

Evolution of Industrial Cluster and Policy: The Case of Gumi City, Korea

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Abstract : This paper aims to analyze the process of the evolution of Gumi electronics industrial cluster and to understand the role of governments for local industrial dynamics. Gumi was a typical satellite platform type new industrial district up to mid-1990s. At that time, Gumi industrial park was the agglomeration of branch plants headquartered in Capital Region with weak local linkages. During the last two decades, however, Gumi has evolved to an electronics industrial cluster with considerable local inter-firm linkages and innovation activities of SMEs. Recognizing government industrial policies is critical in understanding the process of the evolution of Gumi electronics cluster. At the early stage, the state was the developer and locator of business activities within the confines of the Gumi industrial park. In recent years, central government's innovative cluster policy contributed to strengthening networks among firms, universities, and research centers to form local innovation networks as well as networks between large branch plants and SMEs. Gumi city and Gyung-sangbuk-do promoted innovative activities of SMEs through the supports of cooperative networks between universities and SMEs. The increasing roles of SMEs and local governments in addition to the large branch plants and the central government have become the basis of the evolution of industrial cluster in Gumi.

Key Words : Industrial cluster evolution, government policy, innovation networks, branch plants, Gumi

요약 : 본 연구는 구미 전자산업클러스터의 진화과정을 분석하고 지역산업변화에 정부의 역할을 이해하는데 그 목적이 있다. 1990년대 초반까지 구미 산업단지에는 수도권에 본사를 둔 대기업 분공장의 집적지로 구미지역에서의 산업연계가 미약했다. 그러나 최근 20년 동안 구미는 지역 내 기업 간 연계와 중소기업의 혁신활동이 상당히 이루어져 전자산업중심의 클러스터로 발전하고 있다. 정부의 산업정책은 구미전자산업클러스터의 진화과정을 이해하는데 매우 중요하다. 초기의 국가산업정책은 전략산업의 선정과 개발을 통해 구미 국가산업단지의 성장과 전자산업 중심의 전문화에 영향을 미쳤으며, 최근의 혁신클러스터 정책은 기업, 대학, 연구소간의 연계를 강화하고 지역 내 혁신네트워크 형성을 지원하였다. 경상북도와 구미시는 지역 대학 및 기업과 직접 협력관계를 맺고 지역의 연구개발 역량 향상과 중소기업 지원을 위한 정책을 중심으로 지역 발전에 기여하였다. 중앙정부와 대기업의 역할에 더해 지방정부와 중소기업의 역할 증대가 구미산업클러스터 진화의 기반이 되고 있다.

주요어 : 산업클러스터진화, 정부정책, 혁신네트워크, 분공장, 구미

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1. Introduction

Korea has achieved remarkable economic growth during the last half-century. Korea was among the poorest countries in the world following the devastation of the Korean War (1950-1953). The country's per capita GNP was less than US\$ 100 (in 1996) in 1960, but increased to US\$ 20,000 in 2007. Such a remarkable achievement in economic growth is closely related to Korea's successful implementation of the government's export-oriented and sector-specific industrial development strategies, development of human resources, as well as innovation policies since the launch of the First Five-Year Economic Development Plan in 1962. The rapid economic growth within a half-century reflects the characteristic of "compressed economic growth" (Park, 2009).

This compressed economic growth has resulted in several spatial problems, such as the concentration of population and industry in the Capital Region and subsequent regional disparity. However, the non-Capital Region has experienced economic growth and improvements contributed by the development of industrial clusters, which caused dynamic spatial patterns and processes to progress in Korea's economy. In the early industrialization phase, the spatial disparity of economic activities has increased with the bipolar industry concentration. Spatial disparity has persisted through continuous population concentration, creating a new spatial division of labor between the Capital Region and the rest of the country, as well as path dependent trends of industrial development. Despite the persistent spatial disparity of economic activities, that of per capita GRDP has considerably decreased in the last two decades. In addition, a new path creation trend has evolved in the cities of provincial and rural areas with the development of Information and Communication Technology (ICT). The development of

high-tech industries, such as electronics, in the non-Capital Region and the development of ICT have contributed to the spatial dynamics of Korean economy (Park, 2009).

Gumi City is a good example that has contributed to development in the non-Capital Region and the progress of dynamics in the Korean economic space. Gumi City has evolved as a leading global electronics industry cluster in the last four decades, reaching an export value of US\$ 33 billion in 2010. The Gumi industrial park has transformed and evolved from a branch plant agglomeration, with the co-location of many branch plants in the electronic sector, to an industrial cluster with progressive local networks. Recognizing government industrial policies is critical in understanding the evolution of Gumi electronics cluster. This paper aims to examine the evolution of Gumi Industrial cluster with relation to the changes of regional industrial policy in Korea. In the following section Korean industrial and regional policies are introduced to understand the process of the dynamics of Gumi City. The history of industrial development and industrial cluster evolution in Gumi City is then examined.

2. Changes in Regional Industrial Policies in Korea

1) Government industrial policy before the late 1990s

The government's industrial policy has significantly impacted the industrial development and changes during the last half-century. Regional industrial policy has continuously changed in focus from industrial park development in the early industrial development phase to innovation for competitive industrial development

in recent years. Accordingly, understanding this industrial policy is a prerequisite to understanding the industrial transformation and innovation in Korea.

The Korean national government has led the promotion of sectoral and spatial industrial policies since the launch of the First Five-Year Economic Development Plan in 1962. Export-oriented industrialization has become a major strategy since the early 1960s, which was fashioned to promote the most promising industries at a certain stage. Labor-intensive industries, such as textile and apparel, were the key sectors for the expansion of industrial exports before the mid-1970s, whereas heavy and chemical industries, such as petrochemicals, shipbuilding, automobile, and consumer electronics, were 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 (conglomeration) in the Korean economy, due to the allowed borrowing of foreign capital and several incentives for investments in the heavy industrial sector (Park and Markusen, 1995). Since the mid-1980s, high-tech industries, such as semiconductors, have been increasingly favored. The shift of sectoral industrial policies has caused the shift in the industrial structure of Korea from labor-intensive to technology-intensive assembly type. Labor-intensive industries have dominated during the rapid industrialization in the 1960s and early 1970s, but have shown a continuous decrease in their share of total industrial production since the late 1970s. In contrast, assembly-type industries, which include high-tech industries, have continuously increased since the late 1970s (Park, 2009). Since the mid-1990s, especially following the foreign exchange crisis in November 1997, the Korean government has exerted great efforts to promote the development of knowledge-intensive industries and services; open the country fully in trade and capital movements; restructure the economy, including the financial sector; and make the labor mar-

ket flexible.

