The Limits to Urban Growth: Suggestions for Macromodeling Third World Economies*

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I. City Growth and "Overurbanization"

While there are some signs that population growth rates may have peaked in many developing countries, there is yet another demographic event of major proportions currently besetting the Third World—city growth rates of spectacular magnitude. Projections to the end of this century yield urban agglomerations of unprecedented sizes: Mexico City at 31 million, São Paulo at 26 million, and Cairo, Jakarta, Seoul, and Karachi each exceeding 15 million.

While some observers have viewed these city growth projections with alarm, analysts are sharply divided regarding their validity and relevance. Pessimists stress the Third World's inability to cope with the resource and social systems requirements of rapid urban growth and high urban densities, thus prompting the term "overurbanization." The key notion here is that the social costs of continued in-migration to the cities exceed private costs, thus tending to create cities which are "too large" as well as "too many." Optimists view urban growth as the natural outcome of economic development and as the central mechanism by which average living standards and labor productivity are raised.

These city growth projections are based on models which fail to allow for the potential feedback of various city costs on the rural-urban migration decision. In addition, detailed analyses of Third World cities by urban economists and planners conventionally take in-migration as

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exogenously given. It is our view that the debate can be better informed by the application of general equilibrium models of Third World development which include some of the potential costs of urbanization—models which at least make an effort to internalize the most important of various alleged costs so that potential "natural limits" to urban growth can be evaluated and the relevance of UN forecasts assessed. Section II illustrates how existing macro models of the Third World are "pro-urban" biased: typically they minimize the potential limits to urban growth and are silent on the issue of overurbanization. Section III lists some key forces which might serve to retard the rate of urbanization. Section IV develops this theme at length by offering some explicit suggestions on how these forces might be introduced into a general equilibrium model of Third World development. Central to this discussion will be potential cost-of-living differentials between urban and rural areas, urban housing availability, the quality of urban public goods, urban land scarcity, modern sector factor requirements and resource "bottlenecks," and the competing demands of "unproductive" urban capital accumulation. While no conclusive results are offered in the present paper, it seems to us timely nevertheless to open the debate on strategies for macromodeling the "limits to urban growth" in Third World economies.

II. What's Wrong with Our Macro Models of Development?

Based on the firmly held belief that the current structure of an economy can influence its subsequent growth performance, macro models of Third World societies have stressed sectorial detail from the start. The classic examples are offered by the dual economy models pioneered by Lewis, Fei and Ranis, and Jorgenson, the latter extended by Kelley, Williamson, and Cheetham.[1] Central to these models and their more elaborate extensions are the output gains associated with resource transfers from "traditional" low-productivity sectors to "modern" high-productivity sectors. Such resource transfers—and labor migration in particular—have spatial implications, urbanization being the most notable example. In the classic labor surplus version, modernization (or urbanization) augments aggregate output both through short-run efficiency gains and long-run growth effects. In the short run, labor resources with low marginal productivity are shifted to high marginal productivity employment. In the long run, accumulation rates are raised

[1] W. A. Lewis, "Development with Unlimited Supplies of Labour," *Manchester School of Economics and Social Studies* 20 (May 1954): 139–92; J. C. H. Fei and G. Ranis, *Development of the Labor Surplus Economy: Theory and Policy* (Homewood, Ill.: Richard D. Irwin, 1964); D. W. Jorgenson, "The Development of a Dual Economy," *Economic Journal* 71 (June 1961): 309–34; A. C. Kelley, J. G. Williamson, and R. J. Cheetham, *Dualistic Economic Development: Theory and History* (Chicago: University of Chicago Press, 1972).

since saving rates are higher in the modern sectors—indeed, in the extreme version only capitalists save, and capital is an argument in the modern production functions only. Rising (urban) accumulation rates imply increased rates of modern sector job vacancies, a rural-urban migration response, and further urbanization. Thus, output growth, trend acceleration, and increasing urbanization are the likely outcomes of the labor surplus model. The neoclassical dual economy model makes the same prediction,[2] although in this case only the long-run accumulation effects are operative since with marginal factor productivities equated in the conventional neoclassical version, comparative static efficiency gains are not associated with the urban-accumulation-induced labor transfer.

What forces tend to inhibit the rate of urbanization in these dual economy models? In the medium term, the rise in the real wage is typically the only source of retardation in the rate of modernization. The rise in the real wage serves to choke off the rise in the saving rate, to reduce the rate of urban capital accumulation, and to retard the rate of increase in new urban job vacancies, thus to limit urban growth. The ultimate source of the limits to urban growth in the dual economy model is therefore agriculture, through the disappearance of labor surplus and/or through the rise in the relative price of agricultural products—the key wage good in such models. Nowhere in this account are competing, and potentially voracious, urban *"unproductive"* investment demands on the national saving pool considered. In addition, while inelastic agricultural land supply insures an eventual constraint on urbanization through rising food costs and real wage increases, nowhere is the impact of inelastic *urban* land supply on city rents—another key wage good—and urban cost of living considered. It seems to us that such models are poorly equipped to confront urbanization problems in the Third World. They say nothing about the costs of urbanization and are equally silent on the possible limits to urban growth generated within the growing urban sector itself. If our understanding of Third World urbanization is to be enriched by macro modeling, existing multisectoral models must be revised to capture the potential impact of city costs on urban population growth through migration.

III. How Can We Model the Limits to Urban Growth?

How might our models of development be revised to better capture the costs of urbanization? If there are endogenous forces which tend to inhibit the rate of urbanization independent of overt anti-urban policy, what are they? How potent might these forces be? Could they impose

[2] A. K. Dixit, "Models of Dual Economies," in *Models of Economic Growth,* ed. J. Mirrlees and N. Stern (London: Macmillan Co., 1973); Kelley, Williamson, and Cheetham.

important limits to urbanization, offering potential departures from the gloomy predictions produced by UN projections?

No doubt rapid rates of population growth explain much of the spectacular growth of cities in the Third World. Furthermore, one could appeal to the mechanics of the demographic transition as a potential limit to urban growth. It is well known that fertility rates are lower in the cities than in the countryside thus implying an eventual retardation in population growth rates as urbanization proceeds. City growth would retard on that score alone. Yet these long-run demographic transition forces are of doubtful magnitude to offer likely limits to urban growth in the next quarter century.

It seems likely that far more insight might be gained by examining various urban costs which influence the migration decision, on the one hand, and rising urban investment requirements which compete with "productive" capital accumulation, on the other. First among these influences are inelastic urban land supplies. Urban land constraints serve to raise (market or shadow price) rents, augment urban relative to rural living costs, and inhibit in-migration to the city. The importance of these urban land constraints on city rents can only be evaluated in a general equilibrium model which admits housing service activities and confronts issues of equilibrium land use. Furthermore, any urban land use characterization must allow for a variety of urban land requirements—residential squatter settlements, factory sites, land use for public social overhead, and luxury housing sites. Second, the housing-cum–social overhead investment requirements of city growth must be confronted. "Unproductive" urban investments of this type may well take priority over those forms of accumulation which create capacity for future urban employment.[3] In any case, unproductive urban investment requirements compete directly with productive capital accumulation. Any model of urban growth must deal with these competing requirements since new urban housing-cum–social overhead requirements may very well serve to check urban growth. Of course, if the housing-cum–social overhead investment is forgone, then housing costs will rise and the quality of urban services fall, further discouraging in-migration to the city. In short, the rise in the relative cost of living in the city may impose a limit to urban growth and/or the rise of urban unproductive investment requirements will diminish the rate of productive urban capital accumulation, new urban job vacancies, and thus limit urban growth.

[3] An early analysis of this framework is the study by A. J. Coale and E. M. Hoover, *Population Growth and Economic Development in Low Income Countries: A Case Study of India's Prospects* (Princeton, N.J.: Princeton University Press, 1958).

