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Urban growth and the labor market in Korea

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URBAN GROWTH AND THE LABOR MARKET IN KOREA

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ABSTRACT

Urban concentration of population is one of the major concerns of Korea. People believe that its speed is too fast and the population concentrates too much in a few large cities. However, most of their concerns about population concentration are based on general impressions without positive and quantitative knowledge of the benefits and costs of city growth.

The objective of this paper is to analyze quantitatively the effects of city growth on economic efficiency in order to clarify the nature and the causes of the urbanization in Korea using city-based cross-sectional data of 1986 and 1976. The model is a labor market equilibrium model consisted of a labor productivity function and a labor supply function, where parametric external effects of agglomeration are considered as the factors affecting not only the productivity of the cities but also the quality of life of the residents.

The estimation results show that in Korea city size has a favorable effect not only on production but also on consumption of workers, which implies that urbanization in Korea takes the pattern of accelerating city growth. This situation contrasts with the pattern of developed countries where in general city growth has favorable effects on production but it has negative effects on consumption.

However, the results also indicate that the favorable effects of city growth on workers' welfare in Korea are now diminishing rapidly and that the disamenities caused by city growth will dominate the amenities in near future as income and technology develop.

We also found out that urban attributes such as industry-mix, labor force characteristics, the cost-of-living index, and natural environment also affect the productivity, labor supply, and the wage rate of cities. It means that we should take into account the effects of such urban attributes in the analysis of city size, growth, and structure.

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CHAPTER I

INTRODUCTION

1.1 Purpose of the Study

In most developing countries people believe that the present pattern of urbanization is undesirable in that its speed is too fast and the population concentrates too much in a few large cities. Also they worry that the situation will deteriorate in the future. Their major concerns are that large agglomerations defeat common objectives of regional balance, generate an inexhaustible demand for infrastructure to achieve service levels which could be provided in smaller quantities and at lower costs elsewhere, and face the inevitable pollution and environmental deterioration in metropolitan areas (Hamer and Linn 1987).

In this context, various population redistribution policies have been adopted to decelerate rural-to-urban migration trends or to alter urban configuration in most of the developing countries. The programs include "closed city" programs designed to constrain metropolitan growth by stopping or slowing down in-migration, programs aimed at regional dispersion of urban growth through expansion of intermediate-size cities and regional centers, and rural development programs directed at retention of rural populations and the growth of rural service centers. (Fuchs 1983)

However, the programs have had limited effects and may have unintended side-effects (Fuchs 1983). Several reasons can be cited. First, policy objectives are often imprecise because there is no clear understanding of the cause and consequences of city growth. Some people believe that city growth is economically efficient except for the problem of the regional balance. Their concerns are more political and they tend to make political gestures for regional balance while having more interest in improving urban habitat. Others argue that the existence of external effects of city growth such as congestion and pollution creates a divergence between private benefits and social benefits which makes city sizes too large. Still others argue that large conglomeration is the result of the implicit government policies that are not consistent with the goals of explicit population distribution policies. However, most of their arguments are based on general impressions and beliefs. There are few positive or quantitative answers about the cause and nature of city growth, the optimality of city size, and the impact of implicit government policies on population distribution.

Second, even when the policy objectives are well defined, programs and instruments are severely constrained by limited resource availability and inadequate institutions. For example, those initiatives to promote

growth in stagnated areas should compete with all other demands for central financial and administrative resources.

In addition, the absence of reliable methods to evaluate policy effectiveness make the problem worse. The need for government intervention and the relevance of instrument selection can not be assessed without the knowledge of the policy effectiveness.

In short, the questions we have are: Why has city size been growing so rapidly in developing countries like Korea? Are cities growing as places of efficient production or as better places of consumption? Then, will the present pattern of urbanization continue in the future? How will the pattern change as income and technology develop? Do we need government intervention to alter the distribution of population? If necessary, what kind of policies will be relevant?

The first step to take to answer these questions is to understand what are the effects of urban growth on economic efficiency. The right way to do this is to consider the costs and benefits facing firms and consumers when they cluster together in urban areas. However, a difficult question is how to measure those effects correctly.

The purpose of the study is to make a contribution to answer the above questions through the empirical analysis of the behavior of local labor markets in Korea using a labor market equilibrium model. The main point is that labor

markets are at the heart of decisions determining where people to live and work and, therefore, employment and wage rates in a particular urban area reflect urban characteristics associated with city size. We estimate a labor productivity function and a labor supply function simultaneously using local labor market data. We analyze the effects of city growth on labor productivity, labor supply, and wage rates and how they change in different periods.

1.2 City Size Effects on the Economic Efficiency

Heilbrun (1981) says that cities are themselves evidence that an economy has reached a certain stage of development. This implies firms and consumers enjoy some benefits by clustering together in urban areas as they achieve certain level of economic development. Greater scale of economic activities in cities enhances productivity through face-to-face contact among firms, labor market economies from efficient labor force recruitment and training, greater opportunities for specialization, scale economies in the provision of intermediate common inputs (port, warehouse, power, general business services, etc.), and external effects of innovation and market research.

Large communities also afford economies of consumption. In general, the range of types of goods and services offered to the consumer increases as community size increases. For example, good restaurants, theaters, sports and leisure

opportunities, and shopping facilities can be found more in larger cities. This is often called the "city light effect". The workers in large communities also have the advantages of an increasing range of job choice as community size increases.

At the same time there are consumption and certain production diseconomies connected with people clustering together in urban areas. Indeed, the growth of cities is influenced simultaneously by both forces, the positive economies of agglomeration inducing growth, while the negative diseconomies discourage it. Diseconomies of agglomeration occur when the concentration of population or of economic activity in one place either raises the real cost of production by requiring more inputs per unit of output or reduces the real standard of living of consumers by increasing the level of physical or social disamenities (Heilbrun 1981). Commuting cost increases and such disamenities as crime, pollution, and social conflict are good examples.[1]

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1. The term "(dis)amenities" which is often used in this paper, is defined to be location specific characteristics with either positive or negative contributions to consumers' welfare (Bartik and Smith 1987). As it will be explained in Chapter II, according to hedonic price model, consumers reveal their preference for urban amenities as they choose among cities. We can categorize amenities into two types: natural amenities and social amenities. Natural amenities include such conditions as climate and distance from seaside. Social amenities include pollution, congestion, crime, job choice, variety of goods and services. Most of social amenities that we are interested in are associated with urbanization though part of them are affected also by

The questions of the optimality of city size and structure can be solved conceptually by a comparison of those economies and diseconomies of urban agglomeration. Then, the remaining question is an empirical one of how to measure the value of economies and diseconomies of agglomeration, especially in the context of changing technology and income level, and in a system of cities performing different functions.

1.3 Scope of the Study

First, the study makes an attempt to explain what accounts for the concentration of population and economic activities in cities by analyzing the nature and magnitude of the city size effects. Therefore, we do not investigate the specific urban problems arising from city growth such as housing, transportation, urban poverty, and urban public services in this study. However, the analysis of urban size, growth, and structure help to understand these urban problems because urban problems always have significant spatial aspects.

Second, the study focuses on the effects of city growth on economic efficiency rather than on equity and other social goals. The need for population redistribution policies may come from the concerns about regional unbalance

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public sector planning and management, culture, and historical tradition.

in income and wealth distribution or other social conflicts associated with population concentration. However, there is a very difficult question as to how to measure an index of regional balance or of social goals. Therefore, judgement on these problems depends more on political than economic considerations.

Third, we analyze effects on economic efficiency by segregating them into effects on productivity of the city and effects on living cost of the residents. For this purpose, we formulate a simultaneous equations model of labor demand and supply under the hypothesis that the city attributes including city size, price levels, geographical characteristics, and labor force composition affect labor demand and supply in local labor markets. We focus on the effects of city size and try to isolate its effects on productivity, labor supply, and wage rate controlling for other variables.

Finally, we analyze intercity wage differentials as a byproduct of the analysis of city size effects. In our simultaneous equations model the wage rate is an endogenous variable. At the first stage we will estimate reduced form of wage equation which will be explained by city size as well as other control variables and then by the second stage estimation we can interpret the coefficients of wage equations correctly under the structure of local labor markets.

1.4 Organization of the Paper

The study consists of six chapters. Chapter II presents the survey of the literature on the optimality of city size and the nature and magnitude of city size effects on the economic efficiency, including relevant empirical research. The chapter also includes a survey of the literature on interregional and intercity wage differentials. Chapter III describes characteristics of urban growth and local labor markets in Korea. In Chapter IV, I develop the analytical framework and models for the empirical study. Chapter V presents the empirical results on the local labor market structure, city size effects, and on intercity wage differentials. Chapter VI summarizes the major findings, along with the limitations of the study and some policy implications.

CHAPTER II

REVIEW OF THE LITERATURE

Urban growth affects not only firms' productivity but also consumers' welfare. The effects in each area also have both positive and negative aspects. Thereon, one group of economists focus on the production side and investigate the effects of agglomeration on the productivity of firms and on the demand for labor forces in the cities. The other group of economists concentrate on the consumption side and try to estimate the values consumers reveal of disamenities and amenities that urban growth brings into urban areas and their effects on labor supply in local labor markets. They believe the differences in those values among different areas are compensated by wage differences among them.

This Chapter reviews literature in both areas and then examines a few studies that synthesize both areas into a labor market equilibrium model. In this model, equilibrium wage and employment are determined consistently by solving the labor demand and supply functions simultaneously. That is, the effects of city size on the firms' productivity and household costs, reflected in the labor demand and supply functions, are estimated by a simultaneous equations model of local labor markets. In the final section, we will review the theories of intercity wage differentials and show that

the local labor market equilibrium model also works properly in this analysis.

Before we go into details of estimation, we will first review the theories of optimal city sizes to describe a general framework for the evaluation of the optimality of city size. This will lead to a necessity of the labor market equilibrium model.

2.1 Optimality of City Sizes

Conceptually we can derive an optimal city size comparing the value of diseconomies of agglomeration per capita with the value of diseconomies of agglomeration, similarly measured. Richardson (1973) explains the point

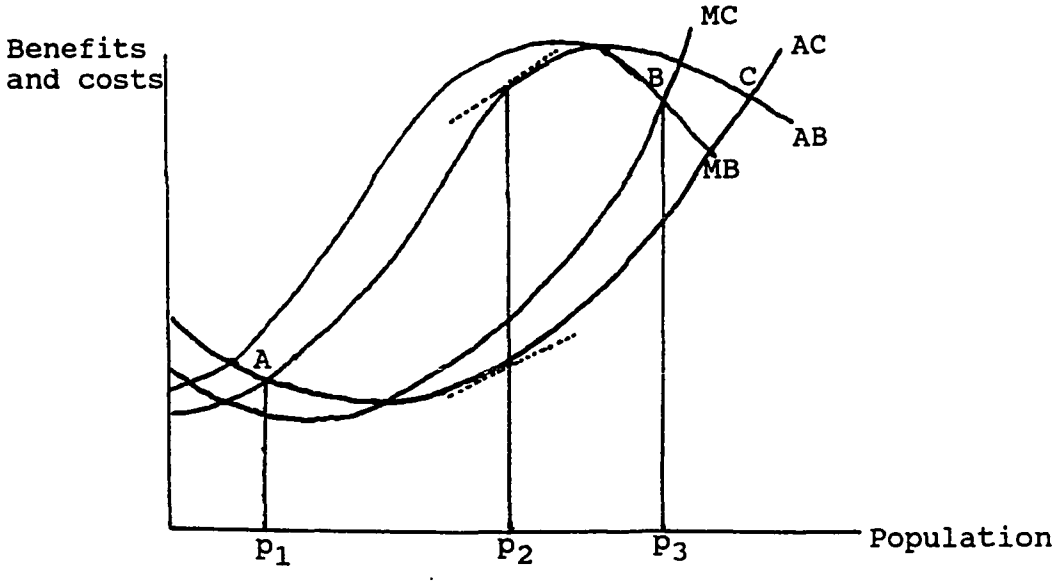

Figure 1. Optimal City Size
Source: Richardson (1973) p.11, Fig. 2.1.

using a simple diagram, which is shown in Figure 1, where MC, MB, AC and AB denote marginal cost, marginal benefit, average cost, and average benefit respectively.

In the diagram Richardson isolates several city sizes of interest. The point A (AB = AC) represents the minimum city size p_1 below which the city is not viable. The city size p_2 is the city size which maximizes net benefits per capita (AB - AC). Beyond p_2 the citizens have a vested interest in keeping out migrants. However, the degree of competition in land market will determine how much of the net benefit the individual is allowed to retain because the land rents will go up as competition increases. The point B is the most important city size. Here the population p_3 is at its optimum from social planning point of view where the total net benefits generated by the city are maximized. However, the costs and benefits perceived by the potential migrant will be average rather than marginal. Therefore, if the urban land market is purely competitive, market equilibrium will be attained at C where AB = AC. This point represents the case for the argument that unconstrained market forces result in big cities becoming too big. This simple model explains fairly well the basic notion of the optimal city size.

However, as Richardson indicates himself, there are several questions we have to answer to apply it to real world. The first question is how to measure the value of

economies and diseconomies of agglomeration that would be needed to determine optimum size. The effects on firms would differ in nature from those on households. Therefore one way of estimating the effects of agglomeration is to estimate the effects on each group separately and then to sum up them for the total effects on a city.

With regard to this, Fogarty and Garofalo (1980) suggest a framework that analyzes the net productivity of cities using a simultaneous model of labor demand and supply. It is simplified in Figure 2. We assume the external effects of agglomeration shifting the supply and demand curves of labor. In the diagram, the effect on production (firms) is assumed to be positive and shifts the demand curve rightward from D_1 to D_2, and the effect on consumption (workers) to be negative and shifts the supply curve leftward from S_1 to S_2 as city size increases from state 1

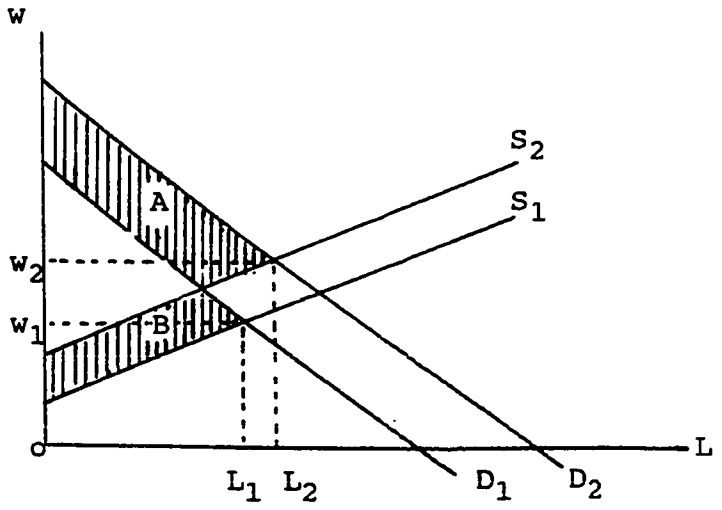

Figure 2. Net Productivity of City

to state 2. Here the shaded area A shows the productivity effect and area B shows the compensating payment for the disamenities of city growth. If area A exceeds area B, the larger city produces a real productivity gain and, from an efficiency standpoint, is preferred over the smaller size of cities.

However, the nature and magnitude of the city size effects and the method of estimation are not so simple as assumed in this diagram but there are many related issues, which we will discuss in later sections in this Chapter.

The second question is how to identify the costs and benefits in a dynamic world in which technology and income are continuously changing. This question is also an empirical one that we can answer with comparative studies of various areas at different stages of development. With regard to this issue, one possibility is that, in a developing economy, both productivity effects and amenity effects are positive and so the society experience self sustaining city growth and persistent in-migration from rural areas or small towns to larger cities. This might happen when people in low income level do not value disamenities such as congestion and pollution as much as consumption variety in large cities.

Third, Richardson's simple model can not explain the need in every society for a variety of cities performing different functions and therefore differing systematically

in size (Heilbrun 1981). According to Henderson (1988), national output patterns are determined by a country's overall natural resources, consumption patterns, trade relationships, and governmental policies. These production patterns then imply a system of cities, broken into different types of cities specialized in the production of different goods. That is, a city's size is determined primarily by which type of industry it attracts, and that depends in part on whether its natural amenities are attractive to that type of industry. In short, there is not a single universally efficient city size, but an optimum set of cities in which each city has the optimum size to perform its expected functions. All of these issues are the subjects we will study throughout the paper.

In the remaining part of this section, we review two empirical works of the optimality of city sizes. The first one is the work of Edel (1972). Edel tests the optimality of city sizes by land values. According to him, as migration approaches a perfect elasticity with respect to net benefits, and to the extent that supply of usable space in the city is inelastic, the entire benefit per resident will be approximated by average land rent (AR).

(2.1) $AR \approx AB - AC$

where AB: average benefit related to city size

AC: average cost related to city size

Thus, the change in land values with city size gives some indication of the net benefits of living in cities of a particular size.

Based on this concept, some of the regression estimates of effects of population on land value (LV) were made.

$$(2.2) \qquad LV = a + bPOP + c_j VAR_j$$

where VAR_j's include background variables such as the presence of railroad, port facilities, the value added in agricultural and mining production, college student, number of factories of top 200 corporations.

Empirical results show that, on the average, economies of agglomeration outweigh costs associated with agglomeration for cities of a size up to at least half a million in population. For metropolitan areas of a somewhat larger size, the balance is more doubtful. However, for some larger cities of several million inhabitants, rising land values again indicates a private net benefit to those taking part in the urban agglomeration. But, these benefits seem limited to cities with certain corporate headquarters functions.

There are some shortcomings in this approach. First, as Edel himself indicated, land prices are an imperfect measure of the net social cost of congestion, and at best can give a rough order-of-magnitude approximation to these costs under stringent assumptions. The economies and diseconomies of agglomeration are capitalized not only in land rent but also

in wage rate, which will be more discussed later. Second, this model is too aggregative. It ignores the differences between the pattern of effect of city growth on firm production and on household consumption.

Next, Yezer and Goldfarb (1978) test the efficiency of city sizes by a comparison of estimated agglomeration economies in production with the compensation variation in occupation-specific wages needed to attract workers to larger cities. According to them, necessary condition for efficient population allocation is that output maximization is achieved when the change in employment-weighted wage rates (household costs) with city size was equal to the marginal firm efficiency effect.

$$(2.3) \qquad L_i[dW_i/dN_i] = Y_i[dg(N_i)/dN_i]$$

where L_i, N_i, W_i and Y_i denote the employment, the city size, the wage rate and total value added in the city i respectively and $g(N_i)$ represents productivity shift factor reflecting scale effects of agglomeration.

