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Interregional Differentials in Wage, Income, Land Value, and Consumer Price Index

by

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Abstract

The objective of this paper is to consider interregional differentials in a unified framework by explicitly incorporating land for housing, and to conduct an empirical analysis on the interregional differential indexes. It is revealed that between regions the CPI varies little, the wage rate varies more, and the land value varies the most. We show that these differentials are related to difficulties in mobility and spatial arbitrage.

1 Introduction

Diminishing interregional differentials is one of the most important domestic policy goals. In fact, income transfer from developed to less developed regions has been incessantly taken place in Japan. Due to central government policies, some interregional differentials have decreased, but there still remain certain differentials between regions. It is often said that the wage rate, the consumer price index (CPI) and the land value are higher in larger cities. Differences between large-small cities are comparable to those between developed-developing countries. In this paper, we will investigate whether such intercity regularities exist empirically or not, and will examine possible economic reasons.

Consider the price of coffee at a café at Avenue de Champs Élysées as an example. Needless to say, it is more expensive than that in a rural area. From the supply side, this is

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because the wage rate of employees differs between the regions, and the price of land also differs. From the demand side, tourists and businessmen have a higher reservation price for coffee at a café at Avenue de Champs Élysées. In other words, locational advantages at Avenue de Champs Élysées are capitalized in the service price of drinking coffee at a café.

However, the price of a can of coffee would be almost the same between the two regions. From the supply side, this is obvious since selling cans of coffee requires very little land and very few labor costs. That is, there exists interregional arbitrage in the case of mobile manufacturing goods. If prices of mobile goods differ greatly between regions, traders or transportation agencies would enter the market to seek the price differences. Since the transportation costs of manufacturing goods such as cans of coffee are very small in general, spatial arbitrage by such traders would diminish interregional price differentials. Thus, we know that the interregional price differentials are totally different between coffee at a café and a can of coffee.

Equilibrium is attained in each region as well as between regions. Intraregional equilibrium is attained when each firm can no longer increase its profit and each consumer cannot increase its utility by intraregional relocation. In the case of residential location, Alonso (1964) derived a locational equilibrium within a region. In equilibrium, land rent is decreasing as one moves from the Central Business District (CBD) so as to compensate for the increasing costs of commuting to the CBD. Since the CBD is assumed a point, there is no room for intraregional differentials in the wage rates and the commodity prices. However, there exists intraregional differentials in the land rent or the land value.

On the other hand, interregional differentials exist in various indexes such as the wage rates and the commodity prices. Rosen (1974) developed a hedonic theory where characteristics are capitalized in the price of goods. For example, locational characteristics such as amenity, congestion and access to the CBD are capitalized in the land rent or the wage rate. Under free migration, interregional utility levels are the same. Since the indirect utility function consists of the wage rate, commodity prices and the land rent, the values of these arguments must be canceled each other: high commodity prices and land rent in large cities must be compensated by high wage rates. In fact, Gerking and Weirick (1983) empirically showed that interregional differentials in real wage rates no longer exist in the United States if the wage comparison is made after controlling the job type, education

level, years worked, sex, and so on.

The question is whether the locational characteristics in large cities are capitalized in the land rent or the wage rates. Henderson (1982) gave a partial answer to this question. Comparing the locations at the city edges between cities, he showed that amenity differences *at city edges* are fully capitalized into wage rates only. The reason is as follows. The residential land rent at any city edge must be equal to the agricultural rent, which is constant everywhere. On the other hand, the amenity level is usually associated with access to the CBD and with congestion, and so it is associated with city size. Hence, higher commuting and congestion costs in larger cities should be compensated by higher wage rates since the land rent at city edges is the same.

Although this result is clear, it holds only at the city edges. If we compare the interregional differentials at the city centers, no clear results hold. This is one motivation to conduct empirical analysis in this paper.

Krugman (1991) developed a two-region general equilibrium model, where each firm produces a differentiated product and each worker consumes each differentiated product. Assuming the CES type of a utility function, Krugman analytically showed that wage differentials are equal to commodity price differentials:

$$\frac{w_j}{w_i} = \frac{p_j}{p_i} \qquad \forall i, j, \tag{1}$$

where w_j is the wage rate in region j and p_j is the commodity price in region j.

Equation (1) implies that in big cities the wage rates are high and CPI's are proportionately high, which is in accord with Gerking and Weirick (1983) mentioned above. This result would explain the persisting wage and price differentials between developed and developing countries. In developed countries, higher wage rates mean higher labor costs, which lead to higher prices of commodities. Conversely, under higher prices consumers demand higher wage rates. In developing countries, the reverse causality is true. As will be empirically demonstrated later, however, the wage rate is not proportionately associated with the CPI between regions within a country. That is, Krugman's model is suitable for depicting international price differentials, but not interregional price differentials in a country.

