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Surviving through Incubation Based on Entrepreneurship-Specific Human Capital Development: The Moderating Role of Tenants' Network Involvement

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Abstract: Drawing upon human capital theory and the co-production view of business support processes, this paper investigates the moderating effects of network involvement on entrepreneurship-specific human capital (ESHC) that determines the tenants' survival in an incubator. Longitudinal data between 2006 and 2009 of 71 ventures located in an incubator in China have been collected and analyzed. The research confirms that network involvement strengthens the influence of entrepreneurial experience on tenants' successful graduation, but does not impact the relationship between entrepreneurial family background and tenants' graduation.

Keywords: China; entrepreneurship-specific human capital; incubator; incubation services; network involvement; tenants' graduation

1. Introduction

In recent years, the global business landscape has undergone dramatic change. Some companies in emerging economies like China have developed quickly and caught-up with leading foreign companies in the global value chain. This phenomenon has attracted significant research attentions from various perspectives, for example the government supports [1] (like subsidy [2]), foreign research and development (R&D) spillovers [3], and so on. However, little is known about how companies from a disadvantaged context like China can overcome challenges in the early stage of development and survive so that they may further achieve sustainability. This paper sets out to explore this important research theme. We focus on the entrepreneurship-specific human capital (ESHC) issue in Chinese young companies which are still located in an incubator. Specifically, we consider the impacts of ESHC on tenants' survival in an incubator moderated by tenants' network involvement.

The impact of access to networks on the tenants' survival in an incubator presents an interesting research topic [4]. The extant wisdom is that incubation services can be developed or orchestrated by means of multiple accesses to a network. A network embedded in incubation services is found to be critical to the tenants' survival. The effects of incubation services on tenants are treated as a binary independent variable [5]. Furthermore, in-depth case studies indicate that access to networks is a facilitator of tenants' growth [6,7]. Although all tenants have the same access to the network of incubation services, it has varying effects on different tenants. The heterogeneity of tenants' network involvement can be an anchor to exploit the varying effects.

Human capital theory and prior studies have identified the significance of tight-coupling between entrepreneurs' human-capital profiles and the growth and survival of new-technology based firms (NTBFs) [8–10]. Moreover, according to the co-production view [11], an entrepreneur is both a receiver of incubation services and the party immediately involved in co-production with the incubator. In this interdependent co-production dyad, the assistance that tenants have received from incubation services is embedded in various kinds of networks, including social networks, virtual networks and so on. The heterogeneous impacts of the same access to network in the focal incubator are an interesting phenomenon that should be a research focus.

This paper has three research objectives. First, previous research examines either ESHC or entrepreneurs' network involvement. The interactions between ESHC and tenants' graduation (TG) have yet to be fully elucidated. In this study, we examine the influence of network involvement on the ESHC–TG relationship. We will disclose the mediating effects of network involvement on each component of ESHC, which determines TG. Second, existing research models treat network involvement as a binary independent variable, and prior studies have only considered whether network involvement is active or not in the process of incubation. Our research focuses on the effect of network involvement in quantitative terms. Third, this paper highlights the significance mechanism of co-production business assistance. Existing empirical works focus on tenants or the incubator management from the theoretical perspectives of resource-based view, competence-based view, and real option theory [12]. Our focus is the entrepreneur him/herself, especially in terms of ESHC in the context of network involvement.

The paper proceeds as follows. In Section 2, we develop the research hypotheses through a literature review. We review the theoretical and empirical literature relating to the impact of tenants' ESHC on their survival. We focus on the role of network involvement on the ESHC–TG relationship. Section 3 describes the dataset along with the econometric models and the dependent and explanatory variables. Section 4 presents the results of the econometric estimates. In Section 5 we interpret the results, and discuss the implications and future research.

2. Literature Review and Hypotheses

In this paper we explore the moderating effects of the tenants' network involvement on the relation of ESHC and tenants' survival. In this section we develop our research hypotheses from the literature. The research model is shown in Figure 1.

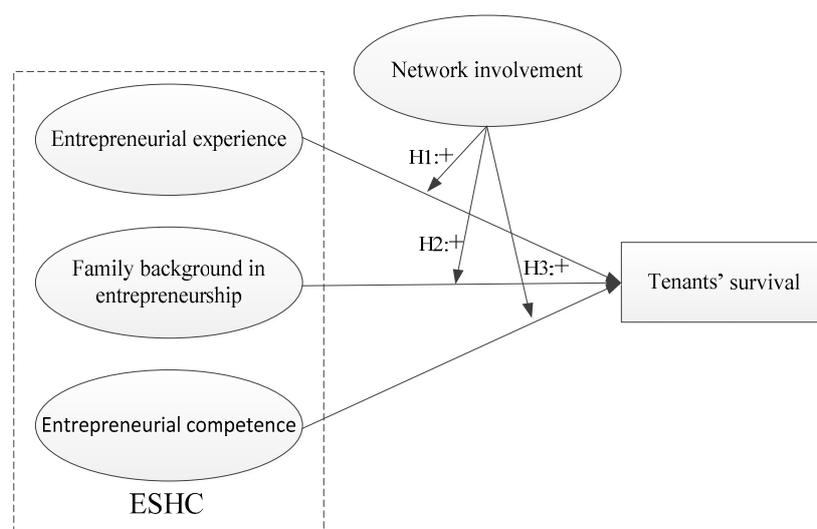


Figure 1. Research model.

