INDUSTRIAL RESTRUCTURING AND SPATIAL DEVELOPMENT IN THE KOREAN MANUFACTURING INDUSTRY, 1983-1993

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ABSTRACT

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This study examines the spatial aspects of industrial restructuring in Korea during the period of 1983 to 1993. Changes in industrial location, regional productivity, and spatial inequalities in location and productivity are analyzed using both descriptive and statistical methods. Analysis of changes in industrial location reveals a new trend of decentralization toward formerly less developed regions. Regional productivity shows a strong association with regional hierarchies. A trade-off relationship between industrialization and regional productivity indicates the importance of improvement of productive efficiencies in new industrializing areas. Analysis of spatial inequality supports the convergence hypotheses, both in terms of location and productivity. Thus, industrial restructuring provides an opportunity for more balanced territorial development in Korea.

To my parents for their dedication to my education

To beloved Daiok, my wife, Hosuk and Helen

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Chapter 1

INTRODUCTION

Problem Statement

Korean manufacturing, once considered the locomotive for the unprecedented rapid economic development of the country, has been undergoing significant structural changes since the late 1980s. Traditionally, the competitive advantage of Korean manufacturing industry has centered on labor, both quantitatively and qualitatively. Industrial development strategy relying on labor cost advantages is no longer considered a viable means for sustained economic development during this period of fierce international competition. The size of manufacturing employment has decreased since 1988 following three decades of expansion. Political democratization after the late 1980s, coupled with the widespread shortage of labor, has been followed by rapid wage increases. In a very short period, Korean manufacturing has witnessed the rapid erosion of one of its major sources of international competitiveness. Therefore, recent industrial restructuring could be understood as an effort to search for new sources of development. Expanded investment in research and development, introduction of advanced production systems and business organizations, and new locational trends exemplify such efforts (Kim, 1995; Park, 1995, Webber, 1995).

Industrial location has been an important determinant of spatial development in Korea. Industrial location has configured the geography of economic well-being of the country for the past three decades. Unfortunately, Korean industrialization has exhibited a classic example of polarized development, corresponding to a general pattern in most developing economies' spatial economy (Meyer and Min, 1987; Nam, 1990). Existing major urban centers, as well as selective growth poles, have been major beneficiaries of economic development. Most rural areas and cities in depressed regions have been the source of labor for the growing regions. Thus, regional economic disparities, with few exceptions, can be viewed as synonymous with disparities in industrial location. Lack of an industrial base has been considered a primary indicator of depressed areas when primary or tertiary activities cannot provide propulsive impetus for regional economies. With limited resources available for national economic development, industrial location became selective in utilizing locational advantages of certain regions. Thus, significant regional disparities have emerged since the initiation of industrial development in the early 1960s.

It is also argued that spatial inequality will exist in regional productivity. The basis of this statement is that insufficient socioeconomic infrastructure in less developed regions will affect those regions' capacities for technological development. In addition, spatial concentration of research and development facilities, institutions of higher education, and advanced business services is greater than that of industrial location (KRIHS, 1993).

Some conditions necessary for reducing spatial disparities, at least in terms of industrial location, have been developed since the late 1980s. Most importantly, a number of urban diseconomies have significantly reduced the attractiveness of urban areas as the locus of industrial activities. Rapidly rising land prices and land shortages, housing problems, high wages, severe traffic congestion, and environment regulations have forced urban industries to move beyond city limits, or even to foreign countries. In contrast, rural regions, with improved transportation and communication accessibility and abundant cheap land, have begun to attract industrial investment. Regional policies provided additional motivation for the dispersion of manufacturing industries by providing assistance and subsidies in various forms. There is an urgent need to investigate how industrial restructuring has affected spatial patterns and processes of industrial location, manufacturing productivity, and inequalities in location and productivity.

Research Purposes

This research will investigate the nature and processes of industrial restructuring in Korea, from a spatial perspective, during the span of 1983 to 1993. The research will focus on three aspects of spatial restructuring of manufacturing industry: location, productivity, and inequality. First, the research examines the changes in industrial location. Emphasis will be placed on the examination of the premise that recent restructuring has brought about deconcentration of industrial location. Locational decentralization has been considered characteristic of developed countries. The regional shift of industrial location from advanced regions toward less developed areas will be examined using the location quotient and regression analysis. Differential performance by different types of regions will be identified. A set of factors will be introduced and tested to explain locational changes.

Second, this study examines the effect of industrial restructuring on changes in regional productivity. If industrial restructuring has brought about the redistribution of production factors over space, regional productivity should have changed. Some regions might have lost employment but managed to compensate for this loss by capital investment as an alternative source of industrial growth, while others may have experienced growth in both employment and capital stock. Regional labor and capital productivity will be directly affected by these locational changes. In recent years, the importance of technological advances has been emphasized as a means to improve the quality of products and competitiveness. A growth accounting model will be employed to measure the technical improvement of production and explain the sources of growth in manufacturing output. Again, factors that are related to changes in regional productivity will be tested. The analysis of regional productivity will provide some answers about how Korean manufacturing industries have adjusted to a rapidly changing industrial environment.

Finally, this research addresses disparities in manufacturing location and regional productivity. The magnitude of spatial reallocation of production factors and resulting changes in regional productivity determine the extent of regional inequality. This study tests, in Korean context, the basic principles of two alternative approaches to spatial disparities. Neoclassical regional development theories, assuming free factor mobility within a capitalist market mechanism, predict the emergence of interregional convergence, whereas structural approaches, based on the principles of cumulative causation, argue that spatial disparities increase as a result of capitalist restructuring. Two indices of inequality and a simple regression model will be employed to test the theme of inter-regional convergence or divergence.

Significance of the Research

A dominant paradigm in the research of industrial location in developing economies, including Korea, has focused on spatial disparities. Spatial concentration or polarization, rather than decentralization or polarization reversal, characterizes the pattern of spatial development in developing economies. Although few scholars have proposed polarization reversal of population and industries in the context of developing countries', their evidence has largely been confined to areas in, or around, primary cities rather than whole nation (Storper, 1984; Townroe and Keen, 1984). It is no surprise that Korea was noted as an exemplary case of polarization reversal as early as in the 1970s, when Seoul, the capital city of the country, began to lose its national share of manufacturing employment (Richardson, 1980). However, if polarization reversal had really occurred, there would have been no need to implement strong industrial decentralization policies during the 1980s and 1990s.

On the contrary, regional development plans or national industrial location policies have assumed that manufacturing is far from evenly distributed over space (Kim and Mills, 1990). A series of government guided industrial location policies has been very effective in developing a group of industrial growth centers away from the Seoul metropolitan region. However, decentralization of industrial location, an important goal of the development of growth centers, for the most part, has been limited to urban areas and their surrounding rural counties (Lee and Choe, 1990).

This research focuses on the most recent spatial process of industrial location, specifically when the nation is losing manufacturing employment. The effect of industrial restructuring on industrial location, as well as regional productivity, is virtually unknown in Korea. In western developed countries, restructuring has brought about significant changes in industrial location and regional development. Such dramatic reconfiguration of industrial location might have not occurred in Korea, considering differences in the history of industrialization, industrial structure, labor market conditions, and technology. However, the rapidly changing international competitiveness of Korean industries will have impacts on communities where manufacturing is the primary source of regional development. In addition, changing regional factor market conditions for land, labor and capital inevitably alter regional potential for the locus of manufacturing industries.

New patterns of industrial location affect regional productivity through the distribution of production inputs and output between urban and rural areas, and between the center and the periphery. Productivity is considered one of the best measures of competitiveness. Thus, the productivity performance of regional industries is an important determinant of regional wealth and development. Literature focusing on regional productivity in Korea is hard to find.

Most existing productivity studies examine national and sectoral level data, accounting for the performance of Korean industry during the period of rapid growth between the 1960s and 1980s. The lack of regional studies is not limited to Korea, but is also true for other developing countries. The current study will contribute to the geographic literature by conceptualizing the relationship between changes in industrial location and productivity, especially in the context of developing economies. In addition, the incorporation of productivity into traditional geographic research agendas, such as location and inequality, will expand our understanding of spatial processes of industrial restructuring and their consequences for national industrial development.

The following three chapters review the theoretical background and empirical studies on the three key subjects of this research: industrial location (Chapter 2), regional productivity (Chapter 3), and spatial inequality (Chapter 4). Based on the review of literature, research hypotheses are developed and the methods of analysis are presented. Chapter 5 explains the spatial scope of the research and discusses data availability, problems, and procedures involved in addressing problems. Chapter 6 presents the results of the analysis. The last chapter provides a conclusion and proposes future directions of research.

Chapter 2

INDUSTRIAL RESTRUCTURING AND LOCATION CHANGE

Industrial Restructuring and Space

The history of capitalism has shown a sequence of development patterns based on different modes of production, which is often called the *regime of accumulation*. Industrial restructuring, from this viewpoint, can be understood as a response to structural crisis in capitalist development, whether it was caused by the fluctuation of business cycles or the fundamental limit of capitalism (Bradburry, 1985; Castells, 1985). Capitalist restructuring aims to restore profitability through a reorganization of the production process (Soja et. al., 1983). The shift toward a new production system results in a break in the secular trend of accumulation, although it is arguable whether the transition can be clearly distinguished in chronological order, or the shift occurs through the process of gradual adjustment (Beauregard, 1989). In general, industrial restructuring is characterized by rationalization of production process, reduction of employment, and a rise in productivity and profit rate (Vazquez-Barguero, 1990).

Each production system has its own geographical character. The spatial structure of the Fordist accumulation system (or Fordism) is associated with a series of great industrial agglomeration in core industrial regions. The main reason for this spatial concentration is to utilize economies of scale and scope, both internally and externally (Rodriguez-Pose, 1994; Scott, 1988b). The traditional spatial production system has dissolved into a new spatial system since the Fordist system entered into crisis during the late 1960s and early 1970s (Scott, 1988a; 1988b). A series of new industrial spaces has emerged away from traditional industrial complexes, reshaping the spatial system of production.

Literature from advanced economies reveals significant changes in spatial development during industrial restructuring (Noyelle, 1983; Scott and Storper, 1992). Recent locational change in manufacturing industry can be characterized by single word *decentralization*. New manufacturing locations include suburban areas of metropolitan centers, smaller cities and peripheral rural regions. In contrast, traditional industrial centers have experienced a significant loss of production employment (Keeble, 1976). The driving force for these locational tendencies was to reduce factor costs through lower labor and land costs in new industrial spaces. Thus, space is used as an instrument in the process of restructuring.

The geographical dispersion of manufacturing industry has been associated with increased capital mobility, plant closure and relocation, and the development of subcontracting networks (Soja, et. al., 1983). Increasingly footloose capital can be free from traditional locational constraints due to technological innovations in transport, communications, and production (Fainstein and Fainstein, 1989). Thus, flexible production sectors found in new industrial spaces are relatively independent of the agglomeration economies of old Fordist industrial centers, such as linkages to mass production complexes and labor skills (Storper, 1990). This locational independence has been the result of the new sectors' changed skill requirement of the labor force (Massey and Meagan, 1978).

Not all localities have benefited from the new locational tendencies. The impact of economic restructuring has been uneven as capital tended to accumulate in some sites at the expense of others. To some scholars, unequal spatial development is a necessary condition for the accumulation of capital and is the logical outcome of capitalist restructuring (Beauregard, 1989; Bradburry, 1985; Harvey, 1982).

Recent empirical studies indicate that deindustrialization theories based on the post-Fordist framework oversimplified industrial transition in older manufacturing regions. Pollard and Storper (1996), in their research on US metropolitan areas, pointed out that the pathway to regional development is multiple; neither the European-style post-Fordist manufacturing sector nor highly specialized urban information economies explains American metropolitan growth in the 1990s. Fielding (1994) found that the overall spatial structure of employment and population distribution in Europe did not show any significant shift in spite of fundamental changes in the production system. In addition, older Fordist manufacturing regions are undergoing a fundamental economic transformation by adopting new production systems to existing industries. Florida (1996) recognized these processes as *regional creative destruction.* The strenuous effort to preserve long-standing comparative advantage has contributed to regenerate industries in new localities within the old industrial regions (Brown et. al., 1996).

Explanations of Location Change

A variety of concepts have been proposed to explain emerging patterns of industrial location, including nonmetropolitan industrialization, urban-rural shift, Snowbelt-Sunbelt shift, filtering down, spill-over, and so on. These relatively new (compared to two centuries of industrialization) locational tendencies revealed a significant departure from the classic pattern of urban concentration. There has been a realignment of the core-periphery relationship in production as industrial heartlands lost competitive advantage to the newly growing industrial spaces in formerly peripheral regions. The decentralization of manufacturing location, in turn, has contributed to reverse the long-lasting population out-migration from smaller settlement systems (Lonsdale, 1979). As a result, the classic center-periphery model of industrial development no longer accurately depicts recent trends. These patterns of spatial restructuring in advanced industrialized countries have been observed in recently industrialized nations in the Southern part of Europe as well (Vazquez-Barquero, 1990). In these countries also, spatial diffusion of manufacturing industry, from core areas toward less industrialized regions, is transforming a long-lasting territorial hierarchy.

One widely held belief is that nonmetropolitan industrialization or industrial decentralization is a normal process of industrial development in advanced economies (Lonsdale, 1979). Product-cycle theory, assuming a close relationship between industrial location and the stage of economic development, explains locational decentralization using the filtering down process (Erickson, 1976; Erickson and Leinbach, 1979; Rees, 1979).

Three distinct phases in the development of production processes and resulting locational patterns were identified. In the first phase, when an industrial product is introduced, location is highly concentrated in high technology regions or large urban areas in order to utilize the pool of skilled labor and a variety of external economies in these areas. During the following phase, when the demand for the product increases rapidly, production is transformed into a mass production method. The new locational requirement for these growing industries is low costs sites, typically smaller urban areas. During the final stage of the product-cycle, the production process becomes standardized and routinized, with less reliance on technology as well as agglomeration economies or economies of scope. Production can be most effectively done by branch plants located in different nonmetropolitan areas that provide advantages in assembly costs. Therefore, the spatial filtering down process reflects firms' locational strategy to reduce production costs, thus enhancing competitiveness.

It was noted that differential settlement size offers different competitive advantage. Thus, the spatial division of labor in manufacturing activities is manifested through regional hierarchies (Moriarty, 1991). Regions at lower levels of the hierarchy have advantages in standardized production whereas those at upper levels have competitive edges in newly growing high technology industries (Norton and Rees, 1979). In addition, there is an order in the spatial filtering process. Within rural regions, areas that are adjacent to metropolitan centers tend to grow faster than non-adjacent rural areas (Haynes and Machunda, 1987). External economies can emerge in peripheries as industrial agglomeration stimulates the creation of local linkages and social infrastructure. They promote further industrial accumulation in these areas (Rees, 1979). One negative aspect of nonmetropolitan or rural industrialization is that slow growing industries attracted to smaller communities contribute little to the improvement of skills and wages, even if they provide jobs for unemployed labor during periods of slow growth (Thomas and Leinbach, 1981).

A recent study (Wojan and Pulver, 1995) raised questions about the general accountability of location theories based on the product cycle and filtering down process. They concluded that there is no linear relationship between regional hierarchies and locational potentials. In many cases, more remote areas had a wider range of business services than those adjacent to larger urban areas. Thus, existing theories are unduly pessimistic about the prospect of economic development of nonmetropolitan areas. On the contrary, high technology industries can do well in smaller communities. They also tend to decentralize toward peripheries as they mature and production processes are standardized. This occurs when access to urbanization economies such as specialized inputs, research facilities and skilled labor market are no longer the primary conditions for the location of high technology industries (Barkley, 1988).

Following Keeble, et. al. (1983), there are three major explanatory frameworks for the decentralization of industrial location. The first approach, the production cost explanation, highlights cost difference as the mechanism for locational shifts from urban to rural regions. In general, urban locations have higher operating costs, including wages and salaries, and factory rents. High production costs in urban areas reduce competitiveness, resulting in lower profitability. This decentralizes urban industries to rural settlements.

The cost advantage explanation of new industrial space is not limited to urban to rural shift, but can be applied at different regional scales. Chinitz (1986) cites the cost pull of the Southern US states as the main force for the locational shift of US manufacturing. The South has lower labor costs, lower operating costs, lower local taxes, and a higher level of subsidies for capital investment, physical facilities and worker training, compared to the North. Carlino and Mills (1987) also emphasize the importance of the spatial variation of production costs for the regional shift of manufacturing employment.

Urban disadvantages in production costs are represented by agglomeration diseconomies. Agglomeration of manufacturing firms and employment in urban areas has a positive impact on productivity, but after a certain level, deglomerative forces come into being due to diseconomies from congestion, rising land costs, lack of space, high wages, labor conflicts, etc (Hakanson and Danielsson, 1985; Haynes and Machunda, 1987). Therefore, larger metropolitan centers are more prone to losing manufacturing industries. A decline in the strength of relationship between urban hierarchies and manufacturing employment density might reflect the diseconomies of large cities (Moriarty, 1991).

The second approach, constrained location theory, focuses on the physical constraints of urban location. Urban place has limited space available for factory expansion, which acts as a ceiling on industrial growth. Thus, for further extension of production capacity, firms need to move out to suburban or rural areas or to displace labor for machinery. In either case, urban manufacturing employment decreases. Tulpule (1969) proposed a series of hypotheses based on physical constraints of urban location. Growing firms need larger factory site to accommodate new machinery to increase output. Thus, industries requiring more space tend to locate in rural areas where land is readily available at lower costs. Two basic conditions need to be met for this dispersion to occur. First, urban areas have to be saturated, thus land supply is short and rent is high. Second, the accessibility of rural areas has to be improved by such means as the development of modern transportation and communication system including information technology. Accepting the basic principles of constrained location theory, the following causal relationships can be expected:

1) A negative relationship between land price and manufacturing employment growth;

2) A negative relationship between the initial density of manufacturing employment and following growth rates; and

3) A positive relationship between the capital-output ratio and the tendency toward rural location.

Fothergill et al. (1987) examined the relationship between employment change and space availability. They found that regions with higher proportions of old buildings and heavily built-up sites with little room for expansion were associated with larger employment losses. Scott (1982) also considered the lack of space in central cities an important motivation for the industrial dispersion to peripheral areas. Thus, capital intensive firms tend to locate at peripheral areas where cheap land is available for horizontal plant layouts, while labor intensive (and competitive) firms concentrate at the center of metropolitan labor markets. The decentralization tendency is stronger when new investment strategies attempt to replace labor with machinery.

The last approach, capitalist restructuring theory, emphasizes capital mobility and flexible production system as the explanation of spatial shift of industrial location. The spatial restructuring is an attempt to recover profitability by reducing factor costs. Especially, the existence of exploitable, unskilled and low cost labor is one of primary locational factors at international scale. Capital employs a variety of strategies to reorganize the production system over space due to its increased mobility and technical innovation. As a result, the range and scope of spatial forms of production organization have greatly increased (Hudson, 1988). An increasingly footloose capital freed from locational constraints more easily makes use of spatial decentralization as an instrument to secure profit. Interregional and international shifts of production facilities are dominated by branch plants, which are specialized for standardized mass production supported by automated technology. In contrast, strategic and control functions such as planning, R&D, administrative and bureaucratic activities are highly centralized in core regions. Therefore, there is a clear spatial division of labor between centers and peripheries, depending on the comparative advantage of respective regions (Capello, 1994; Fainstein and Fainstein, 1989; Spooner, 1995).

The rise of a series of new industrial spaces based on flexible production systems has caught recent attention. Relying on the principle of flexible specialization, firms in new industrial agglomerations are interconnected through dense networks of horizontal and vertical linkages (Graham and Spence, 1995). These new industrial ensembles can arise out of nowhere (such as the Silicon Valley), but more often are found in pre-existing localities with skills and resources for new production system. They include the Third Italy, Los Angeles, New England, the M4 Corridor, etc. (Harvey, 1988). In the latter case in which development is based on endogenous resources, new industrial space does not generate totally new urbanization. This might be the main reason for the relatively stable spatial structure of settlement systems, in spite of considerable changes in production systems (Fielding, 1994). To some scholars (Brown et al, 1996; Camagni, 1991; Florida, 1996), theories based on flexible accumulation are overly pessimistic about the prospect of revitalization of old industrial regions. According to their view, restructuring of traditional industrial centers does not mean monotonic decline of old centers or acceleration toward post-Fordist accumulation system. Rather, there is a simultaneous process of regeneration of some old industries in new localities and decline in other traditional sectors. This regional creative destruction occurs as innovations in new production systems and technologies are adopted by existing industries.

Factors of Industrial Location Change

There are many variables affecting the location of industrial activities across space. The selection of variables largely depends on the theory and method upon which research is based, and the availability of data. In addition, it might be possible that a set of variables performing well in one region do not do well in another region. The same notion could be extended to temporal sequence, industrial sectors, and spatial scale. In this section, some locational factors considered important for industrial and spatial restructuring in Korea are discussed. It must be noted that these factors are not comprehensive. For example, various social, behavioral, and political variables are not considered because no such data are readily available at micro-regional level. Instead, the focus is on economic and geographical factors.

Economic variables have been considered the most important factors for the location of manufacturing industries because they are directly related to the costs of production. Three economic factors are considered in this study. First, the availability of low wage labor is one of primary factors for both regional and global shifts of industrial location (Dicken, 1992; Graham and Spencer, 1995; Haynes and Machunda, 1987; Keeble, 1976; Taylor, 1993). Low regional wage levels are often accompanied by sizable labor reserves, often the result of underemployment i.e., employment in part-time jobs or in occupations in which the worker's skill and ability are not fully used. Thus, even if the unemployment rate is low in a region, the existence of low wage workers means a potential labor supply for high paying firms (Kale and Lonsdale, 1979). However, low average wages do not necessary mean that new firms will pay low labor costs because the wage level can reflect systematic disparities in the structure of regional industries (Smith, 1971). Industrial wage rates tend to increase as city size increases and this, according to Scott (1982), is the outcome of increased transportation costs for the journey-to-work.

Second, the price and availability of industrial land have been central elements in the constrained location model

(Fothergill and Gudgin, 1982; Fothergill et al, 1987; Tulpule, 1969). According to Fothergill and Gudgin (1982), over one half of the difference in employment change between urban and rural areas is due to the employment expansion of existing plants. They claim that the shift of manufacturing out of large cities is because urban firms have great difficulties in undertaking physical expansion. Nonmetropolitan industrialization and the concurrent decrease in urban manufacturing employment reflect the effort to obtain cheap and abundant space (Haynes and Machunda, 1987; Graham and Spence, 1995; Hakanson and Danielsson, 1985). The importance of low cost industrial land in uncongested areas has been increased by the development of transportation networks and the increased use of the automobile by workers (Fuchs, 1973). Scott (1982) noted the importance of the price of land, arguing that high industrial land prices at the urban center will repel manufacturing industry, while low land prices at the periphery of the city will attract industries. The significance of land price (as well as availability) as a factor of industrial location will be greater in countries with smaller territory and higher density such as UK and Korea.

The last economic factor is industrial structure. The demand for labor is strongly affected by the mix of industries. Regions with favorable (thus growth oriented) industrial structures will require a larger labor force than those with unfavorable sectoral composition (Hakanson and Danielson, 1985). Keeble (1976) showed that regional industrial structure, measured by the share of regional employment in rapidly growing industries at the national level, was closely associated with manufacturing employment change. In a study of the location of Japanese investment in Britain, Taylor (1993) found that industry mix of recipient areas was a strong explanatory factor.

Another important measure of industrial structure, with respect to the demand for employment, is labor intensity (or labor-output ratio). It was noted that capital intensive industries have different locational tendencies from labor intensive industries (Fothergill et al, 1987; Scott, 1982). Therefore, in developing economies such as Korea that exhibit a strong tendency to transform industrial structures from labor intensive toward capital intensive, the structural factor will be strongly associated with employment change.

