

Technology commercialization, incubator and venture capital, and new venture performance

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Abstract

This study examines the effects of technology commercialization, incubator and venture capital supports on new venture performance from the resource-based view. This study uses regression analysis to test the hypotheses in a sample of 122 new ventures. The findings highlight the role of technology commercialization as a mediator between organizational resources, innovative capabilities, and new venture performance. Also, the empirical evidence indicates that incubator and venture capital supports moderate the effects of technology commercialization on the performance of new ventures. Finally, this study discusses managerial implications and highlights future research directions.

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Keywords: New venture; Technology commercialization; Incubator; Venture capital; Organizational resource; Innovative capability

1. Introduction

New venture, especially high-tech new venture, receives wide recognition of its important contributions to the economy (Drucker, 1985; Hayton, 2005). Over the last 25 years, two-thirds of the net new jobs and 95% of the radical innovations have come from these entrepreneurial businesses (Allen, 1999; Timmons and Spinelli, 2003). However, high-tech new ventures face greater problems than other firms, including lack of adequate knowledge of their environments, new product development experience as well as financial resources (Feeser and Willard, 1990; Shan, 1990; Zahra and Covin, 1993). High-tech new ventures are highly vulnerable and easy to fail with less than half of them lasting for five years (Li and Atuahene-Gima, 2002; O'Shea and Stevens, 1998). Owing to the increasing importance and high failure rate, managers and scholars show considerable interest in discovering a recipe for successful high-tech new ventures (Zahra and Nielsen, 2002).

Prior studies discuss the direct effects of resources and capabilities on the competitive advantage and performance of

the firms (Hall, 1993; Yeoh and Roth, 1999). From a resource-based perspective, organizations are heterogeneous in relation to their resources and capabilities (Barney, 1991; Mahoney, 1995; Teece et al., 1997). Resources and capabilities determine organizational competence. Technology commercialization is such an important kind of competence. Technology commercialization competence (TC competence) refers to the competence of the firms to use technologies in products across a wider range of markets, incorporate a greater breadth of technologies in products, and get products to market faster (Nevens et al., 1990). Successful technology commercialization is crucial for the survival of firms in light of quick changes in the business environment (Cooper, 2000). Businesses, especially new ventures, rise and fall depending on whether or not they can discipline their commercialization efforts (Nevens et al., 1990). This logic implies that TC competence may play as a mediator in the relationships between resources and capabilities, and performance of new ventures. However, literature examining this mediating issue is scarce (Zahra and Nielsen, 2002). Accordingly, the present study attempts to examine the research issue by adopting the resource-based view to investigate the relationships among organizational resources, innovative capabilities, TC competence, and performance of new ventures.

Secondly, this study examines how incubator and venture capital supports affect the relationships between TC competence

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and new venture performance. Few new ventures make themselves through their early years mainly due to management problems and under-capitalization (Roure and Keeley, 1990). Incubators and venture capital firms represent two popular and controversial intervention approaches to assist new start-ups to solve these critical problems. Many prior studies increase understanding of the roles of incubators and venture capital firms in the development of new ventures (Allan and Bazan, 1990; Barry et al., 1990; Colombo and Delmastro, 2002; MacMillan et al., 1989; Mian, 1996). However, prior researches provide mixed results. From the perspective of resource-based view, the internal competence, such as TC competence, may influence the extent of external resources upon which the new venture is dependent. No prior research in the literature takes this perspective to examine the fits of venture capital and incubator supports with TC competence in influencing the new venture performance. Therefore, the present study also examines the moderating roles of incubator and venture capital supports in affecting new venture performance from the resource-based viewpoint.

Accordingly, this study examines the mediating effects of TC competence and the moderating effects of incubator and venture capital supports on the performance of new ventures. Fig. 1 presents the research model of this study. The rest of the paper is set out as follows. The next section reviews the previous literature and sets out the hypotheses of this study. Following that is the methodology for the study. Then, the paper presents the empirical results to test the hypotheses. The last section provides discussion of the findings and the managerial and scholarly implications.

2. Background

2.1. Organizational resources

Organizational resources are the financial, physical, human, technological, and organizational endowments that allow a company to create value for the customers (Hill and Jones, 2004). From the resource-based view, a firm needs to develop the organizational resources to strengthen its TC competence (Mahoney, 1995; Yeoh and Roth, 1999). Organizational resources include three types: human, tangible, and intangible resources (Grant, 1998). The human resource usually includes the knowledge, expertise, talents, creativity, and skills of a firm's personnel (Cohen and Zysman, 1988; Davenport, 1992). From the resource-based viewpoint, a firm should maintain

strong internal human resources in order to gain competence in technology commercialization (Zahra and Nielsen, 2002). Firms can recruit and maintain a well-trained labor force whose knowledge, skills, and experience can serve as a driving force for strengthening the competence in technology commercialization (Ettlie and Vellenge, 1979; Leonard-Barton, 1995). Recruitment gives the firm access to new technologies and knowledge which can facilitate rapid product development and accelerates technology commercialization (Zahra and Nielsen, 2002). Moreover, experienced and well-trained employees can implement changes more effectively in the internal processes, systems, and technologies for successful technology commercialization (Dertouzos et al., 1988).

From the resource-based viewpoint, tangible resources can be sources of TC competence as well (Yeoh and Roth, 1999; Zahra and Nielsen, 2002). Tangible resources are something physical including financial resources and physical assets (Hill and Jones, 2004). Financial resources and physical assets act as the blood of new ventures. All the functions such as R&D and marketing within new ventures need these tangible resources to maintain their efforts in technology commercialization. For example, a substantial level of R&D investment is necessary for developing new technologies in a timely manner (Capon et al., 1992; Yeoh and Roth, 1999) and a great level of marketing spending is necessary for understanding how to develop customized products for different market segments (Cooper and Kleinschmidt, 1990). Accordingly, sufficient tangible resources increase the likelihood of improving TC competence.

