

Spatial Integration of Corporate R&D and Mass Production Activities in High-tech Manufacturing: A Case Study of Samsung Electronics

첨단제조업분야 연구개발 및 대량생산 활동 간의 공간적 통합:
삼성전자 사례를 중심으로

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I. Introduction

The manufacturing sector still forms Korea's key economic base. A series of recent government slogans, which stress high value-added service sectors such as finance and logistics as Korea's new economic base, may give the public an impression that manufacturing matters less for Korea's economy than before, but this is far from the truth. Those who underestimate the sector's economic significance owing to its shrinking share of total national employment, if any, may be seeing only part of the real situation. As Table 1 shows, whereas the employment share of the manufacturing sector in Korea declined from 37.3 percent in 1991 to 24.2 percent in 2006, the sector's value-added share increased from 24.2 percent to 25.3 percent during the same period.¹⁾ In other words, although the manufacturing sector currently hires fewer people than before, it contributes even more to the national economy in value-added terms. This fact suggests that at present Korea has a manufacturing portfolio that has more high value-added components than before.

The high technology (high-tech) segment of the manufacturing sector is in particular of great importance. Most manufacturing jobs that have been newly created in Korea in the past two decades are in the high-tech sector (Table 2). Between 2000 and 2006, Korea gained 259,881 high-tech manufacturing jobs, while losing 174,516 jobs in the non-high-tech sector. These numbers symbolically show that Korea is no longer an attractive location for price-sensitive manufacturing activities, whereas its high-tech manufacturing sector is growing. Gyeonggi and Chungnam Provinces, whose economies have grown more in relative terms in the last two decades than any other Korean locality (Table 3), accounted for more than half of Korea's total job gains (138,703 out of 259,881) in the high-tech manufacturing sector during the same period.

One puzzle in this trend, which is my main research question, is why high-tech producers

Table 1 _ Share of the Manufacturing Sector in Employment and Value-added, Korea, 1991 and 2006

Year	Employment (1000 persons)			Value-added (billions of Korean Won)		
	Total	MFG	% MFG	Total	MFG	% MFG
1991	11,356	4,231	37.30%	236,128	57,051	24.20%
2006	15,218	3,418	22.50%	857,444	217,282	25.30%

Note: MFG = manufacturing.

Source: Computed by author from the Korea Statistics Information System (<http://kosis.nso.go.kr>).

1) The classification as high-tech or non-high-tech is based on the share of R&D expenditure in annual sales. For further details, see Section 2 of this paper.

Table 2 _ Changes in High-tech and Non-high-tech Manufacturing Employment, Selected Regions, 2000-2006

Region	Changes in Manufacturing (MFG) Employment, 2000–2006		
	MFG Total	High-tech MFG*	Non-high-tech MFG
Korea	85,365	259,881	–174,516
Capital Region	9,643	96,099	–86,456
Gyeonggi Province	146,689	108,236	38,453
Chungcheong Region	58,858	42,718	16,140
Chungnam Province	49,332	30,467	18,865

Note: *I borrowed Kwon and Kim(2002)'s definition on the knowledge-based manufacturing sector to define the high-tech manufacturing sector.

Source: Computed by author from the Establishment Survey Database (<http://ups.kosis.kr>).

Table 3 _ Gross Regional Domestic Product Share by Selected Region, 1985-2006

Regions	1985	1995	2006
Korea	100	100	100
Capital Region	43	48	48
Seoul	25	25	23
Gyeonggi Province	14	18	20
Chungcheong Region	10	10	11
Chungbuk Province	4	3	3
Chungnam Province + Daejeon	6	7	8
Yeongnam Region	31	27	27
Busan	8	6	6
Daegu	4	4	3
The Other Regions	16	15	14

Source: Computed by author from the Korea Statistics Information System (<http://kosis.nso.go.kr>).

prefer the Greater Capital Region²⁾, a high-cost location where they must pay more for production factors, for their mass production base. It is understandable that their headquarters and R&D divisions are seated near Seoul, because those corporate functions tend to put more weight on a set of noneconomic factors, such as pre-existing relational assets, specialized professional services, and high-quality human resources, than on explicit cost savings. But why should this

2) In this paper, I refer to the Capital Region and its neighbor Chungnam Province collectively as the Greater Capital Region.

also hold true for standardized manufacturing processes, which do not seem to have a high demand for high-quality human resources or specialized professional services, even if they are for high-tech products?

This paper explores the puzzle in detail with emphasis on the role of high-quality human resources³⁾ in the high-tech manufacturing process. Although it may be commonly argued that the spatial concentration of the high-tech manufacturing sector in Korea is closely related to that of high-quality human resources, a causal link between the two phenomena has not yet been firmly established. This is because few studies have answered the following two questions: (i) how does the manufacturing process for high-tech products differ from that for non-high-tech goods?, and (ii) why do high-tech manufacturers, in contrast with their non-high-tech counterparts, need high-quality human resources for their mass production lines? Although some studies have explored the location pattern of corporate R&D and its incentives in detail, they have not gone further to answer these questions (e.g., Kwon. 1995; Lee. 2002; Park. 2006). This research is motivated by the need to fill this missing dimension in the existing literature.

