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On the Concentration of Urbanization and Economic Efficiency

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This paper is a product of the continuing research of the Economics of Urbanization Division on the relationship between urbanization and the national economy. In this paper the economic efficiency of large cities as opposed to medium-sized and smaller cities is examined in the context of developing countries as well as developed countries.

Economics of Urbanization Division
Prepared by: Koichi Mera
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ON THE CONCENTRATION OF URBANIZATION
AND ECONOMIC EFFICIENCY

Introduction

1. It is often argued that today's large metropolitan areas have exceeded the "optimal" size and, therefore, development efforts should be directed toward smaller urban centers. This argument is frequently based on the proposition that the economic return from investment, either private, public, or both, in large metropolitan areas is less than that in medium and small-size urban centers. The purposes of this paper are (1) to demonstrate that this proposition cannot be supported by any available empirical analysis and that in terms of economic efficiency even the largest metropolitan area in the world is likely to be less than the "optimal" size and (2) to point out that there is a legitimate objective for pursuing a decentralization policy for urbanization, i.e., inter-regional equity, whereas in practice a decentralization policy is frequently proposed and undertaken for economic efficiency, an objective which this policy seems to affect adversely rather than favorably.

2. Many writers have observed that the currently large metropolitan areas already have excessive population concentration. However, their assertions are rarely consistent with economic efficiency criterion in the sense of increasing a country's total income. If they are made on the economic ground, they are not based on a systematic quantitative analysis but on either visual impressions or partial quantitative data. Only recently, sufficient quantitative data have become available to make a fairly strong judgment on the hypothesis
of diseconomies of concentration. In the following discussion, empirical analyses related to this question are surveyed and additional materials presented.

3. Different areal units are used for analysis, i.e. regions, states or prefectures, counties, metropolitan areas and cities and towns. However, the intention of the paper is to measure the impact of urban agglomeration. Urban agglomeration is defined to be a contiguous area in which every part is functionally interrelated to other parts within the area usually through commuting and trade. Such an area is usually known as a metropolitan area.

The reason for using non-metropolitan data is that metropolitan data are not so readily available as those for governmentally defined units. Therefore, in interpreting analysis with non-metropolitan data, the relationship between the obtained result and the expected result from metropolitan data must be considered carefully.

Interregional Income Disparity as Observed

4. It has long been observed that the per capita income of different regions differs greatly and that the difference is related to the degree of urbanization. For example, in the United States the per capita income of predominantly urban Connecticut is slightly more than twice that of rural Mississippi,\(^1\) and in Japan the per capita product of Tokyo Prefecture is

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\(^1\) The percent of urban population in Connecticut and Mississippi was 78.3 and 37.7, respectively, in 1960 according to the U.S. Census definition of urban population. The stated income differential holds true throughout the 1950's and 60's. Income here refers to personal income.

about two and a half times that of rural Kagoshima Prefecture. Similar relationships are observed in less developed countries. In Brazil, the per capita income of the South is three times that of the Northeast. If we take states as units of observation, urban Sao Paulo has a per capita income six times greater than that of rural Piaui. In India, West Bengal and Maharashtra States which contain the two largest urban concentrations, Calcutta and Bombay, have a per capita net domestic product about 40 percent higher than the national average.

5. Since the empirical income data overwhelmingly associate the level of per capita income with the degree of urbanization, arguments for the diseconomy hypothesis are made on one of two grounds: (1) social overhead cost is sufficiently higher in highly urbanized areas to cancel the gross income advantage, or (2) income per capita shows only average productivity; if marginal productivity is considered it will be less in large metropolitan areas.

Empirical Analysis: Social Overhead Cost

6. The term social overhead cost (SOC) is used to describe those costs of services which the public sector provides. To compare the SOC in communities

1/ The stated per capita product differential holds true for all recent years although the differential has been narrowing recently. If total received income is considered, the differential is greater. Product here refers to income produced within the area. Source: Japan Economic Planning Agency (15).

2/ The figures are from Robock (21), p. 36.

3/ The figures are computed from population data in (13) and state NDP data in (20). Per capita product figures are used for India because the received income reflects the regional distribution of capital ownership which, particularly in India, cannot be considered as representing the productivity of different regions.
of different size, differentials in the scope of the public sector, the quality of services provided and in the prices and wages must be considered. The scope of the public sector varies from community to community and has a great deal to do with the size of the community. For example, in a small town or rural area, fresh water is supplied either entirely from a private well or largely privately by carrying from a public source of supply in the neighborhood, whereas in a large city it is usually supplied by the public sector to individual houses. Mass transport service can be operated by the public or private sector. Schools are in the hands of the public sector to a varying degree. In measuring the social overhead cost per capita the discrepancies due to differentials in the scope of the public sector must be eliminated.

7. The more difficult question is the quality differential. The quality of public services provided is determined to a large extent by the political process within the local government. The demand for public services is related to the ability of the residents to pay and their taste. The quality of public education is known to vary among communities in a number of countries. However, for a number of public services, the measurement of quality is difficult. Consequently, analysts usually use the actual cost incurred for varying levels of service without specifically considering quality differences.

