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The Relationship among Technological Intensity, Export Intensity and Performance of SMEs

기술 집약도, 수출 집약도 및 중소기업 성과의 관계

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Abstract

The purpose of this paper is to test an explanation of how technological intensity may influence performance of Small and medium sized enterprises. The model tested suggests that technological intensity affects performance of SMEs by influencing export intensity of SMEs, which in turn enhances performance of the firms. Results suggest that technological intensity is an antecedent to export intensity, which in turn partially mediates its relationship to performance of SMEs.

keywords : SME, Technolgical Intensity, Export Intensity, Innovation, Internationalization

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Introduction

Small and medium-sized enterprises (hereafter SMEs) are considered to be main drivers of economic and employment growth of a country. Evidently, a stream of research have showed that SMEs are crucial to achieving structural transformation of economies, and Henrekson & Johansson (2010) contend that, to stimulate economic and employment growth, policies on SMEs are vital.

Among the activities of SMEs, R&D investment is of importance (Lee, 2010; Stam and Wennberg, 2009). Recent studies contend that SMEs not only create new products and develop new processes, but also they encourage firm cooperation via R&D investment (Gilsing, Nooteboom, and Vanhaverbeke, 2008). SMEs' R&D investment promotes knowledge spillover and absorptive capacity (Coad and Rao, 2008; Cohen and Levinthal, 1989).

Above all, the fundamental contribution of R&D investment is that it promotes SMEs' growth. According to Acs & Audretsch (1990), it is the key factor for the survival, growth and development of SMEs. A R&D intensity followed by R&D investment or technological intensity provides unique technological know-how, which counterbalance SMEs vulnerability in global business environment (Hoffman *et al.*, 1998). SMEs' ability to innovate is in the very core of value creation (Hurmelinna-Laukkanen, 2008) and it is vital to ensure long-term sustainability (Lagace and Bourgault, 2003). Accordingly, R&D intensity has been proved to have positive effect on SMEs' growth in many context (Golovko and

Valentini, 2011; Nunes, Serrasqueiro, and Leitao, 2012; Romano, 1990; Subrahmanya, Mathirajan, and Krishnaswamy, 2010).

However, practically, there is some cases that high R&D intensity does not result in favorable performance or growth in SMEs. In the past few years, the effectiveness of R&D intensity of SMEs has become a critical issue. That is, R&D spending in Korean SMEs has been increasing at about 20 percent every year and at the same time the productivity of SMEs is continually decreasing from 2005 to 2009 (김용희, 2012; 오윤정 and 박정일, 2011). The reports also mention that investment in R&D does no decisive contribution to growth in terms of employment, sales and size. Thus, the relationship between R&D intensity and growth of SMEs needs further investigation in Korean context.

This paper tries to explain the gap between theoretical explain and practical situation concerning the relationship by incorporating export intensity of SMEs. Globally, SMEs are increasingly internationalizing in operations (Andersen, 1995). Although the number and the magnitude of FDI around the world is growing continuously, export still is an important mode of internationalization for SMEs. Accordingly, Export has been receiving much attention in the field of entrepreneurship.

Throughout many literatures, export intensity of SMEs is known to be theoretically related to the two other factors this paper concerns, namely R&D intensity and growth of SMEs. First, high level of R&D intensity is correlated with high intent of SMEs to internationalize (Cassiman, Golovko, and Martinez-Ros, 2010; Golovko and Valentini, 2011). Because of

liability of newness and foreignness that SMEs may fall in when exporting (Hymer, 1976; Stinchcombe, 1965), certain level of productivity or competitiveness should be guaranteed for the decision to export. Second, export is positively related with SMEs' rate of growth (Becchetti and Trovato, 2002; Lu and Beamish, 2001; Yasuda, 2005). It has been of importance growth strategy to SMEs whose business scope is relatively limited geographically (Barringer and Greening, 1998).