The household costs effect of city size (dW_i/dN_i) is estimated by following piecewise linear regression.

$$(2.4) \qquad WAGE_{ij} = c + \Sigma a_s REGION_s + \Sigma b_t POP_t + \Sigma d_j OCC_j$$

where $REGION_s$, POP_t, and OCC_j are dummy variables denoting region, city size, and occupation respectively.

To test the efficiency of city sizes, this is compared with an estimate of the marginal change in firm efficiency

$(dg(N_i)/dN_i)$, which is based on the following production function of city.

(2.5) $Y_i = g(N_i)F(K_i, L_i)$ assuming $g(N_i) = a + b\log N_i$

They show the empirical results that necessary conditions for efficient allocation of resources are not met for city sizes between 1.5 and 2.5 million, and that rapid increase in the household cost function will not continue as the city grows further.

This approach is very suggestive in that it considers both side effects of agglomeration on production (labor demand) and consumption (labor supply), and it is based on the notion of labor market equilibrium. However, this model uses very rough and aggregative estimation equations of production function and household cost function. In the wage and city size relationship, they don't control for any other prices such as land rent and other (dis)amenities such as natural environment and urban unemployment. For the estimates of production efficiency, they borrowed the results of Segal (1976)'s direct production function estimation. However, Segal's study relies on very controversial estimated data on capital stock and its production function is not industry specific but aggregate one of whole industry in a city . Finally, though Yezer and Goldfarb base their model on the labor market equilibrium, they don't specify explicitly the labor demand and supply functions, instead they just estimate the costs and

benefits of city growth at the equilibrium point indirectly and compare them. They ignore the simultaneity in the labor market.

2.2 Productivity of Cities and Labor Demand

2.2.1 Sources and Nature of Agglomeration Effects

As we already mentioned, the key to the existence of cities is scale economies in production. In the static sense, a larger city permits more specialization and a greater division of labor. In the dynamic sense, the new impressions and new ideas are probably most likely to occur in cities. Creativity or the successful adaptation to change have been more frequent in urban areas (Sveikauskas 1975). On the other hand, the concentration of population in one place increases the real cost of production by requiring more inputs per unit of output. For example, the presence of air pollution and traffic congestion raises production costs of firms. However, evidence shows in general that scale economies outweigh diseconomies in production until city size grow to a considerably high level.

Hoover (1937) disaggregated the scale economies into three different sources: (1) large scale economies within a firm (internal scale economies), (2) scale economies external to a firm but internal to each industry, which is measured by total employment in that industry in that urban

area (localization economies), and (3) scale economies external to the specific industry, which is related to the level of all economic activity as measured by total city population (urbanization economies).[2]

Since Hoover articulated possible sources of scale effects, many economists tried to empirically identify the nature and sources of scale effects. Most studies show that the internal scale effects are not important in explaining the differences in productivity across cities (for example, Segal 1976, Carlino 1979, Henderson 1986b). In this regard, Henderson (1988) says that firm size has no significant effects for firms above some critical minimum size or over some interval of sizes. Therefore, the issue is whether the scale economies external to firm are ones of localization or urbanization.

However, the empirical results about this issue are not conclusive but diversified. Shefer (1973) and Henderson (1986b) point out that scale economies are of localization and that there are a strong correlation between those industries that exhibit localization economies and those industries in which cities tend to specialize. On the other hand, many economists (Segal 1976, Carlino 1979, Sveikauskas et al. 1988) show scale economies as one of urbanization. Nakamura (1985) shows an interesting result from Japan that

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2. The last two scale economies external to firm are often called agglomeration effects in an urbanization context.

firms in light industries,in general, experience more urbanization economies in production whereas localization economies are more significant to firms in heavy industries.

2.2.2 Alternative Estimates of the Productivity and City Size Relationship

Empirical studies of agglomeration effects use various methods depending on the specification of production function, the availability of data, and the purpose of the study.

The first approach, associated with the work of Carlino (1979, 1982, 1985), measures agglomeration effects by the returns-to-scale parameter or homogeneity parameter in an industry production function. This approach define scale effects narrowly as technical in nature. According to Montgomery (1988), this approach is suited to industry-level or city-level data, but it may be less appropriate for data at the firm level.

The alternative and more often used approach views agglomeration effects as having an impact on firm production similar to that produced by a change in a Hicks-neutral productivity parameter. This approach locates the effect in the constant term in an industry production function. Following Henderson (1986b), the typical form of production function in this approach can be specified as

$$(2.6) \qquad Y = g(S)Q(k)$$

where Y = value of output

$g(s)$ = a Hicks-neutral external shift factor: scale effects

$Q(k)$ = the firm's own CRS technology

k = a vector of inputs

Within this group, there are two alternative methods to estimate the magnitude of the agglomeration effects. The first is to estimate production function directly relying on labor, capital, and output data (Rocca 1970, Kawashima 1975, Segal 1976, Shukla 1984, Nakamura 1985, Henderson 1986b). Lacking information on input of capital, the second method uses the first-order conditions of profit maximization to estimate the effects indirectly from data on output, employment, and the wage (Shefer 1973, Carlino 1979, 1982, 1985, Henderson 1986b). This latter approach has the advantage that we can obtain labor demand function specific to a city, which will be integrated with labor supply function to the city into a system of equilibrium labor market. From the estimates of this equations system we can evaluate the productivity and costs of the city, and the optimality of the city size.

To take an example of the direct production function approach, Segal estimates aggregate production function of the form

$$(2.7) \qquad Y_i = AS^a C_i^b K_i^c L_i^d$$

where $d = \Sigma \beta_k q_{ik}$

q = a vector of labor quality variables

C = site characteristics such as climate, natural resources

A = transformation coefficient

S = dummy variable for city size.

Empirical results show that constant returns to scale, where the coefficients c and $\Sigma \beta_k q_{ik}$ sum to unity, obtain across cities of different size; and an agglomeration effect (the coefficient of S) makes units of labor and capital 8% more productive in the largest cities.

On the other hand, Henderson (1986b) uses both methods in estimation of agglomeration effects in the United States and Brazil. Here we explain only his wage-based unit cost function approach, which is relevant to our study. From the above production function (2.6), Henderson derives unit cost function as

$$(2.8) \qquad c = [g(S)]^{-1} c(p)$$

where p: a vector of input prices

c(p): dual representation of the firm's CRS technology

From Shephard's lemma $dc/dw = N_o/Y$, where N_o is own industry employment. Taking the reciprocal and then logs yields

$$(2.9) \qquad \log(Y/N_o) = \log g(S) + \log[(dc/dw)^{-1}]$$

In the spirit of the translog approach, the second term on the RHS is defined to be a function $\phi(\log p_i)$. Then by the first order Taylor series expansion, Henderson derives what he calls 'dual factor usage equation'.

$$(2.10) \quad \log(Y/N_o) = C_1 + \log g(S) + \Sigma a_i \log p_i$$

Then Henderson specifies scale effects as

$$(2.11) \quad g(S) = e^{-\phi/No} N^{\epsilon n}$$

$$\log g(S) = -\phi/N_o + \epsilon_N \log N$$

where

N_o = own industry employment in a city

N = population of the urban area

$\phi/N_o = d(\log Y)/d(\log N_o) = \epsilon_o$

ϵ_o, ϵ_N : elasticities related to localization and urbanization economies respectively

The problem with this approach is the availability and the quality of the data on input prices of materials and capital. Henderson uses distance from regional market centers and regional dummies as the proxies for the differences in the cost of capital and materials in the empirical research of Brazil and the United States. Major results are: (1) economies of scale in manufacturing are generally ones of localization, not urbanization, indicating that agglomeration benefits derive from local own industry employment, not overall urban size, (2) scale effects of agglomeration are Hicks' neutral in their impact, and (3)

firm size has no significant effects, which imply constant returns to scale production technology. However, as we discussed previously in this section, we should note that the result (1) above is not a general one and there are many works that show significant urbanization economies.

2.3 Urban (Dis)amenities and Labor Supply

2.3.1 Consumer Revealed Preferences of Urban (Dis)amenities

As Nordhaus and Tobin (1972) indicated, there are many sources of utility or disutility that are not associated with market transactions or measured by the market value of goods and services. Many of them are associated with urbanization. As briefly explained in Chapter 1, they include the disamenities such as pollution and congestion as well as the amenities associated with city growth such as the varieties of consumption and job choice.

The question is how to value the unmarketed attributes offered by different cities. The basic framework for imputing the value of (dis)amenities is the hedonic price model. This model is based on the idea that consumers choose among cities to maximize their welfare. That is, consumers trade off earnings and costs of living against differences in the consumption of urban (dis)amenities. Therefore, the observed combination of urban attributes, wage rates, and costs of living must satisfy an equilibrium. The implication

is that the differences in wages and living costs between cities with different attributes are in fact the prices that signal the proper assignments of households to cities by choking off demand for preferred locations and impelling people to live in less desirable places because it is cheaper to do so. (Rosen 1979)

Then we can analyze the effects of urban growth on consumers by relating the compensating differences in wages and living costs to city size (Getz and Huang 1978). By analyzing the relationship between employment and real wages or city attributes such as city size, we can also derive a labor supply function specific to the city.

2.3.2 Alternative Explanations for Compensating Differentials

As it is implied in the above explanations, the most important and complicated issue in the estimation of the hedonic price is the extent to which intercity (dis)amenity differences will be capitalized into wages versus rents (costs of living). In short, most economists (Rosen 1979, Roback 1988, Blomquist, Berger, and Hoehn 1988) argue that both wages and rents account for regional differences in amenities and that the implicit price of an amenity is the sum of the land expenditure differential and the negative of the wage differential with respect to the amenity.

With regard to this, Henderson (1982a) explains three basic principles of capitalization. The first is that amenity differences at city edge are fully capitalized into wages. That is, land rents at the city edge contain no capitalization components and equal to the opportunity costs of land in agriculture. The second is that differences in intercity patterns of intracity amenity variations are equalized into differences in average rents to the extent that any difference in intracity patterns is not reflected in amenity differences at the edges of cities. The third is that if two cities have the same average amenities, but different intracity patterns, they will have different average rents corresponding to offsetting differences in wages.

In short, Henderson argues that controlling for average rents, differences in average amenity levels are fully reflected in wage differences. Similarly, Cropper and Arriaga-Salinas (1980) argue that wage-based estimates of benefits can be used in place of property value estimates and it does not underestimate the value of amenities. Using an equilibrium model of urban location which incorporate the spatial dimension of cities, they show that equilibrium conditions in the land market lead to an equation in which real acceptance wage in city i is a function of employment and amenities in that city. With the estimates of the coefficient of this labor supply function, they compute the

value of air quality. Based on the same reasoning, many empirical studies use the compensating wage differential for the evaluation of intercity (dis)amenity variations usually controlling for the level of costs of living.

However, most of empirical research on urban (dis)amenities use reduced form wage models assuming labor market equilibrium and estimate the value of specific urban attributes with some instrumental variables, but there is little research analyzing systematically the effects of city growth by relating this compensating wage differential to the production scale effects of city growth, and also isolating the two effects by the estimation of the structural equations.

For example, the Rosen's model (1979), which is an original model in this area, use the following reduced form of earnings equation.

$$(2.12) \qquad (w/P)_{ij} = \beta E_{ij} + rS_i + e_{ij}$$

where subscript i refers to individuals and j to cities.

w = individual's nominal wage

P = city-specific cost-of-living deflator

E = individual attributes such as education and work experiences

S = (dis)amenity measures

r = compensating wage differential; nonmarketed costs of urbanization

e = disturbance term

Rosen uses five major groups of city attributes: pollution, climate, crime, crowding, and market conditions (unemployment, growth of city, concentration of industry).

The results show that when nominal wages are deflated by a city-specific cost-of-living index, the association with city size remains strong. His findings reveal a positive real wage response ($r > 0$) to specific disamenities such as pollution, crime, unfavorable climate, and the level of unemployment.

2.4 Labor Market Equilibrium Model

2.4.1 Simultaneity Problem

As Montgomery (1988) indicates, if taken individually neither the compensating-differentials perspective (supply side argument) nor the agglomeration economies argument (demand side argument) can provide a completely convincing explanation for the association of wages with city size. In treating city size as exogenous, the literature on differentials ignores the effect of labor demand on wages; in taking wages as exogenous, the agglomeration literature ignores long-run labor supply.

In this regard, Tabuchi (1986) says that the supply-side argument implicitly assumes that high wage rates compensate for laborers' disamenity, often expressed as a function of city size as a surrogate for rent, commuting

cost, air pollution, and so forth. The demand-side discussion assumes large city size is associated with high labor productivity and with a high wage rate. City size here is regarded as a proxy for firms' "amenity" or "business climate." Both approaches are of importance and should be jointly considered in an equilibrium context.

To accomplish the desired objective, the model used must account for the interaction of supply and demand in the labor market.

2.4.2 Models and Empirical Results

With regard to this simultaneity problem, Henderson (1986b), Nakamura (1985), and Carlino (1985) used instrumental variables in connection with the estimation of labor demand function, and Arriaga-Salinas (1985), and Getz and Huang (1978) used instrumental variables for the estimation of labor supply function. However, there are few who have estimated both equations in a system.[3] Here, we explain Tabuchi (1986)'s model. Tabuchi formalizes that a

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3. Kelley (1977) is the first who estimated both labor demand and supply functions simultaneously in a system. His model is as follows.

$\log L_d = c_d + a_1 \log w + a_2 \log S$

$\log L_s = c_s + b_1 \log w + b_2 \log(1/D) + b_3 \log(1/U) + b_4 \log P$

where L_d = labor demand, L_s = labor supply, S = value added, D = density, U = % of urbanized population, P = population.

However, this model is an aggregate one and, therefore, we can not identify economies of urbanization in production. Also, as Fogarty and Garofalo (1980) indicates, this model has a collinearity problem among the variables in the labor supply function.

firm in a competitive industry maximizes its profit with respect to capital (K), labor (L), and city density (N)[4] as

$$(2.13)\quad \max\{[g_L(N)L]^{-p} + [g_K(N)K]^{-p}\}^{-1/p} - w(N)L - rK$$

where $g_L(N)$, $g_K(N)$, and p (= 1/s-1) are parameters, and w(N) and r are wage rate and price of capital respectively. From the first-order conditions and assuming $g_L(N)=a_L N^b$ and $g_K(N)=a_K N^c$, the following form of labor productivity equation is derived.

$$(2.14)\quad Y/L = a_L^{1-s} w(N)^s N^{b(1-s)}$$

where Y = value of output

b = the productivity parameter

s = the elasticity of substitution

Assuming multiplicativity for the sake of simplicity, Tabuchi specifies the labor supply equation as

$$(2.15)\quad L = b_1 w^{b2} N^{b3}$$

Then (2.14) and (2.15) are estimated simultaneously using 2SLS method of estimation.

$$(2.16)\quad \log(Y/L) = \log(a_L^{1-s}) + s\log(w) + b(1-s)\log(N)$$

$$\log(L) = \log(b_1) + b_2\log(w) + b_3\log(N)$$

---

4. Tabuchi (1986) uses population density as a proxy index for urban agglomeration economies while most of literature uses population size. Tabuchi argues that in an integrated country like Japan, population density is more strongly related to population potential or accessibility to establishments of population within a city. It was found in terms of correlation that wage rate was less associated with population than with population density in every industry.

Major empirical results are

(1) All signs of the 2SLS estimates were the same across industries whereas OLS not, and 2SLS gives more significant estimates of the coefficient of city size than OLS.

(2) 2SLS's b (productivity parameter) were all positive and had less variation among industries. Doubling population density will cause an 8.0% increase in labor productivity.

(3) The elasticity between labor supply and population density (b_3) was negative (the reverse of Kelley's result). The negative signs of b_3 may be interpreted that population density is a disamenity and is compensated by a high wage rate.

However, Tabuchi does not account for differences in the cost of living in different cities assuming that all goods are traded in national markets. In addition, Tabuchi does not control for any of differences in labor force quality, natural environment and institutions.

Montgomery (1988) generalized this model into a conceptual model by which we can analyze the effects of specific urban attributes in an integrated system as

$$(2.17) \quad L_d(t) = a_o + a_1 w(t) + a_2' p_d(t-1) + u_d(t)$$

$$L_s(t) = b_o + b_1 w(t) + b_2' p_s(t-1) + u_s(t)$$

where $w(t)$ = the nominal wage in time t

$p_d(t-1)$ = the lagged vector of other input prices (prices of public services, business services,

borrowing costs, and transport costs)

$p_s(t-1)$ = the vector of prices and nonmarket disamenities. (including prices of public services; congestion costs, crime, pollution)

However, when we try to estimate this model, we face two problems. The first is the availability and quality of data on a vector of private and public inputs prices and indicators of urban amenities and disamenities. Second, if we want to analyze the relationship between city size and labor productivity or consumer costs, we have to know also the technical relationship between population size and its effects on inputs prices and urban (dis)amenities.

2.5 Theory of Interregional and Intercity Wage Differentials

Research into the structure of individual earnings has been voluminous and most of them concentrate on labor quality differences among workers by age, sex, education, occupation and the like. Also it has long been observed that wage differences exist persistently among regions and cities even after controlling for the labor force composition.

The first extensive analysis has been done by Fuchs (1967) of the United States in 1960. According to Fuchs, only one-third of the regional differences in hourly earnings is attributable to regional differences in the labor force as measured by color, age, sex, and education;

about one-third is related to regional differences in city size; and the remaining about one-third of the differential can be explained by industry mix and other industry characteristics such as the extent of unionization. One of the important findings of Fuchs is the existence of substantial difference in hourly earnings across city size, which is unaffected by standardization for labor force composition and regional mix. Standardized hourly earnings in the SMSA's of 1,000,000 and over are typically 25 to 35 per cent higher than in the areas outside SMSA's within the same region, and about 15 per cent higher than in SMSA's of less than 1,000,000.

On the other hand, Scully (1969) analyzes interstate wage differentials focusing on the labor demand side and concludes that after accounting for differences in industry mix, the regional wage differential remains substantial because of the two factors, differential endowments of human capital and white-nonwhite wage discrimination.

