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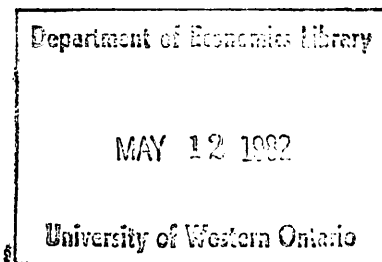
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SQUATTING AND COMMUNITY ORGANIZATION IN DEVELOPING COUNTRIES:

A CONCEPTUAL FRAMEWORK

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I. Introduction

The barriadas of Lima began some 20 years ago as clusters of families...that set up communities of straw shacks on the rocky, barren land outside. The first, small settlements were short-lived, as the police forcibly drove the settlers off, sometimes with fatal beatings of men, women and children, and burned their shacks and household goods...They soon learned that there was greater safety in numbers, and the invasions of land and formation of barriadas became elaborately planned, secretly organized projects involving larger groups...On the appointed day the people recruited for the invasion, usually numbering in the hundreds and sometimes more than 1,000, rushed to the barriada site in taxis, trucks, buses and even on delivery cycles. On arriving, the families immediately began to put up shelters made of matting on their assigned lots.

--W. Mangin (1967b)

The rapid growth of population in cities of the developing world has been accompanied by a dramatic increase in the incidence of squatting.¹ It has been estimated that up to 35-40% of the population in some of the world's largest cities live in so-called "uncontrolled" settlements, where households do not own or rent the land on which they live but are illegally dwelling on it² (Grimes, 1976, Ulack, 1978). This phenomenon is likely to persist as urbanization continues at high levels in the near future, primarily as a result of relatively low income rural households migrating to the cities in a determined effort to seek a better life. These families place a great deal of pressure on an urban housing market which is frequently constrained by government regulation and an underdeveloped financial structure. These pressures combine to make the option of illegally occupying vacant government or privately owned land a viable alternative.

An obvious question is why the legal or formal sector market does not work to meet the excess demand for housing services. Why is there vacant land in the face of population pressure? The largest squatter communities are located on government-owned land (Laquian, 1972) which may have remained

vacant for a number of reasons. The land may be earmarked for some future use (such as a port or government building) and present development is mired in bureaucratic inertia or by lack of immediate financing. Alternatively, the land may be set aside for public recreational use, such as a park or green belt or may be considered marginal, such as rights-of-way of highways and railways, or marshes, flood plains, ravines and hillsides.³ If the land is privately owned, it may be kept vacant for speculative purposes, especially in an environment where a limited financial market constrains opportunities for investment, or where there is monopoly power.⁴ It would not be made available for sale or rent to the incoming migrants because laws regarding minimum development requirements, which are frequently too restrictive (such as the provision of running water, paved streets, etc.) would raise costs beyond what the market would bear or because rent control makes it impossible to gain a reasonable return on an investment. The end result of these restrictions and constraints is a formal market which is unresponsive to the housing needs of a large segment of the population.⁵

Many social scientists have studied squatters. Anthropologists, sociologists, planners and geographers have described the squatters' environment, their life-style, and the evolution of their social structure.⁶ However, rigorous economic analysis has yet to be used in discussing the issues concerned. The previous studies, while useful in documenting the squatter households' situation, do not stress the role of the market in determining how they choose whether or not to squat and how the number of squatters in any given community is determined. Moreover, the hypotheses

and stylized facts that these studies have made popular lack a unifying theoretical framework. This paper is an attempt to begin to fill this gap. In applying a fresh approach to some of the issues regarding squatters, the economic perspective of this paper provides analytically consistent explanations of behavior which can provide insights into some of the stylized facts and hypotheses expounded by other social scientists. Moreover, it derives certain surprising implications for the role of policy.

What are some of the more important stylized notions and facts which can be addressed in an analytical framework? A partial list would include the following: (i) "Most people squat out of necessity;...from sheer desperation" and as "a last resort, a survival strategy for the homeless" (Kearns, 1979). (ii) "Although there are few systematic studies, it has frequently been observed that investment in housing in non-formalized situations is directly related to what might be called the perception of security from non-removal" (Doebele, 1978). (iii) Researchers had found that squatters are on average somewhat poorer than non-squatters (Laquian, 1972, Ulack, 1978), although the differences are not as significant as one might suspect. This is reflected in points (i) and (ii) above, if housing services can be considered as a normal good. However, there is also recent evidence, based on carefully collected surveys, which indicates that there is a substantial amount of overlap in the income distribution profile between squatters and non-squatters. Lindauer (forthcoming), for example, finds that, in what was Manila's and the Philippines' largest squatter area (225,000 population in 1976), "the distribution of...incomes clusters closer toward Manila's median income than it does towards the poorer tail of the

city-wide distribution." Thus, income alone is insufficient to predict a squatting household from a non-squatting one. (iv) Many squatter areas are extremely overcrowded, although some are more so than others. Juppenlatz (1970), for example, found that in his samples, "the diversities of the squatter population seemed to average between 300 and 400 persons per hectare". Laquian (1972) found that squatters are able to achieve very high diversities through doubling up of families. The high diversities, of course, increase the pressure on the provision of urban services (Turner, 1968). (v) Contrary to a misperception featured in the late 50's and early 60's, more recent field work (Mangin, 1967a, Turner, 1968, Laquian, 1972, Ward, 1976) indicates that squatters are well-organized and heavily politicized. This ability to form cohesive and effective coalitions appears to enable them to mount land invasions, enhance a sense of security through their numbers (Portes, 1979, Johnstone, 1978), and control the squatter population (Mangin, 1967a, b). Mangin's (1967b) colorful narrative of a Peruvian land invasion is self explanatory:

The enterprise generally took the form of a quasi-military campaign. Its leaders were usually highly intelligent, articulate, courageous and tough, and often a woman was named the "secretary of defense". For the projected barriada community the leaders recruited married couples under 30 with children...Lawyers or near-lawyers among the recruited group searched land titles to find a site that was owned, or at least could be said to be owned, by some public agency, preferably the national government. The organizers then visited the place at night and marked out the lots assigned to the members for homes and locations for streets, schools, churches, clinics and other facilities.

After all the plans had been made in the utmost secrecy to avoid alerting the police, the organizers appealed confidentially to some prominent political or religious figure to support the invasion when it took place; they also alerted a friendly newspaper, so that any violent police reaction would be fully reported.

In addressing these issues, this paper rejects the view that housing is a last resort and instead views it as a form of tenure choice. Just as households make rational, economically motivated, decisions on whether to own or rent, so do they make judgments on whether or not to squat.⁷ The difference in the analysis comes because the vector of prices and income faced by households under the squatting mode of tenure is uncertain.⁸ In order to focus the attention on how households of similar income and demographic characteristics (see (iii) above) divide into squatters and non-squatters, we assume all households are alike. To make the problem manageable, tastes are also assumed alike. The representative household is assumed to compare maximized utility in the certain environment with maximized expected utility in the squatting environment in making its choice. This paper thus develops a model in which a group of households similar in income and other socioeconomic characteristics would still divide into squatters and non-squatters.

The simplified model makes the central assumptions that the perceived probability of being evicted is negatively correlated and that the costs of being a squatter is positively correlated with the number of squatters in a community. The former assumption is a reflection of (v) above while the latter conceptualizes the costs of living in highly dense settlements (iv). Under these assumptions, the model is able to explain why land invasions occur and why, in a competitive environment, squatter communities tend towards "overcrowding", so that more squatters enter a community than would be optimal. The number of squatters in the urban area depends partly on the degree to which the households who arrive first are able to stake out

and protect their property rights to prevent this overcrowding. (Locational aspects are not considered in this model so that these results hold given location.) If the community is able to fully protect its members' rights and is able to control the squatter population so that the utility of the representative individual is maximized, then it is shown in the paper that government efforts which are meant to reduce the number of squatters may lead to the opposite results. In particular, the imposition of heavier fines or the increase of government expenditures on eviction activity (threat campaigns, eviction in other jurisdictions, etc.) will likely lead to an increase in the optimal number of squatters, unless the decline in expected utility caused by these efforts is so great that squatting no longer becomes viable at any community size. It is also shown in the paper the conditions under which increases in wealth will cause changes in the equilibrium or optimal number of squatters. It is quite possible that a general increase in household income will lead to increased squatting activity, ceteris paribus. It is thus by no means a foregone conclusion that the fast growing cities of Southeast Asia, for example, will rid themselves of their squatters simply as a result of income growth, unless this growth is accompanied by a vigorously pursued government program.

The rest of this paper is divided into five sections. The next section (II) describes the choice to squat and motivates what can be viewed as the demand side model. Section III discusses the assumptions regarding the costs facing the squatters. Section IV is competitive equilibrium analysis, while Section V considers the situation in which squatters are able to form a coalition to restrict entry. The paper concludes with a section on directions for future research.

II. Household Behavior and Equilibrium

This section discusses the decision that a household faces regarding whether or not to squat. The decision is treated as one of tenure choice. All households are assumed to be alike. Let us now consider the following problem: what are the parameters facing a prospective squatter about to enter a city where there is some vacant land, due to some of the reasons outlined in the preceding section? The amount of vacant land available for squatting in the city is assumed to be fixed. Each household is presumed to behave as one individual agent, and, in this initial model, takes all prices as given.

The household thus has the choice of buying housing services in the formal market or squatting. Households are assumed to maximize utility with respect to a flow of housing services, h , and a composite commodity, x , under the parameters they would face in the formal sector market and under squatting. They would then choose the mode of tenure which would yield the greater utility. It is assumed that the presence of squatters does not cause negative utility to the residents of the legal sector. The question of externalities is discussed further in the next section.