This theoretical background concerning export intensity and two other factors might provide a new view toward the direct relationship between R&D intensity and growth of SMEs. Specifically, this paper hypothesizes high technological intensity results indirectly in SMEs' growth. That is, export activity, or export intensity, plays mediating role in the relationship. In SME context, high technological intensity will be transformed into SME growth when the SMEs take up export activity. This paper contributes to the SME and internationalization literature by exploring the mediating role of internationalization of SME. The paper restate the importance of export to SMEs' strategic choices in that export is an effective choice to appropriate value from technological input and to promote firm growth. Practically, the paper shows that the reason why export choice is preferred by SMEs in real world.

To do so, this paper uses data of Korean manufacturing SMEs. The amount of export of Korean firms and SMEs have been continuously increasing since 1995. Also, the R&D expenditure of Korean firms has been continuously growing in the same period of time. As data shows, R&D expenditure and export are among the most interesting topic in SMEs of Korea.

The government created a slogan called "Creative Economy" to boost economy mainly throughout SME growth, and it also encourages SMEs to broaden their business scope abroad to stimulate growth.

This paper is organized as follows. After the introduction section, the paper proposes the theoretical framework for the SMEs technological intensity, export and growth, and proposes the hypotheses to be tested. The third section describes the data and methodology and the fourth presents the results. The discussion and the conclusions bring the paper to the end.

Theory and Hypotheses

Resource-based view is one of the most rigorous framework to analyze competitive advantage of firms and its effect to firm performance or firm growth (Barney, 1991; Wernerfelt, 1984). The theory focuses on the competitive advantage that is created by unique set of resources at the firm (Barney, 1991; Conner and Prahalad, 1996).

Penrose (1995) defines a firm as "a collection of physical and human resources". Wernerfelt (1984) suggests that "resources and products are two sides of the same coin" and presented the possibility that by specifying a resource profile for a firm, it would be possible to find the optimal product-market activities.

Barney (1986) coins in the concept of "assets being valuable" whose strategic factor markets were imperfect due to information asymmetry. Dierickx & Cool (1989) introduces a strategic asset as a stock accumulated over a period of time and

having some key features that makes the asset noninimitable, such as causal ambiguity. Barney (1991) again manages to combine these complex ideas to provide four key characteristics of a resource with sustainable competitive advantage: valuable, rare, immobile or sticky, and nonsubstitutable. RBV addresses the central issue of how superior performance can be achieved compared to other firms and asserts that superior performance results from unique resources of the firm.

Technological resources is one of the most important resources (Penrose, 1995). Technological resources are the tangible and intangible technical assets of the firm. By attaining it, firms can pursue new market opportunities and get prepared for unanticipated market developments (Chan and Heide, 1993; Meyer and Lopez, 1995).

A high level of technological intensity typically followed by a high R&D expenditure provides the firm with unique technical know-how and it in many cases promotes firm growth and expansion overseas. Particularly, it is the most critical asset for a technology-based firm (Hall, 1993; Itami and Roehl, 1991), serving as key success factor to the value of products (Goodman and Lawless, 1994).

In the case of SMEs, R&D expenditure contributes to increased diversification of activities, making SMEs more competitive (Baptista and Karaoz, 2011; Deloof, 2003; Rogers, 2004). Technological resources also explain firm survival of SMEs. SMEs often face liabilities of newness and smallness. This is because SMEs cannot acquire enough critical resources required to buffer from failure (Aldrich and Auster, 1986;

Stinchcombe, 1965). Consequently, SMEs that managed to earn these critical resources should better off in terms of being positioned for survival. As such, literatures have also shown a relationship between resources and the early performance and survival of SMEs (Bruderl and Schussler, 1990; Carroll and Bigelow, 1996; Fichman and Levinthal, 1991).

Thus, this paper hypothesizes that greater level of technological intensity of the SMEs results in higher level of performance because it provides the firms with competitiveness among other firms in the market and a buffer from failure in the early stage of firms.

H1: The greater the technological intensity of the firm, the higher its performance.