Focusing on the prices of mobile manufacturing products, Takayama and Judge (1971) considered a model of spatial price equilibrium by the linear programming approach. They

showed that interregional differences in commodity prices do not exceed the costs of transporting the commodity between regions. However, we do not think this is the main reason for interregional price differentials. If so, CPI in remote regions must be high while CPI in central regions like Tokyo would become low. Obviously, this is not correct at all in reality. Instead, it is often the case that central regions contain big cities whose CPI's are large relative to peripheral regions. So, we must explore other reasons for the interregional price differentials.

If interregional prices of commodities differ within a country, spatial arbitrages would take place. The arbitrages work more sensitively in the markets of more mobile production factors and goods. For example, since manufacturing products can be easily transported with few costs nowadays, their price differentials became very small between regions. On the other hand, prices of services which are immobile usually vary between regions. In particular, rental prices of land which is perfectly immobile are considered to vary greatly between regions. In this way, the interregional mobility should be a key factor in generating the interregional price differentials.

In this paper, we analyze these interregional differentials between regions based upon the foregoing. We use the data of Japanese Standard Metropolitan Employment Area (SMEA) whenever possible.[1]

2 The Coefficient of Variations

There are several indices to describe interregional differentials such as Gini coefficient, Theil's measure of inequality and the coefficient of variations. Among others, the coefficient of variations is the most popular index for measuring interregional differentials since it is a standardized measure of interregional differentials in that it is free from the measured unit.

The coefficient of variations in v is defined as:

$$\mathrm{CV}_v = \frac{s_v}{\bar{v}},$$

[1]The concept of SMEA is similar to that of SMSA or MSA in the United States. See Yamada and Tokuoka (1991) for the exact definition of SMEA.

where

$$\bar{v} = \frac{1}{n}\sum_{i=1}^{n} v_i, \qquad s_v = \sqrt{\frac{1}{n}\sum_{i=1}^{n}(v_i - \bar{v})^2},$$

and n is the number of regions.

Using this formula, we calculated the coefficient of variations in several variables, and listed in Tables 1 and 2 below. Although our concern is the price differentials between metropolitan areas, SMEA based data do not exist except population in Japan. So, we used data of the central city as a proxy for the corresponding SMEA. This may be justified since wages are paid at the CBD and many commodity markets are located at the CBD. There are 118 SMEAs in Japan in the 1985 criterion, but some of the data are missing in 5 SMEAs, and hence 113 is the number of observations in our analysis. Depending upon the availability, the data are either 1990 or 1992.

Index	Value
CPI (total)	0.025
CPI (without rent)	0.022
CPI (food)	0.030
CPI (reading and recreation)	0.039
CPI (housing)	0.119

Table 1: Coefficients of Variations of CPI in 1992

The data of CPI is from National Survey of Prices, Volume 1 in 1992 (Statistics Bureau, 1992). The CV's of several CPI's in 1992 are shown in Table 1. We know from Table 1 that interregional price differentials in goods and services are small relative to that in housing. In other words, interregional price differences in traded goods are little whereas housing price and rent vary considerably across region. Hence, as expected the interregional differentials are determined by the degree of spatial arbitrage, which is inversely related to the costs of transportation. We may say that immobility or non-tradability is associated with interregional price differential.

The wage rate is computed by the wage bill divided by the number of employees in all manufacturing industries in each (central) city. These data are from the Census of Manufactures, 1992 (Ministry of International Trade and Industry, 1992). Per capita

Index	Value	Year
CPI(total)	0.025	1992
wage rate	0.170	1992
per capita income	0.177	1990
unit land value	1.426	1990

Table 2: Coefficients of Variations in Various Indices

income is derived from the tax-based income divided by population in each (central) city (Ministry of Home Affairs, 1990). Unit land value is based on the average price of unit land in a residential area in each (central) city using officially posted land price data (National Land Agency, 1990).

The difference of CV's between CPI and other price variables are evident in Table 2. It is inferred that the transportation costs of traded goods are so low within small countries like Japan that spatial arbitrage works almost perfectly in such markets of mobile goods. Hence, we may safely say that Takayama-Judge paradigm is no longer important within a country like Japan. On the other hand, the price variables of non-traded goods exhibit much greater variations, which is our major concern in this paper. Let us discuss on the other three price variables respectively.