Along with sectoral industrial policies, the national government promoted spatial policy with the establishment of several large industrial estates, especially in the southeastern part of the country, to decentralize industries from the Capital Region in the 1960s and 1970s. The resulting major new industrial cities or production complexes include those of Ulsan, Changwon, Pohang, Gumi, Gwangyang, and Ansan. Free Export Zones in Masan and Iri have been constructed to attract foreign direct investments (FDIs). However, the role of FDIs was relatively insignificant in the 1970s and 1980s, compared to that of imported technology and foreign capital borrowing used by Chaebols to establish large branch plants that significantly contributed to the development and growth of industrial cities. The industrial policy focusing on industrial park development could be regarded as a strategy to establish production systems in the nation. However, the idea of territorial production systems was not successfully implemented in the earlier development stage due to poor local industrial linkages. That is, at first, industrial parks only had limited local inter-firm linkages, and were merely agglomerations of production activities without significant intra-regional production networks.

Sectoral and spatial industrial policies until the 1980s had a significant impact on the spatial structure of the Korean economy. On the one hand, the government's spatial industrial policy has led to the spatial division of labor, concentrating Chaebol headquarters in Seoul while decentralizing production functions to the non-Capital Region (Park, 1993). On the other hand, high-tech industrial policy since the mid-1980s resulted in the re-concentration of industry in the Capital Region, due to the locational advantages of high-tech industries, such as easy access to skilled labor, knowledge, technology information, and finance. The concentration of high-tech industries and advanced

services, including R&D activities, in the Capital Region has intensified the spatial division of labor in Korean production systems and space economy (Park, 1993; 2009).

Several local governments have made significant efforts to attract knowledge-based industries through the realization of local autonomy since the mid-1990s. However, such industries are still overwhelmingly concentrated in the Capital Region due to the favorable locational factors, such as the availability of high quality and skilled labor, advanced information infrastructure, easy access to financial centers, other advanced producer services, and so on. That is, although new industrial parks have developed in the non-Capital Region based on the government's regional industrial policy, regional variation in the growth of knowledge-based industries has persisted in the Korean space economy (Park *et al.*, 2009).

2) Government's innovation policies

In the early industrialization phase of the 1960s, issues of innovation have been relatively neglected because the main goal was the establishment of manufacturing production bases. In the 1970s, the science and technology policy has focused on expanding education in the technical and engineering fields, establishing several government-supported research institutes in the field of heavy and chemical industries, as well as promoting the heavy and chemical industrial development policy. Government-supported research institutes have taken a leading role in the improvement of industrial technologies during this period. Most of the firms were more interested in technology transfer from industrialized countries, rather than the promotion of their own R&D activities. Through the establishment of these research institutes, the national systems of innovation began to evolve in relation to industrial development.

However, innovation systems in Korea have significantly changed since the early 1980s through the considerable growth of private firms' in-house R&D investments. During this time, firms have begun to emphasize technological developments owing to the national industrial development and severe competition in international markets. Chaebols aggressively established R&D centers. In 1981, the share of private firms in the national total R&D expenditure reached 56%, which became the turning point when private firms' share overtook that of the government. Since then, the share of private firms rapidly increased and was 81% in 1985 (MOST, 1990). The number of 54 firms, most of which belonged to Chaebols, that had their own R&D centers in 1980 increased to 2,226 in 1995 (KITA 1995; 1996). Kim (1997) identified three major characteristics of firm innovation activities in the 1980s: 1) Large firms of Chaebols established strategic alliances with global high-tech firms; 2) Large firms, which mostly belong to Chaebols, were aggressive in establishing foreign R&D centers and labs; 3) The difficulties in obtaining a license for leading-edge complex technology led large firms to become actively involved in the merger/acquisition of high-tech firms in the developed countries to secure original technology.

In the 1990s, even small and medium size enterprises (SMEs) have begun to establish R&D centers. Presently, more than two-thirds of the total number of R&D centers in Korea belong to the SMEs. Accordingly, beyond the national innovation systems, regional innovation networks have begun to evolve due to the development of regional clusters of SMEs in technology-intensive sectors. Such development was likewise contributed by the establishment of science and high-tech parks, in addition to the Daeduck Science Town, in the non-Capital Region during those times. According to Park's (2000) questionnaire surveys for SMEs, conducted when Korea began to obtain

financial support from the IMF, the role of SMEs has become important in the country's development of regional innovation systems. Based on the survey, SMEs have become more involved in R&D activities during the 1990s, especially as one of the strategies of industrial restructuring. Out of 825 firms that replied to the survey, 20% conducted R&D activities in 1993. This figure increased to 34% in 1996. Overall, among these firms, larger SMEs participate more in R&D activities than smaller SMEs. However, smaller SMEs show a higher ratio of R&D expenditure to total sales compared to that of larger SMEs. This finding reveals that a considerable proportion of smaller SMEs conducting R&D activities can be regarded as venture businesses even in the early 1990s.

Inter-firm networks between large contract firms and suppliers of SMEs within the local area, as well as collaborations with other firms and trade associations of the same industry, have become an important mechanism for innovation of SMEs in Korea. Large firms belonging to Chaebols played a critical role in forming inter-firm networks by establishing cooperative suppliers of SMEs. For some SMEs, collaboration with universities, government-sponsored research institutes, and other public entities has also become an important contributor to their technological development and innovation. The importance of inter-firm networks for the innovation of SMEs was supported by the extended survey of 1999 (Park and Nahm, 2000). Moreover, since the financial crisis in 1997, even some of the Korean SMEs have been established as the focal point of the network in Silicon Valley, representing that global innovation networks for SMEs are becoming important.

3) Regional innovation and cluster policy in the Participatory Government

The Participatory Government, which began in

2002, has strongly promoted balanced national development with emphasis on regional innovation and cluster policies (Park 2007). The government's regional innovation policy can be regarded as essential for balanced national development, and the basic framework of the policy was intended for the integration of "talents," "technology," and "industry." Major policies for regional innovation provide the basis for the establishment of regional innovation systems, strengthening the innovation capacity of universities in provinces, promoting science and technology in provincial regions, and establishing industry-university-research center networks (PCBND, 2007).