The impact of technological resources, or R&D on export performance is well-researched in the literature. The explanation is two-fold. First, R&D increases productivity of the firms, by which productive firms choose to expand toward foreign market to take full advantage of their higher productivity. This is so-call self-selection mechanism. Second, R&D itself boosts the firm's intent to export because high level of R&D intensity induces firms to pursue greater demand outside domestic market and to pursue monopolistic advantage on innovation.

The impact of R&D and the product characteristics on export performance is a well-researched issue. Some results have supported the positive effect of R&D intensity on export

motivation (Karagozoglu and Lindell, 1998) and performance (Gem□nden, Heydebreck, and Herden, 1992; McGuinness and Little, 1981; Simon, 1992).

First, sunken costs during start-up in becoming an exporter lead to the self-selection of more productive firms into export activity. The general finding in developed countries states that exporting firms have relatively higher productivity than those non-exporters before starting up exports. Also there is no significant advantages in terms of productivity observed among exporters or non-exporting firms over time (Aw, Chen, and Roberts, 2001; Bernard and Jensen, 1999; Clerides, Lach, and Tybout, 1998; Damijan and Kostevc, 2006; Delgado, Farinas, and Ruano, 2002; Fafchamps, Hamine, and Zeufack, 2008; Greenaway and Kneller, 2007; Roberts and Tybout, 1997).

The heterogeneity in productivity before taking up export activity raises an important issue about the sources of high productivity of the exporters. International trade literature has attempted to incorporate firm heterogeneity in the theoretical models. One stream of literature (Hopenhayn, 1992; Jovanovic, 1982) assert that firms are born with an inherent ability and assume that the distribution of productivity across firms is exogenous to firms. Among the literature, work by Costantini & Melitz (2007) explores the relationship between investments in innovation activity and the decision to export activity, and states that innovation results in a shock in future productivity. Similarly, the work of Lileeva & Trefler (2007) contends that the decisions to export and to invest in product innovation are positively related and complementary for productivity growth.

One source of productivity differences is contended to be associated with R&D and innovation investments by the firm (Griliches, 1998). This stream of literature finds that R&D investment constitutes an important source of the productivity differences between firms (e.g., Crepon, Duguet, & Mairessec, 1998; Doraszelski & Jaumandreu, 2013; Griffith & Huergo, 2006; Huergo & Jaumandreu, 2004). Griffith & Huergo (2006) find that both product and process innovations have a positive and significant effect on firm-level productivity.

Second, R&D and innovation activities play an important role in reasoning a firm's decision to export and export volumes. Vernon (1966, 1979) states that the firm's internationalization process follows the product life cycle. Young firms possessing a new product in the early phase of the product life cycle will move into exports to exploit their market power in foreign markets. This is due to the limits of the domestic market in the early growth stage (Hirsch and Bijaoui, 1985). Product innovation actually leads to exports in the search for new demand for the products with potentially superior quality (Hitt, Hoskisson, and Kim, 1997). In addition, increased sales of the exporting firm by conducting exports spread R&D costs, which is usually fixed (Alvarez and Robertson, 2004). And export is a way to generate monopolistic advantages based on specific technological knowledge (Chang, 1995). Moreover, R&D investment enables the firm to meet the demands of its changing domestic and international markets (Zahra and Covin, 1994).

Recent empirical studies relate product innovation and exports directly. Basile (2001) shows, for a sample of Italian manufacturing firms, that firms introducing product and/or

process innovations either through R&D or through investments in new capital are more likely to export. Bernard & Jensen (2004) find that firms switching primary SIC code, which could indicate new product introductions, significantly increase the probability of their entering the export markets. Furthermore, in a related paper, Cassiman & Martinez-Ros (2007) find a strong positive effect of product innovation, but not process innovation, on the decision of a firm to export. Becker & Egger (2013) find, consistent with our argument, that product innovation is of dominant importance relative to process innovation in explaining the decision of a firm to start export operations. Their results also show that process innovation matters for the decision to export only if accompanied by product innovation.

