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Theories of Urban
Form and Land Use:
A Review

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INTRODUCTION

The development of a theory of intraurban land use rests on the identification of the determinants of urban growth and spatial structure, and on an understanding of the interactions between those determinants relative to their impact on spatial configurations. Urban growth and spatial structure are closely related phenomena, since changes in spatial structure are heavily influenced by the rate of growth experienced or anticipated.

Urban spatial structure can be viewed as the particular order and interrelationships among the physical components of an urban area. This order and these interrelationships are continually evolving, thereby making spatial structure a dynamic phenomenon that changes over time and space. Various approaches have been taken to arrive at an understanding of the processes determining urban spatial configurations and growth patterns. These approaches differ significantly in light of the assumptions made concerning the important variables and the interpretations made of observed empirical regularities. However, these approaches have not yet been integrated to provide a coherent theory of land use. This deficiency is largely due to the present inability to relate all the identified variables--

social, economic, technological and institutional--which have been put forth as factors influencing urban spatial structure.

Contributions to a theory of urban land use have been made by researchers in a variety of disciplines: economists, sociologists, geographers, civil engineers, and human ecologists have all contributed to the field. However, these contributions, consisting of partial explanations, have provided few guidelines for policy formation and implementation. Given urban planning's focus on the spatial context and on the actual implementation of desired public objectives, it is perhaps the main challenge of this field to develop a synthesis of the contributions from other fields and to provide a comprehensive conceptual framework enabling systematic research to be carried on by planning scholars and applied by planning professionals. This paper attempts to provide a first step in synthesizing the various contributions to intraurban land use theory.

The following review of selected research is not exhaustive, nor does it cover research modifying or further explicating basic theoretical principles. Rather, this paper focuses on those research works which appear to offer basic insights into the linkages between land use, energy, and environmental dimensions of urban spatial structures. Thus, the subtleties introduced by researchers amplifying basic concepts are relatively unimportant at this early stage.

HISTORICAL-MORPHOLOGICAL APPROACHES

THE AXIAL AND CENTRAL THEORY

The first formal description of intraurban growth patterns was presented by Richard M. Hurd in Principles of City Land Values, first published in 1903. Hurd developed a framework for a theory of urban land use which is analogous to that provided by von Thunen for the agricultural land development process.¹ Further, Hurd is credited with originating the axial and concentric principles of urban growth. It should be noted, however, that Hurd did not invent the actual term "concentric zones." Rather, he originated the idea in his description of "central" growth with the concomitant segregation of land uses into "definite districts" or "zones."

"Central" growth is defined by Hurd as "the clustering of utilities around any point of attraction and is based on proximity."² The specific mixture of utilities or land uses around an attraction point result in a spatial pattern exhibiting observably distinct districts:

Residences are early driven to the circumference, while business remains at the centre, and as residences divide into various social grades, retail shops of corresponding grades follow them, and wholesale shops in turn follow the retailers,

while institutions and various mixed utilities irregularly fill in the intermediate zone, and the banking and office section remains at the main business centre.³

Thus, while the description of zones is fairly crude, Hurd identifies the "circular city" as an ideal type of urban form and pattern of growth. Subsequently, the concentric principle of urban growth was more fully developed by Burgess.

"Axial" growth is defined by Hurd as the "result of transportation facilities and is based on accessibility."⁴ Axial growth thus reflects the occurrence of land development along transportation lines such as railroads, streets and highways, and rapid transit facilities. The effect of these traffic axes is to "project shops through residence areas, create business subcentres where they intersect, and change circular cities into star-shaped cities."⁵ Thus, in Hurd's view, the interaction between jointly occurring axial and central growth patterns theoretically results in a star-shaped urban form. Further, every city is thought by Hurd to experience both types of growth, although initially only one may be dominant. Occurring simultaneously, the two types result in districts "overlapping, interpenetrating, neutralizing and harmonizing as the pressure of the city's growth bring them in contact with each other."⁶

In identifying two ideal spatial patterns, Hurd develops an economic explanation for their occurrence. Relative to non-residential land, this explanation is, in its basic principles, the same as that provided by subsequent land and urban economists. The dominance of the economic approach to urban land use theory is aptly explained

by Hurd:

One more qualification should be made limiting the working of economic laws, viz., the individual factor, which may create or destroy cities, sections within cities, or individual properties within sections. A striking uniformity exists, however, in the obedience of individuals to economic laws, self-interest being a compelling factor so that individual sections, especially on the negative or destructive side, may be classed as exceptions.⁷

