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Government Policy Support and the Performance of Technology-Based Start-Ups: Evidence from South Korea

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Abstract:
This article examines the impact of policy support such as education and consulting, facilities and space, commercialization, R&D, and policy funds on the financial and non-financial performance of technology-based start-ups. The article attempted an empirical analysis through a questionnaire to present implications and suggestions to improve the effectiveness of technology start-up support policies. The surveyed companies were limited to those founded within the previous seven years and belonging to the manufacturing and knowledge service industries that correspond to the technology start-up companies defined by the Ministry of SMEs and Start-ups in South Korea. Policy support has a multidimensional effect on start-up performance, but education and consulting have no significant impact. Facility and space support have an insignificant effect on start-up performance, with a positive effect on non-financial performance overall but a negative effect on early companies. Commercialization support positively impacts non-financial performance but negatively impacts organizational performance. Government R&D support positively impacts overall financial performance, and non-financial performance is positive for early companies. Policy funding has a positive effect on non-financial performance overall, and financial performance is positive for early companies. Limited facility and space support moderates the growth stage. Support for facilities promotes non-financial performance, but support for early companies negatively impacts performance. This study analyzed the effect of policy support on financial and non-financial performance of technology start-up companies. The study implies the necessity to establish and implement differentiated strategies for each technology start-up support policy tool. This study comprehensively reviews the impact of policy support such as education and consulting, facilities and space, commercialization, R&D, and policy funds on the financial and non-financial performance of technology-based start-ups, thus overcoming the limitations of previous studies. This comprehensive analysis is expected to have important implications for presenting the policy direction for the government to support entrepreneurship.

Keywords: technology-based start-ups, government policy support, R&D, firm performance, technological

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innovation, entrepreneurship.

政府政策支持与科技型初创企业的表现：来自韩国的证据

摘要：
本文考察了教育和咨询、设施和空间、商业化、研发和政策资金等政策支持对科技型初创企业财务和非财务绩效的影响。本文尝试通过问卷调查的方式进行实证分析，提出提高科技创业扶持政策有效性的启示和建议。被调查企业仅限于前七年成立，属于制造业和知识服务行业，对应韩国中小企业和初创企业部定义的技术初创企业。政策支持对创业绩效具有多维影响，但教育和咨询没有显着影响。设施和空间支持对初创企业绩效影响不大，对整体非财务绩效有积极影响，但对早期公司有负面影响。商业化支持对非财务绩效产生积极影响，但对组织绩效产生负面影响。政府研发支持对整体财务业绩产生积极影响，非财务业绩对早期公司有利。政策性资金对整体非财务业绩有积极影响，财务业绩对早期公司有利。有限的设施和空间支持缓和了成长阶段。对设施的支持可促进非财务绩效，但对早期公司的支持会对绩效产生负面影响。本研究分析了政策支持对科技初创公司财务和非财务绩效的影响。该研究表明有必要为每种技术创业来支持政策工具制定和实施差异化战略。本研究全面回顾了教育和咨询、设施和空间、商业化、研发和政策资金等政策支持对科技型初创企业财务和非财务绩效的影响，从而克服了以往研究的局限性。这一综合分析有望对政府支持创业的政策方向产生重要影响。

关键词：技术型初创企业、政府政策支持、研发、企业绩效、技术创新、创业精神。

1. Introduction

Korea's economic growth rate is decreasing every year, and the decline in the potential growth rate is expected to be the fastest among OECD countries (OECD, 2014). In a situation where the low growth trend is expected to be solid, start-ups are attracting more attention as a source that can create new wealth and employment. The increase in start-up companies affects the competitive structure of existing industries, creates new business models, and leads to the diversification of products and services and a price decline. Since the activation of start-ups leads to direct and indirect employment effects, it is an effective alternative to overcome the era of 'growth without employment'.

Among the various types of start-ups, technology ones can be defined as technology-intensive, innovative, and opportunity-seeking start-ups. They are confirmed to have greater economic ripple and employment effects than the contrasting concept of livelihood start-ups. According to the Small and Medium Business Administration (2015), the average number of Korean tech-startup companies was 4.6, which were 2.0 for wholesale and retail businesses and accommodation. This is higher than the 2.7 people in the restaurant business. In addition, the average sales amount was 80 billion won, which is higher than the wholesale and retail business of 560 million won and the lodging and restaurant business of 190 million won.

Until now, Korea has devised various support policies by paying attention to the status and role of technology start-up companies. In 1966, the 'Basic Act on Small and Medium Enterprises' was enacted, followed by the 'Small and Medium Business Startup Support Act', an independent law for startup support, in 1986. In 1997, the world's first special corporation that only deals with venture business support, the 'Act on Special Measures on the Promotion of Venture Businesses', was enacted, expressing its policy commitment to revitalizing technology-based start-ups. In addition, the Park Geun-hye administration, which was launched in 2013, presented the creative economy as the first state policy, in which the creation of new markets and the reinforcement of existing industries were emphasized as the main goals. In line with this trend, the budget for start-up support projects of central ministries and local governments as of 2016 is estimated to reach 24,153.8 billion won (Ahn et al., 2016).

