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# A Review of Studies on the Influence of SME's Technological Innovation on National and Regional Economies

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# 중소기업 기술혁신이 국가 및 지역경제에 미치는 영향에 대한 선행연구 고찰

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**Abstract** : The competence of SME's technological innovation is deemed as one of the crucial factors in national and regional economies. Yet, as seen in previous studies, there is a dearth of studies on this subject, and policy and academic circles had been inclined to relatively underestimate the contribution of the SMEs to economies and industries (such as, job creation and GDP contribution). Generally, there is a bias that the innovative activity of the large-sized firm is likely to perform better than that of the small-sized company. According to several case studies, however, SME possesses a more appropriate form for innovative activities, and significantly contributes to creating advanced industrial agglomeration. Hence, this study analyses the contribution of the SME innovation to the national and regional economy along with analysing the extant literature. In doing so, we can reason out theoretical and policy implications.

**Key Words** : SME innovation, regional economic policy, regional industrial policy, case study, SMEs

**요약 :** 중소기업의 기술혁신역량은 국가 및 지역경제에 중요한 요소로 여겨진다. 하지만 이와 관련된 연구가 부족할 뿐 아니라, 중소기업 혁신활동이 경제와 산업에 미친 공헌(예를 들면, 일자리 창출 및 국내총생산 기여도) 역시 학계와 정책입안자들에게 상대적으로 과소평가 받고 있음을 선행연구를 통해 확인할 수 있다. 또한, 일반적 인식으로는 중소기업보다 규모가 큰 대기업에서 혁신활동이 더 활발하게 발생할거라는 편견을 갖고 있지만, 몇몇 사례연구를 살펴본 결과 실질적으로는 중소기업이 혁신활동에 더욱 유리한 조직을 갖췄을 뿐 아니라 첨단산업 집적지 형성에도 상당한 기여를 해왔음을 알 수 있다. 이에 본 연구는 선행연구 고찰과 함께 지난 시간 중소기업의 혁신활동이 국가 및 지역경제에 미친 공헌을 살펴보고, 그러한 성과들을 바탕으로 정책적, 이론적 시사점을 도출하였다.

**주요어 :** 중소기업혁신, 지역경제정책, 지역산업정책, 사례연구, 중소기업

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This paper is one part of the author's doctorate dissertation and has been supplemented and revised by some renewed information.

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# 1. Introduction

Companies are considered to be a basic economic unit, therefore firm-level innovation (e.g., technological, organisational, or process improvement) results in a better outcome of regional and national growth, which implies that the firm is the keystone of the economic system and innovation system as well (Kwon, 2003; Amin, 1999; Edquist, 1997; Freeman, 1995; Lööf and Heshmati, 2002; McAdam et al., 2004; Nelson, 1993; Patel and Pavit, 1997; Tödtling and Kaufmann, 2002).

Notwithstanding its crucial role in the economy and innovation, however, the investigation of Small and Medium Enterprises (hereafter SMEs) innovation along with geographical views in the academic circle of Korea has been relatively underplayed (compared to large-sized companies).

Indeed, the nation's previously developmental pathway which steered economic and industrial development by "picking winners", resulted in the neglect of the aforementioned matter.

This is not only a problem in Korea, according to Rothwell (1989), almost all European countries government showed a similar attitude during the 1950s and 1960s. Policymakers tended to favour large-sized firms and a couple of public enterprises for facilitating the nation's key industrial sector such as the computer industry, engendering that most of the public and R&D funds flowed in merely large-sized corporations. Namely, it is plausible that public financial support to SMEs was very limited in that time period.

There is one question arising from such business environments, as to why European policymakers have changed their behaviours more favourable towards SMEs.

Thus, the aim of this paper is to delve into the role of SMEs by investigating ample previous studies, thereby finding its significant contributions in the economy and industry that may help to figure out given the question above and to break a bias against SME.

