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Research Article

Intellectual Capital and Firm Performance in the Context of Venture-Capital Syndication Background in China

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This paper is intended to investigate the role of Venture-Capital Syndication (VCS) background in the relationship between intellectual capital (IC) and portfolio firm performance (PFP); specifically, this article examines the moderating effect of VCS's leading firm background and member heterogeneity on the effect of IC on PFP. This study used a modified VAIC model to measure IC to compose a 4-component variable including human capital, structural capital, relational capital, and innovation capital. The data were collected from VCS-backed and listed firms in China during 2014 to 2018 applying the pooled OLS model for hypotheses test, Generalized Method of Moments (GMMs) to reduce endogeneity and unobserved factor control, and also return on equity (ROE) instead of ROA for the robustness test. Empirical results showed that IC and its components can improve PFP for VCS-backed firms in China; in detail, IC showed greater impact on performance of firms invested by foreign lead investors than in private or government VCS, specially reflected in the impact of innovation capital on PFP. Furthermore, IC showed weaker impact on PFP of mixed VCS-backed firms compared to pure VCS-backed firms and showed diminished effect on higher VCS member heterogeneity mainly reflected in the impact of relational capital on firm performance. These findings propose a new way of combining IC and VC to improve firm performance and are beneficial to theoretical development of IC and VC as well as a perspective for VC firm managers to choose suitable partners prior to join a VCS.

1. Introduction

In a knowledge-based economy, there have been growing consensus about the relevance of Intellectual Capital on firms long-term profit [1–3], even more, intangible assets are being identified as one of their core capabilities [4]. Intellectual capital (IC) is usually defined as the total of all knowledge that a firm can use as source of competitive advantage [5, 6]. Empirical evidence has shown that intellectual capital can improve firm's competitive advantage [7–9], and it is also closely related to high-level firm performance [2, 8, 10].

Being one of the most of the Asian emerging economies, China has experienced "high growth and high investment" for a long period after the reform and opening policy [11]; Chinese firms have consequently seen an accelerated growth on their own intellectual capital on the latest decades [12]; however, in comparison with developed countries in Europe and America, Chinese research on intellectual capital still needs further development [13]; although the gap between China and developed economies in terms hard power has been narrowed, the construction of soft power can be considered relatively backwards, even more, Chinese reserves in intellectual capital are still insufficient to follow the recent pace of development [14]. Even more, intellectual capital has been tagged by the government of China as a precious resource of a country, emphasizing its importance as a supporting force for the Chinese development strategy during this critical period of economic transformation and upgrade [14].

On intellectual capital, value-added intellectual coefficient (VAIC) is considered a standardized and logical measurement method [15]; it can use relevant data from financial reports to calculate firm value creation efficiency, enabling the possibility of making comparisons with other related firms [8]. In its original form, VAIC assessed IC only through human capital and structural capital [15]; nevertheless, further researchers refined this methodology to include neglected related components such as social capital, customer capital [16–18], and innovation capital [10, 19], innovation capital efficiency being a factor with direct impact on firms' performance [10, 20]; in China as well as other emerging economies, entrepreneurship and innovation are considered the new driving forces for economic growth; based on that importance, innovation capital is a component that needs to be included in the VAIC model to properly identify the impact of intellectual capital on firm performance.

Since capital is the foundation of firm development, knowledge and technology are sources for innovation; in terms of mass innovation, the effective combination of IC and venture capital not only can promote the integration of knowledge, technology, and capital within a firm but also present significance on improving firm performance [3, 19, 21]. Additionally, it is also conducive to innovation and sustainable development of emerging economies [22]. As a financing method to provide capital and service support to firms, venture capital (VC) has been rising for a long time in developed countries; it not only provides sufficient funding support for the portfolio firms but also provides other value-added services [23], such access to enhanced human capital as well as relational capital for firm's portfolio [24, 25] and technological performance [26]. With the notable economic growth of China, this country has seen the emergence of new entrepreneurial firms, while most of these firms have been facing financing constraints [27]; venture capital (VC) provides financing and rapid growth opportunities for some of them [23, 28, 29]. Since intellectual capital plays a key role in entrepreneurial firms [1, 2, 21, 30], it is necessary to investigate the impact of intellectual capital on performance for VC-backed firms' portfolio.

To share resources and risks, most venture capital institutions prefer joint investment [23, 31, 32]; more specifically, they rely on venture-capital syndication (VCS), where even different types of venture capital firms can share participation in entrepreneurships. According to the development background of Chinese VC Industry, capital types, and main funds of VC firms in the database of Zero2IPO Research Center [33], Chinese VC firms can be divided into three types: (1) foreign-funded venture capital (FVC); (2) domestic private venture capital (DPVC); and (3) government-funded venture capital (GVC) [34] as shown in Table 1.

Given its heterogeneity and complementarity, VCS can provide firms wider access to funding, resources, and extensive value-added services that promote faster firm development, overcoming the constraints of previous investment experience and geographical location [31, 35, 36].The impact of different backgrounds of VCS on portfolio firms is different [34, 37], and the impact of intellectual capital of portfolio firms in performance may differ depending on VCS background. Therefore, it makes it necessary to research the role of VCS background between intellectual capital and firm performance.

Although considerable number of studies have addressed the activity of IC in emerging economies [38–40], previous research has been focused on IC measurement [41–44], IC impact on value creation [8, 9, 20], and innovation [21, 41]; research on VCS effects is quite limited. (1) Does intellectual capital (including the four dimensions of human capital, structural capital, relational capital, and innovation capital) have a positive impact on portfolio firm performance? (2) Are these impacts varying with firms backed by FVC-led, DPVC-led, or GVC-led syndication? (3) What is the role of member background heterogeneity in the relationship of intellectual capital and firm performance? This study is oriented to address these questions within the framework of VCS background in China.

VC industry in China offers some advantages as a suitable setting to examine these issues: (1) With the rapid growth of China's venture capital industry in recent years, many VC firms have emerged, supporting also many small and medium-sized firms, providing an appropriate number of observable sample data for our research. (2) With the development of the Chinese market and the gradual dynamization of the economic system, an increasing number of FVC have entered to the Chinese market [45]. Their experience, management methods, and technologies have brought opportunities and challenges to Chinese firms. It is therefore helpful to empirically examine whether the impact of intellectual capital on firm performance vary depending on the VCS background.

For hypothesis testing, this empirical study used the modified Pulic's VAIC™ model to measure IC [41, 46], assessing it in terms of four components: (1) human capital, (2) structural capital, (3) relational capital, and (4) innovation capital. Our sample included 575 Chinese venture-capital syndication backed firms listed in the A-share market during 2014 to 2018. Our model expects that all components of IC may influence the performance of VCS-backed firms, moderated by the background of VCS. Additionally, this exercise also tested moderation by FVC-led, DPVC-led versus GVC-led syndication, as well as the moderating effect of cooperation model and member heterogeneity. Several methods were applied to address the empirical challenges of potential endogeneity: (1) first, the the pooled OLS model were used to test hypotheses; (2) second, the average value of IC of the sample firm's industry was used as its own instrumental variable [46, 47]; (3) third, the generalized method of moments (GMMs) was used to reduce endogeneity problems and control unobservable factors; and (4) finally, return on equity instead of ROA was used to test the models' robustness of the obtained results.

