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Should the Government regulate or Support?: answer from Korean Manufacturing SMEs

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Abstract

The purpose of this study is to investigate the effect of R&D support and regulatory barriers on the technology innovation of SMEs in order to induce technology innovation in SMEs. We conducted empirical studies to overcome them. Using the STEPI technology innovation survey data, 1,223 small and medium-sized manufacturing companies conducted logistic analysis, negative binomial regression analysis, and 3SLS (Three Stage Least Squares) analysis. Small and medium enterprises were divided into industrial type (high technology industry, low technology industry). The results of the analysis are as follows: First, there is a real technology innovation effect even considering the creation of government R&D support. Second, the regulation has a positive effect on technology innovation and supported Porter's theory. Third, it was confirmed that there are differences in the influence of industrial type and innovation performance. Fourth, this study attempted to analyze the impact on technological innovation according to industry type, which can be an important basis for encouraging technological innovation by preparing policies appropriate for the promotion of SMEs. This study will further solidify the basis of government support for SMEs by solving the question of whether it is effective for government support. In addition, the policy implications were to derive a positive effect on government regulation so that it can operate as an effective regulation rather than a way to eliminate it

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1. Introduction

In an environment of fierce competition among companies between countries as the economy is activated due to industrial development and market expansion around the world, companies are making efforts in various ways to ensure sustainable survival and competitiveness. Among them, the company's technological innovation capacity is emphasized in order to expand new industries by discovering new growth engines. This suggests that global competition inevitably puts pressure on companies to innovate for product production and service differentiation[1].

With this background, enterprises have pursued technology innovation in many ways, but there is a limit in reality. In particular, technology innovation activities centered on SMEs are facing limitations, which is because SMEs are short of technical manpower or funds for having technology innovation capability by themselves and therefore a single failure in developing technologies could also affect the very existence of the enterprise[2].

However, technology innovation of SMEs is important not only in enterprise aspects, which secures market competitiveness by enterprise itself, but also in national·social aspects such as national technology advancement and job creation. In this context, the government promoted encouragement of technology innovation in two primary directions.

First, it is deregulation. However, the difficulty still lies in making a decision about the technology innovation effect of deregulation. While the neoclassical school argues that deregulation is needed because the government's market intervention through regulation has a negative effect on economy, Porter's argument is that regulation does not always have a negative effect on economic results. The neoclassical school's claim is that an institutional environment surrounding economic activities including government regulation actually has a negative effect on economic results, so it is needed a response to this[3]. On the contrary to this, Porter's opinion is that if the existing equipment is replaced or new one is introduced due to regulation, the process itself could put pressure on efficiency or innovation in the enterprise's production activity to promote the enterprise's productivity growth[4]. As this Porter's hypothesis was refuted again principally by econometrics, it still has not been secured a completely consistent result for whether the effect of regulation on inducing economic outcomes is positive or negative[5]. Therefore, it is required to analyze the effect of deregulation.

Second, it is government support. The government encourages SMEs to innovate technologies through various types of support policies. Government support is provided in response to the market failure situation due to underinvestment in research and development, vulnerability of enterprise's innovation capabilities or a lack of effort to strengthen abilities, and a typical form of these government interventions is an input of resources such as financial·manpower support, which could be provided by a method to understand influence factors of technology innovation and control them to find and implement policy means that could promote enterprises' technology innovation. As part of the policy means for promoting research and development activities of SMEs, it classifies into tax, financial, contribution, manpower, technology, certification and purchase supports to prepare various support measures. Accordingly, many researchers have carried out studies on the government support and the innovation performance of SMEs, and it was known that the government support had a positive effect on the performance in general[6,7]. However, a common problem of these studies on government support is that a government support itself has endogeneity, nevertheless it is not considered. Therefore, it is needed to understand the effect of government support through a study that minimizes endogeneity in the government support.

On the other hand, these forms of technological innovation differ according to the industrial form of the company. Hanel (2001) said that companies in different industries create different forms of innovation, and the types of technological innovations are different because the results of the innovations are different in each industry[8]. For example, innovation in low-tech industries where technology is easy to imitate is patent-driven, while technology-intensive innovation is difficult to imitate, while complex design and product innovation are more effective than patents[9].