This paper is organised as follows. We will first examine the literature review of 'innovation', 'SMEs', and 'SMEs innovation', and then the historical contribution of SMEs to Western economies (particularly, the UK and the US) and Korea with the case of the Daegu's textile industry will be provided. On the basis of the literature and the case study, conclusions and implications will be drawn in the final chapter where we give a summary with some theoretical and policy implication to the Korean academic and policy circle.

# 2. Literature: Innovation, SMEs, and SMEs innovation

## 1) Innovation

According to numerous authors (Dosi, 1988; Freeman, 1989; Lundvall, 1992; Nelson and Rosenberg, 1993; Niosi et al., 1993), the term "innovation" is derived from Joseph Schumpeter, whose classical concept referred to product and process innovation, technological innovation, the emergence of new markets, and organisational reforms. Because of his considerable efforts and his contribution to the concept of innovation in academia, Schumpeter is regarded as a pioneer of the study of innovation.

Various scholars have since defined the terminolo-

gy about innovation in the context of their academic fields. For example, Christopher Freeman (1982, p. 6) disentangled the confusing notions of "innovation" and "invention":

> An invention is an idea, a sketch or model for a new or improved device, product, process or system. Such inventions may often (not always) be patented but they do not necessarily lead to technical innovations. In fact the majority do not. An innovation in the economic sense is accomplished only with the first commercial transaction involving the new product, process system or device, although the world is used also to describe the whole process.

Dosi (1988, p. 222) defined its meaning with a slightly different view, as follows:

> Innovation concerns the search for, and the discovery, experimentation, development, imitation, and adoption of new products, new production processes and new organizational set-ups.

With these diverse definitions, Lundvall (1992) and Edquist (1997) have pinpointed that innovation is fundamentally reflected by existing determinants and knowledge, thereby creating novelty, i.e., innovation creates something new by means of the combination of existing sources.

Also, all type of innovation is inevitably entailed uncertainty as it is complicated and non-linear processes which involve tons of trial and error (Teece, 1994).

### 2) SMEs

Before addressing the main issue of SMEs' innovation, this research has to examine a normative definition about the size of SMEs due to various notions, depending on the economic scale of each country. Most studies and scholars have adopted the definition of SMEs from a standard given by the Organisation for Economic Cooperation and Development (OECD) (2005). In the US, SMEs are defined on the basis of the number employees, that is, companies having fewer than 500 workers, whereas the standard of the European Union deems that the number of workers is generally fewer than 250 employees at most.

Korea also has its own standards whereby the range of SMEs is determined by the average turnover over the previous three years, rather than considering the number of workers. The reason the Korean government employs a different standard compared to other countries is related to a consideration of growth patterns in domestic enterprises. A previous standard of SMEs in Korea was similar to that applied in the EU and the US, and was based on the number of workers and the company's capital assets.

Yet, tampering with the record of the company's account book meant these two criteria could be artificially manipulated, resulting in certain side effects. For example, some corrupt companies, by deliberately manipulating their account books, used to misuse the government subsidies which were designed to protect SMEs in a free market economy (Homepage of Small and Medium Business Administration, 2019). Therefore, the new regulation for the standard of SMEs in Korea was modified quite recently in 2015 so as to circumvent such potential abuse of the system.

Under the circumstances, a simple comparison of the role of SMEs between Western economies and the Korean economy may be limited owing to its fundamentally different definition of SME (i.e., different size regulation). Notwithstanding, we can also find that there are some common features, in which the meaning of SMEs is technically regarded as the company which suffers from lack of resources (e.g., labour, finance, etc.). Given the aim of this study which is to look at the SMEs' innovation activities that are less known, therefore, we employ the universal sense of SME, thereby figuring out their contribution to the economy and industry.

### 3) SMEs innovation: Radical and Incremental Innovation

With regard to innovatory processes, there are two different pathways: "radical" and "incremental" innovation. These are mostly distinguished by the pattern of innovation applied to improve and foster existing products and processes regardless of any industrial and sectoral boundaries. An incremental innovation is likely to slightly and gradually alter existing products, such as changes in product design (Nelson and Winter, 1982) and processes. So, this type of innovation clearly entails far less effort regarding research competence (Hirsch-Kreinsen, 2008).