II. Literature Review

Where do high-tech industries locate? In contrast to the neoclassical approach based on the cost minimization and profit maximization framework, new location theories tend to emphasize culture, relational assets, and institutions that are embedded in specific locations. Piore and Sabel (1984) introduced the concept of flexible specialization, a reflection of merits of the traditional craft production system on the Fordist mass production system, as an alternative paradigm to Fordism. Succeeding scholars gave further attention to two core elements of a flexible specialization model, industry-wide division of labor and inter-firm cooperation, in explaining location patterns and incentives of high-tech firms. The region, a continuous territorial space that accommodates a group of specialized firms with high economic complementariness, came to stand out as a basic spatial unit of production (Storper. 1997), where transactions costs can be minimized (Scott.1988) and various inter-firm cooperations and informal social interactions can be successfully coordinated and sustained (Saxenian. 1994).

A body of literature underscores a higher possibility of innovation as a primary reason why high-tech firms tend to geographically agglomerate. Knowledge is one of the most crucial

3) I use the term "high-quality human resources" to refer to those who are essential for either corporate management or R&D functions. They often have graduate degrees and rich experience in their professional field.

production factors in high-tech sectors, and in-house capacity for innovation, an ingenious combination of existing knowledge, forms a high-tech firm's core competency (Barney, 2007). On the one hand, high-tech firms prefer where they can benefit from rich relational capital, as they need frequent social interactions to access tacit knowledge and constant mutual learning to improve their innovative capability. Innovation seldom appears in isolation, as valuable knowledge is rarely available for market transactions in a timely manner, and often takes a tacit form, which is hardly codifiable and transferable (Amsden, 2001; Nelson, 1987). This point is also stressed by studies that take the systems approach to innovation—whether regional, national, or sectoral (Asheim, 1996; Breschi and Malerba, 1997; Cooke, 2001; Freeman, 1987; Lundvall, 1992). On the other hand, high-tech firms prefer locations where innovation-encouraging environment is deeply embedded. Long-lasting relational capital matters for high-tech firms, as innovation is a continuous process, not a one-shot game. A more complete form of innovations appears, when “radical” innovations, delinked from old legacy, are incessantly complemented by subsequent “incremental” innovations (Freeman and Soete, 1997).

A set of studies discuss firm location and its incentives from economic globalization and spatial division of labor perspectives. Vernon (1966) theorized that as a product became mature and more competitors existed in the market, rents from technological monopoly would decrease, while pressure for cost reduction would rise. As a result, place of its production would shift gradually from the core to the periphery. Despite an increasing attention to non-physical factor inputs such as knowledge, recent literature still sees location-specific factor conditions, as well as market penetration, as a key incentive for a firm's relocation and expansion strategy (Shatz and Venables, 2000). A similar picture of spatial division of labor also appears in a series of world city studies (Friedmann, 1995; Taylor, 2000). In contrast to a pro-globalist view of economic deterritorialization (e.g., Ohmae, 1999; Friedman, 2005), world city researchers argued that forces of global economic integration would strengthen, not weaken, the existing patterns of spatial division of labor on a national and global scale. With increasing globalization, corporate headquarter functions tend to be concentrated further in existing centers, and hierarchy among cities becomes clearer (Sassen, 2001). Also, globalization never decreases the importance of corporate home base, as a firm's competitive advantage is created through interactions with location-specific factor conditions, but these conditions cannot be easily recreated in other locations (Porter, 1990). In fact, most high-tech leaders still keep their core competency in management and R&D in their home base (Amsden, et al. 2001).

In sum, the literature review of this section provides us with the following implications on high-tech firms' location. First, core competency of high-tech firms such as in-house

technological capabilities is often formed through active and continuous interactions with various external actors, but location-specific factor conditions, which are external to the firms but essential in creating their core competency, are hard to be emulated by other locations. Second, a large fraction of core competency, thus, tends to reside in corporate home base, and its location pattern is relatively robust to external shocks. Finally, high-tech firms, however, are likely to increase outsourcing for their non-core corporate functions such as labor-intensive manufacturing processes, or to relocate those activities to the place where they can take advantage of lower cost factors of production.

III. Hypothesis and Methodology

Even in the high-tech sector, a substantial fraction of the manufacturing process is quite labor-intensive, and is far from the manufacturer's core competency (Sturgeon, 2002). Apple's hit item iPod was developed and designed in California, but its actual production and assembly processes were done outside the firm's home base by various foreign electronics manufacturers. There are also a substantial number of semiconductor manufacturers, which outsource part of the manufacturing function (most notably, wafer manufacturing process) to foundry firms or operate assembly plants in low-cost locations. These examples coincide with the implications drawn from the previous section's literature review.

This is not the case for Korea, however. Until recently, the Greater Capital Region has been more successful in attracting high-tech manufacturing plants than the rest part of Korea, though the former does not necessarily provide lower cost factors of production. Why is this so?

I hypothesize that Korea's leading high-tech manufacturers, which are often large corporations that depend for sources of innovation little on external inter-firm networks⁴⁾, need close organizational and spatial distance between their own R&D and manufacturing divisions, and thus the location of the sector's manufacturing plants depends on the location of its R&D workforce. To test this hypothesis, I took a qualitative approach based on a case study of Samsung Electronics (SEC). I used various secondary data, both published and unpublished documents, for the study of the firm's history. For primary data collection, I visited SEC's Suwon and Giheung R&D and manufacturing complexes in 2006 and conducted open-ended in-depth interviews between 2006 and 2007, complemented by multiple follow-up email interactions, with four SEC engineers and

4) For example, as of 2004, Samsung Electronics alone accounted for 40 percent of the total R&D investment made by all the firms listed on Korea's stock exchange, and the firm's R&D department hired more graduate degree holders than any single university in Korea (Cho, et al. 2005).