The proportion of government research and development (R&D) investment in small and medium enterprises increased from 12.4% in 2011 to 14.8% in 2015, with an annual average growth rate of 10.9%, exceeding total R&D investment by 6.2% (The Ministry of Science, ICT, and Future Planning, Korea Institute of Science and Technology Planning and Evaluation, 2016). In line with the government actively investing, many technology start-up companies are also participating in R&D projects, constantly stimulating public opinion over the lack of effectiveness.

However, prior studies are somewhat limited in their ability to analyze the practical effects of various policy supports on the performance of technology-based start-ups. Several empirical analysis studies related to technology start-ups either overlooked policy support in considering factors influencing performance or used

only proxy variables that correspond to part of the policy (Kim, 2015; Park, 2014; Li & Atuahene-Gima, 2002; Doutriaux, 1991). Moreover, when measuring the performance of technology start-up companies, there was a limit to comprehensive performance measurement using one of the subjective or objective indicators (Kwon & Jung, 2012; Kazanjian & Rao, 1999; Park, 2010; Doutriaux, 1991). Therefore, this study comprehensively reviews the impact of policy support such as education and consulting, facilities and space, commercialization, R&D, and policy funds on the financial and non-financial performance of technology-based start-ups, thus overcoming the limitations of previous studies. This comprehensive analysis is expected to have important implications for presenting the policy direction for the government to support entrepreneurship.

2. Literature Review and Hypotheses

2.1. Technology-Based Start-Ups

Start-up is the first step in the life cycle of a company, and it means that an individual or corporate entrepreneur initiates business activities for profit. Start-up is the creation of a business with sufficient growth potential, and in some cases, it can encompass the process from the actual start-up stage to the stage of independent self-sustainability (Low & MacMillan, 1988). However, in essence, the meaning of a start-up is largely a creative action that creates something of value out of a state of virtually nothing (Timmons et al., 1985).

This study particularly focused on technology-based start-ups; therefore, an understanding of their discriminatory properties must be premised. In general, this type of start-up refers to a technology-intensive start-up that creates a new market based on innovative technology and entrepreneurship (Korea Business Incubation Association, 2015). As entrepreneurship affects the way a company develops its ideas and develops a business plan, and has a significant impact on its performance (Bosco, et al., 2019; Camisón-Haba, et al., 2019; Flamini, et al., 2021; Pakura, 2020), innovative entrepreneurs create new technologies, innovate products and processes, and open new markets (Audretsch, 2002). Prior studies have shown that a technology start-up is a company with a high proportion of scientists, professional engineers, and technicians in terms of above-average R&D investment and manpower composition (Butchart, 1987), establishment of new technology ventures (Jones-Evans, 1995), or biotechnology, medical science, IT, computer, software, and service industries that have been active for less than six years (Maula, 2001).

In this study, the definition of the "Small Business Start-up Support Act" was used from a practical point of view to analyze the effect of the government's current policy support on the performance of technology-based start-ups. In other words, a technology start-up company is a corporation or individual that has not passed the seven-year mark from the start of business corresponding to the manufacturing industry and knowledge service industry, and technology start-up refers to the starting up of such a company.

2.2. Start-Up Performance

Since corporate performance can be defined in various dimensions, such as objective and subjective performance and financial and non-financial performance, it is desirable to use a variety of indicators rather than a single indicator to measure corporate performance (Romanelli, 1989; Stearns et al., 1995; Phillips, 1996; Helms et al., 1997).

Stuart and Abetti (1987) described the existing technology. Four dimensions that can be used to measure performance were presented by analyzing the research on start-up performance factors. First, it can be divided into objective performance, measured by a numerical value excluding the subject's subjectivity, and subjective performance, assessed by a score based on the subject's judgment. Second, it can be divided into dichotomous and multilayered performance, measured by stratifying the stages of performance into two or more stages, and continuous performance, measured by the continuous variable itself. Third, it can be classified into financial performance, such as sales, operating profit, and ROI, and non-financial performance, such as employee satisfaction, knowledge sharing systems, and product improvement. Fourth, the achievement of the goal can also be measured, and the achievement can be measured by checking to what level the actual result matches the originally set expectations and goals.

Financial performance that can be quantitatively measured — reputation in terms of subjective perception, satisfaction and goal achievement—can be comprehensively defined as the performance of a technology start-up. However, in general, there are difficulties in securing data for objective and financial performance measurement due to the nature of technology-based start-ups (Robinson & Pearce, 1986). In the case of early technology-based start-ups, since there is no history of listing or auditing, publicly disclosed data is limited, and companies are sometimes reluctant to provide financial data externally.

Accordingly, several studies tend to overcome the limitations of investigations by using objective financial and subjective indicators in parallel or subjective evaluation of the subject of financial and non-financial information. In some cases, the measurement of non-financial performance may be overly subjective and may face criticism. However, considering that many technology start-up companies are experiencing considerable technological and facility investment

requirements and difficulties in early market development, determining success with financial figures alone is an overly narrow view. In addition, since many technology start-up companies do not undergo public announcements or audits, it is difficult to trust the financial figures disclosed or investigated by researchers. Therefore, it is difficult to judge policy effects based solely on financial performance, and at the same time, it is necessary to comprehensively consider subjective effects.

