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THE IMPACT OF FINANCIAL SUPPORT SYSTEM ON TECHNOLOGY INNOVATION: A CASE OF TECHNOLOGY GUARANTEE SYSTEM IN KOREA

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Abstract

We analyzed the impact of financial support system on technological innovation of small and medium manufacturing firms in Korea, with a special interest in technology guarantee system. This was done using a sample of 1,014 Korean manufacturing firms of which 43% were venture companies. Our study provides two important conclusions. First, the result of empirical analysis indicates that financial support systems have a significant influence on both product innovation and process innovation of SMEs in Korea. Second, a more important conclusion of this research is that technology guarantee system impacts on product innovation; however not on process innovation. This result implies that technology guarantee system attaches more importance to technological innovations related with product development than to those related with process enhancement.

Keywords: Financial support system; Technology innovation; Technology guarantee

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1. Introduction

In theses days of severe struggle for technological innovation, various supporting systems for innovation are introduced and operated in the majority of nations in the world. The national supporting system for technological innovations of companies offers various components such as finance, human power, legislation, and technology information. In this paper, we focus on the financial support system among a variety of supporting systems.

The financial support system for technological innovation refers to financial policies that provide companies with funds to put through technical improvements. There have long been problems that entrepreneurial companies are not able to raise all the capital they need for technological innovation. Therefore, governments in many countries have tried to solve these problems by taking on the role of venture capital investor to support technological innovation of the firms. There are three kinds of financial policies with which the government supports companies for technological innovation: Loans, equities, and guarantees.

In Korea, many types of financial support systems have been developed by the government since the 1980s. And those systems have offered a good sum of loans, equities and credit guarantees. However, there is a question that they really have had an effect on the technological innovation of the manufacturing firms. Moreover, the history of technology guarantee system is relatively short and the evaluation of the impact on technological innovation has scarcely accomplished until now. Therefore, the aim of this research is to answer to these questions. Do Korean small manufacturing firms really receive help from the financial support system to innovate product and process? Does technology guarantee that systems have an effect on the technological innovation? What kind of financial support system do Korean small manufacturing firms implement?

2. Financial support system for Technological innovation

The economics literature has identified at least two main rationales for governments to offer public subsidies for technological innovation of firms.

First, public finance theory emphasizes that subsidies are an appropriate response to activities that generate positive externalities. Innovation and commercialization of new technology usually accompany high uncertainty and risk. Therefore, financial market and firms have a tendency to evade investment on technological innovation to step away from the potential loss. In such circumstances, the amount of investment on technological innovation would be lower than the social optimal level. Mansfield et al. (1977) measured the social and private rate of returns from a sample of innovations. The results indicated that the private rates of return from the investments had been much lower than the social rate of return. Lerner (1999) examined the long-run performance of high-technology firms receiving public funds and found that the fund awardees enjoyed substantially greater employment and sales growth.

The social optimal level of R&D investment may be higher than the private optimal level due to the presence of R&D spillovers (Teece, 1986; Griliches, 1992; Jaffe, 1996). Firms may invest less than the social optimal level because they could not defend and extract all of the rents from the innovation.

A second rationale for public subsidies for technological innovation has pointed to the presence of important financial constraints of small firms. Informational asymmetries may make raising external capital expensive for entrepreneurs (Myers and Majluf, 1984; Greenwald, Stiglitz and Weiss, 1984). An important factor influencing the viability of small firms is capital requirements and there is some evidence that small and medium enterprises (SMEs) are more likely to be subject to liquidity constraints than larger firms (Acs and Audretsch, 1990). Oakey (1995) showed that access to and costs of finance are some of the most important factors, which affect the ability of a technology-based firm to grow. Giudici and Paleari (2000), based on an empirical analysis on a survey of 46 small high-tech Italian firms, argued that traditional financial sources are inadequate to finance innovative projects. And Oakey (2003) argued that a better integration of public and private sector funding would be to the advantage of all funders, the recipients and the wider economies in which all those involved co-exist.

However, other works argue that government involvement may be distorted because of the interested parties to maximize their own benefits. These emphasize the distortion that may result from government subsidies and suggest a more skeptical view of such programs. Olson (1965) and Stigler (1971) argued that direct and indirect subsidies would be captured by groups standing to gain substantial benefits, and that even very small firms could be organized to benefit from public subsidies. And Peltzman (1976) and Becker (1983) formally modeled the theory of regulatory capture.

