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Regional innovation strategies in the knowledge-based economy

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Abstract

This paper aims to examine major regional innovation strategies for regional development in the knowledge-based economy in Korea. Innovation policy and Regional Innovation Systems (RIS) are becoming important issues in Korea in both national and regional perspectives. These issues have been evolving since the mid 1990s, especially since the financial crisis of 1997 in Korea. Five major policy issues for promoting innovation and regional competitiveness are examined in this paper. The major policy issues are: promoting region-specific clustering; building habitats for innovation and entrepreneurship; collective learning processes and innovation networks; building a stock of social capital; and promoting local and global networks. Several strategies are suggested for each of these policy issues. These major policy issues and related strategies for regional innovation and competitiveness can be regarded as common issues required for the successful development of RIS. Taking these basic policy issues into account, each region can develop their own region-specific RIS, with appropriate consideration of distinctive regional characteristics such as the level of development, industrial specialization, local labor market, local business climate, local financial system, etc.

Introduction

Intangible yet created assets such as knowledge and information of all kinds have become increasingly more important in the dynamics of economic space during the last couple of decades. It has been estimated that in the 1950s 80% of the value added in US manufacturing industries was from processed foodstuffs, materials, or mineral products, and the remaining 20% from knowledge. However, by 1995, these proportions had changed to 30% and 70%, respectively (Dunning, 2000). The importance of all kinds of intellectual capital in both the asset-creating and asset-exploiting activities of firms has significantly increased during the last three decades. Due to the importance of knowledge and intellectual capital in this era of globalization, the 'knowledge-based economy' has become one of the most popular buzzwords in our global society.

The term 'knowledge-based economy' is, however, not just a catchword, but reflects fundamental changes in overall conditions and environments in which economic and social activities take place in this global society (OECD, 1999a). Regions are dynamic over time through the evolution of innovation systems and new industrial clusters in the knowledge-based economy. Knowledge creation and innovation are driving forces of economic growth, social development, and job creation in the knowledge-based economy. Knowledge has become the primary source of development and international competitiveness in this era of globalization (World Bank, 1998). Firms that innovate more consistently and rapidly, in general, employ more workers, demand higher skill levels, pay higher wages, and offer more stable prospects for their workforce–in short, innovative firms make many contributions to regional economic development (OECD, 1996a).

Recognizing the importance of the knowledge-based industry as a new motor of regional growth in the 21st century, development of a territorial innovation system for knowledge creation, innovation, and entrepreneurship is an important policy issue for regional development in the 21st century (Park, 2001). In territory-based innovation systems, firms, organizations, and the government interact with one another and become actors in the cycles of knowledge conversion and innovation. In addition, regions, networks, and the knowledge-based economy are interrelated in territory-based innovation systems. In Korea, the national innovation system was important when economic development and innovation were mainly directed by government policies. However, regional innovation systems in recent years have become increasingly important for regional development with the increasing role of local authorities and the local milieu under the globalization of economic processes.

In this paper, major strategies for the development of regional innovation systems are examined as major policy issues and strategies for regional development in Korea. This paper is composed of three major parts. Following this introductory section, theoretical discussions of territorial innovation systems are examined. Following that, industrial and innovation policies in Korea during the last three decades are briefly reviewed. Finally, considering the theoretical

discussions of territorial innovation systems and prospects for future development of the knowledge-based economy in Korea, regional innovation policy issues are examined and strategies for regional development are suggested.

Territorial innovation systems

National innovation systems

Nation states are diverse in terms of economic growth and development. In the past, the production structure or national system of production was regarded as a major factor explaining differences in growth and development. In the 1960s and 1970s, it was assumed that different sectors affect growth differently in the production structure approach used to understand national development. Later, beginning in the 1970s, more dynamic concepts such as vertical linkages in the production system were introduced as important elements in development processes. More recently, Anderson (1992) introduced even more dynamic elements in the discussions of production systems such as backward linkages in the form of flows of information, learning by doing, and life-cycle perspectives in the development of industrial complexes. In Anderson's approach, interactions between user sectors and producer sectors in production systems and the quality of demand became important elements for the development of new technologies. This approach to understanding national production systems, however, does not deal with the role of institutions for economic growth because it focuses on production and intellectual capital (Lundvall and Maskell, 2000).

In addition to the differences in national production systems, national differences in the organization of firms and markets are regarded as important elements determining national differences in growth and development. This aspect of development was explained by Whitley (1996) with the introduction of the concept of national business systems. The national business systems approach is interdisciplinary, combining the elements of economic reasoning with sociological perspectives, because differences in culture and formal institutions are regarded as important factors for explaining how firms and markets are organized in different countries. The basic reasoning of the national business systems approach is that *in nations where the institutional set-up supports the establishment of trust between no-kin agents, and especially where this is combined with credit-based financial system, firms will tend to be involved in cooperative networks* (Lundvall and Maskell, 2000). In such a nation, firms can develop a high degree of specialization and division of labor because they can share their risks with network partners, and their expansion will be based on incremental growth in terms of capabilities and assets.