The Participatory Government has strongly promoted the innovative cluster policy in relation to the regional innovation policy. Seven innovative clusters have been designated as models with the reorganization of selected national industrial parks: electronics and IT cluster in Gumi; machinery cluster in Changwon; automobile cluster in Ulsan; parts and components cluster in Ansan; parts and components of automobile and machinery cluster in Gunsan-Janghang; photonics cluster in Gwangju; and medical instruments cluster in Wonju. Each innovative cluster has developed three to seven mini clusters, which focused on a specific technology or product, to promote collaboration and solve problems in production. Later, the Participatory Government designated six more innovative clusters, and 13 innovative clusters have been supported outside Seoul.

In addition, the Daeduck R&D special district in Daejeon City has been supported under a special law to promote R&D commercialization and diverse innovations. The development of innovative clusters has been promoted through supporting strategic industries in each region. High-tech IT and local culture clusters have been similarly supported to strengthen local innovation through collaboration among diverse economic actors. Private firm development of clusters has

also been promoted, including the Suwon IT cluster by Samsung, Paju's semiconductor cluster by LG-Phillips, and Pohang's material cluster by POSCO.

The regional innovation policies have certainly contributed to the increased density of regional innovation networks in the provinces. However, limitations in the development of high quality manpower in these regions seemed to have resulted in the aggravation of innovation potentials. Such a strong promotion of balanced national development policies through regional innovation and clusters appears to have impacted the relative decrease of the GRDP share compared to the population share in the Capital Region (Park, 2007). The trend of decreasing spatial disparity in terms of per capita GRDP, however, could be the result of the complex mechanisms of economic spaces in Korea.

4) Reshaping regional policy in recent years

Since the launch of the new government of President Lee Myung-Bak, the Presidential Committee on Regional Development (PCRD) has set up a new scheme of regional policy. Drastic changes in the global and domestic economic environments, resulting from the unexpected global financial crisis in 2008 and global climate change, have led the incumbent government to alter its philosophy on regional development policy (Richardson *et al.*, 2011). The PCRD regards this change as a paradigm shift, calling it "reshaping regional policy." The change can be considered as a reshaping because the boundary of regional development plan is not limited to one administrative area, and instead includes several administrative units to make a larger economic region for the synergetic effects of cooperation with other regions. The new regional policies build a spatial foundation for each region to attract and develop new industries, while ensuring their effectiveness and competitiveness (Choe, 2011). The new policy has also emphasized both localization and

decentralization for regional development. The PCRD suggests that the new government altered its policy direction from declaratory "balanced regional development" to "regional specialization and competition," which attempts to implement effective self-reliant localization policies (Choe, 2011).

The new regional policy comprises five key strategies (Choe, 2011). First, the new policy is framed on a three-tiered approach based on different geographical scales: 1) the Economic Region (ER) scheme regroups upper-tier local governments (16 metropolises and provinces) into seven ERs; 2) the Local Area scheme provides quality-of-life services and income-earning opportunities for all residents in lower-tier local governments (163 cities and counties); and 3) the Supra-Economic Region (SER) scheme creates four SERs along the three coastlines and an Inland SER to promote cross-economic region and cross-border cooperation. Second, the government will promote regional development by providing a new regional growth engine based on specialization. Two selected industries for each ER will be fostered to enhance global competitiveness. Interregional linkages and cooperation will be boosted to promote the synergetic effects of strategic industries. Third, several tasks will be promoted to enforce decentralization, delegating power from the central government to local governments. These tasks are the devolution of central government's regional agencies; redistribution of taxes between central and local governments; integration of diverse national subsidies into block grants for regional development; and transfer of development authority to local governments for better planning and implementation. Fourth, the symbiotic development of the Capital Region and the non-Capital Region is pursued through diverse channels. Some examples are the transfer of capital gains earned by developing land in the Capital Region to local governments in the non-Capital Region; reduced regulations and improved institutional environment

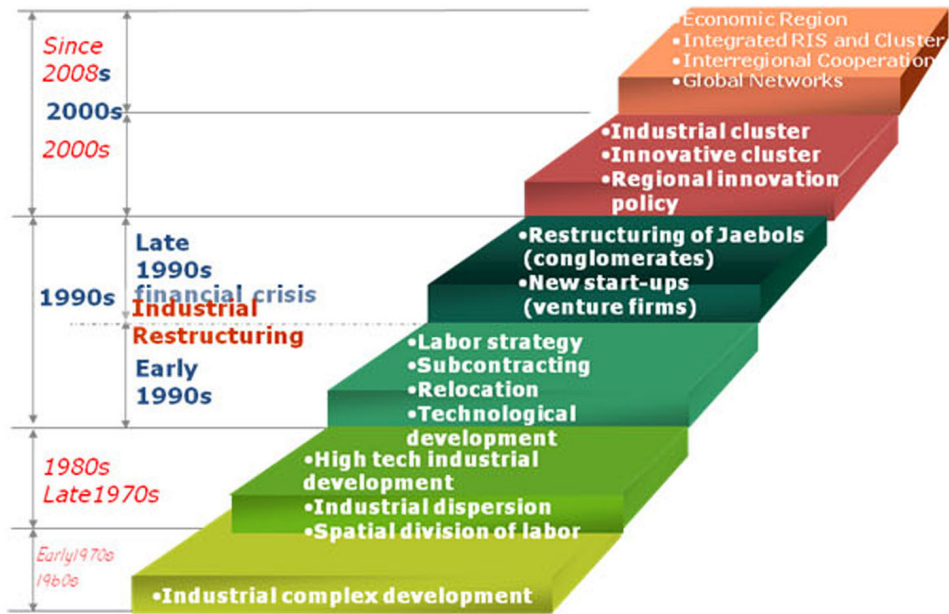


Figure 1. Brief history of Korean industrial policies.
Source: Park, 2010

to reinvigorate the regional economy; and the stepwise deregulation of the Capital Region concurrent with regional development in the non-Capital Region. Fifth, existing regional projects inherited from the former administration will be continued. For example, the dispersal program of government offices and public institutions will progress considering its contribution to create growth hubs in the ER; incentive measures, such as tax exemptions and low-priced land, can be used to attract high-tech business in the non-Capital Region.

Overall, the Korean industrial policy has evolved from the industrial park development in the 1960s and 1970s, to high-tech industrial development in the 1980s, to industrial restructuring in the 1990s, to innovation and industrial clusters by the Participatory Government, and to the establishment of ER with emphasis on interregional networks and cooperation (Figure 1). Along with the changes and reshaping of

the industrial and innovation policies, space economy in Korea has shown several dynamic characteristics: spatial division of labor; development of ICT and spatial changes with the dominance of Seoul; and virtual innovation networks in peripheral areas (Park, 2009). More details will be examined through the case of Gumi, a specialized electronics cluster in Korea.