Nowadays, public subsidies are designed to minimize such distortions and to maximize social benefits. Technology guarantee system came into the world with this background. Technology is one of the most important assets, which determine the future earnings of the company. However it has hardly been accepted as collateral in the financial market, because it is hard to estimate the monetary value of such intangible assets. Recently, technology guarantee system based on technology evaluation is growing up in Korea. In this research, we investigate the effect of technology guarantee system on technological innovation.

3. The Structure and Implementation of Korean Technology Guarantee System

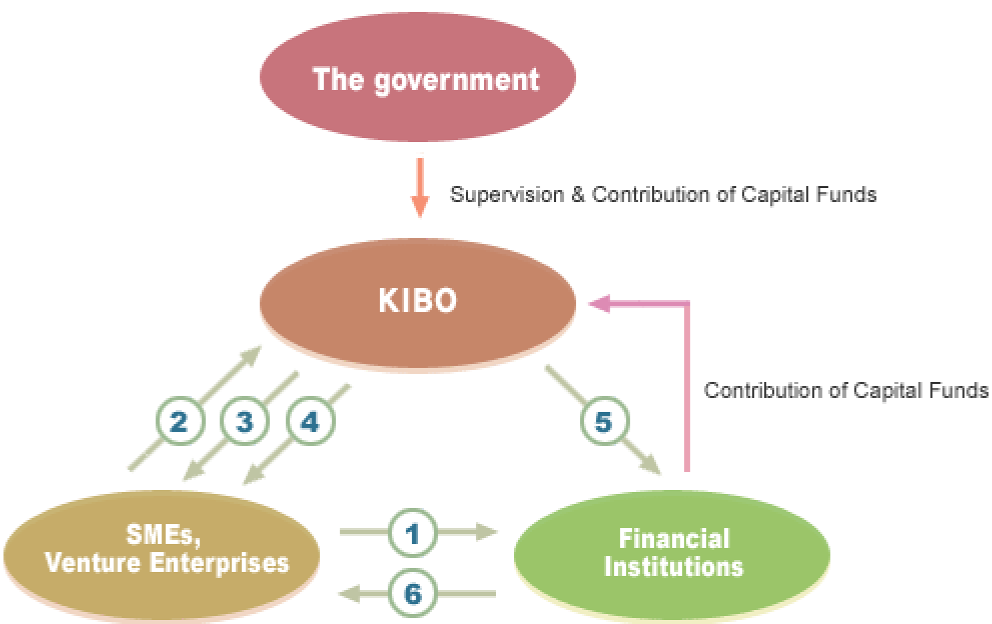
KIBO (which means “technology guarantee” in Korean) was founded in 1989 by the Korean Government as a non-profit guarantee institution under the special enactment, "Financial Assistance to New Technology Businesses Act". The mission of KIBO is to contribute to the national economy by providing credit guarantees to facilitate financing for new technology-based enterprises while promoting the growth of technologically strong SMEs and venture businesses. As an institution specialized in technology financing, KIBO focuses onto technology innovative enterprises. As shown in table 1, its total guarantee amount came up to US$ 11,335 million in 2006, and 97.6% of this sum was preferentially directed to the new technology-based enterprises.

Table 1 Technology Guarantees of KIBO

	2002	2003	2004	2005	2006
New Technology Business	9,449 (84.9%)	9,311 (83.2%)	9,567 (86.0%)	8,886 (88.3%)	11,308 (97.6%)
Others	1,683 (15.1%)	1,876 (16.8%)	1,561 (14.0%)	1,175 (11.7%)	27 (2.4%)
Total	11,132	11,187	11,128	10,060	11,335

Unit: US$ Million.
Source: KIBO technology fund (http://www.kibo.or.kr)

The general process of technology guarantee schemes of KIBO is described in figure 1. A small technology-based company that cannot meet a bank's lending criteria (which usually means the company cannot provide tangible collateral) applies for technology guarantee. And KIBO investigates and evaluates the creditworthiness and the value of technology of the company. In most cases, the banks rely on the investigation and the approval by KIBO for their decision of the loan extension.



