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What Types of Government Support on Food SMEs Improve Innovation Performance?

Harry Jeong [1], Kwangsoo Shin [1,*], Seunghyun Kim [2] and Eungdo Kim [1]

[1] Department of Biomedical Convergence, College of Medicine, Chungbuk National University, Chungdae-ro 1, Seowon-gu, Cheong-ju 28644, Chungbuk, Korea; harry@g.cbnu.ac.kr (H.J.); edkim@chungbuk.ac.kr (E.K.)
[2] Office of Innovative Institution Research, Science and Technology Policy Institute, Building B, Sejong National Research Complex, 370 Sicheong-daero, Sejong 30147, Korea; shkim@stepi.re.kr
* Correspondence: sksidea@chungbuk.ac.kr

Abstract: Since small and medium enterprises (SMEs) play an important role in economic development, the government implements various supports. Nevertheless, SMEs have difficulties in gaining a competitive advantage in the market owing to lack of capital and capacity. Accordingly, SMEs try to secure a competitive advantage through innovation. Government support is necessary for the innovation of SMEs, and it is essential for food SMEs as well. Whether government support for firms can affect firm's innovation is still a matter of debate. In particular, it is necessary to empirically investigate the relationship between government support and innovation for SMEs in latecomers to the food industry such as Korea. Therefore, this study conducted an empirical study on the factors that determine the innovation performance of food SMEs by government support. This study used a two-stage regression model. The government support does not unilaterally affect innovation performance, but rather, an endogeneity problem occurs through the interaction between them. This study examined the interrelationships between variables for a clear estimate of government support. Before two-stage regression, this study used the ordered logistic regression to determine the instrumental variables. Each instrumental variable was estimated for the seven types of government support that are normally implemented. The result suggests that the government certification support is effective in improving the innovation performance of food SMEs. This study is useful to establish innovation strategies for supporting food SMEs' innovation in late-coming countries.

Keywords: food industry; SMEs; government support; latecomer; innovation performance; two-stage regression; ordered logistic regression

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1. Introduction

Food supply forms a global chain because the output of agricultural products, the raw material for food, varies by region and climate. As the proportion of food dependent on foreign countries increases, so do supply risks arising from external factors such as exchange rates risk, climate change, or trade disputes. For instance, the 2008 global financial crisis hiked agricultural product prices, and climate change could further slash supplies of food produce in certain regions. The normal movement of goods within time could be restricted by trade disputes as well. Therefore, governments continue to support the domestic food industry directly or indirectly, even if the added value of food industry is low. The food industry is a relatively low-technology industry. Given its low entry barrier, startups can easily flourish, although survival is seldom guaranteed. SMEs face even more difficulties because of their limited resources and higher cost of operation than large firms [1]. In these business environments, to overcome difficulties and secure a consistent competitive advantage, innovation is stressed in the firm [2]. Hence, SMEs often seek external support, especially government support.

SMEs greatly contribute to the economic growth of a country [3]. The innovation performance of SMEs has comparatively various ripple effects in firm growth. SMEs'

research and development (R&D) investment, new product development, and innovation performances lead to job creation and the emergence of new industries in the long run as well [4,5]. Nevertheless, SMEs lack the capital, research manpower, and technical capabilities ubiquitous among large firms. To correct this imbalance, the government supports SMEs' innovation through special policy. Firms directly attract funds for R&D, education, and technology development from the government or obtain non-monetary support.

Despite these government supports, SMEs are still limited in capabilities, and innovation performance has fallen short of expectations. Therefore, it is necessary to expose and respond to the problems of government support for SMEs. Managers and policy makers have had questions about whether cooperation with the government in the food industry is contributing to the achievement of a substantial competitive advantage for SMEs. In this regard, most studies are focused on advanced economies [6], and an empirical examination of the strategies to increase innovation performance in the food industry is lacking [7]. A common limitation in the literature is the neglect of considering the characteristics of latecomers such as Korea in the food industry. Mathews [8] and Zhang, Shi, and Wu [9] hold that support strategies should consider latecomers more, given the nature of the global value chain of food.

This study adds to a small body of literature on government support for SMEs' innovation in late-coming countries. It is not clear what the overall impact of direct government support has been for the firms involved [10]. It is debatable whether government supports at firm levels can promote firm innovation capabilities [11]. Hence, the implications of government support for the performance of individual firms remain to be explored [10].

This study addresses empirically analyzing what types of government support improved the performance of SMEs. Therefore, this study contributes to the recent literature that aims to provide empirical evidence on the effectiveness of government-sponsored innovation performances using data at the level of food SMEs in Korea. These findings will be of interest to policymakers as they provide information on the direction of support policies for SMEs. In addition, the results of this study suggest that the government support policy decisions for SMEs should be analyzed empirically.

Therefore, this study examined what types of government support of SMEs improve innovation performance. This study focused on the context of the Korean food industry. The competitive marketability and food safety of Korean traditional food have been proven in the global market. A small number of large firms dominate the market in the Korean food industry. In this context, the Korean food industry has developed well through a government-led system so far [12]. To study the relationship between the types of government support and innovation performance, this study used food and beverage SMEs' data from the Korea Innovation Survey (KIS) of 2018, conducted by the Science and Technology Policy Institute (STEPI).

2. Background and Theory

From the early 2000s onward, the value chains of the food industry have shifted their focus from suppliers to consumers. The food industry is in a transition period owing to improved income levels [13]. This industry has been traditionally regarded as a mature and slow-growing sector [14]. Consumer needs were sidelined to minimize production costs [15]. However, depending on the needs of consumers [16–18], food safety and quality are fundamental, and consumers' health concerns have increased. In the industries with conservative and low research intensity, increasingly higher technology has to be implemented.

In recent innovation research, a new innovation policy frame, different from the extant innovation policy, has begun to emerge in response to major social and environmental issues [19]. Diercks, Larsen, and Steward [20] recognize the limitations of the extant approach to growth-centered technological innovation; they consider strategies to respond to social issues such as sustainability, aging, and polarization as new policy areas. In the food industry, potential knowledge found outside the firm is increasingly being used to address

these issues [21]. Food firms cooperate with external players to keep the competiveness. The need for open innovation in the food industry is justified by this industry's unique characteristics. Innovation in the food sector is incremental rather than radical [22,23]; hence, partnerships with external organizations are essential. Empirical studies show that knowledge useful for food firms comes from several scientific and technological sectors such as pharmaceuticals, chemicals, and agriculture [22,24]; machinery and tools; and electricity. Emerging sciences such as the production sector [25], nanotechnology [26,27], and biotechnology [28,29] are also a great source of external knowledge.

