

A Study of Business Ventures' Successful R&D Mechanism through Open Innovation

Do-Hyung Park^{1,*}, In-Jin Yoo² and Bong-Goon Seo³

Abstract

The study focuses on the determinants of business ventures' sales by categorizing intra-enterprise resources in order to properly assess their influence, and classifying firms' competencies into two dimensions to observe the difference between the performance determinants of business ventures in each dimension. Through factor analysis, the firms' competencies including technology, price, quality, design, organization management, and marketing competitiveness were categorized into two dimensions of technological competence and management competence, and the firms were categorized as either technology-driven or management-driven, based on the comparative intensity of the two dimensions. Then, performance determinants were categorized into 6 superordinate categories of enterprise status, entrepreneur resource, human resource, financial resource, technological resource, and external resource, and the influence of the subordinate factors on sales were analyzed using two-year data of "The Survey of Korea Business Ventures." First, the results showed that 22 out of 33 variables used in the model had a significant influence on the sales of business ventures. Second, the analysis on the difference of determinants by group found that of the 33 independent variables, 13 variables at maximum and 8 at minimum were found to significantly influence sales, which verifies the difference between sales determinants in each dimension.

Keywords: business venture, Open Innovation, resource-based theory, performance determinant, technology-driven, management-driven, enterprise competence

1. Introduction

The domestic industrial market environment is rapidly changing, with competition both between domestic and overseas firms becoming more and more fierce due to globalization. It is essential not only for large enterprises but also for small and mid-sized business ventures to secure and develop their core competencies. It is particularly crucial for small and mid-sized business ventures, which are inferior compared to large enterprises in terms

of resource procurement including financing and marketing activities, to focus on consistent R&D investment in order to successfully facilitate innovation so that they can seize a competitive advantage and increase their survival rate. If investment brings success to R&D activities, it may enhance the financial performance of a firm, including through sales growth (Branch, 1973; Heunks, 1998). However, it is difficult for small and mid-sized business ventures to actualize groundbreaking innovation through R&D due to their

¹ College of Business Administration / Graduate School of Business IT, Kookmin University, 77 Jeongneung-Ro, Seongbuk-Gu, Seoul, Korea

² Graduate School of Business IT, Kookmin University, 77 Jeongneung-Ro, Seongbuk-Gu, Seoul, Korea

³ Graduate School of Business IT, Kookmin University, 77 Jeongneung-Ro, Seongbuk-Gu, Seoul, Korea

* Corresponding author: dohyungpark@kookmin.ac.kr

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small size and lack of basic resources such as human and financial resources. R&D may in fact prove fatal to a firm if a substantial investment of time and money does not lead to appropriate outcomes.

It was through the domestic venture boom, national-level promotion policies and multidirectional aid, that Korea could claim a total of 35,027 business ventures as of September 2017. Despite the long-term economic depression, business ventures are creating jobs and contributing to domestic economic growth through innovative technology and challenging growth strategies. However, while business ventures enjoy high returns, their risk factors include low performance to resource input ratio and slow conversion of performance to revenue. Therefore, business ventures with less internal competence compared to large enterprises must apply their resources effectively, and verify key resources in accordance with the competence of the firm.

Also, technology development through external cooperation, or “Open Innovation”, is rising as an alternative to development using internal resources. With less in the way of utilizable internal resources, it is necessary for small and mid-sized business ventures to actively materialize their technology or ideas through external cooperation such as joint development or contracted development with other firms or institutions, rather than focusing on self-led R&D. Previous studies on external cooperation by small and mid-sized business ventures were mainly focused on the following topics: the influence of external resource utilization in small and mid-sized R&D activities on performance; and the determinants of cooperation between small and mid-sized business ventures and large enterprises, and the correlation between such determinants (Belderbos et al., 2004; Lee and Kang, 2006; Kim, 2012). The various methods of technology development promotion, including self-development, and joint or contracted development with universities, national, public and private research institutes, or other enterprises may result in different

outcomes in terms of a firm’s financial performance. Also, as technology development performance may differ based on various factors, it is important to verify which factors influence sales, a criterion of R&D related financial performance.

Meanwhile, resource-based theory sees internal resources as the main cause of differences between firms’ performance, and “resource” here refers to both tangible and intangible assets (Wernerfelt, 1984; Barney, 1991). Therefore, preceding studies from the vantage point of resource-based theory categorize determinants of business ventures’ performance into human resources, financial resources, material resources, technological resources, and organizational resources (Hoffer and Schendel, 1979; Grant, 1991; Diericks and Cool, 1998; Lee, 2007). Moreover, core competence theory, which is derived from resource-based theory, refers to “competence” as the source of a competitive advantage and an internal resource that is differentiated from those of other firms, such as technical skills, product quality, and marketing (Hamel and Prahalad, 2006).

As such, the determinants of business ventures’ performance include in the broader sense the ‘resources’ or ‘competencies.’ Previous studies were focused on case analyses, through which the researchers investigated the determinants of performance from only a single dimension. Therefore, this study aims to verify the determinants of sales by categorizing the internal resources of business ventures, observing the difference in the influences of determinants by classifying firms’ competencies into the two dimensions of management competence and technological competence, and ultimately identifying the difference in the effects of Open Innovation on each type of firm. Based on the results of this analysis, we can expect to summarize the success factors of business ventures, and provide an appropriate guideline for the government in formulating supportive policies for the business ventures.

2. Theoretical Background

2.1 Business Ventures and Performance Determinants

While the definition of a business venture has not yet been academically clarified, it is generally considered to be a new firm founded by an individual or a small number of entrepreneurs, with high risk and high return. More specifically, the term "business ventures" has come to refer to technology-intensive businesses that aim to commercialize a new technology or an innovative idea (Lee et al., 2015). According to Article 2 of the Act on Special Measures on the Promotion of Venture Businesses, domestic business ventures should satisfy the requirements of one of the following: venture investment business, research and development business, or businesses that provide guarantee or loan based on technology evaluation.

In terms of the factors influencing a business venture's performance, the resource-based theory sees internal resources as a cause of differences in individual business performance when two business ventures face similar circumstances (Wernerfelt, 1984; Barney, 1991). Thus, according to the resource-based theory, it is the internal factors, rather than the environmental factors, that decide the differences in performance among individual firms. Here, the "resources" of this theory include both tangible and intangible assets, like capital, facilities, equipment, technological know-how, industrial property rights, and organization management. Thus, according to resource-based theory the factors that influence the performance of a business venture can thereby be defined as tangible and intangible assets that the firm owns internally.