First is the wage rate. In the literature on migration studies (Greenwood, 1985), interregional wage differentials tend to vanish in accordance with economic growth and integration due to a decrease in the migration costs. According to Heckscher-Ohlin theory, if interregional transportation of outputs are costless and there is no agglomeration externalities, then the wage differentials should disappear. However, Table 2 indicates that there does exist significant wage differentials between regions as compared at least to the CPI. So, the Krugman's result of equation (1) does not hold in Japan.[2] It would be attributable to the imperfect interregional labor migration. There exists heterogeneity in household decision to move. Some people easily moves in response to wage differentials while others do not move even in the presence of large wage differentials due to difficulties in adjusting different locational environments. In fact, the number of multilocational firms conducting

[2]This is because land for housing is out of consideration in Krugman (1991) as will be clarified in the next section.

interregional division of labor is increasing recently to exploit such wage differences. Due to the reasons, the coefficient of variations stays in a modest level.

Next, interregional income differentials tend to vanish according to the neoclassical growth theory in the absence of agglomeration economies. If migrants respond not to the wage differential but to the income differential, then the similar argument applies as the above wage differential. It is reported by Tabuchi (1987) and Barro and Sala-i-Martin (1995) that interregional income differentials are decreasing in recent years in Japan and in the United States. But, it is also true that they still persist as in the wage differentials.

The last one is the land value. Unlike traded goods, spatial arbitrage does not work directly in non-traded goods such as land. This would be one reason why the land value differs greatly between regions as compared to other variables. However, since migrants move and commodities are transported almost freely, it works indirectly through the interregional trade of production factors and products.

Let us next check the changes in the CV's from 1975 to 1993. Figure 1 depicts the recent trends in CV's in the land value and per capita income. CV in the land value changed drastically after 1986 possibly due to an influence of the so-called "bubble economy." Since the land is a stock with limited amount of supply, the value of land often varies due to speculative behavior. However, it is confirmed that interregional differential in the land value is greater than that in per capita income even in the non-bubble period. That is, we can conclude that the land value varies more than other variables.

3 Explanation

In this section, we clarify the interregional differences in CV of several indices by using a microeconomic theory of consumption. In preparation for this, let us convert the discrete definition of the coefficient of variations to the continuous one.

Suppose the variable v is continuous and uniformly distributed over a positive interval of $[v_1, v_2]$, then it is simply rewritten as

$$\mathrm{CV}_v = \frac{1}{\sqrt{3}}\left(1 - \frac{2}{v_2/v_1 + 1}\right). \tag{2}$$

since $\bar{v} = (v_1 + v_2)/2$ and $s_v^2 = \int_{v_1}^{v_2}(v - \bar{v})^2 dv / \int_{v_1}^{v_2} dv$.

Employing equation (2), we can say the following.

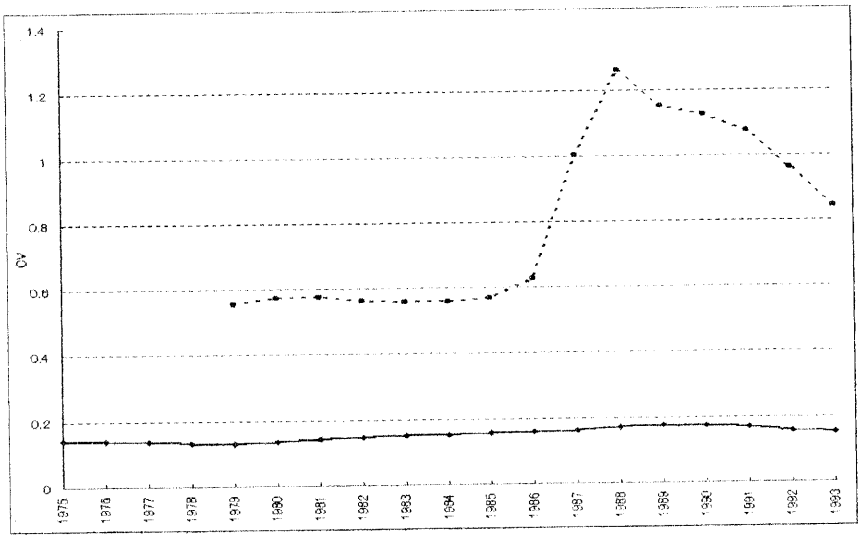

Figure 1: Coefficients of Variations in the Land Value (Dotted Line) and Per Capita Income (Solid Line)

Lemma 1 *The interregional differential (CV_v) increases as the ratio of the maximum to the minimum of the interval (v_2/v_1) increases.*

That is, when regional indices are distributed uniformly, information on the maximum and minimum values is enough to assess the value of CV. This Lemma will be used to derive a proposition in the next section.

Now, consider a representative consumer, who commute to the CBD, work at the CBD, and receive a wage. She maximizes the following utility given the budget constraint as follows.

$$\max_{h_j, z_j, x} \quad u(h_j(x), z_j(x)) \tag{3}$$

$$\text{subject to} \quad w_j = r_j(x)h_j(x) + z_j(x) + t(x) \tag{4}$$

where h is the space for housing, z is the composite good, w is the wage, r is the unit rent, t is the commuting cost, x is the distance from the CBD, and subscript j denotes the regional number. Since CPI varies very little across regions as seen in Table 2, we assume that the price of z is constant interregionally and intraregionally and is set as a numéraire.

