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The relationship between Customized SMEs R&D Support and Job Creation

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Abstract

Purpose – Major countries in the world continue to grow up without employment by the economy opening, more investment in foreign countries and technical innovation. Nevertheless, SMEs have job creation continuously. As this result, support for SMEs that is the source of job creation has increased attention. However, previous research between SMEs and job-creating is limited to the job creation effect of comparing with large companies, and R&D investment effect including government support. Also, many research provides the different result of correlation with technology innovation and job creation. Therefore, previous research has insufficient to explain job creation by which in the technology commercialization stage and the job-specific workforce.
Research design, data, and Methodology - This study investigated the impact of customized R&D support upon job creation by using questionnaires of SMEs R&D service of K-Institution from 2009 to 2013. In detail, we analyzed the relationship between the technology commercialization stage and the usefulness of customized R&D support. Also, we added the analyzed the relationship between the usefulness of customized R&D support and the job-specific workforce.
Results - Research result, Job creation had a significant relation to the usefulness of customized R&D support in product design stage and mass production stage. Also, R&D worker and production worker correlated with the usefulness of customized R&D support. These results indicate the importance of hiring R&D workers and production workers at the higher technology readiness.
Conclusions -Therefore, this study suggests some implications for the government's SMEs support policy and the solve employment problems such as youth unemployment.

Keywords: SMEs, Job Creation, Customized R&D Support, R&D Service, Technology Commercialization.

1. Introduction

According to OECE (2017), In 2016, the employment rate of Korea (66.1%) was lower than the one on average of OECD (66.9%). Considering that Korea's self-employed ratio (25.5%) ranks fifth among the 35 OECD countries, Korea's employment structure is even more serious. The same year, large companies of Korea had reduced 90,000 jobs, and SMEs created 320,000 jobs (National Statistical Office, 2017). As such, SMEs was thought to be the primary source of job creation of national economy (OECD, 1996; 1998), and countries in the world paid attention to SMEs support policy (Haltiwagner et al., 2013).

Not only the United States but also Japan had supported R&D of SMEs for sustainable growth. Especially new employment of R&D workforce by SMEs R&D support could increase the competitiveness of SMEs and job creation of the national economy (Park et al., 2010). This type of SMEs policy goal also has found in Korea. Moon Jae-in Government that the inauguration in 2017, had national goals to expanding of SMEs R&D investment for job creation.

Meanwhile, the success of K-Institution's customized R&D support project since 2009 has led to its expanded to both the public and private sectors (Bae et al., 2017). As a result, Korea's R&D support method expanded

around 2013. In the past limited to R&D investment support, and then, additional support was started to give R&D service.

Nevertheless, research between SMEs and job-creating is limited to the job creation effect of comparing with large companies, and such as government support effect for R&D investment. These studies are verifying job creation status by dividing the performance of R&D support into process innovation and NPD (New Product Development). Researchers present a variety result of positive and negative correlation with job creation and R&D support.

However, studies are insufficient to show what stage of technology commercialization creates job and what kind of jobs are create. Few studies have been conducted on job creation in the type of support for R&D services rather than R&D investment. Accordingly, this study purpose to review the relationship between customized R&D support and job creation.

Chapter 2 theoretical review of previous studies and Chapter 3 present a framework and methodologies. Moreover, Chapter 4 examined analysis results, Chapter 5 we examined the relation between implications and previous studies and presented a limitation of the study.

2. Theories

2.1. Customized R&D Support

Bae et al. (2017) present the government's support arguments for SMEs from three perspectives: market failures, system failures, and social-political perspectives. Market failures in which resources are not allocated efficiently due to weak market functions are described in the support studies of SMEs as factors such as external effects, information, monopoly and public goods. Moreover, a failure of the system is an inefficiency in the process in which the innovator interacts with other principals or institutions. Woolthuis et al. (2005) describe the causes as failures in infrastructure, institutions, networks, and capabilities.

Meanwhile, SMEs in Korea had 99.9% of total business entities and 90.2% of total employees (Korea Federation of SEMs, 2017). As such, SMEs played the role of social universality, and the safety net of life (Choi et al., 2014). So, government's SMEs policy had been political means (Jung, 2002).