However, Coelho and Ghali (1971), in a seminal paper in this area, indicate that in spite of the observed money wage differentials, real wages, money wages deflated by intermediate cost of living index, are not different in the two regions (the North and the South in the U. S.) when due account is taken of differences in industry mix. Although it might be controversial to generalize the conclusion to

different areas, it is their great contribution to call attention to interregional differences in price levels.

Goldfarb and Yezer (1976) also argue, evaluating alternative theories of intercity wage differential, that occupation-specific human capital attribute can not be a sole determinant of wage differentials by region and city, and neither demand shift for the products nor firm size is a major explanation for wage differentials across areas. They find that living cost differences, city size, and amenity differences are major reasons for intercity wage differences. Also they argue that spatial variation in industry mix may be the result and not the cause of factors influencing spatial variation in wage rates.

As Farber and Newman (1989) indicate, recently two lines of research have emerged, as leading competitors in the empirical literature on the determinants of geographic wage differentials. The first, concerned with structural variation, emphasizes the role played by heterogeneous area labor markets, which produce significant differences in wage structure of earnings functions across markets. A second line of research concludes that observed geographic wage differences represent a compensating variation to offset differences in price levels and nonpecuniary attributes.

According to the theory of compensating wage differentials, under the assumptions of perfect information, free geographic and intersectoral labor mobility, and

homogeneous consumer tastes, the nominal wage rates of workers who have similar human capital characteristics, live and work in similar environments and experience similar living costs, are driven to equality.

Gerking and Weirick (1983) test the validity of the compensating wage differential hypothesis using the following general form of the hedonic wage equation.

Real Wage = f (H, P, W, C)

where H = a vector of human capital characteristics such as experience, months worked for present employer, years of schooling, and educational degrees,

P = a vector of personal characteristics such as race, sex, and physical ability,

W = a vector of work environment characteristics such as on-the-job training, the number of persons supervised, union membership, injury rate, and occupation,

C = a vector of city attribute variables such as city size, climate, local government expenditure per capita, and crime.

Their empirical results support the theory of compensating differences. The rewards to attributes relevant in determining real wages apparently are interregionally invariant. They conclude that observed interregional differences in average real wages probably arise from different relative endowments of various heterogeneous labor

types. They argue that conflicting empirical results of interregional difference in the structure of wage equations are due to (1) the treatment of geographic cost of living differences, (2) the completeness of the specifications of the regressors, particularly the human capital measures, and (3) whether part-time workers are included in the sample.

On the other hand, Hanushek (1973, 1981) indicates that earnings functions explained by human capital variables such as schooling, ability, and experience show large differences across labor markets and that much of the observed differences in regional earnings results from structural differences in earnings equations. Then Hanushek categorizes the models explaining the structural differences in earnings function into two classes: pure compensating differential models and labor demand models.

The pure compensating differential model assumes that individuals completely respond to differences among areas. The differentials include differences in price levels, probability of unemployment, and the area amenities such as crime, climate and pollution. The labor demand models concentrate upon the characteristics or mix of employing industries. They assume that area characteristics affect production efficiency and result in different industry mix in local areas and that different industry mix affects labor demands and wages.

Hanushek combines both classes of models, each of which is reflecting labor supply and labor demand in local labor markets respectively, and develop a reduced form of wage equations. Hanushek also includes city size variable in the wage equation which can be interpreted as a proxy either for labor productivity or for area amenities. The estimation results show that both compensating differential and labor demand explanations of earnings variation appear important, and that the most important differences in wages appear to be related simply to city size.

However, since the models considered are reduced-form models, there is a serious interpretation problem of the results, especially the effect of city size. Therefore, Hanushek suggests a more structural approach such as a simultaneous labor market equilibrium model for future research.

CHAPTER III

CHARACTERISTICS OF URBANIZATION AND THE LABOR MARKET IN KOREA

3.1 Urbanization and Structural Changes in the Labor Force

Since the early 1960s, Korea has been urbanized rapidly. The proportion of total population resident in urban areas increased from 28% in 1960 to 65% in 1985 (Table 3.1). During the period total population growth was 1.9% per year and urban population growth was 5.5% per year. Thus the urban growth rate was about three times the total, implying decline in the absolute number of the total rural population.

Table 3.1

Urbanization Trends in Korea

(Unit: 1,000 people)

	1960	1970	1980	1985
Total population	24,989	31,466	37,436	40,467
Urban population*	6,997	12,953	21,434	26,465
Rural population	17,992	18,513	16,002	14,002
Urban as % of total population	28	41	57	65

*Population in cities with 50,000 people or more.
Source: Kim and Mills (1988), Table 1.

The rapid urbanization was in large part due to massive rural-to-urban migration, which was fostered by rapid economic growth. During 1963-85, Korea's economy grew at an average of 8% per year. The sustained high rate of growth transferred labor and other inputs from agriculture to urban industrial and service sectors. Consequently, the proportion of labor in the agricultural (including forestry and fisheries) sector decreased from 63.1% to 21.9%, while the shares of the industry (mining and manufacturing) and service sectors increased from 8.7% and 28.2% in 1963 to 28.1% and 50.0% respectively in 1987 (Table 3.2). Urban population grew and served as the bases for increasing production in industry and service sectors. Large urban

Table 3.2

Sectoral Composition and Growth of Employment

(Unit: %)

Sectors	Sectoral composition			Average annual growth rate
	1963	1975	1987	1963-87
Agriculture, Forestry, and Fisheries	63.1	45.7	21.9	-1.25
Mining and Manufacturing	8.7	19.1	28.1	8.37
Social overhead and other services	28.2	35.2	50.0	5.70

Source: Economic Planning Board, Major Statistics of Korean Economy, 1988.

areas also served as efficient and sizable markets for labor force and products.

Korea's growth and urbanization has been faster than almost any other country's during the last two decades. However, the level of her urbanization cannot be said to be excessive compared with other countries at its stage of growth. Korea's urban population percentage was a little less than that of the average upper middle-income country in 1983, and it was about 10 percentage points below the average for industrial market economies (Kim and Mills 1988).

3.2 Urban Growth Distribution

In Korea, the urbanized jurisdiction is designated as a city, called si, when its population become over 50,000. This definition of city or urban area is quite similar to that of many other countries, although it is a little different from the concept of the SMSA in the United States in that this includes not only the central city but also the counties that contain or are contiguous with the city.

The number of cities in Korea increased from 25 in 1955 to 61 in 1985 (Table 3.3). As of 1985, Korea is made up of the Special City of Seoul, four direct jurisdiction cities (Pusan, Taegu, Inchon and Kwangju) and 56 other cities. Seoul and the four direct jurisdiction cities are responsible directly to the Prime Minister's office; other

Table 3.3

Number of Cities by City Size

City Size	1955	1966	1975	1985
Over 500,000	2	4	6	7
200,000-500,000	3	3	5	12
100,000-200,000	4	10	17	17
50,000-100,000	16	15	7	25
Total	25	32	35	61

Source: Economic Planning Board, Population and Housing Census, 1966, 1975, 1985. Song and Mills (1980) Urbanization and Urban Problems, Table A.4.1.

Table 3.4

Distribution of Urban Residents by City Size
(1,000 persons)

City Size	1966 (Oct.1)		1975 (Oct.1)		1985 (Nov.1)	
	Residents	%	Residents	%	Residents	%
Over 500	6,590	67.4 [22.6]	12,568	74.9 [36.2]	18,905	69.5 [46.6]
(Seoul)	(3.793)	(38.8) [13.0]	(6,890)	(41.0) [19.9]	(9,646)	(35.5) [23.8]
200 - 500	938	9.6 [3.2]	1,433	8.5 [4.1]	4,069	15.0 [10.1]
100 - 200	1,197	12.2 [4.1]	2,251	13.4 [6.5]	2,460	9.1 [6.1]
50 - 100	1,055	10.8 [3.6]	542	3.2 [1.6]	1,726	6.3 [4.3]
Urban Total	9,780	100.0 [33.5]	16,794	100.0 [48.4]	27,160	100.0 [67.1]
Whole Nation	29,160	[100.0]	34,707	[100.0]	40,467	[100.0]

Source: Economic Planning Board, Population and Housing Census, 1966, 1975, 1985.

Table 3.5

Population Growth of Cities Existing since 1966 by City Size (1,000 persons)

City Size (1966)	No. of Cities	Population			Growth Rate (%)		
		1966	1975	1985	55-66	67-75	76-85
Over 500	4	6,590	11,454	16,581	6.2	6.3	3.8
(Seoul)		(3,793)	(6,890)	(9,646)	(8.3)	(6.9)	(3.4)
200 - 500	3	938	1,425	2,199	5.3	4.8	4.4
100 - 200	10	1,197	1,937	2,916	3.6	5.5	4.2
50 - 100	15	1,055	1,461	2,017	3.1	3.7	3.3
Total	32	9,780	16,277	23,713	5.4	5.8	3.8
Whole Nation		29,160	34,707	40,467	3.4	2.0	1.5

Source: Same as Table 3.3.

cities are responsible to the Ministry of Home Affairs (See Appendix 1 for the location of the major cities). Table 3.4 shows the distribution of urban residents living in various size categories for selected years from 1955 to 1985. As of 1985, 46.6 % of total population (69.6 % of urban population) live in cities of over 500,000.

Table 3.5 shows that during the 1960s and early 1970s, the large cities of the city size over 500,000 have gained most population increase at an annual rate of 6.3 %. Seoul, in particular, was a magnet for internal migration. Seoul served as a center for almost all economic activities and trade, and provided special opportunities for a successful life. According to Kim (1988), between 1960 and 1970, Seoul absorbed nearly 52% of total urban population growth and

about 40% of total migration. By concentrating economic activities in a large city, the government could supply firms with more social infrastructure and public services under the limitation of available resources. Firms could gain benefits of agglomeration in their production. They could get various services such as finance, insurance, business services, and government administrative services with ease in the capital city.

It is also said that the growth of the capital city has been encouraged by the popular belief that it provides special opportunities for a successful life. The special attraction of the capital city may be due to the concentration of political decisions, economic wealth, and cultural facilities such as high quality universities. (Lee 1987)

It is sometimes said that the growth of capital city, Seoul, is excessive. However, it is not a peculiar phenomenon to Korea. According to Kim and Mills (1988), largest cities that are two to three times the size of the second largest city are typical throughout the world .

As Table 3.5 shows, after mid-1970s, the growth of metropolitan cities including Seoul slowed down and intermediate-sized cities began to grow faster than the large-size cities. Seoul's share in total population fell greatly from 43% in 1970 to 35% in 1985. The growth of intermediate-sized cities can be explained by several

factors (Hamer and Linn 1987). Among them are the growth of hinterland markets, the decline in the importance of urbanization economies in production along with increasing urban disamenities associated with city size, and the redirection of interregional and public service investments at the margin to modify the relative attractiveness of intermediate centers.

Two phenomena mark the growth of intermediate-sized cities in Korea. The first is the growth of newly industrializing south-east coastal cities and the second is the growth of the satellite cities of Seoul. The first type includes Pohang, Kumi, Ulsan and Masan. The second includes Suwon, Anyang, Puchon, Songnam and Uijongbu. According to Kim (1988), newly industrializing cities on the whole did not experience severe economic distress, whereas satellite cities of Seoul suffered from high unemployment rates. The high unemployment rates in the satellite cities of Seoul indicate a supply-induced growth - population growth exceeding employment growth. The newly industrializing cities suggest a demand-induced growth - employment growth exceeding population growth.

The rapid growth of southeast coastal cities is related to the government's industrial policies, which have been export-oriented and emphasized heavy and chemical industries. As the result, many other cities remained small

and grew very slowly largely due to the insufficient social overhead capital investment.

3.3 Government Policies toward Urbanization

As Kim and Mills (1988) indicated, governments in almost all developing countries and in many industrialized countries have a general dislike of urbanization in general and of large, or primate, metropolitan areas in particular. Korea is not an exception. Policy-makers in Korea believe that the predominance of the principal metropolitan areas may result in growing diseconomies and hinder continued economic growth. The following are among the frequently cited problems (Cho et al. 1986):

(1) Pollution and environmental deterioration in metropolitan areas.

(2) Unbalanced regional development with respect to national land and resource utilization.

(3) Persistent inequalities between regions in terms of access to public infrastructure and socio-cultural amenities.

(4) Growing expenditures for the supply of infrastructure, housing, and educational facilities in metropolitan areas.

(5) Potential social and political unrest in large cities because of a large concentration of marginal workers and students.

Since the early 1970s, the government has attempted to limit the growth of Seoul and other large metropolitan areas and to promote the growth of intermediate cities and regional centers. The major instruments of these policies have been greenbelts, industrial dispersal (including direct controls on location of manufacturing plants in Seoul, tax exemptions and financial assistance to firms locating in designated areas, and construction of a new industrial estates), and placement of new educational and cultural facilities in local areas.

However, the government population redistribution policy seems to have achieved only limited effects. The rural-to-urban migration and the growth of the metropolitan areas have continued since 1970. Several points can be indicated as the reason. First, many people were concerned about population concentration on equity ground of balanced regional development. However, until recently, the government set higher priorities, in general, on rapid economic growth and economic efficiency than regional balance or equity. Therefore, the policy goals often were obscure and the incentives for the population redistribution could not be strong enough to bring about considerable impacts. Of course, diseconomies of agglomeration such as pollution and congestion were also cited as the reasons of such policies, but there was no strong belief at least as for individual firms and workers that the economies of

agglomeration in metropolitan areas are exceeded by the diseconomies.

Second, the majority of the government programs for population redistribution focused on location and relocation of firms. However, the programs have had a minor impact on the location of firms mainly because many of the designated areas have suffered from poorer social capital for example education, housing and welfare facilities (Choe and Song 1984). To improve access to public services and education in small cities and rural areas, we need to put much resources into those areas. However, the local governments in Korea have very weak financial ability. Therefore, those initiatives to promote growth in stagnated areas should compete with all other demands for central financial and administrative resources and ended up with insufficient resource allocations. For example, the government attempted to diverse government agencies, public enterprises and institutions away from Seoul (also once they had the plan to construct a new capital city). However, the attempts were not successful because the investment to improve living conditions elsewhere could not be financed sufficiently in a short period.

Third, throughout the period of rapid growth, the Korean government has had strong formal and informal controls on businesses. Beyond doubt, that situation induced firms to locate near government offices, making the other

government policy to redistribute population ineffective. On the other hand, direct controls by the government on metropolitan growth such as greenbelts might have slowed metropolitan growth, but they also have undesirable side effects in terms of market efficiency.

3.4 Intercity Wage Differentials

Individual earnings vary considerably with respect to individual characteristics such as age, sex, education, race, and occupation. Therefore, the intercity differences in the composition of labor force will contribute to the intercity wage differences. But the distribution of wages across cities is also affected by the city-specific attributes. They include differences in cost-of-living, amenities or disamenities related to site and size of city, and industry mix.

Therefore, to explain intercity wage differences, we should take account of not only the labor force composition but also city-specific characteristics.[5] In other words, the wages work as an equalizing or compensating factor that makes the welfare for similar skill people equal across the

5. By this we do not deny the fact that there is also interaction among the factors affecting wage differences. For example, as Henderson (1986a) indicated, the large cities in developing countries offer positive agglomeration effects in production and consumption and so they also attract more educated labor changing the composition of the labor force in the large cities.

regions once the city-specific characteristics are accounted for.[6]

In Korea, there are great wage differentials by individual attributes such as sex, age, education (Table 3.6, and Table 3.7). According to Park and Park (1984),

Table 3.6

Wage Differential by Sex, Age (1980)

(Unit: %)

	All age	18-19	20-24	30-34	40-44	50-54
Male	175	74	100	190	231	256
Female	98	81	100	120	103	119
All	162	78	100	216	243	271

Source: Ministry of Labor (1980) Report on Occupational Wage Survey.

Table 3.7

Wage Differential by Educational Level (1980)

(Unit: %)

	Middle School and Less	High School	Junior College	College or more
Male	78.5	100.0	134.3	202.7
Female	72.3	100.0	161.0	223.0
All	68.8	100.0	146.3	228.5

Source: Same as Table 3.6.

6. In this context, Coelho and Ghali (1971) shows that the differences in nominal wages between the North and the South in the United States in 1963 disappear when due account is taken of differences in the cost-of-living and industry mix.

about 58% of the individual wage distribution in Korea can be explained only by sex, age, and education.

Compared with these differentials, regional wage differential is expected to be small in Korea due to high labor mobility and small national boundary. Nevertheless, the average wage level in the highest region (Seoul) was 40% higher than the lowest region (Pusan) in 1980 (Table 3.8).

As it was already mentioned, such big wage differences across regions arise from the differences in the composition of labor force in terms of human attributes which are the most significant wage differentials in Korea. When we divide the labor force by sex, we can find that the wage

Table 3.8

Wage Differential by Region (1980)

(Unit: %)

	Average	Male	Female	Below Mid.Sch.	High School	College or More
Seoul	100.0	100.0	100.0	100.0	100.0	100.0
Pusan	71.2	71.4	82.1	94.3	92.2	93.0
Kyongki	74.6	74.1	84.9	93.5	89.5	89.0
Kangwon	95.1	83.1	90.6	141.5	108.4	84.2
Chungbuk	82.4	79.3	90.6	109.8	90.1	87.0
Chungnam	74.6	74.1	91.5	98.4	102.1	83.0
Chonbuk	76.6	74.8	85.9	88.6	92.2	97.7
Chonnam	86.3	79.0	86.8	108.9	95.3	73.7
Kyongbuk	77.1	78.2	87.7	98.4	95.8	90.9
Kyongnam	83.9	82.0	85.9	104.1	97.4	94.4
Cheju	85.4	74.4	98.1	110.6	81.2	80.4

Source: Park and Park (1984), p.357.

differential by region arises mostly from male labor force and it gets much smaller for female. Strikingly when we control for the educational level, the regional wage differential shows a quite different shape. The differential gets smaller in each educational level. Seoul is no longer the highest area in all categories and Pusan is not the lowest.

