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A Meta-Analysis Comparing Factors Affecting the Growth of SMEs: The Case of Germany and South Korea

Minseo Kim[1] and Hyesu Park[2]*

[1,2]Department of Management of Technology, School of Business, Konkuk University, 05029 Seoul, Korea

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This study analyzed the effect size of predictors that affects the growth of SMEs in Germany and Korea using meta-analysis. A total of 34,154 studies from six databases in English and Korean were collected, and finally 38 studies were selected by sorting related empirical studies. A total of 288 effect sizes was used by classifying the predictors from these studies. As a result, the effect size and ranking of factor of predictorsthat lead SME growth in Germany and Korea were different. However, the key factorsin both countries for firm growth was entrepreneurship and innovation. In Germany, investment in human capital and physical capital for R&D was the important factor that led a firm to grow with global competitiveness.In Korea, various characteristics of innovation were found to be simultaneously necessary factors for actual results of innovation success.

Keywords: SMEs' growth, Innovation, Entrepreneurship, Mittelstand, Meta-analysis

Introduction

After the global economic crisis, Germany experienceda rapid economic recovery based on strong and sustained performance in manufacturing. A report by the World Bank in 2018 said that the value added of Germany's manufacturing sector accounted for approximately 30% of EU total gross value added in manufacturing, while the total gross value added of Germany stood at 3.55 trillion euros.The driving force behind this economic resurgence is the achievement of Germany's "Mittelstands," which generally refers to the country's small-medium enterprises (SMEs), which account for approximately 98% of Germany's manufacturing sector and plays a pivotal role in increasing employment and exports. Among the Mittelstands, 1,307 companies in particular are classified as "hidden champions" (HCs), relatively small but global market leaders in niche products.[1] Simon (1990)[2]reported that the core competitiveness of HCs' continuous profitable growth came from exceptional management skills such as strong leadership, employing experts, sufficient fundraising, and constant innovation activities. As a role model for sustainable economic growth, other countries have considered the application of strategic insights of HCs to their manufacturing sectors. In 2011, the Korean government launched the "Global Strong and Small Enterprises Nurturing Policy" to turn promising small companies into successful HCs. Korean SMEs that are in similar size and high value-added range to German HCs have been classified as "High-Potential Enterprises" (HPEs). The selected companies have been supported by various subprograms to accelerate their performance in the global market. Despite the Korean government's efforts, however, the ranking of global manufacturing competitiveness of Korea has dropped from third in 2010 to sixth in 2016, while the ranking of Germany has risen from eighth in 2010 to third in 2016.[3] These facts indicate that the Korean government needs to find new alternatives to enhance the competitive advantages of the manufacturing sector. Therefore, this study focuses on the factors that affect the performances of German and Korean SMEs.Similar with Germany, in Korea, various characteristics of innovation such as technical skills, R&D resources, entrepreneurship etc. and political support by government were found to be simultaneously necessary factors for actual results of innovation success. However, global competitiveness and economic performance of Korean SMEs is lower than German SMEs. Therefore, in this study, we compare Korea with Germany, an advanced manufacturing country, to provide guideline establishing a new paradigm for nurturing policies and firm strategy which is necessary for Korean firms to

*Author for Correspondence
E-mail: hsmot@konkuk.ac.kr

growth as German firms. Since, in global economy, condition of each country's economic and social is different, factors affecting the growth of each country's firm needs to be approached comprehensively, not limited to a specific field. Thus, in this study, by using meta-analysis, the results of previous studies on factors affecting the growthof Korea's and Germany's firm has been analyzed. Meta-analysis has strength on comparing the effect size collected comprehensively from various factors used by previous studies. Since each studies have different scope and variables, meta-analysis which can approach systematically and comprehensively is suitable for this study.