The government’s SMEs policy is relying upon the promise of Presidential Election. Also, SMEs support means was done by organizations, laws, fund, and others. Public research institutes under the government developed SMEs policy’s justification to execute and expand and support. Under these circumstances, Lee Myung-bak government (2008~2013) expanded SMEs support for as a social role of the public research institution.

The K-Institution has established the National R&BD (Research & Business, Development) support system since 2009. As part of such efforts, the K-Institution enhanced support for technology commercialization, such as the establishment of a leading research infrastructure focused on information in the science and technology market, and customized SMEs support. In detail, the K-Institution organized ASTI (Association of Science, Technology, Information) involving more than 12,000 people nationwide, and surveyed the demand for SMEs R&D support. Based on the results, experts visited SMEs companies to enhance demand for R&D support. In this process, customized R&D support was launched.

Customized R&D support was limited to R&D services such as analyzing scientific and technological information, R&D planning, technology road-maps, finding promising new items, utilizing research equipment, super-computing. Customized R&D support started in 2009 as a unit project and developed a unique task for the K-Institution in 2015. Especially, customized information analysis services had spread to the public sector led by public research institutions from 2013, and to the private sector through pilot projects in 2014 (Bae et al., 2017).

2.2. SMEs R&D support and job creation

SMEs are an important source of job creation in the national economy (OECD, 1996; 1998). When large business reduced 90,000 jobs in 2016, SMEs increased job by 320,000. (National Statistical Office, 2017). As SMEs recognized as an important source of job creation, major countries are actively discussing the methodology of creating employment by SMEs support (Haltiwagner et al., 2013).

The United States is pushing for " innovation in the U.S. " aimed at promoting sustainable growth and high-quality job creation, while Japan is also pushing for " new growth strategies " aimed at achieving full employment in science and engineering fields by 2020 (Park et al., 2010). South Korea's Moon Jae-in, the government had presented the national policy that job creation from SMEs R&D support.

SMEs R&D support policy of governments are being reinforced to enhance the output of the job creation across the economy by promoting SMEs innovation by creating jobs focused on R&D worker (Park et al., 2010). However, research has insufficient on the effects of government support on job creation (Bae, 2015). Research studies on job creation for SMEs are divided into those that compare with large companies, and those that create jobs for R&D investment. First, the study that SMEs created large numbers of new jobs (Birch, 1987; Baldwin et al., 1985; Wagner, 1995) or do not (Davis et al., 1996), comparative with large companies. Second, it is divided into research that the government's R&D support is effective in creating jobs (Lee & Kim, 2009; Noh & Hong, 2016; Oh & Kim, 2017), and it reduces jobs (Yoon et al., 2007).

These results related a type of the performance by R&D investment. The R&D investment performance of SMEs is divided into process innovation and product innovation. A case in point is robots put in logistics warehouses of Amazon and digitalization of German manufacturing industry. These process innovations could have reduced employment if they increase productivity (Greenan & Guellec, 20004). On the other hand, product innovation has a positive effect on job creation (VilicaI, 2012).

However, studies showing that NPD creates employment are also insufficient to explain that which technology commercialization stage and which job task are job creation. Also previous studies focused on the R&D investment, etc. So, the study of job creation by the R&D service is insufficient. Accordingly, this study analyzed the relationship between customized SMEs support and job creation.

3. Methodology

3.1. Research design

Purpose of the study was to examine the relationship between customized R&D support and job creation. Specifically, we reviewed the significant relationship between the usefulness of SMEs support in each technology commercialization stage and job creation. Accordingly, the usefulness of SMEs support was set as an independent variable to design a research framework that describes the job creation effects in each technology commercialization stage.

Moreover, this study also analyzes the relationship between customized R&D support and the job-specific workforce of SMEs. This through examines the possibility of creating a new workforce for SMEs. In other words, the usability of SMEs customized R&D support is set as a dependent variable, and each task workforce of SMEs set as an independent variable for statistical verification.

