A higher VAIC suggests a better utilization of firms' resources in the process of value creation. The calculation process is as follows:

Value added (VA) = Net income + Interest + Taxes + Total employee expenditures

CEE = VA/Book value of total assets

HCE = VA/Total employee expenditures

SCE = (VA − Total employee expenditures)/VA

ICE = HCE + SCE

VAIC = CEE + ICE = CEE + HCE + SCE

(3) Control variables. Following Boujelbene and Affes (2013), Hall *et al*. (2014), and Su (2016), firm size (SIZE), debt ratio (LEV), return on assets (ROA), and equity concentration (FIRST) are chosen as control variables. In addition, a year dummy (YEAR) is also included in our models. Table 1 shows the definition of variables in this study.

Table 1: Variable definition

Variable	Symbol	Measurement
Cost of debt capital	COD	Interest expenses/Average short-term and long-term debt
Value Added Intellectual Coefficient	VAIC	CEE + HCE + SCE
Intellectual capital efficiency	ICE	HCE + SCE
Capital employed efficiency	CEE	VA/Book value of total assets
Human capital efficiency	HCE	VA/Total employee expenditures
Structural capital efficiency	SCE	(VA − Total employee expenditures)/VA
Firm size	SIZE	Natural logarithm of total assets
Debt ratio	LEV	Total liabilities/Total assets
Return on assets	ROA	Net income/Average total assets
Equity concentration	FIRST	Shareholding ratio of the largest shareholder
Year dummy	YEAR	Dummy variable that takes 1 for the test year, and 0 otherwise

Source: Authors' illustration

3.3. Models

Model (1) is to examine the impact of the aggregate IC on cost of debt capital.

$$COD_{i,t} = \beta_0 + \beta_1 VAIC_{i,t-1} + \beta_2 SIZE_{i,t-1} + \beta_3 LEV_{i,t-1} + \beta_4 ROA_{i.t-1} + \beta_5 FIRST_{i,t-1} + YEAR + \varepsilon_{i,t-1} \quad (1)$$

Model (2) is used to test H2.

$$COD_{i,t} = \beta_0 + \beta_1 ICE_{i,t-1} + \beta_2 CEE_{i,t-1} + \beta_3 SIZE_{i,t-1} + \beta_4 LEV_{i,t-1} + \beta_5 ROA_{i.t-1} + \beta_6 FIRST_{i,t-1} + YEAR + \varepsilon_{i,t-1} \quad (2)$$

Model (3) is employed to examine the relationship between IC components and cost of debt capital.

$$COD_{i,t} = \beta_0 + \beta_1 CEE_{i,t-1} + \beta_2 HCE_{i,t-1} + \beta_3 SCE_{i,t-1} + \beta_4 SIZE_{i,t-1} + \beta_5 LEV_{i,t-1} + \beta_6 ROA_{i.t-1} + \beta_7 FIRST_{i,t-1} + YEAR + \varepsilon_{i,t-1} \quad (3)$$

where i is the firm; t is the year; β represents the presumed parameter; ε denotes the error term.

4. Results

4.1. Descriptive statistics

Table 2 shows the descriptive statistics of full sample. COD has a mean value of 0.0562, and VAIC has a mean value of 2.2298. Su (2017) pointed out that the higher the VAIC, the lower the COD. The mean value of ICE (2.0510) is almost 11.5 times as much as the mean value of CEE (0.1788), which implies that IC has higher efficiency in value generation than physical capital. IC is generally inimitable and has sustainable value, while physical capital is easy to replicate (Su, 2016). Su (2017) found that CEE is at a lower level in China's agricultural industry with more government regulation. It reflects that HC is an important production mode of enterprise value creation, consistent with Xu and Wang (2019) and Xu and Zhang (2021).

In addition, SIZE has a mean value of 22.0017 with a maximum of 24.9065 and a minimum of 20.4938. Agricultural companies have an average 44% debt ratio. The mean ROA (0.0234) suggest that sampled companies have relatively low profitability, which is in line with Xu and Wang (2019), Xu and Zhang (2021), Xu *et al*. (2021), and Zhang *et al*. (2021). The mean value of FIRST is 0.3294.