Even though the national business systems approach spelled out the institutional dimensions, which had been neglected in the national production systems approach, it has limitations because it neglects the production structure of nations. Furthermore, the national business systems approach neglects the fact that the organization of firms and markets differs by production sector. Accordingly, the integration of the national production systems and business systems approaches is a proper move toward better theoretical understanding. The national innovation systems approach represents *a kind of synthesis of national production systems and national business systems in the sense that it tries to capture the co-evolution of structural and institutional characteristics in a systemic perspective* (Lundvall and Maskell, 2000; p. 359). National innovation systems can provide firms with valuable capabilities and favorable conditions for innovation not available to competitors located in other countries, even under the open market conditions of this era of globalization. A national innovation system can be regarded as *a system of interconnected institutions to create, store, and transfer the knowledge, skills, and artifacts that define new technologies* (Hotz-Hart, 2000; p. 437).

In the national innovation systems approach, innovation is regarded as an interactive learning process that requires knowledge exchange, interaction and cooperation among various actors in a production network. The various actors of interaction and networking include firms, contractors and subcontractors, equipment and component suppliers, customers or users, competitors, private and public research labs, universities and other higher education institutions, providers of consulting and technical services, state authorities and regulatory bodies (Hotz-Hart, 2000). Because of these interactive aspects of innovation in the knowledge-based economy, the production of goods and services is becoming more knowledge-intensive but not necessarily more research and development (R&D) intensive. For example, rapidly growing new advanced service activities such as software and venture capital funds employ highly qualified manpower and are highly intensive in immaterial investment but are not involved in formal R&D (OECD, 1999a). Innovation requires more than R&D and too narrow a focus on R&D may overlook the importance of other types of innovative efforts such as design or market analysis. The breakdown of innovation expenditures in the OECD countries reveals that R&D accounts for 33.5%; product design, 24%; market analysis, 6.6%; patents and licenses, 4.6%; and external spending, 22.4% on average (OECD, 1999a; p. 18). There are, of course, variations in the share of R&D in the innovation expenditures by country and industrial sector.

Regional innovation systems (RIS)

The identification of the major sources of regional advantages of Silicon Valley compared to Route 128 in the United States by Saxenian (1994) significantly contributed to the consideration of RIS as an important policy issue in regional development in many advanced countries. Saxenian (1996; p. 2) described Silicon Valley as a *regional network-based industrial system that promotes collective learning and flexible adjustment among specialist producers of a complex of related technologies.* Furthermore, it is widely accepted that *knowledge spillovers are geographically bounded within a limited space over which interaction and communication is facilitated, search intensity is increased, and task coordination is enhanced* (Feldman, 2000; p. 389).

There are several reasons why regions are important for innovation in firms. Firstly, collaborations and inter-firm networks that operate generally at a regional scale are important for innovation in firms. In particular, for small and medium enterprises (SMEs), collaboration with other firms and organizations makes it possible to gain access to a diverse and specialized expertise to meet customer needs and to share risks and costs (Keeble, 1997). Because of the significant impacts of networks, the design of technology networks has been regarded as an important policy issue at local and national levels in some countries like Denmark. The main strength of networks of SMEs is derived from the ability that small firms have shown to learn from each other and from an intermediary system that has acted as a successful catalyst for cooperation (Huggins, 1996). In inter-firm networks, relationships between large and small firms as well as those between small and small firms are important for innovation (Park, 1996; Young *et al.*, 1994).

Secondly, innovation is an interactive process and shaped by a variety of institutional routines and social conventions that are manifested and reinforced at the regional scale. Innovation is an interactive process between different functions within firms, between suppliers and customers at the inter-firm level, and between firms and the wider institutional milieu (Morgan, 1997). Routines and conventions may help to regulate economic processes by reducing uncertainty and facilitating coordination and cooperation for mutual benefit. The interactive process can be regarded as a process of interactive learning in which institutional routines and conventions can play a role (OECD, 1992).

Thirdly, regional clustering and specialization are important for innovation. In recent years, regions have has been rediscovered as important sources of competitive advantages and as the bases of the organization of the global space economy (Scott, 1995). Clustering and specialization in a region are regarded as some of the key elements of growth and competitiveness, due to the associated reduction of transaction costs, and the value of agglomeration economies and technological and skill advantages (Krugman, 1995; Porter, 1994). In addition to regional competitiveness based on economies of clustering, geographical studies of recent years suggest locally embedded social, cultural and institutional arrangements as a source of knowledge creation and learning (Amin and Thrift, 1995; Storper, 1996). Informally constituted knowledge and information environments derived from local tacit knowledge, face-to-face exchange, the quality of local institutions, long standing social habits and local conventions of communication and interaction contribute to firms' learning-based competitiveness. In this institutional perspective, Silicon Valley and Italian industrial districts are regarded as *learning regions*, which display intensive inter-firm interactions, shared know-how, spillover expertise, and strong support systems (Amin, 1998).