According to classic location theory, under isotropic assumptions, distance (thus transportation cost) is the single most important factor in determining the optimal location of manufacturing industries. The importance of distance (to market, raw materials, and suppliers) has declined significantly as a result of the development of modern transportation and tele-communication networks. However, accessibility is still considered the primary reason for the geographical agglomeration of vertically and horizontally interrelated industries in the new flexible production system. One major difference between classic and modern location theory is that the former is focused on the minimization of transportation cost, whereas the latter emphasizes linkages and transactions among manufacturing firms and between manufacturing and business service firms (Scott, 1988a). Thus, the existence of major transportation axes offers a good opportunity for the location of traditional industrial complexes as well as the formation of new industrial spaces based on the flexible production system. Highly developed highway systems have been a major contributing factor for nonmetropolitan industrialization in the US. The construction of Korea's modern highway system also has played a key role in the location of industry away from the largest cities to newly formed industrial growth centers and adjacent rural areas.

Agglomeration economies have been recognized as a geographical source of cost reduction. Agglomeration economies (including urbanization and localization economies) can be defined as the savings in costs occurring from the accumulation of industries in a particular region, which enables firms to share external expenses with others (Keeble, 1976). In Korea, the existence of agglomeration economies has been considered one of the most important reasons for polarized industrial development (Kwon, 1981).

However, there is a limit to the scale of agglomeration economies, with decreases after a certain point (Smith, 1971). During the periods of locational decentralization, various types of negative agglomeration economies have been noted as major causes for the decay of industrial centers. These factors include high land and housing prices, traffic congestion, pollution, high labor costs, and high incidence of crime. These agglomeration diseconomies raise production costs directly and indirectly, thus reducing the economic efficiency of manufacturing firms. This, in turn, encourages the migration of existing industries to other locations. In addition, more and more newly established firms will seek to locate in less congested areas. These areas do not offer greater external economies compared to established centers, but location in these localities can be more profitable due to technological advances in production, transportation, telecommunication, and information processing.

Hypotheses

It is expected that characteristic differences in the pattern of industrial location will be revealed through the comparison of industrializing and restructuring periods. During the industrializing period (1983-88), manufacturing employment will grow more rapidly in traditional industrial centers. During restructuring period (1988-93), established industrial centers will not continue to add industrial employment due to the growing diseconomies from overconcentration and resulting physical constraints. On the other hand, less industrialized regions, such as smaller cities and rural areas, will experience a net growth of employment due to improved competitive advantages. Therefore, the classic center-periphery model will not explain emerging trends of industrial location in Korea. The following hypotheses can be stated with regard to the spatial patterns of industrial location especially during the restructuring period:

I-1: Rural counties will perform better than urban cities.

I-2: Smaller cities will perform better than larger cities.

I-3: Less industrialized areas will perform better than industrialized areas.

I-4: Peripheral regions will perform better than core areas.

Changes in regional manufacturing employment, as an index of ongoing restructuring of Korean industry, can be associated with a variety of regional factors. The expected causal relationship between the growth of regional employment and a set of explanatory factors is hypothesized as follows. First, rapid wage increases in recent years have been one of the most important reasons for the diminished international competitiveness of Korean industries. High wage levels directly increase production costs, accelerating the rationalization of industries. Thus, it can be hypothesized that:

II-1: Regional wage ratio (to gross output) will be negatively associated with the growth of employment.

The shortage of labor and high wages will promote the adoption of alternative strategies with less reliance on labor. New strategies of industrial development will heavily depend on the use of capital equipment. In the short term, when output remains the same level, the substitution of capital for labor tends to save labor inputs. However, in the context of rapid output growth, a high rate of new capital investment is more likely to generate new employment. Therefore, the second hypothesis states that:

II-2: The growth of the capital-labor ratio will be positively related to manufacturing employment growth.

Industrial restructuring is a process of structural transformation by which firms seek an improvement in productive efficiency and competitiveness. For several decades, low cost labor was one of the most important sources of competitiveness of Korean industry. However, the advantage deteriorated as quickly as the rise in wages. As a result, those regions with industries relying heavily on labor will be more adversely affected by changes in labor markets. Thus, the third hypothesis states that:

II-3: There will be a negative relationship between labor intensity and the growth of regional employment. In addition, the significance of this association will be higher during the restructuring period than the industrializing period.

Industrial location requires open space with such attributes as relatively large, continuous and flat sites located away from residential areas. In most large urban areas of Korea, the supply of industrial land is severely limited due to various constraints. In addition, the price of land has increased rapidly, forcing manufacturing firms to spend large amount of capital for the acquisition of land. It is expected that regions with a higher ratio of factory site value to gross output will be less likely to attract new industrial activities than those with lower land prices. Therefore, the fourth hypothesis states that:

II-4: There will be a negative association between the growth of the ratio of land assets to output and manufacturing employment change.

The relationship between the size of settlement and the growth rate of industrial employment will decline significantly during restructuring period. First, a high growth rate of manufacturing employment in large cities is difficult to maintain because of the large size of base employment. Second, there are strong indications that a variety of urban diseconomies have undermined the competitiveness of heavily populated areas. Thus, the fifth hypothesis states that:

II-5: A negative relationship will prevail between population density and the growth of manufacturing employment. The impact of urbanization diseconomies will be larger during the period of restructuring than the rapidly industrializing years.

During the period of rapid industrialization, major industrial growth poles, including metropolitan centers, accounted for a large part of the growth of manufacturing employment. In recent years, these traditional industrial centers have struggled to continue rapid growth. This suggests that the spatial concentration of manufacturing activities has declined as industry spreads out toward wider geographical areas. Thus, the following hypothesis states that:

II-6: There will be a positive association between the level of industrialization (location quotient) and manufacturing employment growth during the period of industrialization. However, a negative relationship will prevail during the period of restructuring.

Modern highway networks can reduce time and monetary costs significantly, thus improving the potential of industrial location for regions adjacent to the highway system. The positive effect of the highway system on the location of manufacturing industry will spread out toward more distant areas as road system sub-connections are further developed. Thus, the last hypothesis states that:

II-7: There will be a positive association between access to the expressway network and the growth of manufacturing employment. The importance of expressway accessibility will increase over time.

Methods of Research

Location Quotient

The location quotient (LQ) measures the 'relative' concentration of manufacturing employment in a region with regard to the nation as the benchmark region. Formally, the LQ is the numerical equivalent of a fraction whose numerator is the share of employment of manufacturing industry relative to total population in a region, and whose denominator is the share of manufacturing employment relative to total population in the nation. A LQ of larger than unity indicates relative concentration (or specialization) in a region compared to the nation as a whole; less than unity signifies less relative concentration of manufacturing employment (North, 1973). In addition, an increase in the LQ of a region can be considered as an indication of the increasing importance of the region as a locus of manufacturing activities.

It must be remembered that the LQ is affected not only by changes in the growth rate of employment, but also by changes in population. Considering unequal population growth among different regions of Korea, the LQ may not be an ideal measure of location change. Thus, the absolute figures of regional employment change will also be presented to compensate the conceptual weakness of the index.

The location quotient for manufacturing employment in region 'r' is calculated with the following formula:

$$LQ_r = [E_r/P_r]/[E_n/P_n] \tag{2-1}$$

where: E = manufacturing employment; P = population;

r = region; and n = nation.

The LQ will be measured at three points in time: the initial year (1983); the mid-point (1988); and the final year (1993). Comparisons of LQ and employment changes will be made among various regional types (urban and rural areas, industrialized and less industrialized areas, and core and peripheral areas) to identify spatial shifts in manufacturing locations.

Regression Analysis

A multiple regression model is used to explain regional variation in the growth rate of manufacturing employment, an important indicator of restructuring. The growth rate of manufacturing employment reflect the attractiveness of a region as a locus of industrial activity. Independent variables represent regional manufacturing structures and locational characteristics. The generic model assumes an exponential function between the change in regional manufacturing employment and a set of regional variables,

$EMP = e^{f(v_1, v_2, v_3, \ldots, v_n)}$, where: $EMP = EMP_{t2}/EMP_{t1}$

Then, $LnEMP = f(v_1, v_2, v_3, \ldots, v_n)$

The testable regression model can be expressed as follows:

$$LnEMP = a + b_1WAGE + b_2CAPITAL + b_3LABOR + b_4LAND + b_5PDEN + b_6LQ + b_7ACESS + e \tag{2-2}$$

where: LnEMP = logarithmic growth rate of manufacturing employment

WAGE = initial regional wage ratio

CAPITAL = growth rate of capital-labor ratio

LABOR = initial labor-capital ratio

LAND = growth rate of land asset to output ratio

PDEN = initial population density

LQ = initial location quotient

ACCESS = dummy variable for rural highway accessibility

e = residual

The first independent variable (WAGE) examines the effect of the regional wage ratio on the growth of manufacturing employment; the second variable (CAPITAL) tests the impact of capital investment; the third variable (LABOR) tests the effect of labor intensity; the fourth variable (LAND) tests the effect of changes in industrial land prices; the fifth variable (PDEN) tests urbanization economies; the sixth variable (LQ) tests localization economies; and the last variable (ACCESS) examines the effect of rural expressway accessibility.

A set of bivariate regression models will be used to examine differentials in location changes between different types of region (urban versus rural areas, industrialized versus less-industrialized regions, and core versus peripheral areas). The basic model assumes that changes in the LQs are related to the initial level of the index. The model is:

$$\Delta LQ = a + b_1 LQ_{t1} + e \qquad (2\text{-}3)$$

where: $\Delta LQ = LQ_{t2} - LQ_{t1}$ (subscripts are years)

By introducing intercept and slope dummy variables, equation (2-3) can be rewritten as:

$$\Delta LQ = a + b_1 LQ_{t1} + b_2 D + b_3 DLQ_{t1} + e \qquad (2\text{-}4)$$

where, D = 1 for designated regions

D = 0 for other regions

The final model, for designated areas, is:

$$\Delta LQ = (a + b_2) + (b_1 + b_3) LQ_{t1} + e \qquad (2\text{-}5)$$

For others:

$$\Delta LQ = a + b_1 LQ_{t1} + e \qquad (2\text{-}6)$$

The first null hypothesis ($b_2 = 0$) implies that the initial level of industrialization is not significantly different between designated regions and other areas. The second null hypothesis ($b_3 = 0$) suggests that industrial location change is not significantly different between designated regions and others. The third null hypothesis ($b_2 = b_3 = 0$) suggests that there is no structural difference in the changes in industrial location between the two types of region. The rejection of the null hypotheses can be strong evidence of systematic difference in locational pattern between the benchmark region and others.

Cities and counties represent the observational units of the regression models. There were 73 cities and 135 counties in Korea as of 1993 (See Chapter 5 for changes in administrative areas). For the analysis of dummy variables, each city and county will be classified into one group or another (benchmark region) depending on the geographical location or location quotient of manufacturing employment.

The next chapter will begin with a discussion of the relationship between industrial restructuring and productivity. Spatial patterns of productivity and the determinants of regional productivity will follow. In addition, the role of productivity as a source of industrial growth will be examined. Based on the review of literature, research hypotheses concerning spatial patterns and the determinants of productivity will be developed. Last, research methods will be presented.

Chapter 3

INDUSTRIAL RESTRUCTURING AND REGIONAL PRODUCTIVITY

Industrial Restructuring and Productivity

An important objective of restructuring is to improve productivity. Improvement of productivity can be realized by enhancing efficiencies in the use of productive resources. In the long run, productivity is one of the most important sources of competitive advantage and is the best overall measure of competitiveness (Dollar and Wolff, 1993). Firms with high productivity can produce high quality products at a lower cost and raise output with less inputs. Therefore, a nation, or region, with high productivity can compete with others with high incomes and a high standard of living. In his introductory remarks (Kendrick, 1961), Solomon Fabricant succinctly summarizes the definition and importance of productivity:

> Productivity.....is a measure of efficiency with which resources are converted into the commodities..... Higher productivity is a means to better level of economic well-being and greater national strength. .....productivity affects costs, prices, profits, output, employment, and investment, and then plays a part.....in the rise and decline of industries (P. xxxv).

Newly emerging flexible production and organization systems are geared to maximize efficiencies in resource use, thus improving productivity and profits. There has been a massive reorganization of production processes through the introduction of new information technologies for programmable general purpose machinery, the deployment of flexible workers (functionally capable of multi-tasking or numerically adjustable), and close interaction between vertically or horizontally linkaged firms (Asheim, 1992; Gertler, 1992; Mair, 1993; Pinch et al, 1991). Factor substitutions, technological advance, and organizational innovation are some of the most important and widely used methods of cost reduction. Often, productivity improvement accompanies rationalization of existing production systems. The reduction of productive capacity and employment in older and technologically inefficient facilities is done to improve capital efficiency and labor productivity. As a result, surviving industries become more efficient, and newly established enterprises are more likely to adopt best practice production systems (Lansbury and Mayes, 1996).

Widespread business restructuring in advanced industrialized nations since the 1970s can be summarized collectively as an effort to recover competitive advantage of industries. It was reported that there was a turnaround in the productivity of advanced countries since the 1980s after a period of slowdown (Mayes, 1996). The transformation of production toward highly efficient systems was one of the primary reason for the strong recovery of US manufacturing in the 1990s after decades of slowdown. It also explains how US industries have maintained productive advantage over other industrial countries for long periods (van Ark, 1996).

Compared to extensive studies on the objectives, processes and consequences of contemporary restructuring at business and industry level, impact of restructuring on regional productivity is not well documented. This might be due to the difficulties measuring exactly the magnitude of restructuring at the regional level. Only aggregate consequences of restructuring can be estimated from regional data sources. It can be stated that the more a region's industries introduce innovative technologies and the more flexibly organized its industries, the greater the improvement of regional productivity will be.

Spatial Variation of Productivity

Unlike the lack of literature on the relationship between industrial restructuring and regional productivity, there is a body of literature dealing spatial patterns of industrial productivity. It must be remembered, however, that industrial restructuring is not considered a major determinant of productivity gain. None of the statistical models in the literature employs an explanatory variable directly related to business restructuring to account for the change in regional productivity. Rather than examining the impact of restructuring on productivity, studies have focused on the measurement and comparison of productivity among different regions, and explanation of the variations in productivity using a set of regional factors.

Regional differentials in productivity result from unequal distribution of direct and indirect production factors. Direct production factors include capital, labor, material, land, energy, and so on, which can be measured in terms of amount or cost. Indirect factors include scale economies (both internal and external), unionization, social infrastructure, government policies, and so on. In general, more developed regions have advantages in productivity compared to less advanced regions. The former regions tend to have a higher ratio of technology-based industries and superior research and development capabilities. Innovation and new product development begin in advanced regions with easy access to various external economies. In addition, firms in urban areas tend to have higher productivity. They have to overcome greater pressure of higher wages and land prices, which require higher levels of productivity to compensate for their higher costs. The advantage in productivity originating from location is called agglomeration economies, which in turn, can be divided into localization and urbanization economies. The former is related to the number of businesses in a locality and the latter is related to the size of settlement.

A number of studies have verified regional variations in productivity. Two types of regional study can be recognized. The first approach focuses on urban-rural or intraurban variations in productivity. This type of research examines the existence of urban agglomeration economies and their changes over time. Aberg (1973) found a strong tendency for productivity to decline from large cities toward less populated areas in Sweden. High capital intensity and utilization, large scale production, and favorable labor markets were related to the higher productivity in large urban areas. In the studies of the US, Nicholson (1978) confirmed that urban regions have about 12 percent higher efficiency in production than rural regions. Moomaw (1981) also verified urbanization economies in the US, in which productivity increased by 1.5 percent when SMSA population was doubled. For Brazil, Hansen (1990) found that when the distance from Sao Paulo City was doubled, productivity decreased by 8.9 percent, followed by an 8.7 percent decline in labor costs. The trade-off relationship between productivity advantages in metropolitan centers and factor cost advantages in outlying regions was indicated as a reason for industrial decentralization in Brazil.

However, Carlino (1985) found that the urban productivity advantage has been declining in the US metropolitan areas. The decline was most evident in the Northeast and Midwest metropolitan regions. Moomaw (1985) supports this finding by stating that productivity advantages of large urban areas have decreased, as reflected by employment decline in these areas. Blackley (1986) also confirmed advantages in metropolitan areas, though these were diminishing as shown by a decrease in returns to scale.

These studies suggest that declining agglomeration economies and simultaneous improvement in rural conditions resulting from technological innovation in production, transportation and communications, stimulate nonmetropolitan industrialization. In addition, according to Soroka (1994), declining productivity advantage of Canadian large cities is due to government policies favoring geographical dispersion of industries. Therefore, the decline of urban productivity advantages can be a result, as well as a cause, of industrial decentralization.

The second type of regional productivity research has focused on interregional comparisons of productivity and its relationship with locational shift. Garofalo and Malhotra (1989) report that the Northern United States has a 25 to 30 percent advantage in productivity over the South, though the rate of productivity improvement is not different between these regions. Therefore, the expansion of Southern industries is explained by cost (not productivity) advantages and resulting factor input growth. In addition, the decline in the growth of Northern manufacturing is not due to productivity problems. Similar results were obtained by Moomaw (1981), who verified a six to eight percent advantage in productivity by non-South states over the South. The study also implied the importance of low wages for rapid industrial growth in the South and smaller cities.

Haynes and Dinc (1997) related the improvement of productivity to regional employment change. A greater gain of productivity in the US Snowbelt region contributed to the reduction of manufacturing employment in that region. Using a slightly different framework from the above studies, Casseti and Jones (1987) examined the causal relationship between the Sunbelt-Snowbelt shift of manufacturing location and changes in regional productivity. The northern industrial core region had the highest productivity growth before the beginning of the Sunbelt-Snowbelt shift, but the Sunbelt region subsequently had a higher growth in productivity. They explain the improved growth of productivity in the Sunbelt states by the increase of capital investment followed by the infusion of jobs and population.

In summary, the above literature reveals that the locational shift in manufacturing, from urban to rural areas, metropolitan centers to nonmetropolitan areas, and the Snowbelt to the Sunbelt region, is the result of a substitutive relationship between the initial agglomeration advantage in the former regions and the subsequent demand for low cost labor and land in the latter regions. Thus, the interregional shift of manufacturing location is not due to lower productivity in declining cores, but the result of rapid capital accumulation in newly industrializing region based on cost advantages. In addition, the spatial decentralization of manufacturing location has been accelerated by declining urban agglomeration economies and technological development in communications and production processes.

Determinants of Regional Productivity

There are a number of factors affecting the level and growth of regional productivity. Compared to the potential scope of variables that could be conceived as important, the existing literature has utilized a relatively limited number of variables. In addition, rather than developing theories, studies of productivity have tended to focus on testing of generalized hypotheses drawn from basic economic principles.

Moomaw and Williams' (1991) paper offers a starting point for the categorization of independent variables (for statistical analysis). Four types of variables are discussed which are relevant to the current research. However, some of the variables discussed will (and can) not be incorporated in this study. The first type of explanatory variable is related to capital accumulation. One of the most frequently used variables is capital-labor ratio, which originated from the source of growth approach. It is well known that the growth rate of the capital-labor ratio has a positive relationship with productivity growth (Dollar, 1991; Dollar and Wolff, 1993; Rigby, 1995; Wolff, 1991). The positive contribution from capital accumulation is explained by the fact that the most efficient and state-of-the-art technology is embodied in the newest capital. This *embodiment* or *vintage effect* has been a major concept in explaining international/interregional convergence of productivity (Abramobitz, 1986, 1990; Dollar 1991). In addition, new capital tends to require better production organization and management, which can result in additional productivity improvement. Finally, higher productivity can be achieved by *learning by doing* from new capital equipment (Wolff, 1991).

The second type of independent variable is based on the concept of agglomeration and scale economies. The scale and diversity of economic activity in urban areas provide a large and diversified labor pool, specialized business services, and abundant research and education facilities (Beeson, 1987). As mentioned above, agglomeration economies can be divided into urbanization economies and localization economies (Watts, 1987). Urbanization economies are referred to as the cost savings resulting from urban locations that provide a variety of producer services for manufacturing firms at minimal travel costs. Localization economies are the cost savings arising from the spatial proximity of other manufacturing firms, research facilities, and pools of specialized workers. One of the most frequently used indicators of urbanization economies is population density, whereas localization economies are often identified using the location quotient. Scale economies represent cost savings from increasing scale of production. The size of production output is a good testable indicator for the existence of scale economies. Specifically, the positive relationship between the growth rate of output and productivity change is known as *Verdoon's law* or *cumulative causation effect* (Casetti, 1984).

The third type of independent variable includes geographical variables such as transportation accessibility and distance from metropolitan center. Accessibility and distance can affect the speed of the diffusion of new ideas and technology over space. Regions that are readily accessible to the center of innovation through a superior transportation and telecommunication system, or those located near the center, will have advantages over other regions. Moomaw and Williams (1991) used the density of interstate highway mileage to estimate the effect of infrastructure on manufacturing productivity growth. Mas et al. (1996) showed that basic infrastructure, including transportation, has a close relationship to productivity. The positive effect of infrastructure was greater in the initial stage of development. The effect of distance was discussed above (Aberg, 1973; Hansen, 1990). In addition, regional dummy variables have been used to examine the locational effect for differential growth of regional productivity. A given census region or specific city size group is designated as the benchmark region to be compared to remaining regions.

The last type of independent variable includes various socio-economic indicators. The quality of labor, often measured by the educational attainment of workers, is used to test the effect of human capital on productivity growth. R&D activities and the proportion of professional/technical workers can capture the effect of innovative activities. On the contrary, there are regulatory variables that are expected to have negative impacts on the improvement of productivity. These factors include level of unionization, work stoppages, and the existence of right to work laws.

The present research introduces two variables that rarely have been dealt with, but are considered important for understanding Korean restructuring. The first variable is related to the regional wage ratio. Rather than using absolute wage levels, a relative measure of wage rates, i.e., the ratio of total worker remuneration to gross output, is employed. The effect of wage ratio will be positive on the growth of productivity. Higher wage ratios will have a negative impact on the growth of labor inputs, but will have a positive effect on the improvement of capital utilization, resulting in higher productivity. In other words, the positive relationship between wage ratio and productivity growth can be supported by the fact that firms with higher productivity can pay higher wages. This hypothesis was examined by Baily et al. (1996). They found a positive relationship between productivity growth and increases in real wage. Plants with improved productivity tended to have higher wage increases, whereas those with declining productivity tended to pay reduced real wages.

The effect of the wage ratio on the growth of productivity is more complex because the wage ratio is decided by the interaction of the amount of total output and total wages. In some respects, firms will be more responsive to wage ratio than per capita wage level. High wages are payable if productivity is high and the number of workers employed is not too great. But firms with an excessively high wage ratio could not survive whether the size of employment is large or small. Thus, wage ratio can be a positive stimulant for the improvement of regional productivity.

The second variable is related to land price. The purpose of this factor is to examine the effect of rapid land price increases on regional productivity. Rather than the absolute level of regional land prices, the growth of the ratio of land asset to gross output will be employed. This variable represents the amount of additional land assets needed to produce an additional unit of output, thus measuring the efficiency of land resources. High levels for this variable indicate low utilization of land resources, which more are likely to be found in regions with rapid increases in land prices. This variable is preferred to absolute land price because it accounts for the apparent high relationship between land price and population density, both of which are independent variables.

Productivity as a Source of Industrial Growth

The growth accounting approach provides a basic tool in which the growth of productivity and factor inputs (labor and capital) can be related to output growth. The growth accounting model that will be employed in the current research decomposes the growth of manufacturing output (value added) into shares of major production factors: capital input, labor input and technological advance (See Appendix A for the derivation of the model). The model can be transformed to explain the growth of labor productivity by capital deepening (growth of capital-labor ratio or capital intensity) and technological advance (Also see Appendix A).