Conceptual Model and Research Question Development

There are two mainstream company growth theories: the resource-based theory, and the innovation-based theory or so-called Schumpeterian model. According to the resource-based view, companies can create sustainable competitive advantages through core competencies. Core competencies derived from the optimal combination of multiple given resources enable companies to possess inimitable capabilities and to achieve sustainable performances in the marketplace[4]. Another view is the Schumpeterian model, an innovation-based endogenous growth model introduced in 1911. From this perspective, technological innovation and entrepreneurial activities are the main driving forces that transfer the productive resources of a static economy to dynamic innovations. It emphasizes the importance of innovations that can increase the productivity of production factors and develop differentiated products for long-run growth[5]. Based on these classic theories, many previous studies have tended to analyze the relationship between a company's performances such as revenues, growth in sales, imports and exports, market shares, and innovations, and its resources or investments such as assets, human resources, capital investments, R&D intensity, etc. These empirical studies have focused on the factors that influence a company's growth according to Gibrat's rule of proportionate growth[6], but their results have been inconsistent due to differences between samples, timeframes, and methodologies. Therefore, the large number of studies on firm growth with heterogeneous and sometimes even contradictory findings calls for studies to synthesize and generalize the evidence on key factors that determine growth. This study integrates SMEs' growth factors based on two theories for a comparative analysis between Germany and Korea. These predictors are classified into firm characteristics, CEO characteristics, and innovation characteristics (Table 1). Furthermore, a meta-analysis is conducted to obtain generalized results of previous empirical studies and a better understanding of how different effect sizes of determinants are. The research questions are as follows.

Research Question1. Which factors among firm characteristics, CEO characteristics, and innovation characteristicsthat affect SME growth have larger effect sizes on firm growth?

Table 1 — Determinant factor classification

Factor	Subfactor	Definition
Firm Characteristics	Size	Size of firm (no. of employees, turnover, sales, etc.)
	Age	Age of firm
	Finance	Index of financial situation(Cash flow, revenue, property, assets, etc.)
	Subsidy	Whether public subsidies are received
CEO Characteristics	Entrepreneurship	Degree of entrepreneurship: innovativeness, risk-taking, proactiveness
Innovation Characteristics	Product Innovation	Introduction of a good or service that is new or significantly improved with respect to its characteristics or intended uses
	Process Innovation	Implementation of a new or significantly improved production or delivery method
	Marketing Innovation	Implementation of a new marketing method involving significant changes in product design or packaging, product placement, product promotion or pricing
	Organizational Innovation	Implementation of a new organizational method in the firm's business practices, workplace organization or external relations. Searching for external sources or cooperation agreements with external partners
	Innovation Intensity	Degree of innovation activity (investment in current innovation expenditure, patent stock per employee, number of technology alliances, etc.)
	R&D Intensity	The ratio of expenditures on R&D to a firm's sales
	R&D Employees	The number of R&D employees

Research Question 2. Is there any different factor that affects SMEs growth between Germany and Korea?

Materials and Methods

Database development and coding

The data for meta-analysis were collected from studies on German Mittelstand and Korean SMEs. Studies on Mittelstand were collected from Proquest, EBSCo, and Science Direct by the following process. 1) The database was searched using the terms "Mittelstand," "Hidden champion," "Germany," "SME," "Innovation," and "Success". 2) The articles retained were screened by articles including "Scholarly Journal," "Studies," and "English," until 3,227 articles remained. 3) Studies that repeated were excluded, and 139 articles were selected. 4) Finally, 18 articles were selected based on following criteria for the suitability of research model and availability of effect size of variables. Studies on Korean SMEs were collected from "KISS,""KCI," and "DBpia" by the following process.These DB was used since most of the studies on Korean SMEs are on Korean journal DB.1) The data base was searched using the terms "SME," "Innovation," and "Success." 2) From 30,927 articles, repeated studies were excluded and 323 articles were selected by checking abstracts. 3) And from the 323 articles, empirical studies on "Innovation type SMEs," "Innobiz SMEs," and "Korean global hidden champions"were selected. "Innovation type SMEs," "Innobiz SMEs," and "Korean global hidden champions" means companies with innovative competitiveness and global competitiveness that are similar to hidden champions. 4) Finally, 20 empirical articles were selected based on following criteria for the suitability of research model and availability of effect size of variables.