The Organization for Economic Co-operation and Development (OECD) [30] classified innovation defined from various perspectives into four categories: product innovation, process innovation, marketing innovation, and organizational innovation. This classification recognizes innovation activities and intangible assets as major performances of innovation policies. These performances include developmental, financial, and commercial activities [30]. Product innovation refers to the firm product type, quality and performance aspects of targeted improvement or creation, and the right time to put it into the market [31]. Process innovation refers to the firms' development of new products through new technology or new production systems [30]. Firm marketing innovation refers to firms' new means of introduction of new products or promoting existing products in the market. Usually, it is determined from the use of new advertising, promotion, and marketing channels [32,33]. As organizational innovation refers to new organization methods at the workplace [34], it is not directly related to consumers.

The OECD [35] reports that the Korean food industry's growth rate of production, employment, and exports exceeds that of most OECD countries. However, the absolute size of the food industry is small, and exports are limited. Although the global market share of Korean food has increased, its comparative advantages are still inferior. There is an imbalance between R&D investment and the size of the industry.

The food industry in Korea has developed well through a government-led system [12]. However, the industrial context demonstrates the need to move forward strategically to identify further growth opportunities of large firms and SMEs in the food industry [36]. The Korean context and technology-based challenges clearly reflect the necessity of introducing innovation strategies for the growth of domestic food firms [37].

The Korean food market is dominated by few large firms, which also have the highest sales performance. The sales volume of the Korean food industry is 490 trillion Korean Won (USD 420 billion); the industry employs over 2.18 million people [38]. The OECD [35] reports that the Korean food industry's growth rate of production, employment, and exports exceeds that of most OECD countries. However, the absolute size of the food industry is small, and exports are limited. Although the global market share of Korean food has increased, its comparative advantages are still inferior. There is an imbalance between R&D investment and the size of the industry. In Korea, small firms are classified according to the amount of sales determined for each food product under the Framework Act on Small and Medium Enterprises. In the food manufacturing industry, firms with annual sales of 10 billion Korean won (USD 9,000 million) or less are classified as SMEs. SMEs account for 99.7% of all firms, but the sum of their annual sales was USD 293 billion, which accounts for only 50.7% of the total food firms. Only a few large firms, which are 0.3% of the total, account for 49.3% of total sales. In order to promote the balanced development of the Korean food industry, effective ways of supporting SMEs should be considered.

Bach, Matt, and Wolff [39], for example, studied a case of expanding R&D projects through alliances with government-supported firms in Europe. Government-supported firms have already proven their competence in the project selection phase upon evaluation by the government. Thus, the preference for government-supported firms increases when selecting partners [40]. In addition, government support may help indirectly strengthen R&D alliances by reinforcing firms' absorptive capacities [41].

According to the OECD [42], SMEs account for more than 95% of enterprises and 60% to 70% of employment; they create a large proportion of new jobs in OECD countries.

Thus, SMEs' economic performance in the OECD region is critical for creating new jobs and sources of innovation. Job creation, export growth, and productivity improvement by SMEs demands the attention of policy makers. In addition, SMEs play an important role in contributing to regional development and enhancing economic performance through technological innovation and capacity building [43].

SMEs are more innovative in competitive markets [44,45], while large firms perform better in monopoly markets and concentrated industries with high entry barriers. Rothwell and Dodgson [46] also confirm that the role of SMEs is more relevant when a niche exists, and the cost of entry is low.

SMEs need to acquire skills and introduce new and effective technologies to their firms for innovation; however, they are held back owing to lack of resources for investment or development of technologies [47]. Because of the asymmetry of information among SMEs, these firms are in a disadvantageous position in the market in terms of funding, technology development, and securing sales channels compared with large firms. The government has no choice but to protect and foster SMEs despite critics accusing this practice of distorting the market mechanism.

The government supports firms with low investment in R&D or innovation capability. It encourages SMEs to innovate through various forms of support policies. After the 2008 global financial crisis, this trend shifted from providing direct support to SMEs to supporting external experts in order to contribute to a firm's strategy system establishment, organizational innovation, and policies to strengthen firm capabilities [48].

According to the National Innovation System Framework, government support to SMEs could be categorized into four areas: financial policies, business innovation support system, human resource policies, and legal policies [49]. Songling et al. [50] studied the influences of government policies on firm performance, and government policies are separated into two types: financial and non-financial. In addition, there are studies on the relationship of various government policies such as subsidies [51] and R&D support [52] to firms' performance.

Korea established the Ministry of SMEs and Startups in 2017 to shift the center of the economy from large firms to SMEs, ventures, and startups [53]. The Framework Act on Small and Medium Enterprises was amended to systematically support SMEs and ventures, and startups. In accordance with the comprehensive plan for fostering SMEs and startups [54], the Korean government supports their innovation with the goal of digital transformation, creation of a venture boom, and creation of a self-sustaining ecosystem. In particular, the food industry has been designated as a strategic field for the growth of SMEs and is expanding support for activation of the local currency, creation of a new business model based on the online economy, conversion to a smart factory, and establishment of export vouchers.

Seven types of government support have been classified according to the "Oslo Manual" [30] and the support policy of the Ministry of SMEs and Startups [55]. It is supported at the national level or locally, but some may be concentrated in a specific part depending on the capacity of the local government and regional characteristics [56]. In this study, seven policy tools including tax, subsidy, financial support, human resource, technology, certification, and procurement are considered for analysis.

2.1. Tax Support

The way the government can support SME's management stability and growth without making new financial investments is to support tax payments. Although the government's fiscal income is reduced, it is a kind of policy that can support SMEs immediately without creating additional financial resources. The taxes paid by the firms, corporate tax, income tax, acquisition tax, property tax, registration tax, etc., are burdensome to the management of SMEs with a weak financial base. Therefore, the government implements the following policies for technological innovation of SMEs: tax-freedom, tax reduction, tax credit, and tax exception.

Hall [57] claims that tax exemption benefits are more effective than subsidies. According to Guellec and Van Pottelsberghe De La Potterie [58], tax incentives have an immediate and positive effect on R&D. They argue that tax incentive policies become more effective over time. The tax support policy is considered to be effective in inducing firm innovation because it helps to reduce the financial burden of firms and strengthen investment. Therefore, this study proposes the following hypothesis for the study of food SMEs:

Hypothesis 1 (H1). *Government tax support for food SMEs has a positive effect on innovation performance.*

2.2. Subsidy

The government pays the research expenses of research institutes without compensation in order to realize national projects. Subsidy policy allows the government to designate R&D tasks and support all, or part of, the R&D expenses of a project or to develop research in the field of science and technology with public funds. The government promotes technology development by supporting subsidies for projects of strategic importance. The Korean government subsidizes the development of original technology and creation of new products and services; it particularly focuses on promising fields such as biotechnology, medical technology, nanotechnology, information technology (IT), computing technology, technology for climate change response, and information and communication technology (ICT) convergence infrastructure establishment.