This study has a significance for utilizing as empirical base data that could draw implications on government regulations and support directions suitable to domestic circumstances and suggest future policy directions by investigating the effect of the government policy directions on technology innovation of SMEs through an empirical study.

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2. Methods

2.1 Research Model

This study would like to explain about how government support and regulation is impacting technology innovation. For this purpose, the influence factors organized on the basis of the factors mentioned in the preceding studies were utilized to complete a comprehensive study model. The study model was derived through theoretical background and previous studies related to technology innovation, and government support and regulation barriers were utilized as explanatory variables.

In addition, technology innovation was utilized as a dependent variable. Although the method to measure technology innovation performance is different and varies for each researcher, many researchers use patents as a typical technical performance indicator[10,11], which is because patents guarantee a monopoly status in technology and trademark for a certain period of time[12], and there is a merit of objectivistic technical performance[13,14]. However, because of the patent's characteristic that a patent itself does not reflect its value, there is a limit in utilizing technical performance. Because of this limit, the other many preceding studies regarded a product innovation, in which enterprises launch a new product on to the market, and a process innovation which implements a new process as a technology innovation performance and utilized this concept[15]. This study utilized the technology innovation performance to subdivide into technology opportunity, technology extension, product innovation and process innovation to measure.

In addition, in order to minimize errors in the process to verify between explanatory and dependent variables, the information source, R&D characteristics and enterprise characteristics held by respective enterprises were used as control variables.

Finally, in order to examine the impact of technological innovation according to industry type, OECD (2005) sets criteria for distinguishing technology industry groups and according to Technology Intensity[16], four groups (High-tech, Used) It was classified as medium-high tech, medium-low tech, and low tech[17]. In this study, we analyzed the high-tech and low-tech industries classified by Bhattacharya & Bloch (2004)[18].

Table 1. Company Type

Categories		N(Total 1,223)	%
Company type	Independent firm	1,127	92.15%
	Domestic group affiliates	62	5.07%
	Foreign group affiliates	34	2.78%
Legal type	Medium enterprise	635	51.92%
	Small enterprise	588	48.08%
Corporate designation (duplication)	Venture	298	-
	INNO-BIZ(innovative SME under Article 15 of SME Technology Innovation Promotion Act)	480	
	Undesignated	661	
Listed on the stock exchange	KOSPI	31	2.53%
	KOSDAQ	91	7.44%
	Unlisted	1,101	90.02%
Industry Defined	High Technology Industry	665	54.37%
	Low Technology Industry	558	45.63%
Average manpower scale	-	98.35	-

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In general, the chemical, electronics, telecommunications, automotive, medical, and semiconductor industries are classified as high-tech industries. It is classified as a technology industry.

The resulting detailed study hypothesis is as follows.

[H1]. Government support would have a positive effect on SMEs' technology innovation.

[H1-1]. Government support would have a positive effect on SMEs' technology opportunity.

[H1-2]. Government support would have a positive effect on SMEs' technology extension.

[H1-3]. Government support would have a positive effect on SMEs' product innovation.

[H1-4]. Government support would have a positive effect on SMEs' process innovation.

[H2]. Regulation barriers would have a positive effect on SMEs' technology innovation.

[H2-1]. Regulation barriers would have a positive effect on SMEs' technology opportunity.

[H2-2]. Regulation barriers would have a positive effect on SMEs' technology extension.

[H2-3]. Regulation barriers would have a positive effect on SMEs' product innovation.

[H2-4]. Regulation barriers would have a positive effect on SMEs' process innovation.

[H3]. Factors affecting technological innovation by industry type will be different.

2.2 Analysis Data

This study used the technology innovation survey data, which is the Statistics Korea approved statistics being surveyed on enterprises' overall technology innovation status and business status every two years by the Science and Technology Policy Institute, as statistics. Table 1. shows that this survey was designed on the basis of the OECD's Oslo manual, and of the manufacturing business technology innovation survey data in 2012, this study used 1,223 valid data that match the study purpose

2.3 Empirical Model

In this study, technology opportunity, technology extension, product innovation and process innovation were used as dependent variables, and of them, the technology opportunity, product innovation and process innovation were used as bivariate qualitative variables with a value of 0 or 1, which utilized a logistic regression model representing the relation between independent and dependent variables[19].