In all, 38 articles were used for the empirical analysis in this study.

Variable classification

Firm Characteristics

The resource-based view, the firm's resources are classified into static and dynamic resources. Static resources infer a stock of assets that are appropriate semi-permanently,while dynamic resources infer capabilities, including an organization's learning capacity, which generate additional opportunities over time. By possessing resources which other company cannot imitate, firms can lead with a competitive advantage which consequently enables the sustainable growth of firms.[7,8,9,10,11,12]

CEO Characteristics

Entrepreneurship has emerged as an important concept on both the individual and corporate level. An entrepreneur is someone who destroys the existing economic orderby introducing new products and services, exploiting new raw materials, creating new forms of organizations, and founding new businesses and markets.[13,14] Entrepreneurship is described as "innovativeness," "risk-taking," and "pro activeness." Firms with a high degree of entrepreneurial management tend to exploit promising opportunities more frequently than more conservative firms.

Innovation Characteristics

Innovation is a key factor in creating economic performance. The innovation capability of a firm refers to the ability to utilize technology for competitive product development, technology commercialization or related internal resources.[15]This can be measured by various factors of the input and output of innovation activities. From the perspective of input, R&D, represented by innovation, is an indispensable strategy to improve the added value of products and services through product and process innovation and cost reduction.[16]Many studies have shown the positive influence of innovation on rapid growth firms.

Firm Growth

The results of innovation activities of a firm can be labor-saving progress, capital-saving progress, and neutral progress (progress where capital and labor saves at the same ratio) by technological progress. This is based on production function and highly related to financial performance such as efficiency and effectiveness.[17,18]Furthermore, innovation can create and diffuse new knowledge that contributes to expand the economy's potential to promote the development of advanced products and processes. In this study, innovation performance is defined as financial performance in quantitative terms and innovation success, which is non-financial performance from a qualitative aspect. Financial performance includes labor productivity, efficiency (the average of cost saving, reduction of costs by progress innovations), and effectiveness (the average of competitive position, growth, reduction of costs by process innovations). And innovation success includes new product development, process

and market development, and product quality improvement.

Meta-Analysis Procedures

To answer these questions, this study engaged in an assessment by establishing a metricized baseline based on 38 empirical studies, with a total of 288 effect sizes. We conducted coding and analyzed the effect size based on correlation using Comprehensive Meta-analysis (CMA) 3.0. Using the methodology of Borenstein et al (2009)[19], it recalculates the effects of meta-analysis, employing a random effects model. In previous studies, most research provided a correlation matrix that was selected as the effect size metric for the meta-analysis. However, few studies reported beta coefficients (β) or t-statistics (t), and not a correlation coefficient (r). Therefore, β and t have been transformed into r. In Meta-analysis, r is converted into Fisher's Z (z) for minimizing biases, since the distribution of transformed r is under the asymmetric distribution. Under the assumption that studies with larger samples are more reliable and accurate, studies that have a larger sample size are weighted using formulas of inverse-variance weighting (W_i) and weighted averages (M). Lastly, to report estimated effect sizes, z is converted to r for ease of understanding and interpretation.

Results and Discussion

Identifying Heterogeneity and Publication Bias

To identify heterogeneity, the null hypothesis that all studies have a common effect size is assumed and tested. The classical measure of heterogeneity uses Q statistic and I^2statistic based on Cochran (1954).[20]In general, the null hypothesis that the studies are homogeneousis rejected when a p-value is less than 0.05.If the heterogeneity of the studies is confirmed, the random effect model should be preferred. In this study, high heterogeneity is verified since p-values are less than 0.05 and I^2values are over 90% (Table 2). Therefore, the random effect model is used since we do not assume that studies within each subgroup share a common effect size. Publication bias can be checked by fail-safe N, which shows the reliability of research results. When fail-safe N is lower than 5K+10, it is considered hard to rely on. In this study, there is no publication bias since fail-safe N for the entire model is higher than 5K+10.

