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The Impact of Intellectual Capital Efficiency on Corporate Sustainable Growth-Evidence from Smart Agriculture in China

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Abstract: In this paper, we expand the value-added intellectual coefficient (VAIC) model by constructing a comprehensive financial capital (FC) component. Human capital efficiency is subdivided into executive (EHCE) and nonexecutive human capital efficiency (NHCE). We have sampled listed agriculture companies (LAC) in China's Shanghai and Shenzhen A-share markets from 2009 to 2018 and categorized them as high-tech (HTAC) and non-high-tech agriculture companies (NHTAC). We find that capital employed efficiency (CEE) and EHCE have a significant positive effect on corporate sustainable growth (CSG) of HTAC but no significant effect on CSG of NHTAC, while FC has a significant positive effect on both. These results suggest that companies, especially HTAC, should invest in human capital, and their executives and policymakers should develop effective knowledge management tools and begin accumulating the necessary intellectual capital to allow adaptation to their changing environment. In the spirit of the intellectual agriculture concept, we present some new ways to study the performance of agricultural companies using intellectual capital and offer suggestions that can help to modernize the industry.

Keywords: intellectual capital; VAIC model; smart agriculture; corporate sustainable growth

1. Introduction

The population in China has increased, and available resources have become scarce [1]. The inefficiencies associated with traditional agriculture have hindered the optimization of human and land resources and contributed to ecological deterioration and the low recycling rate of water resources [2,3]. Due to the deepening financial crisis, the appearance of new domestic and foreign competitors, and relatively low profitability, China's agriculture has become unstable [3]. Some listed agriculture companies (LAC) have converted themselves to nonagricultural business or operated illegally. The proportion of LAC in the capital markets has decreased, and operating performance has declined [4]. The average net profit margin of LAC remains at only 3%, and total revenue is lower than in other industries [5]. The traditional research approach is to select financial indicators to analyze performance [6–9] and to focus on influencing factors like internal business operations and government policies [10–12]. As this approach is subject to the limitations of GAAP (generally accepted accounting principles), all of the performance and influencing factors cannot be presented in financial statements. Research on business performance has confirmed that the quantity of tangible assets is not the only key factor in maintaining a competitive advantage. Intellectual capital (IC), including knowledge and other nonfinancial factors, has become the dominant resource for the development of economic systems [13–16].

Smart agriculture uses new technology, the Internet, cloud computing, data collection, and information sharing to improve the quantity and quality of products and to reach for large-scale production volumes. This has led to more efficient use of human capital [17–21]. Due to China's large and increasing population, there is a high demand for food. Introducing IC into the daily management of agriculture companies can help them take advantage of it. Good IC management can improve agricultural productivity, optimize resource use, minimize ecological impact, and fulfill the sustainable growth of the company [22–24]. Since 2010, the Chinese government has established a series of policies supporting high-tech agriculture [25]. In 2015, Premier Li Keqiang gave a speech on intellectual agriculture, confirming that China attaches great importance to its development. In 2010, the US Department of Agriculture reported that its widespread popularity had created a huge export surplus. More than 70% of companies with annual sales above $250,000 applied intellectual agriculture techniques to their operations [26]. IC not only has a significant impact on the development of agriculture but also exerts a far-reaching effect on agricultural companies. Therefore, China's agricultural companies should also apply these relevant technologies to modernize Chinese agriculture and achieve a win–win situation.

The concept of IC was proposed by the American economist, Galbraith, in 1969. He believed that IC is an intellectual activity and a "process of value creation", not just knowledge and intellectual capacity [27]. Some scholars have defined IC as the most valuable capital asset and the most powerful competitive weapon [18,20,28,29]. Existing IC research has focused on banking, high-tech, and the IT industry [30–33]. In the aspect of agricultural studies, scholars have not classified and compared samples. Some have focused on high-tech agriculture [34,35], and others have conducted empirical research on agriculture companies in general [36–38]. Since listed high-tech agriculture companies (HTACs) are quite different from non-high-tech companies (NHTACs), it is inappropriate to study them as one group. HTACs apply the latest technologies while NHTACs do not. In HTACs, knowledge, innovation, and product research and development significantly affect profitability. Therefore, when studying the performance of agriculture companies, it is necessary to distinguish between them in order to compare the impacts of IC fairly.

