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ELECTRIFICATION AND REGIONAL ECONOMIC DEVELOPMENT IN THE PHILIPPINES

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I. INTRODUCTION

The possibility that infrastructure investment may lead to changes in the pattern of regional income has long intrigued policy planners and economists. While most of the research on the effect of infrastructure investment on national income has been conducted for developed countries, there is a growing interest in the role that it can have in developing countries. The focus of the research has been on two areas: (a) on the determinants of the investment,[1] and (b) on the resulting effect of the investment. The early works by Hirschman (1958) and Kindleberger (1965) suggest the beneficial effects that one would expect from increased levels of infrastructure such as the supply of electricity.[2]

The purpose of this paper is to empirically test for the positive effects of household electrification on the income levels in the Philippines. Initially we test the following hypothesis: differences in income levels among the provinces of the Philippines can be attributed to variations in the amount of electrification among the provinces. As a second step, we test the thesis suggested by Hansen (1965a, pp. 13-14) that the effect of electrification on income will

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1. See, for example, Glover and Simon (1975), Simon (1975) and Frederiksen (1981).

2. See also Looney and Frederiksen (1981).

be significantly different depending on the level of economic development of the recipient region.

As is true for most developing nations, the Philippine government has recognized the importance of infrastructure investment in its development programs:

> . . . The development of more infrastructure, particularly small-scale irrigation systems, minihydro projects, farm to market roads, bridges, school buildings, telecommunication systems, and other similar projects, will dramatically improve the distribution of economic opportunities, accessibility to rural areas, and marketability of products. By constructing the necessary infrastructure, private activity will become more profitable and efficient.[3]

As to electrification in particular, the Philippine government noted:

> The energy program will remain a priority area and will include the development of non-conventional sources like biomass, dendrothermal, minihydros, coco-diesel, and other sources. Transmission lines will be put up to link new and rich sources to existing grids. Demand management measures such as full-cost pricing and more efficient energy use through improved technology will be employed. . . . Infrastructure support will be geared toward the provision of power, electrification, irrigation, transport such as roads and ports and social infrastructure projects to achieve the most direct and profound impact on livelihood activities.[4]

As noted, in this paper, we are testing for the impact on provincial income. Unfortunately, as is the usual case, little empirical evidence exists to support the importance that governments place on infrastructure investment as an important policy instrument for successful economic development. This paper hopes to fill part of this gap by demonstrating the beneficial impact of infrastructure in the Philippines.

II. THE HANSEN THESIS

Hansen (1965a) has suggested two alternative approaches for the government to promote economic development. On the one hand, the government can start many interdependent projects simul-

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3. Republic of the Philippines. *Five-Year Philippine Development Plan, 1983-1987*, National Economic and Development Authority, Manila, May 1982, p. 5.

4. *Ibid.*, pp. 7-8.

taneously to attain balanced growth (p. 3). On the other hand, the government can aim for unbalanced growth – a few projects are started and "the key sectors would be determined by measuring the backward-linkage and forward-linkage effects in terms of input-output maxima" (p. 4). As Hirschman noted, development occurs:

> . . . with growth being communicated from the leading sectors of the economy to the followers, from one firm to another. . . . The advantage of this kind of . . . advance over "balanced growth" . . . is that it leaves considerable scope to *induced* investment decisions and therefore economizes our principal scarce resource, namely genuine decision-making.

The Philippine government has supported the latter approach.

> The private sector will continue to be the leading partner in national development, with the government setting the necessary direction and basic support. Direct involvement and control of the economy by the government will be minimized and will only be temporary. . . .Government involvement in certain economic activities will be phased out to give way to private initiative once their viability is ensured.[5]

In order to implement such a policy, Hansen separates infrastructure investment into two types: Economic Overhead Capital (EOC) and Social Overhead Capital (SOC). The former consists of such things as roads and other transportation systems, electricity and water supply, bridges, harbors, drainage and sewer systems, and irrigation systems. SOC, on the other hand, is meant to enhance human capital and is comprised of such things as education, public health facilities and the like, fire and police protection, and homes for the aged.