For the technology extension, it is an additional data, which could have a negative value and because it has a characteristic with discrete and also asymmetric distribution, if a least squares method is used to estimate, it has a distorted resul[20], and because of a strong precondition that 'the variance is equal to the mean' assumed by the Poisson model, it is not suitable for most of patent data which variance is greater than the mean (overdispersion). In order to solve this overdispersion problem, this study utilized a negative binomial model.

This study would like to set a model for the factors influencing technology innovation performance to carry out analysis, and for government support of the explanatory variables, various influence factors should be considered. In general, it is estimated that the enterprises supported by the government would show

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enterprise characteristics, R&D characteristics and innovation performance etc., and in this process, if the government support element is used as it is, there would be an overestimation effect.

And, a general regression model assumes that explanatory variables have a unilateral effect on dependent variables, however, for government support, it is not a unilateral relationship, but in reality, it rather interacts internally between respective variables. This interaction is called endogeneity, and if a general regression equation is used, there is a constraint that the limit of explanation exists and the model's result has an inaccuracy problem due to the interaction, that is endogeneity.

In this situation, two-stage least squares (2SLS) and three-stage least squares (3SLS) models are used to examine the interrelationship between variables and minimize endogenous endogenousness. exist. Which of the two estimation methods is appropriate is the difference in view of the equation disturbance term, which selects the model according to the possible correlation between the disturbance terms.

First, The 2SLS model obtains an estimate by making endogenous variables existed in an equation maintain their independence from the disturbance term to apply a regression model, and then, based on this estimate, substitutes with original observation of the endogenous variable and cuts off the association with the disturbance term at stage 1. It is a method to estimate coefficients by substituting the original observation of endogenous variable with the calculated estimate of endogenous variables to apply the regression equation at stage 2[21]. However, in the two-stage least-squares method, since it is a method of estimating each equation separately without considering the correlation among the disturbance terms, there is a disadvantage that the efficiency of the estimate is low if there is a correlation between the disturbance terms in the equation system.

The 3SLS method assumes that there is a correlation between the disturbing terms, and goes through the two-stage least-squares method and obtains an estimate by applying the GLS using the variance and covariance matrix of the error terms in the last three stages. Depending on whether it is possible to derive a better estimator.

In this study, the possibility of correlations across errors of individual equations that make up the equation is considered. Considering that the items appearing in the course of business operation are related, there is a possibility of correlation between the disturbance terms in the equations. high. In particular, the study approached the regression model by dividing the models due to the correlation. Considering these factors, the 3SLS method can effectively improve the estimate.

3. Results and Discussion

Examining the analysis result of conducting logistic regression analysis and negative binomial regression analysis for each dependent variable, first, it showed government support had a positive effect on all the dependent variables such as technology opportunity, technology extension, product innovation and process innovation, so the hypothesis 1 was supported. As a result, it could be interpreted as having a positive effect on SMEs' technology innovation through government support.

Second, also for the regulation barrier, it showed as having a positive effect on all the dependent variables such as technology opportunity, technology extension, product innovation and process innovation, so it could be considered that the hypothesis 2 is supported. It is a result supporting the Porter's innovation theory, which showed that it has a positive effect on SMEs' technology innovation if there is a regulation barrier.

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Table 2. Logistic Regression Analysis Results

Variables		Technology Opportunity		
		Total	High Technology Industry	Low Technology Industry
		β	β	β
Explanatory variable	Government support	0.196***	0.206***	0.186***
	Regulatory barriers	0.086*	0.024	0.162*
Control variable	Average life span of the product	0.001	0.000	0.008**
	Laboratory status	0.848***	0.683*	0.989**
	Ratio of R&D workforce	0.686	2.701	0.247
	R&D investment log value	0.034	-0.052	0.057
	Sales log value	-0.005*	-0.001	-0.019**
	Amount of export log value	0.002	-0.019	-0.009
Constant		-1.283***	-0.746	-0.827
Log likelihood		-743	-199	-195
Pseudo R2		0.115	0.106	0.13

Note : Significant at the * 10%, ** 5%, *** 1% confidence level.