The standards for measuring the performance of start-up companies include an increase in sales through start-up support projects, an improvement in product competitiveness, an increase in organizational members and customer satisfaction, and an improvement in the achievement of corporate goals and vision. First, sales (Shin, 2011; Song, 2010; Choi, 2010; 2013, Kwon, Jung, 2012; Lee, 2012; Park, 2012; Jang, 2013; Park, 2014; Yoon, 2015; Kim, 2016; Doutriaux, 1991; Bamberger et al., 1989; Bantel, 1997; Li, 2001; George et al., 2001; Li & Atuahene-Gima, 2001, 2002) is an observable objective indicator as it can clearly show short-term financial results. This is a criterion that meets exactly the policy goal of revitalizing technology-based start-ups, as companies can allocate the financial resources necessary for survival and growth through increased sales.

Second, customer satisfaction (Song, 2010; Yang, 2011; Kwon & Jeong, 2012; Park, 2012; Lee, 2012; Choi, 2010; Kim, 2016; Park, 2014; Jang, 2013; Yun, 2015; Miles et al., 1999) is an important driver of securing competitiveness in the market. Products and services with high customer satisfaction are an important performance factor because they spread to more customers and become the basis for securing long-term sales.

Third, improving product competitiveness (Zahra, 1996; Park, 2010) is closely related to customer satisfaction and is an essential factor for a company to survive in the long term. Confirming the degree of improvement in product competitiveness through the government start-up support project can help overcome the limitation that it is limited to accurately grasping financial performance due to the nature of the initial company.

Fourth, the goal achievement degree (Lee, 2012; Jang, 2013; Kim, 2015) is a criterion that can be used to determine how far the initial start-up goal has been achieved, regardless of differences between companies; in other words, it is a subjective performance factor. Understanding how much the government's start-up support projects have contributed to the goals initially set by the founders and start-up teams is a useful criterion for measuring effectiveness by encompassing start-up companies in various environments.

Fifth, job security, job satisfaction, and low turnover mean that overall organizational performance (Kohli & Jaworski, 1990; Lim et al., 2009) is high. The high organizational performance of a start-up company can affect the improvement of the employment rate; thus, it can be regarded as the goal of a start-up support project.

2.3. Policy Support and Start-Up Performance

The performance factors of technology-based start-ups can be largely divided into internal and external factors. The former include entrepreneurship, technology, organization, strategy, and general characteristics of a firm; in contrast, the latter include industry, network, industry-university cooperation, and support policies. In particular, external support is a crucial factor for early-stage technology-based start-ups that struggle to achieve self-sustaining results. In the beginning, simple financial support is also important, but the importance of incubation that includes physical and intellectual help is emphasized (Kim, 2015). In addition, investment from external private companies or venture capital is important (Lee et al., 2001; Carpenters et al., 2003), but the influence of government support systems and policies is also large (Song & Park, 2013; Park, 2014; Kim, 2015; Merrifield, 1987; Doutriaux, 1991; Lalkaka, 1997; Mian, 1997; Lerner, 1999; Li & Atuahene-Gima, 2001, 2002; Lee et al., 2001; Rice, 2002; Duch et al., 2005). Regarding the importance of government support, prior studies abroad have also actively studied the effect of the level of policy networks held by founders and companies on corporate performance (Doutriaux, 1991, 1992; Li & Atuahene-Gima, 2001).

In Korea, active policies are being implemented based on the will to revitalize technology-based start-ups. As of 2016, excluding the Forbidden City project, a budget for start-up support projects of KRW 620.3 billion was allocated, showing a strong will to revitalize entrepreneurship (Ahn et al., 2016). Among them, 54 projects highly related to technology-based start-ups are worth KRW 399.3 billion, which is half of the total budget for non-financial projects.

However, performance analysis by policy field has not been actively conducted. Kim (2015) analyzed the impact of the incubation center and youth entrepreneurship academy on the performance of technology start-up companies and confirmed that education, infrastructure, and network support are factors of technical and non-financial performance. Park (2014) found that the recognition of the usefulness of the government's R&D support has a positive effect on financial performance, customer performance, and operational performance through technological innovation capability and technology commercialization capability. Unlike the above studies, Song and Park (2013) analyzed the effects of more comprehensive policy types and considered the perception of the effectiveness of support by sector such as start-up, location, market, fund, tax, technology, and so on as a

factor influencing the performance of venture companies. Because of the analysis, it was found that technical support is important to venture companies involved in the start-up and maturity stages and that more complex support in addition to technical support is needed for growth-stage companies.

In a foreign case, Li and Atuahene-Gima (2002) measured the effect of government support for Chinese technology-based start-ups through five questions on the level of government support; as a result, government support is effective in offsetting environmental uncertainty, and advised that technology-based start-ups should support external partners in a way that helps them attract and connect with them. Doutriaux (1991) analyzed data on the interaction between the Canadian government and tech start-ups over eight years and found that indirect participation in public sector procurement and the government's public R&D projects, rather than supporting R&D subsidies, is more effective as an aspect of corporate growth.

As such, the effects of government support on technology start-up performance differ depending on the type and measurement method of government support and the definition of performance (Kim, 2015; Park, 2014; Song & Park, 2013; Doutriaux, 1991; Lee et al., 2001; Carpenter et al., 2003; Li & Atuahene-Gima, 2001; 2002). Therefore, in order to systematically analyze effectiveness, it is necessary to determine which types of start-up support projects will be analyzed. In this study, information on the budget size and types of start-up support projects based on the current government support was published in 2016 by the Small and Medium Business Administration, and it can be found in the brochure 'Start-up Support Project' (Small and Medium Business Administration, 2016). Here, start-up support projects are divided into nine types: policy funding, commercialization, R&D, facilities and spaces, mentoring and consulting, sales channels and overseas expansion, start-up education, events and networks, and others.