The sustainable growth of the agriculture industry has become an urgent issue as companies try to satisfy market demands and social needs and fulfill future requirements [39]. Sustainability is very important, especially during periods of economic turmoil, and it will become more important in the future [40]. Corporate sustainable growth may be associated with a company's economic, environmental, and social initiatives for guaranteeing the future [41,42]. The commitment to the sustainability of performance can be reflected in IC [43]. Early studies have shown that investments in IC can help a company enhance its competitive advantages and improve its financial performance in the future [44,45]. Although the relationship is expected to be positive, these findings are not completely consistent with the results of those studies. There are different opinions about the actual benefits of IC [40]. Therefore, this critical aspect of sustainability must be further studied, especially in terms of the impact of IC on corporate sustainable growth (CSG).

Most scholars divide company capital into financial capital (FC) and IC [46–49]. On the one hand, most researchers apply the value-added intellectual coefficient (VAIC) model proposed by Pulic [50] to the calculation of IC. It divides IC into capital employed efficiency (CEE), human capital efficiency (HCE), and structural capital efficiency (SCE). On the other hand, researchers just choose one or two financial indicators to evaluate FC [51–53]. An analysis of FC should consider the aspect of profitability, asset utilization efficiency, liquidity, and market share. In order to better analyze the correlation between IC and corporate sustainable growth and to reduce complexity, we applied factor analysis to the financial indicators and developed a comprehensive indicator. In the VAIC model, most scholars use salary as a proxy indicator of human capital efficiency (HCE); however, the contributions of executive officers are different from those of ordinary employees. Executive officers play a decisive role in company operations and have more impact than nonexecutive employees [54,55]. The analysis of HCE needs to differentiate between executive and nonexecutive salaries.

To fill the gaps concerned above, first, this paper divides human capital efficiency (HCE) into executive human capital efficiency (EHCE) and nonexecutive human capital efficiency (NHCE) and divides agriculture companies into high-tech and traditional types and investigates the impact of IC on each. Second, this paper extends the VAIC model and uses factor analysis to calculate FC. Finally, this paper analyzes the impacts of IC on corporate sustainable growth and investigates the impacts of knowledge, intellectual capacity, and nonfinancial factors on the operations of LAC. The rest of this paper includes a literature review (Section 2), research design, hypotheses, and model development (Section 3), results, analysis and discussion (Section 4), and conclusions, suggestions for the industry, and suggestions for follow-up studies (Section 5).

2. Literature Review

2.1. Intellectual Capital: Definition and Methods

IC is not a static asset. In a sense, it is a series of "intellectual activities" rather than just "intellect as pure intellect" [56,57]. Stewart [58] defined IC as "something that cannot be touched, although it slowly makes you rich". Edvinsson and Malone [59] described it as a group of qualities that provide a competitive advantage. They include knowledge, practical experience, customer relations, technologies, and professional skills. The Chartered Institute of Management Accountants [60] defines IC as "the possession of knowledge and experience, professional knowledge and skill, good relationships, and technological capacities, which, when applied, will give organizations a competitive advantage." IC is a main strategic intangible asset, which can help to produce sustainable competitive advantage and achieve excellent financial performance [61]. The growing gap between market and book value has triggered research-interest in this invisible value. Research on the IC concept is at an early stage. Most measurements still require more empirical support before the concept can be confirmed as a theory. Sullivan [62] mentioned that "(the) knowledge capital management movement is believed to have taken off from three distinctly different origins". As for the management of organizations, Sullivan proposed a logical explanation for the dependence on the knowledge and innovation of employees as key factors of business growth rather than the traditional production function [63].

Pulic [64] believed that physical capital efficiency was the only indicator used to measure corporate performance during the last two centuries. He established the VAIC model to assess three types of corporate efficiency: (1) Capital Employed Efficiency (CEE), the efficiency of physical capital and financial capital, (2) Human Capital Efficiency (HCE), the efficiency of employees and, (3) Structural Capital Efficiency (SCE), the efficiency of corporate systems and procedures. The integration of these components generates the value for VAIC. Higher VAIC values indicate more capability to create value. Pulic [50] analyzed 30 (UK) FTSE 250 enterprises between 1992 and 1998. He proved that there is a strong connection between the average value of VAIC and market value.