Technological advance, or total factor productivity (TFP), occupies a central position in the growth accounting model. Technically, TFP accounts for the portion of output growth that is not directly attributable to the growth of factor inputs. For labor productivity, TFP accounts for the portion that is not explained by the growth of the capital-labor ratio. Thus, TFP captures the technical efficiency resulting from such varied sources as efficient capital utilization, advanced human capital, economies of scale, organizational efficiency, specialization and innovation (Dollar, 1991; World Bank, 1993). A large contribution of TFP to the growth of output is found in advanced economies, whereas in developing economies, accumulation of factor inputs accounts for a large part of growth (World Bank, 1991; Lim, 1994; Page, 1994). Hulten and Schwab (1984) showed that TFP is a major source of both growth and decline of regional manufacturing growth in the US.

There have been a few studies focused on the explanation of the source of economic and industrial growth in Korea (Christensen and Cummings, 1981; Dollar and Sokoloff, 1990; Nishimizu and Robinson, 1984). These studies emphasized the role of productivity in the growth of manufacturing output during the 1960s and 1970s. According to Christensen and Cummings (1981), between 1960-73, an early period of industrialization, the growth pattern of the Korean economy was similar to that of developed countries with a large contribution from productivity improvement. Major differences were lower capital intensity and a higher growth of labor inputs in Korea.

Dollar and Sokoloff (1990) also arrived at similar result: the contribution of capital accumulation to labor productivity growth during 1963-79 was modest compared to that of TFP growth. The most salient finding of their study is a strong negative relationship between capital deepening and TFP growth. They attribute this relationship to the poor performance of heavy industries and major productivity advance in labor intensive industries. Dollar and Sokoloff, however, found that TFP was higher in heavy industries, which supports Kwon (1994). Nishimizu and Robinson (1984) compared the sources of Korean manufacturing growth to Japan, Turkey and the former Yugoslavia. The contribution of

TFP growth was largest in Korea, and was as large as the combined share of capital and labor input.

On the contrary, Kwon (1986, 1994) and Park (1986) contended that the role of the growth of TFP has been negligible compared to capital input. Kwon explained the reason for the limited contribution from TFP growth by embodied technology in factor inputs, while Park attributed it to the low level of capital utilization. The only regional study was done by Park (1986), who examined differential productivity growth in manufacturing sub-sectors at the provincial level. According to Park (1986), depressed provinces where investment level was initially low performed better in terms of productivity growth. There was little evidence that economic efficiency resulted from capital accumulation. Instead, heavily capitalized provinces experienced a slowdown of capital productivity due to the low rates of capital utilization.

The literature cited above is based on the period when Korean manufacturing exhibited rapid growth in employment, as well as output. It is questionable whether these accounts of industrial growth are applicable to recent industrial restructuring when absolute labor inputs have decreased. Spatial patterns of productivity growth have remained largely unknown except the fact that technical advances of production do not go hand in hand with the pace of capital accumulation. Therefore, the following hypotheses are focused on spatial aspects of productivity, emphasizing its relationship with the restructuring of industrial location.

Hypotheses

Both the quality and quantity of technological infrastructure are known to affect regional productivity. In Korea, larger cities have the majority of higher education, research facilities, advanced business services, and information infrastructure, while smaller cities have less sophisticated lower order functions. Most rural counties have to depend on nearby cities for those functions. Thus, the spatial variation of productivity will be revealed through the hierarchies of settlement sizes. The pressure from cost-push factors can be another motivating factor for the productivity advantage of larger cities. In addition, industrialized areas with a longer history of industrial development will have higher productivity than less industrialized regions. Established regions will tend to have a larger proportion of skilled workers, which enables firms to master best practice knowledge and technological know-how more easily. A similar relationship will be found for core and peripheral areas. Thus, the following hypotheses can be stated with regard to spatial patterns of productivity.

I-1: Manufacturing productivity will be higher in urban regions than in rural regions. Within urban areas, larger cities will have higher productivity. Within rural areas, those adjacent to urban areas will have higher productivity than those nonadjacent.

I-2: Industrialized regions will have higher productivity than less industrialized areas.

I-3: Core regions will have advantages in productivity over peripheries.

After fast employment growth in the period of 1983-1988, Korean manufacturing witnessed an absolute decline in labor input between 1988-1993 due to the reduction of employment and work hours. The loss of employment is expected to be more significant in advanced types of regions. Capital investment, unlike employment, will increase in most regions during the both periods, reflecting a higher rate of output growth. Three hypotheses can be stated regarding spatial patterns of change in the sources of industrial growth.

II-1: The decline in the share of labor inputs to the growth of manufacturing output will be revealed through regional hierarchies, with higher rates of decline in higher order regions.

II-2: The increase in the share of capital inputs to the growth of manufacturing output will not be clearly revealed through regional hierarchies.

II-3: The share of technological advances will be clearly revealed through regional hierarchies.

The current research will employ seven factors to explain the variations in the growth of regional productivity (TFP). Some of the variables are used to examine established hypotheses in the Korean context, and others have not been examined in western countries. The first hypothesis regards the embodiment or vintage effect of new capital investment. Following Dollar and Sokoloff (1990), and Park (1986), the current research assumes a negative impact of capital accumulation on productivity advance.

III-1: The growth of the capital-labor ratio will be negatively associated with productivity growth.

The second hypothesis reinforces the validity of Verdoon's law or scale economies.

III-2: The growth rate of regional manufacturing output and the improvement of productivity will be positively associated.

The third hypothesis concerns the effect of the wage ratio.

III-3: There will be a positive association between the regional wage ratio and productivity advances.

The fourth hypothesis relates to the effect of the change in land price.

III-4: The growth of the ratio of land assets to manufacturing output will be negatively associated with the growth of regional productivity.

The next two hypotheses examine agglomeration economies.

III-5: Population density, as a proxy for urbanization economies, will be positively related to the growth of productivity.

III-6: The location quotient, as a proxy for localization economies, will also be positively related to the growth of productivity.

The last hypothesis focuses on the effect of transportation accessibility.

III-7: Direct access to expressway will be positively associated with the advance of productivity.

Methods of Research

Indices of Productivity

Productivity measures the efficiency of production in which input factors are converted into final output. A high productivity means that a smaller amount of input factors is used to produce a unit of output. When a single input is related to output, the resulting productivity is called partial productivity. Labor, capital, and land productivity are examples. However, partial productivity is not necessarily decided by the input factor alone; it can be affected by factor substitution. For example, labor productivity can rise either with an increase in capital inputs (factor substitution) or by technological change without change in labor inputs. In this study, labor and capital productivity will be employed. Labor productivity (LP) will be calculated by:

LP = value added at a constant price /(number of workers x hours worked) (3-1)

Capital productivity (CP) is:

CP = value added at a constant price/net fixed asset excluding land assets from total fixed assets (3-2)

An alternative measure of productive efficiency is multi-factor or total factor productivity. In this measure, all input factors are related to output. Input factors are weighted by factor compensation (or factor price) to account for differences in the measurement of input factors. This requires an assumption of competitive factor markets, in which the prices of factors are equal to the marginal contribution of each factor to output. A change in multi-factor productivity captures the changes in overall efficiency from various sources such as technical change, managerial and organizational innovation, resource allocation, capacity utilization, and the skills and attitude of workers (Kendrick, 1961; National Academy of Science, 1979). As an index of multi-factor productivity, nominal total factor productivity (NTFP) will be computed. NTFP is expressed as the ratio of output (Q) to a weighted sum of labor input (L) and capital stock (K) (Dollar and Wolff, 1993; Wolff, 1991):

$$NTFP = Q/[\alpha L + (1-\alpha)K] \qquad (3\text{-}3)$$

where: α is the average ratio of wage share to output.

Growth Accounting Model

A trans-log growth accounting model is derived from a Cobb-Douglas production function to show the sources of output growth (See Appendix A for the derivation of the equation). The model is as follows:

$$Ln(Q) = Ln(T) + \alpha Ln(L) + (1-\alpha)Ln(K) \tag{3-4}$$

where, Ln(Q), Ln(T), Ln(L), and Ln(K) are the logarithmic growth rates of output, total factor productivity (TFP), labor input, and capital stock, respectively. For example, $Ln(Q)=Ln(Q_{t2}/Q_{t1})$; α is equivalent to the average ratio of wage share to output.

According to equation (3-4), the growth rate of output is equal to the sum of the growth rate of TFP, the growth rate of labor input weighted by wage share (α), and the growth rate of capital input weighted by capital share ($1-\alpha$). The growth of technical progress, Ln (T), is measured as a residual after the effects of capital and labor have been accounted for. Thus, it measures the economic and technical efficiency of production. As noted before, TFP includes several important factors that are not attributable to input factors directly. TFP growth rate is a crucial determinant of evolving comparative advantage and exerts a major influence on the growth and structural change of industries in the medium to long run (Nishimizu and Robinson, 1984). There is a strong and positive relationship not only between productivity growth and economic growth, but also between the contribution of productivity to economic growth and national income level (World Bank, 1991).

Equation (3-4) is rewritten to decompose labor productivity growth into the share of capital accumulation (capital-labor ratio) and the growth of TFP (Anderson, 1990; Dollar and Sokoloff, 1990; Wolff, 1991. See Appendix A for the derivation):

$$Ln(Q/L) = (1-\alpha)Ln(K/L) + Ln(T) \tag{3-5}$$

Regression Analysis

A multiple regression model is introduced to test hypotheses concerning regional variations in the growth rates of total factor productivity, an indicator of productive efficiency. Most of the independent variables have been examined and established as important determinants of regional productivity in advanced economies. The effect of land price change on industrial productivity has not been extensively examined, even though land is widely accepted as one of primary production factors. Each of the independent variables represents an important aspect of industrial as well as spatial restructuring in Korea. The regression model is expressed as follows:

$$\begin{aligned} Ln(T) = a + b_1 LnCL + b_2 LnOUT + b_3 WAGE + b_4 LnLO + b_5 PDEN \\ + b_6 LQ + b_7 ACCESS + e \end{aligned} \tag{3-6}$$

where: Ln(T) = growth rate of TFP from equation (3-4)

LnCL = logarithmic growth rate of capital-labor ratio, LnCL = Ln(CL_{t2}/CL_{t1})

LnOUT = growth rate of output

WAGE = ratio of total wage to output

LnLO = growth rate of the ratio of land asset to output

PDEN = population density in the initial year

LQ = location quotient in the initial year

ACCESS = dummy for highway accessibility

e = residual

The first independent variable (LnCL) examines the embodiment or vintage effect of new capital; the second variable (LnOUT) is used to test scale economies, known as the cumulative causation effect or Verdoon's law; the third variable (WAGE) tests the effect of the wage ratio; the fourth variable (LnLO) tests the effect of land price change; the fifth variable (PDEN) is introduced to test urbanization economies; the sixth variable (LQ) tests the existence of localization economies; and the regional dummy (ACCESS) examines the effect of highway accessibility.

The following chapter discusses industrial restructuring and its consequences on spatial inequalities in location and productivity. First, spatial convergence and/or divergence of industrial location, including polarization reversal, will be reviewed. Next, disparities in regional productivity will be examined. Following the literature review, research hypotheses concerning the patterns and changes in spatial inequalities will be developed, and research methods will be proposed.

Chapter 4

INDUSTRIAL RESTRUCTURING AND SPATIAL INEQUALITY

Industrial Restructuring and Inequalities in Location

Industrial restructuring has brought about widespread deindustrialization of traditional manufacturing regions and changes in the economic, social and spatial organization of advanced industrialized countries. Deindustrialization has been most significant in those areas specialized in long-established mature industries (Martin, 1988). They often have such common characteristics as high labor and land costs, high levels of unionization, external diseconomies, and decline in productivity growth, forcing movement of capital from these areas (Fan, 1994). The competitive advantage of large industrial centers, based on the concentration of skilled labor, business services, advanced infrastructure, and superior cultural and recreational facilities, have been offset by a growing number of disadvantages (Dunford, 1993). The resulting loss of manufacturing industries in traditional industrial centers significantly reduced the economic growth of these regions. Thus, specialization in manufacturing tends to have a deleterious effect on regional growth compared to those specialized in producer services, for example (Drennan et al, 1996).

The impact of industrial restructuring can be summarized as *unevenness* over space, industries, and classes (Castells, 1988). In consequence, a new socio-spatial dualism has emerged between highly paid, skilled, white-collar workers in growing regions, and poorly paid, unskilled blue-collar workers in declining regions. The spatial unevenness of the impact of restructuring was examined by Angel and Mitchell (1991). They showed that the variation in real wages was much more greater in the North Central region of the United States than in other parts of the country, suggesting the dismantling of the traditionally homogenous wage structure within the region. The trend of wage divergence was also occurring within the growing Southern region.

On the other hand, the location of manufacturing industries has been trickling down through regional hierarchies toward suburban and rural areas (Moriarty, 1991). The process of *regional inversion*, by which the dominance of core industrial regions has been overturned by a series of new industrial spaces in formerly peripheral areas, is one of the most significant spatial phenomena of the late 20th century (Suarez-Villa and Cuadrado Roura, 1993). The vertically disintegrated post-Fordist flexible firms, specialized subcontracting firms, and branch plants have been major components of rural industrialization. These types of firms are relatively free from traditional locational requirements, such as urban external economies, favoring the low land and labor costs of rural environments. Manufacturing has become a new driving force in newly industrializing spaces (Fan, 1994). Industrialization offers several positive opportunities for the peripheral areas, including the provision of jobs, an increase in the attractiveness of the region, the improvement of regional income, and a reduction of regional income inequalities (Bar-El, 1985; Brown, 1991).

Spatial Convergence and/or Divergence

A classic approach to the examination of changes in spatial inequality relates the level of inequality to the stages of development. Kuznets (1955) proposed the hypothesis that income distribution in a country is related to the level of per capita income and to the growth rate of income. He postulated that greater inequality in underdeveloped countries would be associated with a lower per capita income coexisting with low income growth. Therefore, a reduction in inequality is expected when per capita income rises significantly. The application of the Kuznets hypothesis to regional study was done by Williamson (1965). The so-called *inverted U* hypothesis states (Williamson, 1965):

> the early stages of national development generate increasingly large (regional) income differentials. Somewhere during the course of development ..... convergence becomes the rule, with the backward regions closing the development gap between themselves and the already industrialized areas. ....regional inequality will trace out an inverted 'U' over the national growth path (p. 9-10).

The reduction of regional inequality in mature economies occurs as polarization and backwash effect give way to trickling down and spread effects. Alonso (1968) expressed a similar position on the gradual decrease in regional inequality, arguing that polarization and inequality are normal aspects of the development in the early stages, which will be *corrected* by market mechanisms. Therefore, according to this view, primacy and polarization are growing pains, not diseases. With regard to the temporal pattern of inequality, Alonso (1980), proposed the hypotheses of *five bell-shaped curves*. The bell-shaped path of development can be found in five areas: economic development, social inequality, regional inequality, spatial concentration, and demographic transition.

The principal mechanism for diminishing regional inequality over time is the neo-classical assumption of free factor mobility seeking higher profits. Faster economic growth in peripheral areas can be explained by capital movement into these regions to utilize low cost advantages. In addition, outmigration of population from poor regions tends to increase the per capita income of the region, reducing regional income differentials. On the other hand, disadvantages in advanced regions resulting from over-concentration also contribute to spatial convergence (Suarez-Villa and Roura, 1993). Therefore, economic forces are the primary source of spatial convergence of regional income. The process of spatial catch-up occurs when less developed regions grow more rapidly than advanced regions (Molle and Boeckhout, 1995). Government policy can offer additional momentum for the reduction of regional inequality (Maxwell, 1994; Williamson, 1965). Molle and Boeckhout (1995) list new sources of growth, which can be applied to both regional and national level.

> Important factors in this new growth theory are market access, human capital, technological change, international competitiveness, economies of scale, public infrastructure, institutional efficiency, etc. Some regions and countries succeed in mastering good combinations of these factors and grow; others fail to do so and lag behind. The effect is a synchronic occurrence of both convergence and divergence (p. 109).

The existence of spatial convergence is generally accepted both at national (regional) and international levels. Differential growth rates between core and peripheral areas have been evident in the US, in which the Sunbelt region (periphery) experienced much faster growth than the Snowbelt region (core). However, in recent years, there has been a slowdown in the process of spatial convergence (Amstrong, 1995; Maxwell, 1994). Therefore, in spite of decades of convergence, regional inequality still reveals a distinctive pattern of core-periphery relationship (Nissan and Carter, 1993). Rather than relying on a simple dichotomy, more contemporary patterns of spatial inequality might be described precisely as simultaneous existence of convergence and divergence. An important consideration for the analysis of spatial inequality is spatial scale. It has been noted that what appears to be convergence at one level might turn out to be divergence at different scale (Mehretu and Sommers, 1994).

A growing body of literature reports a new trend of increasing divergence since the 1980s (or mid 1970s), corresponding to the transformation of the capitalist accumulation system. Following this view, rapid economic growth and strong regional convergence during the Fordist era gave way to the slow economic growth and increasing inequality in the post-Fordist age (Dunford and Perrons, 1994). The new pattern of divergence has been affected by the changing macroeconomic environment of the 1980s, including oil shocks and conservative fiscal and monetary policies. In addition, changing patterns of population migration and business investment favoring prosperous regions promoted selective recentralization. Greater variation in patterns of regional growth implies an interruption of the trend of decades of decentralization (Abraham and Rompuy, 1995; Cheshire, 1995). Economic activities that are recentralized are selective, including control functions, advanced service and industrial sectors, and high status jobs and activities. In contrast, decentralization is limited primarily to less sophisticated jobs and activities (Dunford and Perrons, 1994).

Following Fan and Casetti (1994), three phases of regional development and patterns of spatial inequality can be identified: 1) polarization and divergence, 2) polarization reversal and convergence, and 3) re-divergence due to selective regional growth. The most recent phase of regional development was questioned and predicted earlier. Alonso (1980) expected that interregional income levels might cross over rather than stop at convergence, and geographic concentration would diminish up to the level at which negative dispersal emerges. A similar statement was expressed by Amos (1988), who hypothesized that once the inverted-U pattern is complete, spatial inequality will increase rather than remain stable. Therefore, it is apparent that polarization reversal is not equal to the spatial equilibrium proposed by neo-classical regional growth theories, but a short-term adjustment process to a new long-run equilibrium (Hansen, 1995).

Polarization Reversal

The term polarization reversal (PR) has been used primarily in the context of developing economies. This might be because most of advanced industrialized countries had already gone through the process of polarization reversal well before the term began to be used. Polarization reversal is defined as (Richardson, 1980):

> the turning point when spatial polarization trends in the national economy give way to a process of spatial dispersion out of the core region into other regions of the system (p. 67).

According to Richardson, there are several preconditions to be met both in core and periphery for PR to occur. First, PR requires obstacles to sustained rapid growth in core areas, including a rapid rise in land and labor costs, high levels of congestion, housing and infrastructure shortages, and high living costs. Next, agglomeration and scale economies have to be created in peripheral areas to accelerate decentralization of economic activities. Basic conditions for the generation of agglomeration economies in peripheral areas include the diffusion of technology, market expansion from income and population growth, lower factor costs, and improvement of infrastructure. Lo and Salih (1981) also noted four general conditions for PR. They are:

1) Full employment at the national level;

2) Agglomeration diseconomies in core areas;

3) Interregional linkages and spatial diffusion of knowledge; and

4) Complexity in business organization, including inter-firm communication systems.

These conditions seem to be difficult to realize in the earlier stages of development. Rather, they require a certain level of economic accumulation, which can be found in the later stages of industrialization. Among developing countries, leading industrializing countries will have a greater possibility of satisfying those conditions, assuming they have sizable national territory so that spatial dispersion can be meaningful.

One hardly mentioned point in the discussion of PR is how to identify the turning point. Spatial dispersion can be measured both in relative and absolute terms. It seems that Richardson (1980) considered a relative decrease in a core region's share of national economic indicators as the beginning of PR. However, a relative decrease in the share of a core region is not necessarily followed by widespread spatial dispersion. Spatial convergence can be observed without significant reduction of concentration. For example, it might reflect intra-regional convergence within core or periphery, not interregional convergence between core and periphery.

It was the early 1980s when Townroe and Keen (1984) argued that they had documented the first example of PR in a developing country, Brazil. Using population share, a relative measure, as the main index, they mentioned negative externalities in the core, such as congestion, pollution, crime, shortage of infrastructure, and soaring land prices as the major reasons for decentralization. In addition, location policies promoting decentralization and peripheral development were mentioned as the factors that accelerated PR in Brazil. Storper (1984) used industrial employment to measure spatial deconcentration in Brazil. However, Storper could not verify PR at the national level, although the central city, Sao Paulo, was losing employment to other regions within the core. This is the beginning stage of PR, according to Richardson's (1980) definition.

Decentralization was led by dynamic (as opposed to traditional) industries both at national and regional levels. In a later study, Storper (1991) presented detailed analysis of the spatial dispersion of industrial location in Brazil. Instead of PR, he employed a new term, *multiplication of spatial concentration* to describe spatial convergence and regional development in the context of post-Fordist flexible specialization in developing economies. Diniz (1994) used a similar notion, *poligonized development* to explain a new spatial pattern of concentrated decentralization in Brazil. According to Diniz, the trend in Brazil is far from the widespread decentralization which can be seen in advanced countries. It is a limited deconcentration resulting from several causal forces which are similar to those conditions proposed by Richardson (1980). The most obvious difference between Brazil and the US is the lack of fundamental conditions for the location of advanced technology based activities in Brazilian peripheries.

There are few studies dealing with polarization reversal in Korea. Richardson (1980) cited two previous studies to exemplify that PR was taking place in Korea. His argument was based on such indicators as a decline in the share of manufacturing output and a fall in the growth rates of population and GRP in Seoul, a reduction in regional income disparities, and the development of large-scale provincial industrial complexes. However, these relative measures cannot be valid indications of genuine PR in Korea. Well into the 1980s, the spatial concentration of major economic indicators in the Seoul metropolitan area was intensifying in spite of the relative decline of Seoul's share. Decentralization was largely limited to the core. Thus, those examples mentioned by Richardson (1980) represent, and only possibly, a beginning of PR. Lee's (1989) study of regional population growth in Korea during the 1970s supports this argument. She concluded that decentralization of population growth to smaller centers was confined to the core, the Seoul metropolitan area. In peripheral areas, polarization toward larger regional centers was the dominant pattern.

Inequalities in Regional Productivity

Studies of regional inequalities in manufacturing productivity, especially based on index measures such as the coefficient of variation or Gini coefficient, are scarce compared to the wide variety of research on regional income disparities. This is rather surprising, considering productivity is one of the most important components of the competitiveness of regional industries, and it affects regional wage levels, and thus regional incomes (Anderson, 1990; Ark, 1996; Baily et al, 1996). Most of the existing studies are focused on either temporal changes in the productivity of individual industries or sectoral differences at the national scale, rather than spatial variation of productivity. Moreover, studies of regional productivity do not offer a clear answer regarding the extent of spatial disparities in productive efficiency. In most cases, simplistic and aggregated indices of productivity are presented as evidence of interregional productivity disparities.

Systematic methods of examining regional productivity differentials were often carried out with multiple regression analysis. The main objective of regression analysis was to account for the variation in regional productivity by means of a set of causal factors, not to explain inequalities in productivity. In such analysis, spatial convergence of productivity is often tested using a *catch-up* variable. For example, the catch-up hypothesis is accepted when there is a negative and significant association between the initial level of regional productivity and growth rates during a subsequent period.