2.1. Entrepreneurship-Specific Human Capital–Tenants’ Graduation (ESHC–TG) Relationship

Human capital theory defines human capital as the stock of skills, knowledge, experience and capabilities of individuals that are relevant for economic activity and productive uses [13]. Many studies have explored the relationship between human capital “inputs” accumulated by entrepreneurs and the “outputs” that include the survival of the firm. As an example, Monsson and Jørgensen demonstrated that entrepreneurs’ human-capital profiles have a significant impact on firm performance; entrepreneurs with more human capital or higher-quality human capital are coupled with superior ‘outputs’ [14]. This reasoning implies that ESHC is the relevant currency for TG relationships. ESHC is a conception of multi-dimension. It encompasses entrepreneurial experience, family background in entrepreneurship [15], and entrepreneurial competence [16] in entrepreneurship.

Entrepreneurial experience refers to the experience gained by entrepreneurs in previous entrepreneurial practices [15]. Episodically launching a new venture may endow valuable managerial experience, an enhanced reputation and abundant accesses to social and business assistances to entrepreneurs. These experiences help tenants overcome different kinds of bottlenecks embedded in the process of tenants’ growth and promote new ventures, and facilitate entrepreneurs to manage complex information and prior knowledge [17]. Entrepreneurial experiences also have a positive effect on the growth of NTBFs. Entrepreneurs with more entrepreneurial experience, particularly portfolio entrepreneurs involved in multiple practice of entrepreneurship, have more diverse knowledge and more resources to promote the tenants’ survival than inexperienced entrepreneurs [18,19]. Entrepreneurial experiences have a positive impact on harvest sale [12]. Experienced entrepreneurs have a higher likelihood of receiving venture capital funding and receive higher venture capital valuations. Moreover, entrepreneurial experience enables entrepreneurs to identify and pursue more business opportunities [20]. All these findings underpin the argument that entrepreneurs with prior entrepreneurial experience better facilitate tenants’ growth than inexperienced peers [21].

A family background in entrepreneurship means that entrepreneurs have access to stable and trustworthy entrepreneurial assistance from their families which is a Chinese tradition. From the perspective of social capital [22], entrepreneurial family background is associated with relationships within a family, which is a kind of “socially-instituted” relationships. These relationships are particular resources and benefits that can be enjoyed by family members. Entrepreneurial experience from a family provides one source of entrepreneurial assistance that assists an entrepreneur in a range of administrative roles. From the perspective of intergenerational influence theory which focuses on the socialization of children, family has a vital impact on social roles and behaviors of children. The children of entrepreneurs often have access to their parents’ workplaces from early childhood, acquiring entrepreneurial qualifications as a byproduct of everyday interactions. Thus, parental self-employment may serve as a mechanism which facilitates an entrepreneur to launch a new venture by means of transmission of information, beliefs, and knowledge within a family [23,24]. A lot of research demonstrates a tight-coupling between family background in entrepreneurship and NTBFs’ survival [25,26].

Entrepreneurial competence is the core of entrepreneurship. The classic entrepreneurial logic is that entrepreneurs first scrutinize their own abilities and explore external environments, confirm promising opportunities, and then develop strategies to exploit those opportunities [20,27]. Prior studies, e.g., Obschonka et al. demonstrated the positive relationship between entrepreneurial competence and business opportunity identification and pursuits, which in turn affect the survival of tenants [28].

2.2. Moderating Effects of Entrepreneur’s Network Involvement

An incubator offers an entrepreneur an appropriate physical room with discount rent, financial services, entrepreneurial mentoring, technology assistance, and network access [29]. It is the entrepreneur’s competence of co-production with different kinds of service providers to make use of these facilitators that lays out the process and output of entrepreneurship [30]. So the emphasis of business incubation should be placed on entrepreneurs’ involvement rather than just location. Access

to networks has been a primary service that is central to incubation. Although previous studies have identified the tight-coupling between ESHC and NTBFs' survival, the co-production theory of an incubator manifests that the network that entrepreneurs are involved in determines the output of their collaboration [31]. The incubation network is a kind of social network. Its nodes include the incubator management, tenants, financial service providers, entrepreneurial mentors, and partners of technology assistance. Distinct networks can be formed and then expanded when actors involve in specific co-production of financial services, entrepreneurship mentoring, and technology assistance [6]. Moreover, networking infrastructure acts as the intermediary to connect the business assistance to new startups' growth [11]. The heterogeneous network involvement means that the ESHC derived from incubating networks by the focal entrepreneur is heterogeneous. Thus, the entrepreneurs' network involvement can be treated as a moderator when we explore the effect of ESHC on TG which has not yet been fully discussed in the literature.

2.2.1. Moderating Effects of Network Involvement on Entrepreneurial Experience

First, network involvement determines the input of entrepreneurial experience. Considering that the network involvement is an important means by which technology start-ups exchange entrepreneurial experience with other actors embedded in networks, we can argue that the more extensive their network involvement, the more diverse entrepreneurial experience they can receive from other participants. Network involvement helps new startups to access diverse entrepreneurial experience to overcome their vulnerability. Moreover, the experience relating to different industries and business lifecycle enables entrepreneurs to keep abreast of the coming and unpredictable bottle-neck of entrepreneurship, for example, cash flow constraints, inexperienced management, imperfect technology, and so on. In fact entrepreneurial experience can foster successful entrepreneurship only when such experience can synthesize episodic experience embedded in the process of tenants' growth [32]. Network involvement can impact the effect of entrepreneurial experience on tenants' growth in two ways. In one way, network involvement means all kind of communication and cooperation, from which tenants can gain diverse entrepreneurial experience. The intensiveness and commitment of network involvement is a determinant of the stock of entrepreneurial experiences. In another way, network involvement enables tenants to embed in the process of "learning by doing". Through network involvement they can absorb and internalize tacit knowledge gradually, so they improve their competence in using these entrepreneurial experiences [33].