While tangible resources are important, intangible resources are a more durable source of TC competence. Intangible resources are non-physical entities including brand names and the intellectual property (Grant, 1998). Unlike tangible resources can be acquired through market transactions from outside, intangible resources are characterized by imperfect mobility and need to be accumulated within the firms (Peteraf, 1993). Intellectual property rights can facilitate the development of new products and protect them from competitor's imitation while brand names are helpful for new ventures to promote their new products by establishing positions in geographical space as quickly as possible. Overall, this study expects that organizational resources would have a positive effect on TC competence of new ventures. These observations underpin the following hypothesis.

Hypothesis 1. Organizational resources relate positively to TC competence of new ventures.

2.2. Innovative capabilities

The focus now turns to innovative capabilities within the new ventures. Innovative capabilities refer to firm's capabilities, grounded in the processes, systems, and organizational structure, which can be applicable to the product or process innovation activities. The resource-based view suggests that a company with strong capabilities, especially innovative capabilities, can lead to superior competence, such as TC competence, over their rivals. Innovative capabilities tend to

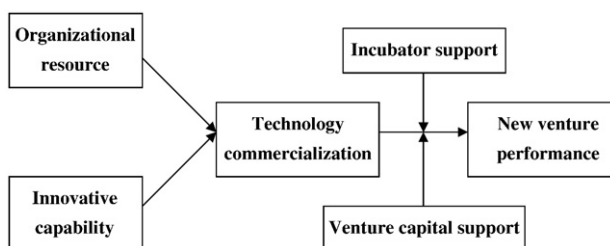


Fig. 1. The research model.

be imperfectly imitable because they are born of organizational skill and accumulative corporate learning. Successful technology commercialization requires strong and varied innovative capabilities to satisfy the customers' needs in terms of the cost, speed, quality, and newness attributes of the technologies (Zahra and Nielsen, 2002). Firms can assemble and then deploy the innovative capabilities to create new products and introduce them to the market in a timely manner (Teece et al., 1997). Following this line of logic, this study proposes the following hypothesis.

Hypothesis 2. Innovative capabilities relate positively to TC competence of new ventures.

2.3. Technology commercialization competence

TC competence refers to the competence to use technologies in products across a wider range of markets, incorporate a greater breadth of technologies in products, and get products to market faster (Nevens et al., 1990). TC competence consists of three dimensions including commercialization speed, market scope, and technology breadth. Technology commercialization speed indicates a firm's ability to introduce new products more quickly than its competitors (Zahra and Nielsen, 2002). When base technologies are widely available and product life cycles are short, getting to market is essential. The new venture that is first to market often can command premium pricing because of its de facto monopoly (Nevens et al., 1990; Porter, 1985). Early entrants also achieve volume break points in purchasing and production sooner than laggards and therefore they gain larger market share and higher profit margin. In terms of market scope, as the cost of developing technologies is high and rising, firms need to spread costs across as many products and geographic markets as possible to maintain price parity (Nevens et al., 1990). These competencies in enlarging market scope provide new ventures competitive advantages and result in higher profit margin. Moreover, in many markets, products incorporate an increasing number of technologies to provide more functions to satisfy customers. Accordingly, new ventures must be able to master or to acquire and integrate the technologies to remain competitive in the markets that they are to compete (Nevens et al., 1990).

Overall, TC competence allows new ventures to gain competitive advantage over their competitors by reducing costs, improving quality, absorbing new technologies, and thus improve their performance. In light of above reasoning, this study proposes the following hypothesis.

Hypothesis 3. TC competence relates positively to the performance of new ventures.

Hypotheses 1 and 2 propose that organizational resources and innovative capabilities both affect TC competence while Hypothesis 3 suggests that TC competence is positively related to the performance of new ventures. These causal chain relationships indicate that TC competence plays the role of intermediate variable in mediating the relationships between independent variables of organizational resources and innovative capabilities, and dependent variable of the outcome of new

ventures. From the process-oriented viewpoint, organizational resources and innovative capabilities would influence new venture performance primarily through TC competence. Accordingly, this study proposes the following hypotheses.

Hypothesis 4. TC competence fully mediates the effects of organizational resources on the performance of new ventures.

Hypothesis 5. TC competence fully mediates the effects of innovative capabilities on the performance of new ventures.

2.4. Incubator and venture capital supports

The above hypotheses suggest that TC competence would positively affect the outcome of new ventures. However, the unique characteristics of new ventures are exemplified in the condition known as resource poverty where they operate in severe constraints in technological, financial, and managerial aspects (Thong, 2001). In order to enable the business effectively to realize better performance, new ventures often need to acquire resources from the external environment. Two types of resource sources that can be useful for new ventures are incubators and venture capitalists. However, the positive effect may be varied when new ventures consider seeking help from incubators and venture capitalists. An incubator is an innovative system designed to provide technology and management supports to assist entrepreneurs in the development of new ventures (Smilor, 1987; Sherman, 1999). Some prior studies have paid attentions to understanding the effects of incubators on the development of new ventures (e.g. Allan and Bazan, 1990; Colombo and Delmastro, 2002; Mian, 1996). According to a national survey of six representative university technology business incubators, Mian (1996) suggests that several university technology business incubator services such as university image, laboratories and equipments, and student employees add major values to the client firms, making the university technology business incubator a viable strategy for nurturing new ventures. Colombo and Delmastro (2002) investigate whether science parks, acting as technology incubators, have been successful in fostering the establishment and growth of new technology-based firms in Italy. They indicate that innovative activities are marginally different between on- and off-incubator firms. However, on-incubator firms, compared to off-incubator counterparts, show higher growth rate, perform better in adoption of advanced technologies, and get easier access to public subsidies. Allan and Bazan (1990) suggest that no significant differences exist between incubated and non-incubated firms in terms of sales and income growth rates.