In considering Regional Innovation Systems (RIS), inter-firm networks and collaboration, learning dynamics with interactive processes, and territorial aspects including regional clustering are regarded as three important dimensions. Asheim and Isaksen identify more clearly the importance of RIS by explaining the following four main building blocks (Asheim and Isaksen, 2000; p. 167):

- *innovation* is increasingly seen as a way for firms, regions and nations to gain competitiveness in the face of globalization because it enhances the learning abilities of firms and workers (Lundvall and Borras, 1997);
- innovation is conceptualized as an *interactive learning process*, emphasizing the importance of cooperation and mutual trust in promoting competitiveness, further promoted by proximity;
- learning is seen as mainly a *localized* process, pointing to the importance of historical trajectories and 'disembodied knowledge', which are highly immobile in geographical terms;
- as a consequence, agglomeration and *regional clusters* are looked upon as an efficient basis for interactive learning, suggesting the importance of bottom-up, interactive regional innovation systems and networks specifically, as well as untraded interdependencies in general, as a stimulus for innovation and learning.

Considering the above building blocks, RIS is not only a theoretical construct to analyze the working of regional clusters but also a policy tool for the creation of supportive innovation systems at a regional scale. For the application of RIS as a policy tool, however, we should consider some limitations, in particular the danger of generalizing the potential of RIS because the regional innovation policies and instruments have developed mainly from experiences in successful places, like Italian industrial districts, Baden-Württemberg, and Silicon Valley.

Competition and cooperation

In considering policy implications of RIS, the importance of the balance between competition and cooperation should be carefully considered. Porter (1990) emphasized the importance of domestic rivalry and competition as the key determinant for global competitive advantage. In other words, competition is an important driving force for innovation. However, in the knowledge-based economy, cooperation among firms is also important because the competitive advantage of firms is based on continuous innovation, and innovation processes are seen as socially and territorially embedded interactive learning processes (Asheim, 2000). Competition provides incentives to innovate, but cooperation at local, national, and international levels are also important in enhancing capabilities to innovate. Empirical studies confirm that firms with a high level of inter-firm cooperation are more innovative than those that cooperate little (Smith, 1995). Cooperation contributes to improving economic performance and reducing costs as firms acquire knowledge and meet their needs more cheaply than producing that knowledge in-house. Cooperation may also make possible economies of scale and scope, enable the sharing of risks and R&D costs, and allow greater flexibility (OECD, 1999a).

It should also be noted that the central feature of industrial districts is the balance between competition and cooperation among firms (You and Wilkinson, 1994). In

certain cases, domestic cooperation is critical to sustain the competitive advantages of firms and regions, because *more domestic rivalry will not result in global competitive advantage when foreign rivals, innovating on the basis of their industry clusters, have already acquired a sustainable competitive advantage* (Hotz-Hart, 2000; p. 447).

In competition and cooperation, both local and global networks are important. The process of creating skills and the important influences on the rate of the innovation process and improvement are intensively local (Hotz-Hart, 2000). Local networks and inter-firm interactions in local areas are important for the exchange of tacit knowledge and for the generation of new knowledge that can be a basis for innovation. Paradoxically, more open global competition makes the home base more important and multinational firms' objectives are to be global and local simultaneously (Porter, 1990). Regionally embedded agglomeration economies based on intensive local competition and cooperation networks can promote incremental innovation. However, if a situation of lock-in occurs, due to too strong and closed local networks that become obstacles to small and medium sized firms' ability to change technological trajectory, the region may lose its competitive advantages as well as its capacity for technological development. In particular, when the existence of a strong industrial atmosphere in a lock-in situation is used to squeeze wages to remain competitive, it does not result in continuous innovation (Glasmeier, 1994). Because of this lock-in effect, non-local networks in global economic space are also important for new technological development. Extending competition and cooperative networks from a local to a global dimension suggests a model for the progression of territorial innovation systems from local, to national and to global levels.