This study will categorize business assets into five categories: (1) Firm status, (2) Entrepreneur resources,

(3) Human resources, (4) Financial resources, and (5) Technological resources.

2.1.1 Firm Status

The current status of a business is not classified as an internal resource of a firm but falls instead into an independent category, and includes objective indices such as the life span and growth stage of the business. Further, Chung (2015) suggests that subcontract transactions with large enterprises place small and medium venture enterprises in a vertical relationship. This study accordingly includes the difference between the current profit rate and the desired, optimal profit rate of the business venture in the model as a vertical intensity that is quantitatively measurable.

Meanwhile, the analysis performed by Oh et al. (2009) on the influence of governmental support policy on business performance reveals that Venture, Inno-Biz⁴ and Main-Biz⁵ business support policies have the most significant influence on business performance. Kim et al. (2011) found significantly higher performance in terms of profitability among Inno-Biz certified business ventures. Thus, whether a business venture has received Inno-Biz and Main-Biz certification may have a significant influence on business performance.

2.1.2 Entrepreneur Resources

Study by Lee et al. (2015) on business ventures suggests that the characteristics of the founder should be a core subject of study, and accounts for the majority of research content. The competence of the founder was a main topic in the early stages of the related research, and many studies have been conducted on the age, education level, and experience

4 A firm certified by the Ministry of SMEs and Startups to show competitiveness based on technological innovation. The name is a compound word of innovation and business.

5 A firm certified by the Ministry of SMEs and Startups to show business innovation in non-technological aspects, such as marketing and organizational management. The name is a compound word of management, innovation, and business.

of the founder (Begley and Boyd, 1987; Sexton and Bowman, 1985; Bollinger, et al. 1983; Bowen and Hisrich, 1986). Some studies have found that education level and relevant business experience of the founder have a high influence on business performance (Birely and Norburn, 1987; Roure and Keely, 1990). However, as more firms are driven by modern technology and innovation, and as the founder and the CEO are not the same person in many firms, it is necessary to separate the factors of the firm's CEO and primary founder. Therefore, this study specifically classifies the entrepreneur resources into CEO and founder, taking into consideration the variables studied in preceding research, such as the influence of age, education level, years of work experience, and past entrepreneurship experience.

2.1.3 Human Resources

Human resources are sometimes represented by the number of workers, but this would be taking only the quantitative aspect into account. Workers in a business can be divided into permanent workers and temporary workers—permanent workers will represent the stability of quantitative human resources in a business, and temporary workers will represent the instability of quantitative human resources. Meanwhile, the qualitative human resources can be represented by the education level or job performance of workers, but there is difficulty in measuring this education level objectively. Thus, a way to indirectly measure such variable could be to measure the positive attitude of a business towards training its employees, whether it does engage in training sessions, and whether it conducts its own training sessions, receives commissioned education or utilizes both. On the other hand, motivating workers to enhance their voluntary efforts and creativity is important, and incentive

levels actually point to higher business performances. This implies that compensatory motivation to workers can improve performance (Kim and Kim, 2005), and this study examined stock options as a method to compensate for performance and motivate workers to enhance their productivity.

2.1.4 Financial Resources

Business ventures have limitations when it comes to securing financial resources through loans or stocks, and a number of analyses on the survival of business ventures have shown that the financial resources of the firm have a significant influence on the survival of the business (Hong, 2002; Lee, 1998; Lee et al., 2005). There is a divergence of opinion with regard to equity structure, as the interest alignment hypothesis claims it can positively influence business performance, whereas the managerial entrenchment hypothesis claims otherwise (Alchian and Demsetz, 1972; Jensen and Meckling, 1976; Demsetz, 1983; Fama and Jensen, 1983; Rhee and Cho, 1999). According to the empirical analysis performed by Kwon and Lee (2004), it was found that R&D costs do not directly influence business value. This study aims to take the analysis a step further and examine what percentage of the total investment is accounted for by equipment and R&D, respectively, and consider how they influence business performance, taking the financial limitations of business ventures and the difference in size among businesses into account. Meanwhile, the size and source of secured funds for that year may lead to differences in business performance (Lee and Moon, 2002). Consequently, it may be projected that business performance may be influenced by the ratio of liabilities that are from individual investors and general liquidities like banks, and not government organizations or policy support.

2.1.5 Technological Resources

Spanos and Lioukas (2001) analyzed the influence of business resources on business performance based on resource-based theory and industrial organization theory, while the study on business venture performance by Song et al. (2012) concluded that as the level of technological resources of a business improves, business performance would be positively influenced. Here, technological resources can be designated as the main skilled technology or know-how that a business possesses, which may take the form of intangible assets like intellectual property or international patent rights. The study by Kim (2012) on the influence of external cooperation on innovative performance did not analyze the influence of the main product cycle on innovative performance. This study attempts to supplement and expand Kim's findings by including the following in the model: the development stages of main products and services, the position of its technology level in domestic and foreign markets, and the domestic and foreign market share.

However, the assets needed to create business outcomes are not always obtainable internally, as with the rise of the "Open Innovation" concept, resources owned by possible cooperative agents such as government and organizations, other businesses, and universities or research institutions can also become an important source of assets for business outcomes (Van de Ven, 1993; Song and Shin, 1998). Business ventures that are relatively lacking in resources and competence may seek to create business outcomes using the resources of external cooperative agents under the aforementioned "Open Innovation" concept. Studies confirm that cooperation with external agents has significant influence on innovation outcomes of business ventures (Park and Lee, 2006; Kim, 2005; Hong, 2005; Kim, 2012). Thus, it can be expected that the identity of the external cooperative agent, and whether and to what extent cooperation

is carried out may influence the business performance of a business venture.

2.2 Open Innovation of Business Ventures

As not only internal competence but external cooperation grows important in the technological innovation of enterprises, the network among firms that is referred to as 'Open Innovation' is becoming crucial. Business ventures that are relatively lacking in R&D resources and technological capacities can set up effective R&D investment strategies by actively utilizing external technical skills and ideas. Businesses can spread risk and cut down on R&D costs by utilizing such external assets, and respond adequately to fast-moving markets and innovation as well (Chesbrough, 2006; Chen et al., 2007; Gann, 2005). Audretsch and Vivarelli (1994) conducted a comparative analysis on patent outcomes in specific regions of Italy, and found that the patent outcomes of businesses were influenced by the research level and R&D level of local universities, and that small and medium-sized venture enterprises in particular benefit more from the infrastructure for innovative activities and research by external agents than large enterprises would.