We can conclude that network involvement determines the stock of inputs of entrepreneurial experience in the process of co-production. It also underpins the improvement of management competence. When providers of incubation services explore partners of network involvement, they have the initiative to co-produce with active tenants because their services are exchanged at equal values at least, or they can even get more profitable enterprise equity as reward if they have made the right choice to pick up potential tenants. Tenants' extensive involvement in multiple social and commercial networks can be a signal of tenants' growth potential, and diverse service providers are more willing to attach to tenants with such a signal [34]. Furthermore, the amount and attribution of relationships determine a tenant's capability to get tangible resource and intangible knowledge [35], thus the tenant's growth and successful graduation. Therefore, network involvement leads to heterogeneous mechanism of attachment, which impacts the positive relationship between entrepreneurial experience and TG.

Moreover, entrepreneurial experience helps tenants gain a good reputation, while a good reputation is relevant to trust and trustworthiness between tenants and service providers [36]. According to social capital theory, tenants' trust and trustworthiness support them to get scarce resource and valuable information. Thus the reputation coupling with network involvement can set heterogeneous scenes when entrepreneurial experience promotes TG [22]. Network involvement facilitates tenants to connect with diverse service providers, and tenants' reputation can be dissimilated through independent paths of multiple networks. Consequently network involvement promotes the amplification of the good

reputation of tenants. Entrepreneurial experience facilitates tenants to be involved in multiple social and commercial networks in which valuable resource and knowledge is embedded [4]. We postulate the following:

Hypothesis 1 (H1): *Network involvement moderates the positive relationship between entrepreneurial experience and TG in such a way that the relationship is stronger when entrepreneurs' network involvement is more extensive.*

2.2.2. Moderating Effects of Network Involvement on Family Background

Family background in entrepreneurship usually provides emotional support and financial convenience. The family members develop networks of emotional communication and financial support. The relationships embedded in those networks are characterized by trustworthiness and intimacy [37]. Network involvement means entrepreneurs take active part in different kinds of cooperation resulting from distinct services [38,39]. Tenants can occupy a favorable network location by actively taking part in diverse networks [40]. According to the theory of social network, incremental nodes and attachments embedded in an emotional communication network and financial support networks resulting from network involvement improve tenants' connectivity and hierarchy [41], while a node's connectivity and hierarchy belong to the structural dimension of social capital [22]. This implies that network involvement has a positive impact on the structural dimension of social capital of tenants' emotional communication network and financial support network.

Emotional communication from an entrepreneurial family is a kind of universal emotional support, while network involvement provides multiple points of access to emotional supports for tenants. Emotional support is embedded in specific financial services, entrepreneurial mentoring, and technology assistance [42]. In this case, emotional support becomes a sort of customized service that can express a clear purpose [32]. The more extensive the tenants' network involvement is, the more customized orientation the emotional support is [43]. Highly customized emotional support is more convenient to smooth away entrepreneurs' anxieties and puzzles. It can facilitate entrepreneurs to engage in entrepreneurship in a good mood.

A tenant's network involvement makes an entrepreneurial family focus on only bridging the tenant with the most matched financial service providers, i.e., acting as a "network broker" [35]. As an entrepreneurial family accompanies a tenant in the whole process of entrepreneurship, network involvement of the tenant facilitates an entrepreneurial family to access all kind of financial service providers. When an entrepreneurial family obtains an abundant supply of financial services from multiple providers, the family should scrutinize those providers and pick out competent ones (ibid).

In sum, network involvement of tenants has an impact on the structural dimension of social capital [44], and customization of emotional support from entrepreneurial family [45]. The above suggests that the more extensive network involvement of tenants, the more the stock of structural dimension of social capital and the higher customized emotional support the tenants can obtain. At the same time, entrepreneurial family can play the role of "network broker" better. Therefore, we could postulate the following:

Hypothesis 2 (H2): *Network involvement moderates the positive relationship between family background in entrepreneurship and TG in such a way that the relationship is stronger when entrepreneurs' network involvement is more extensive.*

2.2.3. Moderating Effects of Network Involvement on Entrepreneurial Competence

In general, entrepreneurial competence refers to the ability to kindle potential investor's interest, and the successful access to those investments [29,46]. As tenants are located in an incubator,

their entrepreneurial competence mainly refers to the ability to acquire tangible resource and intangible knowledge by means of cooperation with diverse service providers. In the process of acquiring multiple investments, tenants usually will make efforts to convince potential investors of the prospect of technology commercialization by revealing the advantage of their core technology and plausible enterprise operation pattern. The network involvement enables entrepreneurs to receive information about the potential of tenant growth [47], which can attract the proactive engagements of multiple financial service providers [48]. The readiness of service providers has an positive impact on outcomes of co-production [11]. The proactive involvement of financial services providers promotes the tenants' growth as well as their successful graduation.

When tenants are involved in the co-production of entrepreneurial mentoring, their entrepreneurial competence mainly refers to ability to communicate with partners smoothly and to achieve cooperation with partners closely. Network involvement facilitates tenants to "co-produce" with more entrepreneurial tutors, successful entrepreneurs, and professional consulting companies. A real-time response interface of entrepreneurial mentoring is required when there are enough service providers for entrepreneurial mentoring. So network involvement transforms the frequency of entrepreneurial mentoring from episodic to continual mentoring [34,49]. The continual involvement of entrepreneurial mentoring promotes the tenants growth as well as successful graduation [11].