Industrial and innovation policies in Korea

The Government's industrial policy

Understanding industrial policy is a prerequisite to understanding innovation policy in Korea since the country's innovation policy has been developed in relation to its industrial policy. Since the First 5-Year Economic Development Plan was launched in 1962, the Korean national government has taken a leading role in the promotion of sectoral and spatial industrial policies. Export-oriented industrialization has been a major strategy since the early 1960s, and the strategy was fashioned to promote the most promising industries. Labor intensive industries such as textile and apparel were key sectors in the expansion of industrial exports before the mid 1970s, while heavy and chemical industries such as petrochemicals, shipbuilding, automobile, and consumer electronics became the leading industries for export expansion in the late 1970s and early 1980s. The government's heavy and chemical industrial policy contributed to the evolution of the *chaebol* system in the Korean economy by allowing the *chaebol* to borrow foreign capital and granting them several incentives to encourage investment in heavy industry (Park and Markusen, 1995). Since the mid 1980s, high-technology industries such as semiconductors have been increasingly favored. From the 1990s, especially following the foreign exchange crisis in November 1997, the Korean government has focused a lot of its efforts on promoting the development of knowledge intensive industries so as to open up the country fully in terms of trade and capital movements, to restructure the economy including the financial sector, and to make the labor market more flexible.

Along with such sectoral policies, the national government established several large industrial estates especially in the southeastern part of the country in order to decentralize industries from the Capital Region. The major new industrial cities or production clusters of Ulsan, Changwon, Pohang, Kumi, Kwangyang, and Ansan were created as a result of industrial policies implemented in the late 1960s and the 1970s. The Free Export Zones in Masan and Iri were constructed to attract foreign direct investment. However, the role of inbound FDI was relatively insignificant in the 1970s and 1980s, compared to imported technology and foreign capital borrowing. *Chaebols* contributed heavily to the development and growth of industrial cities by establishing large branch plants with imported technology and borrowed foreign capital. The industrial policy focusing on the development of industrial estates can be regarded as a strategy to establish national production systems. However, the idea of territorial production systems was not successfully implemented in the earlier development stage nor, one can argue, was it even seriously considered. In the initial stage, the industrial estates in the industrial cities had only limited local inter-firm linkages and the industrial estates were simply agglomerations of production activities without significant intra-regional production networks.

Sectoral and spatial industrial policies have significant impacts on the spatial structure of the economy. On the one hand, the government's industrial decentralization policy has resulted in the spatial division of labor, with the concentration of the headquarters of *chaebols* in Seoul and decentralization of the production functions to non-Capital Region areas (Park, 1993). On the other hand, the high technology focused industrial policy since the mid 1980s has triggered industrial reconcentration in the Capital Region, due to the locational advantages that the Capital Region has for high technology industries. The concentration of high-technology industries and advanced services including R&D activities in the Capital Region have intensified the spatial division of labor in the Korean production system and space economy (Park, 1993).

Several local governments have made significant efforts to attract knowledge-based industries since the realization of local autonomy in the mid 1990s. However, knowledge-based industries are still overwhelmingly concentrated in the Capital Region due to favorable factors such as the availability of high quality and skilled labor, advanced information infrastructure, easy access to financial and other advanced producer services, and so on. Even though new industrial districts have been developed in non-Capital Region areas through the government's industrial policy, regional dis-

parity in the development of knowledge-based industries is persistent in the Korean space economy.

Innovation policy and territorial innovation systems in Korea

In Korea, the issue of innovation was relatively neglected in the early industrialization phase of the 1960s. Instead, the science and technology (S&T) policy was mainly focused on building up basic technological infrastructure such as the establishment of the Korea Institute of Science and Technology (KIST) and Korea Advanced Institute of Science (KAIS) (OECD, 1996b). In the 1970s, the S&T policy focused on expanding education in the technical and engineering fields and on establishing a number of government-supported research institutes in the field of heavy and chemical industries along with the promotion of the development of heavy and chemical industries. Through the establishment of government initiated research institutes, a national system of innovation began to evolve along with industrial development.

In the 1980s, the government launched the National R&D Programme, to develop public and welfare technologies, and the Industrial Generic Technology Development Programme, to provide private firms with financial and technical assistance for developing critical high-risk technologies. However, the national innovation systems in Korea have significantly changed since the 1980s due to significant increases in private firms' in-house R&D investments. Since the early 1980s, firms have emphasized technology development to enhance national industrial development and to cope with severe competition in international markets. Private firms' share in the total national R&D expenditure accounted for 56% in 1981, which was the breaking point when private firms' share first became greater than that of the government. Since then, the share of private firms increased rapidly and reached 81% in 1985 (MOST, 1990). Based on these changes in the environment of technological development since the early 1980s, two distinctive periods and styles of the national system of innovation can be identified: government-led and private sector-led (Kim, 1997; Park, 2000).

The government took the initiative in promoting innovation in the 1960s and 1970s. Government supported research institutes took a lead role in improving industrial technologies during this period. Most of the firms were more interested in technology transfer from the industrialized countries than in promoting domestic R&D activities. Firms endeavored to digest and learn imported technologies. Firms raised their technology level through a learning process focused on imported technology. The major role of universities in innovation system was sourcing human resources to technology development. Therefore, the national system of innovation in the 1960s and 1970s was mainly directed by the government's S&T and industrial policy, which supported technology transfer to firms and the learning process of imported technology. The impact of inbound FDI on the development of the innovation system was not significant during this period. Rather, imported technology was the most critical force of technology development in the 1970s.