Thus,

H2: The greater the technological intensity of the firm, the high its export intensity.

Geographic expansion is one of the most important paths for firm growth. It is a particularly important growth strategy for SMEs whose business scope has been geographically confined (Barringer and Greening, 1998). This strategy is particularly applicable to the internationalization of SMEs because SMEs frequently lack the resources, financial or otherwise (Dalli, 1995; Zahra, Neubaum, and Huse, 1997). Exporting provides SMEs with fast access to foreign markets, with little capital investment required, but the opportunity to gain valuable international experience. (Fina and Rugman, 1996; Root, 1994; Sullivan and Bauerschmidt, 1990; Zahra *et al.*, 1997).

By broadening customer bases through entering into new

markets, firms are able to achieve a larger volume of production, and grow. Further, there are differences in market conditions across different geographic areas. By leveraging resources in different markets, firms are in a position to capitalize on market imperfections and achieve higher returns on their resources. Sooner or later, in the pursuit of growth and/or higher return to resources, SMEs will adopt a geographic expansion strategy to pursue new opportunities to leverage core competences across a broader range of markets (Zahra, Ireland, and Hitt, 2000).

Conceptually, several economic benefits can be gained by exporting. The most obvious are gains related to scale and scope economies (Grant, Jammine, and Thomas, 1988; Kogut, 1985) as achieved from larger volumes of sales and production made possible by revenue growth in the geographic extension of markets. In addition, a presence in multiple, diverse international markets can lead to advantages related to increases in market power (Kim, Hwang, and Burgers, 1993) and gains from the diversification of revenues (Ramaswamy, 1992). The potential economic benefits from exporting, together with the stepping-stone effect for future international expansion (Fina and Rugman, 1996), suggest that the extent of exporting should be positively related to an SME's financial performance.

Thus,

H3: The higher the export intensity of the firm, the higher its performance.

Data and Methods

Sample

The sample used in this study consists of 302 independent manufacturing SMEs based in Korea. The data is collected from KISVALUE, a solution providing financial data of listed Korean firms. The solution, KISVALUE, have often been used in many management papers concerning Korean context.

The target of the analysis is small and medium sized firms which conducts R&D investment and export. To investigate the economic and managerial situations of SMEs, only the firms with less than 300 employees were used in the analysis. Also, to fully capture the image of R&D investment and export strategy of firms, manufacturing sector was chosen in the study and two digit SIC code is controlled in the analysis. All the variables except for the size of firm, which is measured by the number of employees, are the average value for the data from 2011 to 2013. The size of firm is used as of 2013.

Variables

The dependent variable is corporate performance. The paper uses return on asset (ROA), computed as the ratio of net income of a firm to total assets. The data is obtained from KISVALUE as mentioned above, and the average value from 2011 to 2013 is used. ROA has been used in many papers in the field (e.g., Contractor, 2003; Ramaswamy, 1995).

For the measure of internationalization, the paper gathered data of export intensity, which is expressed as a percentage of total sales. The export intensity is widely used in SME internationalization literature simply because SMEs starts their internationalization activity firstly by export activity and

just small fraction of them conduct FDI (e.g., Arnold and Hussinger, 2005). Also, the paper computes technological intensity, R&D expense/total sales. It is known as a good indicator of technological intensity, as a high R&D to sales ratio implies a high expenditure on the product or process, therefore a high add-value on the value chain (Dhanaraj and Beamish, 2003).

The paper includes controls for several variables that is widely known to affect corporate performance. Two-digit SIC industry code is included as dummies to control for industry effect on performance. Firm age as of 2013 and firm size measured by the logarithm of total sales are included. Product diversification is computed following prior studies(Li and Qian, 2005; Tallman and Li, 1996). It is measured as a Herfindahl measure (product diversification , where is the proportion of a firm's sales in product line *i*). Additionally, the paper counts whether a firm is *chaebol* or not as a dummy variable. Chang and Hong (2000) examined the economic performance of firms associated with chaebol, which provides favoring environment to group-affiliated firm with groupwide resource sharing and internal business transactions.