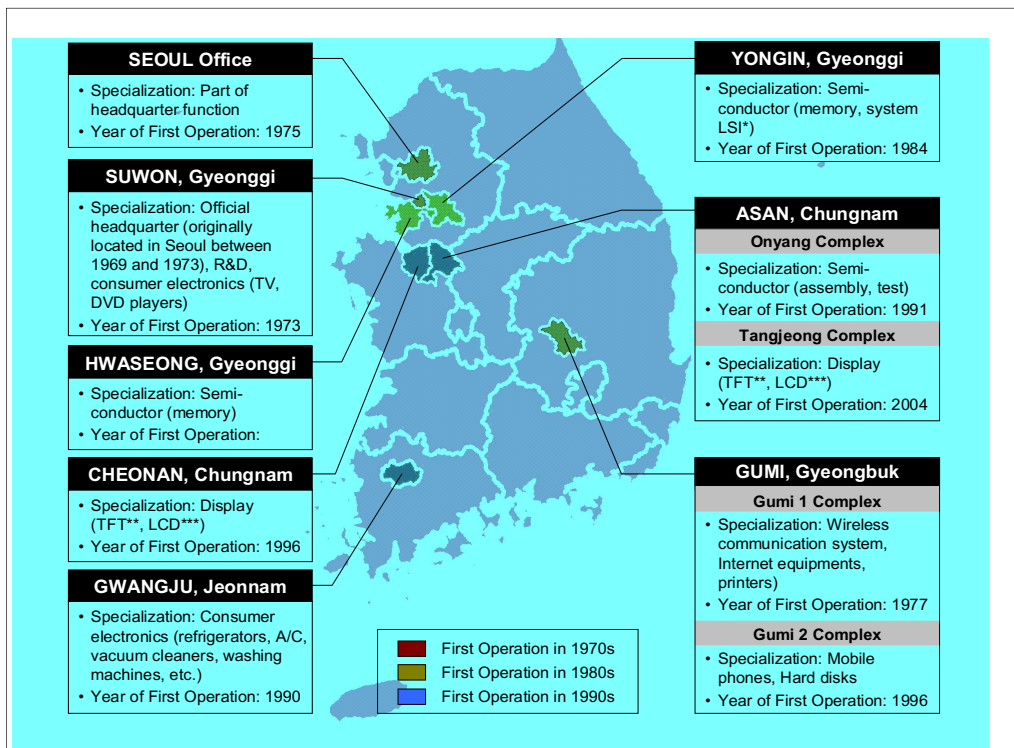
researchers, one Samsung Everland mid-level manager, one management board member of Mirae Asset (the Real Estate Investment Division), and one research fellow of the Samsung Economic Research Institute.

I chose SEC for a case study subject for two reasons. One is SEC's importance in Korea's economy. SEC is one of the largest Korean firms in terms of total assets, annual sales, and profits. Also, in terms of employment, SEC's domestic divisions alone, which have also greatly influenced the geographical location of its 1,200 (or more) primary and many more secondary supplier firms, employed around 70,000 workers as of 2005 (Kang, 2005). In this sense, SEC is a prism through which we can observe Korea's economy. The other reason is that SEC is a high-tech manufacturer, for which both R&D and manufacturing divisions are equally crucial. As of 2004, SEC alone accounted for 16 percent of Korea's total exports and 40 percent of the total R&D investment made by all the firms listed on Korea's stock exchange (Cho, et al. 2005). In other words, SEC consists of giant divisions for innovation and mass production and thus makes it feasible to examine location patterns and incentives for both knowledge-intensive and standardized production activities.

IV. A Case Study: Samsung Electronics

SEC was founded in Seoul in 1969. But with the opening of its first manufacturing plant for consumer electronics, the firm's headquarters were resettled in Suwon, Gyeonggi Province, in 1973. Suwon remained SEC's headquarters for over two decades until 2007. As of 2006, SEC had large manufacturing bases in seven cities (Figure 1). The Suwon complex included the headquarters and plants for consumer electronics and digital media. The Hwaseong, Yongin, and Asan complexes produced semiconductors, while the Yongin and Cheonan complexes manufactured display equipment. The Gumi complex, once the national mecca of the electronics industry, specialized in mobile communication and computer equipment. Finally, the Gwangju plant produced white goods such as refrigerators and washing machines.

Three decades ago, SEC's major divisions were seated in two locations. The firm's headquarters, research centers, and main manufacturing plants for consumer electronics were located in Suwon. The Gumi manufacturing complex specialized in producing office telecommunication devices such as analog switching systems, phones, and fax machines. But since then this location pattern has changed in a way that reduces the degree of geographical concentration of local production bases. SEC relocated a large fraction of its production bases for consumer electronics from Suwon to Gwangju and to other developing countries such as China, and further concentrated its R&D functions in Suwon. Most of SEC's manufacturing investments during the last two decades have

Figure 1 _Geographical Distribution of Samsung Electronics' Manufacturing Complexes, as of 2007

Note: *LSI = Large-Scale Integration (circuit); **TFT = Thin Film Transistor; ***LCD = Liquid Crystal Display.
 Source: Created by author.