If the household were to choose not to squat, it would maximize utility $u(x,h)$ subject to the constraint that $W = ph + x$, where $W \equiv$ wealth and $p \equiv$ the price per unit of formal housing services. The price p can be interpreted as an implicit rental price of housing or as some unit ownership cost. If p is to be interpreted as the latter, it would include financing costs, depreciation, maintenance, foregone interest income, differences in the income tax treatment of renters and owners, net of expected capital

gain, per unit of housing services. It is assumed that x is the numeraire. The usual first order condition would be:

$$\frac{u_h}{u_x} = p . \quad (1)$$

Solving for the equilibrium values of x and h would yield the indirect utility function:

$$V = u[W - ph^*(W,p), h^*(W,p)] \equiv v(W,p) . \quad (2)$$

Households who squat do not have to pay rent. They do have to incur some per unit ownership costs $p_s < p$. They might include fixed costs of setting up and the cost of obtaining urban services, such as water.⁹ Prospective squatters are able to obtain a lower per unit price of housing services only if they are "successful"--i.e., they are not evicted. If indeed a squatter household were not evicted, the budget constraint it would face would be $W = x_n + p_s h_n$, where the subscript n signifies the consumption of the composite commodity and housing services under this state of nature.

However, if a squatter household were evicted, it would have to incur moving costs and possibly a penalty. These are assumed to be a lump-sum cost, C . In this model, the squatter household must precommit itself and spend money on housing services before it finds out whether it is evicted or not. Thus, the evicted squatter would lose whatever it has invested in the settlement and, in addition, would have to find alternative accommodation. It is assumed that it must find this in the formal sector at a price, p .¹⁰ The budget constraint of an evicted household would thus be $W = x_e + ph_e + c + p_s h_n$, where e signifies eviction.

Squatters thus face two possible budget constraints, depending upon whether or not they are evicted. The perceived probability of eviction, π , is assumed to be accepted as given to the squatting household. It is determined partly by government policy, which is a control variable, and will be discussed in the next section. Faced with two possible budget constraints and the probabilities that one would apply rather than the other, the squatter household is assumed to choose its ex post consumption bundle by maximizing expected utility: $Eu = \pi u(x_e, h_e) + (1 - \pi)u(x_n, h_n)$. Substituting in the budget constraint would yield:

$$U^S = \pi u(W - C - p_h h_e - p_s h_n, h_e) + (1 - \pi)u(W - p_s h_n, h_n), \quad (3)$$

where $U^S \equiv Eu^S$, the expected utility of the household.¹¹ Maximizing would yield optimal bundles of h_e^* and h_n^* as functions of the parameters. The first order conditions would be, assuming interior solutions:

$$-p u_{x_e} + u_{h_e} = 0 \quad (4)$$

$$-p_s \{ [\pi / (1 - \pi)] u_{x_e} + u_{x_n} \} + u_{h_n} = 0$$

These conditions would yield demand equations for optimal amounts of housing services under both states of nature: $h_e^* = h_e^*(W - c, p, p_s, \pi)$ and $h_n^* = h_n^*(W, p, p_s, \pi)$. (It can be easily shown that the probability of being evicted is negatively related to h_n^* , as hypothesized in Section I, point [ii].) Substituting h_e^* and h_n^* into (3) would yield the following indirect expected utility function:

$$V^S = \pi v(e) + (1 - \pi)v(n), \quad \text{where}$$

$$v(e) \equiv v(W, C, p, p_s, \pi) = u[W - c - ph_e^*(W - c, p, p_s, \pi) - p_s h_n^*(W, p, p_s, \pi), \\ h_e^*(W - c, p, p_s, \pi)] ,$$

$$v(n) \equiv v(W, p, p_s, \pi) = u[W - p_s h_n^*(W, p, p_s, \pi), h_n^*(W, p, p_s, \pi)] . \quad (5)$$

The $v(\cdot)$'s are thus the indirect utility functions under both states of nature and $v(e) < v(n)$.

The representative household compares its utility under the legal sector with that under the formal sector to decide whether to squat or not. Analytically, this implies that a household will squat if $V > EV^S$. For all households to be in equilibrium, then V must equal V^S , so that there is no incentive for a household to prefer squatting over living in the legal sector:

$$v(W, p) \equiv V = V^S \equiv \pi v(W, C, p, p_s, \pi) + (1 - \pi)v(W, p, p_s, \pi) \quad (6)$$

The characteristics of the household equilibrium are now explored further.

For reasons which will become obvious in the next section, it is useful to characterize this equilibrium in (π, p_s) space:¹² The equilibrium condition (6), which can now be interpreted as the locus of the π and p_s which would make a household indifferent between squatting or not. It can thus be rewritten as:

$$\pi = g(p_s, W, C, p) . \quad (7)$$

If $v(e)$ and $v(n)$ are continuous and monotonic in π and p_s , then $g(\cdot)$ is also a continuous function and π is monotonically related to p_s . It is

shown in Appendix A that this locus is downward sloping:

$$g_{p_s} = h_n^* [\pi v_W(e) + (1 - \pi)v_W(n)] / [v(e) - v(n)] < 0 \quad (8)$$

where $v_W(\cdot) \equiv \partial v(\cdot) / \partial W$. Intuitively, this is so because, starting from a point of equilibrium, an increase in the cost of being a squatter household causes a decline in its utility, relative to the utility of the formal sector household, V . Given $V = \bar{V}$, to restore equilibrium, there must be a compensating decline in the probability of being evicted.

The other property that needs to be derived is the convexity or concavity of (7). The shape of the frontier depends on a number of parameters, including the relative size of the Arrow-Pratt risk aversion measure and the probability of eviction with respect to the price and income elasticities of housing demand.¹³ It is shown in the appendix that the conditions for this locus to be concave in π, p_s space are not overly restrictive. We do not need the assumption of concavity to derive the central results of this paper. Indeed, all the results hold if the locus is convex, as long as a less restrictive condition holds: that it is less convex than the price probability locus to be derived in the next section. The locus is likely to be less convex, the greater is the degree of relative risk aversion and the greater is the mobility of eviction.

Let Ψ represent the difference in utility between the two sectors so that we rewrite (6) as:

$$V^S - V = \Psi(p_s, \pi; W, c, p) \quad (9)$$

$\Psi_0 = 0$ can then be interpreted as the combination of p_s and π along which the representative household is indifferent between renting or owning. Points

closer to the origin represent higher levels of utility in the squatting sector. In Figure 1, $\Psi_2 < \Psi_1 < \Psi_0$. The slope of this locus in (p_s, π) space is, of course, equal to (8).

II. The Price-Probability Locus

This section will outline the constraints on the parameters facing the representative household. First of all, it is assumed that the fixed amount of vacant land is relatively small so that the price of housing services in the formal sector is unaffected by the squatting sector. Squatters thus take p as given. This also implies that the model abstracts from the notion that squatters may cause externalities (by affecting p) to the rest of the urban community. While there may be potentially important considerations in certain situations, we wish to focus our attention on a particular type of squatter community. Moreover, this assumption still allows for large numbers of squatter households in terms of the total urban population.

Other assumptions on the parameters are that $c > 0$, $0 < \pi < 1$, $p_s > \bar{p}_s$, which is some fixed per unit cost of living in an area. The most important assumptions concern the role of the size of the squatter community on the probability of being evicted and the unit cost of obtaining housing services in the formal sector.

It is postulated that the unit price of obtaining housing services in the squatting sector is related to the number of squatters, aside from some fixed component of settling in which is invariant to crowding. As more squatters fill up the vacant land, the more expensive will it be to obtain these services. Mountjoy (1976) claims, for example, that in Africa, situations "such as the three water standpipes in Duala (Camerons) to supply

50,000 squatters are numerous" (p. 135). The price of obtaining a unit of housing services would also tend to rise because of a decline in the amount of land available for settlement. We can thus write

$$p_s = p_s(N) \quad (10)$$

where $N \equiv$ the total number of squatters and $p'_s > 0$. The function is assumed monotone and continuous. We also assume that the increase in congestion costs as more squatters enter the community rise at an increasing rate. This seems to be a reasonable assumption given a fixed amount of amenities and land which yield the services to be consumed. Thus, $p''_s > 0$, and the addition to congestion costs of another squatter will be less when there are few squatters than where there are many. The slope and shape of (10) are depicted in the southeast quadrant of Figure 2, where \bar{p}_s is the amount of the cost not dependent upon N .

The perceived probability of being evicted is a continuous function of two variables:

$$\pi = \pi(G, N) \quad (11)$$

Let G signify a shift variable which reflects official policy about squatters. It can thus be interpreted as the amount of resources devoted to "eviction activities". These could take the form of court orders, official government policy announcements, police harassment, eviction in other communities, etc. We assume that $\partial\pi/\partial G \equiv \pi_G > 0$. Also, while squatters accept π as given if they act individually, it is clear from Section I that the perceived probability

of being evicted is also a function of the number of squatters, N , in a given community. As Johnstone (1972) puts it, "Each additional squatter's hut reduces...space but increases the sense or illusion of security." While it may be relatively easy to carry out a court order to evict one or two squatters, it would probably appear to squatters that governments would have political problems in dealing with a large and more concentrated group. These political problems may come in the form of various acts of civil disobedience or through the polls, in localities where elections are held (Portes, 1979; Mountjoy, 1976; Laquian, 1971). The implication is that the unit costs to the government of eviction rises as the size of the squatter community increases. So, given G , we assume that an increase in the number of squatters, N , will cause a decline in the probability of eviction. Thus, $\partial\pi/\partial N \equiv \pi_N < 0$. We also assume that the decline in the probability of eviction rises with the number of squatters. This implies that $\pi_{NN} > 0$. This appears reasonable given that political pressure from other sympathetic parties (perhaps external) would mount as the number of squatters to be evicted increases. So eviction costs for the government rise at an increasing rate. These considerations are depicted in the northwest quadrant of Figure 2. As N goes to 0, the probability of being evicted approaches 1.