It might be useful to discuss the sources of catch-up. Abramobitz (1986) provides pioneering work on the theorization of the catch-up process. The gap between the leader and followers becomes reduced as the latter adopt newer capital that embodies best practice technology. The pace of catch up tends to diminish over time because frontier technologies cannot make large improvement whenever they are introduced. In a later study, Abramobitz (1990) listed five specific reasons for catch-up by the followers:

1) Embodied technology in new capital and disembodied technology in business organization and management;

2) Rapid capital accumulation;

3) Advances in educational system;

4) Reduction of redundant workers; and

5) Creation of the economies of scale

The catch up process has proved to be a powerful force in the economic growth of advanced industrialized countries. There was a significant reduction in productivity differentials among those nations. Baumol (1986) presented statistical evidence for the international catch up of productivity. A simple regression model using GDP data for 16 industrialized countries from 1870 to 1979, shows that the catch-up variable alone explains 88 percent of the variation of economic growth in these countries. Wolff (1991) computed the coefficient of variation of labor productivity using the same data set. The coefficient of variation of labor productivity has reduced from 0.48 in 1870 to 0.16 in 1979, indicating considerable convergence among the advanced countries. Baumol (1986) emphasizes the role of national policies for productivity improvement and the diffusion of productivity enhancing measures as major mechanisms of international convergence. According to Baumol, a measure that enhances productivity is *public goods* that can be shared by others. Wolff (1991) used the notion of *advantages of backwardness* for international diffusion of advanced technical knowledge. This is because imitation, through the transfer of technology and capital movement, is an easier and more realistic solution than innovation in improving productivity (Elmslie and Milberg, 1996).

The catch up hypothesis has also been applied to comparative studies of productivity between two countries. Dollar (1991), in a study of the convergence of labor productivity between Korea and Germany, showed that different sources of convergence exist for different industries. For heavy industries, rapid capital accumulation in Korea was the primary source of catch up, whereas technological advance was the main source for light industries. A similar study was done by Pilat (1995) for labor productivity differentials between Korea and the US, using capital intensity, scale economies, and worker education level. A large part of the gap remained unexplained, implying the existence of multiple sources of disparity that have not been measured.

Spatial inequality in productivity exists and generates variation in regional growth and development (Garofolo and Malhotra, 1989; Hulten and Schwab, 1984; Moomaw, 1981). In the US, the Snowbelt region generally has higher productivity than the Sunbelt, in spite of obsolete capital stock in the former and faster capital accumulation and lower factor cost in the latter. However, in terms of growth of productivity, the relationship is reversed or no difference can be seen between the regions. This is explained by the faster growth of capital accumulation, and thus output, in the Sunbelt (Garofolo and Malhotra, 1989; Moomaw and Williams, 1991; Williams and Moomaw, 1989).

In the meantime, urban industries tend to have superior productivity than those in rural areas because capital tends to be more intensely used in urban areas, reflecting the relative shortage of factory space and higher wages (Hansen, 1990; Nicholson, 1978). The urban advantage in productivity is explained by easier access to localization and urbanization economies. However, technological changes in telecommunication and production have increased the competitiveness of rural industries. Therefore, urban-rural disparities in productive efficiency can be expected to diminish over time due to the decline of agglomeration economies and concurrent improvement in rural conditions (Blackley, 1986; Carlino, 1985). Disparities exist between different sizes of settlement also, with more populous regions have advantages over smaller regions. A temporal reduction of inequality is expected for the same reason as the reduction in urban to rural disparities (Aberg, 1973; Moomaw, 1985; Soroka, 1994).

Hypotheses

Spatial convergence or divergence depends on differential performance between regions. Convergence will be observed if less developed regions that had lower levels of industrialization and productivity initially performed better than more advanced regions. If this did not happen, spatial divergence would dominate, aggravating regional disparities between advanced and depressed regions. In terms of industrial location, restructuring will promote the spatial shift of industrial location from heavily industrialized areas toward less industrialized areas. Thus, the first hypothesis regarding regional inequality in the location of manufacturing activities states:

I-1: Spatial convergence will be revealed through gross measures of industrial location - the number of firms, employment, output, fixed asset, factory site, and floor space.

Regional inequality in productivity will tend to be reduced through the diffusion of new production technology, management, and business organization, from the center of innovation toward less advanced regions. In addition, locational decentralization which brings about rapid capital accumulation in less industrialized areas will enable firms in these regions to introduce best practice production technology. Thus, the second hypotheses states:

I-2: Spatial convergence will also be the trend for industrial productivity.

Spatial decentralization of economic activities, in relative terms, began well before the Korean economy entered the period of restructuring (Richardson, 1980). Recent spatial restructuring is a response to the problems of overconcentration in a limited number of regions. Thus, decentralization is expected to continue at a wider spatial scale than before. However, it is unlikely that the regional divergence that has occurred in advanced economies will be the case in Korea. The spatial convergence process in Korea would not have reached the point where new divergence emerges between new industrial spaces and old centers. Thus, the third hypothesis states:

I-3: Korean manufacturing can be placed in the late stage of the inverted U type curve in which regional inequalities decrease consistently.

Methods of Research

Inequality Measures

Two indices of inequality will be calculated to examine the convergence/divergence of industrial activities: the Gini coefficient and the coefficient of variation. For both indices, each region will be weighted by its share to the national population. This is because the two indices are unduly affected by arbitrary political boundaries when unweighted measures are used. For example, it is not reasonable to expect that Seoul, with population of about 10 million, and a typical rural county, with population of less than one hundredth that of Seoul, will have the same impact on regional inequality. By employing weighted measures, larger cities contribute a larger share to inequality indices.

The two measures have different statistical characteristics. The Gini coefficient is known to be more responsive to changes in the middle class, rather than among the upper or lower classes (Braun, 1988). A stability of Gini scores over time reflects small changes in the middle class, compared to the high and low ends. Similarly, the growth of the middle class tends to reduce inequality by diminishing the share of the upper and lower classes, which is the heart of convergence hypothesis (Brown, 1991). Thus, the Gini coefficient is useful in examining the interregional transfer of income and economic activities. In contrast, the coefficient of variation is more sensitive to the values of upper and lower classes, and it is known to have a low correlation with Lorenz curve based measures such as the Gini index (Brown, 1988). The coefficient of variation has been widely used since Williamson (1965) employed the index to measure regional income inequality. The index is useful for examining the changing distribution of economic activity over space (Gaile, 1977; Maxwell, 1994).

Considering the different characteristics of the two measures, each measure must be used in an appropriate manner. The Gini coefficient will be more useful for measuring inequalities based on gross indicators of industrial location, while the coefficient of variation will be better for productivity. The value of the national average, an important component of the coefficient of variation, has much more meaning for productivity measures than for location indicators. Similarly, regional summation, an important component of the Gini coefficient, does not have any meaning for regional productivity compared to gross indicators. Therefore, the Gini coefficient will be used for aggregate regional indicators (number of firms, employment, output, fixed assets, site area, and floor space), whereas the coefficient of variation will be employed for productivity measures (labor, capital and total factor productivity). Inequality indices will be computed for three points in time (1983, 1988, and 1993) to examine temporal changes. The indices will be compared between different regions (urban and rural, industrialized and less industrialized, and core and periphery).

The coefficient of variation (CV) weighted by population is computed using the following formula (Gaile, 1977):

$$C.V. = \sqrt{\left[\sum (X_i - \overline{X})^2 P_i\right]} \Big/ \overline{X} \qquad (4\text{-}1)$$

where, X_i is an industrial indicator of region *i*; $\overline{X}$ is the national mean of the industrial indicator; and P_i is the population share of region *i* to the nation.

The weighted Gini coefficient (G) is obtained using the following formula (Gaile, 1977; Hammond and McCullagh, 1974; Morgan, 1962):

$$G = 1 - \sum (P_{i+1} - P_i)(X_{i+1} + X_i) \qquad (4\text{-}2)$$

where, P_i is the cumulative percent of population up to the *i*th ranked region; and X_i is the cumulative percent of the manufacturing indicator up to the *i*th ranked region.

Regression Analysis

A series of bivariate regression models will be employed to test spatial catch up or convergence of industrial location and regional productivity. The model was introduced by Baumol (1986), and is expressed as follows:

$$Ln(Y_{t2}/Y_{t1}) = a + b_1 LnY_{t1} \qquad (4\text{-}3)$$

where: Y denotes an industrial indicator and the subscripts represent time. The generic model of equation (4-3) can be expressed as follows by taking anti-logs:

$Y_{t2} = a^{*} Y_{t1}^{c}$, where: $c = b_1 + 1$

The left term of the equation (4-3) is the growth rate of an index of location or productivity over two time points. The intercept (a) of the equation can be considered the scaling factor, adjusting scale differences between various industrial indices. Of primary significance in the analysis of spatial inequality is the slope term (b_1), which indicates the direction of change in those indices. A negative and significant coefficient b_1 supports the catch-up or convergence hypothesis. This suggests that more rapidly growing regions were at low levels and those with lower growth rates were at high levels at the initial point in time. In the same manner, a positive coefficient suggests spatial divergence.

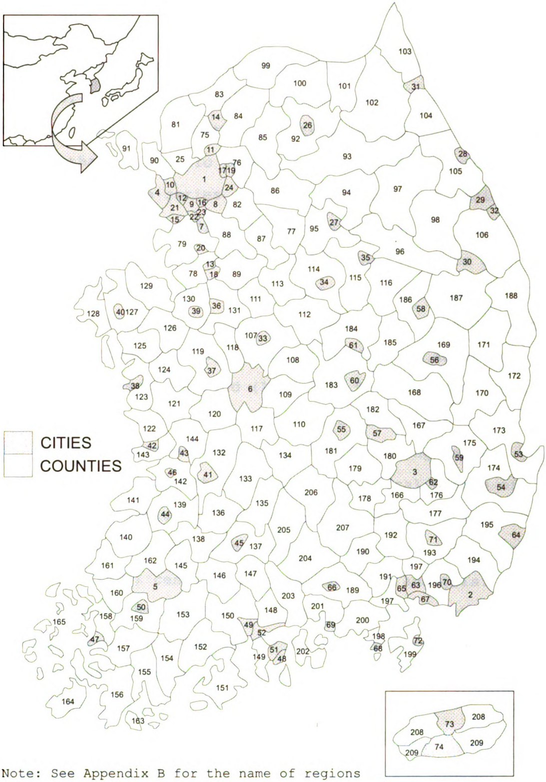
The next chapter will discuss the research area and data. First, the temporal and spatial scope of the research will be defined. Changes in the number of administrative areas (cities and counties), the basic observational units of the statistical analyses, will be explained. Next, the sources of research data will be presented, followed by a discussion of estimation procedures for data not directly available from published censuses.

Chapter 5

RESEARCH DATA

This study focuses on the spatial aspects of recent industrial changes, from 1983 to 1993. These ten years will be divided into two sub-periods, from 1983 to 1988 and from 1988 to 1993. The year 1988 is a turning point for the growth of Korean manufacturing employment. Manufacturing employment reached its highest level in 1988 and decreased until 1992, increasing slightly in 1993. Therefore, the first five years are an extension of the period of rapid industrialization since the early 1960s, whereas the last five years are considered restructuring period. It is expected that some characteristic differences in the spatial processes of Korean manufacturing industry can be revealed through the comparison of these two periods.

Analyses will be carried out at city and county level (Figure 1). There are 73 cities and 137 counties as of 1993, excluding two remote island counties without meaningful industrial activities. Under the Korean administrative system during the research period, cities and counties are independent political units with no common territory. The administrative areas of cities are equivalent to urban areas



Note: See Appendix B for the name of regions

Figure 1 - Research Area

and those of counties are equivalent to rural areas. There have been changes in the number of administration areas. The number of cities grew from 52 in 1983 to 73 for years 1988 and 1993, reflecting population increase in the new cities. Usually a town is promoted to city when its population grows to more than 50,000. To resolve problems of consistency in the regional data series (because the number of regional units is fewer in 1983), a slight adjustment was made for the first time period (1983 - 1988). The 1988 data for the 21 new cities were added to the data of their mother counties. Therefore, there are 187 regional units (52 cities and 135 counties) during the first period. No adjustment was made for the second period (1988-93). There are 208 units (73 cities and 135 counties) during this period.

The main data source is the manufacturing census compiled annually by the National Statistical Office of Korea. The census covers all establishments with five or more workers. The beginning (1983), mid-point (1988) and the last year (1993) censuses will be used for analysis. The regional data that will be analyzed is based on the various gross manufacturing indices at city and county level. Sectoral data, not available at city and county levels, will not be considered.

Non-manufacturing data include expressway accessibility, land price and population. The Ministry of Construction and Transportation compiles an annual report on the change of land prices. The data on 1993 regional industrial land prices were obtained from the Korea Research Institute for Human Settlement. The data for 1983 and 1988 regional land prices were estimated by applying annual price change rates to the 1993 data. Expressway accessibility can be identified using transportation maps. The Ministry of Internal Affairs publishes a population registration in non-census years and the National Statistical Office compiles population census every five years. The years 1983, 1988, and 1993 are not covered by the census.

To measure productivity, value added, not gross output, is used for manufacturing output. All monetary values are converted to constant price using manufacturing GNP deflators. The number of workers is multiplied by annual work hours to compute labor inputs. In addition, the amount of net fixed assets, excluding land assets from total fixed assets, is used for capital input. Thus, an independent capital stock series is not estimated using such a technique as perpetual inventory method, which is often used to adjust the book value of census data to real capital stock using depreciation and inflation rates. In Korea, capital investment data are not available at city and county levels. In addition, depreciation is already reflected in the census. Thus, only the effect of inflation is not reflected in Korean data. Even this omission can be excused assuming that firms consider inflation when they decide depreciation rates, thus trying to reflect the current price of capital on the book. If this is not the case, the capital stock of regions with a long history of industrialization will be underestimated compared to recently industrializing regions.

Since there are no land asset data at city and county levels, data are estimated using manufacturing censuses and the land price data. First, average industrial land prices per square meter are estimated in each region using surveyed land prices. Next, total value of industrial land assets in each region was obtained by multiplying the region's average land price by the area of factory sites in the region (from the manufacturing census). The estimated regional land assets must be adjusted to the census land assets. To accomplish this, the percentage share of each region's estimated land assets to the province's estimated land assets (the sum of estimated regional land assets) was applied to provincial census data to get the final estimation of regional land assets. Now, it is possible to use net fixed asset data as a surrogate for capital stock by subtracting land assets from total fixed assets. This enables estimation of the effect of capital stock more accurately, and separation of the effect of changes in land assets on the location and productivity.

The following chapter will present the results of the analysis. The sequence will follow the order of the literature review. Thus, the analysis of changes in industrial location will be presented first. Then regional productivity will be examined, followed by the analysis of regional inequalities.

Chapter 6

RESULTS OF ANALYSIS

Industrial Restructuring and Location

Industrial Location

Major indicators of Korean manufacturing exhibited a rapid and linear growth pattern throughout the research period (Table 1). The single most obvious difference between the period of industrialization (1983-88) and that of restructuring (1988-93) is the growth of employment. There was an absolute decline in the amount of employment during the second period. The rapid growth of service related jobs, the social tendency to avoid so called 3D (difficult, dirty, and dangerous) jobs, and the rapid rises in wages are considered the most important factors that contributed to decreases in the number of industrial workers. Declining labor hours further reduced total labor inputs, which is represented by smaller figures in man-hours. In fact, with the exceptions of these two changes, the two periods do not show significant differences in the pattern of growth. The sudden decrease in manufacturing employment means that the

Table 1 - Major Indices of Manufacturing Industry

	1983	1988	1993
Establishments	100	153	226
Employment	100	141	130
Man-hours	100	136	117
Fixed asset	100	199	448
Gross output	100	204	320
Value added	100	213	393
Floor space	100	154	238
Site Area	100	133	193

Note: Gross output, value added, and fixed asset are based on constant price.

country had to search for a new strategy of industrial development. The very rapid increase in fixed assets suggests that capital investment became a primary alternative option.

In the following analyses, manufacturing employment will be used as the basic index of industrial location because change in employment growth is the most obvious evidence of industrial restructuring. First, comparison of manufacturing employment changes between industrializing and restructuring periods is carried out for urban and rural areas (Table 2). Since the initiation of a series of economic development plans in the early 1960s, manufacturing concentrated heavily in urban areas, as the market of industrial output and the center of the labor market (Figure 2). During the period from 1983-1988, urban areas accounted for about two-thirds of manufacturing employment growth. The amount of growth in urban areas was about two-fold that of gains in rural areas. Within urban areas, larger cities with population greater than 100,000 absorbed the majority of growth. However, in relative terms, a group of the smallest cities performed best. Six metropolitan cities with population of more than one million experienced the lowest growth rates. Within rural areas, counties adjacent to urban areas accounted for 77 percent of rural manufacturing employment growth. Of adjacent counties, those near metropolitan centers gained more employment than those near smaller cities. In relative terms, however, there was no significant difference between the three types of rural counties.

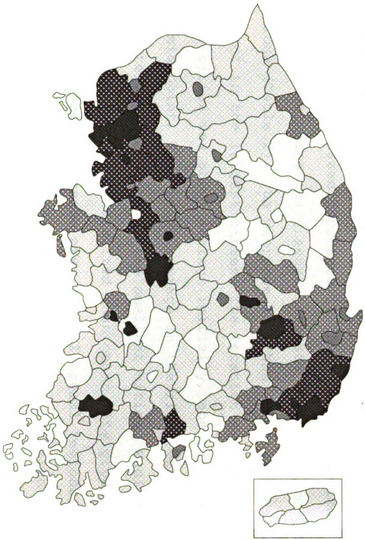
The restructuring period (1988-1993) reveals dramatic differences in the growth of manufacturing employment between urban and rural areas (Figure 3). Urban areas recorded a large decrease while rural areas continued to add manufacturing jobs, although at a reduced rate (Table 2). The loss of urban manufacturing employment was most significant in the largest cities, both in absolute and relative terms, accounting for more than 80 percent of the loss in urban regions. Medium sized cities also lost employment, but not as drastically as in the largest cities. It is notable that the smallest cities gained employment in spite of the general deindustrialization trend of urban economies. On the contrary, all types of rural regions gained manufacturing employment during the restructuring period. Those rural counties adjacent to urban areas gained more employment than nonadjacent counties, accounting for more than two thirds of the growth in total rural manufacturing jobs. The share of nonadjacent rural regions increased during the restructuring period, which is most apparent in growth rates.

One of the most obvious phenomena during the restructuring period is the deurbanization of industrial employment and resulting rural industrialization. During the previous period, urban areas added much more employment than rural areas, although the growth rate was higher in rural

Table 2 - Industrial Location Change by Urban and Rural Region

	Location Quotient				Employment Change			
	1983	1988(A)	1988(B)	1993	1983-88	1988-93	1988(C)	1993(D)
Nation	1.00	1.00	1.00	1.00	905,689	-236,441	1.41	0.92
Urban	1.30	1.13	1.14	0.98	599,099	-414,010	1.33	0.84
Metropolitan	1.22	1.01	1.01	0.83	285,748	-338,781	1.24	0.77
Medium	1.60	1.37	1.46	1.26	233,500	-99,840	1.40	0.89
Small	0.94	1.46	0.98	1.16	79,851	24,611	2.34	1.14
Rural	0.47	0.71	0.64	1.07	306,590	177,569	1.82	1.33
Adjacent	0.69	1.00	0.88	1.37	237,400	129,534	1.81	1.29
Metropolitan	0.99	1.31	1.20	1.71	130,351	52,899	1.79	1.26
Nonmetropolitan	0.50	0.77	0.72	1.18	107,049	76,635	1.82	1.32
Nonadjacent	0.21	0.34	0.28	0.58	69,190	48,035	1.86	1.50

Note: 1) (A): Administrative areas are based on the year 1983
(B): Administrative areas are based on the year 1993
2) (C), (D): 1983 and 1988 = 1.00
3) Metropolitan Cities: Seoul, Pusan, Taegu, Inchon, Kwangju, and Taejon
Medium cities: non-metropolitan cities with population larger than 100,000 in 1983 and 1988
Small cities: non-metropolitan cities with population smaller than 100,000 in 1983 and 1988



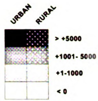


Figure 2 - Change in Employment (1983-1988)

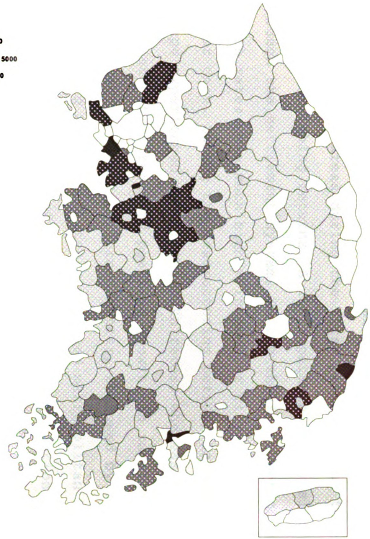
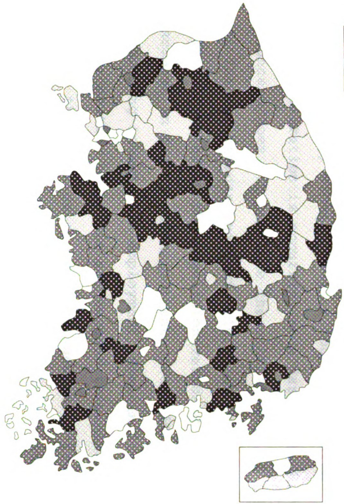
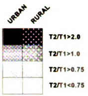


Figure 3 - Change in Employment (1988-1993)

areas. The large absolute increase, though lower growth rate, in urban areas during the first period is due to the law of diminishing returns. A clear pattern is revealed through the settlement system. During the first period, growth rates were much higher in smaller city groups than in larger ones. During the restructuring period, larger city groups experienced negative growth rates, whereas the smallest cities recorded positive growth. In rural areas, nonadjacent counties performed better, followed by counties adjacent to nonmetropolitan cities and metropolitan cities. Therefore, the trend of locational decentralization is true for rural, as well as urban, areas.

The accelerated deurbanization and decentralization of manufacturing employment are much more apparent in changes in location quotients (Figures 4 and 5). Urban areas as a whole have witnessed decreases in the location quotients, whereas rural areas have seen increases over the time periods (Table 2). The decrease in urban areas was most evident in the largest cities. The location quotient of these cities was above average initially, about average at the mid-point, then below average in the final year. The opposite trend is seen in the smallest cities. Medium sized cities are more industrialized than other city groups, but tended to lose dominance over time. In rural regions, all types of counties experienced increases in location quotients throughout the research period. The location quotient for rural areas as a whole was only 36 percent that





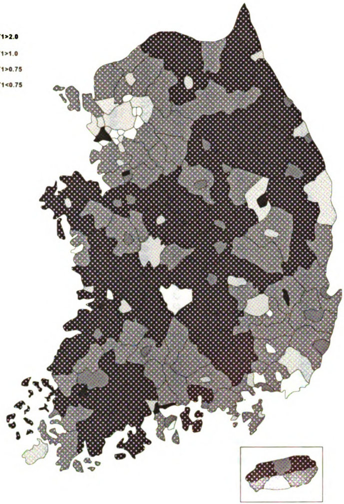


Figure 4 - Change in Location Quotient (1983-1988)

Figure 5 - Change in Location Quotient (1988-1993)

of urban areas in 1983 but became higher than urban areas in 1993. In fact, rural areas, especially those adjacent to metropolitan cities, became the most highly industrialized in 1993.

One point to be kept in mind is that changes in location quotient were affected by regional population shifts. In most cases, an increase in the location quotient was accompanied by an increase in manufacturing employment. In the same manner, a decrease in the location quotient does not always mean the loss of employment. As can be seen in Table 2, the location quotient decreased in urban areas during 1983-1988 in spite of significant increases in total employment. Thus over-dependence on the location quotient as an indicator of spatial restructuring of industrial location can be misleading, especially in a society in which population migration is occurring at a fast rate. However, this concern does not preclude the significance of the index. This is because industrial location has meaning only when it is related to the population residing in a region. An increase in the location quotient, even without a corresponding increase in employment, does indicate that a larger proportion of people are engaged in manufacturing activities that provide an important source of regional income, which is a higher state of industrialization.

An additional comparison of industrial location change during industrializing and restructuring periods is carried out by examining the level of industrialization (Table 3).