been made in other cities in the Capital Region or its neighboring provinces, and not to the other manufacturing center, Gumi, despite little evidence of diseconomies of agglomeration in Gumi.⁵⁾

One puzzle arises from the situation described above, namely, why SEC has preferred the Greater Capital Region to Gumi for manufacturing investment in its more recent businesses like the semiconductor and display panel sectors. At present, SEC spatially separates R&D and manufacturing functions for mobile phones: R&D is done in Suwon, while manufacturing is done in Gumi. In a certain sense, this locational pattern makes good sense from an economic perspective, because it is an appropriate spatial reflection of each city's comparative advantage. But the locational pattern is different for semiconductors and display panels. Despite the high costs of production factors and various policy disincentives, such as a strict

5) For example, wage levels in the manufacturing sector (26 million Korean Won per worker and per year in 2004) and population (608 persons per km² in 2006) in Gumi are no higher than those in comparable industrial cities in the Capital Region (34 million Korean Won and 1,098 persons for Yongin; 23 million Korean Won and 4,668 persons for Ansan; 28 million Korean Won and 836 persons for Pyeongtaek; and 26 million Korean Won and 417 persons for Hwaseong — all as of 2004).

Source: the City of Gumi (<http://gumi.go.kr/sogae/sub103.html>) and the Province of Gyeonggi (http://www.gg.go.kr/0502new/global/about/statistics/stc03/1175823_850.html).

government-controlled manufacturing investment quota for the Capital Region, SEC chose the Capital Region or its proximity to be the manufacturing locations for its semiconductors and display panels. Why did this happen?

Another fact that has attracted my attention is that Samsung Group recently moved the headquarter functions of all its information and communications technology (ICT)-related subsidiaries, including SEC, to Samsung Town in Seoul's Gangnam District, which was completed in 2008. This decision seems to be worth thoroughly examining, given that Suwon, where SEC was headquartered, is already located in close proximity to Seoul (around 26 miles). Furthermore, this fact is hard to reconcile with the fact that SEC's business operations have been expanding spatially on both a national and a global scale. Why did Samsung Group make this decision?

1. Initial Locational Incentives

SEC began its business in Suwon for several reasons (SEC, 1999). First, Suwon had sizable land reserves for its initial manufacturing complex. Second, Suwon lay in proximity to Seoul, Korea's political and economic center. SEC's management needed to visit Seoul frequently to meet high central government officials and foreign business partners for purposes of either raising capital or engaging in technology transfer.⁶⁾ In addition, Seoul was the biggest domestic market for consumer electronics, which SEC initially targeted. Thus, Suwon's excellent access to Seoul was of great merit. Third, Suwon, which the Seoul-Busan expressway passes through, also provided good access to Busan, Korea's major international seaport. Suwon was seated where parts supply and final-goods exports could be managed without serious difficulty. Finally, electricity and water were well served for industrial use in Suwon.

But those initial locational advantages in Suwon created an inertial force. SEC further concentrated its manufacturing bases in Suwon, and even moved its headquarters from Seoul to Suwon to improve efficiency in communication between headquarters and the manufacturing divisions. But not all the firm's manufacturing divisions were settled in Suwon. The firm's first production base for industrial electronics (e.g., analog switches, phones, and fax machines) was established in Gumi, not in Suwon. Why did SEC decide to disperse its manufacturing divisions geographically in two places by production item (consumer electronics vs. office products)?

This geographical dispersion was not SEC's original intention, but is instead related to the

6) Initially, Samsung Electronics formed a joint venture with Sanyo Electronics of Japan in order to enter the electronics sector.

firm's history. In 1977, the Korean government established the Korea Telecommunication Company (KTC), which specialized in producing electronic switching systems (ESS) to meet soaring domestic demand for phone service. In two years, the KTC completed its main plant in the Gumi industrial complex, which at that time had an Asia-high production capacity for ESS (660,000 circuits per year). The Korean government gave political consideration to Gumi for locating the KTC plant because, in accord with the Comprehensive National Territorial Plan, it wanted to raise the city's profile for becoming the mecca of Korea's electronic industry. In 1980, the KTC was merged into SEC according to the government's privatization policy and became the matrix of the firm's telecommunication business. Thus, the firm's geographically bisected production system, one in Suwon and the other in Gumi, was formed without regard to the firm's own will. The Gumi complex still takes full charge of producing Samsung mobile phones and other telecommunication devices.

As time went by, SEC's manufacturing bases came to be further spatially dispersed. Main semiconductor plants have been built in Yongin and Hwaseong since the mid-1980s, and display-panel manufacturing complexes (LCD and TFT) have been developed in Cheonan and Asan since the mid-1990s. Most of the consumer electronics plants have been relocated from Suwon to Gwangju or to other developing countries as a result of limited land reserves for new plants and rising wages. Here a puzzle is why the manufacturing investments of SEC's cutting-edge sectors (e.g., semiconductors and display panels) went to other cities in the Capital Region or in the Chungcheong Region and not to Gumi, which already had SEC's manufacturing clusters and where substantial land reserves and low-waged workers still existed.

The semiconductor industry needs several special conditions for its location. First, the industry needs extremely clean air, because semiconductors are sensitive to even invisibly minute dust. Second, the industry needs places without noise and vibration. Even small noises or vibrations can interrupt the production of semiconductors, which requires micron-level precision, and thus the plant location should be outside the visibility range of highways and railways. Third, the industry should be located close to high-quality human-resource reserves. Yongin and Hwaseong in the Capital Region, which satisfied the above three conditions, were the best places for establishing the semiconductor industry, in addition to their having large developable lands (SEC, 1999).