There are other possible constraints on urbanization worth considering. "Modern" sectors tend to be relatively intensive in both skills as well as intermediate inputs, and imported inputs in particular. The most visible manifestation of the latter influence is the cost of energy. As far as skill bottlenecks go, there is considerable debate. If capital and skills are complements and labor of different skills poor substitutes for each other, then rapid rates of urban capital accumulation imply increasing demands for skilled labor. Any model of the limits of urban growth must take these potential skill bottlenecks into account for they may place important constraints on capacity expansion in the modern urban sectors, retard the rate of growth in urban employment demand in general, and thus place further limits on urban growth. Any effort to relax this constraint by skill accumulation is likely to compete with productive urban capital accumulation and thus offer an alternative limit to urban growth.

We have no way of appreciating how important these and other limits to urban growth may be without their explicit evaluation in a general equilibrium model of Third World development. What follows is an attempt to move in that direction.

IV. A Menu of Possible Modeling Directions

A. Technology, Sectors, and Potential Resource Bottlenecks

It seems to us that the limits to urban growth cannot be adequately confronted unless at least eight sectors are specified. The distinguishing characteristic of our proposed approach is not the number of sectors, however, but rather the characteristics of the sectors. Our key emphasis is that five of these sectors produce outputs which are *nontradeable interregionally*, making rural-urban cost of living differentials possible, perhaps therefore influencing the rural out-migration decision. Our approach distinguishes between manufacturing (*M*), agriculture (*A*), modern services (*KS*), urban "traditional" services (*US*), rural "traditional" services (*RS*), urban high-cost housing (*H,KS*), urban low-cost housing (*H,US*), and rural low-cost housing (*H,RS*). While the first two of these are traded internationally and interregionally, the third is traded only interregionally, and the remaining five are consumed only at the site of production.

Like many multisectorial development models, ours stresses production dualism. Thus, the eight sectors exhibit quite different rates of technical progress, factor intensity, and substitution elasticities. Conventional physical capital, K_i, is used in agriculture, manufacturing, and the modern service sector, although it is specific to a given sector once in place. Unskilled labor, L_i, is used in all sectors except housing. Skilled labor, S_i, is utilized in the manufacturing and the modern service sectors only while land, R, is used as an input in both agriculture and urban housing. In what follows, we shall focus on the two modern sectors—manufacturing and the modern service sector—and reserve discussion of the remaining sectors for sections to follow.

The production process in the two modern urban sectors is viewed to be more capital-cum-skill-intensive than both agriculture and the remaining service sectors. In addition, we shall impose restrictions on elasticities of substitution consistent at least in spirit with the "structuralist" school,[4] namely, that the elasticity of substitution in urban modern sectors is less than one. Yet, the presence of three factors of production in the modern urban sectors makes the conventional constant elasticity of substitution (CES) production function inappropriate. Since it is not possible to confront the issue of earnings distribution or skilled labor bottlenecks without paying explicit attention to labor heterogeneity, we insist that the working population be distinguished at the very minimum by skilled and unskilled labor. Furthermore, we are convinced by several empirical studies that the elasticity of substitution between each of the three pairs of inputs in these modern sectors is not the same. Rather, we are persuaded that conventional capital and skills are relative complements[5] and that this fact goes a long way in accounting for the phenomena of rising urban skilled wages, "wage stretching,"[6] and increased earnings inequality in much of the Third World where capital accumulation and urbanization is so rapid.

Most important, this specification introduces the possibility of skill bottlenecks accompanying rapid modern sector accumulation. Given complementarity between skills and capital in the modern sectors, rapid accumulation breeds sharply rising derived demands for skills. To the extent that skill accumulation is slow in matching that demand, modern sector output growth will be inhibited, new job vacancies for unskilled in the modern sectors suppressed, and rural-urban migration forestalled. Capital-skill complementarity in the modern sectors, therefore, suggests one possible limit to urban growth. Any effort to relax that

[4] H. B. Chenery and W. J. Raduchel, "Substitution in Planning Models," in *Studies in Development Planning*, ed. H. B. Chenery (Cambridge, Mass.: Harvard University Press, 1971).

[5] Z. Griliches, "Capital-Skill Complementarity," *Review of Economics and Statistics* 51, no. 4 (November 1969): 465–68; P. R. Fallon and P. R. G. Layard, "Capital-Skill Complementarity, Income Distribution and Output According," *Journal of Political Economy* 83, no. 2 (April 1975): 279–301; J. R. Kesselman, S. H. Williamson, and E. R. Berndt, "Tax Credits for Employment Rather than Investment," *American Economic Review* 67, no. 3 (June 1977): 330–49.

[6] S. Morley and J. G. Williamson, "Class Pay Differentials, Wage Stretching, and Early Capitalist Development," in *Essays on Economic Development and Cultural Change in Honor of Bert F. Hoselitz*, ed. M. Nash (Chicago: University of Chicago Press, 1977).

limit by accelerated skill accumulation implies forgone physical capital accumulation and thus an alternative limit to growth in those sectors which use capital most intensively, namely, the urban modern sectors themselves.

Given the need to specify modern sector production functions that allow for relative complementarity between skilled labor and capital, the most useful specification is the "nested" CES first proposed by Sato[7] and since applied to developing economies in a number of case studies.[8] The two modern sector production functions therefore take the following form:

$$
\begin{aligned}
Q_i &= A_i Q_{i,F}^{\alpha_{i,F}} Z_i^{\alpha_{i,Z}} \prod_{j=A,M,KS} Q_{i,j}^{\alpha_{i,j}}, \qquad i = M,KS \neq j \\
Q_{i,F} &= \{\xi_i \Phi_i^{(\sigma_i - 1)/\sigma_i} + (1-\xi_i)[zL_i]^{(\sigma_i - 1)/\sigma_i}\}^{\sigma_i/(\sigma_i - 1)}, \qquad i = M,KS \\
\Phi_i &= \{\xi'_i [xK_i]^{(\sigma'_i - 1)/\sigma'_i} + (1-\xi'_i)[yS_i]^{(\sigma'_i - 1)/\sigma'_i)}\}^{\sigma'_i/(\sigma'_i - 1)}, \qquad i = M,KS \\
\Sigma\alpha_{i,j} &= 1, \qquad i = M,KS \neq j = F,Z,A,M,KS,
\end{aligned}
\tag{1}
$$

where Q_i is gross output in sector i, Z_i is imported raw materials, $Q_{i,j}$ are intersectoral inputs (excluding intrasectoral inputs), $\alpha_{i,j}$ are the cost shares of each factor in gross sales, Φ_i is a composite input index of conventional and human capital (skills), ξ_i and ξ'_i are distribution parameters, and σ_i and σ'_i are substitution elasticities. Factor-augmenting technical progress determines the level of $x(t)$, $y(t)$, and $z(t)$.

The reader will also note the presence of both imported raw materials, Z_i, and domestic intersectoral inputs in these modern sector production functions. The distinction is likely to be of substantial importance since without it we could hardly investigate the impact of, say, future increases in the price of energy—another resource bottleneck which may serve to limit urban growth since Z_i is used most intensively in these modern sectors.

B. Labor Migration, "Wage Gaps," and Cost-of-Living Differentials

The most popular model of migration appears to be that first offered by Todaro.[9] Todaro's model was motivated by issues similar to those central to this paper, namely, how to account for apparent overurban-

[7] K. Sato, "A Two Level Constant Elasticity of Substitution Production Function," *Review of Economic Studies* 34, no. 2 (April 1967): 201–18.

[8] For example, see I. Adelman and S. Robinson, *Income Distribution Policy in Developing Countries: A Case Study of Korea* (Stanford, Calif.: Stanford University Press, 1978).

[9] M. Todaro, "A Model of Labor, Migration and Urban Unemployment in Less Developed Countries," *American Economic Review* 59 (March 1969): 138–48.

ization in Third World economies in the sense that urban underemployment in "traditional" urban service sectors was expanding rapidly in spite of impressive rates of accumulation and modern sector expansion.