3. Historical Development of Gumi Industrial City

Gumi is a industrial park established in 1971, and was designed as an electronics district. Gumi is about 267 km south of Seoul, located about a half-hour's drive north of Daegu, which is the third largest city in Korea. In 1977, the erection of factories and buildings began in the first industrial park in considerable

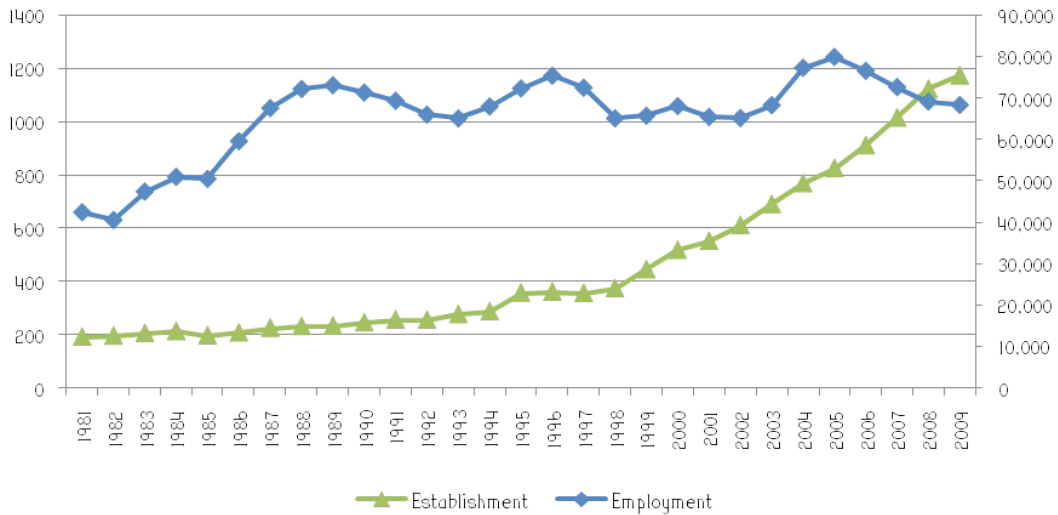


Figure 2. Number of Establishment and Employment of Gumi.

Source: Korea Industrial Complex Corp., 2011

numbers. By the early 1990s, over 240 firms employed more than 70,000 workers, who resided in the complex. Since that period, the number of firms has continuously increased, reaching 1,177 in 2009. However, the number of employees has fluctuated in the range of 65,000 to 80,000 (Figure 2). Growth in industrial output and export has been impressive, with an annual growth rate of more than 18% in the 1980s and continuous growth until 2005, except during the financial crises in 1997 and 2001 (Figure 3). Of course, growth has fluctuated during the last half-century. A negative growth rate has been noticed for the changes of production, export, establishment, and employment in a few years, especially during the financial crisis in East Asia in 1997 as well as the global economic crisis in recent years (Figure 4). During the last four or five decades, export growth rates were generally over 10%, and over 20% for more than half the period (Figure 4).

Gumi's resident population grew by almost four times from 105,000 in 1980 to 404,920 in 2010. Gumi fit into the Park administration's economic

strategy of a new round of export-oriented development in the 1970s, based on electronics in particular. The development of electronics was an obvious route for a resource-poor economy, an attempt to diversify away from South Korea's dependence upon heavy industry (Park and Markusen, 1995). Building the Gumi industrial park and location owed more to the exercise of discretionary political power than a commitment to a regionally balanced industrial growth. Gumi was a personal project of President Park, whose military regime targeted new investments in the southeastern region of Korea. Although situated far from the coasts, which used to be a consideration that dictated the earlier export- and port-oriented selection of Pohang, Ulsan, and Changwon as industrial cities for steel, chemicals, and machinery, respectively, Gumi's countervailing asset was its good fortune in being the hometown of President Park.

In 1969, when its fate was sealed, Gumi was a small agricultural village where no significant economic changes have occurred for generations. The indus-

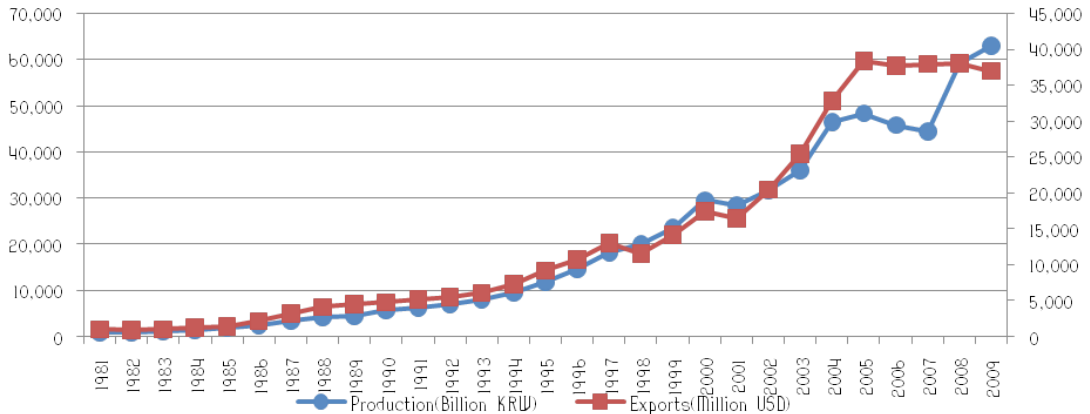


Figure 3. Production and export of Gumi.
Source: Korea Industrial Complex Corp., 2011

