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INTRODUCTION

As early as 1925, Burgess observed that the pattern of land use in American cities was generally in the form of concentric zones. At the heart of the typical city was the central business district. It was surrounded by the homes of the workingmen, which in turn were surrounded by the homes of the more affluent.

This was a very simple picture of a city. Yet it was not until the 1960s that economists such as Kain (1962), Alonso (1964), Mills (1967), Muth (1969) and Solow (1973) started to provide a convincing explanation of the simplified concentric-zone structure. The models these economists constructed stood on heroic assumptions, but somehow yielded very credible results by paying attention to land rents, transportation costs and a competitive urban land market. How do we apply this kind of analysis to cities of less developed countries?

A. Cities of less developed countries

Cities of less developed countries, as we might well suspect, are not quite the same as American cities. Apart from striking differences in per capita income levels, the chief difference might be

the curious phenomenon of urban dualism in LDCs. Urban dualism is the division of a city's economy into two sectors -- the formal and the informal. The formal sector is what other writers have called the "modern", "capitalist" or "capital intensive" sector, and is where employment is often characterized to be contractual and regular. The informal sector, in contrast, has been called the "traditional", "craft" or "labor intensive" sector, and is where employment is taken to be casual and irregular (see Sethuraman, 1976).

It seems likely that this dualism exists because of government intervention in factor markets. The formal sector is apparently protected by such policy measures as subsidies, interest rate ceilings, tariffs, importation privileges and other concessions that artificially make capital cheap. However, the formal sector might also be subject to government regulation and may have to comply with such things as minimum-wage laws which for instance, make labor costly. The rest of the economy is what comprises the informal sector, unprotected and unregulated.

The stylized spatial structure of a dualistic city may still be described in terms of concentric zones. The most plausible picture that comes to mind is of a city whose central zone is the formal business sector -- banks, hotels, department stores and large warehouses. This core is surrounded by a vast zone of mixed land uses -- the informal business sector mized with low-income residences (see McGee, 1968). In

this zone, it would be common to find bakeries, carinderias, sari-sari stores, dress shops, pawn shops, repair shops and other shops of the informal sector usually on the ground floors of two or three-storey buildings. The upper floors would be apartments for low or middle-income households. The outermost zone would, of course, be occupied by the communities of the well-to-do. What would such a structure imply about the conditions of urban dualism?

B. Object and Method of Study

The object of this study is to see how contemporary urban location theory can shed light on the nature of urban dualism in less developed countries. In this study, the formulation of theory follows Solow's method very closely. It departs from Solow's work in at least two respects:

(i) First, the phenomenon of urban dualism is treated explicitly by specifying relative values of factor prices. In addition, dualism in production is linked to dualism among households by way of labor wages.

(ii) Second, the sequence of analysis is altered to suit our own purpose. What has been done before was to take conditions of production as given, use economic theory to derive optimal locations, and finally take given sectoral locations to verify the theory. This time, we still take locations as given, but now accept location theory as valid *a priori*, and use it to infer conditions in the informal sector of which we know very little.

ANALYTICAL FRAMEWORK

We assume a circular city on a homogenous plain. A single private composite good is produced in the city. The price of this good is assumed exogenous. Four sectors compete for the use of the city's land:

(i) the formal producer sector;

(ii) the informal producer sector;

(iii) the formal hosuehold sector; and

(iv) the informal household sector.

In this city, the center is obviously the most accessible point. We assume there is some advantage to being located as close to this point as possible. Competition for land is competition for location as well. Greedy absentee landlords charge rent on all the land.

A. The producer sectors

The production function for the composite good 'Z' is homogenous of degree one. Factor proportions are variable. The factors are land, labor and capital. The assumption of linear homogeneity lets us derive an average cost function with factor prices as arguments (Uzawa, 1964). For the formal sector, the cost function of each firm is given as:

$$(1) \quad C^f(x) = C[r(x), w_f, i_f],$$

and for the informal sector as:

$$(2) \quad C^n(x) = C[r(x), w_n, i_n].$$

where x = distance of the firm from the center of the city

$C(x)$ = unit cost of the composite good at plant location

$r(x)$ = rent per unit of land at distance x

w = wage per unit of labor

i = cost of capital.