Methods

The paper examined the performance implications of internationalization strategies and R&D investment. To reduce any unusual influence of certain year performance, the data used in the analysis were the average of data from 2011 to 2013. With firm records for ROA as a dependent variable, the paper used ordinary least squares. OLS is a method for estimating the

unknown parameters in a linear regression model. It aims to minimize the differences between the observed responses in some arbitrary dataset and the results from the linear approximation of the data.

Table 1
Means, Standard Deviations, and Correlations

Variables	Mean	S.D.	Min	Max	1	2	3	4	5	6
1 Roa	0.021	0.061	−0.222	0.175	1.000					
2 Firm age	24.000	14.253	2.000	96.000	−0.225	1.000				
3 Firm size	24.956	0.781	22.965	27.212	0.099	0.190	1.000			
4 Chaebol	0.026	0.161	0.000	1.000	−0.022	0.068	0.190	1.000		
5.Product Diversification	0.539	0.274	0.000	0.978	−0.081	0.035	−0.013	0.008	1.000	
7Technological Intensity	0.044	0.045	0.000	0.246	0.153	−0.370	−0.470	−0.125	−0.122	1.000
8 Export Intensity	0.435	0.284	0.001	1.214	0.213	−0.258	0.022	−0.074	−0.159	0.264

Table 2
Results of Regression

	(1) ROA	(2) Export intensity	(3) ROA
Industry	−inserted−	−inserted−	−inserted−
Age	−0.201**	−0.137*	−0.181**
	(−2.987)	(−2.352)	(−2.680)
Size	0.223**	0.133*	0.204**
	(3.306)	(2.278)	(3.009)
Chaebol	−0.022	−0.033	−0.018
	(−0.369)	(−0.636)	(−0.290)
Product diversification	−0.049	−0.063	−0.040
	(−0.824)	(−1.230)	(−0.671)
Technological intensity	0.169*	0.136*	0.149*
	(2.261)	(2.100)	(1.992)
Export intensity			0.146*
			(2.117)
N	302	302	302
R^2	0.129	0.351	0.143
adj. R^2	0.054	0.295	0.065
F	1.712	6.252	1.844
Log. Likehood	439	17	441
Degree of Freedom	24	24	25

Standardized beta coefficients; t statistics in parentheses
* $p < 0.05$, ** $p < 0.01$, *** $p < 0.001$

Results

The purpose of this paper is to examine the mediation effect of export intensity of SMEs and the role of export activity in the relationship between technological intensity and

performance of SMEs. To assess the hypothesized relationship, the sobel test with multiple regression is employed.

Table 1 shows the ranges, means, standard deviations, and correlations of all the independent variables except for the industrial code. Before the multiple regression is conducted to test the hypotheses, the correlation between the independent variables is checked. Multicolliearity of our data is tested with the Variance Inflation Factor (VIF). If VIF value is shown to be high, changes of an independent variable then can be explained by combinations of other independent variables. The result of VIF test shows that the data has no multicollinearity issue, with all other variables of the model except for industry code included. The data' s VIF ranges from 1.47 to 1.81 and the mean is 1.43. According to Hair *et al.*(2009), a certain degree of multicollinearity can exists if VIF value is higher than 10. In addition, the age and size of the firm has a relatively low level of correlation, 0.19, which can be a concern for data of SMEs if the value is too high.

To test our hypotheses, model 1 do not contain export intensity, which the paper looks for its mediation effect in the model. Model 2 take export intensity as a dependent variable and technological intensity as an independent variable, and Model 3 contains all the variables designed in the model, following the sobel test procedure. The paper has included the industrial code in the models. Table 2 shows the results for the multiple regression.