Regional categorization is based on the location quotient. Industrialized regions are those with a location quotient larger than unity, while less industrialized regions are those with less than unity. The breaking point between highly and modestly industrialized regions is a location quotient of 2.0, whereas that for moderately less and the least industrialized regions is set to 0.2.

Dramatic changes are revealed in employment growth during the two time periods. During the industrializing period (1983-88), two types of industrialized regions accounted for more than two thirds of total growth. Within industrialized areas, highly industrialized regions gained more than 60 percent of the growth. The vast number of the least industrialized regions, mostly rural counties, accounted for only 4 percent of national growth. These facts suggest that the spatial concentration of industrial location proceeded within established industrial areas during the rapidly industrializing period.

Remarkable changes occurred during restructuring period (1988-93). The most highly and the least industrialized regions moved in opposite direction from moderately industrialized and moderately less industrialized regions. Moderately industrialized areas led deindustrialization, accounting for more than 90 percent of the decrease in national manufacturing employment. The loss is equivalent to more than 20 percent of base employment, or about one-third of the gain from the previous period. The least industrialized regions added more than 60 percent of base employment during the restructuring period. The most highly industrialized regions also experienced a net gain, but the size was negligible compared to industrializing years.

The differential performance by regions of different levels of industrialization was revealed through changes in the location quotients (Table 3). Two industrialized regions and moderately less industrialized regions experienced a decline in the LQ. Only the least industrialized areas witnessed an increase in the LQ. As a result, there was a general decline in the disparity in the index between industrialized and less industrialized regions. In 1983, the location quotient of the most highly industrialized group was 28 times larger than that of the least industrialized group. The difference diminished to 11 times in 1993.

The results strongly suggest that the classic core-periphery model is not a valid analytical framework for the explanation and prediction of locational changes in contemporary Korea. The majority of employment loss has occurred in established areas, while employment has grown in the least favorable regions. It must be emphasized, however, that the most heavily industrialized regions did not lose employment. The decline in the location quotient of this region is due to greater population growth. The ascendance of the least industrialized areas and the status quo of the most highly industrialized areas are somewhat different from advanced economies, in which traditional industrial centers

Table 3 - Industrial Location Change by Industrialization and Core-Periphery

	Location Quotient				Employment Change			
	1983	1988(A)	1988(B)	1993	1883-88	1988-93	1988(C)	1993(D)
Nation	1.00	1.00	1.00	1.00	905,689	-236,441	1.41	0.92
Industrialization								
Industrialized	2.06	1.84	1.87	1.67	621,570	-199,676	1.44	0.90
Highly	2.80	2.49	2.79	2.52	387,937	19,093	1.58	1.02
Moderately	1.67	1.44	1.40	1.15	233,633	-218,769	1.31	0.79
Less industrialized	0.52	0.54	0.52	0.57	284,119	-36,765	1.36	0.96
Moderately	0.71	0.68	0.64	0.65	245,186	-67,619	1.33	0.93
Least	0.10	0.16	0.11	0.24	38,933	30,854	1.81	1.63
Core-periphery								
Core	1.29	1.23	1.23	1.14	778,150	-303,344	1.40	0.89
Capital	1.24	1.19	1.19	1.06	492,644	-151,082	1.48	0.90
Southeast	1.36	1.30	1.30	1.26	285,506	-152,262	1.31	0.87
Periphery	0.39	0.44	0.44	0.62	127,539	66,903	1.45	1.16
Southwest	0.43	0.49	0.49	0.68	119,188	57,688	1.47	1.15
Others	0.19	0.20	0.20	0.32	8,351	9,215	1.34	1.28

Note: 1) (A): Administrative areas are based on the year 1983
(B): Administrative areas are based on the year 1993
2) (C), (D): 1983 and 1988 = 1.00
3) Industrialization is based on the LQ in 1983 and 1988
Highly industrialized regions are those with LQ larger than 2.0
Moderately industrialized regions are those with LQ larger than 1.0
Moderately less-industrialized regions are those with LQ larger than 0.2
Least industrialized regions are those with LQ less than 0.2
4) Capital Region: Seoul, Inchon, and Kyunggi Province
South-east Region: Pusan, Taegu, and Kyungsang Provinces
South-west Region: Kwangju, Taejon, and Jolla and Choongchong Provinces
Other Region: Kwangwon and Cheju Provinces

are losing competitiveness and the most peripheral areas have remained largely underdeveloped. These characteristics are also quite different from developing nations in which acute spatial disparities are persistent between a limited number of core areas and the vast majority of peripheral areas.

A third comparison of industrial location change during the two periods focuses on core and peripheral areas (Table 3). The purpose of the core-periphery comparison is not to emphasize the disparities between the two regions, but to provide a new dimension with regard to recent industrial location changes in Korea. The spatial scale of core and periphery is relatively large, namely at the metropolitan city and provincial level. As of 1993, there were six metropolitan cities with more than a million population. The four largest metropolitan cities - Seoul (No.1 in Figure 1), Pusan (2), Taegu (3), and Inchon (4), and three provinces - Kyonggi (cities 7-24, counties 75-91 including 25) and Kyongsang (North and South: cities 53-72, counties 166-207) surrounding these cities are grouped as the core. Thus, geographically, core areas are not contiguous, but are two separate units: the capital region and the Southeast region. In 1983, 87 percent of national manufacturing employment and 67 percent of population were concentrated in the two cores. Peripheral areas include the Southwest region - the metropolitan cities of Kwangjoo (5) and Taejon (6), and the provinces of Choongchong (North and South: cities 33-40, counties 107-131), Cholla (North and South: cities 41-52, counties 132-165), and remaining regions (Kangwon: cities 26-32, counties 92-106, and Cheju: cities 73-74, counties 208-209). It should be noted that the two metropolitan cities and few growth centers in the periphery are by no means peripheries in the rigorous sense.

During the industrializing period (1983-88), manufacturing employment change shows a typical core-periphery relationship (Table 3). Core regions accounted for as much as 86 percent of new manufacturing jobs, well above the share of industrialized areas as a whole or that of urban areas. Within core regions, the capital region absorbed more than one half of national employment growth, while the Southeast region accounted for about one third. Peripheral areas attracted only 14 percent of new manufacturing employment in the nation during the period. The Southwest region accounted for most of employment growth of peripheral areas. Other regions attracted less than one percent of the national gains in industrial jobs. In relative terms, however, there was no significant difference between core and peripheral areas. Even the least industrialized peripheral areas performed as well as the heavily industrialized Southeast region in terms of growth. Therefore, the pattern during the first period can be summarized as universal gains in terms of growth rates, but a clear core-periphery relationship in absolute growth.

There was a radical breakup in the long-lasting core-periphery pattern of manufacturing employment growth during the restructuring period (1988-93). Core regions lost a considerable number of industrial workers during the restructuring period (Table 3). In fact, employment losses of core regions exceeded total national decreases. The capital region and the Southeast region lost about the same amount of employment, roughly equivalent to 10 percent of base employment. Peripheral areas recorded a net gain, although absolute growth was reduced to one half that of the previous period. Most of the growth occurred in the Southwest region, but other peripheral areas did much better in relative terms. In fact, these areas added more employment during the restructuring period than the previous period. Therefore, the relationship between core and periphery was completely reversed during restructuring, which might be comparable to the Snowbelt-Sunbelt shift in the US, though at a smaller scale.

Location quotients mirror the regional shift of manufacturing employment growth, from core regions toward peripheral areas. The indices of industrial concentration decreased in core regions and increased in the peripheral regions (Table 3). In particular, the capital region, which had a solid level of industrial concentration in the early 1980s, is not an especially industrialized region when population is considered. The Southeast region has maintained its status as the industrial heartland of Korea.

Peripheral areas, while still less industrialized than the nation as a whole, are rapidly catching up to core regions. The difference in the location quotient between the highly industrialized Southeast region and the least industrialized peripheral areas was reduced by about one half during the ten year period.

The last part of this section examines the pattern of growth in manufacturing employment by regional types (Table 4 and 5). Each city and county is classified into one of four categories depending on its growth rate in employment for each period. The first category is composed of 'rapidly industrializing' (RI) regions that have more than doubled manufacturing employment during the five year period. The next category applies to 'moderately industrializing' (MI) regions. They also have gained employment but the growth was less than two times of the initial level. The third category refers to 'moderately deindustrializing' (MD) regions that have lost less than one quarter of base employment. The last category includes 'rapidly deindustrializing' (RD) regions which have lost more than one quarter of base employment. The number of regions in each category shows that how many regions in that category are industrializing or deindustrializing, whether rapidly or moderately.

Of the 51 regions (out of 187) that fall into the first category (RI) during 1983-88, about 90 percent are rural counties (Table 4 and Figure 6). Only five cities more than doubled their manufacturing employment during this period.

Of the 46 rural counties in this category, half of them were located around urban areas and another half were distant from urban centers. Rural counties adjacent to metropolitan cities were more likely to experience rapid industrialization than those adjacent to nonmetropolitan cities. Rapidly industrializing regions were fairly evenly distributed between core and peripheral regions (Figure 6). In addition, about the same percentage of core regions and peripheral regions experienced rapid industrialization during the period. Within the core, the capital region had a higher percentage of rapidly industrialized areas than the Southeast region. Within the periphery, the Southwest region had a higher percent of rapidly industrializing areas. Therefore, the distribution of rapidly industrializing regions is not biased toward a specific type of regions, although rural areas adjacent to metropolitan centers and the capital region comprised a slightly higher proportion of this category.

During the 1988-93 period, the number of rapidly industrializing regions decreased to 35 (from 51) in spite of the increase in the total number of administrative areas (Table 5). The absolute majority of rapidly industrializing regions is located in rural areas (Figure 7). Only three small cities expanded manufacturing employment more than 100 percent during the restructuring period. Within rural areas, nonadjacent counties had a higher proportion of rapidly industrialized region than adjacent counties. The relationship between core and periphery displayed significant differences from the pervious period. Of the 35 rapidly industrialized regions, 22 were located in peripheral areas. Within the core, only two regions were found in the capital region, a substantial reduction from the 11 during the previous period. Within the periphery, about 20 percent of both the Southwest and other regions were rapidly industrializing regions. Therefore, during the restructuring period, rapidly industrializing areas were much more likely to be found in rural areas, especially distant from the Seoul metropolitan region. This is an apparent indication of the ongoing spatial shift in manufacturing employment from established urban industrial centers toward formerly less industrialized peripheral rural areas. These results also suggest that spatial spread or trickling down of industrial location in Korea began well before the industrial restructuring.

The second category (MI) does not display notable changes in the aggregate number during the two periods (Tables 4 and 5). Overall, more than one half of all regions belong to this category during both periods. However, the spatial distribution of this group is quite different during each period especially for urban and rural areas. During the industrializing period (1983-88), 41 of 52 cities, including all metropolitan cities, were classified as modestly industrialized regions. This number declined to 24 (out of 73) during the restructuring period (1988-93). Although all

Table 4 - Regional Types and Patterns of Industrialization (1983-88)

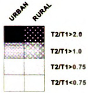
	Total	RI	MI	MD	RD	Total	RI	MI	MD	RD
		(Number of Region)					(Percentage)			
Nation	187	51	108	18	10	100.0	27.3	57.8	9.6	5.3
Urban & Rural										
Urban	52	5	41	4	2	100.0	9.6	78.8	7.7	3.8
Metropolitan	6	-	6	-	-	100.0	-	100.0	-	-
Medium	30	2	24	3	1	100.0	6.7	80.0	10.0	3.3
Small	16	3	11	1	1	100.0	18.8	68.8	6.3	6.3
Rural	135	46	67	14	8	100.0	34.1	49.6	10.4	5.9
Adjacent	68	23	39	4	2	100.0	33.8	57.4	5.9	2.9
Metro.	25	10	15	-	-	100.0	40.0	60.0	-	-
Nonmetro.	43	13	24	4	2	100.0	30.2	55.8	9.3	4.7
Nonadjacent	67	23	28	10	6	100.0	34.3	41.8	14.9	9.0
Core & Periphery										
Core	88	25	50	10	3	100.0	28.4	56.8	11.4	3.4
Capital	29	11	17	1	-	100.0	37.9	58.6	3.4	-
Southeast	59	14	33	9	3	100.0	23.7	55.9	15.3	5.1
Periphery	99	26	58	8	7	100.0	26.3	58.6	8.1	7.1
Southwest	74	22	42	4	6	100.0	29.7	56.8	5.4	8.1
Others	25	4	16	4	1	100.0	16.0	64.0	16.0	4.0

Note: RI: rapidly industrializing, growth of employment > 100%
MI: moderately industrializing, growth of employment > 0%, < 100%
MD: moderately deindustrializing, growth of employment < 0%, > -25%
RD: rapidly deindustrializing, growth of employment < -25%

Table 5 - Regional Types and Patterns of Industrialization (1988-93)

	Total	RI	MI	MD	RD	Total	RI	MI	MD	RD
		(Number of Region)					(Percentage)			
Nation	208	35	108	43	22	100.0	16.8	51.9	20.7	10.6
Urban & Rural										
Urban	73	3	24	29	17	100.0	4.1	32.9	39.7	23.3
Metropolitan	6	-	1	3	2	100.0	-	16.7	50.0	33.3
Medium	32	-	9	15	8	100.0	-	28.1	46.9	25.0
Small	35	3	14	11	7	100.0	8.6	40.0	31.4	20.0
Rural	135	32	84	14	5	100.0	23.7	62.2	10.4	3.7
Adjacent	74	14	52	7	1	100.0	18.9	70.3	9.5	1.4
Metro.	23	5	16	2	-	100.0	21.7	69.6	8.7	-
Nonmetro.	51	9	36	5	1	100.0	17.6	70.6	9.8	2.0
Nonadjacent	61	18	32	7	4	100.0	29.5	52.5	11.5	6.6
Core & Periphery										
Core	101	13	48	27	13	100.0	12.9	47.5	26.7	12.9
Capital	37	2	15	13	7	100.0	5.4	40.5	35.1	18.9
Southeast	64	11	33	14	6	100.0	17.2	51.6	21.9	9.4
Periphery	107	22	60	16	9	100.0	20.6	56.1	15.0	8.4
Southwest	81	17	47	11	6	100.0	21.0	58.0	13.6	7.4
Others	26	5	13	5	3	100.0	19.2	50.0	19.2	11.5

Note: RI: rapidly industrializing, growth of employment > 100%
MI: moderately industrializing, growth of employment > 0%, < 100%
MD: moderately deindustrializing, growth of employment < 0%, > -25%
RD: rapidly deindustrializing, growth of employment < -25%



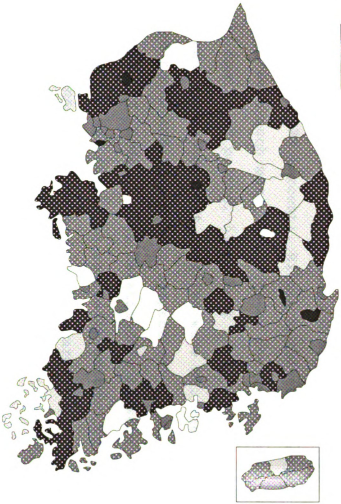


Figure 6 - Growth of Employment (1983-1988)

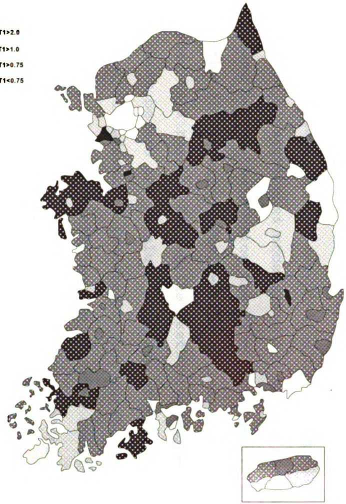


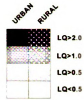
Figure 7 - Growth of Employment (1988-1993)

six metropolitan cities were found in this category during the first period, the number had been reduced to one during the second period. In addition, only nine medium sized cities were classified as moderately industrializing during the second period, well below the 24 cities identified during the first period. Small-sized cities showed a slight increase. As a result, during the restructuring period, rural areas became the absolute majority of the MI group. The number of moderately industrializing rural areas increased by 17, whereas the number of urban areas decreased by 17. Twelve of these rural counties were located adjacent to nonmetropolitan cities. More than 60 percent of rural counties were classified as MI during the restructuring period, an increase from about 50 percent during the previous period. This figure is much higher than that of urban regions (33 percent). Within rural areas, adjacent counties were much more likely to be found in this group. During the first period, 57 percent of adjacent counties and 42 percent of nonadjacent counties were MI. The figures changed to 70 and 53 percent, respectively, during the second period. However, the relationship between core and periphery did not change as radically as that of urban and rural regions. Both the number and share of MI region did not show significant changes between the two periods.

The number of regions categorized as MD more than doubled during the restructuring period (Tables 4, 5 and Figures 6, 7). A clear spatial pattern can be recognized by comparing the two periods. During the industrializing period, there were only four moderately deindustrializing cities. This number increased to 29 cities during the restructuring period, evidence that deindustrialization was not confined to a limited number of urban areas. The category MD became dominant for larger urban areas. Rural areas did not experience a change in their numbers as a whole. There was a slight increase among adjacent counties, but a small decrease among nonadjacent counties. Core and periphery had roughly the same number of moderately deindustrializing regions during the first period. The number of MD regions increased for both types of region though increases were more than two times greater in core areas. Within the core, the rapid increase in the number of modestly deindustrializing regions was mostly attributable to the capital region, which accounted for 12 of 17 additions. Within the periphery, the Southwest region accounted for 7 of 8 increases.

The last category (RD) exhibits a spatial pattern similar to that of moderately deindustrializing regions (Tables 4, 5 and Figures 6, 7). Only two rapidly deindustrializing cities were identified during the first period, but the number increased to 17 during the second period. All sizes of urban areas experienced increases, led by medium sized cities accounting for 60 percent of the change. Rural areas, on the contrary, showed a slight decrease. None of the rural counties adjacent to metropolitan cities experienced rapid deindustrialization during either period. The most radical change can be seen in the comparison between the core and periphery. During the first period, three core regions and seven peripheral regions were grouped as rapidly deindustrializing. The number changed to thirteen and nine, respectively, during restructuring. Within the core, no part of the capital region was classified as rapidly deindustrializing in the first period. However, seven regions emerged as rapidly deindustrializing during the second period. The Southeast region also witnessed an increase. The periphery added only two RD regions during the second period.

Significant changes also have occurred in the pattern of the growth of manufacturing employment between different types of region. During the industrializing period, urban areas and their adjacent rural areas attracted a majority of new industrial employment. In addition, a greater portion of core areas performed well in gaining manufacturing jobs. Industrial restructuring has had a different impact depending on the geographical location and level of industrialization of a region. Whereas more advanced areas were heavily affected by the national trend of deindustrialization, most disadvantaged areas were not adversely affected. As a result, less developed regions have emerged as newly industrializing spaces. This spatial process is very similar to patterns that have occurred in advanced industrialized countries. Comparing two maps



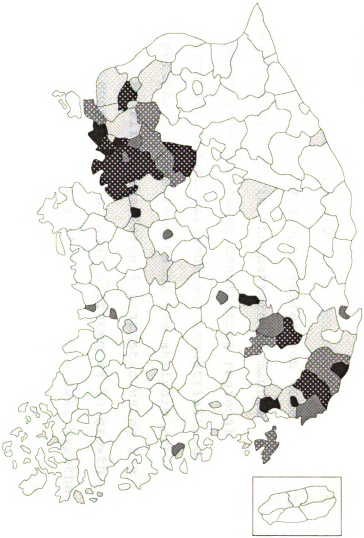


Figure 8 - Location Quotient (1983)

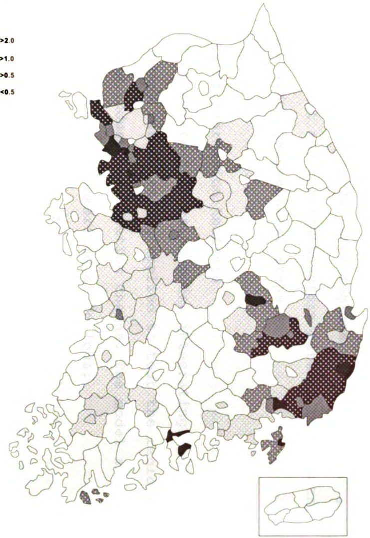


Figure 9 - Location Quotient (1993)

(Figures 8 and 9), it is apparent that industrial location has spread from the two core regions, the capital region in the northeast and the southeastern part of the country, towards wider geographical areas.

Results of Regression Analysis

A bivariate regression model integrating intercept and slope dummy variables was applied to test the regional effect on industrial location change. The model and hypotheses can be summarized as follows:

Model: $\Delta LQ = (a + b2) + (b1 + b3)LQt1 + e$,

where: b2 and b3 are intercept and slope dummies.

Hypotheses:

H1: $b2 = 0$

H2: $b3 = 0$

H3: $b2 = b3 = 0$

Results from the simple regression model confirm overall differences in the pattern of manufacturing employment growth between contrasting regional types (urban/rural, industrialized/less industrialized, and core/periphery). The results of the analysis are presented in Table 6. First, the large F statistic using the *Chow test* strongly supports structural differences in growth patterns between the three pairs of regions. The null hypothesis of the Chow test ($b_2 = b_3 = 0$) is rejected for both industrializing and restructuring periods. In addition, the F statistic is consistently larger for the second period, suggesting a larger structural difference during the later period. With regard to the intercept dummy, the null hypothesis ($b_2 = 0$) is rejected only for industrialized versus less industrialized regions. This result can be disregarded because regional categorization is based on the location quotient in the beginning points. However, the null hypothesis assuming an identical initial level of industrial development between rural and urban areas, and core and periphery, cannot be rejected for any period. With regard to the slope dummy, the null hypothesis ($b_3 = 0$) is rejected in all cases with the exception for core versus periphery during the first period. This implies significant regional differentials in the growth rate of manufacturing employment between two opposite type of regions. Again, the test statistics are consistently larger for the restructuring period, indicating increasing differentials between the regions.

The results demonstrate not only differential growth patterns between contrasting regional types, but also structural changes in the trend of industrial location between the industrializing and restructuring periods. In addition, the regression analysis provides evidence of spatial convergence or catch-up process. The coefficients of intercept dummies are positive in five out of six cases, and those of slope dummies are negative in five out of six cases. The positive intercept and negative slope indicate that benchmark regions (urban, industrialized, and core

Table 6 - Test of Regional Effect on Location Change

	Urban/Rural	Industrialized /Less-indus.	Core/Periphery
1983-1988			
a	0.080**	0.060	0.111*
	(2.647)	(1.455)	(2.541)
b_1	0.171**	0.081	-0.225*
	(4.101)	(0.715)	(-2.548)
b_2	-0.039	0.420**	0.090
	(-0.625)	(3.390)	(1.406)
b_3	-0.343**	-0.308*	0.098
	(-6.877)	(-2.537)	(1.058)
Chow F	36.51**	6.18**	3.21*
1988-1993			
a	0.220**	0.127*	0.143*
	(5.325)	(2.195)	(2.446)
b_1	0.185**	0.268	0.313**
	(4.224)	(1.874)	(3.042)
b_2	0.039	0.686**	0.161
	(0.517)	(4.234)	(1.874)
b_3	-0.503**	-0.612**	-0.513**
	(-8.785)	(-3.976)	(-4.701)
Chow F	55.60**	10.80**	11.55**

Note: Base Model: $\Delta LQ = a + b_1 LQ_{t1} + e$ (1)
Dummy Model: $\Delta LQ = a + b_1 LQ_{t1} + b_2 D + b_3 DLQ_{t1} + e$ (2)
Parentheses are T statistics
Chow F = $\{(SSE_1 - SSE_2)/(K+1)\}/\{SSE_2/(N-2K-2)\} \sim F_{K+1,\ N-2K-2}$
where, SSE_1: Residual sum of square from equation (1)
SSE_2: Residual sum of square from equation (2)
K: Number of restriction (=1)
N: Number of observations
** significant at .01
* significant at .05

regions) tend to have a higher level of industrialization overall, but that growth of the location quotient of these regions tends to fall more rapidly compared to opposing regions.