The wage differential that we are interested in is city size. The question is what relationship exists between city size and wage level, and how city size affects wage level. Table 3.9 shows that manufacturing workers in larger cities receive higher wages by about 15% than those in smaller cities. Several explanations can be possible. Large cities might enjoy agglomeration economies in production and therefore the labor productivity would be higher in large cities. Cost-of-living might be high in large cities due to congestion costs, rent and so on, which makes nominal wages

Table 3.9

Wage Differential in Manufacturing Sector by City Size (1986)

City Size (1,000 Person)	50-100	100-200	200-500	over 500
Number of City	25	17	12	7
Average Wage Level (%)	100	94	115	115

Source: Economic Planning Board of Korea (1986) Report on Mining and Manufacturing Survey.

to the level where real income or welfare is equalized across cities. Also different industry mix could contribute to the increase in the wage in larger cities. On the other hand, consumption amenities in larger cities such as a variety of goods, services, and job choices would work to decrease the wage rates in the large cities offsetting the increasing effects. It is one of the purposes of my study to explain intercity wage differential taking account of all these possibilities.

CHAPTER IV

THEORETICAL FRAMEWORK AND MODEL SPECIFICATION

4.1 Choice of Approach

The review of literature in Chapter II reveals that the attempts to estimate the effects of urban agglomeration have been made from various points of view. The empirical results are, however, still thin and unclear for several reasons.

First, in spite of the fact that rapid urban concentration is one of the characteristics of developing countries, little research has been done about developing countries. We have only a few empirical results from developed countries like the United States and Japan.

Second, most previous research focused on one of two areas: production (firms) or consumption (workers), ignoring the other side. When they consider the other side together, they used reduced forms. However, in order to isolate effectively the productivity effects and consumer welfare effects, and to be able to evaluate the optimality of city sizes systematically, we have to estimate both side effects simultaneously estimating the set of the structural equations.

Third, though several studies have been made to estimate the labor demand and supply functions simultaneously through labor market equilibrium model, they are very simple. They ignore the differences in living costs

across different cities. Also they do not control for any non-city-size-related urban attributes such as natural environment, labor force composition by sex and education, and city industrial base or industry-mix.

This study attempts to extend the previous studies by considering the issues discussed above. The model used in the study is a labor market equilibrium model, where the equilibrium wage rate and employment are determined simultaneously by supply and demand forces. The next two sections specify the demand and supply functions in local labor markets respectively. In final section, we synthesize both functions into a simultaneous equations system and derive the hypotheses we will test concerning the nature of city growth, the optimality of city sizes, and intercity wage differentials.

4.2 Model Specification

4.2.1 Labor Demand Function

In this study, we specify the labor demand function in the context of local labor markets where parametric external effects of agglomeration are considered as the factors affecting the sizes and structure of the cities. That is, we specify the labor demand function in local labor markets in such a way that we can estimate the nature and magnitudes of the scale effects.

To this end, we first specify a production function of the firm.

$$(4.1)\quad Y = G(N)[dL^{-p} + (1-d)K^{-p}]^{-1/p}$$

where

Y = value of output[7]

G(N) = Hicks-neutral productivity (external shift) factor: scale effect

N = city size

L = labor input

K = capital input

d = distribution parameter

p = 1/s - 1 (s: elasticity of substitution)

It is assumed that d and p are the same for all cities in the industry.

A firm in a competitive industry maximizes its profit with respect to a capital, labor, and city size as

$$(4.2)\quad \max\ G(N)[dL^{-p} + (1-d)K^{-p}]^{-1/p} - w(N)L - rK$$

where

w = wage rate

r = price of capital

---

7. Virtually most empirical studies assume a priori that the value added specification is valid. However, as Berndt and Wood (1975) indicated, there is no reason to restrict our analysis to the value added specification since the conditions (the Leontief, Hicksian, and separability conditions) for the value added specification are not satisfied in many cases. Therefore, recently the value of output is preferred to the value added as a dependent variable in the production function estimation (Henderson 1986b, Fuss and McFadden 1978).

The first-order conditions for profit maximization are

$$(4.3)\quad (1-d)G(N)^{-p}(Y/K)^{p+1} = r$$

$$(4.4)\quad dG(N)^{-p}(Y/L)^{p+1} = w(N)$$

$$(4.5)\quad dY/dN = G'(N)[dL^{-p} + (1-d)K^{-p}]^{-1/p} = w'(N)L$$

We use equation (4.4) for parameter estimation.

Next we specify scale effects as

$$(4.6)\quad \log G(N) = \log a + b_N \log N$$

where b_N is the 'productivity' parameter identifying the magnitude of urbanization economies.

Substituting (4.6) for (4.4) and taking logs, we arrive at basic estimation form of labor productivity equation as

$$(4.7)\quad \log(Y/L) = \log[d^{-s}a^{1-s}] + s\log w + b_N(1-s)\log N$$

However, labor productivity and, therefore, labor demand and offered wages are influenced by human capital characteristics of the industry labor force that vary across cities. They are also affected by spatial characteristics such as climate and geography. These effects are distinguished from scale effects since they are not related to city sizes. Therefore, we need to control for these impacts by inserting relevant control variables specific to an industry in an urban area as arguments of G(N).

According to Park and Park (1984), regional wage differences in Korea are in part ascribed to the differences in labor force composition by sex, education level, and industry across regions. To control for these effects, we

estimate scale effects by industry and include sex ratio and average education level specific to an industry in an urban area as explanatory variables.

The economic development strategies in Korea have been export-oriented and the economy heavily relies on the world trade and foreign technologies. Therefore, in the open small economies like Korea, the cities proximate to the world trade markets have the spatial advantages in utilizing foreign output markets and technologies, and tend to gain population. To reflect this effect, we use the distance of an urban area from the nearest seaside as the proxy variable for the proximity to the world economy.

Then, to analyze the effects of localization economies along with those of urbanization economies, we include the ratio of employment in a city relative to total employment in the considering industry as an exogenous variable representing industry size. When the variable has significant positive effects on productivity, it implies the existence of localization effects. Finally, we estimate this function by industry because production technology will vary among different industries and so we need to control for the influence caused by the differences in industry mix across cities.

In summary, we specify the functional form for the industry-specific estimation as follows:

$$(4.8)\quad \log(Y/L) = a_0 + a_1 \log w + a_2 \log N + a_3 SR + a_4 ED + a_5 SEA + a_6 ER$$

where

SR = sex ratio (number of male workers / total industry workers)

ED = average education level of industry workers

SEA = distance from the nearest seaside

ER = the ratio of own industry employment in a city relative to total employment in the industry

4.2.2 Labor Supply Function

According to the compensating wage differential hypothesis, differences in urban (dis)amenities across cities are fully compensated by intercity wage differences. Therefore, in a competitive market economy, the supply of labor to any city varies not only with the wage rate but also with the characteristics of urban (dis)amenities.

In this perspective, as we explained in Chapter II, Tabuchi (1986) specified labor supply function as[8]

$$(4.9)\quad \log(L) = \log(b_1) + b_2 \log(w) + b_3 \log(N)$$

where L = labor supply

w = wage rate

---

8. We think people move across cities to equalize their utility level at equilibrium. Therefore, we assume the utility level is constant across cities. Then the labor supply function in this context is specified to reflect only the price effect of wage without consideration of its income effect.

N = population of the city[9]

But this function does not account for differences in the cost-of-living in different cities. Therefore we include cost-of-living index to control for the effects of agglomeration capitalized in prices other than wages. There are two ways to control for the difference in cost of living. One is to use wage rates deflated by the cost-of-living index. The other is to use nondeflated earnings while it controls for living cost differences by insertion of another independent variable measuring price variations across cities. Henderson (1982a) indicates that the choice of specification has no notable impact on either the qualitative or quantitative results. Therefore, following Henderson, we adopt the specification of inserting the independent variables measuring price variations across cities.

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9. As we explained in Chapter II, Tabuchi (1986) used population density rather than population size as an index of urban externality. However, we use population size instead of population density. The reasons are: (1) We follow the previous research, most of which uses population size as a proxy index for urban agglomeration. Agglomeration effects work not only on the proximity of activities within a city but also on the variety of activities within a city. Especially, in a developing country like Korea the size of market or the variety of activities itself is a very important factor that induces firms and workers to urban areas. In this respect, population size reflects well the both aspects of agglomeration effects while population density reflects mainly the proximity effect. (2) In Korea, the boundary of city has been changed more or less according to the tendency of the structure of the city to spread out to the suburbs. In this situation, city size is more relevant index than density because density might not reflect well the effects of this kind of city growth.

Next the distance from the nearest seaside is included as a proxy for natural environment. Usually they include also climates variables (ex. freezing days) as natural amenities but we don't include them because Korea is a small country so there is no big differences in climate once we control for the distance from the seaside.

We also control for the labor force characteristics such as sex ratio and education level specific to an industry in a city as we do in the labor demand function.

Then the labor supply function for estimation can be specified as follows:

$$(4.10) \quad \log L = b_0 + b_1 \log w + b_3 \log N + b_5 SR + b_6 ED + b_5 \log P + b_6 SEA$$

where P denotes cost-of-living index specific to a city.

4.2.3 Labor Market Equilibrium

Then we estimate equations (4.8) and (4.10) simultaneously in an integrated framework of equilibrium labor market using 2SLS method.

$$(4.8) \quad \log(Y/L) = a_0 + a_1 \log w + a_2 \log N + a_3 SR + a_4 ED + a_5 SEA + a_6 ER$$

$$(4.10) \quad \log L = b_0 + b_1 \log w + b_2 \log N + b_3 SR + b_4 ED + b_5 \log P + b_6 SEA$$

The first stage is to estimate

$$(4.11) \quad \log w = c_0 + c_1 \log Y + c_2 \log N + c_3 SR + c_4 ED + c_5 \log P + c_6 SEA$$

The second stage is to substitute estimated logw* into the structural equations (4.8) and (4.10).

4.3 Hypotheses of the Optimality of City Sizes and Intercity Wage Differences

From the estimation of this model, we expect that the signs of the coefficients should be as follows.

In (4.8) $\log(Y/L) = a_0 + a_1 \log w + a_2 \log N + a_3 SR + a_4 ED + a_5 SEA + a_6 ER$

a_1 and a_5 are positive, and a_2, a_3, a_4, and a_6 are negative.

In (4.10) $\log L = b_0 + b_1 \log w + b_2 \log N + b_3 SR + b_4 ED + b_5 \log P + b_6 SEA,$

b_1, b_2, and b_6 are positive, and b_3, b_4 and b_5 are negative.

We explain the reasons for the expectation of the results and their implications for the nature of city growth, urban structure, and intercity wage differences in the remaining part of the section.

First, the signs of a_1 and b_1 are related to the slope of labor demand and supply curve respectively. The coefficient a_1 should be positive because it expresses the elasticity of substitution (s) as it is shown in equation (4.7). Then, the positiveness of a_1 means the downward slope of labor demand curve. Next, the coefficient b_1 reflects the price effect of wage rate on labor supply.[10] Therefore, we

10. We assume people move among cities to equalize their utility levels in equilibrium. Therefore, we assume the utility levels are constant among cities. Then the labor supply function in this context is specified to reflect only

expect that the sign of b_1 should be positive, and so the labor supply curve should be upward sloping.

The second, the most important, hypothesis is concerned with the city size effects on labor demand and supply measured by the coefficient a_2 and b_2. Before we go into the details of the expected results, we will first explain three different patterns of urban change in terms of population distribution relying on the size of net productivity of cities.[11] The first pattern, which we call the accelerating city growth, is applied to the countries or areas where productivity effect of city growth is positive and household cost effect of city size is also favorable. This situation is illustrated in the diagram (a) in Figure 3. In this situation, urban growth is favorable both for producers and consumers and, therefore, city growth is self-sustaining and tends to accelerate fueling itself.

The second pattern, which we call the self-regulating city growth, occurs in the countries or areas where the productivity effects of city growth are positive while the household costs increase as city size grows. The situation is illustrated in the diagram (b) in Figure 3. This type of city growth will arrive at the stable equilibrium when the

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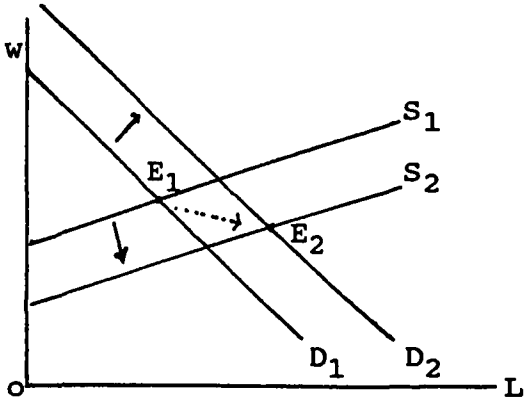
the price effect of wage without the consideration of its income effect.

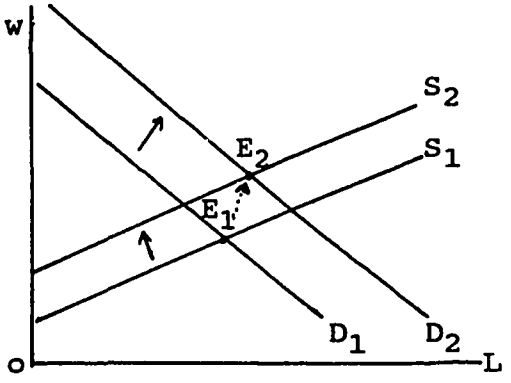
11. In this statement net productivity is the difference between productivity effects of city growth and household costs effects of city growth.

positive productivity effects peter out as city size grows larger and the cost effects increases at an increasing rate as city grows larger. An upward increase in size from the equilibrium increases disamenities more than productivity and thus bids up wages, and reduces the quantity of labor demanded, thereby reducing sustainable city size.

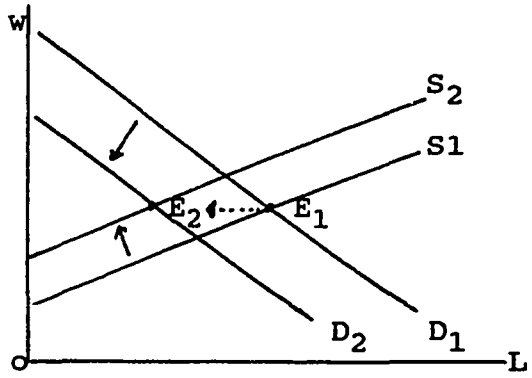
The third type, that we call population deconcentration, appears in the countries or areas where the productivity



(a) Accelerating city growth



(b) Self-regulating city growth



(c) Population deconcentration

Figure 3. Three Types of Urban Change

effects of cities also begin to decline as city size grows larger along with the negative effects of city growth on the consumption side. This situation illustrated in the diagram (c) in Figure 3. Evidences show that this kind of situation begins to appear in some large metropolitan areas in developed countries like the United States.

We hypothesize that the first pattern (accelerating city growth) would prevail in the developing countries like Korea where the income level and the value of time of the people are not high enough to take into much consideration the disamenities of cities (congestion, pollution, crime, etc.) and where the economies still have enough room to enjoy further economies of scale in production. That is, we expect that productivity effect of city growth should be positive and that consumption effect of city size also be favorable. The latter means that the urban attributes associated with city size have positive effect on the labor supply in cities, that is, b_2 in the equation (4.10) should be positive.

One thing we should note is that we hypothesize the positivity of productivity effect of city growth by the negative sign of a_2. As it was shown in equation (4.7), $a_2=b_N(1-s)$ and, therefore, when s (elasticity of substitution) is larger than 1, the negativity of a_2 implies that b_N (the productivity parameter) is greater than zero, that is, city size has positive effect on productivity.

Third, the effects of education and sex ratio on productivity will be positive as human capital theories explain. However, for the same reason as that for a_2, the coefficients a_3 and a_4 should be negative. On the other hand, the effects on labor supply (b_3 and b_4) will be negative because we expect the supply price of male and more educated labor would be higher than that of female and less educated labor.

The fourth is related to trade policy. In a small open economy like Korea, the proximity to world economy will have great effects on the productivity of cities. Therefore we expect nearness to the seaside (distance from the seaside) has positive (negative) effects on productivity. That is, trade policy in Korea might contribute to the further concentration of the people in a few large cities near the port. Therefore, a_5 in the equation (4.8) should be positive as before. On the other hand, the nearness to the seaside (distance from the seaside) is a disamenity (amenity) to workers in Korea because coastal areas are more susceptible to hurricane and flood and because the coastal line in Korea is very rugged, so it is costly to develop good living conditions in coastal areas. Therefore, b_6 in the equation (4.10) should be positive.

The fifth hypothesis is concerning to the nature of scale effects.[12] The inclusion of the variable ER (the

12. Scale economies external to firm can be disaggregated into two different sources: (1) scale economies external to

ratio of employment in a city relative to total employment in a specific industry) will identify the existence of localization economies of scale. When ER has significant positive effects on productivity (or a_6 has a negative sign), we can conclude that scale effects also come from the localization economies. In this case, each city may increase productivity by specializing in specific industry which has economies of localization.

The last hypothesis is related to intercity wage differentials. From the estimation of equation (4.11),

$$\text{(4.11)} \qquad \log w = c_0 + c_1 \log Y + c_2 \log N + c_3 SR + c_4 ED + c_5 \log P + c_6 SEA$$

we expect that c_1, c_3, c_4, and c_5 have positive signs , c_6 negative, but c_2 are indefinite. Here we explain some of them. First, two explanations are possible for the positiveness of coefficient c_5 (coefficient of the costs-of-living index). One explanation is that the wage will increase to equalize the real income or consumer welfare among different cities as cost-of-living index such as housing rent increases. Another explanation follows the argument that the consumption externalities of city size are

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firms but internal to each industry, which is measured by total employment in that industry in that urban area (localization economies), and (2) scale economies external to the specific industry, which is related to the level of all economic activity as measured by city population (urbanization economies). We focus on the estimation of urbanization economies by estimating the labor productivity equation with city size as an explanatory variable by industry.

capitalized into both wage rate and land rent in such a way that the value of city attributes associated with city size is the sum of the land-rent differential and the negative of wage differential with respect to the city size. Therefore, at a certain level of city size, the wage rate in a city should be higher when the living-cost is higher in the city.

Second, the effect of city size on wage rate (c_2) is indefinite. As we can see in Figure 3(b), when both labor demand and supply curve shift upward as city size increases, the wage will increase definitely as city grows. However, when the two curves shift toward opposite direction as in Figure 3(a) and 3(c), changes in wage rate will be indefinite depending upon the sign of net effects of city growth on productivity (labor demand side) and living-cost (labor supply side).

Finally, c_6 (the coefficient of distance from the seaside) will be negative because productivity is lower in cities far from the seaside and, in addition, more workers like to supply their labor in cities far from the seaside.