Table 2. shows the analysis results by industry type. First, government support has a positive effect on technology opportunities in both high and low technology industries. It was analyzed that it has a positive effect and found a difference. These findings suggest that venture firms with low technological opportunities or companies that want to improve manufacturing processes can have a positive effect on government innovation by government R&D support. Only when it comes to innovation will be higher. Regulations are of interest due to the emergence of new materials or new products that did not exist in the past.

Table 3. Negative binomial regression analysis

Variables		Technology Extension		
		Total	High Technology Industry	Low Technology Industry
		β	β	β
Explanatory variable	Government support	0.143***	0.206***	0.068
	Regulatory barriers	0.072*	0.124	0.101
Control variable	Average life span of the product	0.001	0	0.005*
	Laboratory status	0.299*	-0.265	1.083**
	Ratio of R&D workforce	1.843**	4.543**	-1.042
	R&D investment log value	0.08**	-0.017	0.103
	Sales log value	0.009***	0.024***	-0.013**
	Amount of export log value	0	-0.077**	-0.038
Constant		-1.606***	-1.997***	-0.329
Log likelihood		-2259	-566	-469
Pseudo R2		0.057	0.068	0.031

Note : Significant at the * 10%, ** 5%, *** 1% confidence level.

Table 4. Result of Product Innovation Logistic Regression

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Variables		Product Innovation		
		Total	High Technology Industry	Low Technology Industry
		β	β	β
Explanatory variable	Government support	0.09***	0.22***	0.003
	Regulatory barriers	0.161**	0.207**	0.095
Control variable	Average life span of the product	-0.001	0.000	0.000
	Laboratory status	0.494**	0.905**	0.281
	Ratio of R&D workforce	1.051	-0.349	-0.207
	R&D investment log value	0.072*	-0.083	0.224**
	Sales log value	-0.005*	-0.008	-0.004
	Amount of export log value	0.043**	0.094**	0.038
Constant		-0.001	0.258	-0.444
Log likelihood		-665	-176	-196
Pseudo R2		0.071	0.134	0.049

Note : Significant at the * 10%, ** 5%, *** 1% confidence level.

Since new technologies are accompanied by new technical issues that are difficult to apply under the regulatory system for existing technologies, the regulation may affect the spread of new products. Can be. And companies in low technology industries tend to maintain and utilize existing technologies. As a result, if appropriate regulations are established for existing technologies, companies will carry out technological innovation activities such as technology development and new product launches to overcome the related regulations. Therefore, innovation can be seen only when regulations are established in low-tech industries.

Second, Table 3. shows that in the case of technology reinforcement, only high-tech industries have a positive effect on government reinforcement, and regulatory barriers are not affected. These results suggest that, like product innovation, the government's policy for improving patents and existing technologies should be centered on high-tech projects, but should focus on R&D investment rather than regulation.

Table 5. Result of process innovation logistic regression

Variables		Product Innovation		
		Total	High Technology Industry	Low Technology Industry
		β	β	β
Explanatory variable	Government support	0.072**	0.175***	0.093*
	Regulatory barriers	0.237***	0.011	0.473***
Control variable	Average life span of the product	0	-0.001	0.008**
	Laboratory status	0.274	0.862**	-0.123
	Ratio of R&D workforce	-3.523***	-5.593**	-2.401
	R&D investment log value	0.164***	0.098*	0.321***
	Sales log value	-0.001	-0.002	-0.011*
	Amount of export log value	0.016	0.005	0.003
Constant		-1.786***	-1.24**	-2.398***
Log likelihood		-780	-199	-198
Pseudo R2		0.0704	0.093	0.141

Note : Significant at the * 10%, ** 5%, *** 1% confidence level.