8. The price and wage differentials are commonly thought to make a fair comparison difficult. By using the usual price index in different localities, the cost differential attributable to the price differential can be identified. However, in a country where a free market economy prevails, interregional or
or intercity price differentials contain meanings which should not be eliminated in a comparison. The price of an apple of specified quality may be higher in a large city because the rent and wage the retailer has to pay are higher and also because people are willing to pay a higher price for it. At the same time, such a high cost city is not isolated from the rest of the economy. It sells goods and services in exchange for imports. Therefore, a high price index is not an accident but a sustainable property of certain cities. A higher price for a certain good at a specific location implies a relatively higher value of the good at the specific location. The same argument holds for wages. Therefore, the price differentials need not be adjusted in order to compare the SOC.

9. A number of studies have been done in the U.S. on this issue. Earlier studies tended to concentrate on specific areas.\(^1\) Since the publication of the 1957 Census of Local Government finance (31), the scope of study has expanded to the national scale.\(^2\) On the basis of some 3,000 counties which constitute the initial 48 states of the U.S., Schmandt and Stephens (24) found that total local government expenditure per capita within a county shows a U-shaped curve with respect to the population size of the county, having its bottom at $120 in the population range of 15,000 to 50,000. The largest per capita expenditure was observed for counties of one million or over and was about $80 higher than the least. The increasing expenditure per capita was observed as the population size increased from 50,000 for most functions

\(^1\) See Scott and Feder (25), Bollens (3), Sacks and Hellmuth (22) and Wood (34) for specific areas and with a national scope.

\(^2\) Shapiro (26), Schmandt and Stephens (24), Grabler (7) and Brager (4).
except "roads". The relative difference was phenomenal for "police", "fire", "sewerage and sanitation" and "parks".\textsuperscript{1} However, median family income is correlated to per capita expenditure to a higher degree. It was also found that the state aid is highly correlated to expenditures in selected functions such as "welfare", "highways" and "education". They concluded that the evidence supported the proposition "that wealth or resources (measured in terms of median family income and state aid) is far more important than population size or density in explaining variations in total per capita expenditures among local units."\textsuperscript{2} This conclusion is not unique; it confirms earlier studies which tend to show that the expenditure per capita is not very much related to the population size when the expenditure is one way or another adjusted for quality differences.\textsuperscript{3}

10. Although the aggregate local government expenditure per capita rises after county size reaches a certain level, per capita income rises about four times faster than the per capita local government expenditure for the same range,\textsuperscript{4} implying a marginal propensity to consume public services of some 25%. Even if the public sector services are assumed to satisfy fixed needs and, therefore, have no variation in service quality, as Alonso puts it, the

\begin{itemize}
\item The education expenditure is the largest component for all size counties (37% to 53%) while the sum of expenditures for police, fire, sewerage and sanitation, and parks ranges from 3.6% to 21.4% of the total expenditure.
\item Examining statistically the per capita expenditure for different functions of local governments without taking into account quality differences of services but using the family income or other resource variables as explanatory variables, Brager (1), Scott and Feder (2), Hirsch (11), Sacks and Hellmuth (22) found little evidence to scale economies in many of the public services. However, Schmandt and Stephens (23), considering explicitly the output of public services, found a distinct possibility that economies of scale exist for some municipal functions such as police protection, general government, education, and garbage and refuse collection and disposal.
\item Alonso (1), p. 12.
\end{itemize}
optimal size "is far likelier to depend on the productivity-per-capita
function than on the cost-per-capita function." 1

11. The case of Japan presents a similar situation, but supports more
strongly Alonso's hypothesis. In Table 1, the combined per capita expenditures
(including investment expenditures) of prefectural and sub-prefectural govern-
ments for all 46 prefectures are grouped by the population density of the pre-
fecture. Population density for the entire prefecture is used here as an in-
dication of metropolitan population concentration.

Table 1: LOCAL GOVERNMENT EXPENDITURE AND INCOME PER CAPITA AS
RELATED TO POPULATION DENSITY IN JAPAN IN 1965

<table>
<thead>
<tr>
<th>Population Density (persons per sq. km)</th>
<th>No. of Prefectures</th>
<th>Mean Per Capita Gov't. Expenditure (1000 yen)</th>
<th>Mean Per Capita Income (1000 yen)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 200</td>
<td>17</td>
<td>50.8</td>
<td>188.0</td>
</tr>
<tr>
<td>200 - 300</td>
<td>15</td>
<td>46.7</td>
<td>197.6</td>
</tr>
<tr>
<td>300 - 600</td>
<td>8</td>
<td>43.2</td>
<td>209.1</td>
</tr>
<tr>
<td>600 - 1000</td>
<td>3</td>
<td>41.9</td>
<td>228.0</td>
</tr>
<tr>
<td>1000 - 3000</td>
<td>1</td>
<td>53.7</td>
<td>280.0</td>
</tr>
<tr>
<td>3000 or greater</td>
<td>2</td>
<td>56.1</td>
<td>340.0</td>
</tr>
</tbody>
</table>

Source: Japan Economic Planning Agency (15)