CHAPTER V

ESTIMATION AND EMPIRICAL RESULTS

5.1 Data

The data requirements for this analysis include the value of output of each industry, employment, wage rates, city sizes, labor force composition by sex and education, and other city attributes such as cost-of-living indexes, unemployment rates, and the distance from the nearest seaside. All these data need to be summarized for each city for the purpose of the analysis.

The primary data source is the Mining and Manufacturing Survey of Korea, which is conducted by the Economic Planning Board. The annual survey covers all mining and manufacturing establishments with five or more workers. The key variables in the survey for the purpose of this analysis are: the value of output, the monthly average number of workers, end-year number of workers by sex, total wage paid to workers, the two-digit industry code, and the four-digit geocode for the firm's location. The wage rate is calculated by dividing total wage payment by the monthly average number of workers and by twelve.

These data are supplemented by the data on education level of workers and unemployment rate in each city gathered in the Special Employment Structure Survey of Korea, by the data on the cost-of-living and housing rents of

intermediate income families of four in the Family Income Expenditure Survey of major cities in Korea, and by the data on city size in the Population and Housing Census of Korea. Finally, the distance from the nearest seaside is measured by the road distance in kilometers.

5.2 Estimation Procedure

As the main purpose of this analysis is to analyze the effects of urban growth, we choose the city as the unit of observation. The total number of cities in Korea as of 1986 is 61. Therefore, the maximum number of observation is 61. Usually we have smaller number of observations because we use disaggregated models by industry and have missing values of some variables.

The research focuses on the manufacturing industries that typically are leading sources of urban concentration of employment opportunities. Then, we expect that the production technology and labor market behavior will vary among different industries, so we disaggregate the manufacturing industry into nine two-digit industry groups by the standard Korean industry classification. Thereby we can examine the robustness and the variance of the effects of each variable across the industries.

The analysis period is 1986 but 1976 is also referred to when it is needed for comparisons. The choice of the years depends mainly on the data availability. In addition,

both years are in the periods when the Korean economy was very stable.

To evaluate the various hypotheses, we design a series of empirical tests. As for the first step, we estimate the following basic Model (I) without control variables. Though this basic model is not specified in accord with our theoretical framework, it is a possible and easy way to identify the basic pattern of urbanization. Especially we need this estimation because we want to compare the results with those of different periods in different countries, which are available only on this basic form of model.

Model (I):

$$(5.1)\quad \log(Y/L) = a_0 + s\log(w) + b_N(1-s)\log(N)$$

$$(5.2)\quad \log(L) = b_0 + b_1\log(w) + b_2\log(N)$$

where Y = value of output

L = labor input; employment

w = wage rate; total wage payment divided by employment

N = city size; population of the city[13]

s = parameter denoting elasticity of substitution

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13. As we explained in Chapter IV, some researchers use population density rather than population size as a proxy index for urban agglomeration economies. The estimation results of the models using D (population density) instead of N (population size), which are available on your request, show that we can make the same findings from the results on the whole, except that the productivity effect of city growth is stronger but consumption effect is weaker when we use D rather than N.

b_N= parameter denoting productivity effect of city size.

The second step is to reestimate the labor productivity function (5.1) by including the variable denoting the industry size in each city to examine the existence and importance of localization economies in contrast to urbanization economies.

Model (II):

(5.3) $\log(Y/L) = a_0 + s\log(w) + b_N(1-s)\log(N) + b_L(1-s)ER$

(5.4) $\log(L) = b_0 + b_1\log(w) + b_2\log(N)$

where ER = variable representing industry size in a city; the ratio of own industry employment in a city relative to total employment in the industry

b_L = parameter denoting productivity effect of industry size.

The third is to control for other effects as in the following Model (III). We examine the extent to which controlling for the variables of urban attributes affects the magnitude of the city size effects, and we also analyze the nature and the magnitude of the effects of the control variables themselves on productivity, labor supply, and wage rate.

Model (III):

(5.5) $\log(Y/L) = a_0 + a_1\log w + a_2\log N + a_3 SR + a_4 ED + a_5 SEA$

(5.6) $\log L = b_0 + b_1\log w + b_2\log N + b_3 SR + b_4 ED + b_5\log HP + b_6 SEA$

where SR = sex ratio; number of male workers / total industry workers

ED = education; years of schooling acquired by workers

SEA = distance from the nearest seaside; road distance in kilometers.

HP = housing rent of intermediate income families of four member[14]

Finally, using the estimates of reduced forms of wage equations of the previous model, we evaluate the intercity wage differentials.

5.3 Urbanization Pattern and Level of Economic Development

5.3.1 Present Pattern of Urbanization

The 2SLS results for Model (I) for 1986 are presented in Table 5.1. In the first place, the coefficients of wages both in labor demand (s) and in labor supply equations (b_1) are all significant and have the same signs across industries. That is, the signs of s (direct elasticity of substitution in production) are all positive and the signs of b_1 (price effect of wage rate on labor supply) are also all positive as expected.

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14. Intermediate income families include the families earning monthly income between 300,000 won and 500,000 won. (1 dollar was equivalent to 861 won on an average in 1986)

Table 5.1

Estimates of Model (I)

2SLS (a) $\log(Y/L) = a_0 + s\log(w) + b_N(1-s)\log(N)$
(b) $\log(L) = b_0 + b_1\log(w) + b_2\log(N)$

IND[b]	(a) Labor productivity equation[a]					
	a_0	s	$b_N(1-s)$	b_N	R^2	F
31	-26.56**	6.20**	-0.797**	0.153**	0.64	50.4
	(-8.2)	(8.7)	(-6.0)	(14.2)		
32	-14.21**	3.28**	-0.123*	0.054*	0.48	25.4
	(-6.0)	(6.7)	(-1.6)	(1.9)		
33	-21.62**	4.69**	-0.157*	0.042**	0.32	13.2
	(-4.4)	(4.7)	(-1.8)	(2.3)		
34	-16.16**	3.66**	-0.283**	0.106**	0.85	151.5
	(-15.2)	(16.4)	(-4.8)	(5.7)		
35	-10.07**	2.48**	-0.084	0.057	0.42	19.9
	(-4.7)	(6.3)	(-1.0)	(1.0)		
36	-11.44**	2.55**	-0.002	0.001	0.70	68.0
	(-9.5)	(11.1)	(-0.04)	(0.03)		
37	-17.74**	3.58**	0.105	-0.041	0.75	57.1
	(-8.8)	(9.1)	(1.2)	(-1.1)		
38	-14.02**	3.05**	-0.040	0.019	0.71	69.4
	(-10.2)	(10.5)	(-0.4)	(0.4)		
39	-18.31**	4.05**	-0.170	0.056	0.57	29.7
	(-7.1)	(7.3)	(-1.4)	(1.5)		

Note a: t-values are in parentheses.
** = The coefficient is statistically significant at the 5%
* = The coefficient is statistically significant at the 10%
Note b: Detailed definitions are in Appendix 3.
31 = Food, beverage 32 = Textile, apparel & leather
33 = Wood, furniture 34 = Paper, printing & publishing
35 = Chemicals, petroleum, coal, rubber & plastic products
36 = Non-metallic mineral products (china, glass, cement)
37 = Basic metal industries (iron, steel, copper, aluminum)
38 = Fabricated metal, products machinery and equipment
39 = Other manufacturing industries (jewellery, toys, wigs)

Table 5.1 (Continued)

2SLS (a) $\log(Y/L) = a_0 + s\log(w) + b_N(1-s)\log(N)$
(b) $\log(L) = b_0 + b_1\log(w) + b_2\log(N)$

IND[b]	(b) Labor supply function[a]					Number of observations
	b_0	b_1	b_2	R^2	F	
31	-41.51**	9.52**	-0.681**	0.90	243.8	60
	(-12.8)	(13.4)	(-5.1)			
32	-60.67**	12.25**	0.718**	0.96	702.2	58
	(-25.8)	(25.0)	(9.5)			
33	-65.98**	13.10**	0.452**	0.91	270.7	58
	(-13.5)	(13.2)	(5.1)			
34	-28.14**	5.57**	0.602**	0.97	762.0	56
	(-26.5)	(25.1)	(10.1)			
35	-28.11**	5.10**	1.185**	0.89	223.6	59
	(-13.0)	(13.0)	(14.0)			
36	-17.24**	3.69**	0.568**	0.89	242.4	60
	(-14.3)	(16.1)	(9.4)			
37	-36.74**	6.99**	0.654**	0.94	296.6	40
	(-18.1)	(17.7)	(7.5)			
38	-20.96**	4.31**	0.980**	0.91	273.8	59
	(-15.3)	(14.9)	(8.8)			
39	-35.84**	7.55**	0.486**	0.88	162.4	47
	(-13.9)	(13.6)	(3.9)			

Note a: t-values are in parentheses.
** = The coefficient is statistically significant at the 5%
* = The coefficient is statistically significant at the 10%
Note b: Detailed definitions are in Appendix 3.
31 = Food, beverage 32 = Textile, apparel & leather
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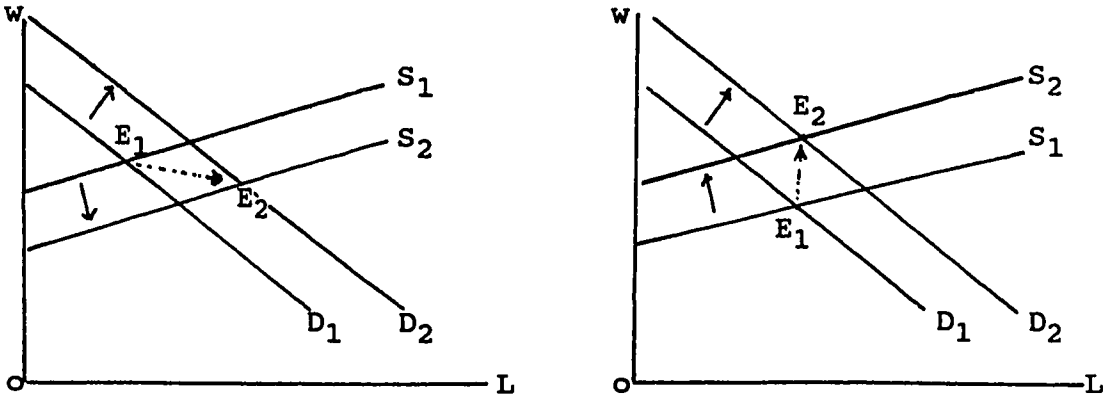

(a) Case of Korea (b) Case of Japan[a]

Figure 4. Local labor markets in Korea and Japan
Note a: The figure is based on Tabuchi (1985).

This accounts for downward sloping labor demand curve and upward sloping labor supply curve as they are depicted in Figure 4.(a). S denotes the supply curve; D denotes the demand curve. It is also observed that the estimate of b_2 is much greater than that of s in every industry. As s is regarded as the elasticity of labor demand provided Y and N are held constant and b_2 is the elasticity of labor supply, we can say that the elasticity of labor supply is elastic relative to labor demand.

Second, all the signs of $b_N(1-s)$, the coefficient of city size in productivity equation, are negative except industry 37 (basic metal industry). Then, when we get the estimates and the t-values of b_N (productivity parameter) by non-linear regression procedure using Gauss-Newton iterative

method, the result shows that b_N also has positive signs in all industries except industry 37 and the unweighted simple average is 0.05. This means that doubling city size will cause an 5 % increase in the labor productivity on average. That is, the productivity of city increases as city size grows. In other words, urbanization economies in production do exist.

However, one thing we should note here is the fact that in light industries such as food (31), textile and apparel (32), wood and wood products including furniture (33), and paper, paper products, printing and publishing (34), the productivity effects of city size are significant and strong, but in heavy industries including chemicals (35), non-metallic mineral products (36), basic metal industries (37), fabricated metal, machinery and equipment (38), they are weak and insignificant. This situation will be discussed more in the next section.

Third, the estimates of b_2 (the coefficient of city size in labor supply equation) show all positive signs and the results are all significant, with only one exception for food industry (31).[15] This is much in contrast with the

15. Two explanations will be possible for the exception of food industry. First, as we can see in Table 5.1, food industries enjoy most urbanization economies. Therefore, firms locating in large cities can pay higher wages to induce quality workers whose supply price of labor is high. Appendix 7, where labor force characteristics (sex, education) are controlled for, supports this argument. There the coefficient of city size (b_1) turn out to be positive. Second, food industries in Korea are highly monopolized

results of Japan that the signs of b_2 are negative in all industries as it will be shown later in this section. The positive signs of b_2 in Korea indicates that the labor supply curve shifts rightward as city size increases. Under the assumption of free migration, this is interpreted that city size is an amenity so that people are willing to supply their labor even at lower wage rates in larger cities.

In developed countries, it is generally admitted that as city size grows, disamenities such as pollution, congestion, and other social conflicts become dominant over the consumption economies such as the variety of goods and services offered to the consumers and the increase in the job choices. In other words, people in developed countries evaluate the losses in welfare arising from disamenities associated with city growth more than the gains in welfare from the variety of goods, services, and job choices.

However, in Korea, while we expect the situation would be common in many developing countries, people evaluate the "city light" more than the disamenities in large cities. The advantages of city growth more than offset the disadvantages of city growth. The reason will include relatively low level of standard of living, which accounts for the low valuation of the time cost and the cost incurred to physical and mental health, regionally unbalanced supplies of public

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industries. So the conditions of local labor markets will not be reflected well into the parameters of the industries.

goods and services, and the traditional favoritism toward the capital cities.[16]

Finally, the effect of city size N on labor L and on wage rate w at the equilibrium point are derived based on the reduced form of the model. From equation (5.1) and (5.2), we can derive

(5.7)

$$\log L = \frac{1}{b_1+s}(b_0 s - a_0 b_1) + \frac{b_1}{b_1+s}\log Y + \frac{b_2 s - b_1 b_N(1-s)}{b_1+s}\log N,$$

(5.8)

$$\log w = -\frac{1}{b_1+s}(a_0 + b_0) + \frac{1}{b_1+s}\log Y - \frac{b_2+b_N(1-s)}{b_1+s}\log N.$$

Therefore,

(5.9)

$$\frac{d\log L}{d\log N} = \frac{b_2 s - b_1 b_N(1-s)}{b_1+s}$$

(5.10)

$$\frac{d\log w}{d\log N} = -\frac{b_2+b_N(1-s)}{b_1+s}\ .$$

The effect of city size N on labor L is shown to be positive both in the demand equation and in the supply function in general as it is illustrated in Figure 5.1.(a), where the subscript 1 and 2 indicate small and large city size respectively. Hence, the equilibrium labor should

16. Confucianism as a moral philosophy has influenced the way people think and behave in Korea since the early time in her history. According to Confucian ethics, filial piety, loyalty, and hierarchy are among the important virtues. In such cultural environment face-to-face contact plays an important role in the daily conduct of business.

always be an increasing function of city size N.[17] This can be shown numerically by substituting the estimates in Table 5.1 for the right-hand side of the equation (5.9). We can also estimate the elasticity (dlogL/dlogN) at equilibrium point directly by regressing the reduced form of the model, the results of which are in the first column of figures in Table 5.2. This result supports the accelerating city growth hypothesis that the city size increases labor productivity and labor demand in large cities inducing population to migrate to larger cities and, in addition, the city size also has favorable effect on consumers' welfare, which makes workers more willing to supply their labor in larger cities at the same wage rate accelerating further the migration to larger cities.

The effect of city size N on wage rate w (dlogw/dlogN) at the equilibrium point, on the other hand, is indeterminate because it is positive in the demand equation but it is negative in the supply equation. However, the regression estimates of the elasticity (dlogw/dlogN) reported in the second column of figures in Table 5.2 have

17. At a first glance, it seems to be natural. However, it is not true for such industries as manufacture of tradable goods, which are produced not for local market but for national market, to always have large employment inherently in large cities. It is possible for particular industry become large in a small city, which specializes in the industry.

Table 5.2

Effects of City Size at Equilibrium

Industry[a]	dlogL/dlogN	dlogw/dlogN
31 (Food, Beverage)	0.214**	0.094*
	(2.7)	(1.8)
32 (Textile, Apparel)	0.249**	-0.038
	(2.8)	(-1.4)
33 (Wood, Furniture)	0.235**	-0.017
	(2.3)	(-0.5)
34 (Paper, Printing)	0.409**	-0.035
	(6.4)	(-0.8)
35 (Chemical, Rubber)	0.445**	-0.145**
	(4.0)	(-3.8)
36 (Nonmetallic mineral)	0.233**	-0.091**
	(3.4)	(-3.0)
37 (Basic metal)	0.153	-0.072*
	(1.5)	(-1.9)
38 (Fabricated metal, Machinery, Equipment)	0.429**	-0.128**
	(3.2)	(-2.9)
39 (Others)	0.281**	-0.027
	(2.1)	(-0.5)

Note a: Detailed explanations of the industry codes are in Appendix 3.

negative signs in all industry except food industry. This means that the equilibrium wage rates would be lower in large cities provided output Y is held constant.

As we will discuss in detail later, the equilibrium wage rate is an increasing function of city size usually in developed countries even if output Y held constant because

the effect of city size on consumers' welfare is negative and so wage rate should be high enough to compensate disamenities in large cities. However, as we explained before, city size is an amenity in Korea and therefore the supply price of labor is lower when city size is larger. Accordingly the negativeness of the elasticity of the equilibrium wage with respect to city size means that this wage-decreasing effect dominates the wage-increasing effect on the demand side.

5.3.2 Comparison between Different Levels of Economic Development

In this section, we discuss how the change in income and technology will affect the optimality of city size by comparing the estimates of 1986 with that of 1976 in Korea, and with that of 1980 in Japan conducted by Tabuchi(1985). For the comparison with the results of Japan by Tabuchi, who utilized population density instead of population size, we use population density instead of population size as a proxy index for urban agglomeration economies in this section. For reference, Table 5.3 shows the per capita income, total population, urban population ratio of total population, and number of cities of varied size in different periods in two countries.

Table 5.3

Basic Data on Urbanization in Korea and Japan

	1976(Korea)	1986(Korea)	1980(Japan)
Per capita income ($)	797	2300	9068
Total population (Mil.)	35.85	41.57	117.06
Urban population as % of total population	48	65	76
Number of cities[a]	35	61	400
city size(N)>1,000,000	3	4	10
500,000<N<1,000,000	3	3	9
200,000<N<500,000	5	12	78
100,000<N<200,000	17	17	96
50,000<N<100,000	7	25	207

Source: Economic Planning Board (1988) Major Statistics of Korean Economy and Management and Coordination Agency of Japan (1985) Japan:Final Report of the 1980 Population Census (Statistical Tables).
Note a: The cities having the population of 50,000 or more are counted.