Hagedoorn and Schakenraad (1994) state that technological cooperation can create economies of scale, and thus the large-scale projects enabled through technological cooperation can lead to a greater number of innovative ideas than individual small-scale projects would. In addition, studies indicating that technological cooperation can shorten product development and expedite market entry (Hagedoorn, 1993; Uzzi, 1997) and studies on the impact of number of partnerships on innovation outcomes (Shan et al., 1994; Kotabe & Swan, 1995) lead to the conclusion that technological cooperation with external organizations can enhance innovation outcomes and improve the competitive power of a company.

Many studies concerning external technological cooperation of domestic business ventures have found that technological cooperation can promote technological innovation in small and medium-sized venture enterprises, and result in higher technological innovation outcomes (Bae and Chung, 1997; Park and Lee, 2006; Kim, 2005). Meanwhile, other studies suggest that technological cooperation with research institutions does not have a significant influence on business ventures in knowledge-based industries. They state that cooperative activities with other businesses have no correlation with financial outcomes, and that there is the risk of exposure of technical information and data due to differences in capital or information asymmetry among businesses, bringing the danger of negative effects related to disadvantageous terms and conditions of business (Small & Medium Business Administration, 2010; Hong, 2005).

Most of the preceding research has been focused on analyzing whether cooperating with large enterprises or institutions will have positive or negative influences on technological development outcomes for small and mid-sized venture enterprises, or on determining the influence it may have on technological innovation outcomes. This study recognizes the need to empirically confirm what determinants influence a company's sales performance according to the level of external cooperation. In addition, this study aims to confirm the relationship with business performance separately according to the agent of external cooperation, which can generally be classified as cooperation with (1) research institutions such as government organizations, university institutions or private institutions, or (2) among firms including large enterprises, companies in the same industry, or others. As research institutions and businesses essentially have different purposes, the motive for cooperation may be different for each, and it can be assumed their level of influence may differ accordingly.

2.3 Competence Dimensions of Business Ventures

Hamel and Prahalad's core competence theory (2006), a concept further developed from resource-based theory, has become a key concept regarding corporate strategy, individual policy and governmental policy. According to Hamel and Prahalad (2006), core competence is the "internal competence of firms that not only differentiates a firm from other competing firms, but also acts as the source of a competitive advantage that takes effect as the core of business success. Furthermore, core competence is based on tangible and intangible assets and organizational abilities, and cannot be consumed and is improved through continuous learning and sharing processes." Also, the ability to create value, the ability to differentiate, expandability and scarcity are suggested as conditions for core competence, among others.

However, previous studies on the core competence of business ventures in Korea were limited to analyzing the influence of each competence on business performance, the influence of each competence on corporate strategy, case studies on the characteristics of core competence and others (Song et al. 2012; Song and Shin, 1998). Song and Shin's research (1998) classified the firm's ability that influences a business venture's performance according to the type of parent organization. It was difficult to generalize this case study, as a small number of samples was targeted for the analysis.

Therefore, this study attempts to classify the core competencies held by a business venture by organizing them according to their realm of competence from the perspective of core competence theory. Here, a firm's core competence is divided into six individual competencies (competitiveness): technology, price, quality, design, organization management and marketing. Through the dimensional reduction using factorial analysis on the six competencies, competence shall be classified

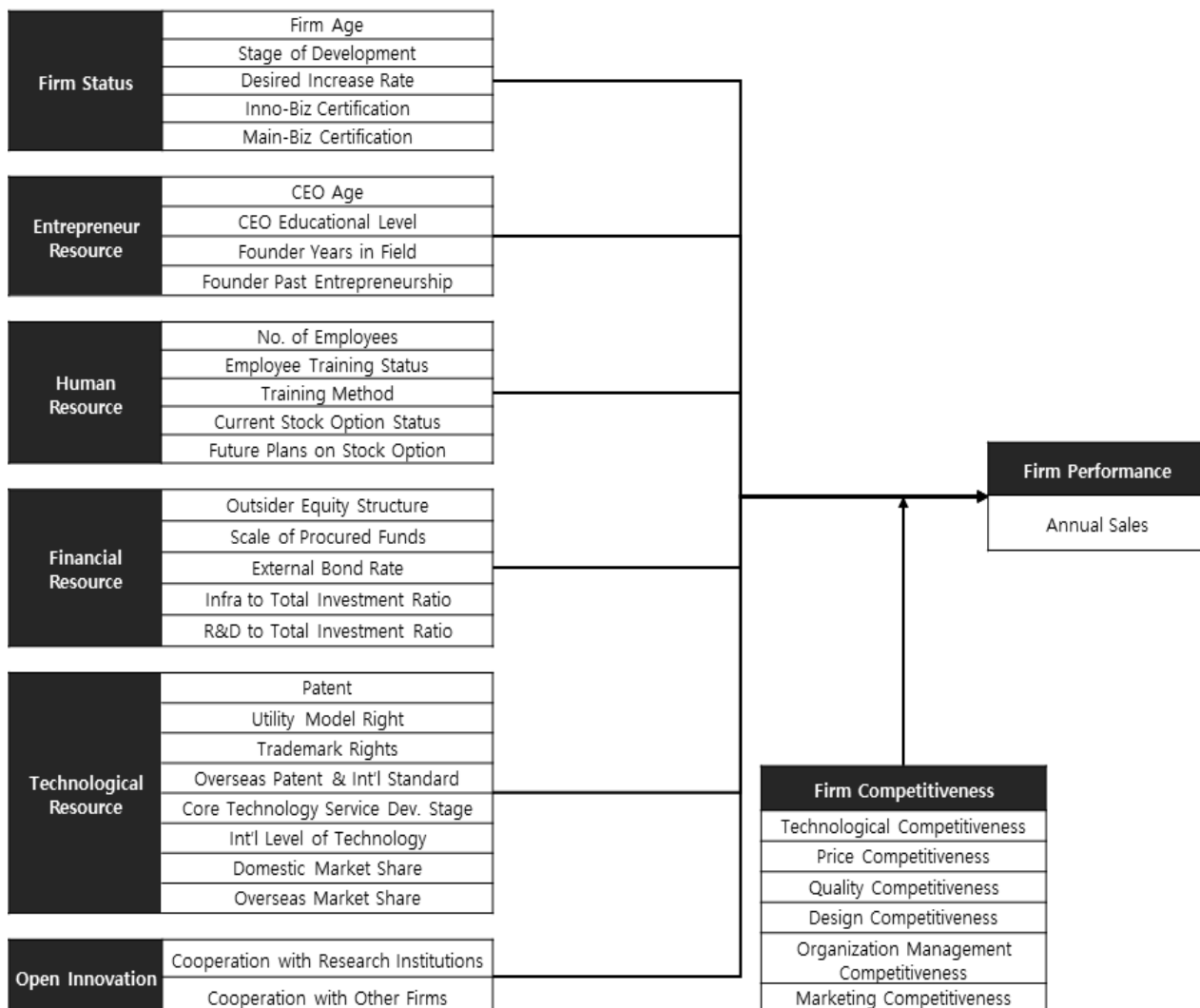
into two competence dimensions. The study aims to verify the difference among each business venture's performance influence factor according to each group after classifying each dimension according to the level of each dimension by forming a two-dimensional surface on X-Y.