Table 2: Descriptive statistics of full sample

Variable	N	Mean	Median	Maximum	Minimum	SD
COD	187	0.0562	0.0512	0.2579	0.0062	0.0291
VAIC	187	2.2298	2.2118	28.9881	-23.7563	3.5530
ICE	187	2.0510	2.0282	28.9951	-23.7615	3.4903
CEE	187	0.1788	0.1634	1.6724	-1.0875	0.2464
HCE	187	1.6135	1.5967	8.4295	-10.7962	1.7953
SCE	187	0.4375	0.4250	29.0307	-23.8018	3.0240
SIZE	187	22.0017	21.8102	24.9065	20.4938	0.9114
LEV	187	0.4378	0.4141	0.9801	0.0689	0.1799
ROA	187	0.0234	0.0148	0.6754	-0.4309	0.1099
FIRST	187	0.3294	0.3122	0.7032	0.0408	0.1516

Source: Authors' calculation

4.2. Correlation analysis

Table 3 demonstrates the results of Pearson correlation analysis. COD is negatively correlated with only HCE. VAIC and ICE are not associated with COD. In terms of IC components, COD does not correlate with CEE and SCE. In addition, all values of variance inflation factor (VIF) are found to be less than 5, indicating that multi-collinearity is not a serious problem in this study.

Table 3: Correlation matrix

Variable	1	2	3	4	5	6	7	8	9	10
1 COD	1									
2 VAIC	-0.048	1								
3 ICE	-0.046	0.998***	1							
4 CEE	-0.033	0.287***	0.221***	1						
5 HCE	-0.097*	0.530***	0.500***	0.565***	1					
6 SCE	0.005	0.837***	0.858***	-0.080	-0.017	1				
7 SIZE	-0.135*	0.208***	0.196***	0.229***	0.233***	0.088	1			
8 LEV	-0.135*	-0.034	-0.041	0.101	-0.161**	0.048	0.059	1		
9 ROA	-0.093	0.443***	0.408***	0.598***	0.803***	-0.004	0.275***	-0.352***	1	
10 FIRST	-0.068	-0.054	-0.054	-0.007	0.070	-0.104	-0.141	0.172**	-0.057	1

Notes: *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively.
Source: Authors' calculation

4.3. Regression results

Table 4 presents the results of Models (1)-(3) in full sample. The Hausman test is applied to determine whether to use the fixed effect (FE) model or random effect (RE) model. In Model (1), the coefficient of VAIC is negative but statistically insignificant, rejecting our H1. For Chinese publicly traded companies, IC negatively influences cost of debt capital (Su, 2016). Boujelbene and Affes (2013) suggested a negative association between IC disclosure and cost of equity capital in French companies. Orens *et al*. (2009), Mangena *et al*. (2016), Bouchareb and Kouki (2019), and Salvi *et al*. (2020) also showed the same results. In Model (2), the coefficients of ICE and CEE are not significant at the 5% level, which leads to the rejection of H2. However, taking Chinese listed firms as the research sample, Su (2017) found that ICE has a much stronger negative impact on cost of capital than CEE. In Model (3), HCE negatively affects COD (β = -0.005, t = -1.98), whereas SCE has no significant impact (β = -0.00003, t = -0.05). The insignificant impact of SCE could be explained by the fact that unreasonable corporate governance structure leads to the disfunction of SC. Therefore, H3 is fully supported, and H4 is rejected. Based on the data from Russian companies, Teplova *et al*. (2017) found that companies can reduce the cost of debt by increasing investments in IC elements.

In addition, there is a significant positive relationship between LEV and COD. The higher firm profitability, the higher cost of debt capital. SIZE and FIRST have no significant impact on COD.

Table 4: Regression results of Models (1)-(3)

Variable	Model (1)	Model (2)	Model (3)
	FE	FE	FE
Constant	0.185 (1.24)	0.164 (1.01)	0.126 (0.78)
VAIC	-0.0003 (-0.50)		

ICE		-0.0003 (-0.52)	
CEE		0.004 (0.34)	0.011 (0.86)
HCE			-0.005** (-1.98)
SCE			-0.00003 (-0.05)
SIZE	-0.007 (-1.04)	-0.006 (-0.84)	-0.004 (-0.59)
LEV	0.058*** (2.65)	0.055** (2.39)	0.060** (2.62)
ROA	0.044* (1.85)	0.036 (1.09)	0.084** (2.04)
FIRST	0.028 (0.40)	0.034 (0.46)	0.037 (0.52)
YEAR	Yes	Yes	Yes
N	187	187	187
R^2	0.1403	0.1411	0.1629
F	2.32**	2.11**	2.27**
Hausman test	Prob > chi2 = 0.0186	Prob > chi2 = 0.0254	Prob > chi2 = 0.0285

Notes: *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively. T-statistics are in the parenthesis.
Source: Authors' calculation

We also divide the full sample into high-IC-level group and low-IC-level group based on the median value of VAIC. The results are shown in Table 5. In high-IC-level group, IC and its components are found to have no significant influence on COD. In the latter group, only HCE exerts a significant and negative impact on COD. In addition, Table 6 in the appendix shows the descriptive statistics by IC level. We can infer that companies with high levels of IC tend to have lower cost of debt capital and higher profitability.