In consideration of the importance of each policy considered in previous studies, the types of start-up support projects were simplified into five categories: education and consulting, facilities and space, commercialization, R&D, and policy funds. Based on the above discussion, the following hypothesis was established for the effect of policy support on start-up performance:

H1: The government policy supports will impact start-up performance.

H1-1: Government's education and consulting support will impact start-up performance.

H1-2: The government's support for facilities and spaces will affect start-up performance.

H1-3: The government's support for commercialization will impact start-up performance.

H1-4: The government's R&D support will impact start-up performance.

H1-5: The government has funding will impact start-up performance.

2.4. Moderating Effect of Firms' Growth Stages

The growth of a company is a process of solving the problems faced by an organization, and efforts have been made to discover and systematically develop different required competencies for each growth stage in relation to the organizational life cycle theory (Kazanjian, 1988; Kazanjian & Drazin, 1990). Technological start-up companies tend to rely on the technical knowledge, leadership and entrepreneurship of the start-up team at the beginning, but as they go through the growth stage, they will be greatly influenced by competencies derived from a more organized system. In addition, as objective technology capabilities such as patents and certifications increase in the process of growth and the R&D-dedicated organization becomes independent, there is a possibility that an impact relationship with performance that did not appear in the beginning may be established. Choi (2010), who analyzed the relationship between network characteristics and the performance of technology-based start-ups, showed that the importance of social networks emerges as the company grows. The study emphasized that, from the beginning, cooperation and win-win growth are based on trust with various stakeholders. Kim and Han (2014) argued that focusing on product diversification and marketing in the early stages of the start-up period and product marketing in the period of maturity or stagnation is a way to increase the growth rate in relation to the effect of product strategy and CEO characteristics on the performance of venture companies. It was found that easing and emphasizing change and innovation helps growth. From this viewpoint, the impact of manager characteristics, technical competence, and policy support on start-up performance may vary depending on the stage of company growth (Song & Park, 2013; Choi, 2010; Kazanjian & Drazin, 1990; Robinson & McDougall, 2001; Qian & Li, 2003). Through this discussion, the following hypothesis was established for the moderating effect of the growth stage:

H2: There will be a moderating effect of the growth stage in the influence of the government's start-up policy support on start-up performance.

3. Research Design

3.1. Data

Data for empirical analysis were obtained by conducting a questionnaire survey targeting technology start-up companies. The surveyed companies were limited to those founded within the previous seven years and belonging to the manufacturing and knowledge service industries that correspond to the technology start-up companies defined by the Ministry

of SMEs and Start-ups in South Korea; further, a detailed list was extracted from the company yearbook produced by Korea Contents Media (Korea Contents Media, 2016). Specifically, out of a total of 441,528 companies in the database, companies that fall under the definition of technology start-up companies were extracted in proportion to 71 business types, seven business powers, and 17 regions, and a total of 9,134 companies were selected as target companies for the survey. A total of 251 responses, corresponding to a 2.7% recovery rate, were collected by conducting a survey using the internet, mobile, and e-mail for these companies. A total of 248 responses were used in the analysis after excluding three of the collected samples with questionable reliability.

The questionnaire survey was designed to identify policy supports as variables that affect start-up performance, and it included the growth stage as a moderating variable. The questionnaire comprised 23 main questions and 95 rumors divided into five categories, such as government policies, firm characteristics, and performance. The survey period was from September 26 to October 26, 2016.

Table 1. Descriptive statistics of respondents (frequency %)

Variables		**All industry (n = 248)**	**Manufacturing industry (A) (n = 129)**	**Service industry (B) (n = 119)**
Total		248 (100.00)	129 (52.02)	119 (47.98)
Gender	Male	213 (85.89)	118 (47.58)	95 (38.31)
	Female	35 (14.11)	11 (4.44)	24 (9.68)
Education	Under high school	16 (6.45)	6 (2.42)	10 (4.03)
	University graduate (2~3 years)	23 (9.27)	16 (6.45)	7 (2.82)
	University graduate (4 years)	95 (38.31)	47 (18.95)	48 (19.35)
	Master's degree	62 (25.00)	35 (14.11)	27 (10.89)
	Doctoral degree	52 (20.97)	25 (10.08)	27 (10.89)
Job	Professor	19 (7.66)	6 (2.42)	13 (5.24)
	Student	23 (9.27)	13 (5.24)	10 (4.03)
	Public Sector Research Institute	12 (4.84)	4 (1.61)	8 (3.23)
	Private Sector Research Institute	16 (6.45)	12 (4.84)	4 (1.61)
	Enterprise	143 (57.66)	77 (31.05)	66 (26.61)
	Government and affiliated organizations	2 (0.81)	0 (0.00)	2 (0.81)
	Others	33 (13.31)	17 (6.85)	16 (6.45)

3.2. Variables

3.2.1. Dependent Variables

Start-up performance is divided into financial and non-financial performances, and it is designed to comprehensively analyze the objective and subjective effects of start-up support policies. Measuring the subjective effect together considers the limitations of the objective performance measurement method of start-ups (Robinson & Pearce, 1986) and accepts the arguments of previous studies that comprehensively consider various performance indicators (Romanelli, 1989; Stearns et al., 1995; Phillips, 1996; Helms et al., 1997).