The subscripts f and n refer to the formal and informal sectors respectively. The two cost functions differ only in the values of their arguments. The formal sector is assumed to have access to cheap capital, hence, $i_f < i_n$. However, it is also more easily subject to government regulation. In this case we assume that it is subject to minimum-wage legislation such that $w_f > w_n$. In this model, we assume the government does not interfere with land prices.

To emphasize the importance of location, we assume that the composite good is sold in a national market at the center of the city. We introduce transport cost per unit of Z, $t(x)$, where $t'(x) > 0$. The transport cost function is the same for both the formal and informal sectors.

B. The household sectors

All households are assumed to have the same preference functions. Members of the households make the same fixed number of trips to the center per unit of time, and incur journey-to-center costs, $j(x)$. Naturally, $j'(x) > 0$. Each household is assumed to have just a single wage-earner, and therefore net household income is given as $w - j(x)$.

In this analysis, we abstract from problems in the valuation of travel time and the labor-leisure choice.

Here, it is more convenient to work with the indirect utility function which is the dual of the direct utility function (Lau, 1969). The indirect utility function is expressed in terms of prices and income instead of quantities of goods and services. For the individual household of the formal sector the indirect utility function may be written as:

$$(3) \quad V^f(x) = V[p, r(x), w_f - j(x)]$$

and for the informal sector as:

$$(4) \quad V^n(x) = V[p, r(x), w_n - j(x)] ,$$

where p is the price and Z. We ignore housing as a consumption good by assuming fixed factor proportions in the housing construction technology and using residential land as the housing proxy. This keeps the analysis as simple as possible.

C. Equilibrium conditions

In this analysis, p, w_f, w_n, i_f and i_n are exogenous. We assume that the market for Z is competitive in the sense that its price must equal average cost including transport cost to the center of the city. Land rent is the residual that adjusts to cover the spread between the

price of Z and the cost of capital, labor and transport per unit of Z. While the firm located close to the center saves on transport cost, it pays the difference in higher rent. In long-run equilibrium this means:

$$(5) \quad p = C[r(x), w_f, i_f] + t(x)$$

and similarly,

$$(6) \quad p = C[r(x), w_n, i_n] + t(x)$$

From these equations, we can derive two implicit rent functions, and show that in either case, $r'(x) > 0$, and that factor substitution makes $r''(x) > 0$.

Among the household sectors, higher incomes in the formal sector means that individual households of that sector achieve a higher level of utility than the rest of the households. The equilibrium condition is that no household can raise its level of utility by changing its residential location. Adjustments in land rents assure that within each household sector no residential location is more attractive than any other in terms of the bundle of goods and services consumed at each place. This means the same level of utility is reached by all households in the same sector. We can thus specify an exogenous common level of utility for each unit of the formal household sector as:

$$(7) \quad V^f = V[p, r(x), w_f - j(x)]$$

and also a common level of utility for the informal sector:

$$(8) \quad V^n = V[p, r(x), w_n - j(x)]$$

where $V^f > V^n$ because $w_f > w_n$.

From equations (5), (6), (7) and (8) we can derive four implicit rent functions, one for each sector. Each rent function represents the highest rent any unit of the corresponding sector would be willing to bid at every point of distance from the center of the city. The equilibrium rent that prevails at each point is the highest bid among all the sectors. That location is of course occupied by a unit of the sector with the highest rent bid. In general, if such rent functions intersect, the sector with the steeper function at the point of intersection gets the location closer to the center of the city.