A multiple regression model was also run for the two periods in order to test factors that are related to industrial location change. Identical variables were used for both periods to examine changes in the impact of independent variables on the growth of regional manufacturing employment between industrializing and restructuring periods. The shortcoming of this approach will be a lower overall explanatory power since the identical independent variables are not necessarily the best fits for the different periods. The results found in Table 7 support this argument, with fewer significant variables and a lower coefficient of determination for the first period.

The proposed regression model explains only 23 percent of the variations in the growth rates of regional manufacturing employment for the industrializing period and 32 percent for restructuring period. The relatively low coefficients of determination reflect the omission of other variables significant for industrial location change in Korea. They include variables related to industrial and locational policies, labor relations, labor market, infrastructure, government regulations, behavioral factors, business organization, and so on. In addition, the model does not have a serious multicollinearity problem between independent variables. The tolerance values range from 0.693 (LABOR) to 0.902 (ACCESS) (Table 7).

The first independent variable (WAGE) tests the effect of the regional wage ratio on manufacturing employment growth. The hypothesis, that a negative association exists between the two variables, can be accepted. For both industrializing and restructuring periods, the coefficient of regional wage ratio is negative and significant. The impact of wage ratio on employment growth was stronger in the period of rapid industrialization than the restructuring period, possibly reflecting the differences in the capacity of labor supply for the two periods. The adjustment of labor inputs to the wage ratio is more flexible when labor supply is abundant. However, in the context of labor shortages and strong labor power, manipulation of employment levels is difficult undertaking. Reduced flexibility in the labor market better represents the period of industrial restructuring than industrialization.

The second independent variable (CAPITAL) tests the effect of the growth of the capital-labor ratio. The hypothesis presuming a positive association between capital accumulation and employment growth can be accepted in both periods. The positive relationship between the growth of capital intensity and employment growth suggests that capital investment has been an important source for the creation of new manufacturing jobs. The possibility of a labor shedding effect by new capital investment, as a

Table 7 - Test of the Factors of Employment Change

Dependent variable: growth rates of manufacturing employment

Independent Variables	1983-88 Std. Coeff.	1983-88 t	1988-93 Std. Coeff.	1988-93 t
CONSTANT	-	5.590**	-	6.097**
WAGE	-0.250 (0.742)	-3.284**	-0.157 (0.874)	-2.522*
CAPITAL	0.325 (0.731)	4.238**	0.211 (0.725)	3.086**
LABOR	-0.097 (0.693)	-1.229	-0.287 (0.714)	-4.168**
LAND	-0.340 (0.852)	-4.786**	-0.173 (0.865)	-2.771**
PDEN	-0.107 (0.841)	-1.490	-0.250 (0.837)	-3.933**
LQ	0.074 (0.864)	1.045	-0.206 (0.822)	-3.212**
ACCESS	0.126 (0.902)	1.818	0.141 (0.905)	2.300*
R^2	0.230		0.324	
F	7.643**		13.705**	

Note: parentheses are tolerance values
** significant at .01
* significant at .05

substitute for labor inputs, was insufficient to change the coefficient of the variable to a negative value. This result supports the hypothesis that high rates of capital investment have been a consistent source of industrial development in Korea. The relationship of capital accumulation to employment growth declined during the restructuring period. This reduced effect of new capital investment on the generation of employment might be due to deteriorating labor market conditions during the restructuring period. In addition, a larger portion of new capital investment might have been expended on such areas as quality or productivity enhancement facilities, including research and development activities that demand fewer labor inputs.

The third independent variable (LABOR) tests the effect of labor intensity on the growth of manufacturing employment. The hypothesis proposing a negative relationship between the two variables can be accepted only for the restructuring period. The coefficient of labor intensity is also negative for the industrializing period, though not significant. This suggests that regional industry structure has become a more important determinant of regional industrial growth in recent years. It also indicates that regions that depend heavily on labor intensive industries are more likely to lose employment compared to regions with less labor intensive (or capital intensive) structures, especially during industrial restructuring. Thus, the change in the significance of the coefficient explains an ongoing transformation of industrial structure from labor intensive toward capital and technology intensive.

The fourth independent variable (LAND) tests the effect of changes in land prices on regional industrial employment. The hypothesis stating a negative effect of growth in the ratio of land assets to gross output can be accepted for both periods. The result suggests that regions that witnessed higher growth in the ratio of land assets would have difficulty in attracting new industrial employment. It is apparent that manufacturing industry has been losing its competitive edge to non-manufacturing activities in those areas with a rapid rise in land prices. An increasing share (value) of land assets to total output will enable existing manufacturing firms to sell (all or part) factory sites and move out of current locations. On the other hand, a higher ratio of land assets means that firms have to expend more for acquisition of land instead of new machinery. In either case, employment will tend to decrease rather than increase. The impact of the variable is stronger during the industrializing period than restructuring, which is not clearly explained. In fact, the variable is most highly associated with employment change in the first period.

The fifth and sixth independent variables (PDEN and LQ) test the effect of agglomeration economies. The hypothesis of negative urbanization economies can be accepted only for the restructuring period. The coefficient of population density (PDEN) is negative for the industrializing period, but not significant. A highly significant and negative coefficient during the second period indicates that diseconomies of urban agglomeration have increasingly deleterious effects on manufacturing industries in densely populated areas. These diseconomies were apparently less serious in the previous period. These results also suggest that the new locational tendency in Korea is similar to that of advanced industrialized countries. The hypothesis regarding the impact of localization economies on the growth of manufacturing employment can be accepted only for the period of industrial restructuring. The coefficient of the location quotient (LQ) has a positive value in the first period, although it is not significant. Industrial location during the industrializing period might take the form of cumulative causation, in which already industrialized areas continued to attract new industrial employment. The highly significant, but negative coefficient for the second period strongly rejects the continuation of the trend of spatial concentration. A negative relationship between the initial level of industrialization and the growth of industrial employment during following years is strong evidence of a new trend of deconcentration of industrial location from industrialized areas toward less industrialized regions.

The last independent variable (ACCESS) tests the effect of rural transportation accessibility. The hypothesis of a positive relationship between the variable and the growth of regional manufacturing employment can be accepted only for the restructuring period. The coefficient of rural expressway accessibility is positive in the first period, but less significant (p=0.07). This result implies that the positive effect of a modern expressway system on manufacturing employment in rural areas has increased over time. The result suggests the existence of a moderate time lag between the construction of a new expressway and industrialization in rural areas. Considering the relatively minor changes in the expressway network during the research period, the increased significance of the variable is the result of the effect of the existing highway system.

Regional Productivity

Growth of Output and Input Factors

Korean manufacturing continued rapid output growth throughout industrializing and restructuring periods (Table 8). However, there was a slowdown in the average annual growth rate during the restructuring period, from 15.1 percent to 12.9 percent. One significant change occurred in labor inputs, which declined in absolute terms after 1988. Capital investment grew more rapidly during the restructuring period, from 13.6 percent to 15.6 percent per year. These trends support the argument that there has been a change in the growth pattern of Korean manufacturing industries since the late 1980s.

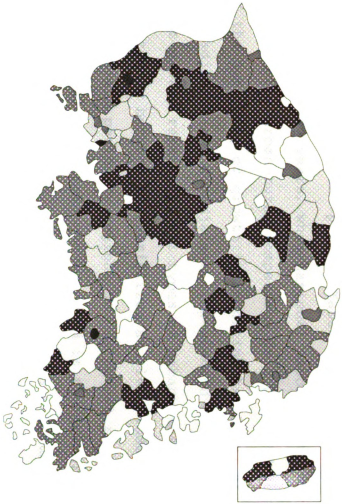
Examination of changes in spatial patterns of manufacturing output and input factors is useful starting point for the discussion of regional productivity because regional productivity is determined by the location of inputs and final output. The spatial redistribution of industrial workers and capital investment, along with output from those factors, reconfigures the geography of productivity. The subdivision of national data into smaller regional units based on location and industrial development reveals clear spatial patterns.

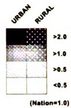
First, in terms of manufacturing output, the slowdown in growth rates was more evident in urban regions than in rural regions (Table 8 and Figures 10, 11). Rural counties recorded much higher rates of growth throughout the research period. Rural counties, both adjacent and nonadjacent to urban areas, fared equally well, although the former did slightly better during the period of industrialization and the latter performed better during the restructuring period. Within urban areas, medium-sized cities led output growth during the first period, though the smallest cities performed best for the last five years. A similar pattern, not as clear as in urban areas, can be observed among industrialized and less industrialized regions. Industrialized regions displayed better performance during the industrializing period and less industrialized regions grew more rapidly during the restructuring period.

Table 8 - Growth of Manufacturing Output and Input
(Percent Per Annum)

	1983-88			1988-93		
	Output	Input		Output	Input	
		Labor	Capital		Labor	Capital
Nation	15.08	6.18	13.63	12.93	-3.03	15.59
Urban	13.39	4.96	11.09	10.35	-4.95	13.19
Metropolitan	11.52	3.60	13.63	9.02	-6.63	9.55
Medium	15.65	7.31	10.37	10.60	-3.19	13.72
Small	11.41	6.98	3.96	16.06	-0.59	18.46
Rural	22.04	11.28	20.85	19.20	4.23	22.37
Adjacent	22.98	11.25	18.92	18.59	3.82	21.82
Non-adjacent	19.05	11.35	24.54	21.93	5.71	24.32
Industrial	15.71	6.58	11.94	11.98	-3.48	14.06
Less-indust.	13.73	5.45	18.16	13.01	-2.17	19.47
Core	15.32	5.94	12.85	11.33	-3.95	13.04
Seoul Metro.	16.85	7.10	19.23	11.90	-3.73	11.92
Southeast	13.87	4.77	9.07	10.72	-4.18	13.85
Periphery	14.33	7.14	15.73	15.12	0.11	20.84
Southwest	13.70	6.97	17.30	16.88	1.40	24.23
Other	15.35	7.38	13.23	12.03	-1.80	12.95

Note: Output: value added
Labor input: number of workers x hours worked
Capital input: net fixed asset (total fixed asset - land asset)





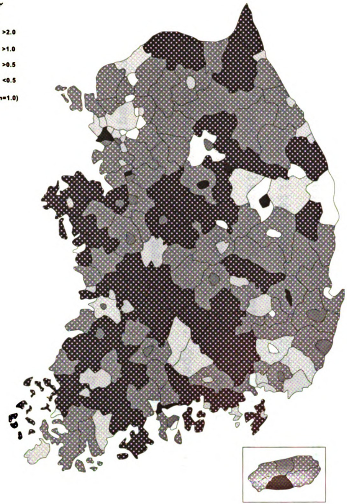


Figure 10 - Growth of Output (1983-1988)

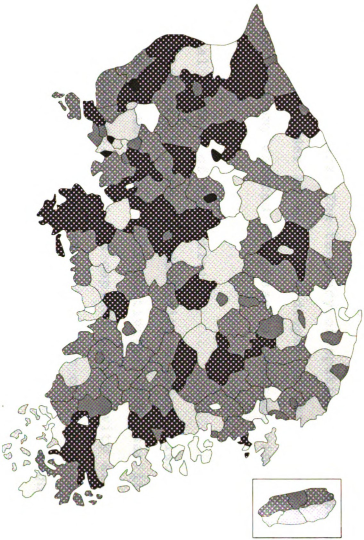
Figure 11 - Growth of Output (1988-1993)

Core and peripheral areas did not show significant differences in the growth rates of output during the first period. Only the Seoul metropolitan region can be singled out as performing better than others. The restructuring period displays a clearer distinction between core and periphery. Overall, the growth rates of peripheral regions were well above those of core areas. Specifically, the Southwest region outperformed all others, both in core and peripheral regions. One of the most important characteristics of regional output growth is the ascendance of a new leader in each category. None of the new leading regions were the best performer during the previous period. In fact, the majority are located in less favored regions.

Labor inputs exhibit clear spatial patterns, especially during the most recent period (Table 8). During industrializing years, when national labor inputs were growing, the urban-rural comparison is a better description of the geography of growth in labor inputs. Rural areas, both adjacent and nonadjacent, experienced much higher labor input growth rates than all types of urban areas. Comparisons between industrialized and less industrialized, and core and periphery regions do not reveal significant differentials. One point to be noted is the low growth rate of metropolitan areas. The largest cities were unable to add industrial workers at a higher rates due to an already high volume of workers accumulated through their longer history of industrialization.

The spatial pattern of labor input growth shows a radical change during restructuring (Table 8). All types of urban areas witnessed negative growth, with higher rates of decrease in larger cities. Rural regions recorded net gains, with better performance by nonadjacent counties. Regional categorization based on the level of industrialization is not a good explanatory framework for the growth of labor inputs. Core-periphery comparison does not reveal any difference within cores, but does single out the Southwest region in the periphery as a net gainer of labor input. Therefore, the spatial pattern of growth of labor inputs during the period of industrial restructuring is most visible from an urban-rural perspective.

The input of capital grew more rapidly during the restructuring period, indicating that recent industrial development has depended heavily on capital investment. The spatial pattern of capital input growth resembles that of output and labor inputs (Table 8 and Figures 12, 13). During the industrializing period, rural areas experienced much higher rates of capital input growth than urban areas. Within urban areas, metropolitan cities recorded the highest growth, possibly due to the substitutive relationship between labor and capital inputs. Because the largest cities had the lowest growth rates of labor inputs, they had to use more capital to maintain a certain level of output growth. The group of smallest cities had the lowest growth rate initially. This pattern was reversed during restructuring,



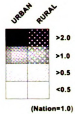


Figure 12 - Growth of Capital Stock (1983-1988)

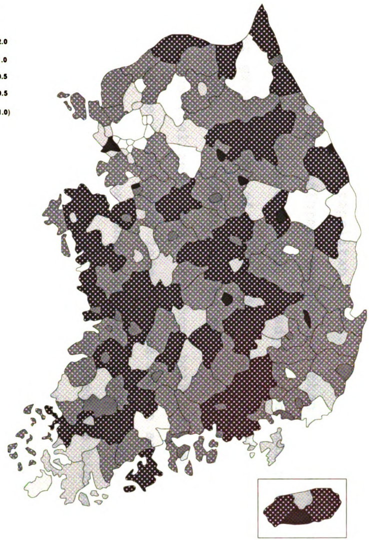


Figure 13 - Growth of Capital Stock (1988-1993)

with the highest growth in the smallest cities and the lowest growth in metropolitan areas.

Rural areas performed much better than urban areas in both periods. In rural areas, nonadjacent counties showed higher growth rates of capital input than adjacent counties. In addition, less industrialized regions performed better than industrialized areas throughout both periods. Higher levels of performance by less favored region are no exception for the core and periphery. Peripheral regions, especially the Southwest region, exhibited the highest growth rates during both periods. The spatial pattern of growth of factor inputs reveals the trend of increasing deconcentration. Higher growth rates of factor inputs and output in rural areas, less industrialized areas, and peripheral areas have shifted the locus of growth away from the former centers. The tendency of spatial decentralization seems to be wider in scope and deeper in extent as the Korean economy entered the phase of restructuring.

Spatial Pattern of Productivity

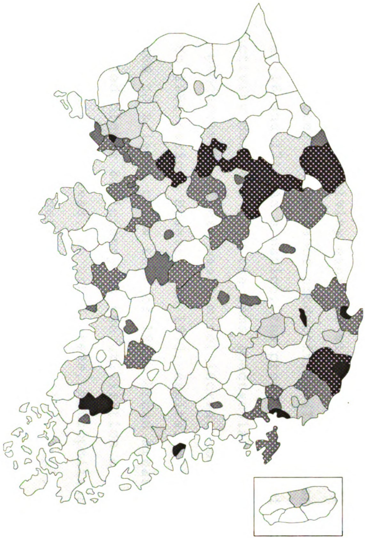
Each of the three productivity measures (labor, capital and nominal total factor productivity: NTFP) has its own characteristics. Labor and capital productivity are simply calculated by dividing output by labor or capital inputs, whereas NTFP combines labor and capital using weights as the denominator (See page 54 for details). Therefore, labor and capital productivity estimates the efficiency of labor and capital inputs, while TFP measures the overall technical efficiency or factor use. Table 9 summarizes changes in productivity by regional types using index numbers. It is apparent that the trends in labor productivity are quite different from capital and total factor productivity. Capital productivity seems to be more closely related to NTFP than labor productivity.

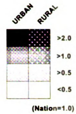
Labor productivity improved rapidly during both periods and improvement was much greater during the second period (Table 9). The accelerated growth of labor productivity is a combined result of the loss of workers, reduction in working hours, and growth in output. Spatial pattern of labor productivity is quite stable over time (Figures 14 and 15). Urban regions as a whole have similar labor productivity to rural areas. As seen in Table 9, the most prominent differentials exist between different urban sizes. Labor productivity is highest for the smallest city group, followed by medium sized and metropolitan cities. Enormous disparities can be seen between the largest and smallest city groups. In rural areas, counties adjacent to urban areas exhibit higher labor productivity than nonadjacent counties. However the disparity between the two types of rural areas is relatively small. Industrialized regions have advantages over the less industrialized regions. Again, the differentials between the two are not significant compared to those among urban areas of different sizes. Finally, peripheral areas display labor productivity

Table 9 - Indices of Regional Productivity

	Labor Productivity			Capital Productivity			NTFP		
	'83	'88	'93	'83	'88	'93	'83	'88	'93
Nation	100	156	336	100	108	91	100	111	99
Urban	101	154	331	107	113	98	106	117	106
Metropolitan	82	121	265	157	142	138	146	145	154
Medium	132	195	388	85	111	95	84	114	101
Small	206	227	522	48	51	45	46	51	46
Rural	96	165	349	76	90	77	77	91	80
Adjacent	98	173	362	82	94	80	82	95	83
Non-adjacent	92	136	305	62	74	66	66	76	70
Industrial	104	165	359	89	103	92	90	106	99
Less-indust.	92	137	292	137	124	90	130	126	97
Core	94	150	322	102	115	106	102	119	115
Seoul metro.	90	146	320	151	134	134	142	135	143
Southeast	98	154	324	79	101	86	81	107	96
Periphery	124	178	377	96	90	68	93	90	70
Southwest	134	187	406	103	85	59	97	83	59
Other	111	166	331	87	97	92	88	102	101

Note: 1983 = 100 for nation
NTFP: nominal total factor productivity





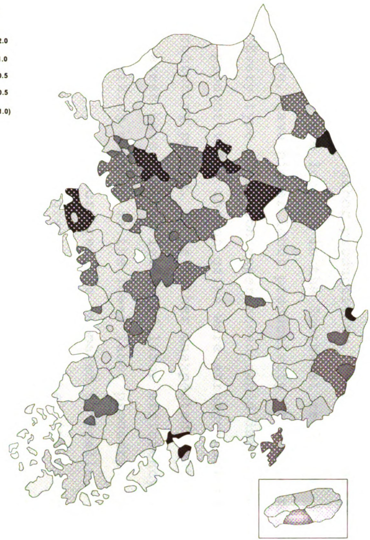


Figure 14 - Labor Productivity (1983)

Figure 15 - Labor Productivity (1993)

well above that of core regions. The two core regions have similar levels of labor productivity. Peripheral areas, whether they are located in the Southwest region or elsewhere, have higher labor productivity than core regions.

Every type of region experienced rapid improvement in labor productivity, though gains were stronger during the restructuring period. It is rather unexpected that urban and rural areas have similar levels of labor efficiency. The most striking outcome is the lower labor productivity of the largest cities and core regions compared to smallest cities and peripheries. The great level of capital intensity in the latter regions might explain why this pattern is consistent over time. More importantly, this does suggest that the former types of region will have to shed more industrial workers in order to enhance labor efficiency.

Capital productivity exhibits significantly different regional patterns from labor productivity (Table 9 and, Figures 16 and 17). As a nation, the progress of capital productivity does not show the same spectacular trend as labor productivity. There was a minor increase during the 1983 to 1988 period. However, in 1993, capital productivity declined to a level below that of 1983. Urban areas maintained higher efficiency in the utilization of capital assets than rural areas. In urban areas, metropolitan cities have absolute advantages over smaller cities, implying positive external economies that were not revealed in labor productivity.

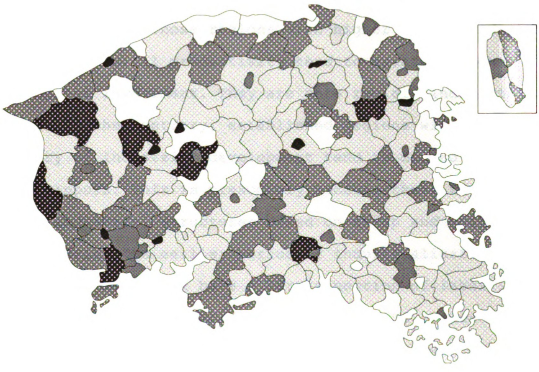


Figure 16 - Capital Productivity (1983)

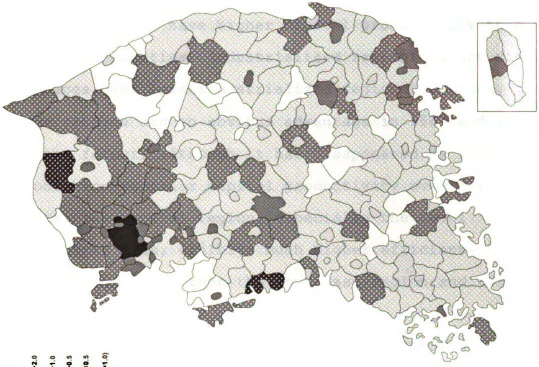


Figure 17 - Capital Productivity (1993)

Similar effects seem to exist in rural areas, in which adjacent counties have higher capital productivity than nonadjacent counties. Industrialized regions do not display advantages over less industrialized regions. In fact, the latter regions had an obvious advantage in 1983 and 1988 over the former, although it had disappeared by 1993. Core regions have superior capital productivity over peripheral regions. The capital region, especially the Seoul metropolitan area, exhibits much higher efficiency in capital utilization than the Southeast region and two peripheral regions.

In general, capital productivity displays regional patterns almost exactly opposite to that of labor productivity (Table 9). These patterns might reflect characteristic differences in industrial development over time and space. Those regions with higher labor productivity but lower capital productivity tend to maintain higher rates of capital investment. They are more rapidly industrializing areas. On the contrary, established regions with a longer history of industrial development tend to depend more on labor inputs. This is presumably because these regions have built industrial structures based on cheap and abundant labor during the earlier period of industrialization. Therefore, they will have a larger portion of labor intensive industries and are more likely to reduce labor inputs during the years of high wages and strong labor power.

Nominal total factor productivity (NTFP) improved during the first five years, but it declined during the restructuring period in most regional groups (Table 9). The primary reason for the negative growth of total factor productivity should be related to the level of capital inputs and their efficiency. As noted before, a rapid increase in capital inputs during the restructuring period was not followed by comparable growth of output. The combined efficiency of labor and capital reveals distinctive spatial patterns (Figures 18 and 19), which are similar to those of capital productivity (Figures 16 and 17).

First, the national trend of improvement during the first five years followed by decreases during the last five years holds true for most regions. The exceptions are found in metropolitan cities in which NTFP tended to increase over time, less industrialized areas and the Southwest region in which NTFP declined throughout the years, and the capital region where NTFP declined initially but increased in following years.

Second, enormous disparities exist between the most advanced types of region and remaining regions. The two regional groups that displayed the highest NTFP are metropolitan cities and the capital region in which two largest metropolitan cities are located. In contrast, the two regional types that had the lowest NTFP are the smallest cities and nonadjacent rural areas. Therefore, a clear core-periphery relationship, in a broad sense, is revealed through the regional comparison of NTFP.