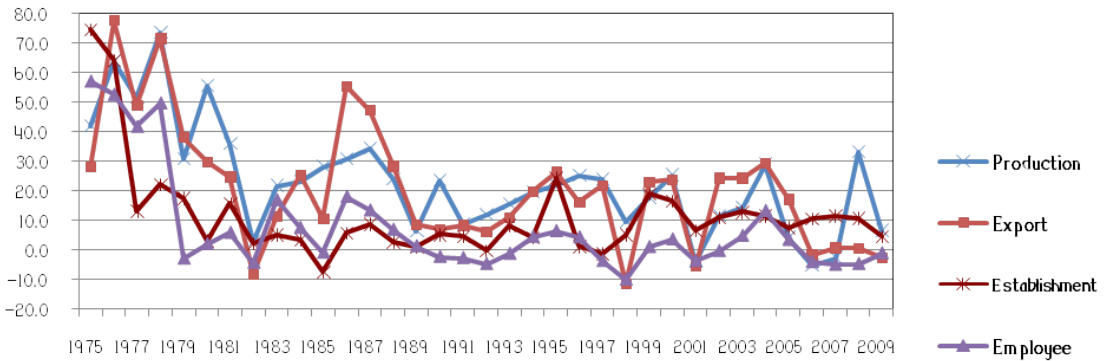


Figure 4. Annual growth rates of production, export, establishment and employees.
Source: Park, 2010

trial park has been built by reclaiming land from the Nakdong River, and building a 12-km embankment to re-channel the river's flow. Factories and dormitories were rapidly erected, filling up the grid lines laid down on planners' maps. The leading agent for Gumi's construction was the Korea Electronics Industrial Corporation, reorganized in 1974 as the Gumi Export Industrial Corporation (KEIC), to acknowledge the fact that the textile business was becoming as important a tenant as electronics in the complex. KEIC was an arm of the national government, under the Ministry of Trade and Industry, with its own special trust

fund to finance land clearance and development. Over the years, KEIC's operations have been increasingly funded out of proceeds from its land and energy activities, but the national government continues to oversee its policy development.

Government subsidies and incentives have played a major role in inducing companies to build plants in Gumi. Land clearance, site preparation, infrastructure, and water and energy supplies are ample and come cheaply, and efficient transportation links to Seoul and southern seaports are assured. Not all the inducements are physical in nature. Tax breaks,

worker education and training programs, as well as a modest level of business services have been provided. Although a plant is supposed to be “clean” to qualify as a Gumi resident, the government has tolerated water and air pollution, an advantage for firms that find restrictions tightening in Seoul. At first, the principal input into the production process in Gumi was labor, the target labor force being young women from the 400 villages within 15 km of Gumi. KEIC actively helped to recruit the labor force by combing the high schools in rural areas. Larger plants have been required to set up their own in-house training facilities, and technical and vocational schools in Gumi supplement the labor supply. A major inducement to the immigration of very young women was the offer of a high school education in the factory itself, as part of the employment conditions. Managers and engineers, on the other hand, were drawn from urban centers such as Daegu, especially from the College of Engineering of Gyungbuk National University. Job opportunities within the region have helped to staunch the flow of educated labor from places such as Daegu to the Seoul metropolitan area. Gumi has grown spectacularly fast as an industrial park. Manufacturing has served as the backbone of this growth.

4. Evolution of the Gumi Industrial Cluster

The Gumi industrial park was created as an agglomeration of branch plants that could transform by generating spin-offs, spawning localized supplier networks, and creating governance structures that resemble those of industrial districts. Several questions were raised in the early 1990s studies (Park and Markusen, 1995). Have the economies of Gumi continued to exhibit the features of a satellite industrial district? Over time,

have there been signs of modernization, local entrepreneurship, vertical disintegration, increased networking among firms, or greater interest in flexible specialization? Or, do state management, branch plants, non-place embeddedness, and exogenous decision making still predominate?

This section examines the changing industrial specialization and industrial and firm organization, as well as the prevalence of indigenous versus exogenous linkages in the context of industrial district evolution. The pressure to restructure these districts has been intense in the early 1990s. Since the late 1980s, national factor advantages such as cheap and abundant labor and cheap industrial land have almost disappeared in Korea compared to other developing countries. As a result, industries in South Korea had to undergo a significant restructuring to regain competitive advantage. The major triggers of this industrial restructuring were rapid wage increase, eruption of labor disputes, currency revaluation, and high financial costs (Park, 1994). Corporate strategies and regional characteristics as well as the role of the state have been shown as important factors in the industrial restructuring at the national level (Park, 1993). Overall, the current study suggests that the Gumi industrial park originally started as a satellite industrial district, as defined by Park (1994), that faced some difficulties, but has evolved into an industrial cluster with continued diversification under the main trend of specialization in the electronics industry.

1) Changes in industrial specialization

Gumi was initially designed for high-level industrial specialization to encourage localization of economies and inter-firm networking. Such specialization is a key feature of industrial districts in the New Industrial District literature (Park and Markusen, 1995). Gumi started with considerable sectoral specialization that

was originally designed to host the electronics sector. In 1990, the electric machinery and electronics share accounted for 49.9% of the total employment (Park and Markusen, 1995). This share increased in the last two decades, reaching 60.2% in 2009 (Table 1). Along with the share increase of the electronics sector, the share of textiles continuously decreased from 38% in 1980, to 28.1% in 1990, and to 6.4% in 2009 (Park and Markusen, 1995; Table 1).

At first, Gumi's success stood on two sectoral pillars?textiles and electronics. The high incidence of textiles in the initial development of Gumi, which was not part of the original plan, is attributable to the strength of the industry in domestic and export markets and to the early difficulties that the complex experienced in attracting the electronics industry. As the nearby older industrial city of Daegu specialized in the textile industry, textile firms that were looking to expand out of the Daegu area were eager to come to Gumi in the early 1970s. Furthermore, when the first Gumi complex was built in the early 1970s, it encountered difficulty in attracting enough electronics plants to absorb the prepared industrial sites. Despite the official designation of Gumi Electronic Industrial Corporation, the management of the complex lowered its high-tech aspirations and built space for textile factories (Park and Markusen, 1995).

Three important trends emerged in the specializa-

tion changes in Gumi. First, despite the continuous increase in the degree of specialization on electronics, there has been a continuous decrease in the share of textiles, whereas shares in other sectors such as machinery increased. The textile industry in the Gumi industrial park significantly decreased its share since the 1990s, because several textile firms closed or relocated to foreign countries due to the government's restructuring policy of labor-intensive industries in the 1990s. Meanwhile, new sectors such as new energy industries emerged in Gumi. For example, LG Electronics changed its PDP production line into solar battery and module production line in 2009; LG InnoTech established solar battery production facilities in 2007; and Seronics produced parts of solar battery through a joint investment with a Japanese firm in 2009 (Chung, 2011). This development can be recognized as the diversification of industry within the general trend of the intensification of specialization in the electronics sector.

Second, within the intensification of specialization on electronics, the diversification trend of products within the electronics sector has appeared. TV was the major product in the early development of the district. However, since the mid-1980s, semiconductors, computers, and some parts and components of the electronics have been produced with the construction of the second district in Gumi (Chung 2011).

