The mismatch between demand and beneficiaries of R&D support programs for SMEs: Evidence from Korean R&D planning programs

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ABSTRACT

Many countries plan and implement various programs to provide direct and indirect support for small and medium businesses to undertake technological innovation. This study focuses on R&D planning support programs, which are one of the policies designed to provide indirect support and improve investment efficiency. This study compares cases of R&D planning support programs in Korea to identify the differences between demanding companies and beneficiary companies and evaluates whether the implementation of the policy was efficient. To compare the characteristics of differing groups of companies, we applied an analysis method based on data mining to profile the characteristics of the companies. In addition, to help improve the efficiency of policy implementation in the future, we used discriminant analysis to present a model for forecasting how high the demand for R&D planning support will be among start-up companies. Based on the model we propose in this study, companies that have experienced R&D planning support have a very different profile from those that are in need of planning support. In other words, we found a mismatch between companies that have been beneficiaries of the policy and demanding companies, those that are still in need of the support. This study proposes a demand forecasting model to redress this mismatch, which we hope will contribute to enhancing the efficiency of R&D support policies and the evidence based decision making.

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1. Introduction

In Korea, R&D planning support programs have been implemented as an effort to increase investment in technology development and improve the success rate by means of providing analytical information or consulting services to assist in R&D planning. A leading example of this in Korea is the 'Small and Medium Business R&D Planning Support Program' offered by the Small and Medium Business Administration (Kbiz, 2014). According to the 2014 statistics on technologies of small and medium businesses, out of the total of 2200 companies surveyed, 13.5% have received funding support or services to assist in R&D planning (SMBA and Kbiz, 2014). Although Korea has thus expanded its R&D planning support, there are hardly any studies that have evaluated the programs' effects or the adequacy of policy implementation.

This study tackles the question of whether Korea's R&D planning support programs have been implemented appropriately for the groups in need. If we were to perform a study measuring the programs' general effects or assessing the investment efficiency, we could adopt the approach of tracking the beneficiary companies and analyze the adequacy of the programs' implementation (Jun et al., 2016; Seo et al., 2015). It

should be noted, however, that there is much room for debate on how to define success for R&D subsidies and we also need to take into account the characteristics of specific subsidization programs (Klette et al., 2000). For example, Korea's R&D planning support programs are designed to encourage favorable responses from small and medium businesses and support outstanding companies by means of linkage to R&D development funding and various other benefits. Therefore, even if the follow-up study results show that the planning support has had a significant effect on superior performance, such conclusions will be challenged by objections that there is a possibility of errors in interpretation due to a sample selection bias. It will be easily argued that strong companies that do not need R&D planning assistance applied to the program to take advantage of the interlinked benefits rather than to seek planning support, and that the criteria used to select the companies receiving support may have favored such companies pursuing the accompanying benefits rather than the companies that are in need of planning support (hereinafter referred to as "demand companies"). This study proposes a method for empirically verifying whether there is such a mismatch between demand companies and beneficiary companies and furthermore presents a model for identifying the demand companies. To adopt an approach that is differentiated from previous studies and obtain results with newer insights, we reference the preceding studies but avoided relying only on these existing findings and hypotheses, and we propose a hybrid approach that also uses

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data mining based on machine learning. Data mining based on machine learning is especially useful for classifying. Using the strength of this approach, we are recommended independent variables that are likely to have a strong explanatory capability in as many candidate variables as possible. Since machine learning also has many limitations, we do not use the independent variables derived through data mining directly in performing forecasts or evaluations, and instead propose a hybrid approach that creates a forecasting model by applying them to discriminant analysis, which is a more conventional method for forecasting analysis. Also, to analyze the suitability of the hybrid approach to the forecasting model thus proposed, we present verifications performed using an entirely new set of data.

In Chapter 2, we will first examine the current status of R&D planning among small and medium businesses in Korea and review the preceding studies related to the issue of technology planning support for small and medium businesses. Chapter 3 explains the contents of the survey we used in this study and the research methods we applied. Chapter 4 analyzes whether a mismatch exists between demand and supply in regards to R&D planning support programs in Korea. Specifically, we use the decision making tree analysis method to profile the characteristics of the group of companies that have been beneficiaries in the past, and the group that represents future demand. Chapter 5 presents a forecasting model to identify the demand companies to redress this mismatch, in which we used discriminant analysis. We hope that these efforts will contribute to the developing and evaluating R&D support policies for small and medium businesses.