The per capita government expenditure shows a U-shaped curve as in the U.S. The
higher expenditures in less densely populated prefectures seem to reflect the
national government's greater assistance to those less developed regions as
well as diseconomies of dispersion. The investment side of the issue is dis-
cussed in the following paragraph. The prefectures in the least expenditure
class are much more urban in Japan than the countries in the U.S. Of the three

1/ Alonso (1), p. 4.
prefectures in this class one is within commuting distance from Tokyo; one has two large cities, one above and the other below the one million mark; and the other has one two million city. In addition the per capita expenditure differential is much less in Japan. The highest is only 34% greater than the lowest in Japan, the corresponding difference in the U.S. is 67% (see Paragraph 9). This seems to reflect a greater uniformity of service in Japan through effective control by the national government. Therefore, the expenditure decision depends less on the willingness of the residents to pay. Consequently, the Japanese data is considered to reflect the quality-adjusted cost curve more closely. The two most densely populated prefectures are those of Tokyo and Osaka. Their higher per capita expenditures may reflect in part the need of multi-million metropolitan areas. However, they also reflect their role as national and international centers and to some extent the greater willingness of the residents to pay for public services. If we interpret the increase in the per capita expenditure from the least to the highest level as entirely a result of the difference in the income level, the marginal propensity to consume public services turns out to be 13%, much less than that found for the U.S. 12. The social overhead capital stock (SOCS) in all prefectures was recently estimated by the Economic Planning Agency of Japan (17). Table 2 shows per capita SOCS and also the per capita government capital expenditure during 1966 for all levels of government including the national government.
Table 2: SOCIAL OVERHEAD CAPITAL STOCK AND GOVERNMENT INVESTMENT EXPENDITURE PER CAPITA AS RELATED TO POPULATION DENSITY IN JAPAN

<table>
<thead>
<tr>
<th>Population Density (persons per sq. km)</th>
<th>No. of Prefectures</th>
<th>Mean Per Capita SOCS in 1963 (1000 yens)</th>
<th>Mean Per Capita All Gov't. Investment Expenditure in 1966 (1000 yens)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Less than 200</td>
<td>17</td>
<td>268.5</td>
<td>32.8</td>
</tr>
<tr>
<td>200 - 300</td>
<td>15</td>
<td>244.8</td>
<td>27.3</td>
</tr>
<tr>
<td>300 - 600</td>
<td>8</td>
<td>206.4</td>
<td>27.6</td>
</tr>
<tr>
<td>600 - 1000</td>
<td>3</td>
<td>205.3</td>
<td>27.5</td>
</tr>
<tr>
<td>1000 - 3000</td>
<td>1</td>
<td>178.4</td>
<td>40.5</td>
</tr>
<tr>
<td>3000 or greater</td>
<td>2</td>
<td>188.0</td>
<td>39.4</td>
</tr>
</tbody>
</table>

Note: 1960 population was used to derive per capita SOCS in 1963.

Source: Japan Economic Planning Agency (17) for SOCS by prefectures. Japan Economic Planning Agency (15) for all government capital outlay by prefectures.

In terms of the stock of social overhead capital, there are substantial economies of higher density. The least stock per capita is observed in the second highest density class. However, it is based on the observation of one prefecture, Kanagawa, which is directly south of Tokyo and, presumably, is enjoying external economies from Tokyo. In terms of the per capita capital outlay, high density prefectures show higher values but they are principal receivers of interprefectural migration. Kanagawa Prefecture with the highest per capita outlay had a 2.8% increase of population due to migration alone during 1960.\(^\dagger\) Therefore, the figures for capital outlay do not contradict

\(^\dagger\) Japan Economic Planning Agency (15).
the economies of concentration hypothesis. The Japanese case reinforces the argument that the "optimal" size is more likely to be determined by the productivity-per-capita basis rather than the cost-per-capita basis.

For India, Bhatia (2) reports that the cost of public utilities per worker was Rs 210 in Bombay State and Rs 30 in Orissa and Rajasthan States in 1956-57. Since the labor participation ratio was higher in Bombay than in Orissa or Rajasthan, the per capita cost differential is greater than these numbers indicate. In view of the better access and availability of public utilities in urban areas, the cost difference is not surprising. For example, the number of telephones per capita in Greater Bombay is nine times greater than the national average and the number of hospital beds per 1000 persons in 1968 was .787 in Maharashtra (into which the State of Bombay merged), .362 in Orissa and .515 in Rajasthan. A study by Stanford Research Institute (26) found through empirical research on India's urban centers that when the quality of services is held constant the infrastructure cost per capita declines rapidly as the size of the city increases to 130,000 population and thereafter remains relatively constant though it declines slightly to the largest observed city of one million population.

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1/ The number in Greater Bombay refers to 1964 and the national average to 1965/66. Source for Greater Bombay is (8) and that for India (13). Greater Bombay is a municipal corporation which includes the old city of Bombay and had a population of 4.9 million in 1967.