First, annual average sales were considered financial performance corresponding to the objective effect. Revenue is a number that can most intuitively show the trend of a company's market performance and growth and has been used in previous studies related to various technology-based start-ups (Shin, 2011; Doutriaux, 1991; George et al., 2001). Since this study surveyed the financial situation for three years from 2013 to 2015, at least one year or more of sales information must exist in order to calculate average sales; therefore, 51 companies with no sales information or no sales for three years were excluded from financial performance analysis.

Next, product competitiveness, organizational performance, customer performance, and target achievement, which correspond to non-financial performance, were measured using a five-point Likert scale. For product competitiveness, five questions were presented about the status and performance of products and services in the market by referring to Zahra (1996) and Park (2010). Organizational performance was structured to understand overall organizational stability and the working environment through three questions on corporate employment stability, turnover rate, and employee satisfaction (Kohli & Jaworski, 1990; Lim et al., 2009). Customer performance was measured by four questions regarding the increase in customers, decrease in claims, and increase in satisfaction with reference to Park (2014), Kaplan and Norton (1992), and Khirallah (2000). The degree of goal achievement was measured as a single item by referring to the methods of Lee (2006) and Kim (2015), who directly inquired about the degree of achievement of their own goals or visions set in various ways for each company.

To confirm the reliability of the measurement tool for non-financial performance, Cronbach's α value was calculated between each item; as a result, it was located at the level of 0.86 to 0.95, confirming the high

reliability of the measurement tool (Table 2).

Table 2. Reliability of the measurement

	Variables	Items	Cronbach's α	
Non-financial performance	Product competitiveness	① Market creation of products and services	0.90	0.92
		② Functional diversity of products and services		
		③ Market convergence of products and services		
		④ Product and service industry competitiveness		
		⑤ Product and service technology innovation		
	Organizational performance	① Employment stability	0.86	
		② Turnover rate		
		③ Employee satisfaction		
	Customer performance	① Claim reduction	0.95	
		② Increased repurchase rate		
		③ Increase of regular and new customers		
		④ Increased customer satisfaction		
	Goal achievement	Goal or vision achievement	-	

3.2.2. Independent Variables

In order to confirm the difference in start-up performance, five types of policy support, including education and consulting, facilities and spaces, commercialization, R&D, and policy funding, are converted into a dummy variable depending on whether or not the policy is supported. Because of the survey asking companies in duplicate whether they have experience in each of the five policy types, 204 companies that have experienced commercialization accounted for the highest share (82.3%), while education and consulting accounted for 136 (54.8%), and policy funding companies were 129 (52.0%), followed by 118 in R&D (47.6%). 93.2% of companies experienced one or more options for policy support, and the scope of the beneficiary was wide enough that most of the survey subjects could experience policy benefits.

There may be several criteria for evaluating a company's growth stage. In this study, in order to exclude the possibility of the researcher's arbitrary interpretation of the growth stage, a method was chosen to directly ask the representative (respondent) of the company about the appropriate growth stage to which the company belongs. The growth stage, which is a moderating variable, was surveyed by dividing the periods of start-up, early growth, high growth, maturity, and decline. Because of the survey, 56.5% of respondents said they were in the early growth period, accounting for more than half, followed by 54 (21.8%) during the start-up period and 30 (12.1%) during the high-growth period. Based on the results of this survey, the start-up and early growth periods were reclassified as 'early', and the high-growth, maturity, and decline periods were reclassified as 'growth periods" (21.8%).

Control variables include firm age (Kazanjian & Rao, 1999; Li, 2001; Li & Atuahene-Gima, 2001; 2002; Zahra & Bogner, 2000; Carpenters et al., 2003; Lee et al., 2001; McGee & Dowling, 1994; Robinson & McDougall, 2001; Zahra et al., 2003) as well as firm size (Park, 2010; Song & Park, 2013; Kazanjian & Rao, 1999; Zahra & Bogner, 2000; Li & Atuahene-Gima, 2001; Lee et al., 2001; Carpenters et al., 2003; Zahra et al., 2003; Zahra et al., 2001; Carpenters et al., 2003; Zahra et al., 2003; Za Firm age is the period from the year of firm establishment to 2016, while firm size was defined as the number of employees in 2015.

3.2.3. Analytical Model and Method

The analysis model can be expressed by the following equation:

$Y_i = \beta_0 + \beta_1 \cdot (education \text{ and } consulting)_i + \beta_2 \cdot (facilities \text{ and } spaces)_i + \beta_3 \cdot (commercialization)_i + \beta_4 \cdot (\mathrm{RD})_i + \beta_5 \cdot (policy\ funding)_i + \beta_6 \cdot (firm\ age)_i + \beta_7 \cdot (firm\ size)_i + e$

(i = 1~284)

H_i) H_0:β_i=0 H1: $\beta_i \neq 0$ (i=1~20)

Multiple regression analysis was performed on the factors affecting start-up performance, and Stata 14.0 was used for the statistical package. After the primary analysis of all technology start-up companies, the model was divided into the start-up period, early growth period, and high growth period to confirm the difference in factors influencing each growth stage and the moderating effect.