The contributions of this study are presented in three ways: (1) first, this study contributes to the literature on the relation between intellectual capital (IC) and portfolio firm performance (PFP), by filling the gap of empirical research on the relationship among IC, background of VCS, and firm

Table 1: Classification of Chinese venture capital firms.

Type	Main source of funds	Representative VC institutions	Investment target
Government venture capital (GVC)	Provided by local government, state-owned firms, government-affiliated institutions, and universities	(i) China Venture Capital (ii) Shanghai STVC Group (iii) Shenzhen Capital Group (iv) Wuhan Huagong Venture Capital, etc.	(i) Realize government policy goals (ii) Support entrepreneurial firms (iii) Cultivate small- and medium-sized technology firms (iv) Guide social capital investment
Domestic private venture capital (DPVC)	All provided by Chinese private firms and domestic wealthy individuals	(i) Fortune Capital (ii) Cowin Capital (iii) Detong Capital (iv) JD Capital, etc.	As a strategic tool for firms, seek new value-added opportunities to realize value creation and capital growth
Foreign venture capital (FVC)	Provided by foreign capital (such as foreign investment banks, foreign firms, and foreign wealthy individuals)	(i) IDG Capital (ii) SEQUOIA China (iii) Matrix Partners China (iv) NewMargin, etc.	(i) Use its rich management experience, professional skills, and financial advantages (ii) Value-added appreciation and profit

performance. Our main results are consistent with the view that human capital, structure capital, and relational capital have positive impact on PFP [30, 48, 49], and innovation capital also has positive association with PFP [10]. In addition, we gave special focus on the moderating effects of venture-capital syndication background. We argue that a positive influence of IC on portfolio firm performance is significantly higher in the context of FVC-led syndication than in DPVC-led or GVC-led syndication. Therefore, in emerging economies, especially the case of China, DPVCs and GVCs would need to learn from the advanced investment management experience and skills of FVCs in line with the local environment, to increase the efficiency of firm intellectual capital.

(2) Second, this study adds both academic and practical value to the field of venture capital and portfolio firms. Our results supported the view of [34, 50], where VC firms are more inclined to cooperate with other VC firms that have smaller differences with themselves. We argue that the positive influence of IC on portfolio PFP in pure VCS is significantly higher than that in mixed VCS, suggesting that when considering financing, portfolio firms may prefer pure VCS, more conducive to value creation of intellectual capital and the improvement of portfolio firm performance. Moreover, the particularity of this research setting provides a fresh perspective on intellectual capital management of portfolio firm for performance as well as relevant implications for portfolio firms in emerging countries.

2. Literature Review and Hypothesis Development

2.1. Intellectual Capital and Its Components. Intellectual capital (IC) was first proposed by Galbraith in 1969, who defined it as an intellectual activity that contribute to a dynamic kind of capital. Stewart [16] defined it as knowledge, intellectual property, information, and experience that can bring competitive advantage and created value for a firm; Sullivan and Patrick [51] considered it as knowledge and information that can be converted into a tangible profit for a firm. Although further consensus is needed, in [16], definition has been widely adopted, considering that IC includes human capital, structure capital, and relational capital [2, 16, 52]. Human capital is mainly reflected in knowledge, skills, culture, and other of employee-related aspects [53, 54]; Structural capital refers to intangible assets such as firm organizational structure, rules, and strategies [55, 56], It is considered relevant on improving business operations efficiency and promoting the maximum value of human capital [57, 58]. Relational capital mainly refers to the value created by stakeholders such as partners, suppliers, and customers [59–61] and can effectively help firms to deal with internal and external relationships reflected mainly in employees, customers, and strategic partners loyalty [48, 62].

As an intangible asset, an objective measure for intellectual capital may be difficult to develop; however, Pulic [15] through his value added intellectual coefficient model (VAIC) addressed this measurement through human capital and structure capital, based in a firm's financial data. Since the VAIC model can clearly reflect value creation efficiency of a firm intangible and tangible assets, it made possible to perform comparisons between organizations and have been extensively adopted in research [62–64]. Nevertheless, further research identified relevant components of intellectual capital that were previously ignored, such as in the case of [65] who identified 4 components: human capital, structural capital, innovation capital, and customer capital, proving the validity and rationality of the modified VAIC model; following the line, [66] introduced customer capital and process capital to the extended VAIC model; Chen et al. [41]

expanded the model including internal and external dimensions, both with its respective human capital, structure capital, and relationship capital. Even in recent years, the VAIC model has evolved giving space to innovation capital into the model [7, 10].

In emerging economies, innovation capital plays an important role in firm development. Previous research defined it as the intangible assets or capabilities that can promote innovation in knowledge, service, technology, and other aspects of the firm [7, 41] and regard it as the product of the firm's human capital, social capital, and reputational capital [41, 67]. It is conducted to the creation of knowledge and the increase of intellectual property [10, 68]. Since the VAIC model does not include innovation capital and its main components include firm's labor, physical capital [69], it designates the efficiency of the labor and capital investment rather than IC [70]. So, in this exercise, researchers modified the VAIC model by defining IC as composed by (1) human capital, (2) structural capital, (3) relational capital, and (4) innovation capital. The calculation of the modified VAIC model can be seen in variable definition and measurement chapter.

2.2. Venture Capital Syndication in China. Venture-capital syndication (VCS) is a common strategy in China; it enables VC firms to choose partners to share resources of capital, human talents, and scientific and technologic knowledge and also distribute venture associated risks [23]. It helps them to overcome boundaries of original investment industry and geographical limitations, being able to obtain information from distant sources, expanding the scope of their investment [36]. Existing literature suggests that VCS has a positive effect on entrepreneurial firms. Hochberg et al. [71] found that firms funded by from two or more VC firms are more likely to successfully exit through an IPO or being sold to another firm. Lu et al. [72] found stronger innovation capabilities in VCS-backed firms in comparison with individual VC-backed firms. Ren [73] pointed out that VCS not only can effectively make up for the human and material resources needed during further development of enterprises but also stimulate innovation capital and structural capital through human capital and constantly strengthen the original relationship capital of firms, effectively enhancing the value of portfolio firms.

According to the background of its members, VCS can be divided into two cooperation modes: "Pure" and "Mixed" [34]. Pure VCS mainly refers to the cooperation of the same type of VC firm, such as GVC with GVC and DPVC with other DPVC. Mixed VCS mainly refers to the cooperation between two or more types of VC firm. Giot and Schwienbacher [74] suggested that, for larger number of VC firms participating in a round of syndication, the larger will be the scale of investment, and the period from investment to successful realization of IPO exit will be reduced. Some literature points out that "mixed" VCS present significantly lower performance than that of "pure" VCS [34]. Different types of VC firms will face differences in resources, experience, and capabilities for management and monitoring, geographic locations, and even industry; their competitive advantages may be different [75]; it means that the value-added service provided for the portfolio will be different, making in some cases the difference an obstacle to articulation between firms; in other words, the effect of intellectual capital on portfolio firm's performance may be likely affected by the VCS background.