When we focus on technology assistance of incubation services, entrepreneurial competence refers to ability to acquire external knowledge. Network involvement facilitates tenants to acquire more explicit and tactic knowledge by means of cooperation with more partners who sell their technologies or are engaged in joint R&D [50]. Incubation is an important policy tool to facilitate knowledge transfer [51], while tenants with incremental knowledge are inclined to involve in extensive knowledge sharing. Tenants' extensive knowledge sharing and network involvement would evolve into mode of dynamic incubation, which is the most powerful pattern to promote the incumbent firms growth [52].

Therefore we can confirm that network involvement stimulates the readiness of financial providers, build a scenario of continuous entrepreneurial mentoring, and evolve into the mode of dynamic incubation. We postulate the following:

Hypothesis 3 (H3): *Network involvement moderates the positive relationship between entrepreneurial competence and TG in such a way that the relationship is stronger when entrepreneurs' network involvement is more extensive.*

3. Methodology

3.1. Estimation Procedure

Let T represent duration between the start event and the last event. Start event refers to the status of firm's location in the incubator, while the last event refers to the status of a firm's exit, graduation or out of research. We use days to measure the duration between the start event and last event.

T is regarded as a random variable with cumulative distribution function

$$P(t) = pr(T \leq t) = \int_0^t f(x)dx \quad (1)$$

The probability that a tenant has not graduated from incubator in the interval $(0, t)$ is

$$S(t) = pr(T \geq t) = 1 - P(t) = \int_t^{\infty} f(x)dx \quad (2)$$

then $p(t) = P'(t) = -S'(t)$.

The hazard function $h(t)$ demonstrates the instantaneous probability of graduation at time t , if the ventures have not graduated successfully in the duration interval $[0, t]$. It also depicts the conditional

likelihood that graduation occurs at duration time t , assuming that it has not occurred in the interval $[0, t]$.

Therefore, the hazard function $h(t)$ is defined as

$$h(t) = \lim_{\Delta t \rightarrow 0} \frac{pr(t \leq T < t + \Delta t | T \geq t)}{\Delta t} = \frac{\frac{dP(t)}{dt}}{1 - P(t)} = \frac{P'(t)}{S(t)} = \frac{-S'(t)}{S(t)} = -[\ln S(t)]' \quad (3)$$

The survival function is an estimate of probability of staying in the incubator longer than that fixed duration.

The proportional hazards model proposed by Cox [53] was applied in this study, meaning that the firms in the sample present hazard functions that are proportional. Then the hazard function of T given x is specified as (1) in its continuous type version because the ratio $\frac{h(t|x_1)}{h(t|x_2)}$ of two firms x_1 and x_2 will not depend on t :

$$h(t|X) = h_0(t) \exp(\beta X^T) \quad (4)$$

$$\beta = (\beta_1, \beta_2, \dots, \beta_m), X = (X_1, X_2, \dots, X_m)$$

where:

We get baseline hazard function $h_0(t)$ if all covariates are equal to zero, while we get the estimated hazard function $h(t)$ if the covariates $X = (X_1, X_2, \dots, X_m)$ are nonzero;

$X = (X_1, X_2, \dots, X_m)$ is a vector of independent variables which describe various characteristics of incubator or tenants;

$\beta = (\beta_1, \beta_2, \dots, \beta_m)$ represents the vector of unknown parameters.

Based on (3) and (4), we obtain the predicted duration, between a starting point and the time a graduation occurred.

$$S(t|X) = \exp\left[-\int_0^t h(t, X) dt\right] = \exp\left[-\int_0^t h_0(t) \exp(\beta X^T) dt\right] = [S_0(t)]^{\exp(\beta X^T)} \quad (5)$$

Based on (4), we get

$$\ln \frac{h(t|X)}{h_0(t)} = \beta X^T = \beta_1 X_1 + \beta_2 X_2 + \dots + \beta_m X_m \quad (6)$$

3.2. Research Setting—Wuhan Donghu Innovation Centre

The studied incubator in this paper is the Wuhan Donghu Innovation Centre (WDIC), which was founded in 1987 as the first state-level incubator in China. Similar to other countries, in China the development of an entrepreneurial ecosystem is a major policy tool to promote innovation and entrepreneurship. Incubators, also called “science parks”, are an important component of this ecosystem. The Ministry of Science and Technology (MOST) initialized the Torch Program, which aimed to promote the formation of such an ecosystem and provide comprehensive value-added services for the tenants. Since 1988, 1103 ventures have entered into WDIC, and more than 900 hi-tech programs have been launched. By the end of 2010, the graduated ventures amounted to 681 in total, and the survival rate reached approximately 75%. Moreover, in 22 years WDIC has created 66,000 jobs. WDIC provided various incubation services to incubator firms to promote entrepreneurship and stimulate technology transfer from academia to the front lines of industry, which has contributed to the improvement of regional economy in global competition (see <http://www.whibi.com/about/intro>).

3.3. Sample and Data

According to the Regulation of Identification and Administration of Technology Business Incubator issued by MOST in 2006, a tenant located in a Chinese incubator should graduate within 3 years (1095 days). Accordingly we have selected the sample tenants that were in WDIC for at least three years

from 2006 to 2009 so that we can get to know their last three statuses—exit, graduation or the end of the study period. The duration of survey appears to be a bit conservative because tenants tended to fall into one of three categories within 1095 days: (1) failure, i.e., the venture cannot survive and has been eliminated; (2) the firm remains in the incubator for failing to meet the graduation qualifications; and (3) successful graduation, i.e., the firm overcomes its nascent vulnerability and finally is competitive in the market.