Table 6. 3SLS analysis results

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Variables		Technology Opportunity	Technology Extension	Product Innovation	Process Innovation
		β	β	β	β
Explanatory variable	Government support	0.066**	2.224***	0.063***	-0.13
	Regulatory barriers	0.005	-0.092	0.008	0.045**
	Private information Utilization	0.042*	-0.631*	0.051***	0.139***
	Public Information Utilization	0.018*	-0.248	0.041***	0.097***
	Average life span of the product	0.000	-0.002	0.000	0.000
	Laboratory status	0.164***	-2.023**	0.044*	0.118**
	R&D investment log value	0.002	-0.164	-0.001	0.058***
	Sales log value	-0.001**	0.042***	-0.001**	0
	Amount of export log value	0.002***	-0.084	0.002	0.011**
	Constant	0.309***	-2.958***	0.637***	0.14*
Control variable	Laboratory status	7.515***	0.819***	0.876***	5.469***
	Ratio of R&D workforce	-0.991**	1.257**	5.022***	0.271
	R&D investment log value	2.655**	-4.348	3.134***	9.145***
	Sales log value	0.074	-0.01	0.115**	-0.015
	Amount of export log value	0.011**	-0.036**	0.009**	0.005
	Constant	0.047	0.019	0.031	0.049*

Note : Significant at the * 10%, ** 5%, *** 1% confidence level.

Third, Table 4. shows that government support and regulatory barriers were positively affected in the high technology industry, but not in the low technology industry. The result is that government support or regulation in the low technology industry does not play a role in corporate innovation. Therefore, the government's policy measures for the development of new products and new technologies should be focused on the high technology industry.

Fourth, Table 5. shows that government support has a positive effect on process innovation in both high and low technology industries, and regulatory barriers have positive effects on process innovation only in low technology industries. There was a difference.

Taken together, the impact on the type of innovation and the type of industry is different, which is interpreted as supporting [H3]. The results of applying the 3SLS model to exclude the endogenousness of the government support effect are shown in Table 6.

As a result, most of the government support effects are still valid, which has a positive effect on the dependent variables of technology opportunity, technology expansion, and process innovation. This is a result indicating that [H3] is supported even when the endogenous resistance is removed.

However, in the case of product innovation, it was found to be insignificant, which means that there is an endogenous relationship between government support and product innovation. can see. This can be judged as a result of government support investing in a company that sells a product or a company that is known for product excellence.

4. Conclusion

The main purpose of this study is to analyze the impact of government support and regulation barriers on SMEs' technology innovation performance. Examining the differentiation of this study based on the result derived as above, it is as follows.

First, it is that clearly measured the technology innovation effect of government support. In accordance with an argument that government support influences technology innovation performance from a diversity of the existing preceding studies, the government's R&D investment has continuously been made, but even though there is endogeneity in the government support itself as an explanatory variable, studies considering it were restrictively carried out. Accordingly, in this study, the 3SLS model was used to minimize the endogeneity held by government support to carry out the study, and as a result, it could be confirmed the technology innovation effect by the government support.

Second, it is that measured and presented the technology innovation effect on regulations from a position of SMEs, and derived a positive effect. As addressed in the preceding studies, the claim to deregulation led by neoclassical school since the 1980s has continuously been maintained so far, and the government has continued its effort for deregulation by operating the regulation reform committee etc. In other words, a cost increase caused by regulation leads to a competitiveness decrease, and in particular, the competitiveness decrease of SMEs with a weak capital structure deepens. Proper regulation, however, prevents enterprises' market failure and provides fair opportunities between enterprises, so this study carried out research based on the Porter's innovation theory, and presented empirical results for it to support the theory. Furthermore, it could be supported the argument that not only makes technological advancements but also innovates products or processes to strengthen fundamental competitiveness.

Third, this study diversified the perspective on examining the technology innovation performance by subdividing the perspective of technological advancement into technology opportunity and technology extension to approach in addition to the product and process innovation used in general. In other words, technological advancement was classified into two subitems such as the technology opportunity, in which SMEs would have technology, and the technology extension, which would continuously extend such a technology opportunity to secure enterprises' competitiveness, to carry out the study.