Because both π and p_s are related to N , there is a locus of combinations of the probability of being evicted and unit housing prices which correspond to the same number of squatters, given G . This price-probability locus, which is determined by the amount by which congestion increases the unit cost of obtaining housing services in the squatting sector and decreases the perceived probability of being evicted by raising the costs to government, is derived in Figure 2's northeast quadrant. Each π corresponds to a certain N which implies

a unique unit price of squatting, given our assumptions. The locus must be downward sloping and convex to the origin, as shown in the Appendix B, so that, the locus can be written as:

$$\pi = f(p_s; G) , \quad (12)$$

$f_{p_s} < 0$ and $f_{p_s p_s} > 0$. Starting from a point on the $f(\cdot)$ locus, a decline in π will, given G , correspond to an increase in N , which will imply a rise in p_s . An exogenous increase in G will cause a shift in the locus away from the origin. To make the notation simpler, define the implicit function:

$$\pi - f(p_s; G) = \Omega(\pi, p_s; G) = 0 \quad (13)$$

Ω thus defines a "technical" relationship between π and p_s given G . The slope of Ω in (π, p_s) space is f_{p_s} . Let $\Omega_i \equiv \Omega(\pi, p_s; G_i)$ in the diagram.

IV. Competitive Equilibrium

The equilibrium number of squatters is defined as that N at which the marginal squatter will be indifferent between squatting or not. The utility obtainable from living in the squatter sector will be equivalent to that in the formal legal sector if for a given $V = V_0$, (9) is satisfied. Define this locus as Ψ_0 , depicted by the heavy line in Figure 3. In addition, the price-probability relationship (13) must be satisfied for a given $G = G_0$, and denoted by $\Omega = \Omega_0$ in Figure 3. In order to obtain the equilibrium N , (9) and (13) must be solved for p_s and π , which would yield the appropriate value for N .

At certain very low levels of squatter population ($< N_1$), it is never worthwhile to be a squatter. This can be shown as follows. To the left of E_1 on Ω_0 , the price-probability locus, household equilibrium is possible

only with some Ψ (such as Ψ_1) which is further away from the origin than Ψ_0 . The household is thus worse off by squatting if the squatter population is less than a certain threshold size N_1 . This is consistent with the phenomenon of land invasions (described in Section I), which are prevalent in Latin America in which families band together to take over vacant land en masse and build a community literally overnight. N_1 would be the minimum number of households needed to enable such a venture to succeed.

There are two possible equilibria in the situation described by Figure 3, since the Ω_0 locus cuts the Ψ_0 locus more than once: N_1 and N_2 . N_1 is an unstable equilibrium. A small decline in N would result in a lower utility level than that represented by Ψ_0 . So, as described in the previous paragraph, more households would leave the squatting sector which would make those remaining even worse off than before, causing even more squatters to leave until none were left. The system would move along Ω_0 to the left in Figure 3. A small rise in N from N_1 , however, would result in squatters being made better off than their legal sector counterparts. This greater attractiveness in the squatting mode of tenure will result in entry into the squatting sector. We would thus move along the Ω_0 locus towards E_2 since all Ψ loci below the Ψ_0 locus correspond to greater utility. Entry would stop at E_2 , at which the squatter population is N_2 . This is a stable equilibrium. Stability conditions require that $f_{p_s} > g_{p_s}$.

There is, of course, nothing to guarantee that both or either equilibria would exist. Consider the following example. The locus of household equilibria may intersect in Ω_0 only one place, such as Ψ_2 . In this case, no land invasion is necessary in order to make squatting viable. This certainly

seems to be the case for Southeast Asian nations where invasions are not as common as in Latin America. A number of factors may cause this, such as lower income or higher prices in the legal sector (because of greater population pressure in Asia's teeming cities) which may cause the Ψ locus to be further away from the origin than it would be otherwise (see below). Another example is the case when there are no squatters at all. Such a locus (not drawn) would be everywhere below Ω_0 where squatting is everywhere inferior to the legal alternative. In the analysis which follows, we focus our attention to the situation in which squatting is viable and in which there is at least one stable equilibrium.

Comparative Statics: In order to determine what happens to the equilibrium number of squatters as a result of changes in the parameters, we must, first, completely differentiate (9) and (13). Then the determination of how the change in π and p_s affect N is required. An equivalent operation would be to differentiate the system containing (6), (10) and (11), as is done in the appendix.

An increase in government activity devoted to eviction activities would result in a shift outward of the Ω frontier to Ω_1 . There would be a rise in the probability of being evicted. There will be no change in the Ψ_0 since this locus is insensitive to changes in G . As a result N_2 can no longer be an equilibrium solution. If the population in the squatting sector were to remain at N_2 , at the new price probability locus Ω_1 , utility in the squatter sector would be lower than that which would prevail in the formal legal sector. Squatters would leave, causing a decline in congestion until equilibrium is reached at E_3 , consistent with a size of the squatter community at N_3 . Analytically, this unambiguous result (see Appendix) is:

$$\partial N / \partial G = \pi_G [v(e) - v(n)] / \Delta < 0 \quad (14)$$

where $\Delta \equiv -(f_{p_s} - g_{p_s}) [v(e) - v(n)] / p'_s > 0$, if $f_{p_s} > g_{p_s}$, as it is at the stable equilibrium point (E_2). At the unstable equilibrium point (E_1), the sign is reversed.

An increase in the penalty to squatting on the cost of moving will cover a shift inward of the Ψ frontier. Let us reinterpret Figure 3 and consider Ψ_1 as the original locus of household equilibrium. An increase in c would mean that the locus must have shifted towards the origin (to a location such as Ψ_0) since, ceteris paribus, households are worse off than they were originally. Analytically, the effect on the squatter population is:

$$\partial N / \partial C = -\pi v_n(e) / \Delta (1 - \alpha \epsilon) < 0 \quad (15)$$

Squatters will leave until equilibrium is restored by lower congestion costs.

An increase in income will have an ambiguous effect on the number of squatters. There will be no impact on the Ω locus. However, the effect on the Ψ locus may be outwards or inwards relative to the origin, depending upon whether an increase in wealth will cause a greater rise in the utility in the certainty case than the uncertain case.

$$\partial N / \partial W = \{v_W - [\pi v_W(e) + (1 - \pi)v_W(n)]\} / \Delta$$

If we assume constant absolute risk aversion, then an increase in wealth will lead to no change in N .

V. Entry Restrictions

As discussed in Section I, most of the evidence to date indicates that squatter communities tend to be well organized, politicized, motivated and cohesive units. The very fact that the leaders are able to plan and coordinate land invasions attests to this ability to be able to form coalitions for the benefit of the members. The strength of the coalition depends, to a large extent, on its ability to monitor and restrict entry into the community group, as documented for a variety of areas around the world. Once again quoting Mangin (1967) for the Peruvian experience:

...it appears that in squatter settlements there is as much and probably more participation in [not necessarily officially sanctioned] local politics than in other parts of the countries. The [neighborhood] associations...do seem to be able to control, to a certain extent, who will be the members of the invasion groups and the new residents...Most important, associations often give people a feeling of controlling their own destinies [and]...have a major accomplishment that is visible at all times, namely, the invasion and successful retention of a piece of land. (pp. 70-71.)

In Rio de Janeiro, Juppenlitz (1970) describes how "A favela [squatter] association was formed, and, by group action of the established families...any persons who could not submit to the rules of probable coexistence, were forcibly evicted from the favela" (p. 85). Another example is provided by Laquian (1972) for the Philippines:

Aside from fostering community cooperation and mutual assistance, community organizations also perform a protective function for members of the community...The most important external threat is the possibility that the land being squatted upon will be grabbed by others...The use of community organization to confront external threats is seen in attempts to prevent other people from getting the land that the [original] squatters occupy. (pp. 66-67.)

Some countries have even gone so far as to give these associations quasi-legal status. In an attempt towards rationalizing the tenure system in Peru, for

example, some of the community associations have even been described in the law books as "the entities, representative of the populators of a barrio marginal [sic], whose fundamental purpose is to collaborate...in the solution of the problems that affect the community and require the civic cooperation of the populators." (Law 13517, "Organic Law of Marginal Districts," as quoted in Manaster [1968].) This includes the ordering of some of the local property rights.

If a squatter community is cohesive enough to be able to organize groups of threshold size to invade vacant lands, then, in all likelihood, it is also strong enough to control the size of the community at some N^* so that the utility of its representative members is maximized. In Figure 4, let Ψ_0 signify the household equilibrium frontier which is consistent with equality of utility between the formal sector and the squatting sector. It is thus in the best interests of the squatter community to restrict the size of its population to N_4^* so that its members are on the locus Ψ_4 , which is the greatest difference in utility that is still allowed by the price-probability locus.¹⁴ (The star indicates optimal points for the community.) The maximum condition is that:

$$f_{p_s} = g_{p_s} \quad (16)$$

which can be rewritten as:

$$\pi_N [v(e) - v(n)] = -[\pi v_{p_s}(e) + (1 - \pi)v_{p_s}(n)] p'_s$$

where the left-hand side is the marginal benefit (in terms of utility) of adding another squatter through the decline in the probability of eviction and the right-hand side is the marginal cost due to the increment to congestion. This, of course, implies a smaller number of settlers than N_2 , which is the competitive

solution. Thus, if the system were to be left to itself, the squatter area would tend to be "overcrowded", in the sense that there would be more people than optimal for its members.

Comparative Statics: Let us consider the case in which the community association is successful in restricting entry so that the utility of the representative squatter is maximized at N_4^* . The implications of the restriction of entry can be derived in the model by examining what happens to N^* as some of the parameters change, such as an increase of government expenditures on eviction activity, G . As in the no entry case, this will result in an outward shift of the price-probability locus as shown in Figure 4. This shift does not necessarily imply that the optimal size of the squatter community will decline. From the appendix, the condition on the direction of change is determined by completely differentiating the optimal condition, which is that $f_{p_s} = g_{p_s}$. It can be shown that

$$\partial N^*/\partial G = \{-[v(e) - v(n)]\pi_{NG} - p'_s \pi_G [v_{p_s}(e) - v_{p_s}(n)]\}/J \quad (17)$$

where J is the Jacobian whose sign depends upon the convexity of the Ψ locus with respect to the Ω locus. It is less than zero if the Ω locus is more convex than the Ψ locus, as is likely given our assumptions about the shape of p_s and π functions. (This condition is necessary in order to obtain nontrivial results.) Thus (16) states that the optimal number of squatters will increase with additional government eviction activity if the latter adds more to the marginal benefit than to the marginal cost of adding another squatter, in terms of utility of the representative individual.