4. Analytical Results

4.1. Policy Support Factors Affecting Start-up Performance

As shown in Table 3, a regression analysis was attempted to confirm the policy support factors that affect start-up performance. Factors influencing the five types of start-up performance, including sales, product competitiveness, organizational performance, customer performance, and goal achievement, were analyzed.

First, R&D support was found to be a significant variable as a policy support factor affecting sales. Among the five types of policy support, R&D support had a positive effect on sales, and the other factors were not statistically significant. The financial effects of policy support may appear in the medium to long term,

but the confirmation of the data in this study is limited.

Second, the factors affecting product competitiveness include managerial innovation, risk susceptibility, technology competitiveness, and patents, and all significant variables were identified as positive signs. Through this, it is evident that managers must have an active attitude to take risks based on innovative thinking and actions, and these managers' efforts lead to the accumulation of intellectual property and technological competitiveness, thereby forming product competitiveness in the market.

Third, the factors that positively influence organizational performance are managerial innovation and initiative, securing R&D organizations, technological competitiveness, and government funding. On the other hand, the government's support for commercialization appeared to be a factor that hindered organizational performance. The fact that the discriminatory effect of commercialization and policy funding among government support was confirmed can be regarded as showing the difference in the characteristics of each type of policy support. Since this facility and equipment can be used comprehensively for operating funds, including labor costs, it appears that they have a significant effect on the satisfaction of members of the organization. On the other hand, the commercialization support project is meant to support a series of business activities to enter the market for companies that have secured core technologies and technical ideas for products and services in the early stages. Therefore, the phenomenon by which commercialization support negatively affects organizational performance implies that companies receiving this stage of support are probably at a stage beyond the 'Death Valley'.

Fourth, the variables that have a significant influence on customer performance are the age of the manager, innovation and initiative, the security of R&D organizations, and technological competitiveness. Among them, the age of the manager has the only negative (-) effect. These results imply that the older the manager is, the less likely they will be able to meet the needs of the customers; thus, it implies that it is necessary to provide tailored training for senior entrepreneurs about the market and customer trends. It was found that policy support was not related to customer performance.

Fifth, the variables that had a significant influence on the achievement of the start-up goal were the manager's age, innovation and initiative, and technological competitiveness. The age of the manager was identified as a negative factor in achieving the start-up goal, and these results were similar to customer performance.

Among the types of policy support in terms of non-financial performance, significance was found only in education and consulting, R&D, and commercialization, all of which had a negative effect on each performance element.

Table 3. Factors affecting start-up performance (*p < .10, **p < .05, ***p < .01; parentheses include t-values)

Variables		**[Model-1] Financial performance :ln(Sales)**	**[Model-2] Non-financial performance**	**[Model-3] Product competitiveness**	**[Model-4] Organizational performance**	**[Model-5] Customer performance**	**[Model-6] Goal achievement**
Policy support	Education and consulting	-0.04 (-0.22)	-0.04 (-0.59)	-0.13 (-1.34)	0.03 (0.32)	-0.03 (-0.29)	-0.04 (-0.37)
	Facilities and spaces	0.16 (0.91)	0.04 (0.48)	0.08 (0.78)	0.01 (0.09)	0.03 (0.28)	0.03 (0.22)
	Commercialization	-0.27 (-1.07)	-0.15 (-1.53)	0.04 (0.27)	-0.29** (-2.01)	-0.23 (-1.57)	-0.13 (-0.82)
	R&D	0.59*** (3.01)	-0.03 (-0.32)	-0.07 (-0.65)	0.05 (0.45)	-0.07 (-0.62)	-0.01 (-0.11)
	Policy funding	0.16 (0.88)	0.12* (1.68)	0.003 (0.03)	0.20* (1.90)	0.16 (1.52)	0.12 (1.10)
Firm age		0.19*** (3.46)	0.02 (0.88)	-0.02 (-0.69)	0.05 (1.61)	0.02 (0.74)	0.02 (0.66)
Firm size		0.15*** (7.36)	0.004 (1.10)	0.01 (1.10)	0.003 (0.73)	0.001 (0.18)	0.01 (1.02)
Constant		2.14*** (2.78)	0.48 (1.62)	0.18 (0.45)	0.06 (0.13)	0.93** (2.18)	0.74 (1.63)
Adj R^2		0.51	0.54	0.40	0.32	0.36	0.36
F		11.22***	15.58***	9.25***	6.88***	8.01***	7.86***
N		197	248	248	248	248	248

4.2. Moderating Effect of Growth Stage

To confirm the control effect of the growth stage, a regression analysis was attempted, as shown in Table 4. Only the pure effect of policy support excluding other factors (Models 7 and 9) and the interaction effect of policy support and growth stage (Models 8 and 10) were analyzed separately. Because of the analysis, differences in factors affecting start-up performance and significant modulating effects were confirmed for each growth stage.

Specifically, looking at the overall impact of policy support on financial performance, some positive effects of R&D support were confirmed, and the other variables were not statistically significant. Looking at the moderating effect at each stage of growth, policy funds only promoted sales for early companies. If the growth stage and interaction effect are not considered, the policy fund has a limited effect only on early

companies, given that its coefficient has a negative value.

The effect of policy support on non-financial performance did not show a consistent trend depending on the model; however, considering the interaction effect of the growth stage, facility and space support had a negative effect on early companies [Model-10]. In addition, although R&D support was generally negative for non-financial performance, it was found that it had a positive effect on early companies.