2. Analysis of preceding studies

2.1. Studies related to R&D planning for small and medium businesses

According to one of the earlier studies by Robson (Robson, 1993) the system of governmental support for R&D increases R&D investment by private companies and thus supplements technological innovation activities. There are many other studies which have likewise shown that governmental support for small and medium businesses has the effect of increasing R&D investment and stimulating commercialization efforts (Audretsch et al., 2002). On the other hand, there have also been arguments that the government's financial support can have a negative effect on technology commercialization and economic performance (Akçomak and Ter Weel, 2007; Svensson, 2007).

Such policies designed to support technological innovation by small and medium businesses can be classified in various ways. Many studies have analyzed funding and human resources by classifying them as a type of policy instruments (Lin and Demner-Fushman, 2006). There have been various other classifications as well, but the classification used by Bemelmans-Videc et al. (Bemelmans-Videc et al., 2011) is an example in which relatively high importance was given to R&D planning (information) support, which is the point of interest in our study. Bemelmans-Videc et al. classified policies into three types—sticks, carrots, and sermons—based on the degree of compulsion of the policy instruments. Among the three categories identified in the typology of Bemelmans-Videc et al. (Bemelmans-Videc et al., 2011), R&D planning support belongs to the category of information providing policy, and can be classified as more of a policy of indirect support rather than direct support.

On the question of the strategic importance of planning, there are opposing research results regarding the technology planning as well. Some researchers have shown that technology planning plays an important role in determining the success of projects and innovations, and that initial planning has a positive influence on success (Dvir et al., 2003; Stockstrom and Herstatt, 2008) but there are also scholars who question the effectiveness of intricate initial planning and instead emphasize capabilities for responding quickly to change and determined efforts to tackle challenges with whatever means possible to achieve (Dvir and Lechler, 2004).

In regards to technology planning, another important factor is who the agent is. One advantage that small and medium businesses have is their ability to flexibly and quickly respond to environmental changes. Due to the pressures of an extremely competitive environment, however, and also due to the increased need for technological capabilities in various fields, such businesses now find it difficult to secure competitiveness in all aspects, and they have been placed at a competitive disadvantage because they are relatively more restricted in terms of absolute scale compared to large companies (Narula, 2004).

A representative example of R&D planning support tools specifically designed for small and medium businesses is the preparation of a technology roadmap (hereinafter referred to as TRM). Arshed et al. (Arshed et al., 2012) critically reviewed the existing literature on technology roadmapping, and argued that there are not enough studies on TRM from the perspective of small and medium businesses. Their argument emphasizes that first, there is still confusion evident in the attention given to the contents of the TRM, and there is still an absence of consensus regarding the significance of what the TRM indicates. Secondly, they pointed out that there have not been sufficient researches on the methods of using the roadmap, and argued that the overall process by which a TRM is adopted within the organizations ought to be evaluated. Lastly, they argued that previous studies on TRM basically tend to respond to the needs of large scale organizations, and that such TRMs conform to the technology push type, while the type of TRMs that would be more suitable for the needs of SMEs is the market pull type. Also, while a small number of studies began exploring alternative approaches to better include SMEs in the TRM process, the researchers pointed out that more efforts are needed to determine whether it is appropriate to include SMEs in the TRM process and if so, the timing when it would be optimal to include them.

As discussed above, technology planning as a form of R&D support has emerged as a subject of interest relatively recently, and studies on this subject have hitherto focused on instruments such as TRM. Especially in the case of small and medium businesses, which have relatively limited resources, a poorly implemented technology development project will not only result in the failure of the project itself, but may even threaten the very survival of the company. Methods for enhancing the effectiveness of technology planning support for small and medium businesses will thus continue to be a promising subject of research for the foreseeable future.

2.2. R&D planning support programs in Korea

The Korea Small and Medium Business Administration has made attempts to implement various policies to encourage the R&D innovation activities of small and medium businesses. Such support programs provide not only funding support at the R&D progress stage but also support that reaches out to areas in the Pre-R&D progress stage as well. A leading example of such programs is the 'small and medium businesses R&D planning support' program. Programs that support the R&D planning of small and medium businesses stimulate the R&D innovation activities of small and medium businesses and thus help them generate stronger innovation performance in an efficient manner. In the R&D planning stage, such programs help SMEs establish efficient strategies for technology development and commercialization by performing meticulous evaluations of various aspects of the technologies held by the small and medium businesses including their technological value, marketability, commercialization value, etc. Each year around 3–4 million dollars of budgetary support is given to assist around 100 small and medium businesses (Seo et al., 2015). Another program that is similar to such R&D planning support programs is R&D roadmap support. In order to help small and medium businesses build technology development strategies, from 2008 the Small and Medium Business Administration began offering support to individual small and medium businesses to prepare technology roadmaps (TRM). This program was implemented up to 2013 (Jun et al., 2013)