Results of Meta-Analysis

Table 2 presents the effect size for relationships between predictor variables and firm growth. The results provide information on the number of r(K) and effect size (ES_r). The boldeditems are factors that ES_r mainly affects (ES_r> 0.2).In the case of Model 1, the

Table 2 — The effect size for the relationship between predictor variables and firm growth

Predictor	Model 1 Total			Model 2 Financial Performance			Model 3 Innovation Success			Model 4 Germany		Model 5 South Korea	
	K	ES_r		K	ES_r		K	ES_r		K	ES_r	K	ES_r
Firm characteristic													
Size	21	0.151	*	12	0.240	*	9	0.037	*	14	0.198*	7	0.047*
Age	17	0.101	*	10	0.131	*	7	0.085	*	15	0.140*	2	0.080
Finance	48	0.206	*	39	0.274	*	9	0.027		34	0.162*	14	0.312*
Subsidy	9	0.012	*	2	0.030		7	0.008		7	0.008	2	0.030
CEO Characteristics													
Entrepreneurship	29	0.342	*	13	0.363	*	19	0.326	*	2	0.252*	27	0.348*
Innovation Characteristics													
Product Innovation	10	0.090	*	8	0.041	*	2	0.461	*	6	0.030*	4	0.242*
Process Innovation	6	0.086	*	4	0.020		2	0.374	*	2	0.016*	4	0.168*
Marketing Innovation	6	0.187	*	4	0.060	*	2	0.469	*	5	0.085*	1	0.784*
Organizational Innovation	42	0.271	*	11	0.086	*	31	0.342	*	28	0.159*	14	0.506*
Innovation Intensity	34	0.228	*	18	0.303	*	16	0.164	*	20	0.134*	18	0.342*
R&D Intensity	51	0.144	*	36	0.092	*	15	0.211	*	14	0.170	37	0.132*
R&D Employees	11	0.219	*	4	0.259	*	7	0.196	*	2	0.358*	9	0.191*
K		288			158			130			149		139
Q		9887.300			5999.990			3887.311			5151.086		4272.287
df(Q)		287			157			129			148		138
P		0.000			0.000			0.000			0.000		0.000
I^2		97.097			97.383			96.692			97.127		96.770
Fail-safe N		9338.000			2875.000			4368.000			1580.000		2603.000

*P<.05

subfactor of firm growth, including financial performance and innovation success, was analyzed by 288 K. In Models 2 and 3, firm growth verified each ES_r by dividing the subfactors into financial performance and innovation success. And a few nonsignificant predictors were found. In particular, subsidy did not have an impact on financial performance and innovation success. In Models 4 and 5, the subfactor of firm growth were compared the performance of Germany and South Korea.