Firer and Stainbank [65] used the VAIC model to analyze the relationship between IC and profitability, productivity, market value, and other traditional measurements of business performance. Although a moderate positive correlation between a company's profitability and the value-added (VA) efficiency of its structural capital was confirmed, the correlation between profitability and the VA efficiency of the most important corporate resource was not confirmed. However, a significant correlation between productivity and the VA efficiency of human capital did exist. In general, the studies of Firer and Stainbank [65] indicate that in South Africa, physical capital is still the most important resource contributing to business performance.

Chen et al. [66] completed an empirical study on the data of Taiwanese listed companies and used the VAIC model to explore the relationship between IC, market value, and corporate performance. Their results showed that investors preferred companies with higher IC efficiency. These results highlight the importance of IC for business and national economic growth.

Barathi Kamath [67] used the VAIC model to analyze the value-based performance of Indian private business banks from 2002 to 2007. This study ranked them based on indicators of IC efficiency and concluded that differences in human capital contributed to differences in performance.

Ghosh and Mondal [68] randomly selected 80 Indian software and pharmaceutical companies and studied the relationship between IC and traditional corporate performance. They used the VAIC model to analyze the impacts of IC (human capital and structural capital) and physical capital on performance and found that there was a connection between IC and corporate profitability, but no obvious correlation between IC and productivity or market value.

Mondal and Ghosh [69] studied 65 Indian banks and measured their value-based performance using the VAIC model. Their IC was critical to building and maintaining a competitive advantage, but there were different relationships between IC and profitability and productivity.

Tripathy et al. [70] analyzed the relationship between IC efficiency and corporate market value in India and found that the explanatory power of the individual elements of IC efficiency (physical capital efficiency, human capital efficiency, and structural capital efficiency) was much better than that of the integrated composite evaluation. Their results also showed that investment in innovation capital and relationship capital can positively affect corporate value.

Meles et al. [71] believed that IC can positively affect the performance of American banks and that HCE generates greater impacts on performance than other components of IC efficiency. Executives and policymakers can realize their goals by developing effective tools for knowledge management and accumulating IC.

These literature reviews underline the relationship between IC and corporate value creation and give solid reasons to develop a strategy of knowledge resource management. However, only a few studies have focused on the application of IC in agriculture in China. In this paper, we examine the relationship between IC and corporate performance in the agriculture industry.

2.2. The Impact of IC on Corporate Sustainable Growth (CSG)

Several studies have confirmed that IC has a significant impact on CSG [17,18,29,72–74]. To operate in a global environment, companies need to build and maintain a competitive advantage, so they must depend on both physical capital and IC. Hitt et al. [75] proved that intangible capital played a more important role than tangible capital. Other studies have confirmed that IC contributed more to the sustainable growth of corporate efficiency, effectiveness, productivity, and innovation than physical capital [66]. Pulic and Bornemann [76] showed that companies can achieve added value through the application of IC and confirmed that it is a critical resource. Other research has also confirmed it as a value creator, and that IC drives corporate performance improvement, and is the most critical element in building and maintaining competitive advantage [77]. Pena [78] proved that IC management contributes to CSG and that it was usually in place at the planning stage. Mehralian et al. [79] examined the relationships between IC and profitability, productivity, and market value, and found that there was a significant positive correlation between human capital and CSG in low as well as in high knowledge-based companies.

3. Methodology

3.1. Definition of Variables

3.1.1. Dependent Variables

The deeper meaning of corporate sustainable growth (CSG) is the continuous creation of value. Only sustainable growth with the continuous growth of value can represent true sustainable growth. Therefore, CSG should prevent financial risks and capital flows from being broken from the perspective of operating capital management, establish a link between value and growth from the value-added perspective, and make the growth serve the value [43]. At present, two types of CSG models are available: accounting-based and cash-flow-based sustainable growth models. We examine the growth of agriculture companies from the perspective of IC. Therefore, the cash-flow-based sustainable growth model is used in this paper. This type of model also includes the Rappaport model [54] and the Colley model [80]. To make the results more reliable, we use these two models to calculate the CSG of agriculture companies in China.

Colley's sustainable growth model is based on the following hypotheses: (1) The asset–liability and dividend payout ratios remain unchanged, (2) pre-tax profits, current assets, current liabilities, fixed assets, and other assets increase in proportion to sales growth, and (3) depreciation can be used for fixed asset reinvestments. The formula is as follows:

$$SGR1 = \frac{(EBIT - I)(1-t)(1+DER)(1-DPO)}{NA_0 - (EBIT - I)(1-t)(1+DER)(1-DPO)} \quad (1)$$

where,

SGR1 represents the financially sustainable growth rate of agriculture companies;

EBIT represents the earnings before interest and taxes;

I represents the interest expenses on debt;

t represents the income tax rate;

DER represents the debt-to-equity ratio;

DPO represents the dividend payout ratio;

NA_0 represents the net assets at the beginning of the period.