2.4 Research Model

Based on earlier studies, the study suggests the following research model, in which annual sales,

an index of the financial performance of a firm, is set as a dependent variable. The determinants of business performance were classified into five categories from the perspective of resource-based theory to analyze their influence, and to verify whether the factors in the categories are subject to changes in their level of influence based on competence dimension categorization. Also, the study aims to check whether or not the relationship between these factors has a moderating effect, by considering the category of external cooperation of a firm.

Figure 1. Research model



The five categories of the factors include firm status, entrepreneur resource, human resource, financial resource, and technological resource; detailed factors are as follows. First, the detailed factors within firm status are: firm's age based on the date of incorporation, firm's stage of development, desired increase in rate of return calculated through appropriate rate of return compared with a firm's current rate of return, and Inno-Biz system and Main-Biz system certification. Second, CEO's age and education, founder's past experience in the field and past entrepreneurship experiences are included in entrepreneur resource. Third, quantitative factors including the number of temporary and permanent workers, and qualitative factors including employee attitude toward the method of training are classified as human resources. Fourth, investment of a firm, equity structure of CEO, founder, and outsiders not affiliated with the CEO or founder, scale of geared fund, ratio of external bonds that are not government or national bonds, and ratio of investment in infrastructure and R&D to total amount of investment are classified as financial resource. Fifth, technological competence includes the total number of intellectual properties owned by a firm, the amount of overseas patent and international standards, the stage of development of core technologies and services, and the firm's technology level and market share in the domestic and international market. Finally, regarding external cooperation, cooperation with university, government and national research institutes will be classified as "Cooperation with research institutions," while cooperation with business ventures, large enterprises, and foreign firms will be classified as "cooperation with other firms" with regard to the intensity of the cooperation.

Lastly, the six competencies will each be classified into two competence dimensions, including technology, price, quality, design,

organizational management and marketing. Figure 1 illustrates the factors discussed above.

3. Research Design

3.1 Sample and Data Collection

Two-year data of "The Survey of Korea Business Ventures" of 2014 and 2015 were used for the analysis of this study model. The survey, carried out under the Act on Special Measures for the Promotion of Venture Businesses, is based on research and analysis of basic statistics regarding the general status and business performance of 29,067 (in 2014) and 29,844 (in 2015) certified business ventures excluding preliminary business ventures as of December of 2013 and 2014, respectively. The survey was conducted for 2.5 months during the 3rd quarter of each year through a combination of various means including on-line surveys, phone, FAX, and e-mail, and total of 4,325 valid samples (2,098 in 2014 and 2,227 in 2015) were collected through systematic sampling based on type, size, and region of business.

Of the 4,325 samples collected from the two-year data, 348 firms listed on the exchange and KOSDAQ and 468 firms aiming to be listed in the near future were eliminated. This was in order to exclude samples with a substantial amount of capital, sales performance, profitability and financial soundness, as these would be likely to distort the performance of ventures and moderate the "high risk" element, in consideration of the core characteristics of business ventures, which are high risk and high return. After excluding listed firms and missing values, 3509 effective samples were formed for model analysis. The operational definitions of each value used to verify the model used in this study are as follows.

Table 1. Definitions and measurement of variables

Variables		Measurement	
Dependent Variable	Annual Sales	Original value as written on the Survey on Sales through R&D	
Competence Variable	Technological Competitiveness	5-point scale ranking the competitiveness of the firm compared to the top-level global firms in the same field	
	Price Competitiveness		
	Quality Competitiveness		
	Design Competitiveness		
	Organization Management Competitiveness		
	Marketing Competitiveness		
Independent Variable	Firm Status	Firm Age	Firm's age as of the time of the survey
		Stage of Development	Stages of growth: Launch, Growth, Shake-out, Maturity, Decline
		Desired Increase Rate	The difference between the current and desired profit ratio
		Inno-Biz Certification	Acquired Inno-Biz Certificate?
		Main-Biz Certification	Acquired Main-Biz Certificate?
	Entrepreneur Resources	CEO's Age	Age of the CEO as of the time of the survey
		CEO's Education Level	The education level of the CEO, from middle school to doctorate
		Founder's Years in Field	Founder's years in field of business at the time of foundation
		Founder's Past Entrepreneurship	Founder's previous experiences in company foundation
	Human Resources	No. of Employees	Total number of employees, including irregular and temporary
		Training Status	5-point scale on training (Very inactive – Very active)
		Training Method	4 types of training methods (Self, Commissioned, Both, None)
		Current Stock Option Status	Current utilization of stock options
		Future Plans regarding Stock Options	Future plan on stock option utilization
	Financial Resources	Outsider Equity Structure	Percentage of equity held by outsiders, who are not founders, CEO or acquaintances
		Scale of Procured Funds	Scale of newly geared fund (million KRW)
		External Bond Rate	Percentage of external funding excluding government subsidy
		Infra to Total Investment Ratio	Percentage of infrastructure investment to total investment
		R&D to Total Investment Ratio	Percentage of domestic R&D investment to total investment
	Technological Resources	Patent	Number of patents registered and held by the firm
		Utility Model Right	Number of utility model rights registered and held by the firm
		Trademark Rights	Number of trademark rights registered and held by the firm
		Overseas Patent & Int'l Standard	Number of overseas patents and international standards registered and held by the firm
		Core Technology Service Dev. Stage	Stage of development of core products and services (Early development, Commercialization, Early market entry, Market expansion)
		Int'l Level of Technology	The technological level of core products and services, compared with the international level
		Domestic Market Share	Domestic market share of the corresponding year
		Overseas Market Share	Overseas market share of the corresponding year
		External Cooperation	Universities
	Government and National Institutions		5-point scale on cooperative activities with government and national institutions
	Private Companies		5-point scale on cooperative activities with private companies
	Small and Mid-sized Ventures		5-point scale on cooperative activities with small and mid-sized ventures
	Large Enterprises		5-point scale on cooperative activities with large enterprises
	Foreign Firms		5-point scale on cooperative activities with foreign firms