Venture capital firm refers to a set of financiers specializing in providing entrepreneurs with the capitals and value-added activities to founding and developing new ventures (Von Burg and Kenney, 2000). Many earlier studies focus on the investment decision-making processes and their different work models (e.g. MacMillan et al., 1985; Tyebjee and Bruno, 1984). Some recent researches start to discuss the influence of venture capital firms on the development of new ventures (e.g. Barry et al., 1990; Fredriksen et al., 1997;

MacMillan et al., 1989; Schefczyk and Gerpott, 2001). Schefczyk and Gerpott (2001) explore the impact of management support by venture capital firms on the performance of invested new ventures. Their findings indicate that venture capital firms can improve the performance of the invested new ventures through consultative management support. According to a large set of initial public offerings (IPOs) by venture-capital-backed companies, Barry et al. (1990) indicate that capital markets recognize the quality of the monitoring services by venture capitalists through better IPOs performance. On the other hand, MacMillan et al. (1989) examine the impact of non-financial assistance of venture capital firms on the performance of new ventures. They report that no significant relationship between the levels of venture capital involvement, whether it was strategic or operational, and venture performance. Fredriksen et al. (1997) suggest that high influence of venture capital firms is associated with better development in some non-economic aspects but not in economic development.

These prior studies provide mixed results on the roles of incubators and venture capitals in the development of new ventures. The inconsistent results may result from the negligence of the TC competence that these new ventures possess. New ventures are more likely to succeed if they possess TC competence in technology breadth, market scope, and commercialization speed. Commercialization speed refers to the extent of the competence in developing and launching the product to the market in a timely manner; technology breadth refers to the extent of the competence in incorporating several technologies into a product; and market scope refers to the extent of the competence in applying technologies to products for different markets. From the resource-based viewpoint, new ventures can leverage their internal resources and capabilities and look to outside for those resources which are essential but weak or not already possessed. Incubators often contribute to provide technological assistances while venture capital firms mainly play the roles in providing the financial and managerial supports to new ventures. Accordingly, incubators will be more helpful for new ventures that are not familiar with how to incorporate several technologies to develop a product and launch the product to the market in time than for those with good technology breadth and commercialization speed competences. On the other hand, incubators will provide more complementary help to new ventures with better market scope competence than those that are not good at promoting their products. Similarly, new ventures that are lack of financial capital or marketing experience to promote their products will get greater help from the venture capital firms than those with better financial and marketing experience. On contrast, new ventures with better technology breadth and commercialization speed competences can leverage the resources and capabilities from venture capital firms than those with worse technology breadth and commercialization speed competences. Therefore, it appears that assistance from incubators and venture capital firms may have different impact on the effectiveness of new ventures with different degree of competencies in technology commercialization. In light of the above reasoning, this study proposes the following hypotheses.

Hypothesis 6a. Incubator support positively moderates the effect of market scope on the performance of new ventures.

Hypothesis 6b. Incubator support negatively moderates the effect of technology breadth and commercialization speed on the performance of new ventures.

Hypothesis 7a. Venture capital support negatively moderates the effect of market scope on the performance of new ventures.

Hypothesis 7b. Venture capital support positively moderates the effect of technology breadth and commercialization speed on the performance of new ventures.

3. Research method

3.1. Data collection and sample

The empirical study employs a questionnaire approach to collect data for testing the validity of the model and research hypotheses. Variables in the questionnaire include background information, organizational resources, innovative capabilities, TC competence, incubator and venture capital support, and new venture performance. All variables, except moderating variables and control variables, require seven-point Likert-style responses ranging from “strongly disagree” to “strongly agree” in multiple items. The questionnaire includes two parts and requests the financial executive to complete the first part – dependent variables and control variables and the other executive to complete the second part – independent variables, mediating and moderating variables, respectively. Due to the collection of the measures of independent and mediating variables from the same source, this study uses the Harman one-factor test to examine the potential problem of common method variance. A principal factor analysis on the items of independent and mediating variables yields seven factors, with eigenvalues greater than one, that account for 74.6% of the total variance, and the first factor accounts for 29.1% of the variance. Since a single factor does not emerge and one general factor does not account for most of the variance, common method bias is unlikely to be a serious problem in the data (Podsakoff and Organ, 1986).

New venture refers to the firm that is established within ten years (Lussier, 1995). The population in this study is Taiwanese new ventures listed in the annual books of the high-tech industries, including semiconductor, computer, communications, precise equipment, photo electronics, and biotechnology, published by the Industrial Technology Research Institute (ITRI) of Taiwan. The author distributes 600 questionnaires to the selected new ventures and does follow-up letters, emails, and phone calls after two weeks. Of the 134 returned questionnaires, 12 responses are incomplete. The remaining 122 valid and complete questionnaires are for the quantitative analysis. It represents a usable response rate of 20.3%.

3.2. Measures

The new venture performance construct is a four-item scale reporting performance as perceived by the respondents. These

four seven-point scale items reflect the degree to which the new venture is satisfied with its market share, sales, net profits, and returns on assets ($\alpha=0.84$). Exploratory factor analysis supports only one factor and accordingly this study averages the four items as an overall performance measure.

Organizational resource construct is a seven-item scale indicating the extent to which the new venture possesses human, tangible, and intangible resources. Exploratory factor analysis supports these three types of organizational resources. The human resource factor reflects the extent of the expertise, talents, and creativity that the new venture's personnel possess (three items, $\alpha=0.83$); The tangible resource factor consists of two items including financial and physical assets (two items, $\alpha=0.84$); Two items of brand names and the intellectual property of the new venture reflect the extent of the intangible resource factor (two items, $\alpha=0.57$). The reliability of the variable of intangible resource (0.57) is somewhat lower below 0.7 but is merely acceptable (Hair et al., 1998).