Rappaport's sustainable growth model is based on the following hypotheses: (1) New shares will not be raised, (2) the gross operating profit margin, the investment growth corresponding to the sales growth per yuan, the target asset–liability and the target dividend distribution ratios remain unchanged, and (3) depreciation is used for maintenance expenses. The formula is as follows:

$$SGR2 = \frac{NP/S_0 * (1 + D/E) * (1-d)}{(CE + WC)/S_0 - NP/S_0 * (1 + D/E) * (1-d)} \quad (2)$$

where,

SGR2 represents the financially sustainable growth rate of agriculture companies;

NP represents net profit;

S_0 represents sales revenue at the beginning of the period;

D represents debt;

E represents equity;

d represents dividend payment rate;

CE represents capital expenditure;

WC represents working capital.

3.1.2. Independent Variables

Independent variables are financial capital and the value-added intellectual capital coefficient (VAIC™). The VAIC includes CEE, HCE, and SCE. Referring to Pulic's [64] calculation of VAIC, these indicators are calculated as follows.

Enterprise Value-Added (VA)

$$VA = OUT - IN \tag{3}$$

where,

VA: added value created;

OUT: total income from products and services;

IN: the total costs, excluding the employees' payroll expenses.

Based on the definition of value-added by Ahmed [81], we use Formula (4) instead of the formula proposed by Pulic [64] to calculate the added value according to the income statements.

$$VA = HC + I + T + NE \tag{4}$$

where,

HC: employees' salaries;

I: interest;

T: tax;

NE: dividends and retained profit (net profit).

Human Capital Efficiency (HCE)

$$HCE = VA/HC \tag{5}$$

Human capital is divided into executive salaries and nonexecutive salaries. Therefore, HCE is calculated as follows.

$$EHCE = VA/EHC \tag{5-1}$$

$$NHCE = VA/NHC \tag{5-2}$$

where,

EHCE and NHCE are, respectively, executive and nonexecutive human capital efficiency;

EHC and NHC are, respectively, executive and nonexecutive salaries.

Structural capital efficiency (SCE)

$$SCE = SC/VA \tag{6-1}$$

$$SC = VA - HC \tag{6-2}$$

In addition, SC is the structural capital.

Capital Employed Efficiency (CEE)

$$CEE = VA/CA \tag{7}$$

where,

CA: physical capital and book value of net assets.

Financial capital (FC): earnings per share, operating profit ratio, net assets per share, current ratio, asset–liability ratio, equity ratio, and quick ratio.

3.1.3. Control Variables

Size of company (TA) and the growth rate of the consumer price index (GCPI) are used as control variables. TA: natural logarithm of total assets; GCPI: development rate of CPI.

3.2. Proposed Hypotheses

Lots of existing literature have dealt with the relationship between IC and CSG, but none have focused on agriculture. We use the VAIC model proposed by previous scholars to evaluate IC. First, we extend the VAIC model and use factor analysis to calculate a comprehensive FC that considers all financial indicators that influence performance. Second, we divide human capital efficiency (HCE) into executive (EHCE) and nonexecutive human capital efficiency (NHCE) and study their impacts on performance. Last, to minimize external impacts, we use the natural logarithm of macroeconomic indicators and total assets as the control variable. Our preliminary model follows.

$$CSG = FC + IC + CV \tag{8}$$

where,

CSG: corporate sustainable growth,

FC: financial capital,

IC: intellectual capital,

CV: control variables.

We use SGR1 and SGR2 as indicators of CSG, and for FC indicators, earnings per share, operating profit ratio, net assets per share, current ratio, asset–liability ratio, equity ratio, and quick ratio, and we use factor analysis to build a comprehensive FC. For VAIC, we use CEE, HCE, SCE to measure IC. We divide human capital into two dimensions, NHCE and EHCE, and we use the natural logarithm of the growth rate of the consumer price index (GCPI) and total assets as the control variable.

Based on previous research results and our analyses, we propose the following hypotheses.