Table 2. Two dimensions of competence

KMO Value of Sample Relevance			0.830
Bartlett's Sphericity Test	Approx. Chi2		7858.642
	Degree of Freedom		15
	Significant Probability		0.000
Competence Dimension	Indices	Component 1	Component 2
Technology	Technology Competitiveness	0.857	0.170
	Price Competitiveness	0.813	0.254
	Quality Competitiveness	0.675	0.273
Management	Design Competitiveness	0.189	0.876
	Organization Management Competitiveness	0.270	0.836
	Marketing Competitiveness	0.537	0.563
Eigenvalue		2.248	1.951
Variance Explanation (%)		37.461	32.518
Accumulated Explanation (%)		37.461	69.979
Cronbach's Alpha		0.765	0.781

3.2 Classification of Business Ventures' Competencies

3.2.1 Competence Reliability and Factor Analysis

Factor analysis on the level of competitiveness, which is used as a competence variable in the study, was conducted to observe the determinants of business venture sales according to each competence dimension. Factor analysis is a statistical methodology which extracts a small number of potential variables from numerous observable variables, and the study aimed to extract potential competence dimensions from the 6 competitiveness variables of technology, price, quality, design, organization management, and marketing.

The results of factor analysis showed that the Kaiser-Meyer-Olkin (KMO) value, an index which explains the appropriateness of the entire correlation matrix on factor analysis, was 0.83, which falls between 0.8 or more and 0.9 or less, and is meritorious under Kaiser's definition. Bartlett's Sphericity Test also rejects the null hypothesis that the coefficient

of variables is 0 with a 99% confidence interval, providing further evidence for the appropriateness of the sample in factor analysis.

Then, it was determined that two components, which was just before the decrease in the eigenvalue, would be selected to be used as the number of factors through Verimax rotation, and it was discovered that two components provided almost 70% of the explanatory power of all variables. Cronbach's Alpha, which indicates the consistency and homogeneity of the variables, was measured as 0.765 and 0.781, respectively, providing an acceptable level of reliability.

3.2.2 Classification of Competitiveness and Competencies

Based on prescribed factor analysis, the 6 competitiveness factors were categorized into two competence dimensions, with technology, price, and quality competitiveness in the technological competence category, and design, organization management, and marketing competitiveness in the management competence category.

Table 3. Difference between the characteristics of technology-driven firms and management-driven firms

Characteristics	Management-driven Mean / SD	Technology-driven Mean / SD	F-Value	p-Value
Dependent_Annual Sales	7402.68	6571.74	2.35	0.13
	16593.97	14653.02		
Firm_Firm Age	10.14	10.11	0.02	0.89
	6.42	6.53		
Firm_Stage of Development	2.78	2.73	2.55	0.11
	0.89	0.89		
Other_Desired Increase Rate	7.77	7.52	1.74	0.19
	5.62	5.57		
Firm_Inno-Biz Certification	0.37	0.36	0.35	0.56
	0.48	0.48		
Firm_Main-Biz Certification	0.06	0.07	0.38	0.54
	0.24	0.25		
CEO_Gender_Male	0.94	0.94	0.01	0.93
	0.24	0.24		
CEO_Age	49.75	50.29	4.02	0.05
	7.64	8.06		
CEO_Education Level	3.03	3.09	2.65	0.10
	1.05	1.14		
CEO_Engineering Major	0.58	0.56	1.35	0.25
	0.49	0.50		
Founder_CEO	0.90	0.89	2.55	0.11
	0.29	0.32		
Founder_Gender_Male	0.95	0.96	2.24	0.13
	0.23	0.20		
Founder_Age Group	37.20	37.53	1.58	0.21
	7.79	7.74		
Founder_Education Level	2.93	3.00	2.64	0.10
	1.05	1.16		
Founder_Engineering Major	0.57	0.56	0.31	0.58
	0.49	0.50		
Founder_Years in Field	10.81	11.14	1.94	0.16
	6.84	7.06		
Founder_Past Entrepreneurship	0.12	0.18	28.99	0.00
	0.32	0.39		
Founder_Successful Past Entrepreneurship	0.12	0.16	6.82	0.01
	0.40	0.42		
Founder_Failed Past Entrepreneurship	0.04	0.09	24.03	0.00
	0.28	0.33		

Founder_Sum of Past Entrepreneurships	0.16	0.25	20.81	0.00
	0.53	0.60		
HR_Corresponding Year_ Regular Employee	26.26	23.29	4.13	0.04
	46.82	35.82		
HR_Corresponding Year_ Total No. of Workers	27.41	24.25	4.13	0.04
	49.50	38.98		
HR_Training	3.26	3.27	0.02	0.89
	0.64	0.64		
HR_Training Method	2.20	2.18	0.14	0.71
	1.03	0.99		
HR_Stock Option_Current and Future	0.04	0.08	43.74	0.00
	0.16	0.22		
HR_Stock Option_Current	0.02	0.03	5.84	0.02
	0.12	0.16		
HR_Stock Option_Future	0.07	0.14	51.98	0.00
	0.25	0.35		
Fund_Equity Structure_Acquaintance	79.90	80.70	0.96	0.33
	23.93	23.46		
Fund_Equity Structure_External	20.10	19.30	0.96	0.33
	23.93	23.46		
Fund_Policy Support_Yes	0.36	0.44	24.96	0.00
	0.48	0.50		
Fund_Procured Fund	299.72	347.76	1.50	0.22
	1031.28	1290.85		
Fund_Gearing Ratio_Government	32.46	38.85	16.56	0.00
	45.50	46.38		
Fund_Gearing Ratio_External Bond	28.36	32.56	7.76	0.01
	43.70	44.40		
Fund_Total Amount Invested	254.79	289.47	1.75	0.19
	782.80	738.54		
Fund_Total Amount Invested_ Infrastructure Ratio	11.45	15.88	18.62	0.00
	28.48	31.96		
Fund_Total Amount Invested_R&D Ratio	41.78	46.74	9.68	0.00
	47.02	45.93		
Technology_Technology Relevance_ Industry	4.17	4.30	2.08	0.15
	2.69	2.63		
Technology_Patent	3.52	4.29	11.38	0.00
	6.08	7.30		
Technology_Utility Model Rights	0.65	0.78	1.81	0.18
	2.83	2.90		
Technology_Design Rights	0.88	1.21	4.14	0.04
	3.55	5.93		