The highly efficient production system in the capital region and metropolitan cities might be based on the vast amount of social and economic infrastructure. It also suggests that these highly urbanized areas have reacted more successfully to the recent changes in the industrial environment. Therefore, it can be said that these regions continued their role as centers of innovation and the origin of new production methods.

The initially high productivity and subsequent decline in less industrialized regions is rather unexpected. Data show that these regions had productivity advantages over industrialized regions until the late 1980s. One plausible explanation for the sudden erosion of advantage is that excessive capital accumulation (or overcapacity) had a negative impact on productive efficiency so that they could not produce output up to their capacity. The same explanation could be applied to the relatively low productivity in industrialized regions and the Southeast region, where the majority of industrial growth centers are located.

Finally, a consistent pattern exists between urban and rural areas (Table 9). The former displayed superior productivity over the latter, implying the existence of urbanization economies. Within urban regions, metropolitan cities had the highest levels of productivity,

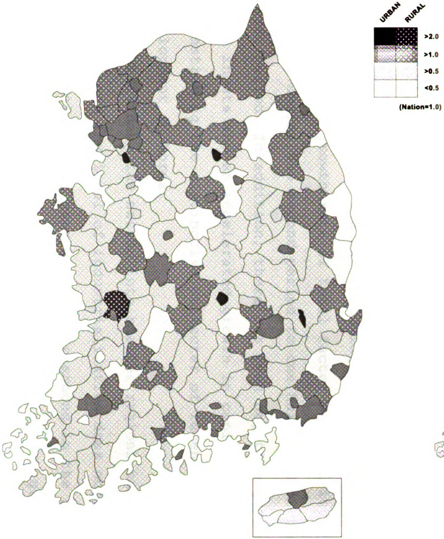


Figure 18 - Nominal Total Factor Productivity (1983)

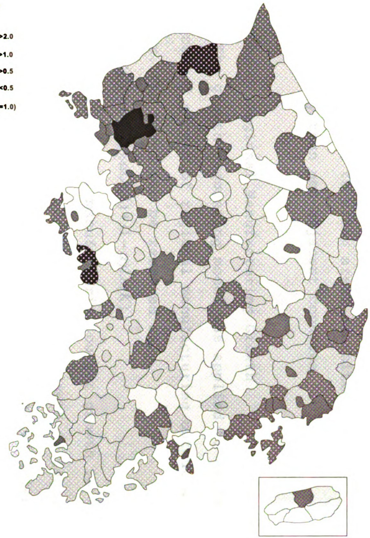


Figure 19 - Nominal Total Factor Productivity (1993)

followed by medium and small sized cities. In rural regions, counties adjacent to urban areas exhibited higher productivity than non-adjacent counties.

Sources of Regional Manufacturing Growth

The growth accounting model was applied to explain the sources of growth of regional manufacturing output and their change. The model can be restated as:

$$Ln(Q) = Ln(T) + \alpha Ln(L) + (1-\alpha)Ln(K)$$

From the model, manufacturing output growth is decomposed into three components: the growth of labor inputs, capital inputs, and TFP or technical efficiency. The results of the growth accounting model verify the overall slowdown in productivity growth and changes in the share of input factors during the restructuring period (Table 10). As a nation, the growth rate of total factor productivity declined during the second period to one half that of the first period. In addition, there has been negative growth in labor inputs and an accelerated growth in capital inputs, demonstrating the distinctive character of recent industrial development in Korea.

Subdividing the nation into smaller regions based on location and the level of industrialization does not alter the national pattern greatly. The turnaround in the share of growth of labor inputs, from positive to negative growth, occurred in most regions. Only rural areas, both adjacent and nonadjacent, and the Southwest region did not experience

Table 10 - Sources of Manufacturing Output Growth
(Percent Per Annum)

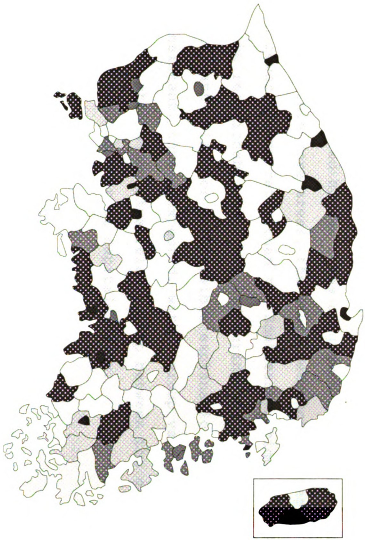
	1983-88				1988-93			
	O	L	K	T	O	L	K	T
Nation	15.08	1.69	9.91	3.48	12.29	-0.83	11.32	1.80
Urban	13.39	1.37	8.03	3.99	10.35	-1.40	9.46	2.29
Metropolitan	11.52	1.15	9.26	1.10	9.02	-2.16	6.44	4.74
Medium	15.65	1.74	7.90	6.01	10.60	-0.82	10.21	1.21
Small	11.41	1.12	3.33	6.96	16.06	-0.12	14.58	1.61
Rural	22.04	2.96	15.39	3.69	19.20	1.03	16.93	1.25
Adjacent	22.98	2.88	14.08	6.02	18.59	0.92	16.57	1.09
Non-adjacent	19.05	3.21	17.61	-1.76	21.93	1.46	18.11	2.37
Industrial	15.71	1.78	8.71	5.22	11.98	-0.94	10.25	2.68
Less-indust.	13.73	1.51	13.13	-0.91	13.01	-0.61	14.01	-0.39
Core	15.32	1.72	9.13	4.47	11.33	-1.13	9.29	3.17
Seoul metro.	16.85	2.07	13.61	1.17	11.98	-1.04	8.59	4.36
Southeast	13.87	1.37	6.47	6.04	10.72	-1.24	9.75	2.21
Periphery	14.33	1.58	12.24	0.50	15.12	0.03	15.95	-0.86
Southwest	13.70	1.34	13.97	-1.61	16.88	0.29	19.23	-2.64
Other	15.35	1.99	9.67	3.70	12.03	-0.52	9.26	3.28

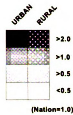
Note: O: output growth
L: labor input growth weighted by wage share
K: capital input growth weighted by capital share
T: total factor productivity growth

negative growth of labor inputs during the restructuring period. In comparison, the accelerated contribution from the growth of capital inputs have occurred in all types of regions, with exceptions of highly urbanized regions - metropolitan cities and the capital region - and the least urbanized peripheral areas.

Regional patterns of the weighted growth rates of labor and capital input should resemble those of unweighted measures (Table 8), as discussed in the previous section. Thus, in this section, emphasis will be placed on TFP. A comparison needs to be made between nominal total factor productivity (NTFP) and total factor productivity (TFP) (See page 53-54 for the detailed explanation). NTFP, as an index measure, is a *static* concept for a single point in time. TFP more likely portrays *change* (or improvement) of NTFP between two points in time. Therefore, a higher level of NTFP does not necessarily mean a higher rate of TFP. Rather, the opposite is the norm, with a negative association between the two indices.

Figures 20 and 21 show spatial pattern of the growth of TFP. There is evidence that agglomeration economies, such as urbanization and localization effects, play a role in the growth of TFP. Urban regions have higher TFP growth than rural regions, and industrialized regions gained more production efficiency than less industrialized regions (Table 10). The same is true for core and periphery regions with higher rates of growth by the former. Therefore, it can





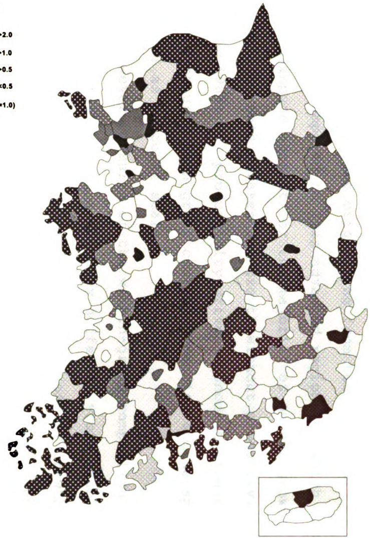


Figure 20 - Growth of TFP (1983-1988)

Figure 21 - Growth of TFP (1988-1993)

be stated that more advanced regions tend to have a larger proportion of output originating from technological advances, compared to less advanced regions in which direct factor inputs account for the majority of output growth. Therefore, such phrases as 'growth without productivity' (Tsao, 1985) or 'productivity driven economies' (Page, 1994) should be used with great caution depending on the spatial as well as temporal scale.

However, results of the within-group comparison between the two periods tell a slightly different story (Table 10). Metropolitan areas had much lower rates of TFP growth than smaller cities during the first period, but much higher growth rates of productive efficiency during the later period. In rural areas, though adjacent counties had an absolute advantage during the first period, nonadjacent counties displayed higher rates of growth during the second period. Within core areas, the Seoul metropolitan region had much lower growth rates than the Southeast region initially, but the relationship was reversed during the later period. A significant point for the possible explanation of this inconsistent, thus unexpected, within group variations is an apparent strong negative relationship between the growth rates of TFP and that of capital inputs.

Sources of Labor Productivity Growth

By transforming the growth accounting model, the growth of labor productivity can be decomposed into the share of capital deepening (K/L) and technological advance (T). The equation is restated as follows:

$$Ln(Q/L) = (1-\alpha)Ln(K/L) + Ln(T)$$

As noted before, there was an accelerated improvement of labor productivity during the second period. Regional variation in the growth rates of labor productivity is relatively small (Table 11). The industrializing period exhibited greater regional variation. Less advanced regions, such as the smallest sized cities, nonadjacent rural areas, and peripheral areas, had lower growth rates of labor productivity. The restructuring period does not display a systematic pattern.

With regard to the sources of the growth of labor productivity, more significant portion is accounted for by capital accumulation than technological advances. As a nation, the ratio between shares of capital accumulation and technological advances was six to four during the first period, but it widened to about nine to one during the second period. Thus it is apparent that accelerated capital accumulation did not accompany technical advances. The share of capital accumulation is consistently larger in rural regions, less-industrialized regions, and peripheries compared to urban, industrialized, and core regions, respectively. The relationship is reversed in the case of technological advances. Therefore, the more advanced a region is, the more likely it is to rely on technology

Table 11 - Sources of Labor Productivity Growth
(Percent Per Annum)

	1983-88			1988-93		
	LP	K/L	T	LP	K/L	T
Nation	8.90	5.42	3.48	15.33	13.52	1.80
Urban	8.43	4.44	3.99	15.30	13.01	2.29
Metropolitan	7.92	6.82	1.10	15.65	10.92	4.74
Medium	8.34	2.33	6.01	13.79	12.58	1.21
Small	4.43	-2.54	6.96	16.65	15.54	1.61
Rural	10.76	7.06	3.69	14.97	13.73	1.25
Adjacent	11.72	5.70	6.02	14.77	13.67	1.09
Non-adjacent	7.70	9.46	-1.76	16.22	13.85	2.37
Industrialized	9.13	3.91	5.22	15.47	12.78	2.68
Less-indust.	8.28	9.19	-0.91	15.19	15.58	-0.39
Core	9.38	4.91	4.47	15.27	12.10	3.17
Seoul metro.	9.75	8.59	1.17	15.64	11.28	4.36
Southeast	9.11	3.06	6.04	14.90	12.69	2.21
Periphery	7.19	6.69	0.50	15.01	15.87	-0.86
Southwest	6.73	8.34	-1.61	15.48	18.12	-2.64
Other	7.97	4.27	3.70	13.84	10.56	3.28

Note: LP: growth of labor productivity
K/L: growth of capital-labor ratio weighted by capital share
T: growth of total factor productivity

improvement than the raising of the capital-labor ratio for the growth of labor productivity.

It is debatable which of the two sources of labor productivity growth must be promoted to enhance the competitiveness of regional industries. Data analysis shows that the dominance of capital accumulation as a source of labor productivity growth increased significantly. A problem with this pattern of productivity growth is that it requires heavy investment for the improvement of the capital-labor ratio if labor inputs are not reduced radically. The over-dependence on the growth of capital accumulation may not be a cost efficient strategy for industry as a whole. The two major expenses, capital investment and wages, must be covered by a higher growth of output, which apparently has not happened. Therefore, in the long run, more emphasis needs to be placed on the improvement of technology, which demands cooperative effort from various sources.

Determinants of Regional Productivity

A multiple regression model was applied to test the major determinants of regional productivity (TFP) growth. The results are summarized in Table 12. The proposed model explains the variation in the growth of regional productivity well, with a coefficient of determination 0.791 for the period of 1988-88 and 0.801 for the 1988-93. The model does not have serious multicollinearity problems. Although one independent variable (LAND) has a relatively

Table 12 - Test of the Determinants of Regional Productivity

Dependent variable: growth rates of TFP

Independent Variables	1983-88 Std. Coeff.	1983-88 t	1988-93 Std. Coeff.	1988-93 t
CONSTANT	-	-4.558**	-	-4.295**
LnCL	-0.727 (0.700)	-17.787**	-0.698 (0.836)	-20.261**
LnOUT	-0.336 (0.608)	7.656**	0.419 (0.666)	10.847**
WAGE	0.343 (0.678)	8.256**	0.481 (0.856)	14.122**
LAND	-0.201 (0.567)	-4.418**	-0.149 (0.749)	-4.093**
PDEN	0.023 (0.851)	0.629	0.076 (0.811)	2.169*
LQ	0.021 (0.826)	0.556	0.101 (0.793)	2.866**
ACCESS	0.019 (0.794)	0.494	-0.025 (0.898)	-0.763
R^2	0.791		0.801	
F	96.503**		115.362**	

Note: parentheses are tolerance values
** significant at .01
* significant at .05

low tolerance value (0.567) during the first period, it does not prohibit the statistical test of the variable. All but one of the seven coefficients of independent variables have identical signs for both periods. The exception is ACCESS (regional dummy for expressway accessibility), which has a positive sign in the first period, and a negative sign in the second period, though it is not significant for any period. Four of seven independent variables are significant (at 0.05 level) for the first period; six are significant for the second period. In addition, variations in the standardized coefficients and significance level of some independent variables for the two periods are relatively large. This indicates that notable changes occurred in the impact of these variables on the growth of regional productivity over time.

The first variable (LnCL), the growth rate of capital-labor ratio or capital intensity, is highly significant for both periods. The variable has a negative coefficient, suggesting the detrimental effect of capital accumulation on productivity advances. The strong negative relationship between the two variables is exactly opposite the relationship found in advanced economies. This exceptional result reveals a clear implication: new capital investment, which has been a primary source of industrial development in Korea, has not served to enhance productivity. Therefore, the embodiment or vintage effect from the introduction of new capital has not been realized in the Korean manufacturing sector. A slightly diminished negative coefficient, but a larger t-value of the variable in the second period, implies that an improvement in capital utilization was minimal even during restructuring.

The second explanatory variable (LnOUT) is also highly significant and positive. Thus, the cumulative causation effect, or Verdoon's law, is confirmed. The positive effect of manufacturing output growth on the advance of productivity was significantly larger during the second period. The third variable (WAGE), the average wage ratio in the initial year, is significant and has positive coefficients for both periods. This suggests that firms are responsive (positively) to changes in wage ratio for the improvement of productivity. A higher level of significance for the second period implies that the importance of the wage ratio as a stimulant of productivity has increased over time.

The fourth variable (LAND), the growth rate of land assets to the output ratio, has a strong negative association with regional productivity growth, reflecting a side effect of rapid land price increases in Korea. It also suggests that excessive acquisition of land assets for speculative purposes, for example, can do harm to industrial productivity. When land prices are rising rapidly, available resources cannot be allocated optimally for productive purposes, resulting in negative consequences on productivity. The fifth variable (PDEN), population density, has positive coefficients for both periods, but significant only in the second period. In addition, the explanatory power of population variable is less than other variables related to output, investment, and wages. The positive effect of population density suggests that urbanization economies were a more significant source of productivity advance during the restructuring period.

The sixth variable (LQ), the location quotient at the initial point, has positive coefficients for both periods, though it is significant only for the second period. Thus the positive effect of localization economies is rather a new phenomenon. This appears to be contradicted by the results of the sources of growth analysis, in which industrialized regions, as a whole, had a higher productivity growth than less industrialized region for both periods. In that case, however, each region was grouped depending on whether its location quotient is greater or less than unity. The last variable (ACCESS), regional dummy for expressway accessibility, is not significant for either period. Thus, in terms of productivity growth, such locational advantages as direct access to modern highway system cannot be verified. The variable has a positive coefficient for the first period, though it is negative during the second. This is presumably because the diffusion of innovative technology and new production systems does not proceed along the transportation network alone, but requires the development of a wide range of social infrastructure.

Spatial Inequality

The preceding analysis of the changes in spatial patterns of industrial location and regional productivity has shown that formerly less favored regions (rural, less industrialized, and peripheral areas) performed well during the period of industrial restructuring. In contrast, more advanced regions (urban, industrialized, and core areas) did not show such stellar performance during the restructuring period as they did during the rapid industrializing period. The evident differentials between the two types of regions strongly suggest that spatial inequalities in location and productivity have declined over the research period.

In this section, more specific evidence of spatial convergence or divergence are provided based on the results from indices of inequality and simple regression analysis. First, two index measures of inequality - the Gini coefficient and the coefficient of variation - are employed to compute the level of regional inequality and to examine its change over time. As discussed before, the Gini coefficients are computed for gross indicators of regional manufacturing activity, whereas the coefficients of variation are calculated for the indices of regional productivity. For both measures of inequality, a weighted formula is employed to account for enormous differences in population size among cities and counties. Second, a series of bivariate regression models are applied to test spatial catch-up or convergence of industrial location and productivity.

Inequalities in Industrial Location

Eight gross measures of industrial location were used as basic data for the Gini coefficients (Table 13). Overall, the Gini coefficients reveal a trend of diminishing interregional inequalities. Comparing industrializing and restructuring periods, changes in the Gini coefficient are slightly different. The first period shows a strong tendency of diminishing inequality. The Gini coefficients reveal decreases in seven (out of eight) indicators of industrial location. The most significant reduction occurred in the value of fixed assets, followed by employment, gross output, worker remuneration, floor space, value added, and site area. However, inequality increased in the distribution of manufacturing establishments.

The second period witnessed a decrease in the inequality in five indicators. Employment exhibited the strongest spatial convergence, followed by worker remuneration, value added, gross output, and fixed assets. It is notable that the spatial distribution of industrial employment is one of the fastest converging areas of manufacturing activity. There were three areas in which spatial disparities increased during the period of restructuring. The number of establishments continued to show spatial concentration. In addition, increasing

Table 13 - Change in Regional Inequality

		1983	1988(A)	1988(B)	1993	1988(C)	1993(D)
GINI	EST	0.311	0.323	0.326	0.327	103.8	100.6
	WKR	0.458	0.419	0.426	0.392	91.5	92.0
	RMN	0.504	0.476	0.484	0.455	94.4	94.0
	OPT	0.594	0.551	0.559	0.538	92.7	96.1
	VAD	0.545	0.527	0.535	0.509	96.6	95.1
	AST	0.648	0.581	0.593	0.590	89.8	99.5
	SIT	0.617	0.602	0.611	0.636	97.7	104.0
	FLR	0.517	0.495	0.505	0.522	95.8	103.4
C.V.	LP	0.764	0.721	0.815	0.710	94.4	87.1
	CP	0.630	0.547	0.506	0.674	86.7	133.2
	NTFP	0.573	0.506	0.533	0.706	88.2	132.6

Note: 1) (A): Based on 1983 administrative areas
(B): Based on 1993 administrative areas
2) (C): 1983=100, (C): 1988(B)=100
3) EST: establishment, WKR: worker, RMN: remuneration
OPT: gross output, VAD: value added, AST: fixed asset,
SIT: site area, FLR: floor space
4) LP: labor productivity, CP: capital productivity
NTFP: nominal factor productivity

inequality was newly found in the areas of factory sites and floor space. Increasing inequality in the number of establishments reflects spatial concentration of newly formed small to medium sized businesses in urban areas, whereas increasing disparities in the two site related indices might be due to the shortage of industrial space in urban areas.

In the meantime, the absolute level of inequality is quite different from temporal changes. In spite of increasing regional inequality in the number of establishments, the absolute level of inequality in the index is lower than any other indicator. In addition, employment, worker remuneration, and floor space have lower levels of inequality than fixed assets and factory sites. Two measures of output, gross output and value added, occupy an intermediate level. The relationship among the inequalities of the eight indices of industrial location seems to be stable over time. This is supported by the fact that the rank order of the Gini coefficients among those indices remained virtually unchanged, with only one exception. The results of the analysis suggest that the spatial restructuring of industrial location has multiple dimensions. As an example example, the spatial spread of manufacturing employment is not accompanied by a comparable decentralization in the number of firms. Therefore, when implementing an industrial location policy, a specific industrial indicator could be set as the target of the policy.

A series of bivariate regression models were run to test spatial convergence or catch-up processes of industrial location and regional productivity. The model is restated as follows:

$Ln(Y_{t2}/Y_{t1}) = a + b_1 LnY_{t1}$, where: subscripts are years

A negative and significant coefficient of the slope (b_1) implies spatial convergence or catch-up, and a positive coefficient suggests spatial divergence. In general, results of the regression analysis reveal a strong tendency of spatial convergence of industrial location (Table 14). During the 1983-88 period, seven out of eight gross indices of industrial location have negative coefficients. Of the seven variables with negative coefficients, four are significant and three are not significant (at 0.05 level). Significant variables are gross output, value added, fixed assets, and site area. Insignificant variables are employment, remuneration, and floor space. It must be remembered that all three insignificant variables also exhibited a decline in Gini coefficients. This might be due to conceptual differences between the two techniques. Regression analysis is affected by the growth rate of indices, whereas Gini coefficients are determined by the absolute level of those indicators. It is a matter of choice whether the reduction of regional inequality should be related to faster growth rates in less developed regions or

Table 14 - Test of Spatial Convergence

	1983-88		1988-93	
	b coeff.	R^2	b coeff.	R^2
Gross indices				
Establishment	0.112**	0.103	-0.042	0.017
Employment	-0.018	0.004	-0.132**	0.215
Remuneration	-0.027	0.008	-0.147**	0.248
Gross Output	-0.085**	0.062	-0.167**	0.255
Value Added	-0.067**	0.041	-0.152**	0.228
Fixed Asset	-0.107**	0.068	-0.153**	0.169
Site Area	-0.085**	0.049	-0.133**	0.098
Floor Space	-0.032	0.009	-0.126**	0.125
Productivity				
LP	-0.288**	0.197	-0.355**	0.323
CP	-0.682**	0.351	-0.522**	0.325
NTFP	-0.603**	0.289	-0.444**	0.228

Note: LP: labor productivity
CP: capital productivity
NTFP: nominal total factor productivity
** significant at 0.01

the absolute interregional transfer of industrial activities from developed areas to less developed. In fact, either of these cases can be accepted as the process of spatial convergence. The number of establishments has a significant positive coefficient, implying increasing divergence. This result is same that of the Gini coefficient.

During the restructuring period, all of the indices of gross measures of industrial location have negative coefficients. Only the number of establishments is not significant. The two indices that showed an increase in the Gini coefficient (site area and floor space) are also highly significant, although their coefficients of determination are smaller than those significant variables. Two conclusions can be drawn from the regression analysis. First, the proposed regression model is a much better fit for the restructuring period. The coefficients of determination are much higher and larger number of variables are significant. This implies that spatial convergence, in relative terms, was more significant during industrial restructuring. Second, neither the regression analysis nor the Gini score supports the spatial convergence of the aggregate number of manufacturing firms.

Inequalities in Regional Productivity

Three measures of regional productivity - labor, capital and nominal total factor productivity - are used as basic data for the coefficient of variation and simple regression analysis. The results (Table 13) show that labor productivity is quite different from capital and total factor productivity. Labor productivity has higher levels of inequality than the other two, though it declines consistently over time. On the contrary, inequalities in capital and total factor productivity decreased significantly during the industrializing period, but increased rapidly during the restructuring period. As a result, the coefficients of variation of the three measures of productivity were much more similar to each other in 1993 than previously. The different behavior of labor productivity and the other productivity indices reflects the locational trends exhibited by different indices affecting productivity measures.