According to several interviewees, SEC originally wanted to build display panel plants in the Capital Region as well, mainly for considerations of high-quality human resources.⁷⁾ As of 2001, the Capital Region accounted for 85.4 percent of Korea's top 20 universities and around 90 percent

7) Interview results.

of their students and faculty members (Park and Kim, 2002: 107). But strong government regulations for local manufacturing investment, which targeted the Capital Region, prohibited the firm from building those plants within the region. So SEC avoided these regulations by building display manufacturing clusters in Cheonan and Asan, outside of but adjacent to the Capital Region. In contrast, it is quite difficult to find highly educated workers in Gumi, which is a main reason why the city has failed to attract R&D facilities (Kwon, et al. 2004). A large number of highly educated workers in the Capital Region are reluctant to move to local areas like Gumi, which are too remote from Seoul, for a number of reasons, such as their children's education or the socio-economic infrastructure.

2. Why High-quality Human Resources Matter for Semiconductors/Display Panel Manufacturing?

Why then are high-quality human resources (R&D work forces) so important in semiconductor and display panel “manufacturing” plants? The most distinct characteristic in SEC's semiconductor and display panel divisions is that R&D functions are spatially integrated within manufacturing complexes. SEC performs R&D for semiconductors within its Hwaseong/Giheung manufacturing complex, and not in Suwon, and similarly operates its display panel R&D center within its Cheonan/Asan manufacturing plants. This locational pattern contrasts with the firm's mobile phone production division, which geographically disintegrates R&D (in Suwon) from manufacturing (in Gumi). To answer this question, we must understand the key nature of R&D in semiconductor and display panel production.

Both the semiconductor and display panel (SC/DP) sectors confront extremely short product life cycles. For example, market-leading memory chips, as Hwang's law⁸⁾ predicts, have changed surprisingly fast, from 128 megabyte dynamic random access memory (DRAM) in 2000 to 256 megabyte DRAM in 2001 to 512 mega-byte DRAM in 2004 (Chang, 2008). The largest TFT-LCD panels have also upgraded quickly, from 57 inches in 2003 to 65 inches in 2004 to 82 inches in 2005. In these industries, how early and fast and how economically a firm can produce new products are as important as the new technologies themselves.⁹⁾

In other words, process innovation is as important as product innovation in the SC/DP sector. To continue improving existing manufacturing processes as well as developing new products is a core responsibility of the sector's R&D department. Researchers and field workers need frequent

8) Hwang's law refers to the tendency that the transistor density of semiconductor chips doubles every 12 months.

9) Interview results.

interactions to discuss the merits and shortcomings of the existing production lines. It is crucial that researchers and engineers maintain first-hand monitoring of production facilities to understand existing problems. Standing meetings in the production line, which researchers, line engineers, and decision makers are required to attend together, are often called by the firm's chief executive officer (CEO).¹⁰⁾ Thus, researchers also need to be physically close to the production line. In fact, of SEC's five divisions, only the Semiconductor and LCD divisions have R&D offices and manufacturing plants within the same complex.

In addition, high pressure for cost savings requires a special R&D function for the SC/DP sector that is seldom found in traditional manufacturing sectors, namely, to find other purposes for existing equipment. The SC/DP sector by nature requires huge capital investment in a timely manner. When SC/DP manufacturers launch newer generational products in the market, they do not simply abandon production lines for older generational products. To minimize sink costs, they must find a way to produce newer generational products by using existing equipment.¹¹⁾ This is a job for the R&D department. Of course, this task can be completed more successfully and quickly when R&D is done in proximity to the production bases.

Problem solving and maintenance in production lines are also crucial responsibilities for the R&D divisions of the SC/DP sector.¹²⁾ Given that this sector is highly time sensitive, it is not surprising to have one generation product in production while the next generation product lines are already being built. To win the speed and cost war in the global market, market-leading firms often purchase the most advanced capital goods available in the market before their competitors. By doing so, they can save huge financial costs—they not only employ the most up-to-date cost-saving technologies, but they also enjoy huge discounts from capital goods suppliers to compensate for the low stability and potential malfunctioning of early products (Shin and Jang, 2006). For this reason, various technical problems exist in relatively new product lines for semiconductors and display panels. Close cooperation between the R&D division and field engineers is necessary to solve these issues as early as possible.

Then what about the case of mobile phone production? Mobile phones and semiconductors/display panels have critical differences, although they are both considered high-tech items. First, in mobile phone production, product innovation matters more than process innovation. Mobile phone production lines, once completed, do not need to be upgraded as

10) Interview results.

11) Interview results.

12) Interview results.

frequently as those for semiconductors/display panels, partly because the former are quite labor-intensive compared to the latter. Mobile phone producers compete on the basis of ingenious combinations of standardized and modularized parts components (differentiated designs or functions) within the basic architecture, such as code division multiple access (CDMA) or global system for mobile communication (GSM) platforms. In the mobile phone sector, standardized product platforms and labor-intensive manufacturing processes substantially reduce the need for face-to-face contacts between the R&D department and manufacturing plants; thus, a higher proportion of interactions between both departments can be substituted by ICT in the mobile device business. In addition, the mobile phone is a final good, while semiconductors and display panels are intermediate products. Assembly and raw materials/parts procurement are more crucial for the former item. Thus, the mobile phone business is more sensitive to labor and logistics costs. This fact may partly account for why SEC still produces mobile phones in Gumi.