We know that a decline in the probability of being evicted as a result of the addition of another squatter causes an increase in expected utility. The first term in the bracketed expression of (16) tells us that this increase in expected utility will be augmented if another unit of resources devoted to G leads to an increase in the marginal propensity of another squatter to reduce the risk of eviction ($\pi_{NG} < 0$). This will tend to increase the marginal benefit of another squatter. Otherwise, if $\pi_{NG} > 0$, the marginal benefit of another squatter will decline with an increase in G. If $\pi_{NG} = 0$, the marginal contribution of another squatter to the welfare of those who are already squatting is unaffected by any changes in G.

We also know that the marginal cost of another squatter dweller is the decline in expected utility as a result of the rise in congestion costs another resident brings. An increase in G will likely lead towards a decline in the marginal cost of adding another squatter. The reasoning is as follows: The change in the marginal cost of adding another squatter is given by the sign of $p'_s \pi_G [v_{p_s}(e) - v_{p_s}(n)]/J$. If this is negative the marginal cost will have dropped, which will occur if $[v_{p_s}(e) - v_{p_s}(n)]$ is positive. Now, it is shown in the appendix (A 11) that $v_{p_s}(e) - v_{p_s}(n) = h_n^* [v_W(n) - v_W(e)(1 - \pi(1 - \alpha\epsilon) + \eta)]$. A sufficient condition for this to be positive, given standard estimates of α , ϵ and η , is that $\pi > .036$.¹⁵ It is thus concluded that marginal cost declines as a result of an increase in G. Intuitively, this holds because another squatter causes a decline in the utility of present squatters in the good state of nature. However, an increase in G causes a decline in the probability of this occurring.

The net effect of the forces described in the preceding two paragraphs as N^* can now be described. If an increase in G causes a rise in (or has no effect on) the marginal benefit of another squatter ($\pi_{NG} \leq 0$), then, this, combined with the decline in marginal cost caused by the increase in G , will mean that at the original N_4^* , marginal benefit will exceed marginal cost (we would be at A in Figure 4). Thus, N^* must have increased relative to its original position. In order for N^* to fall as a result of the increase in G , not only must this activity precipitate a decline in the marginal propensity of an additional squatter to reduce the risk of eviction (a phenomenon on which we have no evidence), but the consequent decline in utility must exceed the decline in marginal cost (demonstrated in utility terms) caused by G . We conclude then, that if a squatter community is able to restrict its size to maximize the utility of its members, it is quite likely that government activity which is meant to threaten that community's existence would actually cause the community to expand! In Figure 4, the community will move from N_4^* to N_5^* , which is implied by the tangency of Ω_1 with a Ψ locus (not drawn) further away from the origin than Ψ_4^* . The only way for government activity to be effective is to shift Ω so that it is above Ψ at all N . Halfhearted threats would probably be doomed to failure.¹⁶

The impact of an increase in penalties or moving costs on the optimal number of squatters will affect the slope of the Ψ locus. If the Ψ locus becomes more steep, then, N^* will drop. Otherwise it will rise. The analytical formula is:

$$\partial N^* / \partial C = \{ [v_W(e)\pi_N / (1 - \alpha e)] + p'_S [\pi(1 + \eta)v_W(e)h_n^*(\rho - e) / (1 - \alpha e)^2 W] \} / J \quad (18)$$

This implies that an increase in the penalty to squatting will increase the marginal benefit of having another squatter to the community. The impact on marginal cost is ambiguous and depends upon the size of ρ with respect

to ϵ . An increase in the cost of squatting will cause a decline in the marginal cost of being a squatter if $\rho > \epsilon$ and $\eta < 1$. These conditions are likely to hold since the most recent evidence indicate that housing demand is both income and price inelastic. Intuitively, a rise in c will cause the disutility imposed by higher housing prices to fall if housing demand is relatively inelastic and the more the household is risk averse. The net effect on N^* of a rise in c is thus positive. We have thus derived conditions under which government activity, either in the form of heavier fines or increased eviction expenditures will lead to an increase in the number of squatters.

In order to determine what happens to the optimal number of squatters as the community becomes wealthier:

$$\partial N^* / \partial W = \{-[v_W(e) - v_W(n)]\pi_N + [v(e) - v(n)]p'_s g_p (\epsilon - \rho)\} / J \quad (19)$$

This reflects the change in slope of the Ψ locus. The first term in $\{\cdot\}$ measures the impact of a change in wealth on the marginal benefit of adding another squatter. An increase, say, in wealth, given risk aversion, will lead to a greater increase of utility under the "bad" state of nature than under the "good" state of nature. This implies that the difference in utility between the two states narrows, so that the marginal benefit of another squatter declines with an increase in W . The second term in $\{\cdot\}$ measures the impact of a change in wealth on the marginal cost of adding another squatter. The marginal cost of adding another squatter to the community is related to the increment in unit housing costs in the squatter sector as a result of entry and the expected disutility caused by this increment. An

increase in wealth will affect the latter but not the former. A unit increase in wealth will cause the expected disutility (and thus the marginal cost) of adding another squatter to rise because housing is a normal good and its income elasticity of demand is positive. Thus as wealth increases, housing demand rises and, ceteris paribus, a unit increase in its costs will have a greater impact on utility. This may be countered by the fact that as wealth increases, the marginal utility of another unit of wealth declines due to risk aversion. The net effect on N^* is thus unambiguously negative if $\epsilon > \rho$. If, as is more likely, $\epsilon < \rho$, the net effect depends upon the size of the change in marginal benefit relative to the change in marginal cost.

VI. Summary

The primary goal of this paper has been to present from an economic perspective, the beginnings of a unified and consistent theoretical framework which can explain some of the stylized facts and hypotheses expounded by other social scientists on the phenomenon of squatting. Under the assumptions that the perceived probability of being evicted is negatively correlated and that the costs of being a squatter is positively correlated with the number of squatters in a community, the model is able to explain why land invasions occur. Further, it provides some insights as to why the number of squatters in the urban area depends partly on the degree to which the households who arrive first are able to stake out and protect their property rights to prevent overcrowding. If the community is able to fully protect its members' rights and is able to

control the squatter population so that the utility of the representative individual is maximized, then it is shown in the paper that government efforts which are meant to reduce the number of squatters may lead to the opposite results. In particular, the imposition of heavier fines or the increase of government expenditures on eviction activity (threat campaigns, eviction in other jurisdictions, etc.) will likely lead to an increase in the optimal number of squatters, unless the decline in expected utility caused by these efforts is so great that squatting no longer becomes viable at any community size.

It should be noted that the model described here can be easily adopted, with few modifications, to describe the increasing incidence of squatting in Western industrialized countries, such as Great Britain, The Netherlands and West Germany. Kearns (1979), for example, estimates that London has a squatting population of 30,000 and "has evolved as a prototype for squatters throughout continental Europe."

Obviously, this model is able to address the characteristics of only certain types of squatter communities in particular urban environments. The conclusions reached here may not completely extend to a larger type of squatter area whose size may affect the parameters governing the legal sector either in the form of externalities or through demand pressures on the price of formal sector housing. Such an analysis requires a broader framework of general equilibrium in which the behavior of certain agents would have to be distinguished carefully: renters, owners, and, in particular, government at the city (or national) level. Political considerations would most likely play a more important role, as in Henderson (1980).

APPENDIXA. Demand Considerations:

Squatter households are assumed to maximize the following expected utility function:

$$U^S = \pi u[W-C-ph_e - p_s h_n, h_e] + (1-\pi)u[W-p_s h_n, h_n].$$

The first order conditions for this maximization problem are:

$$-pu_{x_e} + u_{h_e} = 0 \quad (A1)$$

$$-p_s \{ [\pi/(1-\pi)]u_{x_e} + u_{x_n} \} + u_{h_n} = 0$$

which can be solved to yield demand equations for optimal amounts of housing services under both states of maturity: $h_e^* = h_e^*(W-c, p, p_s, \pi)$ and $h_n^* = h_n^*(W, p, p_s, \pi)$.

The demand equations can be substituted into the expected utility function to yield the indirect expected utility function:

$$V^S = \pi v(e) + (1-\pi)v(n) \quad (A2)$$

where $v(e) \equiv v(W, C, p, p_s, \pi) \equiv u[W-C-ph_e^*(W-C, p, p_s, \pi) - p_s h_n^*(W, p, p_s, \pi), h_e^*(W-C, p, p_s, \pi)]$

and $v(n) \equiv v(W, p, p_s, \pi) \equiv u[W-p_s h_n^*(W, p, p_s, \pi), h_n^*(W, p, p_s, \pi)]$. Note that

$v(e) < v(n)$.