Table 5.4 summarizes the estimation results of Model (I) of different observations. As before, b_N is the productivity parameter in production function and b_2 is the coefficient of city size N in labor supply equation.

When the results of 1986 are compared with those of 1976, it is observed that the favorable effects of city growth on consumer welfare (b_2) are going down rapidly in every industry group. The unweighted average value of b_2

Table 5.4

Comparison of the City Size Effects between Different Periods in Different Countries[a]

IND[b]	b_N			b_2		
	1976	1986	Japan(80)[c]	1976	1986	Japan(80)[c]
31	0.224	0.211	0.110	0.443	-1.929	-1.018
32	0.136	0.122	0.082	1.056	0.024	-0.880
33	0.029	0.070	0.085	0.484	0.185	-1.630
34	0.100	0.153	0.031	0.353	0.125	-0.408
35	0.030	0.119	0.081	2.436	1.488	-0.175
36	0.069	0.084	0.143	0.899	0.525	-0.562
37	-0.211	-0.073	0.062	1.452	1.062	-0.248
38	-0.045	0.047	0.083	1.143	0.920	-0.607
39	0.178	0.153	0.078	-0.119	-0.048	-0.205

Note a: For comparison with Japan, we use population density instead of population size as a proxy index for urbanization economies.
b: Definitions of industry codes are in Appendix 3.
c: The source of the data is Tabuchi(1985) Table 3. The figures are unweighted averages of equivalent industry groups.

decreased from 0.90 in 1976 to 0.26 in 1986. Furthermore, the signs of b_2 for 1980 in Japan were negative in all industries and the unweighted average value was -0.65.

The observations imply that the effect of city size on consumption or consumer welfare is favorable for workers when the level of economic development is low and therefore

the labor supply at the same wage rate is higher in larger cities. However, the magnitude of the effect decreases as the economy develops and finally the effect becomes negative. That is, the value of welfare losses arising from such disamenities as congestion, pollution, crime, rent, and other items associated with city growth increases as the standard of living goes up.

On the other hand, the unweighted average value of b_N has slightly increased from 0.057 in 1976 to 0.098 in 1986. Japan in 1980 had the value of 0.076. This suggests that the scale effects of urban growth in production would exist for a considerable time until the degree of urbanization reaches a rather high point.

Table 5.5 compares the elasticities of labor and wage rate with respect to city size at the equilibrium point. The elasticities of labor with respect to city size (dlogL/dlogN) at the equilibrium point have remained positive in every industry between 1976 and 1986 and the unweighted average value also remained the same with the value of 0.3. But the elasticities of wage rate with respect to city size (dlogw/dlogN) have changed to a considerable extent between 1976 and 1986 from -0.125 to -0.019. In some industries, they began to have positive signs.

On the other hand, in case of Japan, the labor elasticities with respect to city size (dlogL/dlogN) are negative in some industries but positive in others, and the

Table 5.5

Elasticities of Labor and Wage Rate

with respect to City Size[a]

IND[b]	dlogL/dlogN			dlogw/dlogN		
	1976	1986	Japan(80)[c]	1976	1986	Japan(80)[c]
31	0.488	0.090	-0.069	0.014	0.162	0.096
32	0.399	0.273	-0.055	-0.107	0.016	0.072
33	0.109	0.260	-0.092	-0.043	0.005	0.089
34	0.240	0.309	-0.045	-0.020	0.027	0.040
35	0.585	0.614	0.055	-0.366	-0.155	0.024
36	0.440	0.290	0.009	-0.161	-0.054	0.071
37	0.290	0.233	0.009	-0.249	-0.118	0.028
38	0.252	0.414	-0.036	-0.161	-0.102	0.061
39	0.141	0.339	0.032	0.031	0.044	0.033

Note a: For comparison with Japan, we use population density instead of population size as a proxy index for urbanization economies.
b: Definitions of industry codes are in Appendix 3.
c: The source of the data is Tabuchi(1985) Table 3. The figures are unweighted averages of equivalent industry groups.

wage elasticities with respect to city size (dlogw/dlogL) are all positive.

5.4 Urbanization or Localization Economies

Agglomeration economies in manufacturing industries are classified into urbanization economies and localization economies. The former means economies occurring to a firm from the level of overall economic activity in an area. The latter is the advantage to a firm in an industry from the spatial concentration of firms of that industry in a particular area. Thus, urbanization economies reflect external economies that work between firms of different industries in a city, while localization economies are restricted to externalities between firms within the same industry (Nakamura 1985). The urbanization economies is measured by city size while localization economies is measured by employment size within a particular industry in the city.

The issue of whether urban productivity is associated with city size or industry size has important implications. If productivity is associated with city size, efficiency in production suggests that most production should be concentrated in the large cities. On the other hand, if greater productivity is inherent in large industry size, then a process of industrial decentralization, in which particular industries become large in different locations, is feasible. The choice between the city-size and industry-size explanations, therefore, has important implication for

the spatial distribution of industry. (Sveikauskas, Cowdy, and Funk 1988)

However, as we explained in Chapter II, the empirical results about this issue are not conclusive but diversified. To analyze this issue, we estimate the labor productivity function with alternative specifications as follows and compare the results.

(a) $\log(Y/L) = a_0 + s\log(w) + b_N(1-s)\log(N)$

(b) $\log(Y/L) = a_0 + s\log(w) + b_N(1-s)\log(N) + b_L(1-s)ER$

(c) $\log(Y/L) = a_0 + s\log(w) + b_L(1-s)ER$

where ER denotes the ratio of own industry employment in a city relative to total employment in that industry.

Table 5.6 shows the 2SLS estimation results of the three alternative labor productivity equations with the same labor supply equation as in Model (I). As we indicated in previous section, the first column of figures shows that city size (N) has significant productivity effect in light industries (31, 32, 33, 34), but the effect is very weak in heavy manufacturing industries (35, 36, 37, 38).

The estimates of equation (b), which are shown in the second and third column of figures in the Table 5.6, show more clearly the situation. City size (N) has negative signs in light industries (31, 32, 33, 34),but, in contrast, it has positive signs in heavy industries (35, 36, 37, 38). On the other hand, industry size (ER) has negative signs in all industries.

Table 5.6

Analysis of Urbanization and Localization Economies[a]

(a) $\log(Y/L) = a_0 + s\log(w) + b_N(1-s)\log(N)$
(b) $\log(Y/L) = a_0 + s\log(w) + b_N(1-s)\log(N) + b_L(1-s)ER$
(c) $\log(Y/L) = a_0 + s\log(w) + b_L(1-s)ER$

IND[b]	(a)	(b)		(c)
	log(N)	log(N)	ER	ER
31	-0.797**	-0.686**	-0.052**	-0.098**
	(-6.0)	(-4.9)	(-2.1)	(-3.6)
32	-0.123*	-0.052	-0.020	-0.027*
	(-1.6)	(-0.5)	(-0.9)	(-1.8)
33	-0.157*	-0.139	-0.016	-0.021
	(-1.8)	(-1.5)	(-1.0)	(-1.3)
34	-0.283**	-0.233**	-0.012	-0.027**
	(-4.8)	(-3.4)	(-1.3)	(-3.4)
35	-0.084	0.016	-0.031**	-0.030**
	(-1.0)	(0.2)	(-2.0)	(-2.2)
36	-0.002	0.205**	-0.123**	-0.056**
	(-0.04)	(2.5)	(-3.4)	(-2.2)
37	0.105	0.157*	-0.038*	-0.027
	(1.2)	(1.8)	(-1.8)	(-1.3)
38	-0.040	0.175	-0.091*	-0.052
	(-0.4)	(1.1)	(-1.9)	(-1.6)
39	-0.170	0.002	-0.048*	-0.048**
	(-1.4)	(0.0)	(-1.7)	(-2.2)

Note a: t-values are in parentheses.
** = The coefficient is statistically significant at the 5%
* = The coefficient is statistically significant at the 10%
b: Definitions of industry codes are in Appendix 3.

The last column shows the results when we reestimate the equation dropping the log(N) term. Industry size (ER) has significant effect in most industries and the same signs in all industries.

The above results indicate that firms in light industries, in general, experience more urbanization economies in productivities whereas localization economies are more significant to firms in heavy industries and that in most of the industries localization economies, which result from the spatial concentration of firms in the same industry, do exist significantly. This results confirm the findings that Nakamura (1985) made by 3SLS estimation using the translog production function with the cross-section data of Japanese cities in 1979.

5.5 Control for Other Effects

In section 5.3, we found out that the city size works in general as an amenity both in consumption and in production in Korea. However, the literature indicates that other urban attributes also affect the productivity, labor supply, and the wage rate in a city. They include labor force characteristics, unemployment rate, cost-of-living index including housing rents, and natural environment of a city. Therefore, in this section we control for those variables of urban attributes to identify the effects of the variables and to make precise the nature and magnitude of

the city size effect. The model (III) as we described in section 5.2 is specified to comply with this purpose. Table 5.7 and Table 5.8 in this section show the 2SLS estimation results of Model (III).

Table 5.7

Estimates of Model (III): Labor Productivity Equation

$$\log(Y/L) = a_0 + a_1 \log w + a_2 \log N + a_3 SR + a_4 ED + a_5 SEA^a$$

IND[b]	logw	logN	SR	ED	SEA	NOB[c]
31	11.42**	-0.854**	-0.101**	-0.621**	0.021**	43
	(7.1)	(-5.2)	(-6.1)	(-6.5)	(4.8)	
32	3.51**	-0.122	-0.004	-0.103	0.001	43
	(5.9)	(-1.6)	(-0.7)	(-0.9)	(0.5)	
33	3.12**	0.049	-0.015	-0.277**	-0.002	40
	(3.6)	(0.6)	(-1.4)	(-2.6)	(-1.2)	
34	3.86**	-0.233**	-0.008	0.109**	-0.004**	41
	(12.7)	(-3.6)	(-1.5)	(2.7)	(-3.0)	
35	2.10**	-0.010	0.002	-0.042	0.003*	40
	(4.2)	(-0.1)	(0.4)	(-1.0)	(1.8)	
36	2.44**	-0.019	0.012**	-0.017	0.002	44
	(8.5)	(-0.3)	(2.4)	(-0.4)	(1.3)	
37	3.35**	0.009	0.026	-0.002	0.009**	28
	(4.9)	(0.1)	(1.3)	(-0.0)	(2.6)	
38	2.55**	-0.077	0.008	0.164**	0.005**	43
	(7.1)	(-1.0)	(1.4)	(2.2)	(2.4)	
39	4.97**	-0.081	-0.016*	0.265**	0.006*	37
	(5.1)	(-0.6)	(-1.8)	(2.3)	(1.8)	

Note a: t-values are in parentheses.
** = The coefficient is statistically significant at the 5%
* = The coefficient is statistically significant at the 10%
b: Definitions of industry codes are in Appendix 3.
c: NOB = Number of observations

Table 5.8

Estimates of Model (III): Labor Supply Equation

$\log L = b_0 + b_1 \log w + b_2 \log N + b_3 SR + b_4 ED + b_5 \log HP + b_6 SEA$[a]

IND[b]	logw	logN	SR	ED	logHP	SEA
31	16.92**	-0.542**	-0.182**	-0.890**	-0.957**	0.036**
	(10.9)	(-3.4)	(-11.2)	(-9.7)	(-3.2)	(8.5)
32	10.99**	0.910**	-0.070**	-0.172	-0.677**	0.001
	(18.9)	(11.9)	(-12.9)	(-1.6)	(-2.2)	(0.3)
33	10.70**	1.011**	-0.120**	-0.635**	-1.997**	-0.005**
	(8.4)	(11.7)	(-10.6)	(-5.4)	(-3.3)	(-2.5)
34	5.28**	0.794**	0.016**	-0.093**	0.082	0.001
	(19.5)	(12.9)	(3.5)	(-2.6)	(0.3)	(0.6)
35	6.47**	1.080**	-0.095**	-0.239**	-0.284	0.002
	(10.9)	(13.1)	(-12.6)	(-5.7)	(-0.7)	(0.9)
36	5.36**	0.329**	-0.060**	0.142**	-0.281	0.015**
	(18.4)	(5.6)	(-11.4)	(3.2)	(-1.1)	(9.5)
37	8.55**	0.358**	-0.069**	-0.439**	3.078**	0.016**
	(12.5)	(3.1)	(-3.4)	(-6.2)	(6.0)	(4.5)
38	6.67**	0.854**	-0.057**	0.019	-0.004	0.003
	(16.2)	(11.0)	(-9.9)	(0.2)	(-0.0)	(1.2)
39	11.56**	0.465**	-0.101**	0.883**	0.186	0.009**
	(11.8)	(3.1)	(-11.1)	(7.7)	(0.3)	(2.7)

Note a: t-values are in parentheses.
** = The coefficient is statistically significant at the 5%
* = The coefficient is statistically significant at the 10%
b: Definitions of industry codes are in Appendix 3.

The results are as expected in general though the coefficients have less significant values than without control variables because of the smaller number of observations and the multicollinearity between explanatory variables. The results are as follows.

(1) wage rate (w) has significant substitution effects in production in all industries as shown in the first column in Table 5.7 and has strong positive effects on labor supply in all industries as shown in Table 5.8.

(2) City size (N) in Table 5.7 has negative signs in 7 out of 9 industries, which means that city size has favorable effects on productivity in general. However, they are weak especially in heavy industries as before. On the other hand, the effects of city size on labor supply have significant positive effects in all industries except food industry (31) as shown in Table 5.8.

The reported results are similar in their nature to those of the Model (I) without control variables except that the productivity effects (b_N) of city size show to be smaller after control in all industries with the unweighted average going down from 0.050 to 0.034, and that the consumption effects (b_2) show to be a little higher after control. Next we examine the effects of each control variable in turn.

(a) Labor Force Characteristics

The labor force characteristics include the percent of male workers relative to total employment (SR) and school years of workers in manufacturing industries (ED). They have weak effects on productivity as we can see in Table 5.7. That is, sex and education are not so important factors

determining differences in productivity when we consider within specific manufacturing industry. However, they have significant effects on labor supply as they are shown in Table 5.8. The supply price of labor of male or more educated workers is much higher than that of female or less educated workers.

(b) Housing Rent

According to Todaro (1969), people migrate in response to the expected real wages where nominal wage is deflated by cost-of-living index and weighted by one minus unemployment rate in the appropriate city. However, the estimation showed insignificant results for unemployment rate. It was not an important component for migration decision in Korea because in 1986 it was ranging from 1.1 % of the minimum rate to 5.9 % of maximum. Such level of unemployment rates can be considered to be almost natural unemployment rates. That is, unemployment is mostly frictional and therefore would not affect labor supply and the wage rate of the city.[18]

As for the cost-of-living index, the only data we can use is the Family Income Expenditure Survey conducted by the Economic Planning Board, but the survey has small sample size which has the selection rate of 1/1094 on the whole and covers only 44 cities. In addition, we should restrict our sample to the intermediate income families of four member to

18. According to Hall and Taylor (1988), in the United States the natural rate of unemployment was closer to 5 % in the 1960s and, however, it now seems to be about 6 %.

derive the meaningful differences in living cost across cities. Consequently, the number of observations in each city become very small especially in small cities. Therefore, we use average housing rent of intermediate income families of four member in each city (HP) as a control variable in our estimation reported in this paper because housing rents would be affected less by temporary changes in living conditions than other expenditures and because the differences in living conditions between cities are capitalized mainly into housing rents and into wages.

The results show that housing rent (HP) has negative signs in 6 out of 9 industries in the estimates of labor supply equation (Table 5.8). As the rents increase in a city, the labor supply in the city decreases in general. The result also means that the wage rate should be high in the city where housing rent is high to compensate the disamenity. From the estimates in Table 5.8 and Table 5.9, we can also find that the relation between city size and housing rent is positive, which means that people in large cities enjoy more favorable consumption externalities and the consumption amenities are capitalized into high housing rents in Korea.

(c) Natural Environment

Such variables as precipitation, humidity, temperature, and distance to coast are usually considered as the natural environmental variables to affect the quality of life.

However, Korea is a small land composed of a peninsula, which has no big difference in climate across the cities. For example, the average annual temperature ranges ten to fifteen centigrade in the whole country. Therefore, we can use the distance from the nearest seaside (SEA) as a proxy variable for the climate and natural amenities in Korea.

The estimation results show that the distance from the seaside (SEA) in the labor productivity equation (Table 5.7) has positive signs in 7 out of 9 industries, which means that the nearness to the seaside has favorable effects on productivity. On the other hand, the variable (SEA) in the labor supply function (Table 5.8) has positive signs in 8 out of 9 industries, which means that nearness to the seaside generally is a disamenity to consumers in Korea.

The results on the productivity effects of the nearness to the seaside support the argument that in a small open economy like Korea, the proximity to world economy will increase the productivity of cities. The firms depend on foreign counterparts to a considerable degree for markets, new information, and technology. The firms locating in the cities near the seaside will have more advantages in the proximity to the world economy.

In the United States, nearness to the seaside is usually considered as an amenity in consumption because coastal cities have relatively moderate temperatures and also because the nearness to the beach represents the access

to the recreational places in general. However, the results show that the nearness to the seaside is a consumption disamenity in Korea. It is because coastal areas are relatively more susceptible to hurricane and flood but the developing countries can not afford to invest enough fund for the construction of structures to keep the areas from the disasters. In addition, the coastal line is rugged in Korea. Therefore, it is costly to develop infrastructures for good living conditions in coastal areas in Korea.

5.6 Intercity Wage Differentials

This paper concentrates on the effects of the city size on the economic efficiency in the local labor markets. However, as we explained before, the first stage estimation of the model is to estimate the reduced form of wage equation, from the results of which we can make some findings on intercity wage differentials. Table 5.9 shows the estimation results. Although some of the findings are already mentioned, we review in detail all the findings related to the intercity wage differentials.