3. Geographical Dispersion of Manufacturing Plants

SEC currently operates a total of 90 global corporation bodies, including 24 manufacturing complexes.¹³⁾ The firm has continuously relocated its production bases for matured consumer electronics from Suwon to Gwangju as well as to other developing countries. Also, the firm has built semiconductor assembly lines in China, as well as manufacturing plants for mobile phones in Brazil, Spain, and several other places. On the one hand, this globalization strategy helps the firm reduce production costs by giving it access to abundant low-wage labor forces while helping

Table 4 _ Selected Items from SEC's Annual Profit and Loss Statement, 2000-2007

(Unit: billions of Korean Won)

	2000		2002		2004		2006		2007	
Total Sales*	34,284	100	40,512	100	80,629	100	85,425	100	98,507	100
Domestic Sales*	10,903	31.8	12,148	30	13,051	16.2	13,644	16	14,173	14.4
Mean Inventory**	2,802	8.2	2,272	5.6	5,803	7.2	6,753	7.9	7,968	8.1
Transportation Cost	286	0.8	395	1	1,415	1.8	1,591	1.9	1,803	1.8
Wages	370	1.1	536	1.3	1,711	2.1	1,841	2.2	2,085	2.1

Note: *Internal transactions between SEC and its domestic/global subsidiaries are excluded.

**Numerical mean of inventory values between beginning and end of each year.

Numbers in parentheses indicate percentage of each item to each year's total sales value.

Source: Adapted and calculated by author from *Samsung Electronics Annual Report* each year.

13) The official website of Samsung Electronics (<http://www.sec.co.kr>), as of March 17, 2006.

it to avoid trade barriers (e.g., tariffs). On the other hand, this strategy can increase logistics costs owing to geographically dispersed production bases. Thus, the globalization strategy needs to consider both cost-reducing factors and cost-augmenting variables.

To effectively manage logistics costs, SEC by 2002 had established a globe-wide corporate supply chain management (SCM) system, which covers the firm's 24 manufacturing complexes and 49 sales/distribution-specialized regional offices (Lee, et al. 2002). The SCM system, which aims to optimize time and costs for the process order-purchase-production-logistics, appears to provide SEC an effective tool in controlling its logistics/transport costs at a reasonable level. After introduction of the SCM system, SEC's average inventory cycle was reduced substantially, from eight weeks in 1997 to three weeks in 2001 (Lee, et al. 2002), while the firm's mean annual inventory value remained relatively stable at around 8 percent of annual sales between 2000 and 2007 (Table 4). Although the firm's total transport costs for products increased from 0.8 percent of annual sales in 2000 to 1.8 percent in 2007, this was mainly because SEC's exports soared from 2.1 times its domestic sales to 4.1 times during the same period.

Korea's localities other than the Capital Region should regard the fact that firms now have fewer constraints on their globalization strategies thanks to SCM as a serious threat to their economies. As explained earlier, high-tech manufacturing bases prefer the Capital Region or its neighbors, where firms can easily acquire high quality human resources. Labor cost is not a major determinant for location in the high-tech sector. But the opposite situation holds for matured goods producers. The non-high-tech sector is generally price sensitive and faces strong pressure to reduce production costs. If firms can manage logistics costs effectively by introducing SCM, then labor costs will be a more critical determinant than logistics costs for the location of standardized production activities. In this situation, Korea's non-Capital Region economies are sandwiched between the Capital Region domestically and lower-income developing countries globally. On the one hand, they are losing domestic competition for high-tech manufacturing jobs to the Capital Region, while on the other they often fail to bid competitive wages for price-sensitive manufacturing jobs against low-income developing countries.

4. Geographical Concentration of the R&D Divisions

At present, around a third of SEC's total employees are working in R&D activities. In the past, this huge R&D workforce was scattered among Seoul, Suwon, Yongin (Giheung), and Seongnam (Bundang). Spatially dispersed R&D activities were neither efficient nor productive because physical distance often hindered cooperation among R&D offices. If each office were specialized

for a different technology, fewer interactions among R&D offices would imply fewer possibilities for innovation. One dominant trend in the current global electronics market is digital convergence. For example, the mobile phone is evolving into a synthetic digital device by merging the functions of the MP3 music player, the digital camera, the television, and even the computer. To produce a new mobile phone model, the R&D departments of both the ICT and the Digital Media divisions should cooperate closely with one another from a very early stage of development. Given that the mobile phone uses special types of semiconductors and display panels, the project may also need some inputs from the Semiconductor and LCD divisions. In addition, some divisions share a number of common technologies, such as those for semiconductors and LCDs. Thus, SEC has needed to concentrate its R&D activities in one location.

Can these face-to-face interactions among R&D workers be replaced by ICT-mediated communications? None of the interviewees were positive on this question. Researchers and engineers exchange highly tacit knowledge several times even in a day. They cannot fully explain what they know and what they want to know only through the phone, the Internet, or the screen. All four engineers I interviewed said they could not even imagine ICT-organized idea meetings. With one voice they emphasized physical proximity for interactions.