Previous research suggested that venture capital firms with higher shareholding ratio and better reputation can improve firm efficiency through material capital and human capital [46]; in the same line, there is evidence where GVC increased firm efficiency through material capital and structural capital [76]. For VC firms with shareholding ratio higher than a certain threshold, IC may accelerate the improvement of asset utilization efficiency and market value [77]. Since VC firms in syndication have different types -and reputation-, VCS with different backgrounds may present different effect for each IC elements to improve firm efficiency. Therefore, research on how differences on VCS background may have influenced the effect of intellectual capital on portfolio firm performance acquires relevance.

Despite the existence of previous research on performance of mixed syndication involving GVC and DPVC in China [75], there is still a gap on explaining the influence of venture capital syndication (VCS) type on the relationship between intellectual capital (IC) and firm portfolio performance (FPF). Therefore, in the context of the Chinese venture capital market, this empirical exercise considers the type of syndicate leaders and the cooperation model of its members, specifically investigating the moderating effect of VCS in the previously mentioned relationship.

2.3. Intellectual Capital and Portfolio Firm Performance. As knowledge economy grows in relevance, previous studies have explored the impact of IC on PFP; as an instance, Bontis [62] showed that three components elements of IC, (1) human capital, (2) structural capital, and (3) customer capital, have positive relationship with PFP in a Malaysian sample. In [78], using a sample of US multinational firms, they found that IC may significantly improve return rate on total assets. In [79], the Indian software industry was used as context to find that a 2-component IC (human capital and structural capital) had positive impact on firm profitability. For the case of Pakistan, Waseem [13] showed significant positive effect of three IC components (human, relational, and technological) on organizational performance of large textile companies in Pakistan.

For the Chinese context, in [80], by using data from listed firms in computer industry, they found that 3-component IC (human, physical, and structural) showed positive contribution to PFP. In [81], it is confirmed that their 4-component IC (human, innovation, process, and customer) presented positive impact on enterprise value creation for the Chinese pharmaceutical manufacturing industry. Xu and Wang [82] used VAIC^{TM} and Modified VAIC^{TM} model to analyze performance of IC in China and South Korea finding that human, relational, and structural capitals are all positively related to the profitability of textile firms.

Compared to the non-VCS-backed ones, VCS-backed firms are more likely to have higher values on fostering intellectual capital; this may be because various reasons: (1) first, given the reserved character the information in portfolio companies, observers can judge firm quality by referring the behavior of any third party with information advantage [83]; therefore, the availability of information for a VCS partner provides clearer insights on the operation of the portfolio company [23]. Thus, external investors and job seekers regard VCS-backed firms to be more trustworthy, making these firms more likely to attract better human talents and financial support, explaining enhancements in firm performance [31, 84]. (2) Second, VCS often has rich network resources, being able to provide head hunters, patent lawyers, investment bankers, or any other required talents that add value and contribute to portfolio firms [71]; it can also enhance relationships with partners, suppliers, customers, and government. [23, 35]. (3) Third, VCS can provide value-added services such as management, technology, consulting, and others to portfolio firms [23], increasing the utilization rate of existing IC and the subsequent firm innovation performance [72]; consequently, IC of VCS-backed firms will tend to have better market performance. Based on the previous literature, it is possible to define the first hypothesis for this empirical exercise.

H1: 4-component intellectual capital (human capital, structural capital, relational capital, and innovation capital) has significant positive impact on VCS' portfolio firm performance.

2.4. Influence of VCS Leadership Heterogeneity. Leading VC Firm plays a key role in VCS, especially in screening, structuring, and monitoring portfolio firms [85], as the primary decision makers lead VC firms normally exercises a disproportionate influence over various VCS processes [75], therefore having privileged influence in the creation of IC within VCS portfolio firms; therefore, each VC firm definition as leading or nonleading as well as his nature (FVC, DPVC, or GVC) need to be accounted in terms of influence over IC within portfolio VC firms.

It is different that FVCs, DPVC, and GVC faced a late development in China with certain lack on investment and management experiences [86]. In GVC-led syndication, GVCs have the responsibility of stimulating local economic development [87]. In consequence, supervision and value-added services provided in their portfolio firms may be different in comparison with DPVC-led or FVC-led. Analogically, there will be difference on the IC provided by portfolio firms. Previous research showed that most GVC lack on relevant professional knowledge and investment experience [88]. Other studies documented GVC underperformance, for example, Alperovych et al. [89] found that GVCs have poorer results on portfolio firms productivity when compared to DPVC; additional research showed similar results on human capital recruitment [90], sales growth [91], and innovation [88]. Thus, firms backed by GVC-led syndication will face lesser effectivity on IC and value creation.

On regard to FVC-led syndication, their partners are often invited to provide a second opinion on managing or diversifying value-added activities. In the Chinese case, most FVC comes from foreign professional investment banks, investment institutions, insurance institutions, and wealthy individuals from developed countries; compared with DPVCs or GVCs in China, FVCs have more resources in terms of social network, investment experience, management, and risk control [92], thus, FVCs may increase its IC through portfolio value-added services that can enhance firm value creation in higher proportion than GVC or DPVC in China [34]. Based on this, the next hypothesis can be constructed:

H2: compared DPVC-led or GVC-led syndication, intellectual capital shows more effectiveness in portfolio firm performance within FVC-led syndication.

2.5. Moderating Effect of VCS Members. VCS is composed of various VC firms that contribute with different funding sources, experience, talents, etc. Therefore, value-added services provided by each VCS portfolio firms have its own particularities, such as their IC and its ability to create value. The composition of VCS' members may influence the impact of IC on PFP. This exercise studied the role of VCS members in the relationship between IC and firm performance by studying the cooperation mode of VCS members and their heterogeneity.

Different from pure syndication, mixed syndication presents stronger member heterogeneity; in terms of resource-based theory, VCS with higher member heterogeneity implies higher diversity of resources, such as social relations, information access, and competitive advantages [93, 94] [31, 85]; this model based in complementary cooperation provides also advantages in terms of value-added services such as knowledge, technology, and network relations among others [29] helpful for invested firms management of and post investment supervision. For example, FVCs have advantage on helping firms to establish professional governance structure and operating model [34]. By forming a heterogeneous syndicate with other DPVC or GVC in China, they will gain better understanding of local firms and their culture [95], increasing portfolio firm information resources and relationship capital, at the end improving their firm performance [96]. Lu et al. [72] found also that VCS with high member heterogeneity is more likely to be familiar with various stages of firm development, helping firms to use specialized operating models to improve innovation efficiency and develop IC. Therefore, the third hypothesis is built as follows.

H3a: stronger VC syndication member heterogeneity can increase the positive impact of investee's intellectual capital on portfolio firm performance.