In contrast, a radical innovation is meant to significantly reform existing processes and products 'based on a different set of engineering and scientific principles and often opens up whole new markets and potential application' (Henderson and Clark 1990, p. 9). This implies that compared to incremental innovation, radical innovation inevitably needs to be accompanied by higher technological capacities and more time-consuming processes.

## 3. The case of SMEs' innovation

### 1) The influence of SMEs' innovation on national and regional economies

The historical evidence clearly showed how SMEs had contributed to economic growth not only in developed countries, but also in developing countries. Also, these small-sized firms have been acting as game changers in the market by launching highly improved innovative products. Their relatively flexible structure (i.e., no massive burdens from the market and customers) can facilitate the development of risk-driven technology, thereby introducing new and better products (Choi, 2003; Keeble, 1997; Nugent and Yhee, 2002; Rothwell, 1989; Vaessen and Keeble, 1995).

However, academic and policy interest in SMEs, in particular their contribution to the regional economy, has been neglected for a long time (Acs and Audretsch, 1988). Since the 1980s, such issues were highlighted by several scholars, who by analysing eminently successful case regions, examined how SME-rich regions had improved their market competitiveness (Castells and Hall, 1994; Cooke, 2001; Saxenian, 1994; Scott, 1988).

One representative case which shows the performance of SMEs' innovation might be the Third Italy. According to Kwon (2003), SMEs-specialised districts (e.g., Modena) had engendered the growth of the industry, and of national and regional economies with population increase. Further, this study finds SMEs-rich regions in Italy show somewhat differ-

ent hallmarks compared to the regions in the U.S. For instance, SMEs-oriented industrial district in the US has been strongly influenced by universities, research institutions, and other tech-related intermediaries. Whereas, the case of the Third Italy has strongly connected to the regional business networks (such as, business associations) in which the reciprocity between firms in the region is a pivotal factor in sustaining and improving regional and market competitiveness. It implies every region has different socioeconomic milieus, thus there is no 'one size fits all' policy.

On the other hand, an interest in SMEs is seemingly related to geographical variations from the US to Europe as mentioned by Rothwell (1989), whose research discloses how academic and policy interest in SMEs has expanded. According to him, policymakers in the European countries during the 1950s had an obsession about nurturing only large-sized enterprises rather than smaller firms, and therefore, until the 1970s, reserved the support of most public policies and most R&D support for major corporations.

In contrast, the attitude of the US government was more in favour of SMEs, and they were protected under the US Small Business Act of 1953 as follows:

> It is the declared policy of Congress that the Government should aid, counsel, assist and protect as far as possible the interests of small business concerns in order to preserve free and competitive enterprise….

The favourable social and industrial environments for SMEs in the US have consequently turned back to economic rewards to the nation along with the emergence of many high-potential innovative firms specifically in the advanced technology sectors where small-sized high tech companies are pivotal in the Information Technology (IT) and electronics sectors on account of major companies' reluctance to participate in risk-taking research (Taylor and Thrift, 1982). Because of this, a lot of promising SMEs in the high-tech sector were frequently taken by large-sized firms where such SMEs-raiders (i.e., major companies) tended to prevent various types of business failures through SMEs acquisition, also to employ this way for their business diversification (Rothwell, 1989).

In addition, the favourable atmosphere towards SMEs directly and indirectly resulted in the advent of the most innovatory industrial agglomerations in the world, like the Silicon Valley and Route 128.

Under the circumstance, consequently, SMEs sector in the US has created more job opportunities compared with its counterpart of larger size firms (Rothwell, 1989), and has contributed to around half of the US's Gross Domestic Product (GDP) (Hausman, 2005).

As mentioned Hausman (2005), these results are closely related to the common business structure of SMEs where generally there is the high degree of the intimacy between customers and managers. It means SMEs are likely to grasp scant parts of their services or products, which are customer requirements and needs. Also, having a few employees help to improve communications and mutual trust between working people. Under the business environments, innovation activities are also triggered.