Patel and Pavitt [59] argue that government subsidies, as assistance for the market mechanism, could reduce the risk for SMEs, improve risk mitigation capabilities, and optimize innovation resource allocation to encourage SMEs to increase R&D investment. Alecke, Reinkowski, Mitze, and Untiedt [60] find that subsidized firms have a higher level of R&D intensity and patent filing potential than non-subsidized firms. However, Guan and Yam [61] argue that direct subsidies fail to improve firms' innovation performance and may even have a negative effect. Therefore, this study proposes the following hypothesis to determine the relationship between government subsidies and innovation performance.

Hypothesis 2 (H2). *Government subsidy to food SMEs has a positive effect on innovation performance.*

2.3. Financial Support

The government invests in firms for technology development or lends business expenses [62]; it operates a system that guarantees technology. The government supports innovation through investments, loans, interest support, and guarantees in the case of Korea. It supports start-up firms to realize technology commercialization as well as emergency management. The government supports intangible technologies possessed by firms with weak collateral capabilities in receiving loans from financial institutions by issuing a technology guarantee. Thus, the government implements various financial support policies for firms' technology innovation.

SMEs are at a disadvantage compared with large firms in determining loan financing because of their double liabilities: newness and smallness [63]. The government is a stakeholder that provides financial resources to SMEs in order to promote regional economic development [64]. Government financial support is critical to SMEs' innovation. Thus, the government provides financial support by selecting SMEs that meet public goals.

Bradford and Chen [65] find that government credit guarantees for SMEs ease funding pressures and help these firms acquire loans from financial institutions. Martí and Quas [66] show that government loan funding to SMEs has a positive effect on improving access to external sources. Government financial support is essential for enhancing the innovation performance of SMEs. Therefore, this study proposes the following hypothesis to examine the relationship between government financial support and SMEs' innovation performance.

Hypothesis 3 (H3). *Government financial support to food SMEs has a positive effect on innovation performance.*

2.4. Human Resource Support

Human resources are critical to organizational performance [67], and having especially skilled human resources is a major factor in securing a competitive advantage [68]. According to the resource-based view, the difference in performance among companies can be attributed to the difference in their human resources; the knowledge of specialized personnel is a resource that cannot be easily imitated or replaced [69].

Although SMEs create jobs and seek to stabilize the job market [70], they have difficulties in recruiting and retaining human resources [71]. To overcome this predicament, the government supports workers who join SMEs through alternative military service program, funding for research staff, operating of assistant program for recruiting, reemployment.

Almus and Czarnitzki [72], as well as González and Pazó [73], demonstrate that government human resource support has a positive effect on firm's R&D investment. A highly trained and skilled research personnel enhances firm performance through establishing innovative R&D activities. Therefore, this study proposes the following hypothesis:

Hypothesis 4 (H4). *Government human resource support to food SMEs has a positive effect on innovation performance.*

2.5. Technology Support

Firms compensate for scarce resources and capabilities through networks, although SMEs have difficulty forming such networks. SMEs do not have sufficient infrastructure to develop the next level of technology, limiting their own success [74]. SMEs in such need of cooperative networks should be trusted to receive support through the government [75]. Such networks can benefit innovation performance.

The government's technical support for SMEs can be divided into technology development, technology commercialization, technology transfer, and patent strategy. Such support increases the success rate of technology development [76]. In a study of Chinese manufacturing firms, Guan, Mok, and Yam [77] suggest that simple acquisition of technology equipment cannot improve innovation performance. The government can promote the commercialization of competing technologies of SMEs or improve the commercialization of technologies by developing competitive products based on the same technologies [78]. Therefore, this study proposes the following hypothesis:

Hypothesis 5 (H5). *Government technology support to food SMEs has a positive effect on innovation performance.*

2.6. Certification Support

The government supports the certification of SMEs-for both firms and technology products to address information asymmetry in SMEs [79]. For firm certification, the Korean government operates a company-affiliated research institute/R&D dedicated department, a venture business confirmation, INNOBIZ (Certification for technology innovative SMEs), and MAINBiz (Certification for management innovative SMEs). As for the technology product certification system, a New Excellent Technology (NET), New Excellent Product (NEP), and a green certification are in operation. In addition, Hazard Analysis Critical Control Point (HACCP) and Good Manufacturing Practice (GMP) are important certifications in the food industry.

Certification is often presented as a solution to the problem of information asymmetry. It is not known whether value chain certification actually guarantees high quality, but in Europe, the introduction of certification into agro-food businesses is increasing in recent years [80]. When service quality parameters cannot be directly observed, service providers use third-party quality certification [81]. Podolny [82] argues that the quality certification mechanism is claimed to be effective in reducing the marketing cost of the firm. In addition, certification helps firms adopt better resources and also helps them impose premiums on customers [83]. In the stage of export or initial delivery by SMEs, certification can be

a means of increasing the reliability of firms [84]. As such, various certification support policies for SMEs are in effect, and thus this study proposes the following hypothesis:

Hypothesis 6 (H6). *Government certification support to food SMEs has a positive effect on innovation performance.*

2.7. Purchasing Support

The government strategically uses public demand to secure sales channels for SMEs [85]. The government drives the innovation of SMEs using public demand [86]. To support the sales channels of SMEs, the Korean government operates a system that directly purchases SMEs products or recommends public institutions to purchase it; this system labels such products for their high quality.

The government requires public institutions to purchase technology products developed and even patented by SMEs. If the items to be purchased by public institutions have NEP certification, the institution is expected to purchase at least 20% of total items as certified new products.

As a major consumer of goods and services, the government seeks opportunities to directly support SMEs through purchasing policies [87]. The government operates a system that designates products with excellent technology and high quality among SMEs' products and then procures them for institutions under the national contract law. Various certification support policies for SMEs are in effect, and thus this study proposes the following hypothesis:

Hypothesis 7 (H7). *Government purchasing support to food SMEs has a positive effect on innovation performance.*

2.8. Factors Affecting Government Support for SMEs

Because SMEs contribute to the national economy, the government supports their dynamic role at the local, regional, and national levels [43]. While there are firms that seek to receive government support, the government can only provide limited resources. Indeed, governments strictly review various factors when selecting to support a firm. Usually, because governments cannot obtain complete information on SMEs, it is difficult to determine which SMEs most deserve higher supports; such limitations keep government supporting resources from achieving optimal allocation [88].

When intervening in firm innovation, it is important for the government to achieve its policy goals by efficiently allocating limited budgets [89]. To improve the innovation performance of firms, the government reviews and supports the factors that influence innovation despite limited information. This study discussed the factors that influence firm innovation in the following subsections.