2/ Source: India Finance Commission (12).
Examining urbanization in India, Harris (9) states:

"The reliability of power and communication services, the accessibility of cultural and educational facilities, the resourcefulness of local service technicians, the passability of the roads, and the work outlook of the labor force tend to fall off with movement down the scale of size and outward from the metropolitan center. As between independent cities of different sizes, those under a present population of 200,000 tend to be unable to supply so many of the desirable features of an environment which stimulates manufacturing growth that they cannot at present be seriously considered as potential growth centers. Where cities are satellite to and partially dependent upon a larger metropolitan center, this lack of facilities may be partially overcome from that center, and an industrial-growth environment may be established in centers of 50,000 people or less or in relatively new townships, such as Modinagar. The viability of industrial growth is, thus, directly correlated with the size of the city or with the size of an adjacent metropolitan center, inversely correlated with the distance from a large center, and positively correlated with the size and self-contained character of the industrial establishment." (p. 268)

The above statement is supported by income data. The per worker product in the Bombay area is greater than that in other areas by more than the difference in the per worker cost. The per worker product of Maharashtra for the same year was Rs 850, whereas that for Orissa and Rajasthan was Rs 570 and Rs 580, respectively.1/ Although data for less developed countries are not abundant, it is highly likely that the cost hypothesis cannot be supported for other developing countries as well.

Empirical Analysis: Marginal Productivity

The other hypothesis is that the marginal productivity of an input declines after the urban size reaches a certain scale and that the current large metropolitan areas have already reached this critical scale. A

1/ Derived from (13) and (20).
significant contribution to this hypothesis was recently made by Fuchs (5). Using the one-in-thousand U.S. census sample of 1959, he divided the labor force by sex, color, age and education. He still found significant regional differences in the hourly wage rate which could not be attributed to the differences in the labor composition. For example, the actual hourly earnings of white and nonwhite workers in the South were respectively about 10 and 20 percent below the rates which would be expected from the composition of the labor force, classified by the four criteria, in the region. He proceeded to relate the hourly wage rate for each type of labor with the size of the city in which the worker resided. Clearly beyond the one million mark there was a rising relationship between the hourly wage rate and the size of city population. Actual hourly earnings were compared with the expected hourly earnings by city size. They are shown in Table 3.

16. In order to interpret the results he tested the hypothesis that the higher earnings in the large cities might be attributed to unionization or size of employer, but the regression analysis rejected both. As to the cost of living differences, although the present author rejects the appropriateness of the concept itself, he states that "intercity differences in cost of living appear to be small relative to differences in hourly earnings." Then, he states "one of the most promising hypotheses to explain the city-size differential is that it reflects differences in labor quality not captured by standardization for color, age, sex and education. This might take the form of better-quality schooling, more on-the-job training, selective immigration to the big cities of more ambitious and hard-working persons, or other forms." Irrespective of
these reasons, since the wage rate is likely to be highly correlated positively with the marginal productivity of labor, it can be stated fairly confidently that the marginal productivity of labor increases as the size of the urban center increases throughout the observed range.

Table 3: RATIO OF ACTUAL TO "EXPECTED" HOURLY EARNINGS, BY CITY SIZE, 1959

<table>
<thead>
<tr>
<th></th>
<th>Urban Places</th>
<th>Standard Metropolitan Statistical Areas</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Rural 10,000</td>
<td>Under 10,000-99,999</td>
</tr>
<tr>
<td>White males</td>
<td>.83</td>
<td>.84</td>
</tr>
<tr>
<td>White females</td>
<td>.83</td>
<td>.84</td>
</tr>
<tr>
<td>Nonwhite males</td>
<td>.78</td>
<td>.75</td>
</tr>
<tr>
<td>Nonwhite females</td>
<td>.76</td>
<td>.63</td>
</tr>
</tbody>
</table>

Note: "Expected" hourly earnings were obtained by multiplying the national average hourly earnings of each color, age, sex and education by the annual hours worked by members of that cell in the region, summing across all cells in the region and dividing by the total manhours of the region.

Source: Fuchs (5)

17. It is possible to interpret the result of the Fuchs' study that the labor force in large cities is more productive not because a large city offers a highly productive environment but because a large city attracts high quality workers and that the supply of high quality workers is independent of the size
distribution of cities. If this hypothesis holds, a policy that discourages the growth of large cities does not reduce the supply of high quality workers. This hypothesis may be plausible. However, it would seem more plausible to theorize that potential high quality workers are given opportunities for greater development in large cities than in small cities because of the diverse opportunities and severe competition that are only available in large cities.

18. Another significant contribution was made by the Economic Research Institute of the Japan Economic Planning Agency (16). An elaborate multi-regional econometric model was constructed from regional data for 1954 to 1962 by dividing the country into 9 regions. The model which consists of 57 equations, contains such important functions as interregional migration, employment, production and income generation, flow of commodities, and private and government investment. The supply of social overhead capital, the intergovernmental transfer of government funds and interregional transfer of industrial capital are considered as the key government policy variables. Several alternative policies in regard to centralization/decentralization were tried and the 1970 economy was predicted. In general it was found that an increase of GNP is associated with an increase of interregional disparity of income. Specifically the following findings were obtained:

(a) The most effective policy for reducing interregional disparity of income has been the increased distribution of industrial capital to less developed regions. But, interregional equity is achieved at a cost to GNP. Specifically, in comparison to the "neutral" projection (based on the extrapolation of current
policies), the coefficient of variation (c.v.) of per capita incomes of regions is reduced from 0.212 to 0.145, but GNP is reduced by 4.1 percent.