In response to these needs, SEC relocated the R&D departments of both the ICT and Digital Media divisions (as well as the Consumer Electronics division) to two buildings in the Suwon Complex in 2001 and 2005, respectively.¹⁴⁾ Part of the semiconductor R&D department also moved to Suwon. In the intermediate future, SEC plans to particularize the Suwon Complex for R&D activities by relocating existing manufacturing plants for consumer electronics to other areas. Reasons why SEC should concentrate R&D activities in Suwon include the following: (i) Suwon's symbolic position as the hometown of SEC; (ii) available land reserves in the Suwon Complex; (iii) Suwon's easy accessibility to Seoul (i.e., ease of attracting high-quality human resources); and (iv) Suwon's proximity to both the semiconductor and LCD complexes.

5. Geographical Concentration of Corporate Headquarters Functions

Recently, Samsung Group completed the spatial reorganization project of its ICT-related subsidiaries (especially the management and control functions). By 2008, the headquarters of SEC, Samsung Display Interface (SDI), and Samsung Electro-Mechanics (SEM) had been relocated to

14) As mentioned earlier, R&D offices for the Semiconductor and LCD Divisions remain seated in the Yongin (Giheung) Complex and the Cheongan-Asan Complex, respectively.

three new buildings, called Samsung Town, in Seoul's Gangnam area. One question is why Samsung Group chose to relocate SEC's headquarters from Suwon to its present location, although the two localities are close enough (around 26 miles). In addition, why would Samsung Group want to concentrate geographically the headquarters functions of its ICT-related subsidiaries in one location?

One interesting fact to emerge from my interviews is that all five of the Samsung-related interviewees recognized SEC's Seoul Taepyeongro office as the firm's headquarters, although SEC was officially headquartered in Suwon when the interviews were conducted. According to the interviewees, all important decisions for SEC were made in its Seoul office and not in its official headquarters in Suwon. Whenever an important issue arose, the CEO of SEC called a board meeting in the Seoul office. It was not uncommon for directors and key management board members, many of whom had two offices (one in Seoul and the other in a local manufacturing complex), to travel between their offices in Seoul and those outside the city by helicopter to save time. The Seoul Taepyeongro office was first established in 1975 to more effectively manage foreign branches and more easily raise funds (SEC, 1999). At that time, Seoul was not only Korea's socioeconomic center, which provided a superior business environment to that of any other city in Korea, but also its political center, where most of Korea's key central government agencies were settled. The situation remains the same. Seoul is still the best domestic location for corporate headquarters, where firms have an advantage in accessing various private and public resources. No other city in Korea can compete with Seoul in the quality and quantity of its transport and ICT infrastructure, professional producer services, human resources, and various business/culture/leisure facilities, or in accessibility to public services and political power (for lobbying purposes).

Gun-Hee Lee, the then-president of Samsung Group, said that Samsung Group needed Samsung Town to increase the speed of the decision-making process (Chosun Daily Newspaper, January 26, 2005). SEC's projects often need some involvement of other Samsung ICT affiliates. For example, SEC's hit item for the year 2000, a 34-inch flat panel TV model, was jointly developed from earlier stages in cooperation with three other Samsung subsidiaries, SDI, SEM, and Samsung Corning (Lee, et al. 2002). Group-level issues of this kind are discussed and determined in biannual presidential board meetings. Further details on these issues are then discussed among directors or working-level officials at least monthly if not more often. The need for joint collaboration among ICT subsidiaries continues to increase. But before 2008, the headquarters of Samsung's ICT subsidiaries were geographically dispersed. SDI was headquartered in northern Seoul, for example, and SEM was in Suwon. Samsung Group wanted to eliminate this

inefficiency, which interfered with speedy and frequent interactions among its ICT subsidiaries.

At the same time, the corporate headquarters and R&D offices also need frequent face-to-face interactions to fine-tune headquarters-drawn big pictures and researcher-embodied details. Until the Samsung Town project was completed, it took over two hours by car, mainly because of chronic traffic jams, to commute one way between SEC's Seoul office and the Suwon Complex, although their physical distance is very short.¹⁵⁾ The commuting time between Samsung Town and the Suwon Complex has now been reduced to less than one hour.¹⁶⁾

In sum, crucial corporate decisions still depend on face-to-face interactions in SEC's headquarters. It would be unrealistic to expect ICT to substitute perfectly for these needs. The firm's headquarters still prefer pre-existing socioeconomic centers, and physical distance among the relevant headquarters offices remains important for their active interaction. This is why Samsung Group recently decided to make an ICT subsidiary headquarters cluster in Seoul. With Samsung Town, Samsung Group looks forward to a speedier decision-making process and a greater synergy effect among its ICT subsidiaries.

V. Conclusions

I have discussed why the high-sector manufacturing function has been increasingly attracted to the Capital Region or its proximity rather than elsewhere in Korea. This SEC case study reveals two important findings. One is that high-tech sector manufacturing jobs, as well as corporate headquarters and R&D functions, are more globalization proof than price-sensitive ones. As exemplified by SEC's case, high-tech manufacturing jobs (SEC's SD/DP divisions) still remain in Korea or have been newly created, while price-sensitive manufacturing jobs (SEC's home electronics division) continue to leave Korea for low-cost locations. Now firms, with ICT-based SCM techniques, can manage rising transport and logistics costs, caused by the increasing geographical dispersal of their production bases, more efficiently than before. The non-Capital Region economies, as a result, confront huge pressure to expand the high-tech portion of their local manufacturing bases.