The results show that CEO characteristics has the highest ES_r relationship between firm growth from Model 1 (Research Question 1), and the ES_r of CEO characteristics is also higher than other predictors from Models 2 and 3. In addition, the ES_r of innovation characteristics has a positive relationship with firm growth. In particular, in Model 2, financial performance has high ES_r of innovation intensity and R&D employees, while in Model 3, innovation success has a significantly high ES_r of four types of innovation. Based on these results, we can confirm that entrepreneurship and firm innovation are key success factors for a firm's growth. These findings support previous research based on the innovation-based growth theory. As a result of Research Question 2, we verified that the predictors that affect the growth of SMEs in each country were different (model 4 and 5). The bolded items are ES_r statstics that are larger than the other country. The firm characteristics of Mittelstands in Germany have a stronger positive effect size on growth than in Korea. And firm size and age are important factors for Mittelstands' growth. These results and the fact that 45% of Mittelstands are family-owned companies imply that maintaining generational continuity builds up tactic knowledge and management strategies, which plays an important role in creating business performances. And the Mittelstands in Germany show high effect sizes in R&D intensity and R&D employees in innovation characteristics, while SMEs in Korea show high effect sizes in innovation activities. In Germany, investments in R&D human resources and physical capital have been considered key success factors for Mittelstands' growth. Indeed, around 82% of all apprentices who are trained by various programs are working in Mittelstand companies. This investment in R&D employees with capital investments of innovations by a company itself and the government contributes to promote cooperation between researchers and private firms and to strengthen firm competitiveness. Due to these efforts both the public and private sectors, Mittelstands have been able to outperform other SMEs. However, to generalize these results, it will be necessary to analyze more related studies. We used inverse-variance weighting and weighted averages to reduce differences between predictors, but there are significantly large differences between predictors since each country's predictors have different sample sizes. Thus, follow-up studies will need to collect more related studies to balance the number of *K* in each predictor.

Finally, we compared the analysis result ranks of each country's growth sub factors with high *ESr*, which are financial performance and innovation success (Table 3). The five highest factors of *ESr* for German Mittelstand and Korean SME development were drawn by financial performance and innovation success. The factors, R&D intensity and R&D employees, could be considered firm characteristics because the relationship between R&D intensity and finance, as well as the relationship between R&D employees and firm size, is highly correlated. In this case, it has been verified that expanding innovation strategies based on a firm's discriminatory ability is essential for rapid growth.

Specifically, in the case of Germany, entrepreneurship and investment of human resources and finances in R&D were the key factors for firm growth. And in the case of Korea, culture and efforts for innovation and entrepreneurship were the key factors for firm growth. Innovation intensity was the most important predictor of financial performance for German Mittelstands, while entrepreneurship was the

Table 3 — Comparison of top 5 success factors: Germany and South Korea

Ranking	Germany		South Korea	
	Financial performance	Innovation Success	Financial performance	Innovation Success
1	Innovation Intensity	R&D employees	Entrepreneurship	Marketing Innovation
2	Size	Entrepreneurship	Finance	Organizational innovation
3	Entrepreneurship	Organizational innovation	Innovation Intensity	Product Innovation
4	Finance	Marketing Innovation	R&D employees	Innovation Intensity
5	R&D Intensity	R&D Intensity	Organizational innovation	Process Innovation

most important predictor for Korean SMEs. For innovation success, possessing R&D employees was the most important predictor for Mittelstands, while marketing innovation was the biggest success factor for Korean SMEs.

Conclusions

This study conducted a meta-analysis to verify and confirm the effect size of predictors on firm growth by combining data from previous studies on SME growth. By comparing Germany's Mittelstand, with strong competitiveness in the global market, and Korean SMEs, for which global competitiveness has fallen recently, we provided strategic implications for the growth of Korea's SMEs. The verification results of the research questions show that, first, entrepreneurship has a larger effect size on firm growth than other factors in both countries (Research Question 1). Secondly, R&D investment, including human resources and physical capital, has a strong relationship with Mittelstands' growth (Research Question 2).Although the proportion of R&D expenditure to GDP by public institutions in Korea is the highest among OECD countries, R&D investments in SMEs are low. To promote Korean SMEs' sustainable growth, it is suggested that SMEs acquire competencies to develop competitive technologies and products by increasing R&D investments. Furthermore, human resource development programs, such as Germany's apprenticeship system, will be necessary to secure skilled employees, while there should be industry-university linkages for the continuous education and training of workers. The result of this study will contribute on political support and establish of firm strategy for Korean SMEs to grow into global firm such as Mittelstand. For further research, based on the result of this study, additional meta-regression analysis on factors affecting the growth can validate the study result. In addition, investigation on the relationship between innovation success and financial performance could be conducted.

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