These US case studies investigating the role of SMEs in national and regional economies have shown how important the small businesses were, thereby helping to break the prejudice of SMEs' economic contributions.

After witnessing the successful role and contribution of SMEs to the national economy in the US, many European policymakers changed their attitude since the beginning of the 1980s. They eventually devised a considerable number of public policies for revitalising SMEs and establishing industrial agglomerations, like science parks with a pivotal mission, which engages scattered regional innovatory resources so as to boost regional innovation, thereby promoting national and regional prosperity. In a similar vein, SMEs-oriented industrial clusters in Europe such as the Third Italy have drawn attention from academia from the end of the 1970s (Kwon, 2003; Shin, 2004; Boschma, 1999).

As a result, the successful achievement of small business groups in the US have driven European countries government to pay attention to the vitalisation of SMEs and industrial clusters, and this paradigm shift is the answer to the question which has been raised in the introduction why European policymakers have altered their attitudes to SMEs.

Turning to the Korean context, since the 1990s, the Korean government also has been developing SMEs, even though the subject that the role of SMEs on industrial clusters and regional economy is still paucity (Choi, 2003; Jeon, 2018). The reason why SMEs received less attention is related to the past government's attitude which carried out the choice and concentration strategy over the period of industrialisation for the nation's rapid economic development. Whilst the government has initiated a business-friendly industrial policy through several privileges (e.g., credit incentives), the beneficiary of the policy was only a few large-sized corporations (i.e. conglomerates), resulting in an unbalanced structure of the large-sized firms and SMEs, unlike Taiwan and Japan. Therefore, previous studies tended to focus on such large-sized companies in Korea and their market catching-up strategies (Hobday, 1995).

Jeon and Phelps (2018) somehow show the contribution of SMEs to the regional economy in which SMEs innovation had played a crucial role in upgrading an industrial structure towards a high-value added business, drawing on the case study of the Daegu's textile SMEs. One finding of this study is that given the poor business environment in lagging regions with the low-tech industry sector, the innovative activities of SMEs can be triggered by intermediaries where generally government-funded intermediaries possess better research abilities, therefore regional SMEs are able to fulfil their research shortage from them. Shin (2018) also has a similar view with the role of intermediaries by analysing the regional innovation system of Dortmund, Germany.

They also provide the current industrial and business structure which has been changed. Smaller companies particularly belonging to the low-tech sector are massively under pressure due to the reform of the nature of the industrial sector, which is moving towards more heterogeneity and higher value-added manufacturing. Otherwise, those (low-tech sector) SMEs may steadily disappear from the market. For instance, the textile industry where generally most of the local firms are less than 20 employees (i.e. micro enterprises) nowadays connotes not only the garment business, but also the parts and material sectors, in which many textile materials, such as glass-fibre, are widely exploited in the manufacture of significant components of other industrial sectors, such as the automobile and aerospace industries. Whereas the clothing companies also complied with an upsurge in demand for special functionality with regard to existing products, they also added antibac-

terial and environment-friendly properties.

So far, we have reviewed the extant literature on the role of SMEs' innovation, whereby that we can ascertain the contribution of SMEs to the national and regional economies.

Given the previous studies with the changing environments, we do not enough know the role of SMEs and their innovative activities, particularly in the Korean context. Also, as the condition of regions is entirely different, it is plausible that the innovation of the Korean SMEs would show different forms as seen in the industrial clusters of the US and Italy.

### 2) The correlation between the size of firms and innovative activities

There is another bias against innovatory activities, which are generally associated with large-sized firms rather than SMEs. However, this perception was inaccurate and people's views are steadily being changed by them witnessing the emergence of highly innovative (tech-oriented) SMEs (Cumbers et al., 2003; Keeble, 1997; Pavitt et al, 1987; Piore, 1986).

Indeed, a number of scholars have analysed a correlation between the size of companies and innovation performances through both quantitative and qualitative research methods, ascertaining that there is no strong causality between two variables: such research has been conducted in Italy (Hall et al., 2009); in the UK (Cumbers et al., 2003; Rothwell, 1989), and in the US (Acs and Audretsch, 1988).