In general, process innovation is presented the negative correlation between job creation. However, studies by Zimmermann (1991), Smoluy (1998), and Lachenmaier & Rottmann (2011) present the positive correlation. On the other hand, many researchers (Boliacino & VivarellI, 2012; Katsolacos, 1984; 1986) claim that the R&D investment involved in the NPD has a positive effect on the job creation. Also, many studies had a result that government R&D support is a positive effect in creating employment (Lee & Kim, 2009; Noh & Hong, 2016; Oh & Kim, 2017; Bae & Ko, 2017).

Meanwhile, the government provided support directly to SMEs with R&D funds. However, since 2009, an additional support method has emerged, including support for customized R&D support (Bae et al., 2017). Customized R&D support relies on qualitative assessments of the effects of job creation in that it is a different type of SMEs support as R&D fund. So, we used the concept of usefulness.

Davis (1993) used the concept of usability as a relationship that affects the use of information technology systems through the Technology Acceptance Model (TAM). Bae & Ko (2017) also analyzed the impact of the utility of customized R&D support by retired scientific engineers on the technology development capabilities of SMEs and their competitiveness.

This research suggests that the usefulness of customized R&D support in NPD stage and the positive or negative correlation between job creation. We design the following hypothesis.

Hypothesis 1. The usefulness of customized R&D support in NPD stage correlates with job creation.

1-1. The usefulness of customized R&D support in the basic research stage correlates with job creation.

1-2. The usefulness of customized R&D support in the product development stage correlates with job creation.

1-3. The usefulness of customized R&D support in the prototype production stage correlates with job creation.

1-4. The usefulness of customized R&D support in the product improvement stage correlates with job creation.

1-5. The usefulness of customized R&D support in the mass production sage correlates with job creation.

There is a strong correlation between corporate R&D investment and the proportion of R&D workforce (Ha, 2012). Ali – Yrkko (2005) also suggests that the government’s R&D support had a positive influence on job creation of R&D employees. However, non-R&D employees were not influenced.

Thus, the previous study separated R&D worker and non-R&D worker and analyzed job creation correlation with SMEs support. Accordingly, we consider the usefulness of customized R&D support in NPD stage and the positive or negative correlation with a job-specific workforce. Moreover, we design the following Hypotheses.

Hypothesis 2. The job-specific workforce correlated with the usefulness of customized SMEs support in NPD stage.

2-1. The R&D worker of SMEs correlated with the usefulness of customized SMEs support in NPD stage.

2-2. The office worker of SMEs correlated with the usefulness of customized SMEs support in NPD stage.

2-3. The product worker of SMEs correlated with the usefulness of customized SMEs support in NPD stage.

3.2. Data and Methodology

This study used a questionnaire results of the SMEs that joined in SMEs support project of K- Institution from 2007 to 2014. And, among these data only those company's data of participating in the customized R&D support projects were used from 2009 to 2013.

The operational definitions of the variables are shown in <Table 1>. The usefulness of SMEs support for each stage of technology commercialization was divided into tables in that it is used as the independent variables and dependent variables of hypothesis 1 and hypothesis 2 respectively. The effects of job creation and the usefulness of SMEs supporting in the technology commercialization stage were measured on a 7-point scale, while job-specific workforce was estimated the number of employees.

<Table 1> Definition of Variables

Section	Type of the variable	Definitions	Measuring method
Dependent variable	Job creation	Job creation of SMEs	7-scale (to be much effective)
Independent variable	Basic research, product design, prototype production, product improvement, mass production	Usefulness of R&D support	7-scale (to be much effective)
	R&D worker, office worker, production worker	job-specific workforces	Employee (person)

Statistical analysis is performed at p <.05 using the SPSSWIN 22.0.

4. Results

4.1. Customized SMEs support and job creation

The relationship between the usefulness of customized R&D support and the effects of job creation was analyzed. 113 data were used for the analysis, and all variables were found to be significant at the level of 0.005(P<.05).

<Table 2> Correlation between the usefulness of each technology commercialization stage and job creation effect

		Employment	Basic research	Design	Prototype	Product improvement	Mass production
Pearson correlation	Employment	1.000					
	Basic research	.261***	1.000				
	Design	.446***	.602***	1.000			
	Prototype	.407***	.567***	.771***	1.000		
	Improvement	.346***	.628***	.660***	.726***	1.000	
	Mass production	.349***	.489***	.503***	.651***	.728***	1.000

Note: '*, **, ***' indicate significance of 10%, 5% and 1%.