The Todaro hypothesis is simple and elegant. While similar statements can be found elsewhere, the most effective illustration can be found in Corden and Findlay[10] (reproduced in fig. 1) assuming perfect capital mobility. There are only two sectors analyzed, but they are sufficient to illustrate the point. Under the extreme assumption of wage equalization through migration, and in the absence of wage rigidities, equilibrium is achieved at E (the point of intersection of the two labor demand curves, AA' and MM'). Here $w^*_A = w^*_M$ and the urbanization rate is $O_M L^*_M / L$, where M denotes the manufacturing sector and A denotes agriculture. In addition, the Corden-Findlay model incorporates the widely held belief that the wage rate in Third World manufacturing sectors is "pegged" at artificially high levels, say at $\bar{w}_M$. If overt unemployment is assumed away, then all who fail to secure the favored jobs in the M sector would accept lower-paying jobs in the A sector at w^{**}_A. Clearly, the level of employment in the urban sector has been choked off by the high wage in manufacturing and both migration and urbanization have been forestalled. As Todaro initially pointed out, however, urbanization rates have been dramatic in the Third World and furthermore there has been an expansion in traditional urban service underemployment. Todaro explains this apparent conflict

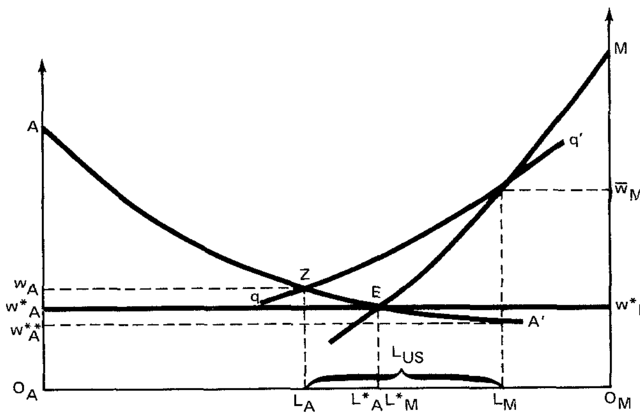

FIG. 1.—The Harris-Todaro-Findlay model

[10] W. Corden and R. Findlay, "Urban Employment, Intersectoral Capital Mobility and Development Policy," *Economica* 42 (February 1975): 59–78.

(e.g., migration in the face of urban underemployment) by developing an expectations hypothesis which in its simplest form states that the favored jobs are allocated by "lottery," that the potential migrant calculates the expected value of that lottery ticket, and compares it with the certain employment in the rural sector. Migration then takes place until the urban expected wage is equated to the rural wage. Given the pegged $\bar{w}_M$, at what rural wage would the migrant be indifferent between underemployment in the traditional urban service sector and employment in the agricultural sector? If his probability of getting the favored job is simply the ratio of L_M to the total urban labor pool, L_U, then the qq' curve in figure 1 indicates the agricultural wage at which he is indifferent between employment locations. The equilibrium agricultural wage, w_A, and urban underemployment (e.g., the size of the traditional, unorganized sector) is thus given at Z.

This conventional wisdom is elegant, and we adopt it here with qualifications. These qualifications are motivated by the following observations. First, we are not convinced that $\bar{w}_M$ can be viewed as pegged in the Third World and independent of market forces.[11] Put differently, the apparent wage rigidity attributed to institutional factors (unions, government regulations) may in fact be explained by market forces, with institutions merely responding to those forces.[12] Second, we agree with Willis that the lottery view of who gets favored jobs is naive and ignores property rights.[13] It seems to us that the allocation of new job vacancies in the favored sectors is hardly random, but rather very much a function of bribes, nepotism, employment search costs, union dues, and the like. That is, these favored jobs have property rights earning rents that command an implicit or explicit price. Third, the Todaro formulation ignores the obvious fact that the majority of the favored jobs are more skill-intensive than either farm labor or traditional urban service activity. Finally, and we think most important, the formulation ignores cost-of-living differentials between regions.

Our approach is a hybrid which attempts to meet at least some of these criticisms. On the one hand, we assume perfect mobility of unskilled labor *within* the rural sector since everyone seems to agree that free entry and costless mobility are reasonable approximations there. We make the same assumption for both skilled and unskilled labor between the two modern urban sectors, certainly an acceptable premise

[11] See D. Mazumdar, "The Urban Informal Sector," Staff Working Paper no. 211 (Washington, D.C.: International Bank for Reconstruction and Development, 1975).

[12] See L. Taylor, *Macro Models for Developing Countries* (New York: McGraw-Hill Book Co., 1979), chap. 5.

[13] R. Willis, "Comment on International Migration in Developing Countries: A Survey," in *Population and Economic Change in Less Developed Countries*, ed. R. Easterlin (Chicago: University of Chicago Press, 1979).

to the Todaro adherents given their willingness to aggregate all modern sector activities. On the other hand, we model the unskilled wage gap between traditional urban services and the modern sectors by inserting an exogenous differential, κ, that reflects the costs of the property right as discussed above. Thus,

$$w_{M,L} = w_{KS,L} = \kappa w_{KS,L} \,. \tag{2}$$

Finally, and most important, the rural-urban migration process must be specified. Here we adopt a position which is closer in spirit to the Todaro hypothesis. The potential rural-urban migrant is assumed to behave as if he calculates expected urban nominal earnings, w_U. These earnings are simply the weighted average of potential urban unskilled earnings and skilled earnings (net of taxes), where the weights are *marginal* probabilities rather than average probabilities as in the simple Corden-Findlay version. Thus,

$$\begin{aligned} w_U = {} & [(1 - \tau_T)w_{M,S}]\left[\frac{\dot{S}(-1)}{L_U(-1)}\right] + \left[1 - \frac{\dot{S}(-1)}{L_U(-1)}\right] \\ & \times \left[w_{M,L}\frac{L_M(-1)}{L_U(-1)} + w_{KS,L}\frac{L_{KS}(-1)}{L_U(-1)} + w_{US,L}\frac{L_{US}(-1)}{L_U(-1)}\right], \end{aligned} \tag{3}$$

where τ_Y is the income tax rate on high-wage skilled labor. The migrant has accessible current information on city wages, but not on his employment probabilities. Thus employment weights are lagged 1 year in the migrant's calculation of expected urban income. In summary, the migrant is induced into the cities with the anticipation of having the chance to gain one of two favored modern sector jobs: either unskilled employment at a higher wage rate, or training and thus (perhaps subsequently) skilled employment at an even higher wage. Training and skills creation will be discussed below (see subsection *D*, "Education, Training, and Skills Accumulation").

Finally, we assume that the migrant is not motivated solely by nominal (expected) earnings gaps, but rather by *real* income differentials. Thus,

$$\frac{w_{A,L}}{\mathrm{COL}_R(-1)} = \frac{w_U}{\mathrm{COL}_{US}(-1)}, \tag{4}$$

where the location-specific cost-of-living indices, COL_i, are influenced by price differentials for nontradeables.

In summary, such a model is capable of generating an endogenous earnings structure in four dimensions: rural unskilled earnings, urban traditional sector unskilled earnings, modern sector unskilled earnings, and skilled earnings. The wage spread over these employment categories will be determined by the endogenous forces of market demand, supply, and the migration process itself. The speed of urbanization will be determined by the same set of forces. While expectations of favored sector employment may well generate the Todaro result of overurbanization, it is also possible that cost-of-living influences may choke off that tendency without the overt introduction of government policy. One such cost-of-living influence is the relative scarcity of urban housing.

C. Housing, Land Markets, and Equilibrium Land Use

At the very minimum, there are at least two competing uses to which land stocks can be put in any model of urbanization—farming and urban residential land sites. We shall assume that urban residential sites implicitly include in fixed proportion factory-site requirements as well as public land (parks, roads, schools). The fixed proportion assumption will simplify the analysis considerably, since we can focus exclusively on the residential site demand component of urban land use. Furthermore, we shall assume that "wasteland" exists in the rural area. This wasteland has no inherent site value, but it can be used for rural housing construction. Thus, the stock of productive land is defined as

$$R = R_{U,US} + R_{U,KS} + R_A , \tag{5}$$

were urban land sites are utilized for two types of housing—low-cost "squatter settlements" ($R_{U,US}$) and high-cost "luxury housing" ($R_{U,KS}$).