Next, define the wage rate net of the commuting cost w_j^d as

$$w_j^d \equiv w_j - t(x) = r_j(x)h_j(x) + z_j(x) \tag{5}$$

If a representative consumer maximizes her utility, the budget constraint (5) should be tangent to her indifference curve for any j as drawn in Figure 2. If the consumer migrates between regions without costs in response to the interregional utility differentials, the utility level should be identical in each region, and hence, she is on the identical indifference curve.

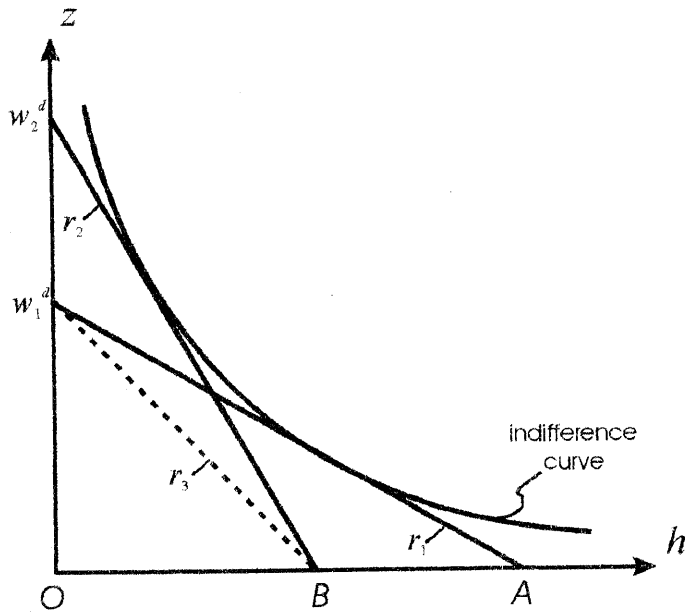

Figure 2: Indifference Curve and Budget Constraint

In Figure 2, let a small city and a large city be 1 and 2 respectively. The slope of the budget constraint is $-r_j$ from (5). Since the land rent is higher in a larger city, the slope of the budget constraint is always steeper in a larger city.

From Figure 2, it is obvious that $w_2^d/w_1^d = r_2/r_3$. However, since the broken line $w_1^d B$ is steeper than $w_1^d A$, $r_3 > r_1$ holds, and so $w_2^d/w_1^d < r_2/r_1$. On the other hand, $w_2/w_1 < w_2^d/w_1^d$ should be always satisfied for all $w_2^d > w_1^d$ given a common distance from the respective CBD, i.e., a common commuting cost. Hence, we obtain $w_2/w_1 < r_2/r_1$ for any utility function that generates a convex indifference curve. By using Lemma 1 , we thus establish the following proposition.

Proposition 1 *For any indifference curve convex to the origin, the coefficient of variations in the land rent is larger than that in the wage rate.*[3]

[3]It should be noted that in order to compare the interregional differences in land rent, we fix the same distance from the CBD in each region.

If the land market is perfect, the market fundamentals determine the equilibrium, and so the flow price of land (land rent) is proportional to the stock price of land (land value) at each location in each city. Hence, the coefficient of variations in the land rent is equal to that in the land value. Proposition 1 is thus consistent with the Japanese empirical finding in Table 2.

Proposition 1 may be intuitively understood as follows. In large cities, as land is scarce good there and the price of the composite good is constant across regions, consumers would reduce the consumption of land for housing h while increasing the consumption of the composite good z. If the land value (or rent) and the wage in a large city are double those in a small city, then consumers would be better off in a large city since the land and the composite good are substitutable. In other words, the wage rate need not be proportionally as high as the land price in a large city to keep the same utility level between large and small cities.

In summary, we may generalize that as we move up the urban hierarchy, scarce goods tend to become more expensive than easily tradable goods. Here, scarcity is defined by the non-tradability or immobility which implies difficulties in interregional arbitrage.

4 Conclusion

If the interregional markets are perfect, and if space is out of consideration, interregional utility differentials do not exist in equilibrium. However, there are externalities such as urban agglomeration economies and diseconomies, which generate interregional differentials in the land value and the wage rate. The presence of space implies existence of urban land constraints, commuting costs, and interregional transportation costs.

Conducting empirical analysis revealed that the CPI is almost invariant between regions whereas the wage rate and the land value vary between regions. In particular, the land value exhibits the greatest interregional variation. We provide a simple explanation of the greatest variation using a microeconomic theory of consumers, and showed that the interregional differentials are determined by the degree of spatial arbitrage.

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