Nonsquatter households have an indirect utility function $V = v(W, p) \equiv u[W-ph^*(W, p), h^*(W, p)]$. In equilibrium, the following equation holds:

$$v(W, p) = V = V^S = \pi v(W, c, p, p_s, \pi) + (1-\pi)v(W, p, p_s, \pi) \quad (A3)$$

To avoid confusing this locus to the opportunity cost locus, let (A3) be rewritten as $\pi = g(W, C, p, p_s)$. (A3) defines the locus of equilibrium points in (π, p_s) space. In order to characterize the locus further, let us assume that the preference orderings are continuous, monotonic, convex and homothetic. We can then show that the locus is downward sloping and concave. Differentiating (A3) and solving for $\partial\pi/\partial p_s$, we can obtain:

$$g_{p_s} = \frac{\partial \pi}{\partial p_s} = - \frac{\pi v_{p_s}(e) + (1-\pi)v_{p_s}(n)}{[v(e)-v(n)] + [\pi v_{\pi}(e) + (1-\pi)v_{\pi}(n)]}$$

It can be shown that $\pi v_{\pi}(e) + (1-\pi)v_{\pi}(n) = 0$, since

$$v_{\pi}(n) = u_{x_n} (-p_s \partial h_n^* / \partial \pi) + u_{h_n} (\partial h_n^* / \partial \pi) = [\pi / (1-\pi)] u_{x_e} p_s (\partial h_n^* / \partial \pi)$$

by (A1), and since, by (4):

$$v_{\pi}(e) = -u_{x_e} p_s (\partial h_n^* / \partial \pi) - u_{x_e} p (\partial h_n^* / \partial \pi) + u_{h_e} (\partial h_n^* / \partial \pi) = -u_{x_e} p_s (\partial h_n^* / \partial \pi)$$

Thus, we can write:

$$g_{p_s} = \frac{\partial \pi}{\partial p_s} = - \frac{\pi v_{p_s}(e) + (1-\pi)v_{p_s}(n)}{v(e) - v(n)} < 0 \quad (A4)$$

which implies the locus is downward sloping, since:

$$v_{p_s}(e) = -u_{x_e} [p (\partial h_e^* / \partial p_s) + p_s (\partial h_n^* / \partial p_s) + h_n^*] + u_{h_e} (\partial h_e^* / \partial p_s) .$$

Using (A1), we can write:

$$v_{p_s}(e) = -u_{x_e} h_n^* (1 + \eta) < 0 \quad (A5.a)$$

where $\eta \equiv (\partial h_n^* / \partial p_s) (p_s / h_n^*)$, the price elasticity of demand for squatter dwellings in the nonevicted state. Similar deviations will yield:

$$v_{p_s}(n) = -u_{x_n} h_n^* + [\pi / (1-\pi)] u_{x_e} h_n^* \eta \quad (A5.b)$$

Thus, $\pi v_{p_s}(e) + (1-\pi)v_{p_s}(n) = -h_n^* [\pi u_{x_e} + (1-\pi)u_{x_h}] < 0$, which shows (A4) is negative.

In order to derive the conditions under which the locus is concave, differentiate (A4) with respect to p_s :

$$g_{p_s p_s} = \frac{\partial^2 \pi}{\partial p_s^2} = - \frac{\partial [\pi v_{p_s}(e) + (1-\pi)v_{p_s}(n)] / \partial p_s}{v(e) - v(n)} - \left(\frac{\partial \pi}{\partial p_s} \right) \left\{ \frac{\partial [v(e) - v(n)] / \partial p_s}{v(e) - v(n)} \right\} \quad (A6)$$

In order to evaluate (A6), it is useful to derive the following:

$$v_W(e) = u_{x_e} (1 - p_s \frac{\partial h_n^*}{\partial W}) = u_{x_e} (1 - \alpha \epsilon) \quad (A7)$$

$$v_W(n) = u_{x_n} + [\pi/(1-\pi)] u_{x_e} \alpha \epsilon$$

by differentiating $v(e)$ and $v(n)$ with respect to W and using (A1), where $\alpha \equiv p_s h_n^*/W$, a share equation and $\epsilon \equiv (\partial h_n^*/\partial W)(W/h_n^*)$, the income elasticity of housing demand. We can thus express:

$$v_{p_s}(e) = -v_W(e) h_n^* (1 + \eta) / (1 - \alpha \epsilon) \quad (A8)$$

$$v_{p_s}(n) = -v_W(n) h_n^* + [\pi/(1-\pi)] v_W(e) h_n^* (\alpha \epsilon + \eta) / (1 - \alpha \epsilon) .$$

Using these definitions, and multiplying and dividing the first term of $v_{p_s}(n)$ by $(1 - \alpha \epsilon)$, we obtain:

$$\pi v_{p_s}(e) + (1-\pi) v_{p_s}(n) = [-\pi v_W(e) h_n^* (1 + \eta) / (1 - \alpha \epsilon)]$$

$$+ [-(1-\pi) v_W(n) h_n^* (1 - \alpha \epsilon) / (1 - \alpha \epsilon)] + [\pi v_W(e) h_n^* (\alpha \epsilon + \eta) / (1 - \alpha \epsilon)] .$$

We add and subtract $\pi v_W(e) h_n^* (1 - \alpha \epsilon) / (1 - \alpha \epsilon)$ to the above expression, so that:

$$\pi v_{p_s}(e) + (1-\pi) v_{p_s}(n) = -h_n^* [\pi v_W(e) + (1-\pi) v_W(n)] . \quad (A9)$$

This implies that:

$$\partial [\pi v_{p_s}(e) + (1-\pi) v_{p_s}(n)] / \partial p_s = -[\pi v_W(e) + (1-\pi) v_W(n)] \partial h_n^* / \partial p_s$$

$$- h_n^* [\pi v_{Wp_s}(e) + (1-\pi) v_{Wp_s}(n)] - h_n^* (\partial \pi / \partial p_s) [v_W(e) - v_W(n)] .$$

Since, from (A8) and Young's Theorem $v_{Wp_s}(e) = v_{p_s W}(e) = \{[-v_{WW}(e) h_n^* - v_W(e) (\partial h_n^* / \partial W)] [(1 + \eta) / (1 - \alpha \epsilon)] - v_W(e) h_n^* \{ \partial [(1 + \eta) / (1 - \alpha \epsilon)] / \partial W \}$ and $v_{Wp_s}(n) = v_{p_s W}(n) = -h_n^* v_{WW}(n) - v_W(n) (\partial h_n^* / \partial W) + [\pi / (1-\pi)] \{ v_W(e) h_n^* \partial [(\alpha \epsilon + \eta) / (1 - \alpha \epsilon)] / \partial W$

+ $[(\alpha\varepsilon + \eta)/(1 - \alpha\varepsilon)] [v_{WW}(e)h_n^* + v_W(e)(\partial h_n^*/\partial W)]$, then, $[\pi v_{WP_s}(e) + (1-\pi)v_{WP_s}(n)] = \pi[-v_{WW}(e)h_n^* - v_W(e)(\partial h_n^*/\partial W)] [(1 + \eta)/(1 - \alpha\varepsilon)] - \pi v_W(e)h_n^* \{\partial[(1 + \eta)/(1 - \alpha\varepsilon)]/\partial W\} + (1-\pi)[-v_{WW}(n)h_n^* - v_W(n)(\partial h_n^*/\partial W)] + \pi[v_{WW}(e)h_n^* + v_W(e)(\partial h_n^*/\partial W)] [(\alpha\varepsilon + \eta)/(1 - \alpha\varepsilon)] + \pi v_W(e)h_n^* \partial[(\alpha\varepsilon + \eta)/(1 - \alpha\varepsilon)]/\partial W = -\pi[v_{WW}(e)h_n^* + v_W(e)(\partial h_n^*/\partial W)] + (1-\pi)[-v_{WW}(n)h_n^* - v_W(n)(\partial h_n^*/\partial W)]$. Thus, we can write the numerator of the first term of (A6)

as:

$$\begin{aligned} \partial[\cdot]/\partial p_s &= -[\pi v_W(e) + (1-\pi)v_W(n)] \partial h_n^*/\partial p_s - h_n^* [-\pi v_{WW}(e)h_n^* - (1-\pi)v_{WW}(n)h_n^*] \\ &\quad + h_n^* [\pi v_W(e) + (1-\pi)v_W(n)] \partial h_n^*/\partial W - h_n^* [v_W(e) - v_W(n)] (\partial \pi/\partial p_s) \\ &= h_n^* \{ [\pi v_W(e) + (1-\pi)v_W(n)] [(\partial h_n^*/\partial W) - (\partial h_n^*/\partial p_s)/h_n^*] \\ &\quad - h_n^* [-\pi v_{WW}(e) - (1-\pi)v_{WW}(n)] \} - h_n^* [v_W(e) - v_W(n)] (\partial \pi/\partial p_s) \\ &= h_n^* \{ [\pi v_W(e) + (1-\pi)v_W(n)] [\alpha\varepsilon - \eta] - h_n^* p_s [\pi v_W(e)r(e) + (1-\pi)v_W(n)r(n)] \} / p_s \\ &\quad - h_n^* [v_W(e) - v_W(n)] (\partial \pi/\partial p_s) \end{aligned}$$

where $r(\cdot)$ is the Arrow-Pratt absolute risk aversion measure, where $r(\cdot) = -v_{WW}(\cdot)/v_W(\cdot)$. Kihlstrom and Mirman (1981) discuss the restrictions on preferences which are necessary in order to interpret the Arrow-Pratt measures in the many-community case. If we assume constant absolute risk aversion, so that $r(e) = r(n) = r$ we can further simplify the expression to:

$$\begin{aligned} \partial[\cdot]/\partial p_s &= h_n^* [\pi v_W(e) + (1-\pi)v_W(n)] [\alpha(\varepsilon - \rho) - \eta] / p_s \\ &\quad - h_n^* [v_W(e) - v_W(n)] (\partial \pi/\partial p_s) \end{aligned} \tag{A10}$$

where $\rho \equiv rW$, the Arrow-Pratt measure of relative risk aversion (see Turnovsky, *et al.* (1980) for a similar expression in a different context). The sign depends upon the size of the parameters.