Table 1. Changes of Industrial Structure of Gumi

Leading industries in Gumi Industrial Park (in %)							
Industry	1999	2002	2004	2006	2007	2008	2009
Textile & Clothing	16.19	14.21	11.47	8.51	8.75	6.28	6.44
Nonmetallic	13.00	14.94	12.49	11.34	11.84	13.80	9.04
Machinery	4.03	3.89	5.24	4.17	4.72	11.97	13.47
Electric & Electronics	55.43	55.30	61.44	66.23	64.55	58.70	60.16
Others	11.35	11.66	9.36	9.75	10.14	9.25	10.89

Source: Park, 2010.

Third, Gumi's economy has become more diversified with the remarkable increase of the service sector. The share of services to the total employment increased from 3.7% in 1980, to 10% in 1990, 34.5% in 1995, and 46.1% in 2009 (National Statistical Office, each year). The service sector has remarkably increased since the 1990s when the number of SMEs increased in Gumi. The increase in the number of SMEs changed the occupational structure of the city with the increase in managerial personnel, which required diverse services to be available in the city. In the 1980s, most of the families of the managers and the white-collar jobs in the large branch plants remained in Seoul because of the children's education. Their monthly salary was sent to their families in Seoul, resulting in the Gumi local labor force mostly made up of production workers whose salary level is low. However, with the increase in the number of small firms headquartered in Gumi, several diverse service activities have been developed in Gumi since the 1990s.

2) Changes in firm size distribution and industrial linkages

The remarkable changes in industrial development in Gumi can be found in the distribution of firm size. Small independent and locally headquartered firms are more likely to engage in and benefit from the potential for networking and cooperation in local areas. The proliferation of locally linked establishments will benefit an industrial district by insulating it from volatile external demand, thus enabling firms to be flexible and share the burden of restructuring during adverse times (Park and Markusen, 1995).

About three-quarters of the establishments in Gumi employed less than 300 workers in 1992. These plants accounted for about 20% of the total employment. Gumi's major plants are large branch plants headquartered mostly in Seoul, revealing a branch plant econ-

omy in the 1980s. Large plants predominated when new construction rates peaked from 1981 to 1986, resulting in the prevalence of smaller plants among the new additions. As seen in Figure 2, the remarkable increase in the number of establishments since the financial crisis in 1997 is mainly attributable to the new addition of small independent firms. The increase in the addition of SMEs resulted in the share of the number of SMEs to increase from 93.9% in 1999 to 96% in 2008, whereas the employment share increased from 34.8% in 1999 to 49.4% in 2008 (Chung, 2011). Considering that the employment share of SMEs to the total employment of Gumi is almost half, it can be assumed that the new industrial structure has evolved from the specialization of large branch plants in Gumi. Changes in industrial structure can be realized from labor restructuring as evidenced in the change in occupational structure. The share of managerial and administrative personnel increased from 2.6% in 1987, to 3.5% in 1992, and to 17.2% in 2010, whereas the share of production workers decreased from 82.3% in 1987, to 75.6% in 1992, and to 17.8% in 2010 (Park and Markusen, 1995; Chung, 2011).

Considering the remarkable increase of the number of SMEs, growing local linkages between suppliers and buyers and among competitors, which might set off endogenous growth dynamics, can be expected. In 1988, Daewoo Electronics, which had branch plants in Gumi, Chunan, Incheon, and Gwangju, had spatial linkages of input materials with the southeastern region of Korea by only 14%, revealing the limited linkages of the branch plant located in Gumi (Park, 1990). The regional share of cooperative firms of the Gumi branch plant of Samsung Electronics was 11.1% in the Southeast Region of Korea (Park, 2004), suggesting low level of local linkages of branch plants in Gumi. Given the weak local linkages of large branch plants located in Gumi, the prospect of Gumi's economy was not optimistic in the 1980s. In addition, considering

that the small firms in Gumi are mostly subcontractors to the large branch plants in Gumi, the increase in the number of smaller firms reveals a growing subcontracting community in Gumi (Park and Markusen, 1995).

However, positive evidence has been identified in Gumi recent years. According to Chung’s survey (Chung, 2011), 54% of the firm respondents procured more than 75% of the total procurement from Gumi, and 55% sold more than 75% of their total products to Gumi, revealing a high level of local input and output linkages. The strong local linkages are related to the restructuring strategy of large firms. Large branch plants in Gumi encouraged employee spin-off to reduce the number of employees and establish a subcontracting relationship with the spin-offs. The senior workers of the large branch plants can utilize their experiences and know-how to start new firms in a related industry, which is beneficial to large branch plants and the local economy of Gumi. The subcontracting activities of the spin-offs fueled the atmosphere of the branch plant economy. However, a new trend emerged with considerable non-local linkages. About 24% of the respondent firms procured less than 25% of the total procure-

ment from Gumi, and 17% sold less than 25% of their total products to Gumi, suggesting that a considerable number of SMEs in Gumi have non-local industrial linkages and are not merely subcontractors of large branch plants in Gumi. Several SMEs in Gumi are still subcontractors to large branch plants, and the subcontracting economy still exists. However, it should be noted that the trend of reshaping the economy has been concurrently evolving in recent years. Evidence from innovation can further explain the evolution of the Gumi electronics cluster.

3) Strengthening Innovation of SMEs

One of the most significant changes in the Gumi industrial cluster is the dramatic increase of innovation since the early 1990s. The number of registered patents in Gumi was negligible until the mid-1980s. This number has increased dramatically since the early 1990s. The number of patents decreased during the financial crisis in 1997, but it continuously increased after 2004 (Figure 5). The rate of the increase is comparable to the average of Korea. Despite the concen-

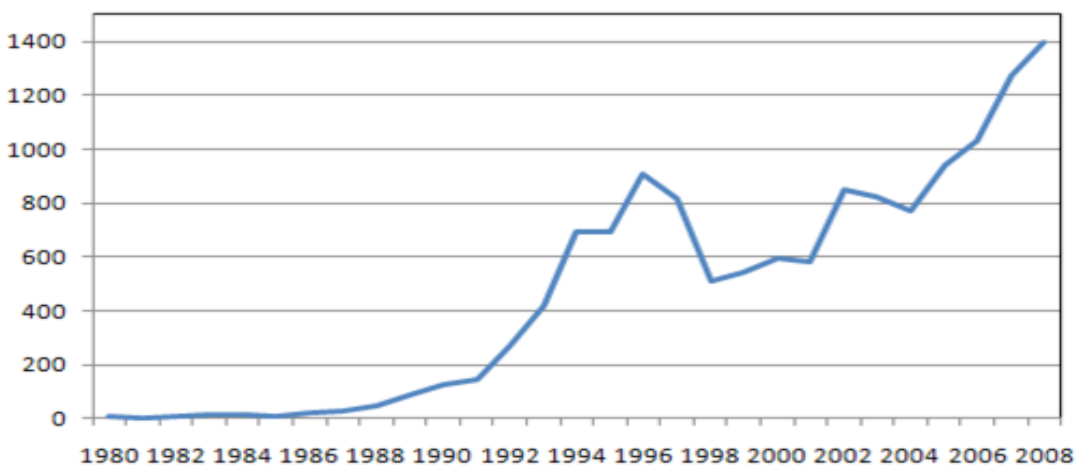


Figure 5. Changes of the Number of Registered Patent of Gumi.