Since the 1980s, however, the major role in R&D and innovation shifted from the government to private firms. With this shift, many firms have established their own R&D centers and have significantly increased R&D expenditures. In 1980, only 54 firms, most of which belonged to *chaebols*, had their own R&D centers, but the figure increased to 2,226 by 1995 (KITA 1995, 1996). In the early 1980s, *chaebols* aggressively established R&D centers. In the late 1980s, even SMEs began to establish R&D centers. Presently, more than two-thirds of existing R&D centers were established by SMEs. Though the number of R&D centers of SMEs is much larger than that of large firms, not surprisingly most large-scale in-house technology development projects have been conducted by large firms belonging to *chaebols.* Some distinctive characteristics of R&D activities of firms in the national system of innovation in recent years are as follows (Kim, 1997): (1) large *chaebol*-linked firms have established strategic alliances with world-wide high tech firms; (2) large firms, which mostly belong to *chaebols*, have been aggressive in establishing foreign R&D centers and labs; (3) due to the difficulties in getting a license for leading, advanced technologies, large firms have been actively involved in mergers with and acquisitions of high tech firms in developed countries in order to secure original technology.

In the 1990s, moving beyond the national innovation system in which large firms took a predominant role, regional innovation networks have begun to evolve due to the development of regional clusters of SMEs in technology intensive sectors. The establishment of science parks and high tech parks in non-Capital Region areas in the 1990s, in addition to the Daeduck Science Town, has also contributed to the development of local clustering of innovation networks. According to Park's (2000) survey of SMEs conducted when Korea began to receive financial support from the IMF, the role of SMEs has become important in the development of regional innovation systems in Korea. According to the survey, SMEs have become more involved in R&D activities during the 1990s, especially as one of the strategies of industrial restructuring. There has been a significant increase in the proportion of SMEs conducting R&D activities during the 1990s. Out of 825 firms that responded to the 1997 survey, 20% conducted R&D activities in 1993. The ratio increased to 34% in 1996. All in all, the survey revealed that larger SMEs are more actively participating in R&D activities than smaller SMEs. However, among the firms that conducted R&D activities, smaller SMEs have a higher ratio of R&D expenditure to total sales than larger SMEs, leading to the conjecture that a considerable proportion of smaller SMEs that conduct R&D activities are venture businesses.

There are several actors who contribute to the technology development and innovation of SMEs. Contract firms (customers), business associations of the same industry, and local cooperative firms are the leading actors for innovation in SMEs in the 1990s (Park, 2000). The survey results confirm that local firms are important for joint development of products, technological support, and acquiring business

information. Local inter-firm networks are also important for technical services. Overall, inter-firm networks between large contract firms and suppliers of SMEs within a local area, collaborations among firms, and cooperation with trade associations of the same industry have become important mechanisms for innovation in SMEs in Korea. Large firms belonging to *chaebols* have a critical role in forming inter-firm networks through establishing cooperative networks with suppliers that are often SMEs. For some SMEs, collaboration with universities, government sponsored research institutes, and other public institutes are also important factors for technological development and innovation. The importance of inter-firm networks for the innovation of SMEs is also supported by the results of the extensive survey of 1997 (Park and Nahm, 2000). It should be noted that, since the financial crisis of 1997, even some SMEs have established links in Silicon Valley, indicating that global innovation networks for SMEs are becoming important.

Regional innovation strategies

Since the 1990s, especially since the financial crisis of 1997, developing Regional Innovation Strategies has become an important policy issue in Korea (Lee, 2001; Kim S.B., 2001). The policy implications of these strategies are generally diverse and vary by region. However, we can identify a basic framework and key strategies for the improvement of innovation potential for regional development. Considering the recent evolution of territorial innovation systems in Korea and the theoretical issues of the regional innovation systems, five major policy issues for promoting innovation and regional competitiveness are examined in this study. They are (1) promoting region-specific clustering; (2) building facilitative habitats for innovation and entrepreneurship; (3) building collective learning and innovation networks; (4) building a stock of social capital; and (5) promoting local and global networks. The basic framework of the strategies is depicted in Figure 1.

Promoting region-specific clustering

Industrial agglomeration or clustering is one of the preconditions for industrial development and innovation. Approaches to clusters in recent years have significant implications for both innovation policy and analytical tools that can underpin industrial and technology policies (OECD, 1999b). Traditionally, the notion of industrial clusters has been understood to be similar to the concepts of industrial agglomeration and regional production systems, which represent production networks among related firms along the value-added chain of production. Since interaction and linkages are very important for clusters, spatial proximity is regarded as an important factor for clusters to reduce transaction costs. In recent years, however, 'clusters' implies a broader concept that includes innovation networks (Lee, 2001). According to an OECD report (1999a; p. 56), *clusters are networks of interdependent firms, knowledge-producing institutions (university research institutes, technology-providing firms), bridging institutions (e.g. providers of technical or consultancy services) and customers, linked in a production chain which creates added value.* The concept adopted by OECD extends the traditional cluster concept in two ways: first, it includes all kinds of networking for knowledge transfer and creation–previous conceptions focused on inter-firm networking; and second, it takes into account supporting systems for clusters beyond the traditional sectoral analysis.