It seems to us that the urban housing market must be central to migration behavior and thus to any analysis of the urbanization process. One of the limits on urban growth rates in the Third World is the availability (and cost) of urban housing facing new urban households, whether the housing is of the informal, labor-intensive, owner-occupier type in squatter settlements, or more substantial dwelling units constructed by capital-intensive techniques and rented in a formal housing market. Any serious model of urbanization must admit this possible source of limits to urban growth. The limits may take various forms, but we shall focus on two constraints in particular. First, urban rents may rise in the long run due to the inflation of urban site rents as in classical urban location theory.[14] In addition, urban rents may also rise in the short run if investment in new structures lags behind demands

[14] E. Mills and B. N. Song, "Korea's Urbanization and Urban Problems, 1945–1975," Working Paper no. 7701 (Seoul: Korea Development Institute, 1977); J. V. Henderson, *Economic Theory and the Cities* (New York: Academic Press, 1977).

generated by rapid urban population growth. Second, to the extent that investment in housing responds to those demands generated by the immigration, aggregate saving available for productive accumulation or training will contract and thus the rate of output expansion will suffer economy-wide.[15] Since physical capital and skills are used most intensively in the modern sectors, the rate of urban labor absorption is diminished. As a result, in-migration to the cities and urbanization rates may slack off.

As we pointed out above, there are two housing types in our model. In this we follow the United Nations' *Habitat* where they state: "In many less developed countries building is characterized by the existence of two sectors: (a) a multiple of very small enterprises . . . which operate in the rural and peri-urban areas, belonging almost entirely to the informal sector of the economy; (b) a small number of large firms using modern techniques and organization,"[16] and where "squatter settlements" "generally refer to areas where groups of housing units have been constructed on land to which the occupations have no legal claim. In many instances housing units located in squatter settlements are shelters or structures built of waste materials without a predetermined plan. Squatter settlements are usually found . . . at the peripheries of the principal cities."[17] According to the same source, these squatter settlements account for the bulk of the growth in urban dwellings throughout the Third World. It seems to us important to distinguish these two types of urban dwellings, the different sectors that produce them as well as the different socioeconomic classes that consume the rental services that flow from these residential structures.

Suppose urban housing services are produced under constant returns to scale with housing structures, H_j, and land $R_{U,j}$, as inputs. While estimates of the elasticity of substitution between land and structures in residential housing production functions vary considerably,[18] the estimates are almost always quite high. We shall, therefore, adopt a Cobb-Douglas specification for urban housing in what follows:

$$Q_{H,j} = A_{H,j}H_j^{\alpha_{H,j}}R_{U,j}^{\alpha_{R,j}} , \quad j = US, KS , \tag{6}$$

where $\alpha_{H,j} + \alpha_{R,j} = 1$, $Q_{H,J}$ is the service flow from housing of type j, *US* denotes squatter settlements, and *KS* is luxury housing. In con-

[15] Coale and Hoover.

[16] United Nations, *Global Review of Human Settlements: A Support Paper for Habitat*, 2 vols. (Oxford: Pergamon Press, 1976), 1:70.

[17] Ibid., 2:11.

[18] For example, see R. Muth, *Cities and Housing* (Chicago: University of Chicago Press, 1969), and "The Derived Demand for Urban Land," *Urban Studies* 8, no. 2 (June 1971): 243–54; G. D. Ingram, *Residential Location and Urban Housing Markets* (Cambridge, Mass.: Ballinger Publishing Co., 1977): Henderson.

trast, rural housing services are not likely to require the input of land of significant site value, so that a fixed coefficient production function $Q_{H,RS} = a_{H,RS}^{-1}H_{RS}$ is assumed to apply.

This rural-urban asymmetric treatment of housing insures that rising land prices and increased site rents will have a disproportionate effect on cost of living in urban areas as urbanization proceeds. Perhaps this can be seen more clearly when the total rental price for urban housing is written explicitly as

$$P_{H,j} = \frac{r_{H,j}^{\alpha_{H,j}} d_U^{\alpha_{R,j}}}{A_{H,j}\alpha_{H,j}^{\alpha_{H,j}}\alpha_{R,j}^{\alpha_{R,j}}}, \quad j = US,\ KS\ , \tag{7}$$

where d_U is the site rent and $r_{H,j}$ is the structure rent. In our model all of these are shadow prices since all dwellings are owner-occupied. (In Korea, for example, 94% of rural and 83% of urban households were owner-occupiers in 1975.)[19] Nevertheless, it will still prove analytically useful to decompose total rental (shadow) prices in this fashion. In percentage rates of change (denoted by an "*"), these rental prices are related by

$$P^*_{H,j} = \alpha_{R,j}d^*_U + \alpha_{H,j}r^*_{H,j}\ , \quad j = US,\ KS\ , \tag{8}$$

Land's share, $\alpha_{R,j}$, has been estimated to be about 0.10.[20] It follows that modest increases in urban rental prices may be consistent with dramatic increases in urban site rents (called the "magnification effect" in the urban literature). Dramatic increases in urban site rents imply equally dramatic increases in urban land prices and the latter have become a notable feature of twentieth-century development even in the Third World. For example, Korean urban land prices have been rising in real terms at 16% per annum since the early 1960s.[21]

What, then, determines land rents and land use in our model?

If the agricultural production function is Cobb-Douglas, land rents per hectare can be written as

$$d_A = P_A\alpha_{A,R}\frac{Q_A}{R_A}\ , \tag{9}$$

where Q_A is agricultural output, R_A is farmland, P_A are farm product prices, and $\alpha_{A,R}$ is the output elasticity of land in agriculture. Alter-

[19] S. M. Suh, "The Patterns of Poverty in Korea," Working Paper no. 7903 (Seoul: Korea Development Institute, 1979), table 11, p. 47.

[20] Muth, *The Derived Demand for Urban Land.*

[21] Mills and Song.

natively, expression (9) can be written as a derived demand function for farmland:

$$R_A = P_A \alpha_{A,R} Q_A d_A^{-1} . \tag{10}$$

Similarly, the urban housing Cobb-Douglas production functions imply derived urban land demands for residential purposes (recalling that "residential" requirements embody commercial, factory, and public site needs). Thus,

$$d_{U,j} = P_{H,j}{}^S \alpha_{R,j} Q_{H,j} R_{U,j}{}^{-1} , \quad j = US, KS , \tag{11}$$

where $P_{H,j}{}^S$ is the net rent received by the owner (imputed, not cash) after paying an urban property tax. Since it is not our purpose here to determine the distribution of urban populations across urban space—as in classic urban location theory—nor to confront the Third World reality that squatter settlements tend to locate at the fringe of the city while luxury housing tends to locate nearer the central business district,[22] we shall assume that urban site rents are the same for all urban households. Thus,

$$R_{U,j} = P_{H,j}{}^S \alpha_{R,j} Q_{H,j} d_U{}^{-1} , \quad j = US, KS , \tag{12}$$

The *aggregate* derived demand function for urban land is simply

$$R_U = d_U{}^{-1}(P_{H,US}{}^S \alpha_{R,US} Q_{H,US} + P_{H,KS}{}^S \alpha_{R,KS} Q_{H,KS}) . \tag{13}$$

Our model is in no way a true spatial framework since distance plays no role in either of the two sectors. Thus, farm gate prices do not rise with greater proximity to urban markets and therefore farmland does not exhibit a "rental gradient" reflecting such heterogeneity. Similarly, proximity to the central business district does not offer any of the advantages typically postulated in conventional urban location theory. There is therefore no urban rental gradient implied. Since urban land is homogenous in this sense, only the "extramarginal" rent at the fringe of the city matters in determining land use.

Figure 2 supplies the optimal land-use solution under such conditions. The equilibrium rent is denoted by $d^*(0)$, and the optimal land-

[22] This process is discussed in R. Mohan, *Urban Economic and Planning Models* (Baltimore: Johns Hopkins University Press, 1979); G. K. Ingram and A. Carroll, "The Spatial Structure of Latin American Cities" (paper read at the American Economic Association Meetings, Chicago, 1978); Mills and Song.

use mix is derived accordingly. What seems interesting to us is how many central land-use issues are captured by this simple framework. Three such issues are confronted in what follows: Does the model predict rising urban densities over time? Can it account for the dramatic rise in urban land values? Will it produce an encroachment on farmland over time?