However, human behavior may bring over a downside on VCS portfolio firms related to value creation within IC. Following the Social Classification Theory and Social Identity Theory, similar attitudes and values within a team will make individuals to identify with each other, classify team members, develop crowd preferences, and outgroup

biases, further making team heterogeneity a factor for member conflicts, impacting negatively the group decision process [97, 98], and moving people away from teamwork [99]. In the case of VCS, member background diversity means greater heterogeneity in terms of values, corporate culture, management models, and investment concepts; however, wider environment is developed for bias development against VC firms with different background, facilitating the appearance of potential conflicts [84].

In terms of portfolio firm management, stronger member heterogeneity within VCS may extend the time for firm's decision-making [32], increasing management costs [50] as well as its portfolio trade sale hazard [100]. The occurrence of this situation harms the ability of the portfolio firms to make full use of the extended resources provided by the VCS, intended to enhance the value creation ability of intellectual capital. In other words, common member background in pure syndication allows smoother in communication and coordination [34, 75] provides more efficient services having also better positive effect on firm performance than the mixed syndication. Given these findings, a complementary hypothesis has been developed as follows.

H3b: stronger VC syndication member heterogeneity can reduce the positive impact of investee's intellectual capital on portfolio firm performance.

3. Methodology

3.1. Sample Collection. This empirical study used data from firms that accepted VCS funding and got successfully listed on Shenzhen and Shanghai stock exchanges during 2014 to 2018. The sample data were composed by two components: (1) VC data, obtaining the sample firms from [33] research database and the CV source database [101]. This dataset included VC firm names, their participation in VCS, firm background information, investment amount, and number of shares. (2) Relevant financial data of the sample firms were obtained from wind financial database [102], widely recognized in China for financial data. After deleting missing data and using tailing treatment at 5%–99% level, also eliminating the impact of extreme data, an overall number of 575 valid observations were obtained.

3.2. Variable Definition and Measurement

3.2.1. Dependent Variables. To measure portfolio firm performance, this study used return on assets (ROA) consistent with the previous literature [2, 7, 10, 19]. It is a widely used indicator on firm profitability and is usually used to measure the efficiency of a firm. A higher ROA represents higher effectiveness of a firm's asset utilization.

For robustness check, this study used return on equity (ROE) as a proxy for firms' performance [10, 82].

3.2.2. Independent Variables. Based on the analysis presented in Section 2.1 of this article, this study measured intellectual capital by using the modified Pulic's VAIC^{TM} model, measurement of IC, and its constituent elements as shown in Table 2.

3.2.3. Control Variables. Consistent with previous studies [72, 103, 104], this empirical exercise included a set of 5 control variables as follows: (1) firm size, (2) debt ratio, (3) permanent asset ratio, (4) board size, and (5) total asset turnover ratio. The method of calculation for each variable is described in Table 2.

3.3. Empirical Models. According to the sample for this study, we assume that there is no individual effect. As the p value of the F test was 0.356 on the statistical assessment, the null hypothesis on individual effect could not be rejected. Therefore, a pooled OLS model was applied; to eliminate the heteroscedasticity and sequence-related problems and OLS + clustering robust standard error were chosen for regression.

3.3.1. Model for Hypothesis (H1). The following model (1) describes the model to assess H1:

$$\begin{aligned}\text{Perform}_{i,t} = {} & \alpha_1 + \beta_1 X_{i,t} + \beta_2 \text{Size}_{i,t} + \beta_3 \text{Debt}_{i,t} \\ & + \beta_4 PPE_{i,t} + \beta_5 BN_{i,t} + \beta_6 TAT_{i,t} + \varepsilon_{i,t},\end{aligned} \tag{1}$$

where *Perform* represents performance, i represents the firm, t represents the year, and $X_{i,t}$ represents $VAIC_{i,t}$, $HCE_{i,t}$, $SCE_{i,t}$, $ICE_{i,t}$, and $RCE_{i,t}$, respectively.

3.3.2. Model for Hypothesis (H2). Regression analysis was ran based on the values on leading type by running it in three groups according to each case: $Lea\ d\_type = 1$; $Lea\ d\_type = 2$; $Lea\ d\_type = 3$; then, group regression coefficients were compared through SUEST command. If the regression coefficients were significantly different, then, heterogeneity was considered significant. To perform in-depth analysis, this study not only grouped regression between the dependent variable (DV) and IC but also grouped regression between the DV and the components of IC.

3.3.3. Model for Hypothesis (H3). To evaluate H3a and H3b, this study introduced two interaction terms: (1) IC and VCS member heterogeneity and (2) IC's elements and VCS member heterogeneity, to construct the model described in the following equation. Then, hierarchical regression test was performed. If the regression coefficient of the interaction term was significant, then significance of its moderating effect was also significant.

$$\begin{aligned}\text{Perform}_{i,t} = {} & \alpha_0 + \beta_1 X_{i,t} + \beta_2 VCtypeHeter_{i,t} \\ & + \beta_3 X_{i,t} * VCtypeHeter_{i,t} + \beta_4 \text{Size} \\ & + \beta_5 \text{Debt}_{i,t} + \beta_6 PPE_{i,t} + \beta_7 BN_{i,t} \\ & + \beta_8 TAT_{i,t} + \varepsilon_{i,t},\end{aligned} \tag{2}$$

Table 2: Variable definitions and measurement.

Type	Variable	Definition	Measurement
Dependent DV	ROA	Return on assets	Net incomes/average total assets
Independent IV	HCE	Human capital efficiency	VA/employee expenses
	SCE	Structural capital efficiency	VA/management expenses
	ICE	Innovation capital efficiency	VA/R&D expenses
	RCE	Relational capital efficiency	VA/sales expenses
	VAIC	Intellectual capital efficiency	HCE + SCE + ICE + RCE
Moderator	VctypeHeter	VCS heterogeneity	$-\sum_i p_i \ln p_i$, where p_i is the proportion of i-type VC institutions in the total number participants within a VCS)
Control	Scale	Enterprise size	Logarithm of total assets
	Debt	Debt ratio	Total liabilities/total assets
	PPE	Permanent asset ratio	Permanent assets/total assets
	BN	Board num	Number of board directors
	TAT	Total asset turnover	Operating income/average total assets

Note: VA is the value added of a firm; VA = net profit + depreciation expense + income tax + financial expenses + salary payable + welfare payable.

where *Perform* represents performance, *i* represents the firm, *t* represents the year, $VCtypeHeter_{i,t}$ represents heterogeneity, and $X_{i,t}$ represents $VAIC_{i,t}$, $HCE_{i,t}$, $SCE_{i,t}$, $ICE_{i,t}$, and $RCE_{i,t}$, respectively.

4. Empirical Results and Analysis

4.1. Descriptive Statistics. Descriptive statistical analysis was conducted based on the background of the VCS leading firm and VCS cooperation model as shown in Table 3.