The numerator of the second term of (A6) can be evaluated as:

$$\begin{aligned}
\partial[v(e) - v(n)]/\partial p_s &= v_{p_s}(e) - v_{p_s}(n) = -\{v_W(e)h_n^*(1+\eta)/(1-\alpha\epsilon)\} + v_W(n)h_n^* - \\
&\quad \{[\pi/(1-\pi)]v_W(e)h_n^*(\alpha\epsilon + \eta)/(1-\alpha\epsilon)\} \\
&= -[v_W(e) - v_W(n)]h_n^* - [v_W(e)h_n^*(\eta + \pi\alpha\epsilon)/(1-\pi)(1-\alpha\epsilon)] \quad (A11) \\
&= h_n^*\{v_W(n) - v_W(e)[1-\pi(1-\alpha\epsilon) + \eta]/(1-\alpha\epsilon)(1-\pi)\} \quad (A11)'
\end{aligned}$$

from (A8). Substituting (A10) and (A11) into (A6), and using (A9) in (A4), we obtain:

$$\begin{aligned}
\xi_{p_s p_s} &= -(\partial\pi/\partial p_s)[\alpha(\epsilon - \rho) - \eta]/p_s + 2(\partial\pi/\partial p_s)h_n^*[v_W(e) - v_W(n)]/[v(e) - v(n)] \\
&\quad + (\partial\pi/\partial p_s)v_W(e)h_n^*[(\eta + \alpha\epsilon\pi)/(1-\alpha\epsilon)(1-\pi)]/ \\
&\quad [v(e) - v(n)] \quad (A6)'
\end{aligned}$$

which can be rewritten as:

$$\begin{aligned}
\xi_{p_s p_s} &= -(\partial\pi/\partial p_s)[\alpha(\epsilon - \rho) - \eta]/p_s + (\partial\pi/\partial p_s)\{h_n^*/[v(e) - v(n)]\}\{-2v_W(n) + v_W(e) \\
&\quad [2 + ((\eta + \alpha\epsilon\pi)/(1-\alpha\epsilon)(1-\pi))]\} \geq 0.
\end{aligned}$$

B. The Price-Probability Locus:

We know that:

$$\pi = \pi(N, G) \text{ , where } \pi_N < 0, \pi_G > 0, \pi_{NN} > 0 \quad (\text{A12})$$

$$p_s = p_s(N) \text{ , where } p'_s > 0, p''_s > 0 \quad (\text{A13})$$

These conditions imply that:

$$\pi = \pi[p_s^{-1}(p_s), G] = f[p_s(N), G] \quad (\text{A14})$$

which is the locus of opportunity costs. The $f(\cdot)$ notation differentiates this locus from the utility locus denoted by $g(\cdot)$. To show that it is convex:

$$\pi_N = f_{p_s} p'_s$$

$$\pi_{NN} = p_s'^2 f_{p_s p_s} + (\partial \pi / \partial p_s) p_s''$$

Rearranging terms, we obtain

$$f_{p_s p_s} = [\pi_{NN} - (\pi_N / p'_s) p_s''] / p_s'^2 > 0 .$$

C. Equilibrium Comparative Statics:

The system in equilibrium will be:

$$\pi = \pi(N, G) \quad (\text{A12})$$

$$p_s = p_s(N) \quad (\text{A13})$$

$$v(W, p) = \pi v(W, G, p, p_s, \pi) + (1 - \pi) v(W, p, p_s, \pi) \quad (\text{A3})$$

Totally differentiating this system will yield:

$$\begin{bmatrix} 1 & 0 & -\pi_N \\ 0 & 1 & -p'_s \\ -\{v(e) - v(n)\} & -\{\pi v_{p_s}(e) + (1 - \pi)v_{p_s}(n)\} & 0 \end{bmatrix} \begin{bmatrix} d\pi \\ dp_s \\ dN \end{bmatrix} = \begin{bmatrix} \pi_G & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & \{\pi v_W(e) + (1 - \pi)v_W(n) - v_W\} & \pi v_c(e) & \{-v_p + \pi v_p(e) + (1 - \pi)v_p(n)\} \end{bmatrix} \begin{bmatrix} dG \\ dW \\ dC \\ dp \end{bmatrix} \quad (A15)$$

since $\pi v_n(e) + (1 - \pi)v_n(n) = 0$. The determinant of the above system is

$$\Delta = -\pi_N [v(e) - v(n)] - p'_s [\pi v_{p_s}(e) + (1 - \pi)v_{p_s}(n)] = -[v(e) - v(n)] p'_s [f_{p_s} - g_{p_s}]$$

sign depends on which equilibrium point we take. If we consider the stable equilibrium, then $\Delta > 0$, since at that point, f_{p_s} (less negative) $> g_{p_s}$. At the unstable equilibrium point, $\Delta < 0$. Thus, from (A15):

$$\partial N / \partial G = \pi_G [v(e) - v(n)] / \Delta < 0, \quad (A16)$$

$$\partial N / \partial W = \{v_W - [\pi v_W(e) + (1 - \pi)v_W(n)]\} / \Delta = \quad (A17)$$

$$\partial N / \partial C = \pi v_c(e) / \Delta = -\pi v_W(e) / \Delta (1 - \alpha \epsilon) < 0, \quad (A18)$$

$$\partial N / \partial p = -[\pi v_p(e) + (1 - \pi)v_p(n)] / \Delta, \quad (A19)$$

$$\partial \pi / \partial G = \pi_G / [1 - (f_{p_s} / g_{p_s})] > 0 \text{ at the stable point} \quad (A20)$$

$$\partial p_s / \partial G = \pi_G p'_s [v(e) - v(n)] < 0 \quad (A21)$$

D. Optimal Entry Restrictions:Solve the Ψ locus for V^S :

$$\text{Max}_{\pi, p_s} V^S = \pi v(W, C, p, p_s, \pi) + (1 - \pi)v(W, p, p_s, \pi) + \lambda[\pi - f(p_s, G)]$$

$$v(e) - v(n) + \lambda = 0$$

$$\pi v_{p_s}(e) + (1 - \pi)v_{p_s}(n) - \lambda f_{p_s} = 0$$

$$\pi = f(p_s, G)$$

which implies $\lambda = [v(e) - v(n)] = [\pi v_{p_s}(e) + (1 - \pi)v_{p_s}(n)]/f_{p_s}$, or $f_{p_s} = g_{p_s}$,

which can be rewritten as:

$$\pi_N [v(e) - v(n)] = -[\pi v_{p_s}(e) + (1 - \pi)v_{p_s}(n)] p'_s \quad (\text{A22})$$

To obtain comparative static results, we totally differentiate (A22), and, if we allow $\pi = \pi(N^*, G)$ and $p_s = p_s(N^*)$:

$$\begin{aligned} & [v(e) - v(n)] [\pi_{NN} dN^* + \pi_{NG} dG] + \pi_N \{ [v_W(e) - v_W(n)] dW + v_C(e) dC + [v_p(e) - v_p(n)] dp \\ & \quad + [v_{p_s}(e) - v_{p_s}(n)] p'_s dN^* + [v_{\pi}(e) - v_{\pi}(n)] [\pi_{NG} dG + \pi_{NN} dN^*] \} \\ = & -[\pi v_{p_s}(e) + (1 - \pi)v_{p_s}(n)] p''_s dN^* - p'_s \{ \pi [v_{p_s p_s}(e) p'_s dN^* + v_{p_s \pi}(e) (\pi_{NG} dG \\ & \quad + \pi_{NN} dN^*)] + v_{p_s}(e) [\pi_N dN^* + \pi_G dG] + (1 - \pi) [v_{p_s p_s}(n) p'_s dN^* + v_{p_s \pi}(n) (\pi_{NG} dG \\ & \quad + \pi_{NN} dN^*)] - v_{p_s}(n) [\pi_N dN^* + \pi_G dG] \} - p'_s \{ [\pi v_{p_s W}(e) + (1 - \pi)v_{p_s W}(n)] dW \\ & \quad + \pi v_{p_s C}(e) dC + [\pi v_{p_s p}(e) + (1 - \pi)v_{p_s p}(n)] dp \} \end{aligned} \quad (\text{A23})$$

Let us define the Jacobian of this system as $J = \pi_{NN}[v(e) - v(n)] + 2\pi_N p'_s [v_{p_s}(e) - v_{p_s}(n)] + (p'_s)^2 [\pi v_{p_s p_s}(e) + (1 - \pi)v_{p_s p_s}(n)] + [\pi v_{p_s}(e) + (1 - \pi)v_{p_s}(n)] p''_s + \pi_{NN} \{ [v_\pi(e) - v_\pi(n)] \pi_N + [\pi v_{p_s \pi}(e) + (1 - \pi)v_{p_s \pi}(n)] p'_s \}$. The last term in brackets $\{ \cdot \}$ is equal to zero because $\{ \cdot \} = p'_s \partial [\pi v_\pi(e) + (1 - \pi)v_\pi(n)] / \partial p_s = 0$.

Thus the Jacobian can be written

$$\begin{aligned} J = & \{ \pi_{NN} + [\pi v_{p_s}(e) + (1 - \pi)v_{p_s}(n)] p''_s / [v(e) - v(n)] \} [v(e) - v(n)] \\ & + \{ (p'_s)^2 [\pi v_{p_s p_s}(e) + (1 - \pi)v_{p_s p_s}(n)] / [v(e) - v(n)] \} [v(e) - v(n)] \\ & + 2\pi_N p'_s [v_{p_s}(e) - v_{p_s}(n)] / [v(e) - v(n)] \} [v(e) - v(n)] \end{aligned}$$

If we use (A4) and (A6)' and the fact that $g_{p_s} = f_{p_s}$ at the optimum:

$$J = \{ [\pi_{NN} - g_{p_s} p''_s] - (p'_s)^2 g_{p_s p_s} \} [v(e) - v(n)]$$

$$J = (f_{p_s p_s} - g_{p_s p_s}) (p'_s)^2 [v(e) - v(n)] \quad (A24)$$

Thus, $J < 0$ if $g_{p_s p_s} < 0$. If $g_{p_s p_s} > 0$, then $J < 0$ if $g_{p_s p_s} < f_{p_s p_s}$;

$J > 0$ if $g_{p_s p_s} > f_{p_s p_s}$. We only consider the case where $J < 0$.