It is common theorem of growth theory that factors in relative inelastic supply will increase in relative rent (and thus price or value) unless technology tends to be very factor-saving of the inelastically supplied input.[23] In our model, capital accumulates, skills are augmented through training, population growth swells the labor force (and thus residential housing stocks), but the stock of land grows exogenously, and presumably at relatively low rates. The presumption is that relative rents will rise over time unless technological change serves to save on land. If one focuses only on land for agricultural uses, "technological change" surely *does* tend to save on land since the agricultural sector declines in relative size with successful economic growth. On the other hand, our model explicitly introduces an additional land use—urban residential site needs—and since successful economic growth implies rapid urbanization, the land-saving attributes of the simpler

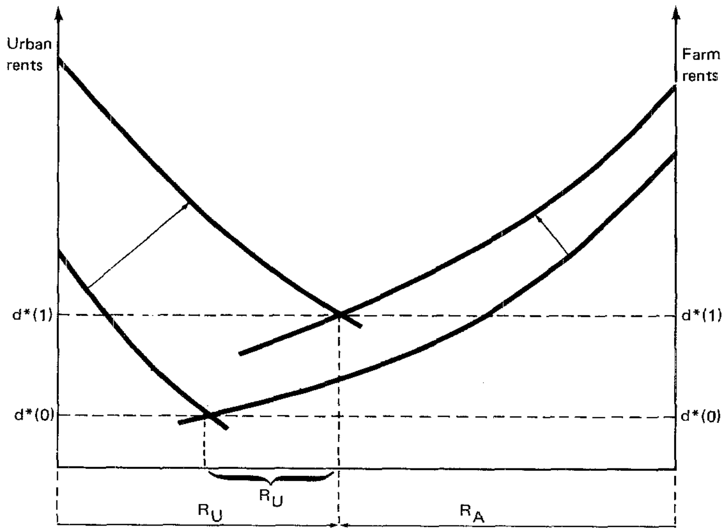

FIG. 2.—The determinants of land rents and optimal land use

[23] See, e.g., D. Nichols, "Land and Economic Growth," *American Economic Review* 60 (June 1970): 332–41.

growth model are no longer so relevant. Indeed, while our urban housing production function specifications include the possibility of extensive substitution of structures for land (guaranteeing that urban densities will increase in the face of rising land rents), rapid urbanization implies a relatively voracious demand for land and the encroachment of farmland at the cities' margin. Additionally, there are forces at work in agriculture which will shift outward the derived demand for farmland: the rising price of foodstuffs and the accumulation of agricultural capital. In short, we would expect such a model to produce an outward shift in the derived demand for land in both uses over time, but we would also expect that the derived demand for urban land would shift outward at a more rapid rate.

The long-run implications of such derived demand growth can be seen in figure 2, where the following trends should be observed: rents rise at a rapid rate, urban and rural; land use shifts in favor of urban residential use, but the rate of shift is choked off by two forces—the downward-sloping character of the derived demand for farmland and the tendency for urban housing to consume less space as land gets scarcer; urban land densities rise. All of these attributes are "stylized facts" of urbanization in the Third World. In addition, urban land values can be calculated assuming naive expectations regarding the behavior of future rents (i.e., d_U is expected to prevail at the current rate forever) and assuming infinite life. Thus,

$$V_U = d_U/i \, , \tag{14}$$

where i is the economy-wide "discount rate." In the absence of any upward drift in i over time, increases in the relative price of urban land should be a characteristic of our model of urban growth as well.

In short, we have uncovered another natural limit to urban growth. Rising urban land scarcity is assured in our model and the resulting increased urban site rents will tend to widen urban-rural cost-of-living differentials as urbanization proceeds. Whether the relative rise in the urban cost of living will seriously inhibit urban in-migration is an empirical issue, but it is a limit to urban growth worth considering in greater detail.

D. Education, Training, and Skills Accumulation

The availability of skilled labor may have a potent impact on growth and urbanization. Slow rates of growth in the stock of skills can constrain expansion in the modern urban sectors where skilled labor is utilized intensively. Demand shifts favoring these skill-intensive sectors serve to raise skilled labor's wage, to produce wage stretching and earnings inequality, as well as to generate skill bottlenecks. The potential importance of these bottlenecks depends critically on the degree to which unskilled labor and capital can be used as substitutes for skills. Debate on this issue has been extensive and until recently divided into two camps: the manpower "structuralists" who see little opportunity for substitution between labor of different skills, and their opponents who argue on the contrary that substitution elasticities are very high between labor of different skills. We have been persuaded by the structuralist position so that relatively low substitution elasticities should be incorporated in the production function presented in equation (1).

The importance of a skilled labor bottleneck also depends on the response of skill accumulation to demand. Skill formation rates are a function of three forces in the specification which follows: the stock of "trainable" urban labor, the relative scarcity of skills, and the level of government expenditures on formal education which influences the ease with which "trainables" can in fact be converted to skilled labor. We are aware that many Third World economies appear to exhibit a glut of formal school graduates. The specification which follows is designed to account for a variety of Third World experience, since the model may generate abundance or scarcity of those formally schooled. In any case, the stock of trainables is limited to *urban* workers only: rural workers, regardless of educational training, must first migrate to urban areas before being considered for training.

How, then, might the skills acquisition process be modeled in a general equilibrium model of urban growth? We shall assume the training to be financed by the industries which utilize skilled labor, and that individuals cannot gain access to training unless selected by firms who find it profitable to make such investments. The full cost of the training is therefore borne by the industries rather than the individual. (Trainees do bear the time cost of training, but only in forgone leisure.) Furthermore, we shall treat our urban modern sectors as if in collusion on their training investments, and no industry tries to obtain a "free ride" by simply hiring newly skilled workers after another industry has made the necessary investments.

The procedure involves first determining the returns to investment in training (and thus the demand function for skills), second determining the costs of training (and thus the supply function for skills), and third determining the supply of workers actually trained. Given the latter, the training activity can be priced and thus the total investment requirements computed. These investment requirements become another claim on the current saving pool. The economy therefore accumulates three types of long-lived assets—physical capital, housing, and skills.

We are conscious of the fact that the *KS* sector relies more heavily on skilled workers drawn directly from the formal education sector (clerks, bureaucrats, teachers, and doctors), while the *M* sector normally relies more heavily on blue-collar workers who acquire skill by on-the-job training. Yet, our simplification does not appear to be totally inappropriate. Public education *is* determined in part by government investment decisions, and thus the formal-education-using *KS* sector can also be viewed in the same light as the *M* sector. Moreover, considerable training may even be required in government activity to convert the formally educated student into a worker of more immediate use.

After taxes, total profits are simply $r_j(1 - \tau_{\Pi,j})K_j$, where r_j is a pretrade rate of return in the jth sector ($j = M,KS$) and $\tau_{\Pi,j}$ is the profit tax rate. With physical capital stocks fixed in the short run, total profits are augmented by the marginal addition of one more trained skilled worker as follows:

$$\frac{\partial[r_j(1 - \tau_{\Pi,j})K_j]}{\partial S_j} = K_j(1 - \tau_{\Pi,j}) \left.\frac{\partial r_i}{\partial S_j}\right|_{S_j + \dot{S}_j} = \Phi_{S,j} \,, \quad j = M,KS \,, \quad (15)$$

where $\Phi_{S,j}$ is the marginal after-tax revenue from the addition of one skilled worker.