Based on Table 3, it can be inferred that (1) from the perspective of IC components, independent of the type of supporting VCS, there is a value pattern, where ICE > RCE > SCE > HCE, meaning that, in terms of firm value creation ability, IC contribution follows the following pattern: innovation capital > relational capital > structural capital- > human capital. (2) From the perspective of VCS leading type, the ROA of DPVC-led syndication backed firms is higher than that those of FVC-led or GVC-led; however, VAIC-value on the GVC-led and DPVC-led are similar, both being higher than FVC-led ones. This result shows difference with previous research hypothesizes, so further analysis needs to be done.

4.2. Correlation Analysis. Table 4 shows the correlation matrix for main variables of study; based on it, it is possible to see the following: (1) there is significant positive correlation between the ROA and the set of IC-related variables (HCE, SCE, ICE, RCE, and VAIC); however, no significant correlation is seen between the ROA and *Lead_type* or *VctypeHeter*. (2) Significant positive correlation was found between VAIC and HCE, SCE, ICE, and RCE, as well as between VAIC and *Lead_type*; although the correlation between VAIC and *VctypeHeter* is not significant, there is negative correlation between HCE and *VctypeHeter* (−0.099). It is also relevant to mention that (3) significant positive correlation appeared between *Lead_type*, *VctypeHeter*; although the correlation between these two variables and ROA is not significant, negative significant correlation is found between these variables and some components of IC (HCE and *Lead_type* was 0.084**). While there is significant positive correlation between components of IC and ROA, further relationship validation will be needed.

4.3. Empirical Result Analysis

4.3.1. Relationship of IC and Firm Performance. Table 5 shows that IC, HCE, SCE, ICE, and RCE all have a significantly positive impact on the portfolio firm performance, consistent with H1, since the *t* values of regression coefficient for VAIC, HCE, SCE, ICE, and RCE are 12.61, 17.52, 17.87, 9.11, and 8.72, respectively, with significance at 1% level. Moreover, the effects of human capital (2.269) and structural capital (2.211) on PFP are significantly higher than innovation (0.312) and relationship capital (0.339). This finding is consistent with the first proposed argument that IC is composed of human capital and structural capital [15] and indicates that VCS can improve firm performance by providing value-added services such as human capital, organizational management operations, and social relationship resources.

4.3.2. Role of VCS Leader Background between Intellectual Capital and Firm Performance. Based on the results shown in Table 6, regression coefficient of VAIC in group 1 (0.647) is higher than in group 2 (0.283) and group 3 (0.227), meaning that compared with DPVC-led or GVC-led backed syndication firms, IC has a greater impact on performance of FVC-led firms supporting H2. As shown in Table 7, SUR estimation group analysis (1 vs 2, 1 vs 3) showed that the

Table 3: Descriptive statistical analysis of the main study variables.

	Type	Variable	Sample	Mean	SE	Min	Max
VCS leader background	Backed by FVC-led syndication	ROA	64	5.919	3.501	0.1	14.843
		HCE	64	1.050	0.724	0.211	3.243
		SCE	64	1.426	0.757	0.402	3.893
		ICE	64	2.758	1.587	0.579	7.441
		RCE	64	2.201	1.901	0.212	7.868
		VAIC	64	7.435	3.530	1.878	15.186
	Backed by DPVC-led syndication	ROA	425	6.323	3.419	-1.881	15.572
		HCE	425	1.440	0.728	0.231	3.478
		SCE	425	1.727	0.822	0.259	4.549
		ICE	425	4.524	3.379	0.543	19.873
		RCE	425	3.427	2.633	0.213	13.931
		VAIC	425	11.117	5.528	1.666	36.034
	Backed by GVC-led syndication	ROA	86	5.483	3.128	-1.772	14.749
		HCE	86	1.346	0.717	0.328	3.298
		SCE	86	1.800	0.899	0.332	4.367
		ICE	86	4.589	3.267	1.158	16.674
		RCE	86	3.482	2.576	0.497	11.975
		VAIC	86	11.218	4.896	3.201	23.82
VCS cooperation model	Backed by pure syndication	ROA	380	6.279	3.568	-1.881	15.572
		HCE	380	1.425	0.755	0.211	3.478
		SCE	380	1.738	0.824	0.259	4.549
		ICE	380	4.388	3.188	0.543	19.873
		RCE	380	3.371	2.601	0.236	13.931
		VAIC	380	10.923	5.466	1.666	36.034
	Backed by mixed syndication	ROA	195	5.907	3.022	0.1	14.843
		HCE	195	1.300	0.688	0.252	3.243
		SCE	195	1.638	0.845	0.332	4.367
		ICE	195	4.236	3.392	0.579	19.595
		RCE	195	3.157	2.536	0.212	13.71
		VAIC	195	10.332	5.171	2.704	29.73

Table 4: Correlation matrix for main study variables.

Variables	ROA	HCE	SCE	ICE	RCE	VAIC	Lead_type	Vctype Heter
ROA	1.000							
HCE	0.425***	1.000						
SCE	0.446***	0.587***	1.000					
ICE	0.208***	0.301***	0.427***	1.000				
RCE	0.243***	0.328***	0.306***	0.198***	1.000			
VAIC	0.370***	0.568***	0.641***	0.809***	0.692***	1.000		
Lead_type	-0.043	0.084**	0.107**	0.129***	0.114***	0.161***	1.000	
VctypeHeter	0.015	-0.099**	0.015	0.037	-0.062	-0.021	0.112**	1.000

Note: ***significance at 1% level; **significance at 5% level; *significance at 10% level.

coefficient difference of VAIC was all significant at 1%; in the case of 2 vs 3, there was no significant difference on VAIC, indicating no significant difference in the impact of IC on firm performance between firms backed by DPVC-led or GVC-led syndication. This is result is similar to that in [34] and in line with those of [92].

From the perspective of the components of IC, this study found no significant differences in the impact of human capital and structural capital on firm performance among firms invested by FVC-led, DPVC-led, or GVC-led syndication. As seen in Table 7, the SUR group test (1 vs 2, 1 vs 3, and 2 vs 3) showed no significant difference on coefficients of HCE and SCE; however, there is significant difference in the impact of innovation capital on firm performance among them; from the coefficients of ICE in Table 6 and result of ICE's SUR-test in Table 7, it can be seen that the impact of innovation capital on firm performance is higher in firms on FVC-led syndication than in the ones backed by DPVC-led or GVC-led. Additionally, the relationship capital of firms backed by GVC-led syndication has no significant impact on performance, but firms backed by FVC-led or DPVC-led syndication can effectively use their relationship capital to foster performance. As seen from the empirical test for groups, regression coefficients of RCE are significant except for group 3 (Table 6).

Table 5: Influence of IC and its constituent elements on firm performance.