The system (A23) can thus be written:

$$\begin{aligned} JdN^* = & \{ -[v(e) - v(n)] \pi_{NG} - p'_s [v_{p_s}(e) - v_{p_s}(n)] \pi_G \} dG \\ & + \{ -[v_W(e) - v_W(n)] \pi_N - p'_s [v_{p_s W}(e) + (1 - \pi)v_{p_s W}(n)] \} dW \\ & + \{ -v_c(e) \pi_N - p'_s \pi v_{p_s c}(e) \} dc \\ & + \{ -[v_p(e) - v_p(n)] \pi_N - p'_s [\pi v_{p_s p_s}(e) + (1 - \pi)v_{p_s p_s}(n)] \} dp \quad (A25) \end{aligned}$$

Thus:

$$\partial N^*/\partial G = \{-[v(e) - v(n)]\pi_{NG} - p'_s \pi_G [v_{p_s}(e) - v_{p_s}(n)]\}/J$$

$$\begin{aligned} \partial N^*/\partial W &= \{-[v_W(e) - v_W(n)]\pi_N - p'_s [\pi v_{p_s W}(e) + (1 - \pi)v_{p_s W}(n)]\}/J \\ &= p'_s \{-[v_W(e) - v_W(n)](\pi_N/p'_s) - h_n^* [-\pi v_{WW}(e) - (1 - \pi)v_{WW}(n)] \\ &\quad + [\pi v_W(e) + (1 - \pi)v_W(n)] \partial h_n^*/\partial W\}/J \\ &= p'_s \{-[v_W(e) - v_W(n)](\pi_N/p'_s) - h_n^* v [\pi v_W(e) + (1 - \pi)v_W(n)] \\ &\quad + [\pi v_W(e) + (1 - \pi)v_W(n)](\partial h_n^*/\partial W)\}/J \\ &= p'_s \{-[v_W(e) - v_W(n)](\pi_N/p'_s) + h_n^* [\pi v_W(e) + (1 - \pi)v_W(n)] [-v \\ &\quad + (1/h_n^*)(\partial h_n^*/\partial W)]\}/J \\ &= \{-[v_W(e) - v_W(n)]\pi_N + [v(e) - v(n)]p'_s g_{p_s}(\epsilon - \rho)\}/J \end{aligned}$$

$$\partial N^*/\partial C = [-v_c(e)\pi_N - p'_s \pi v_{p_s C}(e)]/J < 0$$

where $v_C(e) = -v_W(e)/(1 - \alpha\epsilon) < 0$

$$\begin{aligned} v_{p_s C}(e) &= v_{C p_s}(e) = -\{(1 - \alpha\epsilon)v_{W p_s}(e) - v_W(e)\partial(1 - \alpha\epsilon)/\partial p_s\}/(1 - \alpha\epsilon)^2 \\ &= -(1 + \eta)[-v_{WW}(e)h_n^* - v_W(e)(\partial h_n^*/\partial W)]/(1 - \alpha\epsilon)^2 \\ &= -(1 + \eta)v_W(e)[v(e)h_n^* - (\partial h_n^*/\partial W)]/(1 - \alpha\epsilon)^2 \\ &= -(1 + \eta)v_W(e)h_n^*[p - \epsilon]/(1 - \alpha\epsilon)^2 \end{aligned}$$

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FOOTNOTES

¹A squatter is one who does not own or rent the land on which he lives but is illegally dwelling on it. Usually he owns the structure in which he lives but he may also rent from other squatters.

²Squatting is also starting to become a problem in many European cities (Kearns, 1979).

³For years, until a recent urban development project relocated them, several hundred families eked out a precarious existence perched on a narrow jetty designed originally to protect Manila's harbor from tropical storms.

⁴See, for example, Markusen and Scheffman (1978).

⁵A separate but related and interesting issue is, why the rights being "claimed" by the squatters are not formalized, if that is the efficient solution for society. This would require a different model which is beyond the scope of this paper.

⁶See, for example, Laquian (1971, 1972), Kearns, Manaster, Mangin, Juppenlatz, Eyre, Ulack, Ward, Johnstone. There are many others and citations can be obtained by consulting the references of the aforementioned.

⁷The implicit economic argument underlying point (a) seems to be that the supply curve for formal housing is everywhere above the demand curve of certain segments of the population--such as the indigent. However, this does not appear to conform to reality since households of similar incomes are found in both the formal and squatting sectors. The poorer segments of the urban population can enter the formal sector and consume some housing services by "doubling up". (See Follain, et al, forthcoming.)

⁸Ioannides (1979) develops a model in which the tenure decision is made in an uncertain environment. However, in his intertemporal model, the uncertainty arises because the quality of the house is unknown and would thus not be suitable for this analysis.

⁹We abstract from the problem that housing services are generally not immediately consumable upon occupation of the vacant land. This generalization would add little to the analysis since we are focusing on the equilibrium number of squatter households in this analysis. Furthermore, the concern is not as applicable in developing countries because the conventional wisdom is that most squatter settlements can be occupied immediately.

¹⁰Since the model is only of one period, it abstracts from stock-flow considerations. All that is being assumed here is that the household has to pay its rent, implicit or otherwise, at the beginning of the period.

¹¹It is assumed that the $u(\cdot)$'s are continuous, monotonic, convex and homothetic representations of preference orderings defined on $R_n^+ = \{x, h : x, h \in R, x, h \geq 0\}$.

¹²The usefulness of this approach was pointed out to me by J. Chilton. An alternative exposition might follow Henderson (1977) who discussed optimal city sizes by deriving the utility of the representative city dweller. With respect to city population, utility would be an inverted "U". While the model presented here is also tractable in Henderson's framework, it is not used so as not to blur the distinction between behavioral assumptions regarding $g(\cdot)$ and technical considerations regarding $f(\cdot)$, where $f(\cdot)$ and $g(\cdot)$ are described below.

¹³The conditions under which the Arrow-Pratt measure of risk aversion can be extended to a utility function which has more than one commodity are discussed in Stiglitz (1969) and Kihlstrom and Mirman (1974, 1981). The problem arises because, unlike the one-commodity case, von Neumann-Morganstern utility functions of more than one dimension may represent different preference orderings on the set of commodity bundles. Thus, attempts to compare risk averseness of utility functions representing different ordinal preferences are confounded by differences in these preferences. Kihlstrom and Mirman (1981) obtain the result (Theorem 1) that if the preference orderings are continuous, monotonic, convex and homothetic and if a direct utility function u is an increasing (decreasing, constant) relative or absolute representation of these preference orderings, then the indirect utility function u inherits this property when considered as a function of income. This theorem is invoked to justify the use of the Arrow-Pratt measure with indirect utility.

¹⁴This implies that there is a premium on entry which is equivalent, in utility terms to V^S implied by ψ_4^* and V . We thus assume that squatter area residents have information about how utility levels vary with city size and that they all are owner-occupiers. On the other hand, if the original settlers leave the area and rent out their structures, they could charge housing rents equivalent to the monetized value of the utility premium (equivalent to E_4^*B in terms of \$ per unit of housing services). In this situation, the renters would be indifferent between size N_4^* and N_2 . The outcome would depend upon the political clout of the renters versus the original settlers in the association. See Henderson (1977) for a similar argument regarding optimal city size (Chapter 2).

¹⁵Current empirical work (Mayo, 1981, Jimenez and Keare, 1981, Ingram, 1981) provides the following approximations of the parameters:
 $\alpha = .2$, $\epsilon = .8$, $\eta = -.7$.

¹⁶This seems to be the experience in developing countries to date. According to the report of a Special Committee formed to study housing issues in the Philippines:

"The government's effort to solve the problem of squatting and slum-dwelling have been characterized by sporadic [clearing] campaigns and programs more or less related to specific crises situations... . All in all, the government's activities in the housing, slum and squatter improvement fields have been ineffective and insufficient... . There is a crying need for a definite housing policy and an integrated program that would face up to the problem once and for all" (quoted in Laquian, 1971, pp. 221-223).