2.8.1. Firm Age

Avermaete, Viaene, Morgan, and Crawford [90] state that the history of a company has some influence on innovation as well as the size of the company and the performance of the local economy. Older firms seem to have more stable management than startups. Hansen [91] suggests that firm age tends to be inversely proportional to innovative outputs. Winters and Stam [92] find that there is a negative relationship between firm age and product innovation.

Withers, Drnevich, and Marino [93] find that in a sample study of 676 SMEs in the US, when both young and old firms have highly developed innovation capabilities, older firms have a higher level of innovation activity than younger firms. However, they generally find that when no firm has the ability to innovate, younger firms have a higher level of innovation activity than older firms.

2.8.2. Location in Metropolitan Area

Innovative regions, high-technology areas, clusters of knowledge-based industries, and knowledge spillovers [94,95] are important in innovation systems. Supporting innovation activities at the national level differs between regions, and the observed innovation activities differ by region [96].

In terms of the knowledge-based environment in which a firm operates, Edwards, Delbridge, and Munday [97] find that SMEs are good at seizing the benefits of networking for innovation and using the external economy in a more innovative environment. The proximity of large corporations and universities to R&D centers [98–100] is also an important factor to consider.

2.8.3. Protection of Intellectual Property

As a source of competitive advantage for firms, intellectual property (IP) is increasingly attractive, and it becomes an essential element for all economic actors [101]. Obtaining information on relevant laws, taxes, customs regulations, business advisory services, educational opportunities, and sources of financing to construct a network of information can be both time-consuming and costly for firms [102]. It is undeniable that constructing an information network for SMEs is one of the key elements in supporting SMEs [103]. In Korea, the Korean Intellectual Property Office, government agencies supporting SMEs and chambers of commerce are scattered. Supporting SMEs' IP creation, IP acquisition cost reduction, and IP market revitalization are key considerations [104].

2.8.4. Regulation on Large Firms

SMEs benefit from large firms through a number of methods. In addition, SMEs play the key role of suppliers to large firms [105]; although large firms outperform SMEs in terms of innovative capabilities, the technology transfer process can be improved through supplier–buyer linkages [106].

There are technological differences between large firms and SMEs, so their competitiveness is different [107]. In a free market economy, large firms could freely conduct business activities; however, the specific business areas of SMEs need to be protected. Korea restricts the entry of large firms into the market by designating certain industries as suitable for SMEs. Such industries are protected, and the government actively discourages large firms from withdrawing or expanding their business through consultations between large firms and SMEs for the next three years [107]. The purpose of this system is to present various criteria for the division of roles through social consensus and to provide opportunities for SMEs to secure competitiveness, given that the indiscriminate entry of large firms can harm the business of SMEs [108].

2.8.5. Regulation for Customer Safety

Customer safety and hygiene regulations, along with occupational safety and health regulations, are one of the most influential factors in innovation in the manufacturing sector [109,110].

Since food is consumed directly by consumers, this industry has the most regulations on customer safety. Basic hygiene regulations must be observed in the food manufacturing industry. The government regulates food firms to practice quality hygiene as stipulated under the HACCP and GMP [111]. It is mandatory to operate a hygiene program for products that are consumed by the public and have a high risk of harm.

2.8.6. Certification

Start-ups or SMEs face information asymmetry problems owing to their lack of resources and uncertain portfolio [112]. As a result, the business of these firms is less likely to succeed, creating a vicious cycle that is not attractive to investors. The government can solve the problem of information asymmetry by granting certification to firms with high growth potential [79].

The Korean government offers firms venture certification [67], MAINbiz [113], and INNOBIZ [114]. Venture certification is given to firms that satisfy one of the following three conditions: venture-invested firms, R&D-invested firms, and excellent technology evaluation firms [115]. MAINBiz fosters innovative SMEs and evaluates innovation [91] and leaders in the organization. INNOBIZ is based on the Oslo Manual and is given to firms with technology with high future growth potential [114]. It uses an index that evaluates the technology of the firm.

2.8.7. Licensing

Licensing is a method of contractually combining resources [116] across firm boundaries; licensors provide technology and licensees provide complementary assets [117] such as sales and distribution channels. It is one of the easiest ways to leverage external research results [118], but it requires paying a fund the value of the license. Commercialization of technology transferred by the purchase of licenses [119] requires marketing capabilities to understand customer needs for identifying, evaluating, and selecting licenses and negotiating license agreements [120].

2.8.8. Procurement

To support the nation's growth engine through innovation, the Korean government strives to facilitate and spread the innovation of private entities [121], such as firms in public demand [86]. In this context, the Public Procurement of Innovation (PPI) is in effect. The amount spent on public procurement in Korea is about USD 112 billion (as of 2018), accounting for about 7% of GDP. From this, USD 4 billion is being used for public purchases made for technology development products of SMEs [122]. The EU also strategically exploits public demand, which accounts for about 16% of GDP [85].

3. Methodology

3.1. Data

This study used the data based on KIS 2018 conducted in 2018. KIS 2018 is a survey on firm-level innovation activities designed according to the OECD Oslo Manual. KIS is conducted by the STEPI every two years, starting from 1996, on domestic manufacturing and service firms with 10 or more regular employees engaged in firm activities for three years prior to the survey year. The sample of KIS 2018 was 3500 firms extracted from 23 manufacturing industries (excluding tobacco manufacturing) and 3500 firms extracted from 33 service industries (excluding public administration, national defense and social security administration) using a multi-stage stratified system extraction method. The KIS 2018 survey was conducted based on business operation and innovation activities from 2015 to 2017. In principle, an online survey and a fax survey were conducted simultaneously. The KIS data is possible to refer to previous studies using the EU Community Innovation Survey; it has the advantage of allowing us to compare it with international statistics such as OECD and European Statistical Office on firm's innovation activities.

This study selects firms classified as SMEs among food and beverage manufacturing industries from the KIS 2018. Food and beverages are separated and aggregated from the data. Since food and beverages can be classified into the same category, this study did not separately classify the "beverage" category, but integrated and analyzed it into one category called "food". The total number of food firms in the manufacturing sector surveyed is 224. The study analyzed data from all 204 food SMEs, excluding 20 large firms. Table 1 presents the basic information on the data: The average history of firms was 15.2 years. The number of workers was an average of 69.8 as of 2017, and the ratio of dedicated R&D personnel was 7.3% as of 2017.

Table 1. Descriptive information on the food SMEs.