In performing multiple regression analysis, the input method of the variable was selected as the backward. Backward is a way to adopt only the most important variable by eliminating the not statically

significance variables (Bae & Ko, 2017). Through this, it is possible to identify the variables for customized R&D support that are statistically significant to the effects of job creation.

<Table 3> Regression result for the job creation effect

section	(constant)	Basis research	Design	Prototype	Product improvement	Mass production
Model 1	.977	-.094	.522**	.106	-.048	.195
	(.819)	(.173)	(.208)	(.213)	(.215)	(.146)
Model 2	.954	-.105	.514**	.096		.179
	(.809)	(.166)	(.204)	(.207)		(.128)
Model 3	.980	-.098	.572***			.206
	(.804)	(.165)	(.161)			(.114)
Model 4	.766		.526***			.188**
	(.717)		(.142)			(.110)

Note: '*, **, ***' indicate significance of 10%, 5% and 1% each.

Only the usefulness of the design stage was analyzed to be statistically significant in Model 1, as shown in <Table 3>. Accordingly, the removed the product improvement stage, the prototype stage, and the basic research stage as variables of lesser statistical significance. As a result, it has been analyzed that the usefulness of the design stage and the mass production stage are effective in creating employment. Therefore, only hypothesis 1-2 and 1-5 were adopted.

On the other hand, an interesting point was found in the analysis result. Although not statistically significant, the basic research and product improvement stage in model 1 were a negative correlation between job creation. This result could give many implications for the development of the R&D service industry in that it is a negative relationship between the usefulness of customized R&D support and the job creation. Accordingly, we reviewed the usefulness of customized R&D support and a correlation between the job-specific workforce.

4.2. Job-specific workforce and usefulness of customized R&D support

Each regression models analyzed the relationship between the usefulness of R&D support in each stage of technology commercialization and the job-specific workforce. Accordingly, 444 data of basic research stage, 337 data of design stage, 273 data of prototype stage, 254 data of product improvement, and 139 data of mass production was used. The correlation between variables shows in <Table 4>.

<Table 4> Correlation between the usefulness of each technology commercialization stage and job-specific workforce

		Dependent variable	R&D worker	Office worker	Production worker
Basic design (N=447)	Basic research	1.000			
	R&D worker	-.105**	1.000		
	Production worker	-.025	.549***	1.000	
	Office worker	-.026	.489***	.552***	1.000
Design (N=337)	Design	1.000	-.084	.003	.082
	R&D worker	-.084	1.000	.498	.505
	Office worker	.003	.498***	1.000	.510
	Production worker	.082*	.505***	.510***	1.000
Prototype (N=273)	Prototype	1.000			
	R&D worker	-.143***	1.000		
	Production worker	.030	.539***	1.000	
	Office worker	.046	.459***	.458***	1.000
Product improvement (N=254)	Improvement	1.000			
	R&D worker	-.096	1.000		
	Production worker	.103**	.503***	1.000	
	Office worker	.022	.468***	.467***	1.000
Mass production (N=139)	Mass production	1.000			
	R&D worker	-.081	1.000		

	Office worker	.020	.494***	1.000	
	Production worker	.112*	.702***	.553***	1.000

Note: '*, **, ***' indicate significance of 10%, 5% and 1% each.

<Table 5> Regression result for the usefulness of technology commercialization stage

Model		Basic research	Design	Prototype	Product improvement	Mass production
Model 1	(constant)	5.729*** (.070)	5.697*** (.074)	5.727*** (.084)	5.645*** (.093)	5.412*** (.146)
	R&D worker	-.009** (.004)	-.011** (.004)	-.020*** (.006)	-.015*** (.005)	-.027*** (.010)
	Office worker	.001 (.002)	9.166E-5 (.002)	.003 (.002)	.001 (.002)	.000 (.003)
	Production worker	.001 (.001)	.002** (.001)	.002 (.001)	.003*** (.001)	.005*** (.002)
Model 2	(constant)	5.734*** (.068)	5.698*** (.072)	5.757*** (.082)	5.654*** (.090)	5.408*** (.141)
	R&D worker	-.008** (.004)	-.011*** (.004)	-.018*** (.006)	-.014*** (.005)	-.027*** (.010)
	Production worker	.001 (.001)	.002*** (.001)	.002** (.001)	.003*** (.001)	.005*** (.002)
Model 3	(constant)	5.744*** (.067)				
	R&D worker	-.007** (.003)				

Note: '*, **, ***' indicates significance of 10%, 5% and 1% each.