1. Application for Loans
2. Consultation and Application for Technology Guarantee
3. Credit Investigation and Evaluation
4. Approval of Technology Guarantee
5. Issuance of a Letter of Guarantee
6. Provision of Loans

Figure 1: The structure of technology guarantee system
Source: KIBO technology fund (http://www.kibo.or.kr)

4. Empirical Analysis

4.1. Data and variables

This research is based on a survey data. The sample consists of 1,014 Korean SMEs that are observed over a 3-year period (2003-2005). They were all manufacturing firms, were established in 1980 or later, were independent at founding time, and had remained so up to the end of 2005. The number of employees of the sample firms ranged from 10 to 499. 70 companies were listed in the Korean stock market, 101 companies were listed in the KOSDAQ market, and the other 843 companies were not listed in the stock market. 436 (43%) companies were designated as "Venture Company" by the government, and the others were not. Table 2 reports the distribution of industry and size of sample firms.

Table 2 Distribution of sample firms according to the industry and the size.

Industry	Employees					Total	
	10-19	20-49	50-99	100-249	250-499		
1. Food processing, Tobacco	8	9	13	11	13	54	5.3%
2. Textiles, Apparel, Leather	1	7	11	20	7	46	4.5%
3. Wood, Pulp, Paper	1	2	4	12	10	29	2.9%
4. Chemicals, Rubber, Plastic	19	27	36	57	35	174	17.2%
5. Metal, Nonmetal	12	17	13	23	17	82	8.1%
6. Machinery	45	91	50	52	34	272	26.8%
7. Computers, Electronics, Precision	42	69	51	66	37	265	26.1%
8. Automobile	4	11	14	24	24	77	7.6%
9. Others	2	4	4	2	3	15	1.5%
Total	134 13.2%	237 23.4%	196 19.3%	267 26.3%	180 17.8%	1014	

Table 3 shows the variables used in this analysis. Dependent variable is binary: 1 indicates that the firm is reported to succeed in innovation during 2003-2005 and 0, otherwise. According to the type of innovation, PRODUCT and PROCESS mean product innovation and process innovation, respectively.

In order to analyze the impact of the financial support system on innovation performance, we investigated five main public funds in Korea. They were MOST (Ministry of Science and Technology) fund, MOICE (Ministry of Commerce, Industry and Energy) fund, MIC (Ministry of Information and Communication) fund, SBC (Small Business Corporation) fund, and KIBO technology fund. 1 indicates that the firm received financial support from one of these funds during 2003-2005 and 0, otherwise.

We used four control variables: AGE, VENTURE, RDI and SIZE.

Researchers have not shown any consensus of opinions about the influence of firm age on innovative performance. Shan et al. (1994) and Powell et al. (1996) argued that the influence of firm age on innovative performance was insignificant. However Stuart (2000) showed that firm age was significantly related to the sales growth rate in a high technology industry. We used AGE, the age of the firm, as a control variable to examine the influence on technological innovation.

In Korea, the "Venture Company" means the enterprise certified by the government for the title. Technology-based venture firms may be more innovative than non-venture firms (Lim et al., 2005; Lee and Oh, 2003). We used a dummy variable, VENTURE, which represents whether the firm was a venture enterprise.

R&D expenditure is one of the most significant factors affecting innovative performance of a firm (Cohen and Levinthal, 1989, 1990; AHUJA, 2000). We employed RDI, which represents R&D intensity (the average R&D expenditure for three years divided by the average sales for the same period) to examine the impact of R&D expenditure on technological innovation.

The relation between firm size and innovation has been extensively investigated by many researchers. Schumpeter (1942) argued that large firms were more innovative than small ones because the former can cope with high R&D costs and can appropriately utilize the results of R&D. However, many researchers have indicated that large firms with dominant market power are less innovative because they are bureaucratic and not threatened. Small firms, on the other hand, can be more innovative due to organizational flexibility and quick decision making (Scherer, 1965; Kamien and Schwartz, 1982; Scherer and Ross, 1990). We controlled the size effect using a variable, SIZE, which represents the number of employees.