Fourth, this study attempted to analyze the impact on technological innovation according to industry type, which can be an important basis for encouraging technological innovation by preparing policies appropriate for the promotion of SMEs.

Through this study, the question about the effect of government support on SMEs' technology innovation could be resolved to more strengthen the government's basis for supporting SMEs, and the positive effect of regulation could be confirmed to draw out implications that induces a perspective change into the need of the efficiently working regulation rather than unconditional deregulation. Nevertheless, the limitations of this study are as follows. Product innovation and process innovation utilized as innovation results are limited in measuring strength by using bivariate data, and further research should be conducted including new variables to measure strength.

In addition, this study utilizes the 2012 Technology Innovation Survey data. However, there is a limit to clearly confirm the effect as a single year data.

References

[1] Schilling MA. Strategic management of technological innovation. 3rd ed. New York: McGraw-Hill Education; 2010.

[2] Cho KW. Effects of firm characteristics on qualification for government R&D supports. Journal of Technology Innovation. 2010 June;18(1):99-121.

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ISSN: 0193-4120 Page No. 4212 - 4221

[3] Nicoletti G, Scarpetta S. Regulation, productivity and growth: OECD evidence. Economic Policy. 2003 April;18(36):9-72.

[4] Palmer K, Oates WE, Portney PR. Tightening environmental standards: The benefit-cost or the no-cost paradigm?. The Journal of Economic Perspectives. 1995 April;9(4):119-32.

[5] Jaffe AB, Palmer K. Environmental regulation and innovation: A panel data study: Review of Economics and Statistics, 1997 November; 79(4): 610-619.

[6] Lach S. Do R&D subsidies stimulate or displace private R&D? Evidence from Israel. The journal of industrial economics. 2002 Dec;50(4):369-90.

[7] Grossmann, V. How to promote R&D-based growth? Public education expenditure on scientists and engineers versus R&D subsidies. Journal of Macroeconomics. 2007 Dec;29(4):891-911.

[8] Hanel, P. Current intellectual protection practices by manufacturing firms in Canada. Université de Sherbrooke. Département d'économique. 2001 Sep;01-09:1-57.

[9] Arundel A, Kabla I. What percentage of innovations are patented? Empirical estimates for European firms. Research policy. 1998 Jun;27(2):127-41.

[10] Lichtenberg FR. The effect of government funding on private industrial research and development: a re-assessment. The Journal of industrial economics. 1987 Sep;36(1):97-104.

[11] Shrieves RE. Market structure and innovation: a new perspective. The Journal of Industrial Economics. 1978 Jun;26(4):329-47.

[12] Smith GV, Parr RL. Valuation of intellectual property and intangible assets. 3rd ed. New Jersey: John Wiley & Sons, Inc; 2000.

[13] Pavitt K. Sectoral patterns of technical change: towards a taxonomy and a theory. Technology, Management and Systems of Innovation. 1984 Jan;13(6):15-45.

[14] Griliches Z. Patent statistics as economic indicators: a survey. In R&D and productivity: the econometric evidence. Chicago: University of Chicago Press; 1998. pp. 287-343.

[15] Organization for Economic Cooperation and Development. Science, technology and industry scoreboard 2005. Parris: OECD; 2005.

[16] Organization for Economic Cooperation and Development. Oslo Manual. 3rd ed. Parris: OECD; 2005.

[17] Hatzichronoglou T. Revision of the high-technology sector and product classification. Parris: OECD; 1997.

[18] Bhattacharya M, Bloch H. Determinants of innovation. Small business economics. 2004;22(2): 155-62.

[19] Agresti A. Categorical Data Analysis. 2nd ed. New Jersey: John Wiley & Sons, Inc; 2002. pp. 267-313.

[20] Ver Hoef JM, Boveng PL. Quasi-Poisson vs. negative binomial regression: how should we model overdispersed count data?. Ecology. 2007 Nov;88(11):2766-72.

[21] Gujarati DN, Porter DC. Basic econometrics. Tata McGraw-Hill Education. 5th ed. New York: McGraw-Hill Education; 2009.