(1) The first column of figures shows that the wage rate of a city increases as the value of output (Y) increases in the city. The reason is self-evident because the increase in the output increases the demand for labor, which will increase the wage rate as long as the labor supply curves in the local labor markets have positive slopes. That is, the

elasticity of wage with respect to the value of output (the coefficient of logY in the reduced form of wage equation; c_1) is derived to be $1/(a_1+b_1)$ from Model (III), where a_1 is the direct elasticity of substitution in production and b_1

Table 5.9

Estimates of Model (III): Reduced Form of Wage Equation[a]

$$\log w = c_0 + c_1 \log Y + c_2 \log N + c_3 SR + c_4 ED + c_5 \log HP + c_6 SEA$$

IND[b]	logY	logN	SR	ED	logHP	SEA
31	0.035	0.048	0.010**	0.053**	0.053	-0.002**
	(1.2)	(0.9)	(4.0)	(2.1)	(0.3)	(-2.0)
32	0.069**	-0.057*	0.005**	0.018	0.080	-0.000
	(4.8)	(-1.7)	(2.8)	(0.5)	(0.7)	(-0.1)
33	0.062**	-0.069**	0.009**	0.066**	0.212*	0.001
	(2.9)	(-2.1)	(4.1)	(2.9)	(1.8)	(0.9)
34	0.111**	-0.070	-0.001	-0.003	0.079	0.001
	(4.5)	(-1.2)	(-0.3)	(-0.1)	(0.4)	(0.4)
35	0.110**	-0.124**	0.011**	0.032**	0.106	-0.001
	(4.7)	(-3.3)	(6.5)	(2.4)	(0.8)	(-0.9)
36	0.128**	-0.041	0.006**	-0.016	0.055	-0.002**
	(6.8)	(-1.3)	(2.7)	(-0.7)	(0.4)	(-3.2)
37	0.084**	-0.028	0.004	0.038**	-0.296**	-0.002**
	(5.4)	(-0.8)	(0.7)	(2.4)	(-2.0)	(-2.5)
38	0.106**	-0.085**	0.005**	-0.018	0.044	-0.001
	(6.6)	(-2.6)	(3.1)	(-0.6)	(0.3)	(-0.9)
39	0.060**	-0.025	0.007**	-0.069**	0.017	-0.001
	(2.8)	(-0.4)	(2.9)	(-2.5)	(0.1)	(-0.7)

Note a: t-values are in parentheses.
** = The coefficient is statistically significant at the 5%
* = The coefficient is statistically significant at the 10%
b: Definitions of industry codes are in Appendix 3.

is the elasticity of labor supply with respect to the wage rate. Therefore, as a_1 and b_1 are positive, c_1 should always be positive.

(2) The second column in Table 5.9 shows that the city size (N) would have negative effect on the wage rate provided output is held constant. As it was explained in section 5.3, the city size has in general positive productivity effects and therefore increases the wage rates on the production side. However, on the consumption side, it decreases the wage rates because people in this sample take city size as an amenity and therefore supply their labor at lower wage rates in larger cities. Accordingly, the negativeness of the effects of city size on the wage rates at the equilibrium point imply that the wage-decreasing effects on the supply side dominate the wage-increasing effects on the demand side.

However, it does not mean that the wage rates in large cities are lower than those in smaller cities, but means that people would accept lower wages to reside in larger cities. In fact, when we estimate the wage equation dropping the variable of value of output (Y), the city size has positive effects on the wage rates.[19] We can make the following interpretation of the fact. As we explained, city size has favorable effects both on the production and on the

19. The results are reported in Appendix 6.

consumption side in Korea, which is accelerating the city growth and the increase in output in large cities. Then the increase in output in large cities increases the wage rates in large cities. Therefore, if we do not hold output constant, wage rate may have positive relationship with city size. However, when we control for the wage effect of the increase in output, wage rate has negative relationship with city size in Korea in contrast to developed countries.

(3) Labor force characteristics, sex (SR) and education (ED), are generally believed to be important factors affecting the wage rate. Table 5.9 shows that SR and ED have positive effects on the wage rates in general though ED has negative signs in some industries.[20]

There have been various explanations about the reasons for which wage differences by sex and education exist. The most important among them are labor productivity and discrimination theory. The 2SLS estimates of structural equations reported in Table 5.7 and Table 5.8 show, as we explained in the previous section, that sex and education have no significant effect on productivity but have significant effect on the supply price of labor in Korea. The observation indicates that differences in wage rate with

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20. In Appendix 7, we report the estimation results of the model where we drop the less significant other control variables and keep only SR (sex ratio) and ED (education level) as control variables. Then the coefficients of SR and ED have more significant values to support the following argument in text of labor force characteristics.

respect to sex and education are attributed more to the differences in the supply price of labor between different labor groups rather than to the differences in their productivity. This situation can be interpreted that in Korea there exists strong wage discrimination with respect to sex and education level in the sense that male and more educated workers are employed at higher wage rates without regard to their productivity, and it occurs due to the differences in the supply price of labor. According to Park and Park (1984), the differences in other family income including non-labor income and in wealth between different labor groups are among the reasons for which the supply prices of labor are varied.

(4) The fifth column of the Table 5.9 shows that the housing rent (HP) have positive signs in 8 out of 9 industries though they are not so significant. Since Coelho and Ghali (1971) indicate that living costs differences across regions are major reasons for interregional wage differences, cost-of-living index is generally admitted as one of important intercity wage differentials. The estimation results confirm the argument.

(5) The last column shows that the distance from the seaside (SEA) have negative effects on the wage rate in general. In other words, the nearness to the seaside has a positive effect on wage rates because the seaside has favorable

effects on productivity. In the previous section, we found also that the place near the seaside are not considered as a good place to live in by workers and, therefore, the wage rates should be higher to compensate the disamenity. Consequently, as a city locates nearer the seaside, the wage rate in the city become higher not only on the labor demand side but also on the supply side.

(6) Finally, the above discussions are based on the separate estimates by industry to exclude the effects of industry mix. Consequently, we could not see how different industry-mix accounts for the intercity wage differences. To see the effects of industry mix, simply we estimate the following wage equation using the data including all the manufacturing subindustries. The equation includes dummy variables each of

(5.11)[21]

$$\begin{aligned}\log w = {} & \underset{(3.4)^{**}}{2.275} + \underset{(4.3)^{**}}{0.062}\,\log N + \underset{(7.4)^{**}}{0.0067}\,SR + \underset{(2.6)^{**}}{0.024}\,ED \\ & + \underset{(2.8)^{**}}{0.182}\,\log HP - \underset{(-2.1)^{*}}{0.0007}\,SEA + \underset{(5.5)^{**}}{0.320}\,IND31 + \underset{(3.0)^{**}}{0.175}\,IND32 \\ & - \underset{(-1.1)}{0.070}\,IND33 + \underset{(3.2)^{**}}{0.199}\,IND34 + \underset{(4.5)^{**}}{0.284}\,IND35 + \underset{(2.7)^{**}}{0.170}\,IND36 \\ & + \underset{(1.7)^{*}}{0.128}\,IND37 + \underset{(3.0)^{**}}{0.184}\,IND38 \qquad R2 = 0.4555\end{aligned}$$

21. Observations: 359. t values are shown in parentheses.
**: The coefficient is statistically significant at the 5 %.
*: The coefficient is statistically significant at the 10 %.
INDxx: A industry dummy; 1 if industry is xx, 0 otherwise.

that denotes each subindustry. Industry 39 (other manufacturing industries) is adopted as a reference industry.

The result shows that industry dummies have significant coefficients, which implies that differences in industry mix across cities are responsible for part of the wage differences across cities.

Also, the results show that wage rates in food (31) and chemical (35) industries are the highest and wood products (33) and other manufacturing industries (39) are the lowest when we take into account the locational and labor force characteristics. When we compare the market wage rate without any control variable, basic metal industries (37) and paper, printing and publishing (34) are among the highest.

CHAPTER VI

CONCLUSIONS

6.1 Summary of Major Findings

Urban concentration of population is one of the major concerns of Korea. Therefore, various population redistribution policies have been adopted to decelerate rural-to-urban migration trends and to change the urban configuration. However, if the change is to be for the better, it should be based on an understanding of why things are the way they are. To put it more specifically, we should answer the questions: Why has city size been growing so rapidly in Korea? Are cities growing as places of efficient production or as better places of consumption? How long will the present pattern of city growth continue in the future and how will it change as income, technology, and industrial structure change? What accounts for the recent slow-down of the growth of metropolitan cities in Korea? Population redistribution policies implemented without the adequate knowledge of the nature and the causes of the urban concentration may bring more distortions and welfare losses in the economy.

In this respect, we have tried in this study to identify the nature of current urban concentration in Korea and to estimate the magnitude of the effects of city growth on economic efficiency. The analysis is based on the labor

market equilibrium model, where the equilibrium wage rate and the equilibrium labor reflect both the effects of city size on labor demand and on labor supply. The findings can be summarized as follows:

First, in Korea, city size has a favorable effect not only on production in manufacturing industries but also on consumption of workers. City growth increases the productivity of cities and therefore increases the wage rate and the quantity of labor demanded in larger cities. Furthermore, people enjoy more consumption amenities in larger cities and are willing to supply more labor. Therefore, the amount of labor employed at the equilibrium point increases as city size grows. This means that urbanization in Korea takes the pattern of accelerating city growth. The firms in large cities induce people to migrate to large cities enjoying higher labor productivity. The migrants to large cities enjoy also favorable living conditions and the resulting further increase in the number of migrants makes the wage rate lower than otherwise in large cities. Therefore, the firms facing the lower wage rates increase labor demand further in large cities.

This situation contrasts with the pattern of developed countries where in general city growth has favorable effects on production but it has negative effect on consumption increasing living costs in larger cities. In this pattern of urbanization, city growth is self regulated because city

growth from the equilibrium increases the wage rates in large cities to compensate the disamenities arising from city growth, and reduces the quantity of labor demanded, thereby reducing sustainable city size.

Second, we found that the effect of city size on the wage rate is negative at the equilibrium point provided the output of specific industry in each city is held constant. That is, the wage rate becomes lower as the city size grows. It is because people like to supply their labor in large cities with regard to consumption externalities and job choice. Though city size has favorable effect on labor productivity and increases demand price of labor in large cities, the effect is dominated by the effect of city size on the supply side decreasing the wage rate through the increase in the labor supply in large cities. From this we can conclude that urban concentration in Korea is largely due to the characteristic behavior in the labor supply market. The better living conditions for workers in large cities induce in-migration of the workers.

The advantages for workers in large cities may include the varieties of consumption goods and services, the varieties of job choices, and better supplies of public goods and services in large cities. Traditional favoritism toward the center will make the advantages in large cities more considerable.

On the contrary, in developed countries, it is believed that the wage rate increases as city size increases because disamenities in large cities increase the wage rates in larger cities and the high wage rates are supported as long as agglomeration effects in production can afford it.

Third, however, the comparison of the estimation results of different periods in different countries shows that the favorable effects of city growth on consumers' welfare in Korea are now diminishing rapidly and that the effect of city size on consumption will become negative in near future because consumer disamenities caused by city growth will dominate amenities as income and technology develop. This explains the recent slow-down of the growth of metropolitan cities in Korea.

Fourth, the estimation results show that agglomeration effect on production is ascribed not only to urbanization economies but also to localization economies, and that urbanization economies are significant in light manufacturing industries and localization economies in heavy manufacturing industries.[22] The existence of localization economies implies that different cities have different optimal sizes as they specialize in specific industries, and

22. As we explained in Chapter II and V, urbanization economies reflect external economies that work between firms of different industries in a city, while localization economies are restricted to externalities between firms within the same industry. The former is measured by city size while the latter is measured by employment size within a particular industry in the city.

that industrial decentralization may proceed as the industrial structure changes to the structure with more heavy manufacturing products where localization economies of production appear especially significant.

Fifth, we also found out that urban attributes such as labor force characteristics, the cost-of-living index (e.g. housing rents), and natural environment (e.g. nearness to the seaside) also affect productivity, consumers' welfare, and the wage rate of cities and, therefore, they influence the spatial distribution of economic activities and employment. It means that one should take into account the effects of such urban attributes for the analysis of city size, growth, and structure as we did in this study.

When housing rents are high in a city, the wage rates in the city are high. High rents discourage the labor supply in that city and therefore the wage rates should be high enough to compensate the disamenity to keep the labor supply from decreasing. The results also show that cities locating near the seaside have higher productivity and higher wage rates. One implication of this result is that the more an economy relies on foreign markets, information and technology, the more the population tends to concentrate in large cities near ports.

Finally, the wage rates of the cities with proportionately more male and educated workers are significantly higher than those with more female and less-

educated workers. However, we found out that under the control for the effect of the industry for which the workers are employed, the human characteristics such as sex and education have no significant effect on productivity whereas they have significant effects on the labor supply. The supply prices of labor of the workers who are male and more educated are significantly higher. From this findings, we can conclude that there exists strong wage discrimination by sex and education in Korea in the sense that a large part of the wage differences by sex and education can not be explained by labor productivity difference, but by the differences in the supply price of labor between different groups of workers.

6.2 Policy Implications

The implications of this study for population distribution policy and other government policies can be summarized as follows:

(1) Using the labor market equilibrium model, we have shown that the equilibrium wage rate and labor reflect the costs and gains of locating in cities of different sizes and that, therefore, we can estimate the effect of city size indirectly by examining labor market behavior. It implies that the effectiveness of the population redistribution policies can be improved by the analysis of local labor market behavior and intercity wage differentials. The wage

rate in a city serves as a major indicator of the efficiency of the city. Therefore, policy makers should pay adequate attention to the movement of the wage rate and its divergences across cities.

(2) Present pattern of urbanization in Korea reveals that the urban concentration is inevitable on the basis of economic efficiency. The behavior of firms and workers with respect to the decision to locate in large cities are economically efficient even if we take into account the external effects of resulting city growth.[23] It implies that most of coercive or subsidizing population redistribution policies may have limited effects or adverse side effects in terms of economic efficiency in Korea.

(3) However, the above argument is not to deny the need of government intervention with respect to population

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23. According to the arguments of the economists who stress the external diseconomies of city size including Mishan (1967, 1977) and Tolley, Graves, and Gardner (1979), there are externalities that can not be identified by labor market behavior or by economic efficiency standards. Tolley et al. (1979), for example, classifies external diseconomies associated with overurbanization into three types: (1) environmental externalities such as pollution and congestion, (2) government-induced externalities resulting from government policies such as property taxation, welfare, and minimum wage laws, and (3) broader social goals such as income distribution, racial or ethnic integration, the cohesiveness of society, national security, and prevention of breakdown of the family. Our analysis focusing on the effects of city size on economic efficiency does not deal directly with the government-induced externalities and broader social goals. We discuss this issue later in this section.

distribution in Korea. First, as we explained in previous section, the favorable effect of city size will dissipate and then the diseconomies of city size become dominate the economies in the future as income and technologies develop, especially as the industrial structure changes to the structure with more heavy manufacturing products. Therefore, we need to make preparation for keeping population from being overconcentrated in large cities in the future.

Second, the above argument does not take into consideration the problems related to equity and non-economic social goals. Regional imbalance in income and wealth distribution, military security concerns with a large concentration of population and industrial facilities near the border in Seoul, and potential political and social conflicts because of a large concentration of marginal workers and students and breakdown of the family may require government intervention to excessive urban agglomeration irrespective of economic efficiency.

Third, the most important need of government intervention may come from the understanding that the better achievement of efficiency in large cities is partly due to the existing distortions in resource allocation such as public goods and services, credit, quality education, housing, and medical services. In this situation, elimination of such distortions will contribute to the deceleration of excessive migration without welfare losses.

We can conclude from the above discussions that the population redistribution policies may be required for several reasons. However, we need to make clear the cause of government intervention and the goals of the policies. The programs should be least damaging to the economic efficiency and implemented gradually examining the effects carefully. Also, policy makers should set high priorities on eliminating existing distortions which accelerate urban concentration.

(4) The estimation results have shown that the main reason for urban concentration in Korea is the favorable effect of city size on labor supply. Therefore, when we adopt population redistribution policies, we should concentrate on the policy programs which will improve the living conditions in smaller cities rather than on the programs for relocation of manufacturing firms.

However, the majority of the programs Korean government adopted for population redistribution focused on location and relocation of firms. Previous research (Kwon 1985, Lee 1985, Murray 1988, Choe and Song 1984) on industrial location policies in Korea indicate that they have had a relatively minor impact on the location decision of manufacturing firms and some policies, for example strict zoning regulations, have rather had important adverse effects from efficiency and development perspectives. As Kwon (1985) indicated, it is more important to compensate

the welfare loss of the relocated workers and their household than moving industries themselves. In this sense, the plans and programs for population redistribution should include the appropriate provision of social infrastructure; e.g., housing, education and medical facilities, and entertainment and recreational facilities. In this connection, the autonomous local government system planned to be introduced in Korea in 1990 will contribute to mitigating the regional disparity problem.

(5) As a byproduct of the analysis, we found out that significant wage discrimination by sex and education exists in Korea regardless of labor productivity and that it is due to the differences in the supply price of labor. Therefore, the policies to eliminate wage discrimination should aim at the factors affecting the supply price of labor with the efforts to correct the practices and labor market structures making wage discrimination possible. To equalize opportunities of nonlabor income and wealth distribution and to eliminate discriminating practices in hiring, promotion, and job assignment will be helpful.

6.3 Limitations of the Study and Suggestions for Further Research

The study analyzed the effect of city growth on economic efficiency based on a labor market equilibrium model. This model treats labor market as being in

equilibrium where adjustment and transactions costs are negligible. However, as Bartik and Smith (1987) indicate, we can expect that quality of empirical estimates can be enhanced with advances in modeling the role of adjustment costs for the dynamic behavior of the firm and the labor.

To isolate the effect of city size from the effects of other variables which are not directly associated with city size, we included control variables such as city industry base, labor force composition by sex and education, the distance from the coast as a proxy for natural environment, and cost of living index. However, because of data limitation, we could not include the variables representing the existing distortions which may be resulted from previous policies favoring large cities, for example, in provision of public goods and services, credit rationing, opportunities for quality education, etc. Also, the socio and cultural factors such as traditional favoritism toward center are not considered because of difficulties of empirical management.

The original purposes of the data used in this analysis are not for the analysis of geographical or locational characteristics of the covered areas. If the surveys are conducted so as to be more appropriate for the analysis of locational characteristics, we could get more meaningful results.