INTRAURBAN LOCATION AND SECTORAL CONDITIONS

In conventional location analysis, conditions of production are taken as given, and economic theory is used to infer optimal locations from such given conditions. In this instance we are taking locations as given, and trying to infer conditions of production. This is done by comparing rent functions between sectors. For clarity, we add subscripts to our rent functions such that:

$r_1(x)$ = rent function of the formal producer sector;

$r_2(x)$ = rent function of the informal producer sector;

$r_3(x)$ = rent function of the formal household sector; and

$r_4(x)$ = rent function of the informal household sector.

A. Conditions in the producer sectors

First, let use examine the rent function of the formal producer sector, $r_1(x)$. By differentiating equation (5) with respect to distance x we get

$$(9) \quad C_r^f(x)\, r_1'(x) + t'(x) = 0$$

and rearranging gives the slope of $r_1(x)$:

$$(10) \quad r_1'(x) = \frac{-t'(x)}{C_r^f(x)}$$

where $$C_r^f(x) = \frac{\partial C[r_1(x),\, W_f,\, i_f]}{\partial r_1(x)} \quad .$$

The cost function is convenient, in this analysis because it yields $C_r^f(x)$ which is simply the demand for land per unit of Z in the formal sector. The partial derivative of the cost function with respect to a given factor price gives the factor demand (Solow, 1973).

Turning to the rent function of the informal producer sector, we repeat the process using (6) and derive

$$(11) \quad r_2'(x) = \frac{-t'(x)}{C_r^n(x)}$$

where $C_r^n(x) = \dfrac{\partial C[r_2(x), W_n, i_n]}{\partial r_2(x)}$

Similarly, $C_r^n(x)$ is demand for land per unit of Z in the informal sector. It is clear that $r_2'(x) < 0$

We take as given that firms in the formal sector tend to locate closer to the center than firms in the informal sector. This condition means

$$(12) \quad |r_2'(x)| < |r_1'(x)| \ ,$$

that is, the rent function of the formal sector is steeper than that of the informal sector. The condition is satisfied only if $C_r^f(x) < C_r^n(x)$. In other words, if indeed the formal producer sector locates closer to the center than the informal, then the formal producer sector also uses less land per unit of Z than the other producer sector.

We have specified than $i_f < i_n$. The effect of this is in the direction of satisfying condition (12). The formal sector will tend to substitute the cheaper capital it has access to for some of land in production. However, we have also specified that $W_f > W_n$, the effect of which is in the opposite direction. Relatively expensive labor in the formal sector pushes the optimal combination of factors towards

greater land usage. But what condition (12) means is that the net effect is substitution away from land. In short, the advantage the formal producer sector gets from government protection more than compensates for the disadvantage it gets from regulation in terms of the factor prices it is made to face.

B. Household incomes and location

Differentiating (>) with respect to x gives

$$(13)\quad V_r^f(x)\, r_3'(x) - V_w^f(x)\, j'(x) = 0$$

$$(14)\quad r_3'(x) = \frac{j'(x)}{V_r^f(x)/V_w^f(x)}$$

where $$V_r^f(x) = \frac{\partial V[p,\, r_3(x),\, W_f - j(x)]}{\partial r_3(x)}\,,$$

$$V_w^f(x) = \frac{\partial V[p,\, r_3(x),\, W_f - j(x)]}{\partial [W_f - j(x)]}\,.$$

In words, $V_r^f(x)$ is the partial derivative of the formal household's indirect utility function with respect to residential land rent and $V_w^f(x)$ is the partial derivative with respect to net household income.

The interesting thing about (14) is that $-V_r^f(x)/V_w^f(x)$ gives demand for land per household in the formal sector. This is a property of the indirect utility function (Katzner, 1970).