The above analysis results suggest that the policy tools to induce start-up performance should be applied differently for each stage of business growth; in other words, although the impact of facility and space support is insignificant, it can exert a limited positive effect on companies after the growth period in terms of non-financial performance. R&D support has a positive effect on the sales of technology-based start-ups overall, but there is no difference between growth stages. However, in terms of non-financial performance, negative impacts were found on the whole, and positive effects were seen for early companies, which differed by growth stage. Policy funds have an overall positive impact on non-financial performance and can promote early corporate sales.

Table 4. The moderating effect of growth stage (*p < .10, **p < .05, ***p < .01; parentheses include t-values)

Variables		**[Model-7] ln(Sales)**	**[Model-8] ln(Sales)**	**[Model-9] Non-financial performance**	**[Model-10] Non-financial performance**
Policy supports	Education and consulting	0.05 (0.25)	0.16 (0.37)	0.01 (0.07)	-0.19 (-0.89)
	Facilities and spaces	0.19 (1.03)	0.57 (1.54)	0.06 (0.66)	0.38* (1.93)
	Commercialization	-0.13 (-0.49)	0.11 (0.25)	0.22* (1.71)	0.23 (1.09)
	R&D	0.56*** (2.82)	0.60 (1.37)	0.14 (1.46)	-0.17 (-0.79)
	Policy funding	0.30 (1.55)	-0.29 (-0.74)	0.16* (1.67)	0.39* (1.94)
Policy supports*Growth stage	Education & consulting*early growth		-0.13 (-0.27)		0.25 (1.04)
	Facilities & spaces*early growth		-0.53 (-1.25)		-0.40* (-1.77)
	Commercialisation*early growth		-0.34 (-0.73)		0.03 (0.13)
	R&D*early growth		-0.07 (-0.15)		0.39* (1.67)
	Policy funding*early growth		0.78* (1.76)		-0.28 (-1.24)
Firm age		0.20*** (3.43)	0.18*** (2.95)	-0.04 (-1.30)	-0.04 (-1.45)
Firm size		0.17*** (8.44)	0.17*** (8.25)	0.02*** (4.14)	0.02*** (4.30)
Constant		2.37*** (6.40)	2.49*** (6.60)	2.84*** (16.58)	2.84*** (16.29)
Adj R^2		0.39	0.39	0.11	0.12
F		16.56***	10.60***	4.87***	3.64***
N		197	197	248	248

5. Discussion and Conclusions

5.1. Main Findings of This Study

This study attempted an empirical analysis through a questionnaire to present implications and suggestions to improve the effectiveness of technology start-up support policies. The main findings of the study are summarized as follows: The effect of policy support had a multidimensional effect on start-up performance, although education and consulting support were not statistically significant. The impact of facility and space support on start-up performance is generally insignificant, and while it has a positive effect on non-financial performance overall, it is likely to have a negative effect on early companies. Support for commercialization has a positive effect on non-financial performance, but when limited to organizational performance, it acts as a negative factor. The government has support had a positive impact on overall financial performance, and the impact on non-financial performance was found to be positive only for early companies. Policy funding such as financing and investment operated by public institutions has a positive effect on non-financial performance overall, and the effect on financial performance was positive only for early companies. In the case of the moderating effect of the growth stage, this was significant with limited support for facilities and spaces. Overall, support for facilities and spaces promoted non-financial performance, but support for early companies was found to be a negative factor in performance.

5.2. Comparison with Other Previous Studies

Previous research has frequently focused on individual policy support, such as R&D or financial assistance. In addition, prior research has been limited in its ability to examine the practical implications of various policy supports on the performance of technology-based start-ups. Several empirical studies on technological start-ups either ignored policy support when assessing performance characteristics or used only proxy variables that correlate to a portion of the

policy (Kim, 2015; Park, 2014; Li & Atuahene-Gima, 2002; Doutriaux, 1991). Furthermore, there was a restriction to complete performance measurement using one of the subjective or objective indicators when measuring the performance of technological start-up organizations (Kwon & Jung, 2012; Kazanjian & Rao, 1999; Park, 2010; Doutriaux, 1991).

However, this study investigates the multidimensional effects of numerous policy supports. More specifically, this study differs from past research in that it examines the impact of various policy supports on the financial and non-financial performance of technology-based start-ups in depth.

Furthermore, this study focuses on technological start-ups in South Korea, whereas prior studies looked at start-ups in other nations or industries. The study sample of technology start-ups created during the last seven years in the manufacturing and information service industries is likewise more targeted than earlier research.

Finally, the findings of the study point to the significance of implementing distinct strategies for each technology start-up support policy tool, which is a fresh contribution to the literature on entrepreneurship policy. Previous research has not gone into as much detail about the importance of specialized policy interventions for different kinds of start-ups.

5.3. Implications of the Study

The following implications can be derived from the above analysis results: It is necessary to establish and implement differentiated strategies for each technology start-up support policy tool. First, training and consulting support must be reviewed overall for effectiveness. The research hypothesis was rejected because the impact of education and consulting support on start-up performance was not significant in all models. This proves that the current education and consulting support projects are ineffective and require a general redesign. From the perspective of the consumer, a redesign is required throughout the current support system so that the content that is truly necessary can be delivered through optimized means.