Source: Chung, 2011

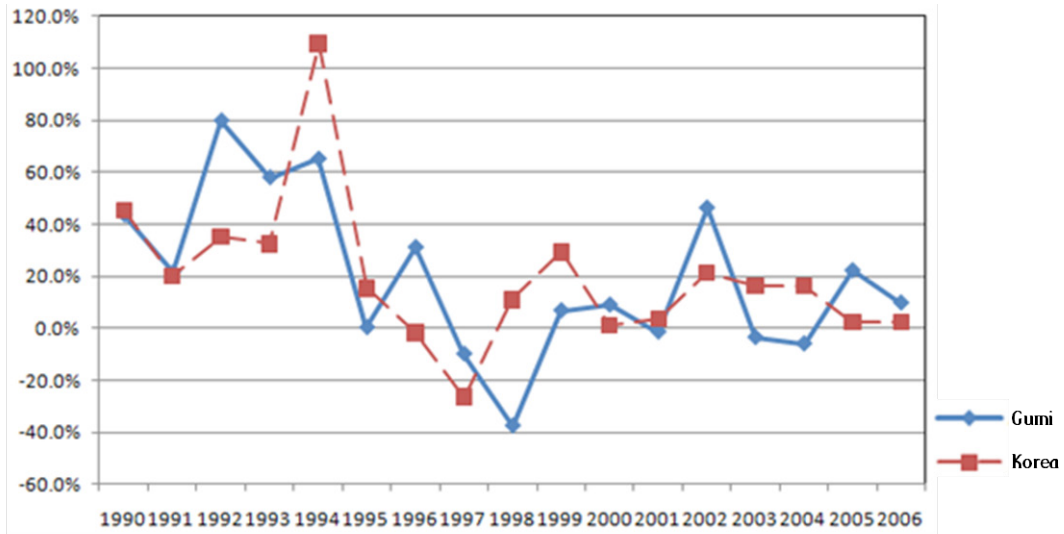


Figure 6. Growth Rate of the Number of Registered Patent: Gumi and Korea.

Source: Chung, 2011

Table 2. Patent Application of Electronics Communication in Gumi

Applicants	Before 2005		Since 2005		Total	
	# of Patents	%	# of Patents	%	# of Patents	%
Large firm	101	63.9	40	24.2	141	43.7
SMEs	42	26.6	94	57.0	136	42.1
Individuals	10	6.3	14	8.5	24	7.4
Univ. & R&D centers	0	.0	3	1.8	3	.9
Joint Patents	5	3.2	14	8.5	19	5.9
Total	158	100.0	165	100.0	323	100.0

Source: www.kipris.or.kr; Chung, 2011:78

tration of innovation activities in the Capital Region, Gumi is now moving toward innovation cluster from the branch plant economy (Figure 6).

The innovation cluster started to emerge in the early 1990s. About 61% of the respondent firms of Park and Markusen's (1995) survey in 1992 introduced new technology in the last two years, and 43% of the firms responded to the introduction of new technology for production. The most important finding is that the major actors of the innovation are moving from large

firms to SMEs. Before 2005, large enterprises had a 64% share and SMEs shared 26.6% of the registered patents. These values were completely reversed after 2005, in which large enterprises had 24.2% share compared to the 57% registered patent share of SMEs (Table 2). After 2005, the shares of the individual and joint patents increased from 6.3% and 3.2% to 8.5% and 8.5%, respectively. Table 2 shows that the role of SMEs in the innovation activities in Gumi has proliferated in recent years, and collaboration with other ac-

tors tends to increase. Technology alliances with transacted firms and firm's technology development were recognized as the most important factors in the introduction of technology and innovation (Chung, 2011). In the process of restructuring and specialization, large firms in Gumi have supported subcontracting SMEs to improve technology and promote R&D activities to subsequently improve the quality of supplied parts and components. They regard that the technological progress of the subcontracting SMEs is critical for keeping the competitive advantages of their final products in the global market.

Large customer firms are the most important original source of innovation information. However, small and medium customer firms, supplier firms, and competitive firms are also considered as vital sources of innovation information. Such knowledge and innovation networks of Gumi firms suggest that the Gumi industrial park is now evolving toward innovative cluster from the early satellite platform-type industrial district, despite the continuously significant role of large branch plants (Park, 2010).

4) Changes in the role of local government in recent years

Along with the previously examined innovation policies of the central government, changes in the role of local government have also considerably contributed to the evolution of the Gumi industrial cluster. As the local autonomy system, in which city mayors and governors of provinces are all directly elected by the people, was put into operation in Korea in 1995, local governments have transformed themselves from mere administrators to active planners for their own development (Park, 2007; Choe, 2011). Corresponding to the central government's innovation policies, the Gyongsangbuk provincial government and the Gumi City government cooperate to build local innovative

capacity and cooperative relationship between firms in the Gumi industrial cluster. The Gyongsangbuk provincial government sets up a blueprint for local industrial development and tries to attract supportive programs from central government bearing some expenses for the project, whereas the Gumi City government sets up and operates R&D institutes and cooperative associations (Chung, 2011).

The central government establishes key industries for each province considering the opinion of the provincial government and long-term national development. During the start of the Participatory Government in Korea in 2003, the central government, in collaboration with the provincial government, selected promising local strategic industries for each province and fostered them intensively. Gyongsangbuk province selected electronics and information technology as a strategic industry in 2004. The Korean government at present also tried to select and nurture leading industries for each economic region. Gyongsangbuk province selected IT and new energy as its leading industries. The central government provides financial support to promote the strategic or leading industries in the province. In addition, based on the Korean government's action plan for regional development, the "Revised 4th Comprehensive National Territorial Plan (2008?2020)," Gyongsangbuk province set up the "Revised 3rd Comprehensive Provincial Territorial Plan (2008?2020)." Based on the 3rd Comprehensive Provincial Territorial Plan, Gyongsangbuk province established plans for restructuring its electronic industry and development of new energy industry, and suggested the continuous development of the Gumi industrial cluster (DGDI, 2010; Gyunsangbukdo, 2011).