Innovative capability construct is a six-item scale reporting the extent of new venture's ability in operating the innovative activities to create new products or processes. Exploratory factor analysis supports two types of innovative capability including product and process. The product innovative capability factor consists of three items including the new venture's capabilities in idea generation, design, and development of new products (three items, $\alpha=0.72$) while process innovative capability factor includes three items regarding the new venture's capabilities in idea generation, design, and development of new processes which are more efficient and quality effective to produce products (three items, $\alpha=0.70$).

TC competence refers to the competence to get products to market faster, use technologies in products across a wider range of markets, and incorporate a greater breadth of technologies in products. Researchers have selectively analyzed particular dimensions of TC competence while ignoring others (Zahra and Nielsen, 2002). This study attempts to address these gaps in the literature by considering multiple dimensions of TC competence. Exploratory factor analysis categorizes three factors of TC competence, including commercialization speed, market scope, and technology breadth. The commercialization speed factor reflects the extent to which new ventures can initiate, develop, and launch the product to the market in a timely manner (three items, $\alpha=0.92$); The market scope factor is a four-item scale to indicate the extent to which new ventures apply technologies to improve existing products or create new products for different demographic and geographic markets (four items, $\alpha=0.83$); Technology breadth factor includes four items regarding acquisition and integration of the technologies to improve existing products or create new products (four items, $\alpha=0.81$).

Incubator support construct is a categorical variable with "1" indicating that the new venture receives support from the incubator and "0" that the new venture does not get any help from the incubator. Similarly, venture capital support construct is a categorical variable with "1" representing that the new venture receives support from the venture capital firm and "0" that the new venture does not get any help from the venture capital firm.

This study includes three firm-level control variables in the analysis. The first control variable is the age of the new ventures because older firms tend to be more experienced and thus more successful. This study measures the age of the new ventures as the number of years since the establishment of the new venture. Size may affect the new venture performance because larger firms tend to have more resources and capabilities to enhance their business operations. This study includes two firm size variables, the amount of capital and the number of employees, in the analyses. The author uses the logarithms of the amount of capital in million NT dollars and the logarithm of the total number of employees in the new venture to measure these two firm size variables. In addition, this study uses five dummy variables for the industry type to indicate whether the firm belongs to semiconductor, communications, computer, biotechnology, and photo electronics industry.

4. Results

Table 1 presents correlations, means, and standard deviations for all variables. This study attempts to understand the roles of TC competence, incubator and venture capital supports in determining the performance of new ventures. Table 2 displays the results of the regression analyses of the effects of organizational resources and innovative capabilities on TC competence. Models 1a to 1c in Table 2 are the base models that include the three control variables. Models 2a to 2c capture the effects of organizational resources on TC competence. These models are all significant at the $p<0.001$ level and explain an additional 17.0, 24.6, and 16.1% of variance over what the control variables alone explain ($R^2=0.311, 0.369, \text{ and } 0.314$, respectively). Coefficients for human resource are positive and significant for commercialization speed ($p<0.001$), market scope ($p<0.001$), and technology breadth ($p<0.05$). Tangible resource has positive effects on the three factors of TC competence but the relationships are not significant. Intangible resource has positive and significant relationships with commercialization speed ($p<0.05$) and with technology breadth ($p<0.001$). These findings moderately support Hypothesis 1 and indicate that in general new ventures would achieve a higher level of TC competence when their organizational resources are more abundant.

Models 3a to 3c show the relationships between innovative capabilities and TC competence. These models are all significant at the $p<0.001$ level and R^2 is 0.410, 0.531, and 0.521, respectively. Product innovative capability has positive and significant effects on all three factors of TC competence ($p<0.001$). Similarly, coefficients for process innovative capability are positive and significant for commercialization speed ($p<0.05$), market scope ($p<0.001$), and technology breadth ($p<0.001$). These findings support Hypothesis 2 and indicate that new ventures would achieve a higher level of TC competence if they possess stronger innovative capabilities.

Next, the study examines how TC competence affects the performance of new ventures. Model 4a, in Table 3 is the base model that includes the three control variables. Model 4b presents results with the three TC competence factors included

Table 1
Correlation matrix and summary statistics ($n=122$)

Variable	Mean	S.D.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
1. Semiconductor	0.17	0.38																		
2. Communications	0.15	0.36	-0.19																	
3. Computer	0.23	0.42	-0.24	-0.23																
4. Biotechnology	0.13	0.34	-0.18	-0.17	-0.22															
5. Photo electronics	0.19	0.39	-0.22	-0.20	-0.26	-0.19														
6. Age	5.48	2.87	-0.63	-0.33	-0.17	0.15	0.51													
7. Capital	3.29	1.62	-0.12	-0.12	-0.25	0.16	0.30	0.32												
8. Number of employees	3.46	1.33	-0.03	-0.06	-0.06	0.07	0.24	0.06	0.65											
9. Human resource	5.04	1.16	0.05	-0.02	-0.22	0.04	-0.04	0.14	0.04	-0.13										
10. Tangible resource	4.47	1.50	0.14	-0.16	0.19	-0.05	-0.03	-0.13	0.10	0.30	0.05									
11. Intangible resource	5.02	1.22	0.06	-0.16	0.15	0.01	-0.09	-0.05	0.08	-0.01	0.22	0.13								
12. Product innovative capability	5.16	1.03	0.23	-0.12	-0.16	-0.01	0.06	-0.03	0.19	0.12	0.18	0.14	0.18							
13. Process innovative capability	5.27	0.98	0.04	-0.09	-0.04	-0.05	0.21	0.05	0.11	0.06	0.19	0.11	0.13	0.40						
14. Commercialization speed	4.75	1.34	0.25	-0.08	-0.11	0.01	0.13	-0.16	0.05	0.10	0.30	0.07	0.37	0.54	0.38					
15. Market scope	5.48	0.94	0.19	-0.04	-0.25	-0.06	0.17	0.01	0.15	0.12	0.45	0.21	0.29	0.65	0.51	0.47				
16. Technology breadth	4.71	1.03	0.10	-0.29	0.01	-0.08	0.16	0.10	0.18	0.18	0.22	0.19	0.44	0.57	0.50	0.59	0.61			
17. Incubator support	0.29	0.45	0.14	-0.07	0.08	0.05	-0.21	-0.13	-0.29	-0.33	0.07	-0.01	0.15	0.01	0.13	-0.09	0.17	0.12		
18. Venture capital support	0.32	0.47	0.20	-0.05	-0.16	-0.02	0.11	-0.06	0.35	0.23	0.16	-0.02	-0.12	0.13	-0.03	0.30	0.05	0.09	-0.43	
19. New venture performance	3.85	1.15	0.21	-0.22	-0.15	0.15	0.02	-0.01	0.19	0.11	0.36	0.05	0.28	0.35	0.19	0.52	0.41	0.49	0.01	0.12