The sample consisted of 71 firms admitted to WDIC in 2006. The data were collected through survey. We could obtain longitudinal data which depicted multiple, unequivocal status of tenants' growth by surveying their initial "inputs" and final status i.e., "outcomes". Thus, our sampling was likely to disclose the determinants of new venture creation and successful graduation. At the end of 2009, 31 tenants met the qualifications for graduation, 18 were terminated from the incubation program, and 22 remained in the incubator due to their vulnerability. Because the terminal event of successful graduation was only observed in the first group, the other two groups consisted of right-censored data. In addition, 4 ventures had multiple founders while other 67 firms had just one founder. Among those 4 ventures, only one founder made arbitrary decisions from a position of absolute authority. Thus, the sample allowed us to have the accurate and convenient measurement of predictor variables that can maintain a distance from the unclear effect of multiple founders on the dependent variables.

3.4. Measures

3.4.1. Dependent Variables

The dependent variables include the duration of location and its final status when the last event occurred. Status is coded as 1 if the tenant graduated and 0 if the graduation time is censored or tenant exits because of failure. Duration refers to days between a tenant's admission to an incubator and its graduation or exit.

3.4.2. Explainable Variables: ESHC

As mentioned above and shown in Figure 1, ESHC consists of three components: entrepreneurial experience, family background in entrepreneurship, and entrepreneurial competence. Entrepreneurial experience is measured by the counts that a firm founder had previously launched new ventures. The founder is included in the counts as long as it is in the primary stages of growth, no matter the venture is successful or not.

Family background in entrepreneurship is assessed with three questions adopted from Carr and Sequeira [23]: does your parent currently own a business or have they ever launched a new venture? Does your family member other than parents currently own a business or have they ever launched a new venture? Have you ever worked in those ventures owned by family members? Family background in entrepreneurship could be assessed by summing the time of "Yes" responses.

Entrepreneurial competence is measured using six-item scale obtained from Chandler and Hanks [16]: (1) I am conscious of potential consumer needs accurately; (2) My time and energy focus mainly on exploring and exploiting products or services that will meet my customer needs; (3) One of my greatest strengths is concentrating on developing goods and services to meet customer needs; (4) One of my prominent abilities is to make use of high-quality business opportunities; (5) I am extremely willing to push forward this venture through to full of competition; and (6) One of my prominent abilities is to develop novel goods and services that are technically advanced. Each item is measured using a seven-point Likert scale ranging from 1 to 7 (1 = strongly disagree, 7 = strongly agree). The items measuring entrepreneurial competence focus on entrepreneur's ability to develop products or services that can meet consumer needs. The scale has exhibited eligible internal consistency, with a Cronbach's alpha of 0.92. There is no increment of Cronbach's alpha if we deleted any items. It indicates that six items as whole are appropriate.

3.4.3. Moderator

Network involvement is measured by a four-item scale obtained from Hughes, Ireland and Morgan [52]: (1) We often take part in diverse business network organizations since we are admitted to the incubator; (2) We find it is good to embed in a business network deeply; (3) We often resort to business networks embedded in the incubator for assistance; (4) We often engage in all kinds of networks available by means of the incubator. We assess each item by using a seven-point Likert scale. The response scores of these items range from 1 to 7 (1 = strongly disagree, 7 = strongly agree). We can explore network involvement of entrepreneurs by means of these items. This scale possesses excellent internal consistency because its Cronbach's alpha is 0.96, and there is no any increment of Cronbach's alpha even if the deletion of any items. It indicates that all items should be retained in the scale.

3.4.4. Control Variables

Theoretically, human capital contributes to the success of new firms. Prior research shows that a founder's human capital plays a vital important role for tenants' growth and success [10,27]. According to Firkin [15], human capital consists of general human capital and specific human capital. General human capital refers to status of formal education, prior work experience, and a range of individual characters of entrepreneurs. Specific human capital consists of industry-specific and entrepreneur-specific components. To assess the distinct contribution of ESHC to TG, we have controlled general and industry-specific human capital variables in this study.

The status of formal education refers to years of education for entrepreneurs. Considering an additional one year of formal education may have little marginal effect on start-up success, we convert the years of formal education into three categories according to their degrees: 1 = bachelor's degree or less; 2 = master's degree; 3 = doctor's degree. The time of involving in full-time jobs previously is used to measure work experience. It is a proper proxy to ascertain the amount of and the level of attainment of work experience [20]. We square the number of full-time jobs to eliminate the variance.

In the literature, an entrepreneur's age [54] and gender [55] have been used as proxies of personal attributes of the entrepreneur. A dummy variable is a proxy for the gender of entrepreneurs. Female is marked as a value of "0", while male is marked a value of "1".

Industry-specific human capital captures the founders' prior work experience in a specific industry. Thus, we use how many years the founders have worked in the same industry to assess industry-specific human capital.

3.5. Uni-Dimensionality and Reliability

We use multiple-item scales to assess two independent variables—entrepreneurial competence and entrepreneur's network involvement. It is necessary to conduct a principal components factor analysis (PCFA) to assess their uni-dimensionality. The result indicates that one factor explains 49.91% and 37.45% of the original variance of these two constructs respectively, with an initial eigenvalue of 4.99 and 3.75, respectively. This implies that they are scales of uni-dimensionality.

We assess the statistical reliability of the multiple-item scales by computing Cronbach's alpha. Cronbach's alpha is 0.92 for the six items of entrepreneurial competence, and 0.96 for the four items of network involvement. Hence, the multi-item scales applied in our econometric model are reliable.