The appropriate investment (either EOC or SOC) will depend on the characteristics of the recipient region. Hansen identifies three broad categories of regions: congested, intermediate, and lagging. Congested regions are typically ". . . characterized by high concentrations of population, industrial and commercial activities, and public overhead capital" (Hansen 1965a, p. 5). In the case of the Philippines, it is obvious that Metro Manila is a typical congested region. Here, any marginal social benefits which might accrue from further investment are far less than the marginal social costs of pollution and congestion. Intermediate regions have an environ-

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5. Republic of the Philippines, *op. cit.*, pp. 8-9.

ment conducive to further expansion – well trained labor, cheap power and an abundance of raw materials, and a large supply of SOC. Lagging regions have little to offer to attract new industries. Standards of living are low and the only industrial or agricultural activity is either on a very small scale or declining. In this case, Hansen suggests the appropriate investment is in SOC.

III. REVIEW OF THE LITERATURE

Empirical work on the effect of infrastructure investment in a developing countries is scant. Most of the work in the area has been in identifying the determinants of the investment and not the resulting effects. In other words, the investment variable has been considered the dependent variable rather than the independent variable in most previous studies. An excellent summary of the work done so far on the effects of investment is contained in Haveman (1976). Much of the empirical work to date deals with the effects that roads have had on development, and this work has been summarized by Voigh and Witte (1981). These studies have been micro-oriented, however, and have tended to focus on the benefits to a particular village or region rather than to the country as a whole. Hansen (1965b) found that for the communities of East Flanders, Belgium, variations in *per capita* EOC expenditures were explained by differences in various growth factors such as changes in housing density.

In a test of the Hansen thesis for Mexico, Looney and Frederiksen (1982) examined the effect of nine different types of infrastructure investment on the income levels of the Mexican states for 1975. It was found that expenditures on EOC had a positive (and statistically) significant effect on income levels in the relatively well-developed states but no discernible effect on income levels in the poorer states. On the other hand, SOC expenditures had a significant effect on income levels of the relatively poorer states and no effect on income of the richer states. One of the drawbacks of this study was the sample size. Excluding the capital of Mexico City, which was assumed to be a congested region, the sample size was 31 states. Since Hansen offers no practical way to distinguish between intermediate and lagging regions, a cluster analysis was performed using the following variables: percent of population in urban areas, percent of population regularly consuming milk, value of sales per worker in industry, percent of work force that are non-laborers, percent of houses with electricity and piped water, and percent of population with 6 years or more of education. This procedure naturally aggravated the sample size problem since regression equations were estimated for each group identified by the cluster procedure.

In an attempt to generalize the results to other countries and to increase the sample size, Frederiksen and Looney (1982) tested for the impact of road building (EOC) on the income levels of the Philippine provinces. For the country as a whole, it was found that only when the road variable was specified as paved road density did the estimated coefficient become statistically significant. Breaking the provinces into two groups, the model was reestimated for each group. The results confirmed the Hansen thesis: paved road density was found to be statistically significant in explaining variations in income levels only in the intermediate group. The analysis further indicated that unpaved road density had little, if any, statistically discernible effect on income. This paper attempts to test the Hansen thesis for another infrastructure variable – electrification – in the Philippines.

IV. THE MODEL AND COUNTRY WIDE RESULTS

The production function employed to test for the effect of electrification on national income in the Philippines is as follows:

$$INC = f(POP, AREA, ELEC),$$

where INC is the provincial income level, POP the population, AREA the area, and ELEC is the percent of households with electricity.[6] The hypothesized rates of change are:

$$\frac{\partial f}{POP}, \frac{\partial f}{AREA}, \frac{\partial f}{ELEC} > 0$$

The equation to be estimated may be expressed in linear form as.

$$INC_{i,t} = a_t + b_1 POP_{i,t} + b_2 AREA_{i,t} + b_3 ELEC_{i,t} + \varepsilon_{i,t} \quad (1)$$

6. Data were reported by the following departments of the Republic of the Philippines: National Economic and Development Authority, National Electrification Administration, National Power Corporation, Bureau of the Census and Statistics, and Department of Finance.

where i represents the individual province, t the year (1975), and the error term has the traditional statistical assumptions.