(b) On the other hand, further centralization of industrial capital increases the GNP almost one percent above the neutral level, but the coefficient of variation increases to 0.229.

(c) Intergovernmental transfer of funds is an effective tool for changing the distribution of per capita incomes without affecting much the aggregate efficiency of the economy. Without appreciably changing GNP, it has been demonstrated that the c.v. can be reduced to 0.204 with a decentralization policy, and increased to 0.225 with a centralization policy.

(d) Interregional transport investment tends to produce desirable results on both accounts. Under a policy of improving the accessibility of the less developed regions to the developed regions, GNP is predicted to increase one percent over the neutral level with a c.v. of 0.202, and with a general improvement of accessibility roughly in proportion to the current pattern, the GNP is predicted to increase two percent over the neutral level with a c.v. of 0.205. However, in these cases population migration is accelerated and the predicted distribution of population is quite similar to that obtained with other centralization policies. ¹/

¹/ The higher returns of transport investment seem to reflect the particular economic conditions of Japan, and may not be applicable to many other countries.
Related research for Japanese regions, using the same regional data collected and used for (16), as well as prefectural data has also been done by the present author (19). To examine the effect of urbanization or concentration of activities on productivity, the analysis uses spatial density variables, i.e., both the output and the three kinds of inputs (labor, private capital and social overhead capital) are measured in terms of per square kilometer for the geographical unit considered. Relevant conclusions are:

(a) By estimating production functions for the three major sectors (primary, secondary and tertiary) from the regional data, it was found that there are diseconomies of concentration in primary sector production but economies of concentration in the secondary and tertiary sectors.

(b) For the 46 prefectures clear relationships were observed between social overhead capital and labor and private capital inputs. The density of either of the two private inputs is very much related to the density of social overhead capital.¹/²

¹/ The best estimated equations are

\[
e = 1.9496 g + 0.000634 g^2 \\
(28.22) (7.20)
\]

\[
k = 27.29 + .000883 g^2 \\
(7.80) (38.88)
\]

where \( e \) is the number of workers in thousands per square kilometer, \( k \) is the value of private capital per square kilometer in thousand yen, and \( g \) is the value of social overhead capital per square kilometer in thousand yen, and all data used refer to 1963; and the number in parentheses in the t-value of the respective estimated value. From the above equations we obtain

\[
\frac{dg}{de} = \frac{1}{1.9496 + .00126 g}
\]

\[
\frac{dg}{dk} = \frac{1}{.001766 g}
\]

Thus, the marginal requirement of SOCS diminishes, for both labor and capital, as the density of SOCS increases.
(c) For the same prefectural data, it was also found that both the wage rate and return to private capital are higher in areas of higher social overhead capital density.\textsuperscript{1/}

(d) Consequently, the higher per capita income in high density areas can be explained by both savings in social overhead capital cost and increased efficiency of inputs.

(e) Therefore, policies to develop less developed regions tend to reduce the economies of concentration. If per capita income in the three sectors were to be equalized for the nine regions by a hypothetical instantaneous redistribution of social overhead capital where the distribution of labor and private capital

\textsuperscript{1/} The estimated equations are

\begin{align*}
w &= 28013 + 11.8684 g \\
    &= 26827 + 31.8495 g - 0.0230 g^2 \\
    &= -0.001185 + 0.0000012 g \\
    &= -0.0002481 + 0.0000034 g - 0.000000003 g^2
\end{align*}

\begin{align*}
R^2 &= 0.3693 \\
R^2 &= 0.4386 \\
R^2 &= 0.5887 \\
R^2 &= 0.7218
\end{align*}

where \( w \) is the wage rate per month in thousand yen, \( r \) is the annual rate of return from private capital; and the number in parentheses is the t-value of the respective estimated value.

The two quadratic regression equations suggest the existence of diseconomies of concentration beyond a certain level. In the case of the wage rate, the "optimal" density is exceeded only by Tokyo. However, the fact is that the wage rate is highest in Tokyo. Therefore, the derived "optimal" density should be considered to be biased downward by the specification of the estimating equation. In the case of the return to private capital, the three most densely populated regions have similar rates which are substantially higher than others. Therefore, the exact "optimal" density derived from the estimated equation does not have much meaning.
remain the same, it is estimated that national income would drop about 30 percent.

(f) On the other hand when labor and private capital respond to the redistribution of social overhead capital, the cost of national income for achieving equality of per capita incomes is less. Such an experiment for 46 prefectures gave a drop of national income of about 15 percent from the current observed level.

20. The findings in Fuchs (5), the Japan Economic Planning Agency (16) and Mera (19) all indicate that on the whole large urban centers are more productive than smaller ones. Since the average productivity is found to be higher in larger urban centers, there is no reason to believe that the marginal productivity in large metropolitan areas is less than that in smaller urban centers.