3.6. Common Method Bias

All of the items to assess the dependent, independent and control variables are included in a single PCFA to conduct a Harman one factor test in order to make it clear whether one component can account for most of the variance. First, there are six components with eigenvalues greater than 1.0. Second, those six components account for 83.31% of the variance, while the largest component only accounts for 32.31%. These evidences indicate that there is no common method bias that can affect the results.

4. Results

We have performed descriptive statistics on all of the firms in the population. The results are summarized in Table 1. Table 2 presents a correlation matrix. The correlation analysis indicates that several variables are positively correlated to one another. In order to ascertain whether there is a serious multi-collinearity, we have analyzed the VIF (variance inflation factor) and the tolerance of variance, and tested the eigenvalues. Since $VIF < 10$, $Tolerance\ of\ Variance > 0.1$, $Eigenvalues \neq 0$ and the corresponding condition index < 30 , there is no multi-collinearity. Table 3 presents the results obtained from the hierarchical Cox regression models associating ESHC, incubation services and control variables with the hazard rate of tenants' graduation.

Table 1. Descriptive statistics.

Variables	Minimum	Maximum	Mean	Std. Deviation
Bachelor's degree or less	0	1	0.52	0.503
Master's degree	0	1	0.34	0.476
Doctorate degree	0	1	0.14	0.355
Work experience	0	3	1.10	0.679
Age	31	49	40.75	4.711
Gender	0	1	0.58	0.497
Industry-specific human capital	1	11	4.65	2.673
Entrepreneurial experience	0	5	1.87	1.362
Family background in entrepreneurship	0	3	1.21	0.791
Entrepreneurial competence	1.00	5.50	3.288	1.315
Network involvement	1.00	6.25	2.370	1.479

Table 2. Correlation analysis.

	1	2	3	4	5	6	7	8	9	10
2.Master's degree	−0.745 **									
3.Doctorate degree	−0.422 **	−0.289 *								
4.Work experience	−0.027	0.160	−0.179							
5.Age	0.087	−0.305 **	0.290 *	−0.099						
6.Gender	0.135	−0.129	−0.018	−0.210	0.040					
7.Industry-specific human capital	0.000	0.061	−0.084	0.263 *	0.160	0.017				
8.Entreneurial experience	−0.027	0.199	−0.231	0.230	0.071	0.080	0.572 **			
9.Entrepreneurial Family background	−0.029	0.225	−0.263 *	0.200	−0.005	0.024	0.454 **	0.741 **		
10.Entrepreneurial competence	−0.144	0.211	−0.079	0.197	−0.017	−0.084	0.365 **	0.474 **	0.592 **	
11.Network involvement	−0.044	0.167	−0.164	0.282 *	0.020	0.022	0.455 **	0.699 **	0.732 **	0.521 **

* $p < 0.05$, ** $p < 0.01$ (two-tailed). 1–Bachelor's degree or a lower degree.

Table 3. Results of survival analysis.

Variables		Model 1		Model 2		Model 3		Model 4		Model 5	
		β	p	B	p	β	p	B	p	β	p
Control variables											
Formal education (degree 1 as reference)	Master	0.493	0.234	−0.549	0.282	1.117	0.099	0.945	0.145	1.244	0.064
	Doctor	−0.082	0.901	1.037	0.163	0.387	0.637	0.361	0.661	0.512	0.535
Prior work experience		−0.004	0.990	0.257	0.447	−0.411	0.292	−0.380	0.309	−0.418	0.270
Age		−0.017	0.708	−0.086	0.067	−0.115	0.105	−0.113	0.097	−0.126	0.094
Gender (female as reference)		0.316	0.399	0.009	0.982	0.247	0.590	0.311	0.488	0.387	0.389
Industry-specific human capital		0.373	0.000	0.203	0.030	0.372	0.017	0.362	0.016	0.483	0.003
Explainable variables: ESHC											
Entrepreneurial experience		0.720	0.172	0.658	0.014	−7.627	0.017	0.323	0.473	0.361	0.438
Entrepreneurial family background				1.171	0.000	−0.672	0.366	0.274	0.881	0.070	0.915
Entrepreneurial competence				0.550	0.019	1.440	0.000	1.283	0.001	−1.549	0.183
Moderators											
Network involvement						0.955	0.321	3.706	0.001	−0.923	0.543
Interactive effects											
Entrepreneurial experience	× Network involvement					2.835	0.011				
Entrepreneurial family background								−0.092	0.880		
Entrepreneurial competence										1.137	0.012
−2Log likelihood		223.207		179.081		105.661		111.545		106.034	
overall score Chi-square (p-value)		0.000		0.000		0.000		0.000		0.000	

As the base model, Model 1 includes control variables directly related to the probability of tenants' graduation. Model 2 tests the collective impacts of ESHC components with the objective of calculating their total contribution to the tenants' graduation. Model 3, Model 4 and Model 5 test the interactive effects of each components of ESHC and network involvement based on the cross-products between the two.

The overall significance of Model 1 is assessed using overall χ^2 . The Chi-square statistics for all models is significant at $p < 0.001$; thus, the hypothesis that all of the parameters in the model equal to 0 is rejected. This base model for the control variables indicates that a founder's status of formal education and duration of prior work are not statistically significant, in line with findings by Montgomery, Johnson and Faisal [56]. A range of entrepreneurs' personal attributes variables, such as an entrepreneur's age and gender, are not statistically significant as well. In addition, our results yield a significant finding regarding the impact of industry-specific human capital on the survival of a new venture, lending support to studies by Ucbasaran, Westhead and Wright [20].