Local governments have focused on increasing their local R&D capacity and promoting the new industry because the central government set up a general scheme of development direction. As part of this local

government policy, a complex of R&D facilities for electronic industry was built within the Gumi industrial cluster in 2002, and the Gumi Electronics & Information Technology Research Institute (GERI) was established through a joint investment of the central government, Gyongsangbuk province, and Gumi City in 2007 (DGDI, 2010). GERI supports the R&D activities of SMEs, R&D of electronics industry, experts training and education, incubation of high-tech industry, and development of new renewable energy industry. Gumi City is in charge of operating GERI (Chung, 2011).

Meanwhile, Gyongsangbuk province and Gumi City tried to attract foreign firms to the Gumi industrial cluster by designating the Gumi Foreign Investment Zone within the Gumi industrial cluster, and attempting to agglomerate the new industries such as LED and new energy industry through several subsidies and incentives (DGDI, 2010). Unlike the early stage of the Gumi Industrial Park development, business networks were established between the existing electronic firms and the newly entered energy sector firms to restructure the existing industries and enhance the local R&D capacity, in addition to the relocation of large facilities to Gumi.

The Gumi City government also supports the formation of cooperative relations between SMEs by supporting the establishment and operation of business associations of SMEs. Previously, cooperative relations in Gumi mainly consisted of subcontracting activities from the large branch plants located in the Gumi industrial park (Park and Markusen, 1995). Given the increase in the proportion of SMEs in the region and the change of government industrial policy into an innovation-oriented one, the importance of diverse cooperative relations among firms was emphasized (Chung, 2011). The Gumi Small and Medium Business Association (GSMBA) was set up in 2002 through the voluntary participation of local SMEs.

GSMBA serves as a channel agency in the performance of the central and local governments' support program for SMEs, such as providing joint research activities for product development and process innovation, business support services, and so on. Gumi City furnishes the GSMBA with operation fund and authorizes the group as an independent SME support institution through a Gumi City ordinance. A total of 758 SMEs have participated in the GSMBA since 2007, which is equivalent to 65% of the total SMEs in Gumi (Chung, 2011). Such changes and strengthening of the role and function of the local government for R&D-focused policy and SME support have significantly contributed to the evolution of the local economy and industrial cluster in Gumi.

5. Conclusion

Gumi was the typical satellite platform-type new industrial district until the early 1990s. In a previous study on Gumi, Park and Markusen concluded as follows (Park and Markusen, 1995: 100): "In Gumi, large branch plants predominate, surrounded by a growing number of smaller subordinate firms with captive subcontracting relationships. Gumi's branch plants have maintained significant intra-organizational but non-local linkages to other establishments of their parent firms located in other regions. Most establishments, with the exception of captive subcontractors, have extensive relationships with firms headquartered outside the region, even outside the country. In other words, they are non-locally rather than locally embedded, and embedded within the vertically integrated structure of their parent firms, rather than among a set of vertically disintegrated firms. Most continue to operate with mass production processes and little local R&D, with the more customized and innovation-intensive work

remaining in Seoul. They fit the depiction of 'global Fordism' more closely than they do that of 'flexible specialization.'"

In the last two decades, however, Gumi experienced considerable changes and has evolved into an industrial cluster with significant local linkages and innovation activities, despite the continuously significant role of branch plants in shaping Gumi's industrial and economic atmosphere. The government's industrial policies have significant impacts on the changes in the Gumi industrial cluster. The state was the developer and locator of business activities within the confines of the Gumi industrial park, both in origins and in their contemporary operation, as demonstrated in the case of Changwon (Markusen and Park, 1993). The state initiated to develop several national industrial parks in the late 1960s and 1970s such as Ulsan (petrochemical and transportation equipment), Cahngwon (machinery), Pohang (steel), and so on, along with the industrial decentralization policy.

The promotion of innovative cluster policy during the Participatory Government (2002?2007) contributed to R&D activities and the formation of local networks of knowledge and technology. Before the 1990s, local universities were not important actors in the industrial cluster formation and R&D activities, although the region's ability to supply university-educated, engineering labor facilitated the development of Gumi. However, in recent years, with the emphasis of innovative cluster, the Geumho Institute of Technology in Gumi strengthened its role in participating in R&D activities and technology networks with local firms of Gumi.

The Role of the State during the initial development of Gumi industrial park was critical and the State has been important for evolving industrial cluster. However, the role of provincial and city governments in supporting the innovative activities of SMEs during the last decade has been progressive. The role of

the state in creating a broader picture of industrial development remains important, and the large branch plants share more than half of Gumi's production and export. In addition, local government, local university, and SMEs are becoming important agents in reshaping Gumi's local economy. An increasing trend of cooperation among local government, local university, and local firms has emerged in recent years. The share of SMEs in the number of registered patent surpassed that of large firms in the last five years, revealing the significant role of SMEs in reshaping Gumi's future industrial environment. Local inter-firm networks among the SMEs for input and output material linkages, information and knowledge networks, and cooperation for technology development with other local actors evolve in the Gumi economy. Notably, despite the core-ring hierarchical relationship between the large firms and SMEs in the industrial linkages, large branch plants have significantly contributed to the emergence of local SME networks with technology transfer, management consulting, and collaborative research.

The case of Gumi suggests the important aspects of industrial cluster development in developing countries. The mere agglomeration of establishments without significant local networks in its initial development can possibly result in the formation of local networking and cooperation. The initial momentum of industrial development is based on entirely exogenous rather than endogenous phenomenon by the government policy and the investments of large firms. However, in addition to material linkages, the industrial cluster with the formation of local innovative networks for information, knowledge, and technology have evolved over time. The time period, however, should be carefully noted. In the case of Gumi, more than a quarter of a century was required to enable local cooperative networks of knowledge and technology to emerge beyond the core-ring relationships between the

large branch plants and SMEs.

Considering the considerable resilience with sustained growth after the financial crisis in 1997 and the recent global economic crisis, the case of Gumi can be regarded as a successful Korean model for industrial specialization and development. However, the future prospects of Gumi electronics cluster may depend on the innovative activities and cluster formation with the intensification of local and global networks concurrently as well as industrial networks with related sectors. In addition, the supply of qualified labor and knowledge-intensive advanced services is also important for the competitiveness and sustainability of Gumi in the future.

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