Correlations above 0.18 are significant at $p < 0.05$; correlations above 0.23 are significant at $p < 0.01$.

in the model. This model is significant ($F=6.93, p < 0.001$) and yields an R^2 of 0.409. The results for commercialization speed suggest that it is a significant determinant of new venture performance ($p < 0.001$). The positive and significant coefficient of commercialization speed indicates that new ventures would realize higher performance when they can initiate, develop, and launch the product to the market in a timely manner. The positive coefficient for market scope is consistent with the prediction that market scope competence is positively related to the performance of new ventures. However, the relationship is not significant. The positive and significant coefficient of technology breadth ($p < 0.05$) indicates that new ventures would experience higher performance when they are more familiar with utilization of varied technologies for their products. In summary, all three factors of TC competence have the expected signs, but only commercialization speed and technology breadth have significant effects on the performance. Accordingly, the results moderately support Hypothesis 3.

The study follows Baron and Kenny's (1986) procedure to analyze the mediating effects of TC competence on new venture performance. The first step is to examine the relationship between the dependent variable, new venture performance, and the independent variable, organizational resource and innovative capability. As shown in Model 5a in Table 3, two organizational resource factors, human resource ($p < 0.001$) and intangible resource ($p < 0.05$), are positively related to new venture performance. Also, Model 6a indicates that product innovative capability ($p < 0.01$) and process innovative capability ($p < 0.05$) are positively related to new venture performance. Secondly, as demonstrated in Models 2a to 2c in Table 2, two organizational resource factors, human resource and intangible resource, are positively related to the mediator, TC competence. Moreover, Models 3a to 3c indicate that both product and process innovative capability factors are positively related to the mediator, TC competence. Thirdly, the results in Model 4b in Table 3 indicate that two TC competence factors, commercialization speed ($p < 0.001$) and technology breadth ($p < 0.05$), have positive effects on the new venture performance. Finally, this study includes the mediator, TC competence, in the models to examine the mediating effect. Full mediation occurs if it reduces the effects of the antecedents on new venture performance to non-significance. Otherwise, there is partial medication. The results of Model 5b show that the mediator, TC competence, reduces the effect of intangible resource to non-significance and reduces the effect of human resource but not to non-significance. These findings moderately support Hypothesis 4 and indicate that TC competence partially mediates the effect of human resource and fully mediates the effect of intangible resource on new venture performance. In addition, the results of Model 6b show that the mediator, TC competence, reduces the effects of product and process innovative capability factors into non-significance. These findings support Hypothesis 5 and indicate that TC competence fully mediates the effect of innovative capability on the performance of new ventures.

Table 4 presents the results of regression analyses of the moderating effects of incubator and venture capital supports on the performance of new ventures. Model 7a shows that both

Table 2
Results of regression analyses of the effects of organizational resources and innovative capabilities on TC competence

Variable	Dependent variable (TC competence)								
	M1a commercialization speed	M1b market scope	M1c technology breadth	M2a commercialization speed	M2b market scope	M2c technology breadth	M3a commercialization speed	M3b market scope	M3c technology breadth
Semiconductor	-0.22	-0.60	-1.72	-0.31	-1.05	-1.42	-0.49	-0.91	-2.19
Communications	-0.85	-0.90	-2.29	-0.70	-0.98	-1.89	-0.59	-0.75	-2.28*
Computer	-0.56	-1.07	-1.29	-0.32	-1.13	-1.05	-0.40	-1.00	-1.36
Biotechnology	0.16	-0.61	-1.22	0.26	-0.65	-1.02	0.27	-0.55	-1.25*
Photo electronics	0.88	0.05	-0.34	1.20*	0.27	-0.10	0.71	-0.13	-0.64
Age	-0.21	-0.11	-0.19	-0.25	-0.18	-0.16	-0.19	-0.05	-0.20
Capital	0.01	0.03	0.03	-0.04	-0.01	0.01	-0.08	0.07	-0.05
Number of employees	0.03	0.04	0.10	0.15	0.07	0.15	0.06	0.05	0.15*
Human resource				0.42***	0.35***	0.16*			
Tangible resource				0.07	0.08	0.01			
Intangible resource				0.24*	0.12	0.31***			
Product innovative capability							0.59***	0.48***	0.42***
Process innovative capability							0.24*	0.26***	0.37***
R ²	0.141	0.123	0.153	0.311	0.369	0.314	0.410	0.531	0.521
F	2.32*	1.98	2.54**	4.50***	5.84***	4.58***	7.72***	12.58***	12.07***
N	122	122	122	122	122	122	122	122	122

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

incubator and venture capital supports do not have direct effect on the dependent variable. Model 7b presents the interaction effects between incubator support and three TC competence factors on the performance of new ventures. The positive and significant coefficient of the interaction term between market scope and incubator support indicates that new ventures with better market scope competence can realize higher performance if they obtain incubator support. Fig. 2 presents the interaction effect of market scope and incubator support on new venture performance. This finding is consistent with the theoretical

prediction. From the resource-based viewpoint, new ventures can leverage their internal resources and capabilities and look to outside for those resources which are essential but not already possessed. Accordingly, new ventures with better market scope competence can get more complementary help in technology development from incubators to improve their performance. The findings support Hypotheses 6a.