Figure 1

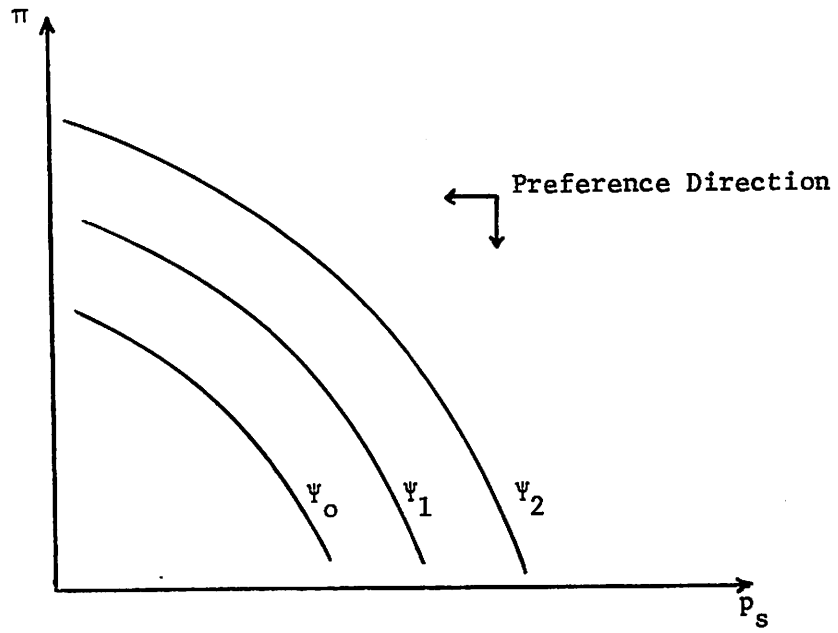


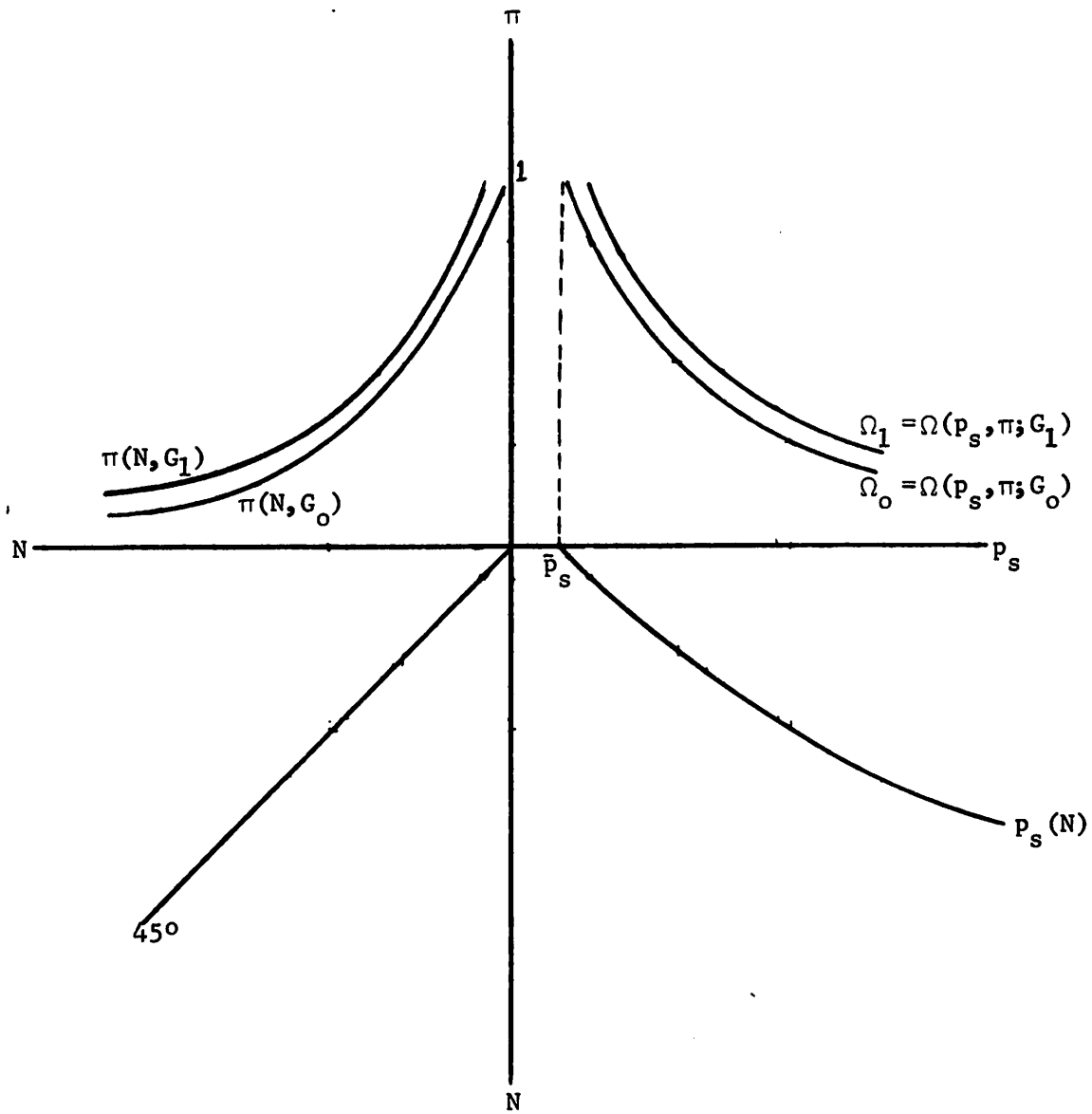
Figure 2

Figure 3

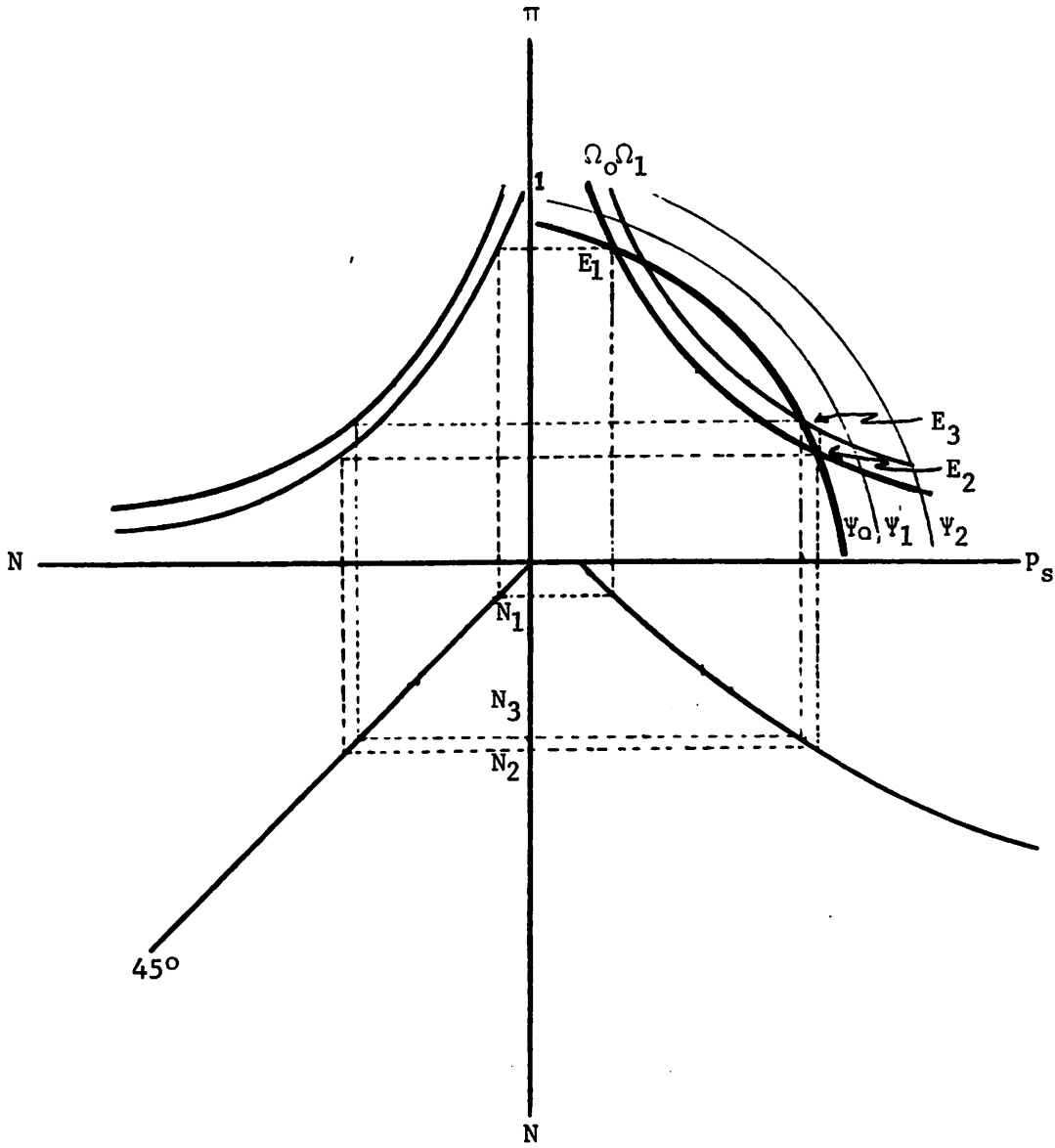
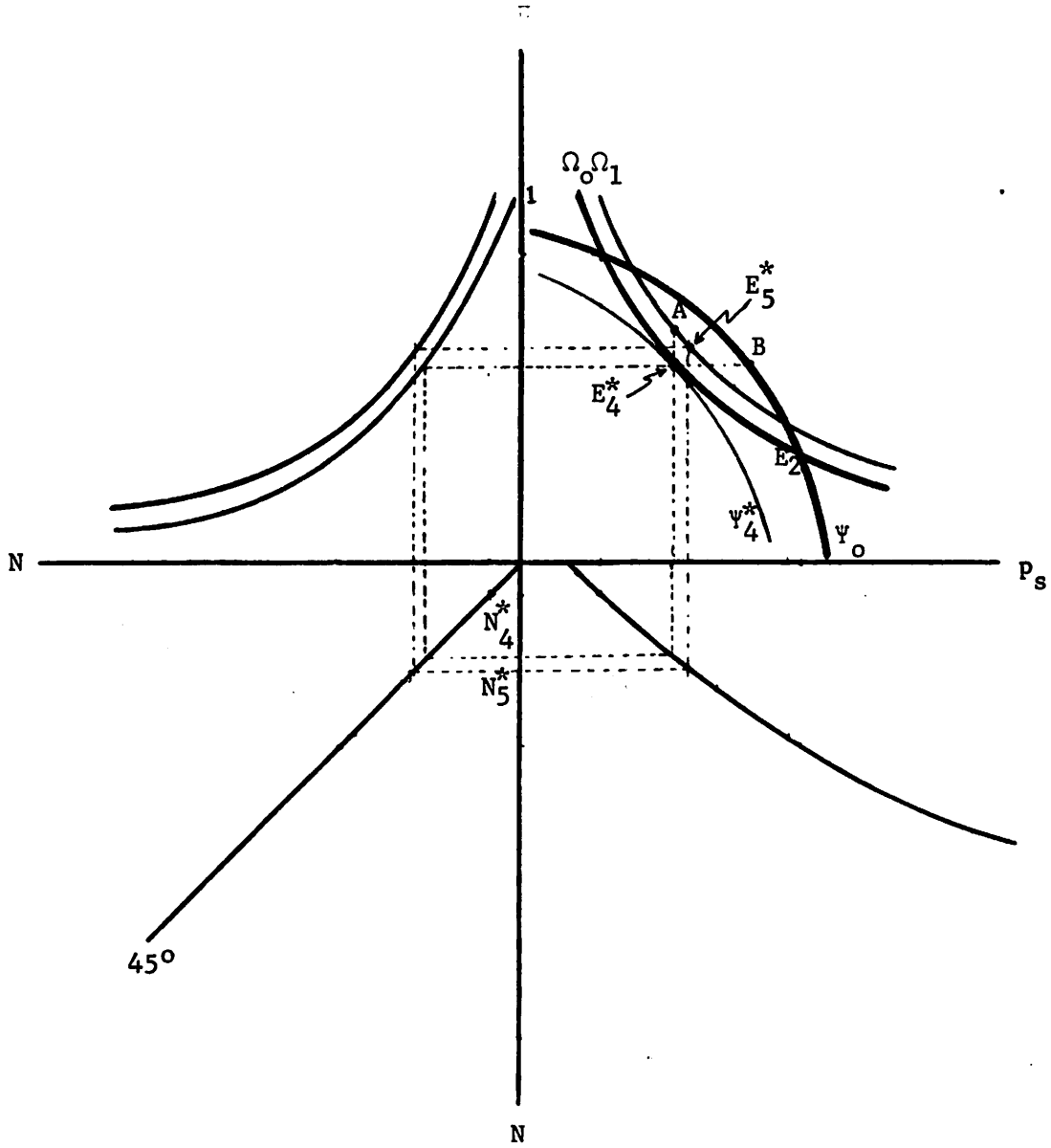


Figure 4



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