Over the whole models, age and size of a firm are shown to be significant at 1 percent or 5 percent level. Firm age is significant but in negative direction. The result may seem

counter-intuitive. However, in many literatures, the size and the rate of growth have shown to be independent. This is so-called 'Gibrat's law' (Santarelli, Klomp, and Thurik, 2006). Also, in many other literatures, a negative relationship between firm size and the rate of growth was empirically proved especially for smaller firms (Caves, 1998). Literatures contend that on average, younger firms outgrow other firms, and the smallest firms grow faster than the rest (Caves, 1998; Lotti, Santarelli, and Vivarelli, 2003).

In model 1, the technological intensity measured by the ratio of R&D expense to total sales is supported (p<0.05). The coefficient of technological intensity is statistically significantly positive and it implies that hypothesis 1 is supported. This finding is in line with other literatures concerning innovation and growth of a firm, which contend R&D expenditure is the main driver of firm growth.

To test the hypothesis concerning mediation effect of export intensity, the model 2 includes export intensity as a dependent variable and technological intensity as an independent variable. The result shows that model 2 is supported at 5 percent level. This implies that high level of technological intensity results in high level of export intensity.

Hypothesis 3 states that high level of export intensity results in high level of ROA. The result shows that model 3 is significant at a 5 percent level, supporting hypothesis 3.

According to sobel test procedure, to claim that there is mediation effect, the effect of the independent variable is reduced and the effect of the mediator should remain significant. As is shown in the result table, the coefficient of technological

intensity is reduced from 0.169 (Model 1) to 0.149 (Model 3), and the export intensity in model 3 is significant. It can be concluded that export intensity has mediation effect in the model. In addition, in the model, export intensity has a partial mediation effect because technological intensity is still significant in model 3.

Discussion and Conclusion

This article explores the mediation role of export intensity in the widely held relationship between technological intensity and performance of SMEs. The result of the study shows that technological intensity of SMEs are inclined to increase firm performance, specifically ROA, via increasing the export intensity of a firm. Firms with high level of technological intensity tend to choose internationalization strategy, and those SMEs that tends to have high export tendency may have higher performance than those do not.

The results shed light on new role of export intensity in the literature. Literatures have dealt with internationalization as one of main driver of performance of a firm or as a major independent variable in the empirical test. However, in this paper, export intensity turns out to have a partial mediation effect in the relationship between innovation and firm growth.

This perspective contributes to the innovation literature by incorporating the concept of geographic extension. By entering into a new market, regardless of the commitment that a firm put into the market, a firm can appropriate more value from innovation input than before. Many studies have shown advantages of internationalization and export on firm

performances. However, not many have contended the role of geographic extension to innovative performance. Also, the result of this paper contributes mainly to the literature of internationalization, of course. As mentioned above, the mediation role of internationalization can be seen as a new positive effect on the innovation of SMEs. As SMEs put much emphasis on innovation, their geographic extension can reinforce their main strategic driver, innovation.

As the paper uses Korean context to test the hypothesis, it shed light on the real economic and managerial situation in Korea. Korean SMEs have shown to invest a lot in R&D activity. However, in contrast, output of the activity is far under the expectation in terms of patent registration, rate of growth, and productivity. Meanwhile, several reports state that the amount of export of SMEs is continuously increasing over the past ten years. Managers may obtain some implications from the result of the study.

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국문초록

본 논문은 기술 집약도가 중소기업의 성과에 미치는 영향을 연구한다. 본 연구가 제시하는 모델은 기술 집약도는 수출 집약도를 거쳐 최종적으로 중소기업의 성과에 영향을 준다고 설명한다. 논문의 후반부에 제시된 실증연구 결과에 따르면, 모델에서 제시한 바와 같이 기술 집약도는 수출 집약도에 선행하며, 수출 집약도는 기술 집약도와 중소기업의 성과의 관계 사이에서 매개 변수의 역할을 하는 것을 발견하였다.

주요어: 중소기업, 기술 집약도, 수출 집약도, 혁신, 국제화

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