For purposes of simplification, assume for the moment that the per unit costs of training a worker are constant at c. These are marginal (and average) costs common to both industries. While these training costs are all incurred in the current time period, the revenue stream will continue throughout the working life of the skilled worker. We shall assume that firms find it profitable to train only young workers with a long working life. For computational simplicity, we shall also assume that firms compute the present value of these anticipated returns assuming naive expectations that $\Phi_{S,j}$ shall prevail indefinitely and that the young skilled laborer can be viewed (at least approximately) as an asset with infinite life. The resulting present value of the benefit stream generated by current investment in training is simply

$$\hat{r}_{S,j} = \frac{\Phi_{S,j}}{i} \,, \quad j = M,KS \,, \quad (16)$$

where i is an economy-wide discount rate, the latter taken as the weighted average of returns to physical capital in the various sectors. Thus, we have explicitly introduced the notion that training must compete with alternative investments in economy-wide physical accumulation. Presumably, the firm is indifferent between investment in training and alternative modes of accumulation such that current costs and capitalized benefits are equated:

$$\hat{r}_{S,j} = c \,, \quad j = M,KS \,. \tag{17}$$

What determines the stock of potential trainables? Generally, this includes all of last year's unskilled workers (excluding deaths and retirements) plus all new entrants who are children of urban households, but excludes any of this year's rural in-migrants. The exclusion of recent in-migrants is based on a two-staged view of in-migration: only those unskilled who have already had some exposure to urban work are considered trainable by modern sector firms. The urban unskilled are also distinguished by level of *formal* education, the latter dictated by previous government educational policy and the demographic structure of the urban population. Thus, the current stock of urban trainables by formal educational achievement is determined exogenously. Furthermore, it seems reasonable to assume that those with high formal educational attainment tend to be relatively cheap to train. A "step" cost function of the following kind might be postulated:

$$c = \begin{cases} c_0 \,, & 0 \leq \dot{S} \leq L_{U,0} \,, \quad k = 0 \,, \quad Ed > n \text{ years} \\ c_1 \,, & L_{U,0} < \dot{S} \leq L_{U,1} \,, \quad k = 1 \,, \quad n - 1 < Ed \leq n \\ \vdots & \qquad\qquad\qquad\qquad\qquad\qquad\qquad \vdots \\ c_n \,, & L_{U,n-1} < \dot{S} \leq L_{U,n} \,, \quad k = n \,, \quad Ed = 0 \end{cases} \,, \tag{18}$$

where K represents the formal education class ($k = 0$ denoting highest attainment), and the total trainables constraint is

$$\dot{S} = \Sigma_j \dot{S}_j \leqq L_U \,, \quad j = M,KS \,, \tag{19}$$

where L is the optimal class trained satisfying (17) and $\dot{S}$ are total workers trained.

Figure 3 portrays the training market. Anticipated returns and the discount rate dictate the aggregate demand function for training. High anticipated returns generate buoyant demands in the two industries combined; such high anticipated returns may manifest themselves in skill bottlenecks with sizable skill premia. Figure 3 illustrates two possibilities. At point X, demand ($\hat{r}_i$) is slack and a substantial share of those in the $k = 1$ educational class would find themselves glutting the market and thus employed at unskilled tasks. (In the $k = 1$ class $\overline{AB}$ workers will be trained and $\overline{BC}$ workers will remain untrained.) In contrast, at point Y, a much larger share of those with formal education are trained as skilled workers, leaving perhaps only elementary school graduates ($k = 2$) and dropouts plus illiterates ($k = 3$) in unskilled jobs.

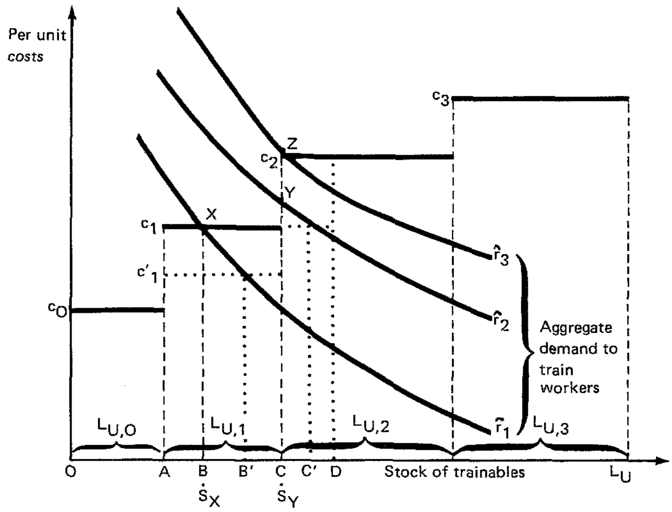

FIG. 3.—The skills investment market

Note too that an expansion in demand for skilled workers may in some circumstances be met with a rise in skilled wages and *no* additional training (from Y to Z), while in other circumstances the training rate may rise (from X to Y). The stock of trainables by k class as well as the height of the step in the cost function both matter to this result.

Total training costs, or total investment in training, can be written in either of two ways:

$$\text{Training costs} = \Sigma_k c_k L_{U,k} + c_l[\dot{S} - \Sigma_k L_{U,k}], \quad k = 0, \ldots, l-1 \tag{20}$$

and

$$\text{Training costs} = P_{KS} \cdot I_{S,KS} \ . \tag{21}$$

These training costs must lay claim on some real resources in the economy, that is, some "capital goods" sector must allocate resources to that investment activity and the investing firm's training cost ("tuition") must accrue as income to some sector. As is apparent in equation (21), it seems sensible to us to assign this capital goods activity to the KS sector since, after all, KS includes formal education. We are aware that this specification may have important implications for wage structure dynamics: high skill premia and earnings inequality imply profitability of investment in skills acquisition. The training investment response places demands on the KS sector. These added demands for KS output imply the augmentation of demand of skills (since they are used especially intensively there), and thus the wage premium may remain high in spite of rapid skills accumulation.

E. Housing Investment, "Productive" Accumulation, and Aggregate Saving

Aggregate saving determines accumulation possibilities, and this savings pool is generated from three sources: retained after-tax corporate and enterprise profits, government saving, and household saving. (Foreign saving serves to augment government resources and thus indirectly appears as a component of government saving; see subsection F, "Demand, Urban Bias, and the Role of the State".) These three sources can be written as

$$\begin{aligned}\text{Savings} = {} & (1 - \psi_M)[(1 - \tau_{\Pi,M})(r_M - \delta_M \bar{P}_M)K_M] \\ & + \delta_M \bar{P}_M K_M + (1 - \psi_{KS})[(1 - \tau_{\Pi,KS})(r_{KS} - \delta_{KS}\bar{P}_M)K_{KS} \\ & + \delta_{KS}\bar{P}_M K_{KS} + s_{US}L_{US} + s_M L_m \\ & + s_{KS}L_{KS} + s_R L_R + s_C C + s_S S + G_s \, ,\end{aligned} \tag{22}$$

where the ψ_j are after-tax firm pay-out rates, δ_j are depreciation rates, s_j are class-specific per capita savings, G_s is government savings, and C are the number of property income recipients. There are three competing demands on this savings pool: investment in physical ("productive") capital, investment in human capital (training), and investment in ("unproductive") housing. Following the conventional emphasis in the development literature, the value of physical capital accumulation (investment goods produced by the M sector or imported) is written as a residual in equation (23):

$$\bar{P}_M I_M = \text{Savings} - \text{Housing} - \text{Training costs} \, , \tag{23}$$

but it should be emphasized that these three modes of accumulation are determined simultaneously and in competition. The determinants of training investment were described above. This section will focus on housing investment demand under imperfect capital markets. It will then conclude with a summary of the mechanism which dictates overall investment allocation.

Following Coale and Hoover, we distinguish between "productive" and "unproductive" investment. Unproductive investment is captured by housing requirements, a component which is sensitive to demographic and urbanization forces. Furthermore, housing investment might be viewed in much the same way that subsistence consumption requirements are treated in most consumer demand systems. That is, private households might be assumed to behave in a fashion such that housing needs receive first priority in their investment portfolios. Only after these investment needs are satisfied might households release their residual savings for productive accumulation purposes, through banks, nonbank financial institutions, and informal "curb" markets. This characterization is motivated by McKinnon's emphasis on "financial market fragmentation."[24] Since the formal mortgage market is poorly developed or nonexistent in much of the Third World, we might for simplicity assume that *none* of the three private housing sectors (rural, urban squatter settlements, and urban luxury housing) are able to secure external finance to satisfy investment requirements. Housing investment would therefore be self-financed by each household sector independent of other surplus-generating sectors. While this specification eliminates the possibility of *inter*sectoral housing financial flows, it does not exclude the possibility of *intra*sectoral housing financial flows. For example, fathers may loan to sons, but middle-class skilled households cannot loan to poor unskilled households. Certain sectors may therefore be starved for housing finance while others have a surplus which they allocate to the national saving pool for productive accumulation or training investment.