Table 3 Variables and their descriptions

Dependent Variable	
PRODUCT	Product innovation
PROCESS	Process innovation
Independent Variable	
SUPPORT_ALL	Whether the firm received at least one the financial support (dummy)
SUPPORT_01	Financial support from MOST fund (dummy)
SUPPORT_02	Financial support from MOCIE fund (dummy)
SUPPORT_03	Financial support from MIC fund (dummy)
SUPPORT_04	Financial support from SBC fund (dummy)
SUPPORT_05	Financial support from KIBO Technology Fund (dummy)
AGE	Age of firm
VENTURE	Venture firm (dummy)
RDI	R&D intensity = R&D investment / Sales
SIZE	Number of employees

4.2. Analysis and results

We estimated the impact of independent variables on technological innovation using a logistic regression model. The model was divided into two categories based on the type of innovation: product innovation and process innovation. In model 1 and model 3, we analyzed the total impact of the financial support systems. And in model 2 and model 4, we identified the impact of five main public funds in Korea.

Table 4 shows the results estimated by the logistic regression model. The results of model 1 and model 3 indicate that the financial support systems, as a whole, have a significant influence on both product innovation and process innovation.

Model 1 and model 2, which show the impact on product innovation, indicate that SUPPORT_05 (financial support from KIBO technology fund), AGE, VENTURE, SIZE have a significant influence on product innovation. The financial support from KIBO technology fund affects product innovation; however it does not affect process innovation as shown in model 4. This result can be explained in the following sense. The KIBO technology fund used to be granted to the companies with product-based technology rather than those with process-based technology. Meanwhile, SUPPORT_2, which indicates MOICE (Ministry of Commerce, Industry and Energy) fund, has a significant influence on process innovation (model 4).

Table 4 Logistic regression of the likelihood of product innovation and process innovation

	Product Innovation				Process Innovation			
	Model 1		Model 2		Model 3		Model 4	
Constant	0.035	(0.173)	0.061	(0.171)	-0.282*	(0.169)	-0.251	(0.167)
SUPPORT_ALL	0.374***	(0.143)			0.381***	(0.140)		
SUPPORT_01			0.516	(0.388)			-0.137	(0.331)
SUPPORT_02			0.144	(0.208)			0.509***	(0.199)
SUPPORT_03			-0.354	(0.284)			0.209	(0.281)
SUPPORT_04			0.065	(0.166)			0.150	(0.158)
SUPPORT_05			0.353**	(0.171)			0.199	(0.163)
AGE	0.015**	(0.006)	0.015**	(0.006)	-0.006	(0.005)	-0.007	(0.005)
VENTURE	0.519***	(0.159)	0.514***	(0.159)	-0.048	(0.153)	-0.082	(0.154)
RDI	-0.250	(0.428)	-0.268	(0.429)	-0.640	(0.674)	-0.647	(0.690)
SIZE	-0.002**	(0.001)	-0.001**	(0.001)	0.003***	(0.001)	0.003***	(0.001)
-2 Log Likelihood	1304.339		1299.721		1373.984		1366.262	
N	1014		1014		1014		1014	

* Significant at 10%, ** Significant at 5%, *** Significant at 1%
Standard error in parenthesis

Both AGE and VENTURE have a positive effect on product innovation in model 1 and model 2. This result supports that firm's age is significantly related to the innovation as indicated by Stuart (2000) and that venture firms are more innovative than non venture firms as indicated by Lim et al. (2005) and Lee and Oh (2003).

SIZE has a negative effect on product innovation; on the other hand it has a positive effect on process innovation. This result can be interpreted as small firms focus on new product development while large firms focus on process enhancement.

5. Conclusion

In this research, we investigated the implication of financial support systems on innovative performance of small and medium enterprises, with a special interest in technology guarantee system. This was done using a sample of 1,014 Korean manufacturing firms of which 43% were venture companies. Using a logistic regression model, we found the evidence that financial support systems, as a whole, have a significant influence on both product innovation and process innovation of SMEs. It is worthy of note that the technology guarantee system impacts on product innovation; however not on process innovation. This result implies that technology guarantee system attaches more importance to technological innovations related with product development than to those related with process enhancement.

The age of a firm has a positive effect on product innovation, and the venture companies make more product innovation than non venture companies. The size of a firm has a negative effect on product innovation, while it has a positive effect on process innovation. It means that small firms put their resources into product innovation, while medium(?) firms concerns about process innovation.

Despite the several implications mentioned above, our research has some limitations. First, there can be a bias arising from self-evaluation because our analysis was based on a survey data. Alternative methods measuring the performance of innovation can be applied to get better results. Second, the results may reflect some characteristics of one country because the sample data was composed of Korean firms. A comparative study among countries is remained as future research.

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