In particular, the Science Policy Research Unit (SPRU) in the UK revealed the innovative activities of British corporations from 1945 to 1983 by means of their own database (see Table 1), which collected and analysed over 4,400 cases of significant innovation. The results suggested that small firms (fewer than 199 employees) in the UK had steadily increased their innovation activities, and had eventually leapfrogged medium- and large-sized firms with

Table 1. Innovation share by size of innovating unit in the UK, 1945-83

| Time period | Size of corporation | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | 1-199 | 200-499 | 500-999 | 1000-9999 | 10000-29000 | 30000-99999 | 100000+ | No. of Innovations |
| 1945-49 | 18.6 | 9.3 | 8.8 | 48.7 | 11.5 | 0.9 | 2.2 | 226 |
| 1950-54 | 20.1 | 13.6 | 6.1 | 46.8 | 9.2 | 2.8 | 1.4 | 514 |
| 1955-59 | 17.9 | 14.0 | 11.5 | 39.7 | 11.9 | 2.7 | 2.3 | 514 |
| 1960-64 | 17.4 | 12.7 | 10.2 | 41.8 | 11.7 | 3.4 | 2.8 | 684 |
| 1965-69 | 21.4 | 14.2 | 11.4 | 37.9 | 9.2 | 3.3 | 2.6 | 720 |
| 1970-74 | 24.5 | 14.0 | 11.4 | 37.9 | 9.2 | 3.3 | 2.6 | 720 |
| 1975-79 | 31.3 | 13.6 | 13.0 | 29.8 | 8.3 | 2.7 | 1.3 | 823 |
| 1980-83 | 32.1 | 17.7 | 10.1 | 29.3 | 6.8 | 2.8 | 1.3 | 396 |
| Number of innovations | 1025 | 605 | 480 | 1625 | 427 | 125 | 91 | 4387 |
| Average percentage | 23.4 | 13.8 | 11.0 | 37.1 | 9.8 | 2.9 | 2.1 | 100 |

Source: Roy Rothwell, 1989, p.54.

regard to the number of innovative activities during the 1980s (from 1980 to 1983). Although the data is quite old, it at least gives details of SME's peculiar structure, which clearly showed a more risk-taking tendency, and this has helped break the prejudice that SMEs are unlikely to conduct innovatory activities.

As seen in the table above, large-sized businesses have not vigorously conducted innovative activities, and this has had a bearing on their structural characteristics.

Instead, major companies that have sufficient financial assets tend to take over small-sized firms, which already have new knowledge and technology, thereby avoiding some of the risks of research and development and so saving on the initial installation costs. For the reason, Taylor and Thrift (1982) pinpointed that most of the innovations in the US tended to come from small businesses and universities.

In contrast, SMEs have several merits when carrying out innovation, especially in terms of behavioural perspectives:

> [S]mall firm advantages are those of entrepreneurial dynamism, internal flexibility and responsiveness to changing circumstances, i.e. they are behavioural advantages. (Rothwell 1989, p. 52)

The relatively simple organisational structure in small firms, which are managed by few owner families and professional managers, facilitates rapid decision making, as there are also fewer demands from particular customers and directors. Therefore, the executives are willing to attempt uncertain challenges (i.e., innovation activities) that are accompanied by high-potential risks and big rewards in a specific niche market (Hausman, 2005; Love and Roper, 2015; Olson et al., 1995; Sivades and Dwyer, 2000; Vossen, 1998). Hence, smaller firms inevitably display high birth and death rates (Taylor and Thrift, 1982).

This result also shows somehow different views that Schumpeter (1934) and Rogers (2004) argued that the size of the business is important for securing resources, therefore the innovative activities of SMEs has inevitably limited with several drawbacks compared to that of large-sized corporations.

Yet, it is important to bear in mind that we can't tell which one (i.e., large- and small-sized firms) is better in creating innovative activities because there are so many different technologies and industrial environments which respond to firm's innovations.

Therefore, the point of this study is to postulate whilst there is a bias that large-sized firms are likely to show a much better innovation performance, SMEs' innovation has shown enough contributions to not only economies but also industrial sectors.