The other finding is that high-tech manufacturing bases in Korea are located where there is a large pool of high-quality human resources because of the strong need that high-tech producers have for spatial integration between their R&D and mass production divisions. For example,

15) My own experiment at non-rush hour times on a weekday.

16) Based on the SEC-operated commuting bus schedule table (Yangjae-Suwon Route), which was provided by an interviewee.

process innovation is as important as product innovation for the R&D department of SEC's SC/DP divisions. Both researchers and engineers should have a thorough, often first-hand, knowledge of existing manufacturing lines, and they should learn from field engineers or workers about existing or potential problems that could be improved so that they can come up with solutions for how to produce the same product at a lower cost, or how to produce various products using the same equipment or production lines. In addition, because industrial sectors of this kind are highly time-sensitive, they will often try to introduce more advanced technologies or machines, though not yet fully tested, to their production lines earlier than their competitors. Thus, it is not uncommon for new production lines to have various technical problems, and sometimes they must be modified substantially. Because these technical problems need to be solved as quickly as possible, a close spatial integration between the R&D and manufacturing divisions is a big plus.

In Korea, this strong need for such integration in the high-tech sector has had a negative impact on interregional economic divergence, because most of the high-quality human resources, in contrast with unskilled or semi-skilled workers who can be easily found anywhere in Korea, are concentrated around Seoul. Thus, firms have a strong incentive to build high-tech manufacturing bases near Seoul where they can effectively conduct R&D activities. In sum, access to high-quality human resources affects R&D locations, while R&D locations in turn determine high-tech manufacturing locations.

In conclusion, I believe that an effective interregional convergence mechanism in Korea can be created with an effort for a spatial redistribution of domestic high-quality human resources. In his bestselling book, Florida (2003) argues that most declining local economies in the United States cannot be revitalized without hosting the "creative class" in the first place. My conclusion shares the same insight with his, although he defines the "creative class" more broadly than high-quality human resources that I focus on in this paper. It seems clear to me what non-Capital Region economies need to do first to build a strong high-tech manufacturing base: that is to create a solid local pool of national talent. High-tech firms will not be much interested in locations where access to high-quality human resources is hard, even though production costs may be low. In this sense, regional policies that target people (e.g., economic subsidies for high-quality human resources) could be more effective than those that focus on firms (e.g., tax incentives for new manufacturing plants) as an initial step for creating interregional convergence dynamics.

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ABSTRACT**Spatial Integration of Corporate R&D and Mass Production Activities in High-tech Manufacturing: A Case Study of Samsung Electronics**

Keywords: Korea, Regional Disparity, Samsung Electronics, High-tech Manufacturing

This paper argues that the high-tech manufacturing sector's location pattern in favor of the Capital Region is a key variable that can explain both divergent local manufacturing performance and Korea's monocentric economic geography. My major findings from the case study of Samsung Electronics (SEC) can be summarized as follows. First, high-tech firms have strong incentives to integrate their R&D and manufacturing divisions spatially, because this can encourage process innovation and save substantial time for problem solving in existing production lines. Second, high-quality human resources, essential for corporate management and R&D activities, are difficult to access outside the Capital Region. Thus, uneven geographical distribution of high-quality human resources, combined with the strong need for spatial integration between R&D and mass production divisions, caused the uneven distribution of the high-tech manufacturing sector. My findings in this paper suggest that (i) non-Capital-Region economies will be able to attract high-tech manufacturing jobs only after creating a sizable local pool of national talent, and (ii) people-targeting regional policies can be more effective than firm-targeting policies in creating the dynamics for interregional convergence.

**첨단제조업분야 연구개발 및 대량생산 활동 간의 공간적 통합:
삼성전자 사례를 중심으로**

주제어: 지역격차, 첨단제조업, 삼성전자, 고급인력

본 논문에서는 첨단제조업부문의 수도권 지향 입지성향과 심화되고 있는 지역격차의 연관성을 삼성전자의 사례와 함께 분석하였다. 주요 발견사항은 다음과 같이 요약될 수 있다. 첫째, 삼성전자와 같은 첨단제조업체들에게는 연구개발부서와 제조업공정을 공간적으로 통합하고자 하는 강한 동기가 존재한다는 점이다. 이유는 두 부서의 공간적 통합을 통해 생산공정상의 혁신을 장려할 수 있고 속도경쟁으로 말미암아 흔히 발생하는 공정상의 문제점을 보다 빠른 시간 내에 해결할 수 있기 때문이다. 둘째, 비수도권지역에서는 연구개발부서에 필수적인 고급인력에 대한 접근성이 떨어지고, 이러한 수도권 편향의 고급인력의 분포는 첨단제조업체들이 추구하는 연구개발 및 생산부서간의 공간적 통합전략과 맞물려 수도권 편향의 첨단제조업기반 분포라는 결과로 이어지고 있다는 사실이다. 본 연구결과가 국내 지역격차에 시사하는 바는 크게 두 가지로 (1) 지역고급인력풀을 늘리는 작업이 비수도권지역 첨단제조업기반 구축에 선행되어야 하며, (2) 이러한 작업에 있어 세금감면 등 제조업체들을 대상으로 펼치는 지역정책보다는 보조금 지급 등을 통해 고급인력의 지방정착을 유도하는 “사람을 대상으로 하는 지역정책”이 더 효과적일 수 있다는 점이다.