As demonstrated in Model 2 of Table 3, ESHC exhibits significant independent effects on the survival of new ventures while the variables related to ESHC are all included; the regression coefficients for ESHC are statistically significant at $p < 0.05$. Moreover, the $-2\log$ likelihood in Model 2 is smaller than that of Model 1. This demonstrates the increased fit of Model 2 when ESHC components are all included.

We have further specified the models including interactive terms. When comparing the differences in $-2\log$ likelihood between Model 2 and Models 3, 4 and 5, the reduction in $-2\log$ likelihood indicates superior fit for the Models 3, 4 and 5 if the interaction terms are entered. It indicates that the interactive term included in the models contributes to the explanation.

H1 predicts the moderating effect of network involvement when we uncover the impact of entrepreneurial experience on the probability of tenants' graduation. The interaction of entrepreneurial experience and network involvement is significant at the 0.05 level (Table 3, Model 3), and the interaction of entrepreneurial competence and network involvement are significant at 0.05 level (Table 3, Model 5), indicating that network involvement moderates the impact of entrepreneurial experience on TG as well as the entrepreneurial competence on TG. In other words, the more extensive network involvement, the greater the impact of entrepreneurial experience as well as entrepreneurial competence on the probability of tenants' graduation, lending strong support for H1 and H3.

The interaction between entrepreneurial family background and network involvement is not significant (Table 3, Model 4). It means that a high or low level as well as positive or negative variations of entrepreneurs' network involvement does not affect the relationship of entrepreneurial family background and the hazard rate of tenants' graduation, therefore H2 is not supported.

To interpret the effect of network involvement, we have conducted cluster analysis to subdivide the tenants by means of their relative degrees of network involvement. The final cluster solution has created three groups of network involvement, i.e., low, medium, and high ones corresponding to the degree of network involvement. The difference of survival curves among the three groups illustrates the impact of varying network involvement on the survival probability of TG (Figure 2): the group labeled as high reach the average graduation rate 43.7% after 559 days, whereas the medium-level group fail to reach the benchmark in 613 days, and the other group are far from the benchmark till the end of the period of location.

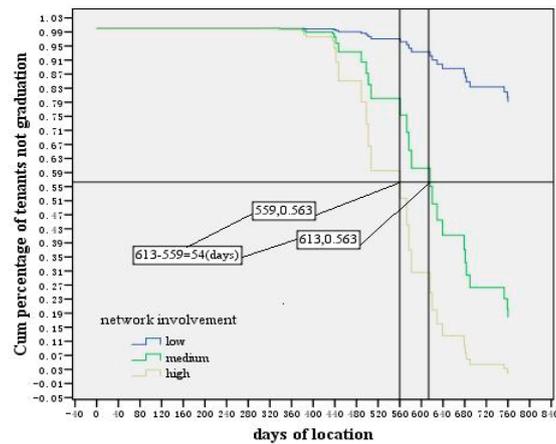


Figure 2. The impact of network involvement on the survival probability of tenants’ graduation (TG). (Note: The graduation rate is 0.437, i.e., 31 of 71 tenants graduated; un-graduation rate is 0.563).

To further interpret the interaction effects, which are statistically significant in the models, we have plotted the regression equations for all conditions of network involvement. Figure 3a,b graphically depict the entrepreneurial experience and TG relationship, and entrepreneurial competence and TG relationship as moderated by network involvement, respectively.

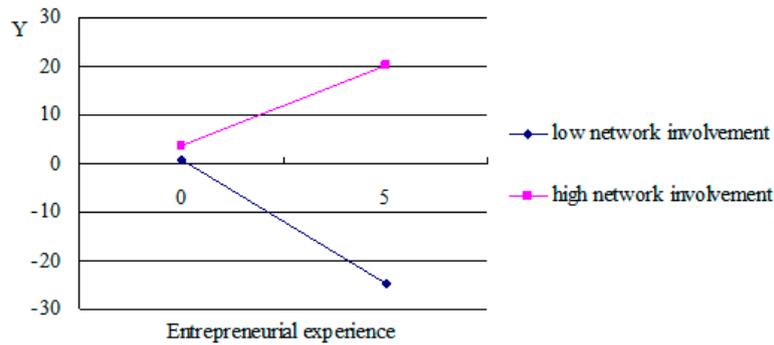


Figure 3a

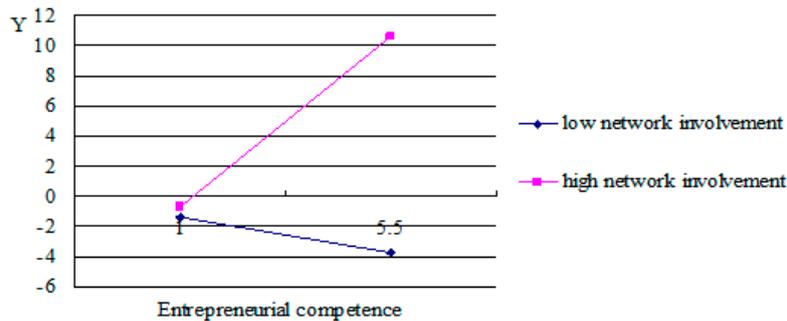


Figure 3b

Figure 3. The network involvement as a moderator of entrepreneurship-specific human capital (ESHK)–Y relationship. (Note: The Y axes is $\ln \frac{h(t|X)}{h_0(t)}$, for $(\ln x)' = \frac{1}{x} > 0$ ($x > 0$), the $\ln x$ is monotonically increasing, thus $\ln \frac{h(t|X)}{h_0(t)}$ and $\frac{h(t|X)}{h_0(t)}$ are positively relative in a strict way, and the impact of covariates on $\ln \frac{h(t|X)}{h_0(t)}$ and $\frac{h(t|X)}{h_0(t)}$ should be in the same direction according to (4) and (6)).