The negative sign for the interaction term between commercialization speed and incubator support is consistent with the prediction but the relationship is not significant. Moreover, the

Table 3
Results of regression analyses of the mediating effects of TC competence between organizational resources, innovative capabilities, and performance of new ventures

Variable	Dependent variable (New venture performance)					
	M4a	M4b	M5a	M5b	M6a	M6b
Semiconductor	-0.43	0.08	-0.82	-0.26	-0.54	0.47
Communications	-1.36	-0.50	-1.55	-0.78	-1.23	-0.19
Computer	-0.87	-0.28	-0.82	-0.38	-0.79	-0.01
Biotechnology	-0.02	0.27	-0.05	0.23	0.03	0.44
Photo electronics	-0.21	-0.40	-0.02	-0.27	-0.28	-0.03
Age	-0.12	-0.01	-0.19	-0.08	-0.11	0.03
Capital	0.12	0.10	0.08	0.09	0.07	0.13
Number of employees	-0.01	-0.04	0.07	-0.01	0.01	-0.07
Commercialization speed		0.30***		0.23**		0.33***
Market scope		0.13		0.02		0.25
Technology breadth		0.25*		0.32*		0.29*
Human resource			0.37***	0.21*		
Tangible resource			0.05	0.03		
Intangible resource			0.23*	0.11		
Product innovative capability					0.28**	0.16
Process innovative capability					0.21*	0.14
R ²	0.146	0.409	0.369	0.443	0.220	0.429
F	2.41*	6.93***	5.68***	6.08***	3.14***	6.25***
N	122	122	122	122	122	122

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

Table 4
Results of regression analyses of the moderating effects of incubator and venture capital supports on the performance of new ventures

Variable	Dependent variable (new venture performance)		
	M7a	M7b	M7c
Semiconductor	0.36	-0.06	-0.18
Communications	-0.34	-0.39	-0.67
Computer	-0.14	-0.18	-0.27
Biotechnology	0.38	0.11	0.17
Photo electronics	-0.36	-0.44	-0.43
Age	0.01	-0.01	-0.01
Capital	0.13	0.13	0.12
Number of employees	-0.07	-0.04	-0.06
Commercialization speed	0.31**	0.39***	0.31**
Market scope	0.13	0.05	0.06
Technology breadth	0.27*	0.34*	0.33*
Incubator support	0.19	0.44	
Venture capital support	0.27		1.22
Incubator support* commercialization speed		-0.25	
Incubator support* market scope		0.74**	
Incubator support* technology breadth		-0.53*	
Venture capital support* commercialization speed			0.29
Venture capital support* market scope			-0.71**
Venture capital support* technology breadth			0.72**
R ²	0.418	0.463	0.491
F	5.96***	6.08***	6.83***
N	122	122	122

* $P < 0.05$, ** $P < 0.01$, *** $P < 0.001$.

negative and significant coefficient for the interaction term between technology breadth and incubator support suggests that incubator support is more helpful to new ventures with a lower degree of technology breadth competence, compared to those with a higher degree of technology breadth competence. Fig. 3 presents the interaction effect of technology breadth and incubator support on new venture performance. This empirical evidence supports the theoretical arguments, based on the resource-based viewpoint, that new ventures can look to outside for synergistic help in getting those resources which are essential but weak. Accordingly, new ventures that are not

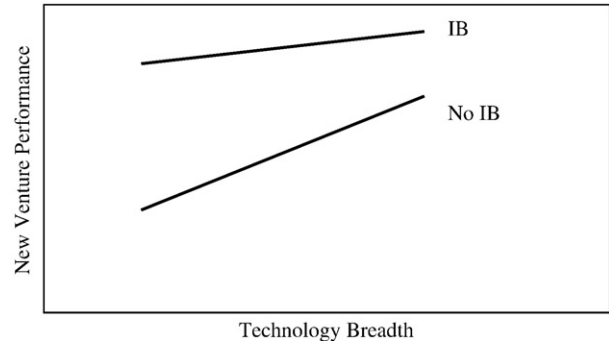


Fig. 3. Interaction effect between incubator support and technology breadth.

competent in incorporating technologies in products can get more help in technology development from incubators to improve their performance. Accordingly, the results moderately support Hypotheses 6b.

Similarly, Model 7c presents the interaction effects between venture capital support and three TC competence factors on the performance of new ventures. The negative and significant coefficient for the interaction term between market scope and venture capital support suggests that the assistance from venture capitalists is more helpful to new ventures with a lower degree of market scope competence, compared to those with a higher degree of market scope competence. Fig. 4 presents the interaction effect of market scope and venture capital support on new venture performance. This finding is consistent with the theoretical prediction. From the resource-based viewpoint, new ventures that are lack of marketing experience to promote their products can get more synergistic help in market development from venture capital firms to improve their performance. Accordingly, the findings support Hypotheses 7a.