Empirical Analysis: Developing Countries

21. The empirical analyses presented above are derived primarily from observations in the developed countries. There are good reasons to believe that situations are different in the less developed countries. Below, some research findings are presented, all of which tend to reaffirm the results derived for developed countries.

22. An early result of the on-going study by Fukuchi (6) indicates that in Brazil there is a large technological gap between the developed and under-developed regions. The technological gap is shown by comparing output per worker in different regions while capital per worker is held constant. For example, the technological efficiency of the South is approximately twice as large as that in the Northeast.

1/ The traditional location theory is still relevant. Some industries such as resource-oriented industries are not necessarily attracted by large cities.
23. Williamson (33) contributed to this question by examining regional disparities of income with respect to the degree of economic development. His findings can be summarized as follows: (1) from international cross-section data it was found that the degree of regional inequality increases as the degree of development increases until the level of Kuznet's middle income class is reached, which includes Italy, Spain, Brazil and Colombia, and thereafter it declines and (2) from time-series data of several countries it was found that "increasing regional inequality is generated during the early development stages, while mature growth has produced regional convergence or a reduction in differentials." Although the study does not explicitly deal with urban concentrations, from the association of urban concentration with higher income levels it can be interpreted that at least at the early stage of development, urban concentration seems to be a necessary condition for economic development.\(^1\)

24. Another relevant study is El Shaks' which is cited by Alonso (1). "El Shaks finds that a cross-section of the world's nations results in a near-normal curve of primacy on economic development.\(^2\) That is to say, primacy is rare in very underdeveloped countries, rises during the take-off stage, and

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\(^1\) From this study one cannot derive the conclusion that urban concentration is less in high income countries because the reduction of regional disparity at this stage is caused largely by a growing scarcity of labor in underdeveloped regions due to increasing employment opportunities in the modern sector and the increased mobility of labor. See paragraph 25 on this point.

\(^2\) "Primacy" is used here to imply the degree of concentration of urban population.
decreases thereafter. His time-series studies of developed countries also support this view, although not as neatly as the cross-section data." This study reinforces the interpretation derived from the Williamson study; urban concentration is a necessary condition for economic development in an early stage. The relative advantage of urban concentration is greater in less developed countries than in developed countries. However, this statement should not be taken as implying that the advantage of urban concentration disappears once a country reaches a certain stage of development. The findings for the U.S. and Japan show that there are still observable advantages in concentration.

25. It has been demonstrated convincingly by Sovani (27) and Kamerschen (18) that industrialization and urbanization are highly correlated particularly in early stages of economic development. However, the relationship which existed in the currently developed countries during the late 19th century differs from that which exists now in the currently developing countries. Kamerschen goes further to relate urban concentration with the level of economic development. The population of the largest city as a percentage of the total population of the four largest cities in a country was used to measure urban concentration and per capita GNP was used to measure economic development. Using cross-section data for 80 countries during the 1955-56 period, he found that for developed countries urban concentration was negatively correlated with the level of development, but for developing countries it was positively correlated with the coefficient of correlation of .10. The correlation is not impressive, but this analysis fails to explore the dynamic relationship between the urban concentration and economic development. The issue is whether or not
further urban concentration is conducive to economic development for each country. To determine this relationship from a simple cross-section analysis requires the rather strong assumption that every country follows a more or less similar path of urban concentration in the process of economic development. The degree of urban concentration crucially depends on the structure of the economy and on the size of the country. In addition, it depends on the jurisdictional boundary of the cities.

26. In order to examine the relationship between urban concentration and economic development without being affected much by inter-country differences in the structure of the economy and the political unit of cities, the present author conducted an analysis relating the growth rate of a country to the difference in its urban concentration over time. The degree of urban concentration, primacy, was measured by the share of the cities considered in the country population. The change in the share, \( \Delta p \), was computed for a recent seven-year period for all less developed countries for which reliable data were available.\(^{1/}\) If urban concentration of population increases efficiency, those countries which showed a large positive change in the primacy should have increased national product more than those which

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\(^{1/}\) Population figures for cities were taken from the U.N. Demographic Yearbook (30). Those countries which did not have population figures at two different dates for the largest city or largest three cities, whichever the case may be, were excluded as were those for which figures were not sufficiently recent, apart from each other in time, meaningful or comparable. Specifically, in order to be acceptable, (1) city population figures for the initial year must be for 1955 or more recent and for the terminal year for 1960 or more recent, (2) there must be at least a four-year time span between the two dates for which city population data were available, (3) any estimate must have at least two digits which are meaningful and sufficiently reliable and (4) however the city population is defined, for city proper or for the urban agglomeration, the population figures for any single city at two observation dates must refer to the same geographical area. Whenever data were available for both city proper and agglomeration for an urban center at two observation dates, the figures for agglomeration were used.
did not, other things being equal. Therefore, the hypothesis is that the
growth rate of per capita GDP is positively related to the change in
primacy. In Table 4, countries are grouped by the change in the primacy
measured by the population share of the largest city, $\Delta p_1$, for countries
which had populations over one million in 1960. $^1$ The median growth rate
of per capita GDP is shown for each group. The table supports the hypo-
thesis. Specifically, those countries for which the change in primacy is
less than 1.0 in general, had a substantially lower growth rate of GDP per
capita than that of any other group. The group of countries for which the
change in primacy is more than 4 percentage points has a growth rate of GDP
per capita markedly higher than that for any other group. Excluding the
exceptional case of Libya which is growing at a phenomenal rate since a
recent discovery of oil deposits, the GDP per capita growth rate, $r$, was
regressed on the change of the largest city primacy for the remaining 46
countries:

$$r = 1.763 + .411 \Delta p_1 \quad R = .297$$

$$(4.388) \quad (2.064)$$

The number in the parentheses is the t-value for the estimate directly
above. The coefficient of $\Delta p_1$ is positive at the 2.5% level of significance.