Under conditions of rapid population growth, it is quite possible that household savings will be fully exhausted by housing investment requirements. This potential demographic burden would be reinforced in our model by rapid rates of urbanization since migration of even a stable aggregate population requires new housing construction in the receiving regions, and net investment economy-wide. Yet, future in-migration and urbanization may well be curtailed given the urban housing requirements that current population movements imply. After all, increased urban housing investment serves to inhibit the accumulation of productive capital, and we know that the rate of productive capital accumulation is a central determinant of the relative expansion of employment in the modern sectors and thus migration and urban growth. On the other hand, urban housing investment shortfall will result in a rise in urban rents thereby attenuating in-migration through cost-of-living effects.

What remains is to convert these qualitative descriptions of investment demand in housing under capital market fragmentation into explicit quantifiable equations. At given prices and incomes, suppose we were to specify the following type of investment demand equation:

[24] R. McKinnon, *Money and Capital in Economic Development* (Washington, D.C.: Brookings Institution, 1973).

$$I_{H,j} = \min\{s_jL_jP_j^{-1}, I_{H,j}^N + \delta_{H,j}H_j\} ,$$
$$I_{H,j} = \max\{0, \mathrm{I}_{H,j}\} , \tag{24}$$

where $s_jL_jP_j^{-1}$ is the saving generated by households consuming the jth type of housing (deflated by P_j and thus converted into housing investment quantities), $I_{H,j}^N$ is *net* investment in housing, $I_{H,j}$ is *gross* investment in housing, and H_j is the housing stock of type j ($j = US, RS, KS$). The first expression simply states that household saving in sector j may be binding on housing investment in that sector. If not, dwelling investment will not exhaust the sector's household saving and a surplus will be available for accumulation in other forms. The second expression above simply states that gross investment cannot be negative. This expression is unlikely to be binding under conditions of rapid population growth, even with substantial rural out-migration rates.

In discussing the determinants of net investment, it will be helpful to define the following terms, some of which are new while others are added to refresh the reader's memory:

$\hat{r}_{H,j}$ = an index of profitability of housing investment in the jth housing stock, a "benefit-cost" ratio computed as the ratio of the discounted stream of net rents to current construction costs;
P_j = per unit construction costs of H_j;
$r_{H,j}$ = per unit "structure rent" on H_j (a shadow price since owner-occupied status is assumed, and thus rents are fully flexible with no market stickiness);
i = the discount rate, or average rate of return on physical capital economy-wide;
$P_{H,j}$ = total rental price, including both the site and structure rental components.

Using these definitions, net investment in housing in the jth sector is written as

$$I_{H,j}^N = \Theta_{H,j}(\hat{r}_{H,j}^{\varepsilon H} - 1) , \tag{25}$$

where $\hat{r}_{H,j}$ is the index of investment profitability:

$$\hat{r}_{H,j} = [(r_{H,j} - \delta_{H,j}P_j)i^{-1}]P_j^{-1} , \quad j = US, KS, RS . \tag{26}$$

High values of $\hat{r}_{H,j}$ indicate high profitability with positive gaps between capitalized anticipated net rents and current construction costs. This expression also states that net investment in housing should be zero when the benefit-cost ratio is unity, that is, where the economy-wide percentage rate of return equals the rate of return on sector j's new housing investment. Higher values of $\hat{r}_{H,j}$ imply more housing investment at the expense of alternative investment elsewhere in the economy.

As equation (26) reveals, structure rents are central to the determination of $\hat{r}_{H,j}$. Given Cobb-Douglas urban housing service production functions (see subsection *C*), urban structure rents are

$$r_{H,j} = \left(\frac{A_{H,j} P_{H,j}{}^{S} \alpha_{H,j}{}^{\alpha_{H,j}} \alpha_{R,j}{}^{\alpha_{R,j}}}{d_{U,j}{}^{\alpha_{R,j}}} \right)^{1/\alpha_{H,j}} , \quad j = US, KS . \tag{27}$$

Recall that $r_{H,j}$ is a shadow price since we have assumed for convenience that all housing is owner-occupied. Note, too, the presence of $P_{H,j}{}^{S}$ in the expression for $r_{H,j}$. It is the total rental price *after* urban residential property taxes have been assessed and paid.

There are three sectors involved in housing construction in our simplification. $I_{H,RS}$ represents rural dwellings produced by the informal *RS* sector, perhaps even constructed by the occupying household itself and with waste materials. $I_{H,US}$ represents similar low-cost urban dwellings (shanty housing or squatter settlements) produced by the informal labor-intensive *US* sector, also perhaps even constructed by the occupying household itself. $I_{H,KS}$ denotes high-cost housing, produced by the formal construction sector, which, as part of *KS* activities, is relatively capital- and skill-intensive, and generates intermediate input demands in the primary product and manufacturing sectors. When these housing investment requirements are valued by current construction costs, P_j, total investment demand for housing is obtained in value terms:

$$\text{Housing} = P_{RS} I_{H,RS} + P_{US} I_{H,US} + P_{KS} I_{H,KS} . \tag{28}$$

It might be helpful to summarize saving, accumulation, and capital goods sector activity at this point. In terms of the majority of computable general equilibrium models, we are suggesting an unusual treatment of accumulation. There is not just one capital goods sector, but rather four (*KS* producing skills; *RS*, *US*, and *KS* constructing dwellings; and *M* producing physical capital goods). There is not just one mode of accumulation, but rather there are three (skills, physical capital, and housing). Note, too, that the three modes of accumulation are explicitly competitive. Skills accumulation takes place up to the point where rates of return are equated to the economy-wide rate on physical capital accumulation. Physical capital goods are allocated across the three capital-using sectors so as to minimize rate of return differentials. Dwelling investment will utilize household saving only up to the point where rates of return are equated to the economy-wide rate on physical capital accumulation. Of course, there are important institutional and technological features which seriously restrict the economy's ability to equate rates of return at the margin. Any of the three dwelling markets may be starved for funds since the absence of an intersectoral mortgage market may leave housing investment requirements in excess demand. The immobility of physical capital stocks between sectors makes it possible that current physical investment allocations are insufficient to equalize rates of return to capital. Indeed, the larger housing investment requirements are, the smaller is the residual pool available for "productive" capital accumulation and the more likely it is that current investment allocations are insufficient to equalize sectoral rates of return between *A*, *M*, and *KS*. Furthermore, firms' demands for skills may be unsatisfied if the stock of "potential trainables" is insufficient to meet the training investment levels which would equalize rates of return economy-wide. In short, capital market disequilibrium may well be a permanent attribute of our urbanizing economy.

F. Demand, "Urban Bias," and the Role of the State

Thus far we have made no mention of demand, either public or private, and this is an obvious pro-urban force. Private sector demand can be dispatched quickly. Whichever formal demand system one favors (and we favor the extended linear expenditure system), it will clearly exhibit a pro-urban bias since implied income elasticity of demands will surely favor urban goods following Engel's law. Given high income elasticities attached to saving, we have an additional pro-urban demand bias since the majority of the capital goods producing sectors are urban located. The same is likely to be true of the government sector, although here the pro-urban bias is almost certainly larger. While we have focused on supply-side limits to urban growth up to this point, this section therefore dwells on some especially strong urban growth stimuli coming in particular from government demand.

It seems apparent that government demands are far more urban biased than are private demands, and we capture this characteristic by assuming that *all* government final demands are satisfied by the capital-cum-skill-intensive (*KS*) modern service sector. Thus, a shift in current income from the private to the public sector imparts an inevitable pro-urban bias from the demand side. The key to this urban bias is therefore the endogenous determinants of the tax revenue share in GNP.

Total tax revenues, *T*, come from a wide range of sources. For brevity, it will suffice to simply list these sources: taxes on households' consumption of M sector goods; taxes (or subsidies) on agricultural intermediate inputs purchased from manufacturing (e.g., fertilizer); taxes on urban property (uncommon in Third World economies at present, but a potential future revenue source); taxes on net enterprise income in the M and KS sectors; taxes on high-income households—that is, taxes on distributed profits, rental income in agriculture, skilled labor's income; and foreign trade duties. Any total tax revenue function with these component sources is certain to exhibit a high elasticity with respect to GNP and its correlates—especially urbanization itself—an increase in the share of manufactured goods in total household expenditures, a rising share of modern sector output, a shift of the labor force into higher-skilled occupations, and an increasing inequality in the distribution of income in the early to intermediate stages of economic development. A rising share of taxes and government spending in GNP is a likely outcome from our model, and such patterns would conform with several empirical studies.