The positive sign for the interaction term between commercialization speed and venture capital support is consistent with the prediction but the relationship is not significant. In addition, the positive and significant coefficient for the interaction term between technology breadth and venture capital support indicates that new ventures with better technology breadth competence can experience higher performance if they obtain venture capital support. Fig. 5 presents the interaction effect of technology breadth and venture capital support on new venture

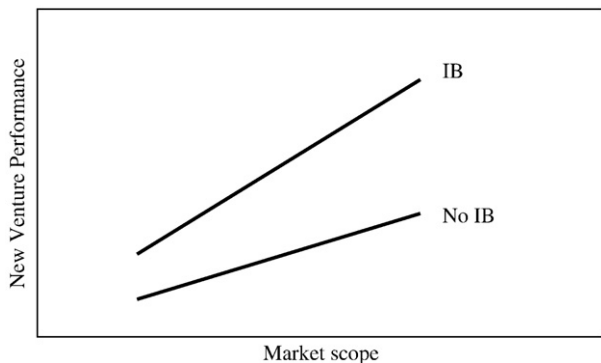


Fig. 2. Interaction effect between incubator support and market scope.

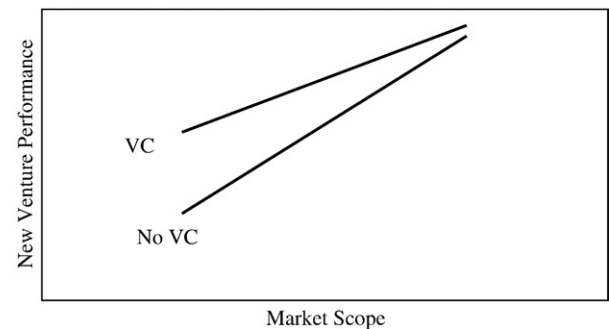


Fig. 4. Interaction effect between venture capital support and market scope.

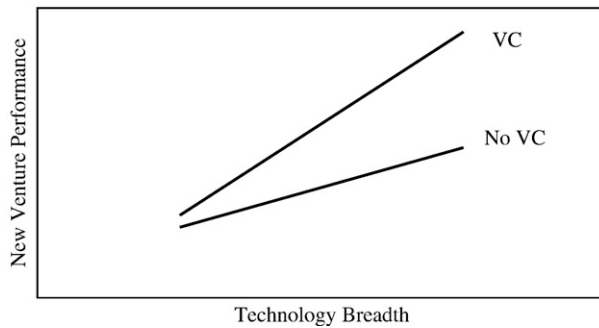


Fig. 5. Interaction effect between venture capital support and technology breadth.

performance. This empirical evidence supports the theoretical arguments, based on the resource-based viewpoint, that new ventures with better technology breadth competence can get more complementary help in market development from venture capital firms to improve their performance. Therefore, the findings moderately support Hypothesis 7b.

5. Discussion and conclusions

This study examines the mediating effects of TC competence and the moderating effects of incubator and venture capital supports on the performance of new ventures. The major findings and the implications are: First, the results of the regression analysis indicate that in general if new ventures possess more abundant human and intangible resources, the level of TC competence will be more favorable and then the performance will be more satisfied. These findings show support that organizational resources can deliver a better performance for new ventures but primarily do so through the mediating effects of TC competence. The key point is that human and intangible resources work their beneficial effects on the performance through shortening commercialization speed and enlarging market scope and technology breadths because human and intangible resources are better equipped to implement changes, facilitate the development of new products, and promote the new products into the market quickly. The present evidence implies that new ventures would realize higher performance if they utilize organizational resources more effectively to improve their TC competence. Therefore, firms should understand that they need to provide sufficient investment in human and intangible resources. Through the utilization of abundant organizational resources such as skilled employees and intellectual property rights, firms can improve their TC competence and, accordingly, achieve a more satisfied outcome.

Secondly, the present results are also quite instructive in helping to explain the effects of innovative capabilities on the outcomes of the new ventures. Innovative capabilities do not have direct effects on the performance of new ventures. However, it does lead to strengthen the TC competence and then indirectly result in better outcomes. These findings indicate that in general if new ventures possess stronger innovative

capabilities, their TC competence will be more favorable and then they will achieve a better performance. These results imply that new ventures would realize higher performance if they utilize innovative capabilities more effectively to improve their TC competence. Innovative capabilities are imperfectly imitable and are sources of TC competence. New ventures should strengthen their innovative capabilities through refining their organizational structure, process, and system to accumulate organizational learning and skills. They can assemble and deploy strong innovative capabilities to create products and introduce them to the market in a timely manner, thus leading to a more satisfied outcome for the new ventures.

Thirdly, the results of the regression analysis indicate that incubator and venture capital supports play the moderating roles in affecting the relationships between TC competence and new venture performance. Incubator support is more helpful to new ventures when they possess a lower degree of technology breadth competence or a higher degree of market scope competence. On the contrary, new ventures would get a better improvement effect on the performance through the help of venture capitalist when they possess a lower degree of market scope competence and a higher degree of technology breadth competence. These evidences imply that new ventures with different competence of technology commercialization should seek help from different outside sources. Incubators often contribute to providing technological assistances while venture capital firms mainly play the roles in providing the marketing and financial supports to new ventures. Accordingly, new ventures that are not familiar with how to incorporate several technologies in a product or need certain key technologies from outside could seek help from incubators while venture capital firms are more helpful to provide marketing experience for new ventures to promote their products.

The theoretical contributions of this study are: First, this study contributes to the theoretical development of a conceptual model for explaining the roles of TC competence, incubator and venture capital supports in affecting the outcomes of new ventures. This study recognizes resources and capabilities as the sources of competence of the organization and treats technology commercialization as an important kind of competence. The above logic implies that TC competence plays as a mediator in the relationships between resources, capabilities, and performance of new ventures. However, literature examining this mediating issue is scarce. This study takes the process-oriented perspective to build up the conceptual model and adopts the resource-based view to investigate the relationships among organizational resources, innovative capabilities, TC competence, and performance of new ventures.