$^1$ The exclusion of small countries is to eliminate the impact of extreme
volatility which primacy in these countries may exhibit.
Table 4: PER CAPITA GDP GROWTH RATE FOR COUNTRIES GROUPED BY THE CHANGE IN THE PRIMACY OF THE LARGEST CITY

<table>
<thead>
<tr>
<th>Group I</th>
<th>Group II</th>
<th>Group III</th>
</tr>
</thead>
<tbody>
<tr>
<td>Algeria</td>
<td>-3.5</td>
<td>Madagascar</td>
</tr>
<tr>
<td>Morocco</td>
<td>0.3</td>
<td>Burundi</td>
</tr>
<tr>
<td>India</td>
<td>0.9</td>
<td>Sudan</td>
</tr>
<tr>
<td>Cambodia</td>
<td>1.1</td>
<td>Cameroon</td>
</tr>
<tr>
<td>Ceylon</td>
<td>1.3</td>
<td>Indonesia</td>
</tr>
<tr>
<td>Iraq</td>
<td>1.9</td>
<td>Philippines</td>
</tr>
<tr>
<td>Mexico</td>
<td>2.8</td>
<td>Kenya</td>
</tr>
<tr>
<td>Portugal</td>
<td>5.1</td>
<td>Nigeria</td>
</tr>
<tr>
<td>Libya</td>
<td>21.4</td>
<td>Venezuela</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Peru</td>
<td>2.9</td>
<td>Colombia</td>
</tr>
<tr>
<td>Spain</td>
<td>6.9</td>
<td>Costa Rica</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Taiwan</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
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<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Median 1.3</td>
<td>1.1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Group IV</th>
<th>Group V</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dominican Rep.</td>
<td>-0.7</td>
</tr>
<tr>
<td>Ghana</td>
<td>-0.1</td>
</tr>
<tr>
<td>Colombia</td>
<td>1.5</td>
</tr>
<tr>
<td>Costa Rica</td>
<td>1.7</td>
</tr>
<tr>
<td>Jamaica</td>
<td>1.7</td>
</tr>
<tr>
<td>Guatemala</td>
<td>1.9</td>
</tr>
<tr>
<td>Chile</td>
<td>2.3</td>
</tr>
<tr>
<td>Ireland</td>
<td>3.1</td>
</tr>
<tr>
<td>Nicaragua</td>
<td>4.1</td>
</tr>
<tr>
<td>Iran</td>
<td>4.8</td>
</tr>
<tr>
<td>Ivory Coast</td>
<td>5.4</td>
</tr>
<tr>
<td></td>
<td>Median 1.9</td>
</tr>
</tbody>
</table>

Note: The countries are grouped by the change in the primacy of the largest city, $\Delta p_1$, according to the following rule:

- Group I, $\Delta p_1 \leq 0.0$; Group IV, $2.0 \leq \Delta p_1 \leq 4.0$;
- Group II, $0.0 < \Delta p_1 \leq 1.0$; Group V, $4.0 < \Delta p_1$;
- Group III, $1.0 < \Delta p_1 \leq 2.0$;

Where $\Delta p_1$ stands for the change in population share of the largest city in percentage points during a recent seven-year period.
27. In order to eliminate further the volatile impacts expected of smaller countries, the same regression equation was estimated for the countries which had a population of 10 million or over in 1960. 19 countries were observed, and the result was:

\[ r = 1.305 + 0.859 \Delta p_1 \quad R = 0.503 \]

The correlation coefficient was higher and the coefficient of \( \Delta p_1 \) was greater than for the larger sample. Therefore, the hypothesis is supported more strongly for larger countries which are affected less by "accidental" developments. The result may also imply that primacy of larger cities is more conducive to economic development than primacy of smaller cities, as the largest city in a large country tends to be greater than the largest city in a small country.