5. Discussion and Conclusions

5.1. Theoretical Reflections

Our research contributes to the study on ESHC and network involvement in the context of incubators. It demonstrates that network involvement sets the baseline for the impact of ESHC on client ventures' graduation. Our analytical results expose the factors common in most incubators that lead to the varying effectiveness of the network involvement.

Previous research focuses on either ESHC or network involvement of entrepreneurs but not both, collectively and interactively. This study adds to the literature and demonstrated the impact of network involvement on the relationship between ESHC and TG. Specifically, entrepreneurial experience and entrepreneurial competence significantly impact ventures' survival in the presence of network involvement, while network involvement does not moderate the effect of family background in entrepreneurship on TG. The plausible explanation is that entrepreneurial experience and entrepreneurial competence are in tacit forms and are embodied in entrepreneurs themselves. Face-to-face communication and immediate cooperation facilitate the transfer of tacit knowledge among tenants, as well as between tenants and service providers. When entrepreneurs' network involvement promotes a co-production dyad, which enables entrepreneurs to pursue entrepreneurial experience and entrepreneurial competence by themselves, tacit knowledge can be transferred among different parties embedded in the incubating process. This explains the moderating effects of network involvement on entrepreneurial experience and entrepreneurial competence when those two ESHC factors facilitate tenants' survival in incubators.

H2 on the relation of family background in entrepreneurship and network involvement is not supported. The reason is that a Chinese entrepreneur is not accustomed to share the resource and knowledge within his (or her) own family. As the saying goes, 'every miller draws water to his own mill.' Resource and knowledge obtained from Chinese family are deeply embedded in its own "GUANXI" network, which cannot be substituted by those from incubation network [42]. Moreover, Chinese people like to turn to their family when meeting challenges, rather than outside help. Traditional family ties in China lead to the phenomenon that assistance from family is just close at hand. Due to the excessive reliance on family, a Chinese entrepreneur is often reluctant to resort to incubating network; in turn, network involvement does not strengthen the pooling of knowledge and resource from entrepreneurial family. Moreover, the expertise and knowledge derived from entrepreneurial family is highly customized, which in most cases cannot be used by other entrepreneurs at all. Consequently, as we have observed, network involvement does not amplify the effect of an entrepreneurial family background on the tenants' graduation.

5.2. Managerial and Policy Implications

The study results have useful implications for the incubator management and policy makers that sponsor and initiate incubation services. Incubator management should take effective measures to assist tenants to access to networks and have network involvement so that they can make use of knowledge and resource embedded in incubating networks proactively. Furthermore, an incubator should strive to be 'core node' for the flow of resource and expertise, which may ultimately affect tenants. The government should stimulate the 'nodes' to engage in networking, including entrepreneur, incubator and other resource providers involved in co-production.

Institutionalizing the incubating network should be a priority of the incubator management in enhancing incubation services. Network institutionalization refers to mechanisms and norms that drive actors to take active part in formal and informal networks and contribute to cooperation practices. On the one hand, incubator management can institutionalize formal networking through measures like bringing external experts on site; establishing regular processes for exchanging information and know-how across the incubator; implementing economic incentives for networking initiatives; etc. [6]. On the other hand, incubator management can institutionalize informal networking by means of

appropriating layout of incubated firms' physical location [57]; appealing social interaction scenes [38]; and so on.

In particular, the roles of information and communication technology (ICT) in supporting efficient networking should be recognized [58]. In China the government has supported the construction of nationwide ICT infrastructure and ensured the affordability and availability of Internet services and mobile technologies to society. An incubator should leverage different ICT tools such as socialising applications e.g., WeChat and on-line platforms like Alibaba etc. to support web-based collaboration between tenants, and their contacts with external sources. The government can consider building a national ICT-based incubating platform for different incubators to exchange their best practices of offering incubation services, and for tenants in different incubators to explore broader business opportunities.

5.3. Limitations and Future Research

In this paper we investigate the relationship between ESHC, network involvement, and tenants' survival. We focus on the process of incubation co-production of tenants, the incubator management, and external service providers [11] as the theoretical anchor. We have examined three ESHC dimensions—entrepreneurial experience, family background in entrepreneurship, and entrepreneurial competence. Further research can consider other factors, and focus on the impact of network involvement on general human capital rather than ESHC. The conclusions of our study should encourage future exploration on contextual variables which can impact the co-production of all of the “inputs” embedded in the process of incubation.

Our research context is an incubator. We have considered financial services, entrepreneurial mentoring, and technology assistance provided by an incubator to tenants when examining the moderating effects of tenants' network involvement on entrepreneurial competence that determines the tenants' survival. The ability to develop novel goods and services is a facilitator for acquiring additional financial services, entrepreneurial mentoring, and technology assistance, which may help tenants survive eventually. In this condition, it is assumed innovation has no direct link with the tenants' survival. Moreover, the ability to develop novel goods and services is not the focus of this research. As suggested by Chandler and Hanks [16], we have included it in the dimension of entrepreneurial competence. According to Colombelli, Krafft and Vivarelli [59], innovation is a source of a “survival premium”. Future research on tenants' survival can include a proxy for innovation, and analyze the impacts of tenants' ability to develop novel goods and services separately.

Our research points directions for future research. Researchers may consider establishing a new scale to examine the new dimensionality of network involvement, and evaluating network involvement derived from questionnaire responses focusing on the cooperation embedded in on-line social networks.

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