IV	ROA				
VAIC	0.283(8.69) ***				
HCE		2.269*** (11.98)			
SCE			2.211*** (12.23)		
ICE				0.312*** (5.62)	
RCE					0.339*** (6.17)
Scale	-0.444* (-2.55)	-0.377* (-2.42)	-0.899*** (-5.50)	0.331*** (9.11)	0.0688 (0.38)
Debt	-0.051*** (-6.07)	-0.043*** (-5.68)	-0.038*** (-4.99)	-0.055*** (-6.08)	-0.056*** (-6.16)
PPE	-9.545*** (-8.45)	-6.815*** (-6.84)	-9.977*** (-9.64)	-8.167*** (-6.89)	-8.735*** (-7.21)
BN	-0.135 (-1.53)	-0.134 (-1.67)	-0.095 (-1.18)	-0.028 (-0.31)	-0.110 (-1.16)
TAT	6.133*** (10.99)	6.602*** (12.97)	4.318*** (8.19)	5.647*** (9.48)	6.063*** (10.11)
Constant	14.75*** (3.97)	11.22*** (3.38)	23.35*** (6.70)	7.126 (1.83)	4.716 (1.21)
Observations	575	575	575	575	575
R-squared	0.3060	0.4023	0.4035	0.2274	0.2218
Mean VIF	1.10	1.09	1.13	1.10	1.09

Note: *t* statistics in parentheses. ***Significance at 1% level; **significance at 5% level; *significance at 10% level.

Table 6: Test results of VCS leading firm background heterogeneity.

Type	IV	ROA				
FVC-led syndication (group 1)	VAIC	0.724*** (4.20)				
	HCE		3.423* (2.28)			
	SCE			2.828*** (4.22)		
	ICE				1.966*** (5.05)	
	RCE					0.706** (2.23)
	Control	Y	Y	Y	Y	Y
	R^2	0.7207	0.570	0.721	0.771	0.502
	Observations	64	64	64	64	64
	Mean VIF	1.95	2.59	1.91	2.12	1.84
DPVC-led syndication (group 2)	VAIC	0.283*** (9.94)				
	HCE		2.146*** (9.95)			
	SCE			1.798*** (8.73)		
	ICE				0.308*** (5.67)	
	RCE					0.397*** (6.3)
	Control	Y	Y	Y	Y	Y
	R^2	0.408	0.382	0.344	0.213	0.271
	Observations	425	425	425	425	425
	Mean VIF	1.11	1.11	1.15	1.11	1.10
GVC-led syndication (group 3)	VAIC	0.227*** (3.66)				
	HCE		2.129*** (4.24)			
	SCE			2.529*** (5.65)		
	ICE				0.255*** (2.71)	
	RCE					0.048 (0.31)
	Control	Y	Y	Y	Y	Y
	R^2	0.530	0.513	0.599	0.486	0.345
	Observations	86	86	86	86	86
	Mean VIF	1.41	1.36	1.44	1.60	1.39

Note: *t* statistics in parentheses. ***Significance at 1% level; **significance at 5% level; *significance at 10% level.

4.3.3. Moderating Effect of VCS Member Heterogeneity. As shown in Table 8, the regression coefficient of the interaction between IC and heterogeneity type of VCS members is −0.259 significant at 5% level, implying that VCS member heterogeneity has significant negative moderating effect on the impact of IC on firm performance, indicating that stronger heterogeneity on VCS member background may reduce the positive impact of IC on firm performance, consistent with H3b.

From the perspective of IC components, regression coefficient of the interaction terms corresponding to relational capital is -0.531 significant at 5% level, in other words, stronger VCS member heterogeneity can also reduce the positive impact of relational capital on firm performance. However, the regression coefficient for the interaction terms corresponding to human capital (-0.665), structural capital (-0.602), and innovation capital (-0.382) is not significant, suggesting that more background does not imply better results within the VCS.

Table 7: SUR-group test (1 vs 2, 1 vs 3, and 2 vs 3) coefficient difference.

Main variable	"Foreign" and "private" (group 1 vs 2)		"Foreign" and "government" (group 1 vs 3)		"Private" and "government" (group 2 vs 3)	
	Chi2	p-value	Chi2	p-value	Chi2	p-value
VAIC	8.50	0.004***	9.09	0.003***	0.44	0.507
HCE	0.79	0.375	0.78	0.378	0.01	0.969
SCE	2.20	0.138	0.15	0.699	2.65	0.103
ICE	49.68	0.001***	31.81	0.001***	0.16	0.690
RCE	1.24	0.266	4.52	0.033**	4.33	0.037**

Note: ***Significance at 1% level; **significance at 5% level; *significance at 10% level.

Table 8: Moderating effect of VCS member heterogeneity.

IV	ROA				
IC/elements	VAIC 0.353*** (8.95)	HCE 2.612*** (10.01)	SCE 2.350*** (9.81)	ICE 0.435*** (5.13)	RCE 0.417*** (5.35)
VCtypeHeter	3.282** (2.74)	2.609* (2.37)	1.632 (1.53)	1.824 (1.86)	2.431** (2.66)
VAIC ∗ *VCtypeHeter*	-0.259** (-2.94)				
HCE ∗ *VCtypeHeter*		-0.665 (-0.89)			
SCE ∗ *VCtypeHeter*			-0.602(-1.04)		
ICE ∗ *VCtypeHeter*				-0.382(-1.90)	
RCE ∗ *VCtypeHeter*					-0.531** (-2.49)
Scale	-0.512 (-1.88)	-0.243 (-0.94)	-0.960*** (-3.59)	-0.350 (-1.18)	-0.240 (-0.81)
Debt	-0.063*** (-5.20)	-0.06*** (-5.04)	-0.043*** (-3.68)	-0.06*** (-4.74)	-0.059*** (-4.40)
PPE	-7.081*** (-4.25)	-4.296** (-2.70)	-7.740*** (-4.87)	-7.19*** (-3.94)	-5.455** (-2.99)
BN	-0.144 (-1.19)	-0.254* (-2.16)	-0.100 (-0.87)	0.005 (0.04)	-0.106 (-0.79)
TAT	6.927*** (8.08)	7.598*** (9.25)	5.028*** (5.96)	7.611*** (8.09)	6.805*** (7.21)
Constant	14.20* (2.46)	8.103 (1.48)	23.80*** (4.21)	11.22 (1.79)	9.941 (1.58)
R^2	0.397	0.444	0.448	0.280	0.267
Observations	575	575	575	575	575
Mean VIF	2.42	2.18	2.24	1.96	1.63

Note: t statistics in parentheses. ***Significance at 1% level; **significance at 5% level; *significance at 10% level.

4.3.4. Endogeneity Problems and Robustness Check

(1) Endogeneity Problems. An increase of intellectual capital contributes to firm performance; nevertheless, considering that firms with higher performance may also attract intellectual capital improvement like better human resources, there may be reverse causation. Additionally, although multiple control variables have been selected in this research, there may be other endogenous problems such as missing variables. For these reasons, this exercise used the generalized method of moments (GMMs) to reduce endogeneity problems and control unobservable factors for the causality model. Following [46] and [47], the average IC value of the sample firm's industry was used as its own instrumental variable, which represents on average the impact of industry IC on firm performance. Generally, firms in the same industry learn and communicate with each other, influencing their IC and its components, but without directly affecting the firm's value-added activities.

The traditional Hausman test were used to carry out the endogeneity test on the main explanatory variables, showing that prob > chi2 = 0.0443; the DWH test with robust heteroscedasticity showed Durbin ($p = 0.0433$) and Wu Hausman ($p = 0.0443$). These results prove the existence of endogenous problems and the applicability of the GMM method in this empirical exercise.