Characteristics	Number	Percentage
Size (number of employees, as of 2017)		
≤100	163	79.9
101~300	39	19.1
>300	2	1
Firm age (years since foundation)		
Young (≤20)	154	75.5
Established (>20)	50	24.5
Region		
Metropolitan area		
- Seoul	3	1.5
- Incheon	7	3.4
- Gyeonggi	61	29.9
Others	133	65.2
Ration of R&D labor (as of 2017)		
0	106	52
<3	4	2
3~5	19	9.3
5~10	47	23
>10	26	12.7

3.2. Variables

This study examines the effect of government's support on firm's innovation performance, which are classified as process innovation, product innovation, marketing innovation, and organization innovation. This study measured the four types of innovation performance and treated it as the dependent variable.

This study used a two-stage regression estimation model. In the first stage regression, the following eight variables were used as the instrumental variable or control variable; firm age, positioning in metropolitan, protection of intellectual property (IP), regulation on large firms, regulation for customer safety, retention of certification, acquisition of license, and experience in procurement. When the endogenous variables determined by each significant instrumental variable in second stage were applied, the remaining seven variables were used as control variables.

The explanatory variable estimated by the instrumental variable is used as an explanatory variable in the second stage regression.

Table 2 summarizes the definitions of the variables.

Table 2. Operational definitions of variables.

Variable	Definition
age	Firm's history as of 2018, 2018—(Firm's founding year)
metropl	Position in metropolitan (Seoul, Incheon, Gyeonggi) (1), or not (0)
ip_protect	Counting the record of protecting innovation performance: Sum of intellectual property protection method: (a) patent application, (b) utility model right, (c) design right, (d) trademark right, (e) trade secret, (f) copyright, (g) complex design method, (h) market preoccupation (min sum and max sum score)
large_reg	The effect of restrictions on the entry of large firms into the sectors suitable for SMEs on innovation activities; greatly promoted(5), somewhat promoted(4), no influence(3), somewhat inhibited(2), very inhibited(1)

Table 2. *Cont.*

Variable	Definition
safe_reg	Impact of customer safety and Hygiene Regulations (Product Liability Act, Food Sanitation Act) on innovation; greatly promoted(5), somewhat promoted(4), no influence(3), somewhat inhibited(2), very inhibited(1)
certi	Total number of certifications held: (a) Venture business, (b) R&D dedicated department, (c) Inno-biz, (d) Main-biz, (e) Green-biz, (f) Company specialized in parts and materials (min sum and max sum score)
license_in	Acquisition of external intellectual property rights(1), or not(0)
procure	Performance procured to the domestic public sector(1), or not(0)
g_tax	Importance of government support by tax: high(4), normal(3), low(2), not important or not used(1)
g_subsidy	Importance of government support by subsidy: high(4), normal(3), low(2), not important or not used(1)
g_finance	Importance of government support by financial support: high(4), normal(3), low(2), not important or not used(1)
g_manpw	Importance of government support by human resource: high(4), normal(3), low(2), not important or not used(1)
g_tech	Importance of government support by technology: high(4), normal(3), low(2), not important or not used(1)
g_certi	Importance of government support by certification: high(4), normal(3), low(2), not important or not used(1)
g_buy	Importance of government support by purchasing: high(4), normal(3), low(2), not important or not used(1)
innovation	Success of innovation (1) (It means that at least one of the four types of innovation has succeeded; process innovation, product innovation, marketing innovation, or organization innovation), or not(0)

3.3. Analytic Model

This study used the ordinary least square (OLS) estimation model to examine the effect of government support on firm's innovation performance, with other explanatory variables such as government regulation and internal R&D. The OLS regression is as follows:

$$IP_i = \alpha + \beta GS_{ti} + \gamma age_{1i} + \delta metropl_{2i} + \varepsilon ip\_protect_{3i} + \theta large\_reg_{4i} + \lambda safe\_reg_{5i} + \mu certi_{6i} + \pi license\_in_{7i} + \psi procure_{8i} + \sigma_i \quad (1)$$

In the above equation, *IP* is firm's innovation performance; *GS* indicates government support, which is the primary explanatory variable. The variable *age* refers to the firm's age; *metropl* indicates the firm's positioning in a metropolitan area. *ip_protect* represents the firm's protection of IP; *large_reg* indicates regulation on large firms; *safe_reg* refers to regulation for customer safety; *certi* represents firm certification; *license_in* refers to acquisition of a license; *procure* indicates domestic procurement of the firm; i indicates individual firm and t refers to the type of government support; α is a constant; β, γ, δ, ε, θ, λ, μ, π, and ψ are the estimated coefficients; σ is an error term. This study aims to estimate β, which determines the effect of government support on a firm's innovation performance. If *GS* is strictly exogenous, then this study can estimate *GS* using the OLS estimation.

However, this results in an endogeneity problem, which may bias the results of estimation, for two reasons: First, collaboration with other organization affects both government support and innovation performance. The more firms cooperate with other organizations, the more government support will increase innovation performance. Second, a reverse causality may arise, where firms that already have high innovation performance may receive more support from the government.

This study adopted a two-stage regression model using instrumental variables to overcome the endogenous problem. It is important to determine the instrumental variable for the regression. Hence, this study selected eight variables among the variables that can affect government support and conducted an ordered logistic regression to determine the instrumental variable for each type of government support. Then, this study proceeded with a two-stage regression.

The instrumental variables for each type of government support were determined by the ordered regression, as shown in Table 3.

Table 3. Ordered logistic regression for determination of instrumental variables.

Variables	g_tax	g_subsidy	g_finance	g_manpw	g_tech	g_certi	g_buy
age	0.006	0.016	−0.020	−0.003	−0.013	0.003	−0.023
	(0.011)	(0.011)	(0.013)	(0.011)	(0.011)	(0.011)	(0.014)
metropl	0.072	−0.573	−1.766 ***	−0.889 ***	−0.847 ***	−0.245	−1.496 ***
	(0.337)	(0.338)	(0.414)	(0.312)	(0.328)	(0.322)	(0.432)
ip_protect	0.160	0.149	0.236 *	0.264 ***	0.375 ***	0.341 ***	0.399 ***
	(0.107)	(0.102)	(0.103)	(0.0970)	(0.103)	(0.104)	(0.116)
large_reg	1.022 ***	0.641 *	0.500	0.783 ***	0.285	−0.115	0.922 ***
	(0.331)	(0.286)	(0.265)	(0.275)	(0.309)	(0.280)	(0.312)
safe_reg	−0.447 *	−0.341 *	−0.252	0.210	1.037 ***	0.925 ***	−0.116
	(0.185)	(0.170)	(0.177)	(0.156)	(0.184)	(0.172)	(0.191)
certi	0.868 ***	0.0761	−0.221	−0.270	0.361	0.845 ***	−0.260
	(0.325)	(0.291)	(0.317)	(0.286)	(0.282)	(0.310)	(0.332)
license_in	1.414 *	0.195	−0.462	−0.876	0.974	−0.509	0.171
	(0.570)	(0.584)	(0.663)	(0.630)	(0.621)	(0.588)	(0.595)
procure	0.561	1.032 *	0.598	0.596	0.415	0.410	1.045 *
	(0.464)	(0.460)	(0.487)	(0.442)	(0.467)	(0.457)	(0.493)
χ^2	59.03 ***	38.61 ***	49.83 ***	31.73 ***	77.46 ***	77.15 ***	60.70 ***
Observations	204	204	204	204	204	204	204

Note: Standard deviation is in parentheses, *** $p < 0.001$, * $p < 0.05$.