Table 5: Regression results of Models (1)-(3) by IC level

Variable	**High IC level**			**Low IC level**		
	Model (1)	Model (2)	Model (3)	Model (1)	Model (2)	Model (3)
	RE	RE	RE	RE	RE	FE
Constant	-0.012 (-0.16)	-0.008 (-0.10)	-0.005 (-0.07)	0.166* (1.67)	0.170* (1.71)	-0.061 (-0.20)
VAIC	0.0003 (0.29)			-0.0006 (-0.64)		
ICE		0.0004 (0.37)			-0.0006 (-0.59)	
CEE		0.011 (0.48)	0.012 (0.52)		-0.001 (-0.13)	-0.010 (-0.73)
HCE			0.002 (0.55)			-0.008*** (-3.07)
SCE			0.0003 (0.32)			-0.001 (-1.20)
SIZE	0.004 (1.20)	0.004 (1.14)	0.004 (1.06)	-0.004 (-0.84)	-0.004 (-0.88)	0.004 (0.31)
LEV	0.011 (0.54)	0.005 (0.18)	0.004 (0.15)	-0.023 (-1.22)	-0.024 (-1.18)	0.084** (2.51)
ROA	-0.019 (-0.62)	-0.035 (-0.76)	-0.052 (-0.88)	0.074* (1.74)	0.074 (1.33)	0.288*** (4.27)

FIRST	0.002 (0.08)	0.002 (0.10)	-0.002 (-0.09)	-0.013 (-0.46)	-0.013 (-0.46)	0.040 (0.40)
YEAR	Yes	Yes	Yes	Yes	Yes	Yes
N	93	93	93	94	94	94
R^2	0.1850	0.1872	0.1894	0.1430	0.1450	0.3315
F	18.62**	18.66**	18.69**	9.66*	9.73*	2.07**
Hausman test	Prob > chi2 = 0.2846	Prob > chi2 = 0.3311	Prob > chi2 = 0.3866	Prob > chi2 = 0.1110	Prob > chi2 = 0.0608	Prob > chi2 = 0.0280

Notes: *, ** and *** indicate significance at the 10%, 5% and 1% level, respectively. T-statistics are in the parenthesis.
Source: Authors' calculation

5. Conclusions

The motivation of this study is to explore the impact of IC and its components on cost of debt capital of China's agricultural listed companies. Pulic (2000)'s VAIC model is used to measure IC, and cost of debt capital is measured by the ratio of interest expenses to average short-term and long-term debt. The main conclusions can be listed as follows. First, IC has no significant impact on cost of debt capital. Regarding IC components, HC negatively and significantly affects cost of debt capital, while physical and structural capitals have no significant impact. Second, for agricultural companies with low levels of IC, there is a negative relationship between HC and cost of debt capital.

Our findings provide clear-cut management implications to agribusinesses. First, agricultural listed companies should consider the investment efficiency and put great emphasis on the role of IC to optimize corporate capital structure. Second, corporate managers should respect every employee, make employees have a sense of participation and achievement, publicize corporate culture, and establish a sound mechanism of employee recruitment, training and promotion. Finally, the insignificant impact of SC suggests that creditors do not pay enough attention to IC. The government should strengthen the system construction of IC evaluation and guarantee or establish a system for creditors to participate in corporate management in order to provide more convenient conditions for enterprise financing on the basis of protecting the interests of creditors.

There are still some limitations in this paper. First, the sample is limited to agricultural sector, and further studies could include other sectors. Second, other elements of IC such as relational capital and innovation capital could be taken into consideration in future studies.

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Appendix

Table 6: Descriptive statistics by IC level

Variable (Mean)	High IC level	Low IC level	Difference *t*-statistics
COD	0.0512	0.0612	-2.364
VAIC	3.8183	0.6581	6.776
ICE	3.5773	0.5409	6.592
CEE	0.2410	0.1172	3.539
HCE	2.4908	0.7456	7.591
SCE	1.0865	-0.2047	2.981
SIZE	22.1841	21.8212	2.771
LEV	0.4283	0.4472	-0.717***
ROA	0.0697	-0.0224	6.307*
FIRST	0.3087	0.3498	-1.868

Notes: * and *** indicate significance at the 10% and 1% level, respectively.
Source: Authors' calculation