The variables input method was set backward to perform regression analysis. The analysis shows that only the R&D worker has a statistically significant variable in the all stage at the 0.005 ($P < .05$) level. And, product worker was found to be significant variables in the stage of product design, prototype, product improvement, and mass production. As a result, hypothesis 2-1 and 2-3 were adopted, and hypothesis 2-2 was rejected.

On the other hand, the job-specific workforce could be found to have differences their influence according to the usefulness of each stage of technology commercialization. R&D workers were identified negative correlation. The order of influence was mass production (-.027), prototype (-.018), product improvement (-.014), product design (-.011), and basic research (-.009). The influence order by production workers was explained by mass production (.005), product improvement (.003), and product design and prototype (.002). These results indicate the importance of hiring R&D workers and production workers at the higher technology readiness. Also, it was found that the smaller the number of R&D worker was more useful in the customized R&D support.

5. Discussion and conclusion

5.1. Discussion

The previous studies that related to job creation for SMEs remained within the subject of tax incentives and R&D worker employment support. Some studies have analyzed the effects of support for innovation such as process innovation and NPD innovation on job creation. Process innovation has a negative effect on job creation because of its large substitute effects (Shin et al., 2012). On the other hand, NPD innovation claims to have a positive effect on job creation if the replacement of the demand for existing products is excluded (Boliacino & VivarellI, 2012; Katsolacos, 1984; 1986). However, they research lack to analyze the effects of the NPD on job creation in each technology commercialization stage. Accordingly, this study analyzed how the usefulness of customized R&D support affects job creation.

The analysis result showed that the usefulness of SMEs support in the design stage and at the mass production stage has a statistically positive effect on job creation. As a result, hypothesis 1-2 and 1-5 were adopted. Also, the analysis of the impact of the job-specific workforce on the usefulness of SMEs support revealed that only R&D workers correlated between in all stages. Product worker was found to be significant variables in the other

stages excepted the basic research stage. The R&D worker analyzed for negative correlation, and the production worker analyzed to a positive relationship. So, hypothesis 2-1 and 2-3 were adopted.

The conclusion of this study is summarized as follows.

- SMEs represent negative relationships in which the insufficient of R&D workers gives usefulness of customized R&D support are increased. We found the impact of usefulness for customized R&D support by R&D worker has been highest in the mass production stage.
- Production workers were a positive relationship between the usefulness of customized R&D support. Particularly in the mass production stage, the usefulness of customized R&D support had the most significant influence as did R&D workers.
- Nevertheless, the job creation effects were only statistically significant in the mass production stage and the design stage. These stages are characterized by the generation of the expectations for NPD or future profit.

The finding coincided with that of previous studies that NPD and government's R&D support had a positive influence upon job creation (Bae & Ko, 2017; Boliacino & Vivarelli, 2012; Katsolacos, 1984; 1986; Lee & Kim, 2009; Noh & Hong, 2016; Oh & Kim, 2017).

5.2. Summary

The implications of this study are as follows:

First, we analyzed the effects of job creation by customized R&D support in each technology commercialization stage. The previous study analyzed the effects of job creation by dividing it into the NPD and production process. However, we have divided the stages of NPD and reviewed each stage to see how the usefulness of customized R&D support can help job creation.

Second, we analyzed the effects of the job-specific workforce on the usefulness of customized R&D support. This is also significant in that it is the result of original research without previous studies.

Third, it is significant that such research results can suggest not only the government's support policy means for SMEs but also the government's methodology for implementing policies to solve employment problems such as youth unemployment.

There is also a limit to the study.

First, the analysis on characteristics of customized R&D supported by the technology commercialization is insufficient. The fact that the characteristics of the industry, growth stages of the company and the technology readiness are not included in this study limited more detailed analysis for SMEs support.

Also, there is a limit to the generalization of the study results in that the sample used in the study is small.

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