The candidates of instrumental variables determined by the results of the ordered logistic regression are summarized in Table 4.

Table 4. Summary on the candidates of instrumental variables.

Endogenous Variable	Candidates of Instrumental Variable
g_tax	large_reg, safe_reg, certi, license_in
g_subsidy	large_reg, safe_reg, procure
g_finance	metropl, ip_protect
g_manpw	metropl, ip_protect, large_reg
g_tech	metropl, ip_protect, safe_reg
g_certi	ip_protect, safe_reg, certi
g_buy	metropl, ip_protect, large_reg, procure

However, as a result of OLS regression to confirm the instrumental, *ip_protect*, *safe_reg*, and *license_in* directly affect innovation performance, so they are excluded from the instrumental variable. Table 5 shows the result of OLS regression for innovation performance.

The instrumental variables determined by the results of the ordered logistic regression and the corresponding explanatory variables are summarized in Table 6.

Table 5. Result of OLS regression for confirming the instrumental variables.

Variable	OLS
age	0.003 (0.006)
metropl	0.013 (0.186)
ip_protect	0.134 * (0.057)
large_reg	−0.113 (0.147)
safe_reg	0.921 *** (0.092)
certi	0.326 (0.171)
license_in	0.935 ** (0.359)
procure	0.212 (0.272)
Constant	−1.334 * (0.610)
Observations	204
R-squared	0.488

Note: Standard deviation is in parentheses, *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Table 6. Summary on the determined instrumental variables.

Endogenous Variable	Instrumental Variable
g_tax	large_reg, certi
g_subsidy	large_reg, procure
g_finance	metropl
g_manpw	metropl, large_reg
g_tech	-
g_certi	certi
g_buy	metropl, large_reg, procure

The variables *age* and *license_in* estimated to affect only a single endogenous variable were excluded from the analytic model according to the results of ordered logistic regression. The two-stage regression model using instrumental variables is as follows.

$$f(GS_{ti}) = a_0 + a_1 Z_i + a_2 X_{1i} + a_3 X_{2i} + a_4 X_{3i} + a_5 X_{4i} + a_6 X_{5i} + \omega_i \quad (2)$$

$$IP_i = \alpha + \beta f(GS_{ti}) + \gamma X_{1i} + \delta X_{2i} + \varepsilon X_{3i} + \lambda X_{4i} + \mu X_{5i} + \sigma_i \quad (3)$$

In Equations (2) and (3), a_0 is a constant; a_1, a_2, a_3, a_4, a_5, and a_6 refer to the estimated coefficients; ω is an error term; Z represents the instrumental variable, and *f(GS)* refers to an explanatory variable based on the result of the first stage regression. X_1, X_2, X_3, X_4, and X_5 are *metropl*, *ip_protect*, *large_reg*, *safe_reg*, *certi*, *or procure*, respectively. One of them is used as instrumental variable. After adopting it as the instrumental variable, others are used as control variables in the second stage.

4. Results

Table 7 summarizes the mean and standard deviation of the variables for the study on effective type of government support.

Table 8 shows the results of analyzing the correlation between variables. If the correlation between variables is 0.8 or more, there exists a risk of multicollinearity. The analysis result shows that the correlation coefficient was less than 0.8, indicating no variable with multicollinearity.

Previously, this study identified factors that determine government support, an endogenous variable, through logistic regression analysis. After setting the factor as an instrumental variable for each endogenous variable, two-stage regression analyses were conducted, as shown in Table 9. Columns 1, 4, 7, 9, 12, 13, and 15 in Table 9 report the results of the standard OLS estimates with positioning in metropolitan, protection of IP, regulation, regulation on large firms, regulation for customer safety, certification, and procurement. Column 2 and 3 in Table 9 presents IV estimates to be compared to the OLS presented in Column 1. The following columns are presented in the same way as above; column 4 to column 5 and 6, column 7 to column 8, column 9 to column 10 and 11,

column 13 to column 14, column 15 to column 16, 17, and 1718. Since *g_tech* does not have an appropriate instrumental variable, it is presented only in OLS estimate without an IV estimate to compare with it in column 12.

According to the result of OLS regression, government technical support increases the innovation performance of food SMEs ($p < 0.001$). However, this study does not claim its results, as the *g_tech* variable is likely to be endogenous, the OLS estimates may be biased. Although out of the significance level ($p > 0.05$), the two-stage regression shows that the government tax support, financial support, and human resource support each have negative effects on increasing the innovative performance of food SMEs.

In the result of two-stage regression, of the seven types of support investigated in this study, only government certification support was found to have a positive effect on increasing the innovation performance of food SMEs ($p < 0.05$). The results of this study through two-stage regression are summarized in Table 10.

Table 7. Descriptive statistics (N = 204).

Variable	Mean	Standard Deviation	Minimum Value	Maximum Value
metropl	0.313	0.465	0	1
ip_protect	0.955	1.585	0	8
large_reg	1.818	0.628	1	5
safe_reg	2.328	1.009	1	5
certi	0.372	0.542	0	4
procure	0.122	0.328	0	1
g_tax	1.750	1.065	1	4
g_subsidy	1.833	1.106	1	4
g_finance	1.750	1.046	1	4
g_manpw	1.911	1.013	1	4
g_tech	2.029	1.068	1	4
g_certi	2.140	1.163	1	4
g_buy	1.598	0.923	1	4
innovation	1.808	1.590	0	4

Table 8. Correlation coefficients between variables (N = 204).