In addition, many prior studies have paid attentions to understanding the roles of incubators and venture capital firms in the development of new ventures. However, the results of prior research provide mixed results. The inconclusiveness of the effects of incubator and venture capital supports on the performance calls for the development of better theoretical models to trace the path. This study tries to fill up the gap by adopting the resource-based view to hypothesize the

moderating effects of incubator and venture capital supports on the performance of new ventures.

The third contribution of this study is the derivation of empirical support for the model's prediction using data from actual new venture cases. The empirical evidences of this study prove the mediating role of TC competence and moderating roles of incubator and venture capital supports in affecting the performance of new ventures. In terms of TC competence, the results provide the theory-building, explanatory variance as missing in the literature that only looks at the black box of relationships between resources and capabilities, and outcomes. The present results indicate the way to the inclusion of critical intervening variable, TC competence, in the conceptual model explaining the dynamics between organizational resources and innovative capabilities, and performance of new venture. As to incubator and venture capital supports, the empirical evidences show that the interactions between incubator and venture capital supports with TC competence are critical to the outcomes of new ventures. The findings of this study fill the gap in the new venture literature that is lack of examining these moderating effects on the performance of new ventures.

This study has some limitations. First, a problem common to the organizational-level study concerns whether an individual response can represent the intended firm-level situations. To alleviate this problem, this study requests the executives who are familiar with the topic to complete the questionnaire. However, this problem may still exist and therefore is noted as a possible limitation of this study. Secondly, the self-report data used in this study may have the problem of common method variance. Though this study asks two executives to answer the questionnaire together and uses the Harman one-factor test to verify that common method variance is not a significant problem, the issue may still exist and accordingly is addressed as a potential limitation. Thirdly, this study only concerns the effect of innovative capabilities on TC competence and new venture performance. Other types of capabilities may potentially affect TC competence and new venture performance as well. Future research may work on examining their impacts on TC competence and new venture performance. Fourthly, this study shows TC competence as a potential mediator between organizational resources, innovative capabilities, and new venture performance. The author follows Baron and Kenny's (1986) sequential procedure of regression analysis to test the mediating effect. Future research could use a structural equation model to explore the direct and indirect relationships between the variables in the study simultaneously. Finally, the empirical results of partial mediation of TC competence on the relationship between human resource and new venture performance imply that TC competence is not the only possible mediator. Accordingly, future research can work on exploring other mediators in the black box between the variables.

To conclude, organizational resources and innovative capabilities are important antecedents for new ventures to achieve superior performance. The viewpoints proposed in this study highlight the crucial importance of the mediating role of TC competence in examining the relationships between the two antecedents and new venture performance. The study also

highlights the moderating roles of incubator and venture capital supports in affecting the relationship between TC competence and new venture performance.

Appendix A. Measurement items

Please answer the following questions based on the situations of the company in the past three years.

I. New venture performance (4 items, $\alpha=0.84$) (1=Strongly disagree, 7=Strongly agree)

(1) Our firm was satisfied with its market share; (2) Our firm was satisfied with its annual sales; (3) Our firm was satisfied with its net profits; and (4) Our firm was satisfied with its returns on assets.

II. Organizational resource:

1. Human resource (3 items, $\alpha=0.83$) (1=Strongly disagree, 7=Strongly agree)

(1) Our employees possessed the expertise to do their work; (2) Our employees possessed the talents to do their work; (3) Our employees possessed the creativity to do their work.

2. Tangible resource (2 items, $\alpha=0.84$) (1=Strongly disagree, 7=Strongly agree)

(1) Our firm owned adequate financial assets for operating the business; (2) Our firm owned adequate physical assets for operating the business.

3. Intangible resource (2 items, $\alpha=0.57$) (1=Strongly disagree, 7=Strongly agree)

(1) Our firm possessed popular brand name(s) in the market; (2) Our firm possessed many patents and know-how to prevent the products from imitation.

III. Innovative capability:

1. Product innovative capability (3 items, $\alpha=0.72$) (1=Strongly disagree, 7=Strongly agree)

(1) Our firm was very capable of ideas generation for new products; (2) Our firm was very capable of product design for new products; (3) Our firm was very capable of product development for new products;

2. Process innovative capability (3 items, $\alpha=0.70$) (1=Strongly disagree, 7=Strongly agree)

(1) Our firm was very capable of ideas generation of new processes to produce products more efficiently and quality effectively; (2) Our firm was very capable of the design of new processes to produce products more efficiently and quality effectively; (3) Our firm was very capable of the development of new processes to produce products more efficiently and quality effectively.

IV. TC competence:

1. Commercialization speed (3 items, $\alpha=0.92$) (1=Strongly disagree, 7=Strongly agree)

(1) Our firm possessed the competence to initiate the idea of the product in a timely manner; (2) Our firm possessed the competence to develop the product in a timely manner; (3) Our firm possessed the competence to launch the product to the market in a timely manner.

2. Market scope (four items, $\alpha=0.83$) (1=Strongly disagree, 7=Strongly agree)

(1) Our firm was very competent on improving existing products for different demographic markets; (2) Our firm was

very competent on improving existing products for different geographic markets; (3) Our firm was very competent on creating new products for different demographic markets; (4) Our firm was very competent on creating new products for different geographic markets.

3. Technology Breadth (4 items, $\alpha=0.81$) (1=Strongly disagree, 7=Strongly agree)

(1) Our firm possessed the competence to acquire the technologies to improve existing products; (2) Our firm possessed the competence to acquire the technologies to create new products; (3) Our firm possessed the competence to integrate the technologies to improve existing products; (4) Our firm possessed the competence to integrate the technologies to create new products.

V. Incubator and venture capital support

(1) Have our firm received support from the incubator?

Yes _____ No _____

(2) Have our firm received support from the venture capital firm?

Yes _____ No _____

VI. Background information

What year was our firm established? _____

(2) What was the average amount of capital for our firm?

(3) What was the average number of employees in our firm?

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