Test results of instrument variables showed that ① Anderson canon corr: LM statistic was 23.556, with a p value of 0.000, strongly rejecting the under identification null hypothesis, indicating that the instrument variable is reasonable. ② Cragg-Donald Wald F statistic was 24.115, higher than the corresponding critical value of 16.38, rejecting the original hypothesis of "weak identification." Based on the above instrument variable tests and instrument variable method regression results, the results of this study appeared to be stable.

First-stage regression showed that all the coefficient of instrumental variable showed higher significance (p value = 0.0001), and second-stage regression was also consistent to the conclusion, as shown in Table 9.

(2) Robustness Check. As shown in Tables 5–9, the value of mean VIF stayed between 1.59 and 2.09, meaning the absence of multicollinearity problems. For the moderate effect model, ROE was used instead of ROA to test moderating effect models' robustness of our results. As shown in Tables 10–12, the empirical results were materially consistent

Table 9: Instrumental variables (GMM) regression.

IV	ROA				
VAIC	0.362*** (3.46)				
HCE		2.703*** (3.90)			
SCE			2.877*** (4.72)		
ICE				0.855** (2.81)	
RCE					0.675* (2.25)
Scale	-0.918** (-2.68)	-0.442* (-2.02)	-1.191*** (-4.20)	-0.383 (-1.48)	0.0504 (0.25)
Debt	-0.0491*** (-5.63)	-0.0428*** (-5.51)	-0.0348*** (-4.39)	-0.060*** (-5.88)	-0.063*** (-5.63)
PPE	-11.69*** (-6.56)	-6.952*** (-6.75)	-11.18*** (-7.24)	-10.33*** (-5.99)	-10.26*** (-5.53)
BN	-0.252* (-2.24)	-0.156 (-1.74)	-0.137 (-1.53)	-0.115 (-1.01)	-0.204 (-1.60)
TAT	6.432*** (9.98)	6.684*** (11.40)	3.891*** (5.94)	5.611*** (8.27)	6.446*** (8.76)
Constant	24.03*** (3.49)	12.34** (2.89)	28.96*** (5.05)	12.53* (2.42)	5.013 (1.18)
Observations	575	575	575	575	575
R-squared	0.189	0.398	0.370	0.011	0.151

Note: t statistics in parentheses. ***Significance at 1% level; **significance at 5% level; *significance at 10% level.

Table 10: Robustness check results of different VCS leading backgrounds.

Type	Main IV	ROE				
FVC-led syndication	VAIC	0.707*** (3.03)				
	HCE		3.597* (2.23)			
	SCE			3.458*** (3.93)		
	ICE				1.557** (2.73)	
	RCE					0.646 (1.2)
	Control	Y	Y	Y	Y	Y
	R^2	0.584	0.469	0.654	0.560	0.455
	Observations	64	64	64	64	64
	Mean VIF	1.58	2.25	1.51	1.51	1.94
DPVC-led syndication	VAIC	0.316*** (7.80)				
	HCE		2.845*** (9.51)			
	SCE			2.790*** (10.18)		
	ICE				0.286*** (3.80)	
	RCE					0.455*** (5.46)
	Control	Y	Y	Y	Y	Y
	R^2	0.327	0.380	0.401	0.223	0.261
	Observations	425	425	425	425	425
	Mean VIF	1.10	1.10	1.14	1.11	1.09
GVC-led syndication	VAIC	0.341*** (4.08)				
	HCE		2.818*** *** (4.34)			
	SCE			2.318*** (4.16)		
	ICE				0.400*** (3.15)	
	RCE					0.235(1.18)
	Control	Y	Y	Y	Y	Y
	R^2	0.530	0.545	0.534	0.480	0.398
	Observations	86	86	86	86	86
	Mean VIF	1.25	1.24	1.33	1.26	1.26

Note: t statistics in parentheses. ***Significance at 1% level; **significance at 5% level; *significance at 10% level.

Table 11: Robustness check results of SUR-test of group (Types 1 vs 2, 1 vs 3, and 2 vs 3) coefficient difference.

Main variable	"Foreign" and "private" (type 1 vs 2)		"Foreign" and "government" (type 1 vs 3)		"Private" and "government" (type 1 vs 2)	
	Chi2	p value	Chi2	p value	Chi2	p value
VAIC	4.19	0.040 **	3.12	0.077 *	0.05	0.820
HCE	0.76	0.381	0.73	0.392	0.00	0.962
SCE	0.49	0.481	1.15	0.284	0.56	0.452
ICE	9.02	0.003***	6.89	0.008***	0.43	0.513
RCE	0.41	0.521	1.44	0.229	1.12	0.290

Note: t statistics in parentheses. ***Significance at 1% level; **significance at 5% level; *significance at 10% level.

Table 12: Robustness check results of moderating effect of VCS member heterogeneity.

IV	ROE				
IC and its elements	VAIC	HCE	SCE	ICE	RCE
	0.379*** (6.78)	3.175*** (8.77)	2.866*** (8.60)	0.398*** (3.41)	0.453*** (4.24)
VCtypeHeter	3.156 (1.86)	2.801 (1.83)	1.893 (1.27)	1.391 (1.03)	3.091* (2.47)
VAIC ∗ *VCtypeHeter*	−0.211 * (-2.03)				
HCE ∗ *VCtypeHeter*		−0.289 (−0.28)			
SCE ∗ *VCtypeHeter*			−0.514 (-0.64)		
ICE ∗ *VCtypeHeter*				−0.186 (-0.67)	
RCE ∗ *VCtypeHeter*					−0.614* (-2.10)
Scale	−0.266 (-0.69)	0.0251 (0.07)	−0.865* (-2.33)	−0.0672 (-0.16)	0.0489 (0.12)
Debt	−0.056** (-3.23)	−0.051** (-3.17)	−0.032 (-1.94)	−0.055** (-2.97)	−0.051** (-2.77)
PPE	−10.68*** (-4.53)	−7.336*** (-3.33)	−11.58*** (-5.24)	−10.61*** (-4.22)	−8.713*** (-3.49)
BN	−0.232 (-1.36)	−0.392* (-2.40)	−0.197 (-1.23)	−0.076 (-0.42)	−0.190 (-1.03)
TAT	9.325*** (7.68)	10.22*** (8.98)	6.956*** (5.93)	9.991*** (7.70)	9.268*** (7.17)
Constant	9.137 (1.12)	2.186 (0.29)	21.65** (2.75)	5.679 (0.66)	3.967(0.46)
Observations	575	575	575	575	575
R^2	0.321	0.401	0.400	0.231	0.234
Mean VIF	2.52	2.27	2.36	1.96	1.64

Note: t statistics in parentheses. ***Significance at 1% level; **significance at 5% level; *significance at 10% level.

with previous research, demonstrating the robustness of the conclusions of this study.