Assuming a linear form, the least square estimate of equation (1) for the country as a whole (63 provinces) was calculated to be as follows:[7]

$$\underset{}{INC} = -170.3 + \underset{(8.4)^{***}}{9.2POP} + \underset{(2.5)^{**}}{0.3AREA} + \underset{(3.6)^{***}}{108.4ELEC} \quad (2)$$

$$R^2 = 54.0\,,\; N = 64$$

The signs of the estimated coefficients are as hypothesized and are all significantly different from zero at at least the 95 percent level of confidence. The correlation coefficients between POP and AREA, POP and ELEC, and AREA and ELEC were 0.40, 0.24, and –0.28, respectively, indicating little collinearity among the independent variables. The statistically significant estimated coefficients in equation (2) tentatively confirm the role that population, area, and electrical investment play in determining the provincial income levels of the provinces of the Philippines. The results offer little practical guidance as to where the investment should take place to be most beneficial.

V. A TEST OF THE HANSEN THESIS

If the Hansen thesis holds true, we would expect to find that electrification – EOC in the Hansen schema – has had a significant impact on income levels in the intermediate provinces and little or no effect in the lagging region. As already noted, Hansen provides no operational guidelines to disaggregate the provinces into groups. Thus a cluster analysis was performed to avoid a purely judgmental classification. Four variables were used to measure the level of economic development of each province. The four variables were as follows: (1) average household income, (2) percent of population living in urban areas, (3) percent of population with some

7. Throughout the paper *** indicates significance of the t-value (which appears in parentheses under the estimated coefficient) at the 99% level, and ** indicates significance at the 95% level.

college education, and (4) percent of houses with piped water. The mean values of each variable are given in Table 1.[8]

TABLE 1
MEAN VALUES OF FACTORS IN CLUSTER

Factors used	Intermediate group, $N = 27$	Lagging group, $N = 37$
1. Average Household Income	6012.1	3813.0
2. % of Population in Urban Areas	26.7	16.4
3. % of Population with Some College Education	11.9	9.0
4. % of Houses with Piped Water	19.3	15.2

Using these two groups as our classification, the hypothesized production function was estimated for each group. We would now expect the coefficient for ELEC to be statistically significant in the intermediate group but not the lagging group. The estimated equations are as follows:

(A) Intermediate Group

$$\text{INC} = \underset{}{107.5.6} + \underset{(3.5)^{***}}{6.9\ \text{PIP}} + \underset{(1.6)}{0.6\text{AREA}} + \underset{(2.8)^{**}}{152.3\ \text{ELEC}} \qquad (3)$$

$R^2 = 64.8, N = 27$

8. Average houshold income from *Journal of Philippine Statistics,* Third Quarter 1978, pp. 101-106; percent of people living in urban areas from Regional Profiles in *Philippine Almanac and Handbook of Facts: 1977,* Philippine Almanac Printers, Quezon City, 1977; percent of population with some college education from Republic of the Philippines, *Social Indicators: Vol. II*, National Census and Statistics Office, Manila, 1973, pp. 29-30; percent of houses with piped water from Regional Profiles, *op. cit.*

(B) Lagging Group

$$INC = -48.1 + \underset{(9.7)^{***}}{12.0POP} + \underset{(1.6)}{0.2AREA} + \underset{(1.4)}{56.2ELEC} \quad (4)$$

$R^2 = 59.0, N = 37$

The results confirm the Hansen thesis for the effect that electrification has on the levels of income in the Philippine provinces. While the coefficient for population is statistically different from zero in both groups, the coefficient for the electricity variable is only different from zero in the intermediate group – the result predicted by Hansen. The coefficient for the size of the province, while significant for the countrywide results, is not significant when the provinces are split into two groups.

VI. SUMMARY AND CONCLUSIONS

Although most policymakers would agree to the beneficial effects of infrastructure investment in the process of development, few guidelines exist to help the policymaker decide what kind of investment is most beneficial or where to optimally locate the investment. The Hansen thesis suggests that the appropriate investment in intermediate regions is EOC, and in lagging regions the appropriate investment is in SOC. This paper has examined the role of one type of EOC infrastructure investment – electrification – on income levels in the Philippines. Initial results indicated the importance of population, area, and electrification in explaining variations in income levels for the country as a whole. To confirm the Hansen thesis, a cluster analysis was conducted using four variables to split the country into an intermediate region and a lagging region. The production function was reestimated for each group. Electrification of households was found to be significant only in the intermediate region. Population was found to be significant in both regions.

From the policy point of view, the results obtained here and in earlier studies seem to have some important implications for economic development. In deciding the type and location of the proposed investment, it would seem that the guidelines – EOC type investments in intermediate regions and SOC type investments in lagging regions – would at least serve as a starting point for decision-makers in the process of allocating scarce resouces.

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