Technology_Trademark Rights	0.99	1.11	0.82	0.36
	4.08	3.18		
Technology_Overseas Industrial Property	0.28	0.37	1.41	0.23
	2.18	2.50		
Technology_IP_Total	6.33	7.76	10.69	0.00
	11.48	14.44		
Technology_Overseas Patent and International Standards	0.42	0.47	8.29	0.00
	0.49	0.50		
Technology_Core Technology Service_Development Stage	4.25	4.35	7.57	0.01
	1.04	0.89		
Technology_Product and Service_Structure	1.97	2.07	20.11	0.00
	0.68	0.68		
Technology_Technology Level_Global	3.31	3.12	37.41	0.00
	0.87	0.95		
Technology_Technology Level_Domestic	2.70	2.45	65.68	0.00
	0.87	0.91		
Technology_Number of Brands	0.81	0.97	4.48	0.03
	2.44	1.79		
Technology_Domestic Market Share	13.14	13.89	1.18	0.28
	19.88	20.13		
Technology_Foreign Market Share	1.50	1.24	1.10	0.30
	7.98	6.32		
Technology_Raw Material or Component Import	0.23	0.31	34.12	0.00
	0.42	0.46		
Cooperation_University	1.22	1.48	17.24	0.00
	1.84	1.94		
Cooperation_Government	0.63	0.86	19.13	0.00
	1.49	1.71		
Cooperation_Private Company	0.18	0.19	0.12	0.72
	0.83	0.86		
Cooperation_Small and Mid-sized Venture	0.28	0.43	13.85	0.00
	1.04	1.24		
Cooperation_Large Enterprise	0.23	0.37	15.16	0.00
	0.93	1.17		
Cooperation_Foreign Firm	0.10	0.14	3.22	0.07
	0.63	0.75		
Cooperation with Research Institution	0.68	0.85	24.21	0.00
	0.99	1.06		
Cooperation with Other Firms	0.20	0.31	22.45	0.00
	0.62	0.73		

The analysis on the difference in the characteristics of technology-driven and management-driven firms found that 31 out of 60 variables had statistical significance. Specifically, management-driven firms showed a higher mean value than technology-driven firms in the following four variables:

‘HR_Corresponding Year-Regular Employee’; ‘HR_Corresponding Year_Total No. of Workers’; ‘Technology_Technology Level_Global’: and ‘Technology_Technology Level_Domestic.’ In contrast, technology-driven firms showed a higher mean value than management-driven firms in the following 27 variables: ‘CEO_Age’; ‘Founder_Past Entrepreneurship’; ‘Founder_Successful Past Entrepreneurship’; ‘Founder_Failed Past Entrepreneurship’; ‘Founder_Sum of Past Entrepreneurships’; ‘HR_Stock Option_Current and Future’; ‘HR_Stock Option_Current and Future’; ‘HR_Stock Option_Future’; ‘Fund_Policy Support’; ‘Fund_Gearing Ratio_Government’; ‘Fund_Gearing Ratio_External Bond’; ‘Fund_Total Amount

Invested_Infrastructure Ratio’; ‘Fund_Total Amount Invested_R&D Ratio’; ‘Technology_Patent’; ‘Technology_Design Rights’; ‘Technology_IP_Total’; ‘Technology_Overseas Patent and International Standards’; ‘Technology_Core Technology Service_Development Stage’; ‘Technology_Product and Service_Structure’; ‘Technology_Number of Brands’; and ‘Technology_Raw Material or Component Import.’

4. Results

4.1 Determinants of Business Venture's Annual Sales for All Firms

The research was conducted across 3,509 business ventures based on the two-year data of 2014 and 2015, using moderated regression analysis. The results are as shown in Table 4.

Table 4. Determinants of annual Sales of business ventures

n=3509					Collinearity Statistics	
Dependent Variable: Annual Sales		Standardized Beta	t	p	Common difference	VIF
(constant)		-	1.471	.141	-	-
Firm Status	Firm Age	.103	5.662	.000	.487	2.052
	Stage of Development	.006	.379	.705	.583	1.715
	Desired Increase Rate	.001	.081	.935	.971	1.030
	Inno-Biz Certification	.007	.467	.640	.682	1.467
	Main-Biz Certification	.030	2.277	.023	.934	1.071
Entrepreneur Resources	CEO's Age	-.008	-.520	.603	.610	1.638
	CEO's Education Level	-.019	-1.436	.151	.909	1.100
	Founder's Years in Field	.032	2.153	.031	.743	1.346
	Founder's Past entrepreneurship	-.012	-.913	.361	.939	1.065
Human Resources	Number of Employees	.605	41.963	0.000	.780	1.282
	Training	-.018	-1.332	.183	.910	1.098
	Training Method	-.003	-.209	.834	.941	1.063
	Current Stock Option Status	-.014	-1.016	.310	.838	1.193
	Future Plans regarding Stock Options	-.003	-.226	.821	.769	1.301

Financial Resources	Outsider Equity Structure	-.009	-.680	.496	.958	1.044
	Scale of Geared funds	-.011	-.807	.419	.888	1.127
	External Bond Ratio	.026	1.797	.072	.790	1.266
	% Infrastructure to Total Investment	.010	.698	.485	.811	1.232
	% R&D to Total Investment	-.022	-1.486	.137	.719	1.390
Technological Resources	Patent	.021	1.473	.141	.778	1.285
	Utility Model Right	-.012	-.908	.364	.886	1.129
	Trademark Rights	.012	.906	.365	.905	1.104
	Overseas Patent & International Standard	-.004	-.260	.795	.854	1.170
	Core Technology Service Development Stage	-.007	-.545	.586	.891	1.123
	Technology Level in Global Market	-.028	-2.059	.040	.886	1.128
	Domestic Market Share	.000	.024	.981	.900	1.112
	Overseas Market Share	.008	.584	.559	.934	1.070
External Cooperation	Cooperation with Research Institutions	-.010	-.706	.480	.788	1.269
	Cooperation with Other Firms	-.021	-1.525	.127	.839	1.192
		Adjusted R2	Change in R2	Change in F	p-Value	
		0.431	0.436	92.681	0.000	

The analysis of 3,509 business ventures revealed that 6 independent variables out of 6 competencies, 27 independent variables and 2 constant variables had a significant influence on the firm's annual sales.