H1: Capital employed efficiency (CEE) has a significant positive impact on CSG of high-tech and non-high-tech agriculture companies.

H2: Nonexecutive human capital efficiency (NHCE) has a significant positive impact on CSG of high-tech and non-high-tech agriculture companies.

H3: Executive human capital efficiency (EHCE) has a significant positive impact on CSG of high-tech and non-high-tech agriculture companies.

H4: Structural capital efficiency (SCE) has a significant positive impact on CSG of high-tech and non-high-tech agriculture companies.

H5: Financial capital (FC) has a significant positive impact on CSG of high-tech and non-high-tech agriculture companies.

3.3. Modeling

Our models follow.

Model 1:

$$SGR1_{i,t} = \alpha + \alpha_1 FC_{i,t} + \alpha_2 EHCE_{i,t} + \alpha_3 NHCE_{i,t} + \alpha_4 SCE_{i,t} + \alpha_5 CEE_{i,t} + \alpha_6 C_{i,t} + \varepsilon_{i,t} \tag{9}$$

Model 2:

$$SGR2_{i,t} = \alpha + \alpha_1 FC_{i,t} + \alpha_2 EHCE_{i,t} + \alpha_3 NHCE_{i,t} + \alpha_4 SCE_{i,t} + \alpha_5 CEE_{i,t} + \alpha_6 C_{i,t} + \varepsilon_{i,t} \tag{10}$$

In Formulas (9) and (10), i refers to the company i; t refers to the year t; α_i means the coefficient of the variable; C is the control variable; $\varepsilon_{i,t}$ is the error term of the model.

3.4. Statistical Methods

In this paper, many methods are employed to explore the relationship between intellectual capital efficiency and corporate sustainable growth. First, we adopt the descriptive and correlation analysis to reveal the basic characteristics of the samples. Second, we perform the F test and the Hausman test to examine whether the fixed effect model or random effect model should be employed. Third, the Wald test and Wooldridge test are performed to examine the groupwise heteroskedasticity and autocorrelation in panel data, respectively. Finally, the regression model is performed to demonstrate the impacts of intellectual capital efficiency on corporate sustainable growth.

4. Empirical Analysis and Discussion

This paper studies the impact of intellectual capital efficiency on corporate sustainable growth. We refer to the contents of "*National economic industry classification*", "*Industry classification guidelines of listed companies*", and "*National key leading enterprises of agricultural industrialization*". From the perspective of industry classification, agricultural companies include not only companies engaged in planting, forestry, animal husbandry, and aquaculture, but also companies closely related to agriculture, including agrarian sideline products processing industry and food manufacturing industry. From the perspective of the industrial chain, most companies cover the links of agricultural production and postnatal production.

We sampled 50 agriculture listed companies in Shanghai and Shenzhen A-share markets from 2009 to 2018 and divided them into one group of 29 non-high-tech companies, and another group of 21 high-tech companies. Using their annual reports and the Wind Website, we sorted and calculated them according to the VAIC model, and processed the data with Excel, Eviews, and Stata. Table 1 contains the descriptive analysis of variables, and Table 2 and Table 3, the correlation analyses of variables of the two groups. The time span (T = 8) is relatively short, and its effect is not considered.

Table 1. Descriptive statistics of variables.

Variable	Mean		Max.		Min.		Stand. Dev.	
	HTAC	NHTAC	HTAC	NHTAC	HTAC	NHTAC	HTAC	NHTAC
SGR1	0.692	0.124	1.687	0.532	0.145	0.012	0.551	0.843
SGR2	0.884	0.001	2.165	1.115	−0.161	−0.414	3.471	4.624
FC	0.369	4.728	4.161	199.389	−3.349	−55.839	0.878	18.081
EHCE	63.182	70.402	551.492	921.789	−188.59	−303.65	91.495	141.59
NHCE	95.126	8.388	5955.03	67.211	−511.26	−24.651	619.49	13.909
SCE	1.058	0.709	26.482	3.512	−0.513	−8.241	2.316	1.113
CEE	0.101	0.082	0.363	1.463	−0.621	−1.168	0.125	0.192
CPI	2.883	2.883	5.4	5.4	1.4	1.4	1.273	1.273
TA	22.079	22.158	23.613	24.284	19.399	19.478	1.794	1.858

Note: HTAC (high-tech agriculture companies), NHTAC (non-high-tech agriculture companies), SGR (financial sustainable growth rate), FC (financial capital), EHCE (executive human capital efficiency), NHCE (nonexecutive human capital efficiency), SCE (structural capital efficiency), CEE (capital employed efficiency), CPI (consumer price index), and TA (total assets).