Using the recently expanded concept of clusters, establishing region-specific clusters is a precondition for the development of regional innovation systems. Several strategies to be considered by different regions are as follows:

(1) *Supporting the specialization of the existing industry*: It should focus on providing professional services and networking between firms along the value-added chain, between firms and universities or research institutions, and in training and retraining systems. In particular, professional services such as financial, accounting, legal, and consulting services are important for promoting innovation, which lag behind in non-Capital Region areas in Korea.

(2) *Establishing Techno Parks*: If a target area does not have an industrial specialization or cluster, the government can build a Techno Park to facilitate or attract high tech firms, professional service providers, R&D institutions, innovation incubators, etc. The Techno Park is considerably different from the traditional industrial park in that the former emphasizes inter-organizational interactions, collective learning processes, and innovative networks, while the latter primarily focuses on the agglomeration of production activities.

(3) *Restructuring traditional industrial parks*: In order to improve the innovative potentials in traditional industrial parks, 'creative destruction' is required. New technologies should be incorporated into existing industries via the strengthening of industry-university relationships, technology transfer, and manpower training. The retraining of work forces, establishment of information centers, and incorporation of information and communication technologies into existing firms can contribute to the restructuring of regional industries. Policies for supporting incubation, high-tech ventures, R&D activities, and inter-firm networks are also important.

Building habitats for innovation and entrepreneurship

In order to promote continuous innovation and sustainable development at the regional level via clustering, the culture and business climate for innovation and entrepreneurship should be embedded or developed in the region. Silicon Valley is, of course, an example of an innovative region. In a recent publication, Lee *et al.* (2000) identified 10 important features of Silicon Valley's habitat as follows:

- Favorable rules of the game: distinctive American system of innovation and entrepreneurship;
- Knowledge intensity: a cauldron of ideas for new products, services, markets, and business models;
- A high quality and mobile work force: a magnet for talent;

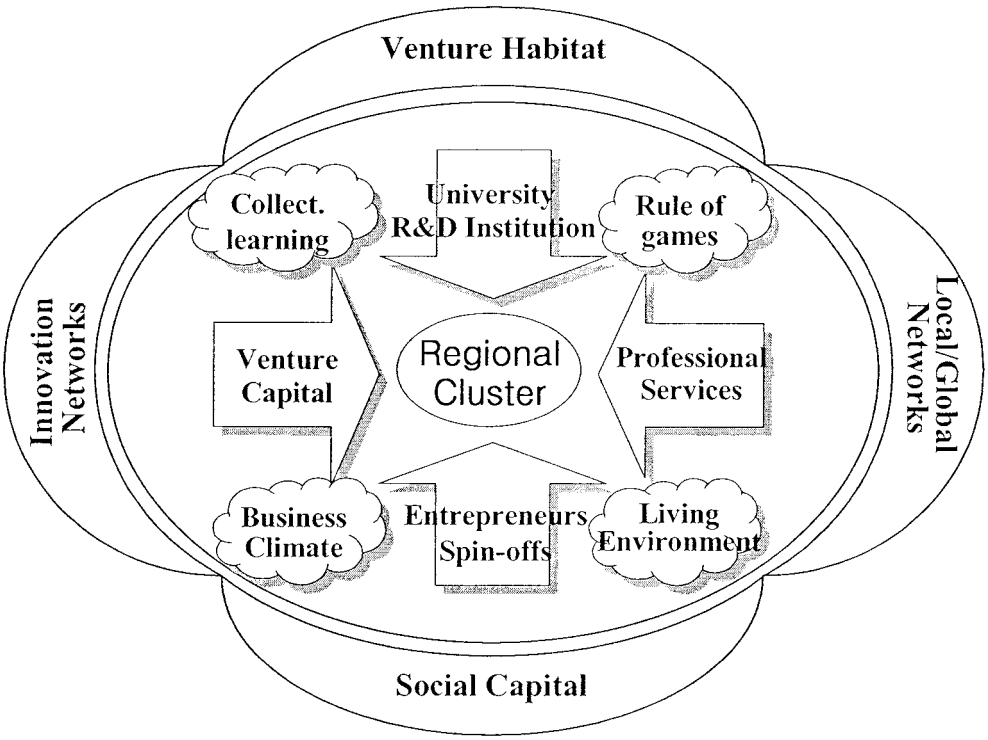

Figure 1. Regional Innovation Strategies.