Variable	g_tax	g_subsidy	g_finance	g_manpw	g_tech	g_certi	g_buy	metropl	ip_protect	large_reg	safe_reg	certi	procure
g_tax	1												
g_subsidy	0.503 ***	1											
g_finance	0.465 ***	0.559 ***	1										
g_manpw	0.522 ***	0.545 ***	0.685 ***	1									
g_tech	0.348 ***	0.287 ***	0.363 ***	0.421 ***	1								
g_certi	0.299 ***	0.248 ***	0.247 ***	0.328 ***	0.753 ***	1							
g_buy	0.553 ***	0.604 ***	0.629 ***	0.672 ***	0.536 ***	0.434 ***	1						
metropl	−0.099	−0.185 **	−0.323 ***	−0.254 ***	−0.098	0.063	−0.289 ***	1					
ip_protect	0.282 ***	0.206 **	0.198 **	0.227 **	0.346***	0.297 ***	0.341 ***	−0.128	1				
large_reg	0.314 ***	0.275 ***	0.260 ***	0.268 ***	−0.029	−0.159 *	0.298 ***	−0.208 **	0.051	1			
safe_reg	−0.198 **	−0.224 **	−0.225 **	−0.092	0.383 ***	0.429 ***	−0.143 *	0.262 ***	0.034	−0.394 ***	1		
certi	0.273 ***	0.104	0.017	0.069	0.295 ***	0.352 ***	0.094	−0.075	0.317 ***	−0.003	0.198 **	1	
procure	0.270 ***	0.259 ***	0.118	0.150 *	0.158 *	0.147 *	0.228 **	0.005	0.208 **	0.203 **	0.012	0.323 ***	1

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$.

Table 9. Innovation performance by government support.

Variable/ Type of Analytic Method	OLS	IV large_reg	IV Certi	OLS	IV large_reg	IV procure	OLS	IV metropl	OLS	IV metropl	IV large_reg	OLS	OLS	IV Certi	OLS	IV metropl	IV large_reg	IV procure
g_tax	0.126 (0.088)	−0.186 (0.664)	0.748 (0.487)															
g_subsidy				0.040 (0.082)	−0.267 (0.978)	0.414 (0.444)												
g_finance							0.113 (0.087)	0.018 (0.304)										
g_manpw									0.170 (0.088)	0.023 (0.393)	−0.196 (0.725)							
g_tech												0.430 *** (0.088)						
g_certi													0.247 ** (0.084)	0.727 * (0.379)				
g_buy															0.005 (0.104)	0.024 (0.408)	−0.229 (0.840)	0.667 (0.779)
metropl	−0.018 (0.188)	0.003 (0.172)	−0.061 (0.198)	−0.001 (0.190)	−0.070 (0.310)	0.084 (0.202)	0.054 (0.195)		0.065 (0.191)		−0.096 (0.397)	0.139 (0.181)	−0.011 (0.185)	−0.013 (0.191)	−0.008 (0.194)		−0.107 (0.428)	0.272 (0.371)
ip_protect	0.167 ** (0.056)	0.206 (0.111)	0.088 (0.105)	0.179 *** (0.056)	0.210 (0.126)	0.141 * (0.070)	0.171 ** (0.056)	0.181 ** (0.066)	0.163 ** (0.056)	0.180 (0.073)	0.206 (0.111)	0.106 (0.055)	0.144 * (0.056)	0.068 (0.102)	0.182 ** (0.058)	0.179 * (0.091)	0.222 (0.164)	0.070 (0.151)
large_reg	−0.116 (0.151)		−0.349 (0.301)	−0.079 (0.150)		−0.177 (0.277)	−0.097 (0.149)	−0.074 (0.270)	−0.130 (0.150)	−0.078 (0.307)		−0.132 (0.141)	−0.055 (0.145)	−0.026 (0.207)	−0.071 (0.152)	−0.077 (0.298)		−0.272 (0.351)
safe_reg	0.962 *** (0.094)	0.907 *** (0.219)	1.072 *** (0.116)	0.946 *** (0.094)	0.895 *** (0.258)	1.008 *** (0.135)	0.951 *** (0.094)	0.941 *** (0.123)	0.931 *** (0.093)	0.938 *** (0.116)	0.949 *** (0.107)	0.745 *** (0.097)	0.835 *** (0.098)	0.630 *** (0.211)	0.940 *** (0.094)	0.940 *** (0.116)	0.939 *** (0.126)	0.943 *** (0.110)

Table 9. *Cont.*

Variable/ Type of Analytic Method	OLS	IV large_reg	IV Certi	OLS	IV large_reg	IV procure	OLS	IV metropl	OLS	IV metropl	IV large_reg	OLS	OLS	IV Certi	OLS	IV metropl	IV large_reg	IV procure
certi	0.257	0.386		0.308	0.319	0.294	0.322	0.311	0.322 *	0.311	0.295	0.225	0.204		0.310	0.312	0.286	0.377 *
	(0.175)	(0.306)		(0.172)	(0.175)	(0.162)	(0.172)	(0.163)	(0.171)	(0.163)	(0.190)	(0.163)	(0.172)		(0.173)	(0.164)	(0.208)	(0.180)
procure	0.223	0.345	−0.019	0.246	0.448		0.245	0.268	0.230	0.267	0.321	0.205	0.237	0.168	0.270	0.263	0.366	
	(0.276)	(0.414)	(0.431)	(0.281)	(0.759)		(0.275)	(0.292)	(0.274)	(0.296)	(0.369)	(0.260)	(0.270)	(0.362)	(0.279)	(0.319)	(0.488)	
Constant	−1.562 *	−1.268	−2.148 *	−1.504 *	−1.035	−2.077	−1.611 **	−1.470	−1.575	−1.461	−1.291	−1.426	−1.583 **	−1.855 *	−1.447 *	−1.460	−1.279	−1.921
	(0.607)	(1.631)	(0.995)	(0.617)	(2.500)	(1.126)	(0.615)	(0.983)	(0.602)	(0.952)	(1.577)	(0.570)	(0.593)	(0.856)	(0.609)	(0.952)	(1.613)	(1.038)
Observations	204	204	204	204	204	204	204	204	204	204	204	204	204	204	204	204	204	204
R-squared	0.474	0.441	0.343	0.469	0.432	0.413	0.473	0.470	0.478	0.471	0.432	0.526	0.491	0.405	0.469	0.468	0.455	0.358

Note: *** $p < 0.001$, ** $p < 0.01$, * $p < 0.05$, Instrumental Variable Estimation (IV).

Table 10. Results for the study on effective type of government support.

H	Path	Result	Significance	Effect
H1	Tax support → Innovation performance	Not supported	$p > 0.05$	Negative
H2	Subsidy → Innovation performance	Not supported	$p > 0.05$	-
H3	Financial support → Innovation performance	Not supported	$p > 0.05$	Negative
H4	Human resource support → Innovation performance	Not supported	$p > 0.05$	Negative
H5	Technical support → Innovation performance	Not supported	$p > 0.05$	-
H6	Certification support → Innovation performance	Supported	$p < 0.05$	Positive
H7	Purchase support → Innovation performance	Not supported	$p > 0.05$	-

Note: H, Hypothesis.