Results of the regression analysis are more convincing. All coefficients for the three productivity indices are negative and significant for both periods. Thus, the hypothesis of spatial convergence or catch-up can be accepted for labor, capital, and total factor productivity. It must be noted that the negative and significant association between the growth rate of productivity and initial level of productivity seems not to be a sufficient condition for the convergence of regional productivity toward the national average. The coefficients of variation for capital and total factor productivity increased during the second period, while regression analysis revealed the existence of spatial catch-up. Therefore, in spite of the strong performance by regions with lower productivity, the absolute disparities in capital and total factor productivity seemed to persist.

The results of various analyses presented in this chapter generally supported research hypotheses, in spite of minor exceptions and unexpected outcomes. In particular, proposed hypotheses better explained more recent changes than changes in the previous industrializing period. The following summaries (Table 15) concisely compare major research hypotheses and results.

Table 15 - Summary of Results

Topic	Hypothesis	Result
Industrial location		
Locational pattern	Deurbanization	C2
	Rural industrialization	C
	Decentralization	C
	Regional effect	MC
Factors of Location Change		
Wage ratio	Negative effect	C
Capital accumulation	Positive effect	C
Labor intensity	Negative effect	C2
Land asset growth	Negative effect	C
Urbanization effect	Negative effect	C2
Localization effect	Negative effect	C2
Highway access	Positive effect	C2
Regional Productivity		
Pattern of productivity	Regional hierarchy	MC
	Industrialization effect	PC
	Core advantage	MC
Sources of growth and regional hierarchy	Declining labor share in high order region	C
	High technology share in high order region	MC
Determinants of productivity		
Capital deepening	Negative effect	C
Output growth	Positive effect	C
Wage ratio	Positive effect	C
Land asset growth	Negative effect	C
Urbanization effect	Positive effect	C2
Localization effect	Positive effect	C2
Highway access	Positive effect	NC
Regional inequality		
Industrial location	Spatial convergence	MC
Industrial productivity	Spatial convergence	MC
Regional inequality	Overall decrease	MC

Note: C: confirmed
C2: confirmed for restructuring period
MC: mostly confirmed
PC: partly confirmed
NC: not confirmed

Chapter 7

CONCLUSION

Conclusions

Industrial restructuring has brought about substantial changes in traditional growth patterns of regional manufacturing employment in Korea, even if it might be premature to conclude these changes were caused by a fundamental shift of the regime of capitalist accumulation. During the industrializing period (1983-88), broadly defined core areas, such as urban areas and their adjacent rural counties, industrialized areas, the capital region and the Southeast region, attracted the majority of new manufacturing employment. During the industrial restructuring period (1988-93), these more advanced regions were heavily affected by a national trend of deindustrialization, whereas less industrialized and peripheral regions including rural areas, and the Southwest and most remote provinces, emerged as newly industrializing spaces.

These new patterns of industrial location might be comparable to those that have taken place in western advanced countries (Haynes and Machunda, 1987; Keeble, 1979;

Scott 1988a). Also, they were observed in recently industrialized countries in southern Europe (Vazquez-Barguero, 1990), as well as newly industrializing countries such as Brazil (Storper, 1991) and Taiwan (Selya, 1993; Todd and Hsueh, 1988). In addition, the spatial spread of industrial location through regional hierarchical system was very similar to the filtering down process suggested by theorists of regional product-cycle (Erickson, 1976; Erickson and Leinbach, 1979; Moriarty, 1991; Rees, 1979). Gross employment change, location quotients, and simple regression analysis provided ample evidence of the emerging process of decentralization of industrial location.

Multiple regression analysis identified a significant association between the growth of regional manufacturing employment and economic and geographical factors. Throughout the research period, rapid rises in the regional wage ratio and land prices were negatively associated with the growth of manufacturing employment, whereas capital investment had a strong positive impact. These three factors are some of the most important triggers of industrial restructuring in Korea (Kim, 1993; Park, 1994). Factors that became more important in recent years were agglomeration indicators, such as population density and the location quotient, and the labor intensity of regional industries, all of which had negative (and significant) coefficients only for the restructuring period. Accessibility to modern highway networks had positive impact on the location of manufacturing industries, but with some time lag.

Therefore, the emergence of new industrial spaces in former peripheral areas can be explained by cost advantages in these regions (Carlino and Mills, 1987; Chiniz, 1986; Hakanson and Danielsson, 1985), as well as physical constraints in urban location (Fothergill et al, 1987; Fothergill and Gudgin, 1982; Scott, 1982; Tulpule, 1969). However, a large portion of variation remained unexplained, reflecting the omission of socio-political variables. In summary, the overall process of industrial location in Korea revealed similarities to typical developing economies during the industrializing period, but more closely resembled advanced economies during the restructuring period.

The examination of regional productivity revealed not only the distinctive characteristics of the growth of Korean manufacturing industry, but also clear spatial patterns. Throughout the research period, the growth of output of Korean manufacturing depended largely on the growth of factor inputs, especially capital investment. The accelerated growth of capital accumulation was universal, leading to the rapid growth of labor productivity, but a decline in capital efficiency. The role of productivity advances was very limited, with decreases over time, suggesting a slowdown in the improvement of technical efficiency of Korean industry. The opposite phenomenon was the case in advanced countries (Mayes, 1996). Thus, it is unlikely that Korean industries have fully accomplished such objectives of restructuring as rationalization of production systems, and improvement of productivity and profit rates (Vazquez-Barguero, 1990).

A clear spatial pattern of productivity was exhibited through regional hierarchies. Urban areas, industrialized areas, and core areas had more efficient production systems than rural areas, less industrialized areas, and peripheries, respectively. This spatial pattern corresponds to results from Sweden (Aberg, 1973), the US (Moomaw, 1981; Nicholson, 1978) and Brazil (Hansen, 1990). Metropolitan cities and the capital region, in particular, had absolute advantages over other types of regions. This might be due to the positive agglomeration economies in these regions. There was no evidence that urban productivity advantages are declining as in US metropolitan areas (Blackley, 1986; Carlino, 1985; Moomaw, 1985) or Canadian cities (Soroka, 1990).

Regression analysis revealed critical factors that are associated with the technological improvement of production. First, the accumulation of capital, the single most important source for the growth of Korean manufacturing, had a strong negative relationship with productivity growth. The vintage effect from new capital embodying productivity enhancing components was not confirmed in Korea, which is contrary to advanced industrialized economies (Abramobitz, 1986, 1990; Dollar, 1991; Dollar and Wolff, 1993; Wolff, 1991; Rigby, 1995). But, as pointed out by Dollar and Sokoloff (1990) and Park (1986), this does not seem to be unusual in Korea. It is rather surprising that industrial restructuring has not brought about any significant improvement of capital efficiencies. However, the growth rate of output or economies of scale was positively associated with the improvement of productivity, corresponding to Casetti (1984). In addition, more efficient resource allocation was also found to be advantageous for productivity, as exemplified by the negative coefficients of the growth of land assets ratio. With regard to the effect of wages, a higher regional wage ratio was shown to be a positive stimulant for productivity, which is comparable to Baily et al (1996). Urbanization and localization economies were also important factors (Beeson, 1987; Watts, 1987), but more so for the period of restructuring. However, the positive impact of highway accessibility was not confirmed, suggesting the need to employ a more comprehensive transportation index (Mas et al, 1996; Moomaw and Williams, 1991).

An important interpretation can be drawn from the relationship between new locational trends and spatial patterns of productivity. A clear trade-off relationship exists between the trend of locational decentralization and the improvement of competitive advantage of national industries. The decline of manufacturing employment in more advanced regions is not due to disadvantages in productivity, but because of cost disadvantages compared to less developed areas. Deindustrialization in regions with more efficient production systems and rapid industrialization in less efficient areas might interact to reduce the overall efficiency of Korean manufacturing industry. Thus, two options can be pointed out. First, new industrial location policies should be selective, considering both positive external economies on productivity in established regions, and cost benefits in new industrial spaces in order to maximize locational potentials. Second, further effort should be made to enhance technological advances of industries in newly industrializing areas.

The negligible contribution of productivity advances to the growth of industry output poses a challenge for the improvement of the overall efficiency of Korean manufacturing industry. The meager contribution of technological improvements for industrial development does not seem to be unique in Korea. It was found to be true in Singapore (Tsao, 1985) and Taiwan (Choi, 1990) as well. Lower productivity of Korean manufacturing means that capital expenses for investment did not yield enough revenues to recover costs. This can lead firms with lower productivity to seek external sources for new investment, causing financial difficulties during economic downturns.

With regard to regional inequality, the impact of industrial restructuring is less conclusive. Different methods of analysis revealed slightly different results.

Gini coefficients suggest that the spatial convergence of gross indicators of manufacturing activities was not as strong during the period of restructuring as in the industrializing period. A slight increase in inequality occurred during the restructuring period in site area and floor space, reflecting growing disparities in the availability of industrial land. However, inequality in employment, worker remuneration, and output (both value added and gross output) continued to decline.

Inequalities in regional productivity show similar patterns to location change between the two periods. The coefficients of variation indicate that regional disparities decreased in three measures of productivity - labor, capital, and total factor productivity - during the industrializing period. However, during the restructuring period, disparities increased in capital productivity and TFP, but decreased in labor productivity. This might be due to the subpar performance of productivity by newly industrializing regions compared to established regions.

On the other hand, the results of regression analysis suggest that the spatial catch-up process was stronger during the later period, especially for gross indicators. The three productivity measures exhibited spatial catch-up in both periods. Therefore, industrial restructuring had not radically altered the existing spatial system of manufacturing activities (Fielding, 1994) and spatial patterns of industrial productivity, in spite of the superior performance of less developed regions. This suggests that 'regional inversion' (Suarez-Villa and Cuadrado Roura, 1993) has not taken place in Korea yet. Analysis of regional inequality indicates the importance of interpretation of the outcome with the acknowledgement of their basic principles.

In conclusion, industrial restructuring in Korea since the late 1980s has accelerated the process of polarization reversal of manufacturing location, which began in the late 1970s (Richardson, 1980). Locational decentralization is a strong indication that geography is playing an active role for Korean industrial restructuring. The general implication of industrial restructuring on spatial development seems to be more optimistic in Korea compared to advanced countries. An increasing number of regions that were not the locus of previous industrialization are participating in the new phase of development. However, convergence of regional productivity was not as clear as industrial location. The trade-off relationship between industrialization and regional productivity might constrain the pace of spatial convergence of economic well-being. Therefore further effort is needed for the improvement of productive efficiency of industries in less developed areas, in addition to the promotion of decentralization.

Future Research Areas

The current research has examined spatial aspects of industrial restructuring with an emphasis on location, productivity, and inequality of Korean manufacturing industry. There are several areas that merit additional investigation in order to deepen understanding of the process of industrial and spatial change. There is a need to improve the explanatory power of regression models of change in industrial location. The current research employed a very limited set of explanatory variables, which though significant, accounted for a small part of the variation in the growth of regional manufacturing employment. There are additional variables available from published data sources that could be incorporated into future studies. They include variables related to regional industrial policies, such as the provision of industrial estates and various locational subsidies; indices of social infrastructure comprising various modes of transportation, telecommunication, and basic infrastructure; and variables related to labor relations and human capital.

The current research focused on whole cities and counties in Korea to provide an overall picture of industrial and locational changes. A micro scale locality study is needed to examine the effect of industrial restructuring more specifically. One of the traditional industrial centers or new industrial spaces, or a pair of them, could be selected as a study area. Specific strategies of business restructuring in such areas as labor relations, production processes, external linkages, and research and development activities could be surveyed to examine the effect of such strategies on productivity and business profits. In addition, business failure or success can be investigated using the variables related to the extent of restructuring effort, productive efficiency, and geographical location.

Another area that demands further investigation is industrial complexes. These are (and will be) the central places of Korean manufacturing industry, and were *created* by government policies. It is virtually unknown whether firms in these complexes are more efficient and innovative than those in other places. One of the primary objectives of the provision of industrial complexes should be the generation of endogenous external economies from dense networks of inter-firm linkages. The current study identified positive localization economies, but from an aggregated data set. It will be possible to examine the net performance of industrial complexes, both individually and in the aggregate, in a few years when recently published data sets are accumulated.

One of the most interesting and significant findings of this study is the strong negative association between capital accumulation and improvement of regional productivity. Although the negative association is not a new phenomenon in Korea (Dollar and Sokoloff, 1990), there is little evidence that the efficiency of capital use improved, even during the restructuring period. How does this happen and why is it so stable over the periods? The answer for the question is crucial because it is widely believed that excessive capital investment with diminishing efficiency led to the financial crisis of Korean industries in the late 1990s. How can geographical studies contribute to the understanding of the mechanisms and processes of negative cumulative causation effect of capital investment on the efficiency of the Korean production system?

The final list of additional research area involves examining the impact of industrial restructuring on regional development. It has been shown that industrial restructuring has brought about the overall convergence of industrial location and regional productivity. However, it remains unanswered whether restructuring has reduced regional gaps in income and wealth through the decentralization of manufacturing location or aggravated regional disparities by deepening the spatial division of labor with concentration of advanced and profitable activities in a limited number of regions.

The economic crisis of the late 1990s not only provides research opportunities, but also demands diagnoses and practical solutions from the academic world. The magnitude and impact of the imminent restructuring of Korean economy in the late 1990s and thereafter will surpass that which occurred since the late 1980s. The massive economic restructuring experience of western developed countries can be a starting point for the upcoming spatial reorganization of the Korean production system. How will unprecedented business failures and restructuring affect and be affected by geography? How can geographers contribute to organize advanced production systems over space? Further research effort should be made to extend our limited knowledge of the geographic *modus operandi* of the capitalist accumulation system.

APPENDICES

APPENDIX A

APPENDIX A

Derivation of Growth Accounting Model

The output of an economic activity depends on the factors of production that are used. The general form of this relationship can be written as:

$$Q = f(K, L, T) \tag{A-1}$$

where, Q is output; K, L, and T are the total inputs for capital, labor, and the level of technology, respectively. Equation (A-1) can be converted to a traditional Cobb-Douglas production function:

$$Q = TL^{\alpha}K^{\beta} \tag{A-2}$$

where: α and β are output elasticities of labor and capital.

Assuming neutral technical change and constant returns to scale on output, the sum of α and β is equal to unity. In this case, the equation (A-2) becomes:

$$Q = TL^{\alpha}K^{1-\alpha} \tag{A-3}$$

The assumption of constant returns is more reasonable as a longer term explanation, rather than for a single year, since it is based on the long-term equilibrium of factor elasticities in a competitive economy (Park, 1986). Under long-term equilibrium, when factors are paid for their marginal products, the output elasticity of labor input is equal to labor's distributional share of output. Therefore the share of wages to outputs can be an estimator of α. Taking the logarithm, equation (A-3) can be rewritten to show the sources of output growth (Dollar and Wolff, 1993; Jefferson and Xu, 1994; Park, 1986; Wolff, 1991):

$$Ln(Q) = Ln(T) + \alpha Ln(L) + (1-\alpha)Ln(K) \qquad \text{(A-4)}$$

where: Ln(Q), Ln(L), and Ln(K) are the logarithmic growth rates of value added, labor input, and capital input between two time points, respectively; Ln(T), a residual term, is the growth of total factor productivity; α equals the average wage share to value added over the period.

Equation (A-3) can be rewritten to decompose labor productivity growth into the contribution of capital accumulation (capital-labor ratio) and the growth rate of TFP or productive efficiency as a residual (Anderson, 1990; Dollar and Sokoloff, 1990; Wolff, 1991). From equation (A-3),

$$\begin{aligned} Q/L &= TL^{\alpha-1}K^{1-\alpha} \\ &= TL^{-(1-\alpha)}K^{1-\alpha} \\ &= T(K/L)^{(1-\alpha)} \end{aligned}$$

Therefore, taking the logarithm,

$$Ln(Q/L) = (1-\alpha)Ln(K/L) + Ln(T) \qquad \text{(A-5)}$$

where: Ln(Q/L) and Ln(K/L) are the logarithmic growth rates of labor productivity and capital-labor ratio between two time points, respectively; Ln(T) and α are same as above.

APPENDIX B

APPENDIX B

Study Area

NO	CITY	'83	'88/'93	NO	CITY	'83	'88/'93
1	SEOUL	✓	✓	38	DAECHON		✓
2	PUSAN	✓	✓	39	ONYANG		✓
3	TAEGU	✓	✓	40	SOSAN		✓
4	INCHON	✓	✓	41	JONJOO	✓	✓
5	KWANGJOO	✓	✓	42	KOONSAN	✓	✓
6	TAEJON	✓	✓	43	IRI	✓	✓
7	SOOWON	✓	✓	44	JONGJOO	✓	✓
8	SONGNAM	✓	✓	45	NAMWON	✓	✓
9	ANYANG	✓	✓	46	KIMJE		✓
10	POOCHON	✓	✓	47	MOKPO	✓	✓
11	UIJONGBOO	✓	✓	48	YOSOO	✓	✓
12	KWANGMYONG	✓	✓	49	SOONCHON	✓	✓
13	SONGTAN	✓	✓	50	NAJOO	✓	✓
14	TONGDOOCHON	✓	✓	51	YOCHON	✓	✓
15	ANSAN	✓	✓	52	E-KWANGYANG		✓
16	KWACHON		✓	53	POHANG	✓	✓
17	KOORI		✓	54	KYONGJOO	✓	✓
18	PYONGTAEK		✓	55	KIMCHON	✓	✓
19	MIKUM		✓	56	ANDONG	✓	✓
20	OSAN		✓	57	KOOMI	✓	✓
21	SIHUNG		✓	58	YONGJOO	✓	✓
22	KOONPO		✓	59	YONGCHON	✓	✓
23	UIWANG		✓	60	SANGJOO		✓
24	HANAM		✓	61	JOMCHON		✓
25	KOYANG	✓	✓	62	KYONGSAN		✓
26	CHOONCHON	✓	✓	63	CHANGWON	✓	✓
27	WONJOO	✓	✓	64	ULSAN	✓	✓
28	KANGNUNG	✓	✓	65	MASAN	✓	✓
29	TONGHAE	✓	✓	66	JINJOO	✓	✓
30	TAEBAEK	✓	✓	67	JINHAE	✓	✓
31	SOCKCHO	✓	✓	68	CHOONGMOO	✓	✓
32	SAMCHOK		✓	69	SAMCHONPO	✓	✓
33	CHONGJOO	✓	✓	70	KIMHAE	✓	✓
34	CHOONGJOO	✓	✓	71	MILYANG		✓
35	JECHON	✓	✓	72	JANGSUNGPO		✓
36	CHONAN	✓	✓	73	JEJOO	✓	✓
37	KONGJOO		✓	74	SOGWIPO	✓	✓

NO	COUNTY	'83	'88/'93	NO	COUNTY	'83	'88/'93
75	YANGJOO	✓	✓	117	KUMSAN	✓	✓
76	S-YANGJOO	✓	✓	118	YONKI	✓	✓
77	YOJOO	✓	✓	119	KONGJOO	✓	✓
78	PYONGTAEK	✓	✓	120	NONSAN	✓	✓
79	HWASONG	✓	✓	121	POOYO	✓	✓
80	SIHUNG	✓		122	SOCHON	✓	✓
81	PAJOO	✓	✓	123	PORYONG	✓	✓
82	KWANGJOO	✓	✓	124	CHONGYANG	✓	✓
83	YONCHON	✓	✓	125	HONGSONG	✓	✓
84	POCHON	✓	✓	126	YESAN	✓	✓
85	GAPYONG	✓	✓	127	SOSAN	✓	✓
86	YANGPYONG	✓	✓	128	TAEAN		✓
87	YICHON	✓	✓	129	TANGJIN	✓	✓
88	YONGIN	✓	✓	130	ASAN	✓	✓
89	ANSONG	✓	✓	131	CHONAN	✓	✓
90	KIMPO	✓	✓	132	WANJOO	✓	✓
91	KANGHWA	✓	✓	133	JINAN	✓	✓
92	CHOONCHON	✓	✓	134	MOOJOO	✓	✓
93	HONGCHON	✓	✓	135	JANGSOO	✓	✓
94	HOENGSONG	✓	✓	136	IMSIL	✓	✓
95	WONJOO	✓	✓	137	NAMWON	✓	✓
96	YONGWOL	✓	✓	138	SOONCHANG	✓	✓
97	PYONGCHANG	✓	✓	139	JONGUP	✓	✓
98	JONGSON	✓	✓	140	KOCHANG	✓	✓
99	CHOLWON	✓	✓	141	POOAN	✓	✓
100	HWACHON	✓	✓	142	KIMJE	✓	✓
101	YANGGOO	✓	✓	143	OKKOO	✓	✓
102	INJE	✓	✓	144	IKSAN	✓	✓
103	KOSONG	✓	✓	145	TAMYANG	✓	✓
104	YANGYANG	✓	✓	146	KOKSONG	✓	✓
105	MYONGJOO	✓	✓	147	KOORYE	✓	✓
106	SAMCHOK	✓	✓	148	KWANGYANG	✓	✓
107	CHONGWON	✓	✓	149	YOCHON	✓	✓
108	POEUN	✓	✓	150	SEUNGJOO	✓	✓
109	OKCHON	✓	✓	151	KOHEUNG	✓	✓
110	YONGDONG	✓	✓	152	POSONG	✓	✓
111	CHINCHON	✓	✓	153	HWASOON	✓	✓
112	KOESAN	✓	✓	154	CHANGHEUNG	✓	✓
113	UMSONG	✓	✓	155	KANGJIN	✓	✓
114	CHOONGWON	✓	✓	156	HAENAM	✓	✓
115	JECHON	✓	✓	157	YONGAM	✓	✓
116	TANYANG	✓	✓	158	MOOAN	✓	✓

NO	COUNTY	'83	'88/'93	NO	COUNTY	'83	'88/'93
159	NAJOO	✓	✓	185	YECHON	✓	✓
160	HAMPYONG	✓	✓	186	YONGPOONG	✓	✓
161	YONGKWANG	✓	✓	187	PONGHWA	✓	✓
162	CHANGSONG	✓	✓	188	ULCHIN	✓	✓
163	WANDO	✓	✓	189	CHINYANG	✓	✓
164	JINDO	✓	✓	190	UIRYONG	✓	✓
165	SINAN	✓	✓	191	HAMAN	✓	✓
166	TALSONG	✓	✓	192	CHANGNYONG	✓	✓
167	KOONWI	✓	✓	193	MILYANG	✓	✓
168	UISONG	✓	✓	194	YANGSAN	✓	✓
169	ANDONG	✓	✓	195	ULSAN	✓	✓
170	CHONGSONG	✓	✓	196	KIMHAE	✓	✓
171	YONGYANG	✓	✓	197	CHANGWON	✓	✓
172	YONGDOK	✓	✓	198	TONGYONG	✓	✓
173	YONGIL	✓	✓	199	KOJE	✓	✓
174	KYONGJOO	✓	✓	200	KOSONG	✓	✓
175	YONGCHON	✓	✓	201	SACHON	✓	✓
176	KYONGSAN	✓	✓	202	NAMHAE	✓	✓
177	CHONGDO	✓	✓	203	HADONG	✓	✓
178	KORYONG	✓	✓	204	SANCHONG	✓	✓
179	SONGJOO	✓	✓	205	HAMYANG	✓	✓
180	CHILKOK	✓	✓	206	KOCHANG	✓	✓
181	KUMRUNG	✓	✓	207	HAPCHON	✓	✓
182	SONSAN	✓	✓	208	N-CHEJOO	✓	✓
183	SANGJOO	✓	✓	209	S-CHEJOO	✓	✓
184	MOONKYONG	✓	✓				

Note: 1) Checked marks reflect administrative areas in respective year.
2) Regional numbers are identical to those in Figure 1 (page 80).

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