First, of the 5 variables listed under 'Firm Status', CEO's age and Main-Biz Certification were confirmed to exert a significant influence over annual sales, at a 95% confidence interval. In such cases, the positive influence of both factors was contingent on firms' age, which was represented by their date of establishment and the acquisition of Main-biz certification. Second, it was observed that of the 4 variables listed under 'Entrepreneur Resources', the founder's years in the field prior to foundation influenced the company's annual sales up to a 95% confidence interval. In other

words, the more experience in the field of business the founder has prior to setting up a company, the more positive influence it has on the firm's annual sales. Third, of the 5 variables listed under 'Human Resources', the number of employees was found to have a significant influence over annual sales, at a 99% confidence interval. In such cases, the total employee number—which includes both temporary and full-time employees—was proven to exert a positive influence over annual sales. In particular, a high standardized β value points to the influence of human resources, which play an important role against a business backdrop characterized by either an individual or a small group of employees. On the other hand, considering that the employee number reflects the size of the company, it is possible to speculate that company

size causes deviations in annual sales performances. Fourth, of the 5 variables listed under 'Financial Resources', the ratio of external bonds was observed to exert a significant influence over annual sales, at a 90% confidence interval. Depending on the rate of positivity afforded by external bonds, deviations in a firm's annual sales can be attributed to differing sources of capital. Lastly, of the 8 variables listed under 'Technological Resources', the level of technology on a global scale was seen to have a significant influence over a firm's annual sales, at a 95% confidence interval. The lower a firm's technology skill compared to international competitors, the more of a negative influence it had on annual sales.

4.2 Determinants of Business Ventures' Sales:

Technology-driven vs. Management-driven

A separate regression analysis was conducted for the variables identified in the aforementioned factor analysis to illustrate the differences in sales that result from disparities in corporate ability. Based on competence level, 1,462 firms were classified as technology-driven, while 2,047 were classified as management-driven. The results of the analyses are as shown in Table 5.

The analysis of 1,462 technology-driven firms showed that 7 independent variables among the 27 independent variables and 2 control variables had a significant influence over a firm's annual sales.

The variables listed under the first two categories—'Firm Status' and 'Entrepreneur Resources'—were shown to have no significant influence over sales.

In contrast, of the 5 variables listed under 'Human Resources', the number of employees and training method were each found to have a significant influence over the firm's annual

sales, at a 99% and 90% confidence interval, respectively. In this case, the number of employees, in tandem with the overall firm model, was observed to exert a positive influence over annual sales and exhibit a high standardized β value. Conversely, training methods were revealed to have a negative influence over a firm's sales.

Of the 5 variables listed under 'Human Resources', the external bond ratio and percentage of R&D investment to total investment were each observed to have a significant influence over firm's annual sales, at a 90% and 95% confidence interval, respectively. The external bond ratio was shown to have a positive influence over annual sales, just like the overall model. In contrast, the percentage of R&D investment to total investment, which reflects the rate at which investment is allocated toward R&D, was seen to exert a negative influence over a firm's annual sales. This outcome is attributable to the fact that funds channeled towards developing a product are used up as expenses during the development process, failing to generate any form of actual annual sales.

Lastly, of the 8 variables listed under 'Technological Resources', the number of patents and the level of technology in the global market were each observed to have a significant influence over a firm's annual sales, at a 99% and 95% confidence interval, respectively. The more patents a firm possessed, the greater the positive influence it had on annual sales. However, the lower the firm's technology level was in the global market, the more of a negative influence it had on a firm's annual sales, just like the overall model.

The analysis of 2,047 management-driven firms was conducted in the same manner as the analysis for technology-driven firms, and the results are outlined in Table 6.

Table 5. Determinants of annual Sales of technology-driven business ventures

n=1462					Collinearity Statistics	
Dependent Variable: Annual Sales		Standardized Beta	t	p	Common difference	VIF
(Constant)		-	1.615	0.107	-	-
Firm Status	Firm Age	.031	1.132	.258	.471	2.123
	Stage of Development	.014	.583	.560	.573	1.746
	Desired Increase Rate	-.007	-.359	.720	.945	1.058
	Inno-Biz Certification	-.003	-.151	.880	.662	1.511
	Main-Biz Certification	.006	.300	.764	.922	1.085
Entrepreneur Resources	CEO's Age	-.020	-.835	.404	.617	1.620
	CEO's Education Level	.001	.074	.941	.890	1.124
	Founder's Years in Field	.028	1.309	.191	.754	1.327
	Founder's Past entrepreneurship	-.006	-.326	.744	.918	1.089
Human Resources	Number of Employees	.681	32.280	.000	.783	1.277
	Training	-.018	-.944	.345	.930	1.075
	Training Method	-.034	-1.748	.081	.949	1.054
	Current Stock Option Status	-.004	-.201	.840	.826	1.211
	Future Plans regarding Stock Options	-.008	-.365	.715	.733	1.364
Financial Resources	Outsider Equity Structure	.004	.198	.843	.935	1.069
	Scale of Geared funds	-.010	-.492	.623	.909	1.100
	External Bond Ratio	.037	1.785	.074	.816	1.226
	% Infrastructure to Total Investment	-.029	-1.356	.175	.787	1.270
	% R&D to Total Investment	-.054	-2.469	.014	.718	1.393
Technological Resources	Patent	.060	2.692	.007	.695	1.439
	Utility Model Right	-.018	-.835	.404	.761	1.314
	Trademark Rights	.006	.328	.743	.892	1.121
	Overseas Patent & International Standard	-.004	-.218	.828	.860	1.162
	Core Technology Service Development Stage	.006	.282	.778	.859	1.164
	Technology Level in Global Market	-.044	-2.225	.026	.877	1.140
	Domestic Market Share	-.018	-.934	.350	.908	1.101
	Overseas Market Share	.028	1.471	.142	.938	1.066
External Cooperation	Cooperation with Research Institutions	.003	.139	.890	.789	1.267
	Cooperation with Other Firms	-.035	-1.724	.085	.859	1.164

Table 6. Determinants of annual sales of management-driven business ventures

n=2047					Collinearity Statistics	
Dependent Variable: Annual Sales		Standardized Beta	t	p	Common difference	VIF
(constant)		-	.756	.450	-	-
Firm Status	Firm Age	.143	5.883	.000	.491	2.036
	Stage of Development	.000	.004	.997	.582	1.720
	Desired Increase Rate	.001	.087	.931	.975	1.026
	Inno-Biz Certification	.012	.557	.578	.675	1.482
	Main-Biz Certification	.048	2.710	.007	.926	1.080
Entrepreneur Resources	CEO's Age	.002	.088	.930	.591	1.691
	CEO's Education Level	-.035	-1.951	.051	.907	1.103
	Founder's Years in Field	.031	1.536	.125	.718	1.393
	Founder's Past entrepreneurship	-.014	-.819	.413	.947	1.056
Human Resources	Number of Employees	.569	29.175	.000	.761	1.315
	Training	-.022	-1.207	.228	.873	1.146
	Training Method	.017	.978	.328	.916	1.092
	Current Stock Option Status	-.021	-1.133	.257	.837	1.194
	Future Plans regarding Stock Options	-.001	-.054	.957	.797	1.254
Financial Resources	Outsider Equity Structure	-.015	-.867	.386	.950	1.053
	Scale of Geared funds	-.011	-.606	.544	.853	1.172
	External Bond Ratio	.014	.706	.480	.759	1.317
	% Infrastructure to Total Investment	.034	1.818	.069	.815	1.227
	% R&D to Total Investment	-.002	-.083	.933	.711	1.406
Technological Resources	Patent	-.007	-.347	.729	.787	1.270
	Utility Model Right	-.016	-.916	.360	.929	1.077
	Trademark Rights	.022	1.232	.218	.887	1.127
	Overseas Patent & International Standard	-.006	-.337	.736	.831	1.204
	Core Technology Service Development Stage	-.015	-.842	.400	.895	1.118
	Technology Level in Global Market	-.018	-.973	.331	.880	1.136
	Domestic Market Share	.011	.632	.528	.875	1.143
	Overseas Market Share	-.004	-.241	.810	.909	1.100
External Cooperation	Cooperation with Research Institutions	-.017	-.872	.384	.773	1.293
	Cooperation with Other Firms	-.011	-.594	.553	.810	1.234