Second, facility and space support did not affect financial performance and had a limited positive effect on the non-financial performance of all companies. It was found that it had a rather negative impact on the non-financial performance of early companies; therefore, facility and space support should be structured in a direction that promotes the overall non-financial performance of technology-based start-ups from a long-term perspective. It is desirable for the entity operating the facility and space support business to have sufficient incubation capabilities and experience in terms of corporate performance, and they must work on the program with responsibility as a management entity that not only provides simple physical infrastructure but also grows together.

Third, support for commercialization had a limited positive effect on non-financial performance but negatively affected organizational performance, and overall, the relationship with performance was not significant. Although the analysis in this study was limited, it is desirable to have a more sophisticated commercialization support strategy by attempting an effectiveness analysis for each segmented company type, such as B2B, B2C, domestic, and overseas. Thus, it is necessary to examine whether the current support for commercialization is excessively biased toward some types of companies, such as manufacturing or promising exporters. In addition, companies receiving commercialization support are likely to have reached the so-called ‘death valley’ ahead of full-scale product and service expansion in the market after technological development, thus requiring employment support to overcome the disruption of organizational competence at this stage. The proper linkage of projects can also be a policy alternative.

Fourth, it was confirmed that R&D support has a positive effect on financial performance. However, the impact on non-financial performance was positive only for early companies. This raises concerns that it is only a short-term increase in sales due to the direct R&D subsidies and does not lead to long-term growth potential. Additional analysis is required to review the long-term effects of R&D support for technology-based start-ups, but as the impact on non-financial performance is generally very limited, a comprehensive review of the qualitative performance of R&D support for technology-based start-ups is necessary. Therefore, the R&D support for innovation and knowledge infrastructure construction for initial companies remains current but gradually shifts to a paradigm centered on investment and recovery rather than direct research fund support to discover and support projects with high potential for success in the market. There is a need to improve qualitative performance, such as by increasing accountability in the industry. To this end, in selecting a support project, it is necessary to actively induce the participation of private entities that have an excellent view from a business model perspective and require a higher level of accountability from the participating companies.

Fifth, policy funds were found to be a positive factor in start-up performance overall, but the positive impact on financial performance was limited to early companies. Therefore, policy fund support for early companies should be maintained at the current scale; on the contrary, policy fund support for growing companies should be continuously tracked and analyzed for effectiveness throughout the subsequent growth path.

Lastly, regarding support for each stage of growth, a more detailed analysis in terms of time series is

required. However support for the initial stage must focus on maximizing performance by making similar or duplicated projects more efficient and reinforcing evaluation from the perspective of markets and business models. In addition, if small-scale 'spreading' projects are pursued indiscriminately by prospective and early founders, investment in companies with real potential will inevitably shrink. In order for linkage support for each stage of growth to be effective, close handovers and acquisitions must be made between the support subjects as to what kind of support has been received at each stage and what characteristics it has. However, currently, most of the business groups of start-up support organizations operate with projects accompanying a specific project, and it is difficult to expect such long-term responsible tracking and management as they comprise of non-regular workers, except for a few managers. Therefore, to support linkage by growth stage, based on policy coherence, the actual executive departments of each support organization should perform their work with high responsibility and commitment to their respective companies.

5.4. Strengths and Limitations of the Study

This study analyzed the effect of policy support on both financial and non-financial performance for technology start-up companies meeting the legal standards defined in the Small and Medium Business Start-up Support Act. It determined whether various policy supports such as education and consulting, facilities and space, commercialization, R&D, and policy funds lead to actual corporate performance and whether there is a significant moderating effect for each growth stage of the company. Moreover, based on empirical analysis, it presented policy implications for effective outcome creation for each type of policy support.

Despite these achievements, this paper has several limitations in the following areas: First, as the input of policy support could be simplified by experience, it was not possible to derive deeper implications for various policy aspects such as the characteristics of each support method, quality level, frequency, and duration. Second, just as in previous studies, it was difficult to derive and secure performance indicators with objective and high reliability according to the specificity of technology-based start-ups. Third, although the effect of policy support on the performance of technology-based start-ups was confirmed, an analysis of the impact of all factors that mediate the policy and other mediating and adjustment factors that can be considered in the relationship between policy and performance was not reviewed. This limitation is expected to be supplemented in the future by collecting panel data related to the performance of technology start-up companies from a longer-term perspective and by securing objective data related to support projects held by policy providers.

5.5. Recommendations for Future Research

Based on the findings of this study, further research could investigate why education and consulting support had no substantial impact on start-up performance. Measuring the quality of education and consultation provided and the level of the involvement of start-ups with these support services may be beneficial.

Furthermore, additional research might look at the precise types of facilities and spaces that are most useful to start-ups, as well as how the timing of facility and space support affects start-up performance.

Another interesting subject for future research is to investigate the relationship between commercialization assistance and organizational effectiveness. Understanding the mechanisms that influence start-up performance could lead to more effective policy interventions.

Further research might look into the long-term effects of government R&D assistance and policy funding on start-up performance, as well as how these policies affect different types of start-ups, such as those in different industries or at different stages of development.

Finally, future research should investigate the efficacy of diverse strategies for technological start-up support policies, as proposed by this study, and how such strategies might be effectively implemented by governments and other policymakers.

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Authors' Contributions

Conceptualization, S.A.; methodology, J.K.; validation, S.A.; writing-original draft preparation, S.A.; writing-review, and editing, J.K. and K.-H.L.; funding acquisition, K.-H.L.

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