Table 2. Correlation coefficients among variables in high-tech agriculture companies (HTAC).

Variable	FC	EHCE	NHCE	SCE	CEE	CPI	TA
FC	1						
EHCE	0.071 ***	1					
NHCE	−0.056 *	0.020 *	1				
SCE	−0.099 *	−0.071 *	−0.011 *	1			
CEE	0.136 **	0.570 ***	0.090 **	−0.090 *	1		
CPI	0.121 *	0.070 *	0.010 *	−0.014	0.181 *	1	
TA	−0.203 ***	0.390	0.152	0.273 *	0.154 *	−0.110 **	1

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

Table 3. Correlation coefficients among variables in non-high-tech agriculture companies (NHTAC).

Variable	FC	EHCE	NHCE	SCE	CEE	CPI	TA
FC	1						
EHCE	0.318 ***	1					
NHCE	0.512 *	0.531	1				
SCE	0.028 **	0.041 **	0.090 *	1			
CEE	0.425 **	0.470 **	0.551 *	0.020 ***	1		
CPI	0.279 *	0.082 *	0.180 *	0.019 *	0.207 ***	1	
TA	0.067 ***	0.530	0.157	0.011 *	0.139 *	−0.132 **	1

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

The F test results are shown in Table 4. For the high-tech group, Model (1) and (2) reject the null hypotheses, so the fixed effect model should be chosen. For the non-high-tech group, Model (1) and (2) also reject the null hypotheses, so the fixed effect model should be chosen for them as well.

Table 4. F test of models.

Group	Variables	The Null Hypothesis	F	Prob.> F
HTAC	SGR1 (M1)	H0: F test that all u_i = 0	F (20, 97) = 7.03	Prob.> F = 0.0000
	SGR2 (M2)	H0: F test that all u_i = 0	F (20, 97) = 4.08	Prob.> F = 0.0000
NHTAC	SGR1 (M1)	H0: F test that all u_i = 0	F (28, 137) = 8.10	Prob.> F = 0.0000
	SGR2 (M2)	H0: F test that all u_i = 0	F (28, 137) = 3.61	Prob.> F = 0.0001

Note: M1, Model 1; M2, Model 2.

The results of the Hausman test are shown in Table 5. In the high-tech group, Model (1) rejects the null hypothesis (Prob. = 0.0000) and indicates that the fixed effect model should be chosen. An endogeneity problem will occur if we use the random effect model. Model (2) does not reject the null hypothesis, indicating that both the fixed effect and the random effect models are consistent, but the value of Prob. = 0.9869 implies that the random effect model is more appropriate. In the non-high-tech group, Model (1) does not reject the null hypothesis, indicating that both the fixed effect and the random effect models are consistent, but the value of Prob. = 0.0984 implies that the random effect model is more appropriate. Model (2) rejects the null hypothesis with Prob. = 0.0523, indicating that the fixed effect model should be chosen.

Table 5. Hausman test of models.

Group	Variables	The Null Hypothesis	Chi2	Prob. > Chi2
HTAC.	SGR1 (M1)	H0: Difference in coefficients not systematic	chi2(8) = 45.75	Prob. > chi2 = 0.0000
	SGR2 (M2)	H0: Difference in coefficients not systematic	chi2(8) = 1.35	Prob. > chi2 = 0.9869
NHTAC	SGR1 (M1)	H0: Difference in coefficients not systematic	chi2(8) = 2.57	Prob. > chi2 = 0.9584
	SGR2 (M2)	H0: Difference in coefficients not systematic	chi2(8) = 15.37	Prob. > chi2 = 0.0523

Note: M1, Model 1; M2, Model 2.

According to the results in Table 6, in the HTAC group, Model (1) rejects the null hypothesis (Prob. = 0.000), so there is in-group heteroscedasticity. In the NHTAC group, Model (2) rejects the null hypothesis (Prob. = 0.0000), and there is also in-group heteroscedasticity.

Table 6. Modified Wald test for groupwise heteroskedasticity.