- Results-oriented meritocracy: ethnicity, age, seniority, and experience do not dictate opportunity or responsibility;
- A climate that rewards risk-taking and tolerates failure;
- An open business environment: an attitude that all can gain from sharing knowledge rather than an atmosphere of company secrets;
- Universities and research institutes that interact with industry;
- Collaboration among business, government, and non-profit organizations;
- High quality of life; and
- A specialized business infrastructure: an array of support services (financial, law, accounting, and consulting firms) for new high-tech businesses.

We cannot expect every regional cluster to have these ten features that distinguish Silicon Valley. In particular, it is difficult to engender all these features in local areas of Korea. However, in order to encourage innovation, clusters in Korea should have some characteristics similar to those above.

In order to build a habitat for innovation and entrepreneurship, at a minimum the following four strategies should be initially promoted:

(1) The role of universities as a source of knowledge, technology, and manpower, and centers for innovation networks should be promoted. University-industry relationships should be strengthened through the exchange of manpower, internships and training, collaborative research, and encouraging spin-offs from both universities and industry.

(2) Incentives should be provided to attract professional service providers such as management and technology consultants, accountants, lawyers, head-hunters, etc. It should be noted that professional service providers are critical actors for supporting innovative environments in the knowledge-based economy.

(3) Various sources of finance such as angel investors, venture capital, corporate capital, and government funds should be provided for high tech start-ups and each growth stage of ventures. It should be noted that cooperation between local and national governments is important in providing financial incentives.

(4) The government should provide a favorable business and cultural climate with flexible labor markets, compensation systems based on capability and performance, and favorable business rules. When appropriate, the government should initiate the removal of regulatory barriers to entry and other obstacles to risk taking (OECD, 1999a).

In addition to the above strategies, many other strategies can be developed by considering the characteristics and the level of development of each region.

Building collective learning and innovation networks

As mentioned above, innovation is an interactive learning process and networking has become an effective innovation technique in its own rights (OECD, 1999a). In addition to internal R&D activities and intra-firm networks for successful creation and application of new knowledge, firms increasingly rely on interactions with a variety of actors such as suppliers, customers, competitors, professional service providers, universities and other institutions (Park, 2000; Park and Nahm, 2000). Recent trends of innovation clearly reflect that firms rarely innovate on their own and the collective learning process is critical for innovation. Through

the collective learning process and inter-firm networks, firms have better access to information, knowledge, skills, and experience and more rapid and effective development of innovation networks. Networking also results in the reduction of risks, moral hazards, and information and transaction costs. Learning economies developed via collective learning are far more important than scale economies even in the chemical industry (Lieberman, 1984). Localization and networks can promote diffusion of innovation and technology among firms. This results in regional competitive advantages due to incremental innovation and locally resilient economies. Some strategies to promote collective learning and innovation networks are as follows:

(1) Inter-firm cooperation and alliances should be promoted and legal and regulatory obstacles that prevent the formation of cooperative networks should be removed or reduced.
(2) Incentives should be provided for collaborative research between industry and universities as well as for co-funding among various actors.
(3) Firms should be provided with easy access to knowledge intensive professional services. Supporting the provision of advanced producer services for high tech venture firms and incubators are critical in the formation of innovation networks.
(4) Formation of social networks among various actors and work forces should be promoted through diverse workshops, seminars, conferences, and informal meetings. It should be noted that informal networks among work forces are an important source of the exchange and transfer of tacit knowledge.

Building a stock of social capital

The building of a stock of social capital should be supported to enhance the regional innovation potential and regional development in lagging or struggling regions. According to Putnam (1993), social capital means the features of social organization – such as networks, norms and trust – that facilitate coordination and cooperation for mutual benefits. Social capital can be a vehicle for creating human and financial capital (Coleman, 1988). Putnam explains one instance of contemporary regional differences in endowments of social capital as a result of historical differences in governance systems between north and south Italy dating back to the Middle Ages, suggesting that social capital is not easily constructable. However, recent studies in rural Mexico suggest that social capital can be built (Bebbington and Perreault, 1999).

Fox (1996) traced three pathways through which social capital has been and can be built: (1) 'state-society convergence' in which reformers inside the government can play a key role in building social capital; (2) collaboration among local and external civil society organizations: local Non Government Organizations (NGOs), churches, international organizations, and others play an important role in networking, political support, and funding for communities; (3) autonomous formation of local networks and groups, representing the production of social capital from below. Shared identity and repeated interactions through social networks in economic activities can reduce transaction costs on the one hand and enhance the cycles of knowledge conversion through collective learning on the other. The following strategies should be promoted for the formation of a stock of social capital:

(1) The roles of NGOs and Non Profit Organization (NPOs) should be encouraged to promote networking, diffusion of information and knowledge, and collective learning processes.
(2) Social norms and fair rules of the game in business should be established with the help of an active civil society. Churches, NGOs, international organizations and others should have cooperative networks for the formation of a stock of social capital, especially in developing areas.