5. Discussion

The results of this study are different from previous studies reviewed above: Guellec and Van Pottelsberghe De La Potterie [58], Martí and Quas [66], Almus and Czarnitzki [72], as well as González and Pazó [73]. In this study, tax support and financial support for food SMEs have a negative effect on increasing innovation performance, although it is out of significance. This study proves that tax support, financial support, and human resource support, which are usually one of the most core forms of government support for SMEs, have at least no effect on the creation of innovative performance of food SMEs.

Additionally, contrary to the arguments of Patel and Pavitt [59], Alecke, Reinkowski, Mitze, and Untiedt [60], and Guan and Yam [61], this study did not present that government subsidies to food SMEs had any effect on increasing innovation performance. Further study is needed on the effect of subsidy on innovation performance.

Guan, Mok, and Yam [77] stated that the government's technical equipment support had limitations in improving innovative performance. SMEs have difficulties in securing promising technologies due to lack of resources and capabilities. The government disseminates technology to supplement such areas, but it is not easy to secure competitiveness in the market with the degree of technology supported by the government. This study did not prove the effect of the government's technical support for SMEs on the innovation performance. It is also an area that requires further study.

The government opens the public sector as a sales channel for SMEs [85] and leads the innovation of SMEs by that channel [86]. The public sector can generate a certain amount of revenue as it becomes a stable source of demand for SMEs. SMEs will make efforts to increase innovation performances to meet the conditions of public procurement. This study did not prove that SME support by public procurement had any effect on innovation performance. Guerzoni and Raiteri [123] argued that public procurement is more effective than any other tool; it does not seem to be true for SMEs in food latecomers such as Korea. It is estimated that SMEs cannot have a food safety easily enter the public procurement sector due to the nature of public procurement that emphasizes food safety.

A characteristic of the Korean food industry is that, unlike developed countries, the proportion of SMEs is extremely large. In order to develop the food industry, it is important to support SMEs. Government and firms need to pay attention to the effect of government support on food SMEs' certification is significant in the Korean context. Just as venture capital firms identify the potential of startups by acting as scouts and coaches for them [124], when governments support food SMEs according to the certification system, government could be expected to serve most effectively as scouts and coaches to SMEs. Therefore it is necessary to expand certification support that can maximize the scouting effect in order for SMEs to have competitiveness in the food industry.

According to Kakouris and Sfakianaki [125], certified firms in the food industry benefit from quality awareness, increased productivity, improved workforce engagement and efficiency, improved image, and new markets entered. These advantages are directly related to competitiveness in the market. Therefore, if the government supports the

certification project of food SMEs, it can be expected to produce a significant behavioral additionality effect [126].

In addition, customer requirements are the main motivation for food SMEs to implement a certification system such as HACCP [127]. Certification for SMEs is one of the most important information for consumers in food choice. Certification can create a competitive advantage for certified firms by reducing information asymmetry in the supply chain [128]. When food SMEs send a signal of 'certification' [129] to their own organization, it can activate innovation activities. In addition, this will be a driving force to induce more choices from consumers.

6. Conclusions

The study on effective types of government support analyzed what types of government support increased the innovation of food SMEs using data from 204 food SMEs, from the KIS 2018. Since research on firms' open innovation strategies shows that government support did not promote R&D investment and cooperation with other firms, it was necessary to determine what types of government support would increase SME innovation. There are seven types of government support for SMEs; tax support, subsidy, financial support, human resource support, technical support, certification support, and purchase support. However, there is an endogeneity between the government support and firm innovation performance. To solve the endogenous problem, this study used a two-stage regression. An instrumental variable was used to control endogeneity. By determining instrumental variable, this study used an ordered logistic regression and OLS regression on the possible variables. The following three instrumental variables were identified: location in metropolitan area, regulation on large firm, retention of certification, and experience in procurement. The result of two-stage regression using these instrumental variables shows government certification support only have a positive effect on increasing innovation performance of food SMEs.

The study is a study on the targets of SMEs promoting open innovation to increase innovation performance. The study on effective type of government support is a study on the relationship between the form of government support and innovation performance. Government support is critical to SMEs that lack the resources and capacity for innovation. As argued by Jeong and Shin [130] regarding food firms' open innovation strategies, government support for food SMEs is not adequately effective. The government support failed to increase R&D investment and cooperation with other firms, which, in turn, did not lead to an increase in innovation performance. As confirmed in the study on effective type of government support, all forms of government support are not effective for food SMEs. Whether other types of government support had an effect on the improvement of innovation performance of SMEs, except for the certification support, is not clear within a meaningful significance. What this study supports is that certification support for SMEs in the food industry increases the innovation effect.

Government support to SMEs should be strengthened, centering on certification support, the identified support type from this study. In the institutional aspect of certification, the government should support the integrated operation of general management systems (MainBiz, InnoBiz, etc.) or food firm-specific certifications (HACCP, GMP, ISO22000, etc.) when supporting food SMEs. If each certification system is operated individually within the firm, unnecessary tasks for each certification increase and go against innovation. Therefore, it is necessary to develop an integrated certification operation model suitable for food firms through cooperation among government departments.

The government should support each firm's members to increase their understanding of the certification system. Firms that will operate the certification system have to apply the generally presented principles according to their own circumstances, but SMEs that lack competence inevitably have difficulties in applying them. The government needs to provide an education system that enables organizations related to certification of food SMEs to increase their understanding of the certification system.

The government should support food SMEs to enhance the risk management capability of the certification system. The value chain of the food industry involves various stakeholders, from manufacturing to distribution [131], and accordingly, various risks exist. New risks such as environmental factors and legal regulations also threaten the food business. The government should activate a prompt and accurate information-sharing platform so that it can respond to these various risks properly through the certification system.

This study has following contributions. This study explored the determinants of innovation in food SMEs in a latecomer country in order to suggest more targeted policy suggestions, where most research focuses on large firms in advanced economies [131]. Overall, this study studied the innovation strategies in the food industry's value chain for industrial development in Korea, a latecomer to the food industry. The insights from this work have policy implications in terms of firm survival based on the relationship between innovation strategies and SMEs. In particular, this study implies that the effects of adopting innovation strategies may differ depending on the size of firms. Since most literature is focused on large firms, this study can offer managerial and policy implications for SMEs. Finally, this study is applicable beyond its Korean context.

Despite novel results and policy implications from this study, as discussed in the previous section, there are some limitations to the study. First, this study used data on a small number of samples (three year data for 204 firms); future studies should incorporate a far larger sample of data. Second, it is necessary to consider the period in which the innovation performances derived from the research period were expressed. Third, this study found that government supports, except for certification supports, which are common government supports, on innovation performance of food SMEs were not effective. However, those forms of government support might help firms' other activities, which could ultimately affect the firms' innovation performance. Therefore, future study is needed to determine if these forms of support helped firms' other activities.

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