Group	Variables	The Null Hypothesis	chi2	Prob. > chi2
HTAC	SGR1 (M1)	H0: $\sigma i^2 = \sigma^2$ for all i	chi2(21) = 12759.53	Prob. > chi2 = 0.0000
NHTAC	SGR2 (M2)	H0: $\sigma i^2 = \sigma^2$ for all i	chi2(29) = 1387.82	Prob. > chi2 = 0.0000

Note: M1, Model 1; M2, Model 2.

According to the autocorrelation test results in Table 7, in the HTAC group, Model (1) rejects the null hypothesis (Prob. = 0.0004), and there is no first-order sequence autocorrelation. Model (2) does not reject the null hypothesis (Prob. = 0.6816), and there is a first-order sequence autocorrelation. In the NHTAC group, Model (1) rejects the original model (Prob. = 0.0025), and there is no first-order sequence autocorrelation. Model (2) rejects the original (Prob. = 0.0146), and there is also no first-order sequence autocorrelation.

Table 7. Wooldridge test for autocorrelation in panel data.

Group	Variables	The Null Hypothesis	F	Prob. > F
HTAC	SGR1 (M1)	H0: no first-order autocorrelation	F (1,20) = 18.150	Prob. > F = 0.0004
	SGR2 (M2)	H0: no first-order autocorrelation	F (1,20) = 0.173	Prob. > F = 0.6816
NHTAC	SGR1 (M1)	H0: no first-order autocorrelation	F (1,28) = 11.064	Prob. > F = 0.0025
	SGR2 (M2)	H0: no first-order autocorrelation	F (1,28) = 6.784	Prob. > F = 0.0146

Note: M1, Model 1; M2, Model 2.

The final regression results are in Table 8.

Table 8. Regression results of the models.

	SGR1 (M1)				SGR2 (M2)			
	HTAC.		NHTAC		HTAC		NHTAC	
FC	1.6087 ***		0.0491 **		1.2776 ***		0.0654 ***	
EHCE	0.0001 *		0.0005		0.0099 **		0.0003	
NHCE	−0.0023		−0.0009		−0.0002		0.0181 *	
SCE	0.0217		−0.0024		0.0385		−0.0409	
CEE	36.8592 ***		−0.3017		80.0755 ***		1.8197 ***	
CPI	−0.1025		−0.0779 *		−0.3226 *		0.0518	
TA	−0.7671 *		−0.4539 ***		−0.6454		0.0785	
_cons	17.7642 *		9.9087 ***		13.2791		−2.2462	
	R-sq.	0.5136	R-sq.	0.3792	R-sq.	0.4707	R-sq.	0.4375
	F	170.45	Wald chi2	38.16	Wald chi2	1535.3	F	35.98
	Prob.	0.0000	Prob.	0.0000	Prob.	0.0000	Prob.	0.0000

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

In the HTAC group, the coefficient of CEE in Model (1) is 36.8592, and the P-value is less than 0.01, while the coefficient of CEE in Model (2) is 80.0755, and the P-value is less than 0.01. Therefore, CEE has a significant positive correlation with both SGR1 and SGR2. H1 is confirmed. As one dimension of IC, CEE can be a good reflection of the positive impacts of IC. The coefficient of NHCE in Model (1) is 0.0023, and the P-value is greater than 0.1. The coefficient of NHCE in Model (2) is 0.0002, and the P-value is greater than 0.1. Therefore, NHCE has no significant correlation with SGR1 and SGR2. H2 does not hold. The coefficient of EHCE in Model (1) is 0.0001, and the P-value is less than 0.1, and in Model (2), it is 0.0099 with a P-value of less than 0.05. Therefore, EHCE has a significant positive correlation with SGR1 and SGR2. H3 is confirmed. The coefficient of SCE in Model (1) is 0.0217, and the P-value is less than 0.1, and in Model (2), it is 0.0385, and the P-value is greater than 0.1. Therefore, SCE has no significant correlation with SGR1 and SGR2. H4 does not hold. The coefficient of FC in Model (1) is 1.6087, and the P-value is less than 0.01, and in Model (2), it is 1.2776, and the P-value is less than 0.01. Therefore, FC has a significant positive correlation with SGR1 and SGR2. H5 is confirmed.