Turning to the informal household sector, we differentiate (8) with respect to x to get

$$(15) \quad V_r^n(x)\, r_4'(x) - V_w^n(x)\, j'(x) = 0$$

$$(16) \quad r_4'(x) = \frac{j'(x)}{V_r^n(x)/V_w^f(x)}$$

where $V_r^n(x) = \dfrac{\partial V[p,\, r_4(x),\, W_n - j(x)]}{\partial r_4(x)}$

$$V_w^n(x) = \frac{\partial V[p,\, r_4(x),\, W_n - j(x)]}{\partial [W_n - j(x)]}$$

and $-V_r^f(x)/V_w^f(x)$ is demand for land per household in the informal sector. Note that $r_3'(x),\ r_4'(x) < 0$ because $V_r^f(x)/V_r^f(x)$, $V_r^n(x)/V_w^n(x) < 0$. Negative signs in front of these two ratios give positive demands for land per household in the two sectors.

Now we ask, why is it that affluent households tend to be more suburban (or located farther away from the center) than poor households? Formally, we are asking why

$$(17) \quad |r_4'(x)| > |r_3'(x)|.$$

The reason is simple. Since $w_f > w_n$, formal sector households would demand more land per household than informal sector households. That is,

$$\frac{-V_r^f(x)}{V_w^f(x)} \quad \frac{-V_r^n(x)}{V_w^n(x)} \quad .$$

This seeming paradox of why the poor live near the center on expensive land while the rich live far from the center on cheaper land was resolved in slightly different ways by Alonso, Mills and Solow. But the common answer is that the poor use much less residential land per household than the rich.

C. The informal household and producer sectors

Normally, production units tend to be located closer to the center of the city than households. In terms of rent gradients, this means

$$(18) \qquad \left|\frac{-t'(x)}{C_r(x)}\right| > \left|\frac{j'(x)}{V_r(x)/(V_w(x)}\right|$$

where the absence of the superscripts f and n indicate the absence of urban dualism. However, where dualism exists, we observe that the producer and household sectors tend to be located within the same zone. In other words, their rent functions tend to coincide, or

$$(19) \qquad \left|\frac{-t'(x)}{C_r^n(x)}\right| = \left|\frac{j'(x)}{V_r^n(x)/V_w^n(x)}\right| \quad .$$

How does the presence of dualism change the picture from (18) to (19)? Since the transportation functions of the numerators

of (18) and (19) are identical, the answer must lie in the denominators. For the shift from (18) to (19) to ensue, the changes in conditions should be towards making

$$(20) \quad C_r^n(x) > CC_r(x)$$

and

$$(21) \quad \left|\frac{V_r^n(x)}{V_w^n(x)}\right| < \left|\frac{V_r(x)}{V_w(x)}\right| ,$$

remembering that $V_r^n(x)/V_w^n(x)$ and $V_r(x)/V_w(x)$ are both negative satisfying (20) and (21) implies something about the relative values of w_n and i_n.

A relatively low informal sector wage ($w_n < w$) works towards fulfilling (21), since low incomes mean low demands for residential land per household. However, such a low w_n tends to work against fulfilling (20) since inexpensive labor promotes factor substitution away from land in production.

To resolve the conflict, we must infer that the cost of capital must be relatively high in the informal sector ($i_n > i$). Indeed, it must be so high that inspite of inexpensive labor, net factor substitution in production is towards more land per unit of output in the informal sector. This way, both (20) and (21) can be satisfied.

On the basis of intraurban locations, we infer that conditions in the informal sector are such that labor is very cheap and capital is very costly relative to conditions where urban dualism is absent.

CONCLUSION

This paper was obviously not intended to serve as a definition piece. Clearly, there remain weak gaps in the analysis. In the first place, the analysis hinges on a concentric-zone land-use pattern specified for cities of less developed countries. While this specified pattern may seem very plausible as well as consistent with descriptive studies by sociologists and urban planners, it has not really been established in a systematic empirical fashion.

Moreover, the analysis has yielded nothing beyond qualitative descriptions of what might be the conditions in the urban informal sector. We have been unable to specify the factor prices in terms of parameters of either cost functions or production functions.

What has been accomplished, at the very least, is a suggestion that the economics of urban location can give us insights about economic conditions in cities of less developed countries.

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