Promoting local and global networks

It is well known that strong local networks and embeddedness were critical factors for the industrial development and innovation in Italian industrial districts (Park, 1996). Local networks and embeddedness are important for knowledge creation and diffusion through collective learning processes. However, with the active role of multinationals in the globalization process, local immobile features or innovative capacities can be utilized by multinational firms, whose objectives are to be both global and local simultaneously. Variety and diversity among regions with respect to education and culture can be an essential source of innovation for multinationals (Hotz-Hart, 2000). Significant diversity in culture, level of development, history, education, etc. among countries and regions is sometimes considered a barrier to close interactions. However, in the era of globalization, diversity is a potential asset for innovation through local-global interactions in knowledge conversion. Through such local-global interactions, a global innovation system can dynamically evolve as suggested by Hotz-Hart (2000; pp. 446–447).

Some strategies for promoting local and global networks are as follows.

(1) Local and national governments should have incentives to improve immobile factors such as particular skills, regulatory frameworks, or financial systems and to support the formation and enhancement of local networks. The growth of localized innovation clusters should serve as a stimulus to attract foreign R&D investments and personnel.
(2) Cross-border learning regions should be developed with inter-governmental cooperation. The development of cross-border sub-regions such as the SIJORI (Singapore-Johr-Riao) Growth Triangle, the South China Growth Region, and the Maquiladoras suggest the possibility of cross-border learning regions in the knowledge-based economy. In the Yellow Sea Rim economic cooperation can be developed as a cross-border learning region in the future (Kim W.B., 2001).
(3) Collaborative inter-regional technology networks should be promoted, especially in the Pacific Rim, to supple-

ment the cross-border learning regions. Inter-regional cooperative networking in global economic space necessitates the development and transfer of technology. International cooperation in R&D should be supported and enhanced. In particular, the development of environmentally sound technology and inter-regional diffusion of the technology are critical issues in international R&D cooperation because cooperative inter-regional networking should pay due attention to the environmental consequences of rapid industrial development, particularly in certain areas of the Pacific Rim (Park, 1997).

(4) Learning from best practices should be promoted at regional and national levels. There are significant differences among countries and regions in the capacities and traditions of their innovation policy institutions. There are opportunities for improved mutual learning among countries and regions from their successes and failures in addressing common objectives (OECD, 1999a). Developing regions and nations in particular should utilize 'latecomer advantages' to catch up to more advanced regions.

Conclusion

With the shift toward a knowledge-based economy in the 21st century, knowledge-based industry and innovations are driving forces of economic growth, social development, and job creation in Korea. The crucial role of knowledge in economic activities involves a challenge to regional development theory and for regional and industrial policies. This paper examined major strategies for the development of territorially based innovation systems for regional development in the knowledge-based economy in Korea. In a knowledge-based economy, knowledge intensive industries or services cluster in a certain region despite the sometimes- predicted dispersion effects of globalization. These clusters are expected to be the next motor of regional growth. Regional clustering is related to the development of territorial production systems and innovation systems in dynamic economic space.

In Korea before the 1980s, innovation systems were less important than production systems because industrial policies were more focused on technology transfer and the expansion of production bases. Since the 1980s, the key actors in the national innovation system shifted from the national government to private firms with increased R&D investment by the private sector. The government has encouraged the development of regional clustering of innovation since the 1990s by establishing science parks and technology parks. Regional innovation systems have been evolving since the mid 1990s, especially since the financial crisis of 1997 in Korea. Recently, Innovation strategies and regional innovation systems are becoming important issues at both national and regional levels in Korea.

Five major policy issues for promoting regional innovation and competitiveness are examined in this paper. They are: promoting region-specific clustering; building habitats for innovation and entrepreneurship; enhancing collective learning processes and innovation networks; building a stock of social capital; and promoting local and global networks. Several strategies pertinent to these policy issues were suggested above.

These major policy issues and related strategies for regional innovation and competitiveness may be considered general guidelines for successful Regional Innovation Strategies. Understanding and using these basic policy issues and strategies, each region can expand on them and develop their own region-specific RIS, considering distinctive regional characteristics such as the level of development, industrial specialization, local labor market, local business climate, local financial system, etc. However, it should be noted that there are some limitations in applying RIS as a policy tool in Korea because the regional innovation policies and instruments have been developed mainly based on experiences in successful regions in the knowledge-based economy. In the implementation of regionally based innovation strategies, open systems and non-local networks in global economic space should be carefully considered in order to avoid the possible lock-in effects of locally embedded strong networks. It should also be noted that regional, national, and global innovation systems can and should coexist in this era of globalization and knowledge-based economies.

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