In the NHTAC group, the coefficient of CEE in Model (1) is 0.3017, and the P-value is greater than 0.1, and in Model (2), it is 1.8197, and the P-value is less than 0.01. Therefore, CEE has a significant positive correlation with SGR2 but has no correlation with SGR1. H1 is partially confirmed. The coefficient of NHCE in Model (1) is 0.0009, and the P-value is greater than 0.1, and in Model (2), it is 0.0181, and the P-value is less than 0.1. Therefore, NHCE has a significant positive correlation with SGR2 but has no correlation with SGR1. H2 is partially confirmed. The coefficient of EHCE in Model (1) is 0.0005, with a P-value greater than 0.1, and in Model (2), it is 0.0003, with a P-value greater than 0.1. Therefore, EHCE has no significant correlation with SGR1 and SGR2. H3 does not hold. The coefficient of SCE in Model (1) is -0.0024, and the P-value is greater than 0.1, and in Model (2), it is -0.0409, and the P-value is greater than 0.1. Therefore, SCE has no significant correlation with SGR1 and SGR2. H4 does not hold. The coefficient of FC in Model (1) is 0.0491, and the P-value is less than 0.05, and in Model (2), it is 0.0654, and the P-value is less than 0.01. Therefore, FC has a significant positive correlation with SGR1 and SGR2. H5 is confirmed.

Table 9 shows a comparison between null hypotheses and empirical results, where "/" indicates that the hypothesis is partially confirmed, and "N" indicates that the hypothesis does not hold.

Table 9. The comparison between hypotheses and empirical results.

Hypothesis	HTAC		NHTAC	
	Expected	Results	Expected	Results
H1	+	+	+	/
H2	+	N	+	/
H3	+	+	+	N
H4	+	N	+	N
H5	+	+	+	+

Note: / indicates that the hypothesis is partially confirmed, and N indicates that the hypothesis does not hold.

We compare our results with the results of Lee and Mohammed [82], where they explored the impact of intellectual capital on agricultural firm performance. They also examined whether firm size and corporate governance characteristics as control variables influence performance. Their results indicated that intellectual capital has a positive impact on financial and productivity performances. However, the relationship between intellectual capital and economic performance is insignificant. The results also revealed that the capital employed and structural capital are major determinants of financial and productivity performances. Different from the study of Lee and Mohammed [82], this paper aimed to explore the relationship between intellectual capital and corporate sustainable growth. We used the variables proposed by Colley and Rappaport to represent corporate sustainable growth. Therefore, the results show that intellectual capital has a significant positive impact on corporate sustainable growth. In addition, we also divide human capital efficiency into two components to further explore the relationship between human capital and corporate sustainable growth, which is the main contribution of our study.

5. Conclusions

We have divided listed agricultural companies into high-tech (HTAC) and non-high-tech (NHTAC) groups and compared them using VAIC. We explain the impacts of IC on each group and demonstrate the effects of IC on CSG. Through the comparison, we have developed the following conclusions.

- For HTAC, increases in physical capital lead to higher CSG. Capital employed efficiency (CEE), as one dimension of IC, can reflect the positive impacts of IC. However, for NHTAC, physical capital does not have a significant positive impact on CSG.
- For HTAC, executive human capital efficiency (EHCE) has a significant positive correlation with CSG. However, for NHTAC, executive human capital has no significant impact.

- For both HTAC and NHTAC, structural capital efficiency (SCE) has no significant impact on CSG.
- For both HTAC and NHTAC, FC is significantly and positively correlated with CSG.
- Companies should optimize their financial indicators (liquidity ratio, asset–liability ratio, equity ratio, quick ratio, earnings per share, operating profit ratio, and net assets per share). HTAC can improve economic efficiency through the development of intellectual agriculture and produce significant impacts on financial indicators.

The most critical part of IC is human capital (executive professional quality, ability to acquire knowledge, work experience, leadership strategy, and dynamic learning capacity). Therefore, investment in human capital should be included in long term plans. Although our results show an insignificant correlation between structural capital and CSG, many studies indicate that structural capital does have positive impacts on CSG. Structural capital can influence how human capital is applied to increase CSG. Considering the impacts of human capital, structural capital, and financial capital on CSG and the mutual interaction between these dimensions of IC, it is important to balance and coordinate the development of IC.

Because of the short-listing period of some companies, we have only selected companies listed from 2009 to 2018. In addition, we have focused on the Shanghai and Shenzhen stock markets. Hong Kong, Macao, and Taiwan's agriculture companies are not within the scope of this study. Scholars who are interested in this subject should expand their scope by introducing samples from other regions.

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