Recently economists (Blomquist, Berger, and Hoehn 1988, Roback 1982, Rosen 1979) have begun work on the estimation

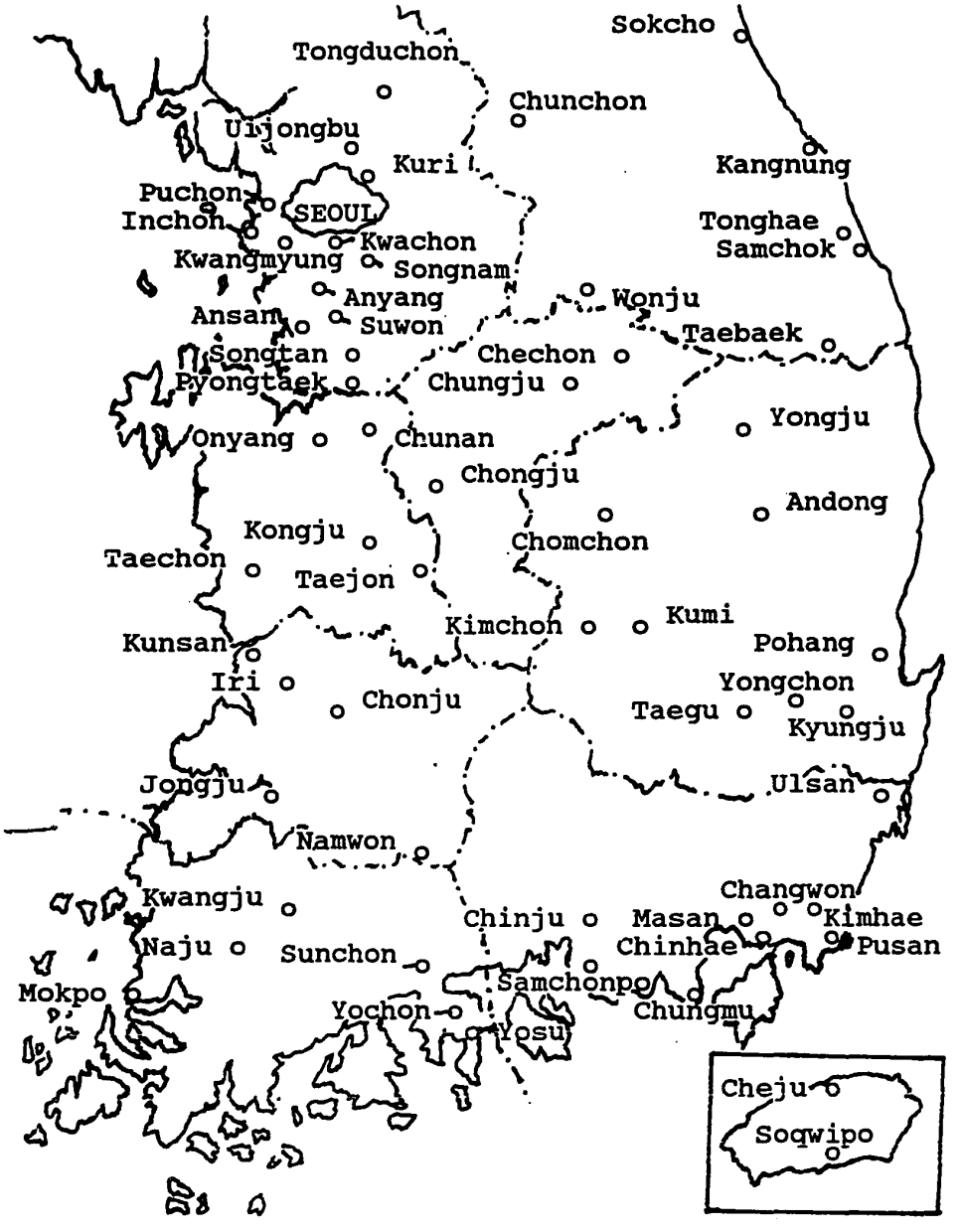
of quality of life in urban areas for the comparisons of the bundles of amenities available at one location to bundles elsewhere. The basic concept of the analysis is the same as that of our study. That is, the differences in equilibrium wages and land rents between cities with different attributes are in fact the implicit price that signals the proper assignments of households to cities by equalizing the welfare of the people living in different places. Equilibrium wage and land rent differentials are used to compute the implicit prices of amenities such as climatic conditions, environmental variables, urban attributes, and also other variables controlling for personal and structural characteristics. The implicit prices are, in turn, used to construct a quality of life index across urban areas. This means that the reduced form of wage equation in our model can be used to compute the quality of life index if we have detailed data on locational characteristics of cities. The model can be further developed for this purpose by treating land rent as an endogenous variable depending on urban amenities and disamenities.

Finally, the conceptual framework of this study can also be developed to estimate the costs of specific disamenities such as air pollution, congestion, and crime for the analysis of urban problems. Instead of entering population size per se in our regressions, we include specific measures of environmental attributes under the

control for other effects. By relating the disamenity measures to population size, we can decompose the costs of city growth into the effect of specific items associated with city growth.

APPENDICES

A.1 Locations of Cities in Korea



A.2 Definitions of Variables and Parameters

Y = value of output

L = labor input; employment

w = wage rate; total wage payment divided by employment

N = city size; population of the city

SR = sex ratio; number of male workers / total industry workers

ED = education; years of schooling acquired by workers

P = cost-of-living index specific to a city

HP = housing rent of intermediate income families of four member

SEA = distance from the nearest seaside; road distance in kilometers.

ER = variable representing industry size in a city; the ratio of own industry employment in a city relative to total employment in the industry

s = parameter denoting elasticity of substitution

p = 1/s -1

b_N = parameter denoting productivity effect of city size (urbanization economies)

b_L = parameter denoting productivity effect of industry size (localization economies)

A.3 Definitions of Industry Codes in Korea

31 = Food, beverage, and tobacco industries

32 = Textile, wearing apparel, footwear, and leather industries

33 = Wood and wood products including furniture and fixtures primarily of wood

34 = Paper, paper products, printing, and publishing

35 = Chemicals (organic, inorganic chemicals, chemical fibres, fertilizers, etc.), chemical products (paints, drugs, soap, cosmetics, etc.), petroleum refineries, rubber and plastic products, miscellaneous products of petroleum and coal

36 = Non metallic mineral products: pottery, china, earth ware, glass and glass products, other non-metallic mineral products (clay, cement, lime, concrete, etc.)

37 = Basic metal industries (iron and steel and nonferrous metal such as copper, aluminum, lead, zinc, etc.)

38 = Fabricated metal (cutlery, tools, structural metal products, etc), machinery including electrical and electronic machinery, transport equipment, and professional and measuring equipment

39 = Other manufacturing industries (jewellery, musical instruments, sporting goods, dolls, toys, wigs, etc.)

A.4 Data on Manufacturing Sector by City (1986)

City	N (1,000)	Y (Bil. Won)	L	w (1000 Won)	SR	ED (Years)
Seoul	9646	7441	539235	243	52.8	11.2
Pusan	3517	6021	410806	228	51.0	10.3
Taegu	2031	1912	171700	220	52.2	9.8
Inchon	1387	5129	201048	290	65.6	10.5
Kwangju	906	453	18630	294	55.8	10.2
Suwon	431	1329	46137	323	55.9	11.2
Songnam	448	687	52451	237	52.7	9.7
Uijongbu	163	156	8815	252	59.9	10.8
Anyang	362	1155	45847	309	61.6	11.4
Puchon	456	1247	90941	247	65.8	11.1
Kwangmyong	220	419	12788	346	80.1	10.7
Songtan	66	96	3570	227	71.6	8.9
Tongduchon	69	119	4246	219	60.9	9.3
Ansan	96	1235	58714	295	73.9	10.6
Kwachon	65	3	210	253	59.2	13.8
Kuri	84	85	7727	212	65.4	10.7
Pyongtaek	72	29	1488	257	78.1	9.6
Chunchon	163	31	3265	204	47.9	9.6
Wonju	151	69	3958	206	58.3	9.0
Kangnung	133	25	1959	179	56.9	10.0
Tonghae	92	271	2709	335	71.8	8.9
Taebaek	114	14	535	276	81.8	8.0
Sokcho	70	14	1131	138	39.6	7.5
Samchok	51	61	1167	406	94.8	9.0
Chongju	350	666	33713	248	36.8	10.4
Chungju	113	26	2320	129	50.6	8.7
Chechon	102	14	946	202	62.6	10.6
Taejon	867	704	41541	230	51.2	10.1
Chonan	170	321	19206	207	35.1	10.3
Kongju	54	3	510	171	47.6	8.2
Taechon	52	7	535	185	62.8	6.5
Onyang	56	47	2135	274	65.2	11.0
Chonju	426	396	17300	257	43.9	9.8
Kunsan	186	304	14443	230	53.2	10.1
Iri	192	271	24918	219	44.0	10.3
Jongju	79	30	1612	184	64.9	9.7
Namwon	61	13	1540	170	48.5	9.2
Mokpo	236	139	7325	235	53.7	8.6
Yosu	172	121	6884	210	43.4	9.8
Sunchon	122	18	1205	212	53.8	10.5
Naju	59	54	910	257	50.9	10.1

(Continue)

(Continued)

City	N (1,000)	Y (Bil. Won)	L	w (1000 Won)	SR	ED (Years)
Yochon	54	2674	6342	585	89.1	8.1
Pohang	261	1952	33171	440	94.2	11.9
Kyungju	128	80	5117	224	55.9	10.4
Kimchon	77	56	4153	202	40.9	9.0
Andong	114	20	2167	186	68.5	7.6
Kumi	142	1945	58949	266	49.9	10.9
Yongju	85	13	1057	311	66.9	8.1
Yongchon	53	26	1909	223	44.5	8.7
Sangju	62	4	585	132	43.1	9.8
Chomchon	58	9	339	320	85.7	8.7
Changwon	174	1936	49531	388	85.4	11.9
Ulsan	551	6228	83666	466	89.1	11.5
Masan	449	1202	62366	254	35.1	11.0
Chinju	227	206	12386	250	64.0	9.8
Chinhae	121	347	13318	315	77.8	9.3
Chungmu	87	55	3544	247	54.2	9.8
Samchonpo	63	24	2387	171	35.2	6.4
Kimhae	78	150	10809	241	52.6	9.9
Cheju	203	23	1423	235	73.3	10.2
Sogwipo	83	5	588	116	45.5	8.8
Total	27160	48094	2219927	263	57.1	10.6

A.5 Data by Industry (1986)

Industry	Y (Bil. Won)	L	w (1000 Won)	SR	ED (Years)
31	4394	126984	287	58.1	10.0
32	7691	643612	211	35.2	9.9
33	784	53834	233	76.1	9.4
34	1577	93558	314	75.8	11.8
35	11481	316467	261	57.4	11.1
36	1385	58350	295	76.2	10.6
37	4764	91305	375	92.2	11.4
38	15143	731981	294	68.2	11.4
39	876	103836	210	45.4	10.0
Total	48094	2219927	263	57.1	10.6

A.6 Estimates of Alternative Wage Equation

$$logw = d_0 + d_1 logN + d_2 SR + d_3 ED + d_4 logHP + d_5 SEA^a$$

Industry[b]	logN	SR	ED	logHP	SEA
31	0.091**	0.010**	0.051**	0.018	-0.002**
	(2.3)	(3.9)	(2.0)	(0.1)	(-2.8)
32	0.044	0.003	0.130**	0.032	-0.001
	(1.4)	(1.4)	(3.7)	(0.2)	(1.1)
33	0.001	0.006**	0.065**	0.359**	0.000
	(0.1)	(2.8)	(2.6)	(3.2)	(0.0)
34	0.111**	0.008**	-0.011	-0.098	0.001
	(2.0)	(2.0)	(-0.3)	(-0.4)	(0.5)
35	-0.011	0.010**	0.031*	0.415**	-0.001
	(-0.3)	(4.8)	(1.9)	(2.6)	(-0.8)
36	0.082**	0.011**	0.019	0.057	-0.003**
	(2.0)	(3.5)	(0.6)	(0.3)	(-2.9)
37	0.053	0.012	0.062**	-0.019	-0.002*
	(1.2)	(1.6)	(2.7)	(-0.1)	(-1.8)
38	0.018	0.008**	0.080**	0.462**	0.001
	(0.4)	(3.1)	(2.1)	(2.5)	(0.4)
39	0.078	0.006**	-0.089**	0.043	-0.001
	(1.5)	(2.3)	(-3.0)	(0.2)	(-0.4)

Note a: t-values are in parentheses.
** = The coefficient is statistically significant at the 5%
* = The coefficient is statistically significant at the 10%
b: Definitions of industry codes are in Appendix 3.

A.7 Estimates of Alternative Model: Control for Labor Force Characteristics only

A.7.1 OLS $\log w = c_0 + c_1 \log Y + c_2 \log N + c_3 SR + c_4 ED$[a]

IND[b]	Constant	logY	logN	SR	ED	R^2	F	NOB
31	3.54**	0.089**	0.021	0.0098**	0.041	0.57	17.3	58
	(15.2)	(3.4)	(0.4)	(4.8)	(1.9)			
32	4.33**	0.059**	-0.042*	0.0046**	0.044**	0.63	21.7	56
	(22.1)	(5.8)	(-1.7)	(3.6)	(2.0)			
33	4.00**	0.079**	-0.065**	0.0085**	0.040**	0.50	11.2	50
	(17.3)	(4.7)	(-2.3)	(4.3)	(2.1)			
34	4.71**	0.099**	-0.022	0.0005	0.006	0.54	13.7	51
	(15.1)	(5.1)	(-0.5)	(0.2)	(0.3)			
35	3.86**	0.117**	-0.109**	0.0101**	0.036**	0.73	30.0	50
	(17.8)	(7.7)	(-3.8)	(6.4)	(3.2)			
36	4.35**	0.155**	-0.068**	0.0050**	-0.023	0.68	27.1	55
	(15.7)	(8.2)	(-2.2)	(2.2)	(-1.3)			
37	4.01**	0.082**	-0.057	0.0103**	0.025*	0.76	19.8	30
	(9.4)	(5.1)	(-1.6)	(2.1)	(1.7)			
38	4.15**	0.116**	-0.104**	0.0075**	0.016	0.79	49.1	56
	(13.0)	(9.9)	(-2.9)	(5.5)	(0.7)			
39	5.24**	0.059**	-0.022	0.0075**	-0.073**	0.48	8.6	42
	(17.0)	(3.4)	(-0.5)	(3.5)	(-2.9)			

Note a: t-values are in parentheses. NOB=No. of observations
** = The coefficient is statistically significant at the 5%
* = The coefficient is statistically significant at the 10%
b: Definitions of industry codes are in Appendix 3.

A.7.2 2SLS (a) $\log(Y/L) = a_0 + a_1 \log w + a_2 \log N + a_3 SR + a_4 ED$
(b) $\log L = b_0 + b_1 \log w + b_2 \log N + b_3 SR + b_4 ED$

IND[b]	(a) Labor productivity equation[a]						
	Constant	logw	logN	SR	ED	R^2	F
31	-17.61**	4.83**	-0.340**	-0.035**	-0.216	0.73	36.0
	(-9.5)	(10.4)	(-4.2)	(-6.8)	(-5.3)		
32	-13.53**	3.20**	-0.131*	-0.007	0.002	0.54	15.2
	(-5.8)	(5.6)	(-1.8)	(-1.6)	(0.0)		
33	-14.50**	3.59**	-0.075	-0.008	-0.123*	0.37	6.7
	(-4.2)	(4.6)	(-1.0)	(-0.9)	(-1.6)		
34	-17.66**	4.09**	-0.324**	-0.009	-0.008	0.83	56.9
	(-12.7)	(13.0)	(-5.0)	(-1.6)	(-0.3)		
35	-9.64**	2.46**	-0.018	0.002	-0.080**	0.62	18.5
	(-5.4)	(6.3)	(-0.3)	(0.3)	(-2.0)		
36	-10.79**	2.13**	0.035	0.016**	0.024	0.81	52.6
	(-10.2)	(9.3)	(0.7)	(3.2)	(0.7)		
37	-15.66**	3.29**	0.054	-0.001	-0.002	0.79	23.1
	(-7.4)	(5.4)	(0.6)	(-0.0)	(-0.0)		
38	-14.91**	3.16**	-0.043	-0.003	0.045	0.80	50.8
	(-11.1)	(10.5)	(-0.5)	(-0.6)	(0.6)		
39	-28.24**	5.56**	-0.200*	-0.023**	0.332**	0.56	12.0
	(-5.6)	(6.1)	(-1.7)	(-2.6)	(2.9)		

Note a: t-values are in parentheses.
** = The coefficient is statistically significant at the 5%
* = The coefficient is statistically significant at the 10%
b: Definitions of industry codes are in Appendix 3.

(Continued)

IND[b]	(b) Labor supply equation[a]						
	Constant	logw	logN	SR	ED	R^2	F
31	-22.23**	6.42**	0.107	-0.076**	-0.242**	0.92	149.2
	(-12.0)	(13.8)	(1.3)	(-15.0)	(-5.9)		
32	-60.25**	13.84**	0.847**	-0.070**	-0.744**	0.97	383.7
	(-25.9)	(24.1)	(11.9)	(-15.1)	(-8.6)		
33	-36.20**	9.10**	0.900**	-0.100**	-0.380**	0.91	116.0
	(-10.5)	(11.6)	(11.8)	(-11.3)	(-5.0)		
34	-29.91**	6.01**	0.548**	0.003	-0.055	0.96	313.1
	(-21.4)	(19.1)	(8.5)	(0.6)	(-1.6)		
35	-23.32**	6.07**	0.946**	-0.088**	-0.229**	0.93	154.6
	(-13.0)	(15.5)	(13.5)	(-14.0)	(-5.9)		
36	-17.30**	4.33**	0.404**	-0.048**	0.121**	0.93	166.7
	(-16.3)	(19.0)	(8.1)	(-10.0)	(3.7)		
37	-33.43**	8.96**	0.650**	-0.125**	-0.307**	0.95	114.3
	(-15.8)	(14.7)	(6.7)	(-6.6)	(-5.9)		
38	-20.95**	5.48**	0.939**	-0.062**	-0.184**	0.94	202.7
	(-15.6)	(18.2)	(10.5)	(-12.3)	(-2.5)		
39	-60.45**	11.38**	0.575**	-0.103**	0.896**	0.89	77.3
	(-11.9)	(12.5)	(4.7)	(-11.7)	(7.8)		

Note a: t-values are in parentheses.
** = The coefficient is statistically significant at the 5%
* = The coefficient is statistically significant at the 10%
b: Definitions of industry codes are in Appendix 3.

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