## 4. Conclusions and implications

This study has dissected the role of the SME of innovation and its characteristics. Whilst SMEs are a key component of national and regional economies (for instance, 99% of registered companies in Korea are SMEs), the policymakers and academic scholars have relatively paid less attention to the role of such smaller sized companies and their innovative activities (Acs and Audretsch, 1988).

Some previous studies analysing on SMEs with geographical matters tended to focus on the subject

of open innovation (Lee and Lee, 2012), regional innovation system (Shin, 2004) and science and technology policy (Kang and Kim, 2015). So, there is a dearth of studies on the innovative activities and contribution of SMEs to economies and industries.

As mentioned by several scholars (e.g., Hall et al., 2009; Hausman, 2005), one reason having a lack of studies on the subject of SMEs is related to methodological issues. Given the process of innovation which happened without the result of formal R&D activities, the typical indicator of innovative activities seems to be hard to grasp the innovative activities of SMEs. It means qualitative research is more appropriate to approach this matter in some ways (Hausman, 2005). For the reason, the role and contribution of SMEs to economies and industries are also underrated.

Therefore, one of the aims of this study is to evince much interest in the subject that the SMEs' (technological) innovation has been playing a pivotal role in both national and regional economies as well as industrial sectors through an analysis of previous empirical studies.

As we mentioned before, unlike the US, European and Korean policymakers were not in favour of SMEs in the early days because of their (economic and industrial) development plans. Yet, since the business sector of SMEs in the US had shown significant roles in economic development, policymakers and scholars in the world have changed their bearing. According to the extant literature particularly Western economies like the UK, US, and Italy, we can see that SMEs' innovation had contributed to 1) job markets, 2) the nation's significant economic indicator like GDP, and 3) industrial sectors (e.g., new market creation and tech-industrial agglomeration).

In the context of Korea, this study also confirmed the crucial role of SMEs in the regional economy and structural change (Jeon and Phelps, 2018), thereby giving the evidence how (low-tech) SMEs' innovation has helped to upgrade the industrial structure.

Yet, we can also witness that there is no watertight environment for the SMEs' innovation. In the US, the innovative activities and growth process of SMEs are strongly connected to external organisations, such as universities, research institutions, and other intermediaries. It means the successful condition of SMEs innovation is not pertaining to the firm's ability, instead to the location matter like how close to being located in prestigious knowledge providers as seen in Silicon Valley. Whereas, the innovative activities of SMEs in Italy show different shape. The business environment in the Third Italy (such as Modena) is entirely different with regard to knowledge organisations compared to that of the US. Thus, the most important factor of SMEs innovation is a firm's individual competence like entrepreneurship, and companies tend to cooperate with other regional firms for vitalising innovative activities. Simply, SMEs in the Third Italy fully employ internal resources by means of business network consolidation. As seen in the Korean context with the study of Jeon and Phelps (2018), intermediaries can be a key trigger in vitalising SME's innovative activities. Hence, this research argues there is no one size fits all model which facilitate the SMEs innovation, therefore the Korean policymakers and academia need exhaustive speculation on this matter with the various geographical condition (e.g., lagging regions).

On the other hand, several empirical studies provided a clue that there is no clear correlation between the size of the firm and the performance of innovation. In some ways, as seen in the UK case the smaller companies are willing to conduct innovative

activities rather than large-sized firms because of its flexible business structure and the sake of survival in markets. Therefore, we can infer that SMEs innovation may be a more radical way which accompanies risk-taking activities with a high return.

This argument is different from the typical Schumpeterian opinion (i.e., there are strong relationships between firm size and innovative activities), therefore further empirical research is needed.

Hence, we had confirmed the diverse contribution of SMEs to national economies and industrial sectors, therefore SMEs might be regarded as unsung heroes, instead of economic laggards.

With sufficient proofs, this study postulates that both academic and policy circles in Korea need to draw more attention to SME and their innovation activities for securing sustainable economic growth and market equilibrium.

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