According to the results, of the 6 competencies, 27 independent variables and 2 constant variables, 5 independent variables were observed to exert a significant influence over a firm's annual sales.

First, of the 5 variables listed under 'Firm Status', firm's age and Main-biz certification were each shown to have a significant influence on a firm's annual sales, at a 99% confidence interval. In alignment with the overall model, both variables were observed to have a positive influence over a firm's annual sales.

Second, of the 4 variables listed under 'Entrepreneur Resources', the CEO's academic level was observed to have a significant influence over a firm's annual sales, at a 90% confidence interval. Contrary to expectations, a firm's annual sales enjoyed a higher rate of increase when the CEO's academic level was low.

Third, of the 5 variables listed under 'Human Resources', the number of employees was observed to have a significant influence over a firm's annual sales, at a 99% confidence interval. Here, the number of employees had a positive influence over a firm's annual sales, just like in the overall model, and exhibited a high standardized β value.

Fourth, of the 5 variables listed under 'Financial Resources', the total fund infrastructure rate showed a significant influence over a firm's annual sales, at a 90% confidence interval. An increase in the amount of funds allocated towards infrastructure was reflected by an increase in firm's annual sales. Lastly, the 8 variables included under 'Technological Resources' were observed to lack any significant influence over a firm's annual sales.

5. Conclusion

This study focused on investigating the influence that 6 factors—corporate status, entrepreneur resources, human resources, financial resources, technological resources, and external resources—

have on firm performance, from the perspective of resource-based theory. Furthermore, this study divided a firm's competence into two areas, technology and management, so that the varying effects of technology, price, quality, design, organization management and marketing could be discerned more clearly. Moreover, this study categorized cooperation with external organizations into two types—cooperation with research institutes and with other firms—to obtain proof that both variables are correlated with a firm's performance.

To achieve the study's purpose, a close analysis of 3,509 firms using two-year data of 2014 and 2015 was conducted. Selection of factors deemed to have influence over firm performance was grounded in resource-based theory. The 5 identified factors were: firm status, entrepreneur resources, human resources, financial resources, and technological resources. Additionally, firms were classified as technology-driven or management-driven based on the level of technological advancement, price, quality, design, organization management and marketing—the 6 components that comprise a firm's competence. As an extension of this analysis, the 6 competencies were observed to assess whether their influence changed according to the firm's type. The highlights of this study are outlined below.

First, it was confirmed that out of the 29 variables used in the research model, 6 variables exerted a significant influence over a firm's annual sales. Second, upon analyzing the differences of variables for firms classified as technology-driven vs. management-driven, it was found that 7 and 5 variables out of 29, respectively, had a significant influence over a firm's annual sales.

The study has the following implications for theory and policy making. First, theory-wise, the study focused on comprehending the idiosyncratic effects various variables have on a firm's R&D performance. Whereas previous studies have been limited to

analyzing just a few variables due to a lack of data, this study encompasses a full range of variables that stem from a survey conducted by a government organization and data accumulated over the course of 2 years.

Second, the study attempted to verify the success factors of R&D of business ventures by categorizing 6 competencies into two dimensions based on core competence theory, and classifying business ventures as technology-driven or management-driven accordingly. The origin of business ventures can be largely classified into 1) founder with a core technology, and 2) founder with a differentiated idea and a discerning eye for the market. As business ventures tend to reflect the characteristics of their founders, the authors presumed that the business ventures could also be classified into technology-driven and management-driven firms. The results of the analysis suggest that business ventures actually do seem to inherit the personal characteristics of their founders, and that there is a big difference between the performance determinants of technology-driven and management-driven firms.

The political implications of the study are as follows. First, in forming policy on technical development, ventures should understand which factors increase sales in accordance with the characteristics of the firm (technology-driven vs. management-driven). Also, each firm should decide whether it should self-develop or opt for external cooperation, and which partner it should cooperate with, considering the characteristics of target technology, firm's competencies, and level of R&D activity.

Second, national institutions with business venture support programmes should establish adaptive guidelines with different evaluation criteria in accordance with the task and purpose of support, rather than evaluating all firms with identical standards, in order to effectively execute the budget. Also, the government should establish customized support measures for firms subject to Open

Innovation-related policies to enhance policy effectiveness.

While the study was carried out carefully, it unavoidably has certain limitations. First, the six variables of firm competence were collected based on surveys of firms, rather than accurate data. Therefore, cautious data design and interpretation are required considering that subjective ideas may have been included in the survey. Second, the study lacks analysis by each industry, and reflection of results over time. Third, using various analytic methods on mass data can act as a strength and weakness of the study at the same time. Due to its exploratory characteristics, diverse variables were taken into account in analysis, resulting in a lack of selection and concentration. The variables found to be significant in the study should be selected for a more concentrated analysis in the future. Also, while the study was based on data collected by the government, a more appropriate dataset acquired through adequate investment will enable a more in-depth analysis. Fifth, the variables shown to have a significant influence, including the age and education level of the CEO, are in fact among those that are the most difficult to utilize in policy-making. However, these variables seem to be widely utilizable indirectly. For example, the fact that business ventures managed by younger and less-educated CEOs show better performance can be seen not as a causal relationship, but as a sign of desperation, which can be indirectly considered in policy-making in terms of motivation. Lastly, a few variables, including financial support and overseas patents, showed results that were contrary to original expectations. A moderating effect showing a direction opposite to what was originally expected should be interpreted as a decrease in the effect of the corresponding variable through external support, rather than seeing it as a negative effect. Additional research is required for a more precise analysis.

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