5. Discussions and Conclusions

This study was intended to investigate the positive effect of intellectual capital (IC) on Chinese portfolio firm performance (PFP) and examine the influence of VCS leading firm heterogeneity as well as the moderating impact of member heterogeneity on this relationship (IC and PFP) by assessing three aspects: (1) VCS leading firm background, (2) VCS cooperation model, and (3) VCS member heterogeneity. Our results suggested that higher intellectual capital may provide advantages for VCS backed firms, and these advantages vary according to the nature of the syndication (FVC-led, DPVC-led, or GVC-led). The positive impact of innovation capital on the performance of firms backed by FVC-led syndication is higher than firms backed by DPVC-led or GVC-led syndication; the positive effect of relational capital on the performance between firms backed by DPVC-led or FVC-led is similar, but in firms backed by GVC-led syndication, there is no significant effect. Additionally, in pure syndication backed firms, IC positive effect in PFP is stronger than that in mixed syndication backed firms; on member heterogeneity, it reduces the positive effect of IC on PFP.

This study contributes to managerial theory and practice in various ways:

(1) First, this study considered the multidimensional characteristics of intellectual capital in Chinese portfolio firms by introducing innovative capital into the modified VAIC model. Most of previous studies have considered IC as composed by human capital, structure capital, or relational capital [30, 62, 79]; in contrast, just few studies gave attention to other components such as innovation capital. So, this study provides comprehensive analysis on IC efficiency within Chinese portfolio firms.

(2) Second, this empirical exercise contributes to existent literature on the association between intellectual capital and firm performance as most studies have focused on IC and firm performance in the context of developed countries [1, 10, 78] or specific industries in emerging economies [30, 40, 49, 82]. This study extended the field of study to the role of venture-capital syndication (VCS) background in the relationship of intellectual capital (IC) and VCS-backed firm performance, finding that the applied 4-component IC (human capital, structure capital, relational capital, and innovation capital) can effectively improve the performance of VCS-backed firms in China. This study presents a certain difference with [2] who found that relational capital has a negative effect on firm performance; nevertheless, this can be explained by the difference of samples that in this study represents VCS-backed and successfully conducted IPO firms in China; since VCS-backed firms have stronger competitive advantages compared to others [23, 29], these firms can efficiently use their relational capital to improve firm performance. This reminds us to carefully analyze the key elements of VC firm intellectual capital, especially in the context of emerging economies.

(3) Third, this study extends also the actual literature on cross-border VC syndicates; previous studies focused on the impact of cross-border VC syndicates on investment performance [34, 105] or portfolio companies [95, 106, 107]. This empirical exercise performed further analysis on the importance of VeCS leading VC firms in their portfolio, finding that, in FVC-led syndication backed firms, IC has stronger positive impact on firm performance than in GVC-led syndication or DPVC-led syndication backed firms, consistent with [34], also supporting [108], where venture capitalists seem to prefer cross-border partners over domestic ones. Moreover, this study found that the mentioned effect is specially

evidenced in the impact of innovation capital on firm performance; the impact of human capital and structural capital on PFP showed no significant difference between firms backed by FVC-led, DPVC-led syndication, or GVC-led syndication. However, whether FVC-led or FVC-led syndication backed firms, relational capital has significant positive impact on PFP but not in firms backed by FVC-led syndication. This may be explained by the Chinese GVC political connections and restrictions, making it unable to make full use of its social relationships to improve the firm performance [61, 86].

In empirical terms, this study contributes to the growing literature on social identity theory and intellectual capital of portfolio firms, by complementing the previous studies that usually used the resource-based theory to emphasize the role of VCS in improving IC and PFP [23, 29, 109]. However, fewer studies have focused on the impact of VCS's shortcomings on their portfolio companies [50, 75]. Based on the social identity theory, this research revealed negative effect of mixed VCSs on their portfolio companies, such as increase of communication costs [50] and growth of decision-making cycle [32], attenuating the positive effect of IC on PFP for firms backed by mixed VCS in comparison with pure VCS backed firms. These results also explain why VC firms would prefer to choose partners with similarities for joint investment, consistent with [50].

(4) This study contributes to managerial practice as new ventures can be more aware of the influence of VCS on the value creation ability of their IC. By one side, they could make comprehensive use of resources and capital advantages of VCS, by developing the elements of IC, especially human capital and structure capital, because based on these results, these components have stronger impact on PFP compared with innovation capital and relational capital. By the other side, VC firms could also pay attention to the downside of VCS, especially in relation with mixed VCS, as they need to minimize potential addition on coordination costs and maximize internal organizational management effectiveness. Therefore, firms can effectively combine the management of IC with VCS to enhance sustainable growth capabilities, combine the available VCS resources, improve the construction of their own relational capital, as well as introduce advanced knowledge, technology, and talents to increase the performance.

For VC firms, on the one hand, they can be aware of the differential influence of the VCS leading VC on their portfolio firms; this study showed that, for Chinese VC firms, it is relevant to strengthen the international cooperation and communication, in order to develop advanced capital operation methods and management concepts from FVC to improve their investment effectiveness; on the other hand, special attention should be given to the negative impact heterogeneity when selecting syndicate partners; this study showed that pure syndication may be a better choice to improve their PFP.

This study has some limitations: (1) first, it was mainly focused the role of VCS background between IC and PFP, the impact of factors such as experience heterogeneity and regional heterogeneity of VCS members were not included in this study; however, these can be included in future studies. (2) Second, given the difference of institutions between countries (especially compared with other in emerging economies), sample data did not include other countries or regions; further studies may expand the geographical range to a comparative study with referents in Asia and North America would be meaningful.

In summary, this study investigated the positive effect of IC on Chinese PFP and the role of Venture-capital syndication (VCS) background in the relationship between IC and PFP based on a sample of 575 VCS-backed and listed firms in Mainland China during 2014–2018. By using Pooled OLS model to test hypotheses, using GMM to reduce endogenous problems and control unobservable factors, and using return on equity instead of ROA to test the robustness of the results, this study results suggested that (1) intellectual capital (human capital, structural capital, innovation capital, and relational capital) has a positive impact on VCS' portfolio firms in China; results also showed that (2) VCS leading firm heterogeneity influences the relationship between IC and PFP; compared with DPVC-led or GVC-led syndication, IC is more effective to develop performance on firms backed by FVC-led syndication, which also suggest that (3) heterogeneity within syndication is less conducive to the value creation of the intellectual capital of their portfolio firms.

These results showed that VCS-backed firms, the increase of intellectual capital (including human capital, structure capital, innovation capital, and relational capital) is conductive to increase of firm performance; the relationship between intellectual capital and performance of portfolio firms is influenced by the background of syndicate members. This study highlights the importance of intellectual capital and the background of different syndication members in the promotion of firm value. It also points out that the effective combination of intellectual capital and venture capital firms can provide important value-added function for VC firms and its related actors.

Data Availability

The data sets used for this empirical study are publicly available in https://www.pedata.cn/data/index.html [33]and https://www.wind.com.cn/NewSite/data.html [99].

Conflicts of Interest

The authors declare that there are no conflicts of interest regarding the publication of this paper.

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