Unlike most general equilibrium models, government spending is *not* exogenously given in our model.[25] The present model attempts, albeit in a highly simplified fashion, to capture aspects of government spending over time by appealing to much the same forces that determine private consumption and saving behavior. The government is assumed to allocate its budget to saving, G_S, in response to increments in the resources available to it from taxes and foreign sources, and in response to demographic and urban pressures—by assumption the main source of public investment demands. Thus,

$$G_S = \alpha_G + \beta_G(T + \bar{F}) + \gamma_G[\dot{N}_U(-1)] , \tag{29}$$

where $\dot{N}_U(-1)$ is the lagged increase in the urban population and $\bar{F}$ denotes external aid and net private foreign capital, both assumed to flow through government channels. We anticipate that government's marginal propensity to save, β_G, exceeds that of the private sector, based on the literature accumulated to date on this issue.[26] We also expect, contrary to the Coale and Hoover hypothesis, that public saving is positively related to increasing urban populations, $\gamma_G > 0$.[27] Some analysts, like Michael Lipton, would view this prediction as an accurate

[25] For an exception, see P. S. Heller, "A Model of Public Fiscal Behavior in Developing Economies," *American Economic Review* 65, no. 3 (June 1975): 429–45.

[26] R. F. Mikesell and J. E. Zinser, "The Nature of the Savings Function in Developing Countries: A Survey of the Theoretical and Empirical Literature," *Journal of Economic Literature* 11, no. 1 (March 1973): 1–26; P. Yotopoulos and J. Nugent, *Economics of Development: Empirical Investigations* (New York: Harper & Row, 1976); J. G. Williamson, "Why do Koreans Save 'So Little'?" *Journal of Development Economics* 6, no. 3 (September 1979): 343–62.

[27] Coale and Hoover.

reflection of the realities of the "urban bias in world development."[28] A pooled sample of representative Third World economies covering the 1960s and early 1970s confirms both expectations. Indeed, $\hat{\beta}_G$ and $\hat{\gamma}_G$ are estimated as 0.334 (9.19) and 0.484 (4.06), respectively (*t*-statistics in parentheses). This result is not conditional on our definition of saving since similar results are forthcoming when expenditures on education are excluded from government saving.

Finally, note that since $\hat{\beta}_G < 1$, changes in levels of foreign aid do not augment the domestic saving pool by an equal amount, but rather by only $\hat{\beta}_G \cdot d\bar{F}$. This places us squarely in the "revisionist" foreign aid camp.[29] That literature has pointed out that domestic saving appears to bear a negative correlation with foreign aid levels, implying that the domestic savings effort is relaxed with the addition of foreign aid. Presumably, the "relaxation" of the domestic saving effort lies primarily with the government sector where, it is thought, the tax effort is diminished and current expenditures are expanded at the expense of government saving. While our model has little to say about a diminished tax effort, it is apparent from the expression $\beta_G \cdot d\bar{F}$, where $\hat{\beta}_G = 0.334$, that foreign aid does not augment the domestic saving pool dollar for dollar.

V. Research Agenda

The popular and scientific literature has raised cries of alarm over the exceptionally rapid urban growth in the Third World. This alarmist reaction to an important historic event makes all the more imperative research on demoeconomic models capable of revealing the causes and consequences of urban growth. Descriptive accounts of poverty in sprawling squatter settlements, of urban congestion and pollution, and of rising social and political unrest provide insufficient evidence for passing final judgment on the merits of urban growth. Nor does such evidence necessarily imply overurbanization.

Those who view urban growth as unequivocally bad have failed to consider the far worse counterfactual alternative of no growth at all. They certainly fail to take seriously the thousands of migrants voting

[28] M. Lipton, *Why Poor People Stay Poor: Urban Bias in World Development* (Cambridge, Mass.: Harvard University Press, 1977).

[29] K. B. Griffin and J. L. Enos, "Foreign Assistance: Objectives and Consequences," *Economic Development and Cultural Change* 18, no. 3 (April 1970): 313–37; T. Weisskopf, "The Impact of Foreign Capital Inflow on Domestic Savings in Under-developed Countries," *Journal of International Economics* (February 1972), pp. 25–38; G. F. Papanek, "Foreign Aid, Private Investment, Savings, and Growth in LDC's," *Journal of Political Economy* 81 (January/February 1973): 120–30; J. Bhagwati and P. Grinols, "Foreign Capital, Dependence, Destabilization and Feasibility of Transition to Socialism," *Journal of Development Economics* 2 (June 1975): 85–98; E. Grinols and J. Bhagwati, "Foreign Capital, Savings and Dependence," *Review of Economics and Statistics* 58, no. 4 (November 1976): 416–24.

with their feet. Migrants leave the farm in favor of the city because they project improvements in their living standards. Equally important, recent arrivals, on net, *stay* in cities even after personally experiencing the alleged disamenities and high pecuniary costs of urban life. This evidence offers an overwhelming rejection of the view that migrants are irrational, that they fail to take into account the nonpecuniary costs of urbanization, and that they are misinformed regarding the true costs and benefits of urban life.

Analysis of urbanization must, it seems to us, be shifted from the normative perspective which the word "overurbanization" implies. It should shift its focus back to the underlying causes of growth, accumulation, and spatial distributions of population.

The present study has suggested some components which might be incorporated into a general equilibrium model of Third World urbanization. While the complete model is developed more fully elsewhere,[30] here we have focused our discussion on the limits to urban growth in an effort to redress the imbalance in the literature which stresses overurbanization. Having said as much, we must emphasize that our model is neutral on the overurbanization issue. It is a general *equilibrium* model, after all, but we feel that it is a relevant perspective for any realistic assessment of the sources of third World urbanization.

One way to characterize our somewhat complex model is to divide it into two parts; the first part offers a detailed specification of migrant behavior; and the second part embeds that specification in an elaborate economic superstructure which influences and is influenced by this behavior. The migrant responds positively to prospects for improving his living standards. Factors in this decision include his known rural and his anticipated urban rates of pay, his prospects for obtaining favored urban employment, the relative regional costs of housing and other services, and the opportunities he and his children have to consume various urban amenities and public goods (e.g., formal education and on-the-job training). While no single model can specify every aspect of migrant behavior, we feel our characterization is quite rich.

The remainder of the model—the economic superstructure—makes endogenous many features of a potential migrant's decision. This includes relative wage rates, housing and service prices, training opportunities, job creation in various industries, and the like. Central to this modeling effort is the general equilibrium notion of feedback: migrants respond to economic change, and economic change is influenced by migration. Adjustment occurs in markets where prices (e.g., output prices, interest rates, rents, wages) play a signaling and rationing

[30] A. C. Kelley and J. G. Williamson, *Modeling Urbanization and Economic Growth* (Laxenburg, Austria: International Institute for Applied Systems Analysis, 1980).

function, and where factors (e.g., capital, land, labor, commodities) move in response to the signals. While our model does not assume perfect and instantaneous market adjustment—indeed, capital market fragmentation, imperfect labor markets, and nonmarket activities are prominent features of our Third World paradigm—a tendency toward long-run equilibrium is a key attribute of the system. It is this attribute which gives analytic content to the primary prediction of our study—even in a dynamic and growing economy, forces are set in motion which generate endogenous *limits* to urban growth. The paper has spelled out in considerable detail some of these forces.

When will city growth slow down and then cease? At what level will urbanization ultimately settle? These are empirical questions of more than just academic interest. They can be answered by parameterizing demoeconomic models like the one outlined in this paper, by simulating these economies over time, and by analyzing in detail—possibly through the use of the historical counterfactual—many of the forces which are alleged to explain urban growth. It should be apparent that this represents a very ambitious research agenda. We would argue, however, that it also represents the minimum necessary effort for providing even a preliminary assessment of the sources and consequences of Third World urbanization. While serving as a catalyst for such research, alarmist prophecies of doom are poor substitutes for computable general equilibrium models in providing useful answers to questions of overurbanization in the Third World.