28. In order to view urban concentration effects in a wider context, primacy was then measured by the share of the three largest cities in the country population. The change of this primacy index for the same seven-year period, \( \Delta p_{1-3} \), was used as the independent variable to explain the per capita GDP growth rate. Because of the increasing paucity of data, only 21 countries were observed. The result was:

\[ r = 1.422 + 0.600 \Delta p_{1-3} \quad R = 0.441 \]

The coefficient of \( \Delta p_{1-3} \) was positive at the 2.5 percent level of significance. However, the result was not significantly different from the one obtained in the preceding paragraph using the largest city alone.
29. In order to separate the impact of the growth of the second and third largest cities from that of the largest city upon the per capita GDP growth rate, two primacy indices were used next. One is the change in the primacy of the largest city, $\Delta p_1$, the other is the change in the primacy of the second and third largest cities together, i.e., $\Delta p_{2,3} = \Delta p_{1-3} - \Delta p_3$. For the same 21 countries the following was obtained:

$$r = 1.428 + .454\Delta p_1 + 1.229\Delta p_{2,3} \quad R = .487$$

$$(2.320) (1.281) (1.600)$$

and the matrix of correlation coefficients was:

<table>
<thead>
<tr>
<th></th>
<th>$r$</th>
<th>$\Delta p_1$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta p_1$</td>
<td>.358</td>
<td></td>
</tr>
<tr>
<td>$\Delta p_{2,3}$</td>
<td>.409</td>
<td>.252</td>
</tr>
</tbody>
</table>

The result implies that the change in the primacy of the second and third cities together is related slightly more to the per capita GDP growth rate. The estimated coefficient to it is significant at a higher level, but $\Delta p_1$ and $\Delta p_{2,3}$ are also positively correlated. Given the t-values and the mutual correlation among independent variables, the two impacts cannot be separated from this sample.

1/ Both the mean and the standard deviation are much less for $\Delta p_{2,3}$ than for $\Delta p_1$:

<table>
<thead>
<tr>
<th></th>
<th>Mean</th>
<th>Standard Deviation</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\Delta p_1$</td>
<td>1.100</td>
<td>1.1413</td>
</tr>
<tr>
<td>$\Delta p_{2,3}$</td>
<td>.269</td>
<td>.653</td>
</tr>
</tbody>
</table>
The change in the primacy may be biased by the particular political boundary used for measuring city population. The actual metropolitan population may be increasing, but a large portion of the increment may be housed outside of the city boundary. The population of the central city may even be declining when the metropolitan population is increasing. Such internal shifts of population distribution within a metropolitan area are well documented for the U.S. urban centers. They are generally true for urban centers in other countries, too. In previous regression analyses, measurement of the change in primacy was based on urban agglomeration where these data were available. However, in many cases measurement was based on politically defined city data. The use of the city population as opposed to agglomeration population must have biased the result of our analysis by lessening the relationship between urban concentration and per capita growth.\footnote{This distinction is important. For example the population of Mexico City in 1960 is reported to be 2.8 million in (30) on the city basis, but according to another U.N. publication (29), is estimated to be close to 5 million on the agglomeration basis in 1960 and is one of the fastest growing urban centers. If $\Delta p_1$ for Mexico had been measured on the agglomeration basis, Mexico would not have been placed in Group I in Table 1.} The bias seems to be greater for the change in the primacy index of the largest city than for that of the second and third largest cities. To obtain a more accurate estimate of the relationship between the change in primacy and the per capita GDP growth rate, only those countries for which the agglomeration population for the largest urban center was given in (30) were chosen for further analysis. 19 countries were qualified and the estimated question was

\[ r = 1.271 + 0.678 \Delta p_1 \]

\[ (1.926) \quad (2.283) \]

\[ R = 0.484 \]
The result is comparable to, though slightly better than, that obtained with $\Delta p_{1-3}$. This confirms the hypothesis that, if the agglomeration population is used for measuring the change in primacy, the association between the per capita GDP growth rate and urban concentration is stronger than that found in preceding paragraphs. Also, the lesser correlation coefficient obtained for $\Delta p_1$ with $r$ than for $\Delta p_{2,3}$ with $r$ may be largely a result of the greater disparity between the two different methods of population measurement in the change of primacy for the largest city.

The foregoing analysis confirms the results of earlier studies which tend to support positive correlation between urban concentration and economic development in developing countries.

Conclusions

It has been observed that the per capita cost of government expenditure for public services is least for cities having a population under several millions. However, higher expenditures in large cities are attributable more to the greater willingness of large city residents to pay for public services than to diseconomies of large scale. In addition the difference in income greatly exceeds the difference in cost. Therefore, if there is any optimal size, it is likely to be determined more by productivity than by cost.

The available empirical analyses presented above show that large cities are more productive and that the largest cities are likely to be particularly more productive relative to others in a less developed country. Therefore, a decentralization policy of investment and population distribution over the country cannot be encouraged, particularly for less developed countries,
if the national goal is to maximize the growth rate of national product.  
34. However, it is known that urbanization generally increases per capita income of the areas affected. Therefore, if the national goal is to achieve a more equitable distribution of income over different regions, even at some sacrifice to the GNP growth rate, then a policy directed toward the development of underdeveloped regions can be justified.  
35. In sum, a decentralization policy may be effective for achieving a more equitable distribution of income over different regions, but is not likely to be a desirable policy for the aggregate efficiency of the economy for most underdeveloped countries.
REFERENCES


(28) Stanford Research Institute (Menlo Park, Calif.), School of Planning and Architecture (New Delhi) and Small Industry Extension Training Institute (Hyderabad, India), Costs of Urban Infrastructure for Industry as Related to City Size in Developing Countries: India Case Study, 1968.