Interestingly, Hurd goes on to suggest that the identification of the economic factors underlying urban land use patterns leads only to an intermediate explanation:

Underneath all economic laws, the final basis of human action is psychological, so that the last stage of analysis of the problems of the structure of cities, the distribution of utilities, the earning of the buildings which house them, and the land values resulting therefrom, turn on individual and collective taste and preference, as shown in social habits and customs.⁸

Unfortunately, non-economic analyses to help explain urban spatial structure have been largely subsumed by economic explanations. Moreover, both economists and non-economists have correspondingly failed to integrate economic factors with social, political and institutional forces in the attempt to formulate models of urban spatial structure and land use. Thus, the interaction of economic and non-economic forces remains largely a matter of conjecture and overly generalized descriptions. In many respects, the development of a theory of urban land use has progressed very little beyond the observations and perceptions of Hurd.

In identifying the economic factors contributing to the

location of particular land uses, Hurd focuses on the principles of accessibility and proximity forming the bases for central and axial growth. These principles underlie land values with businesses and individuals bidding for land:

Since value depends on economic rent, and rent on location, and location on convenience, and convenience on nearness, we may eliminate the intermediate steps and say that value depends on nearness.⁹

Land goes to the highest bidder, "the highest bidder being the one who can make the land earn the largest amount."¹⁰

Hurd exempts single-family residential land from the above economic explanation:

. . . the basis of residence values is social and not economic--even though the land goes to the highest bidder--the rich selecting the locations which please them, those of moderate means living as near by as possible, and so on down the scale of wealth, the poorest workmen taking the final leavings, either adjacent to such nuisances as factories, railroads, docks, etc., or far out of the city. . . . The main consideration in the individual selection of a residence location is the desire to live among one's friends, or among those whom one desires to have for friends; for which reason there will be as many residence neighborhoods in a city as there are social strata. . . ."¹¹

Thus, as later more fully described by Hoyt, Hurd portrays high-grade residences as the determining factor in a city's residential location patterns. Once the rich decide upon their desired home sites, the remaining social classes locate as near as possible to the positions of the wealthier. However, the location of residents containing more than one tenant, i.e., tenements, apartments, or hotels is viewed by Hurd as conforming to economic principles rather than social.¹² He

does not discuss the location of multi-family dwellings in any further detail.

Hurd also notes the dynamic nature of urban land use patterns, which suggests that the spatial structure of a growing urban area is continually in a state of disequilibrium. Two forces, "the centripetal force of economy in the transaction of business and the centrifugal force of cheap land," are seen as conflicting factors leading to a continual readjustment process:

The uniform tendency as a city grows is toward greater concentration in the business centre and greater dispersion in the residence sections, and as long as there is an outward movement so long is there certain to be a continual readjustment at the business centre to conform to it.¹³

Moreover, Hurd notes that this adjustment process is relatively slow and that in the absence of a known rate of adjustment, accurate predictions of future movements of urban growth are impossible.¹⁴ Factors noted by Hurd as contributing to changes in city structure and land values include new inventions, habits, and social customs.¹⁵ Factors modifying the star-shaped spatial structure of cities include topography and the private ownership of land.¹⁶ Like institutionally enforced restrictions on land use, private land ownership is seen as a factor potentially interfering with economic forces leading to efficient land use patterns:

The chief disadvantage in restricting land to certain uses is that the utility of American city land changes rapidly, and when residence property should be converted to stores but cannot owing to restrictions, a serious detriment to values occurs.¹⁷

In general, Hurd's book has provided the basis for much of the subsequent research on urban land use theory. The basic ideas presented by Hurd were built upon and more fully explored by Burgess, Hoyt, and Ullman and Harris in the development of their principles of urban spatial structure and growth. Hurd formally initiated the reliance on economic forces to explain intraurban spatial patterns while recognizing that economic forces themselves must ultimately be explained as social phenomena.¹⁸ The principal deficiencies of Hurd's work are the overly generalized and cursory references to those non-economic factors and to the location of types of residential land uses.

THE CONCENTRIC ZONE THEORY

McKenzie, studying Columbus, Ohio, in 1923, suggests the division of the city into concentric circles as a means of expressing the form of urban growth.¹⁹ Robert Park, in a 1936 article entitled "Human Ecology," draws the analogy between the human world and the plant world, outlining concepts subsequently used by E. W. Burgess in the development of the concentric zone theory. Park notes the "competition" between various population groups of an urban area, the "dominance" of one group in the "natural" or "functional areas" of a metropolis, the "invasion" of a natural area by a competing group, and the "succession" of a new group to the position of dominance within the urban areas.²⁰ This competition is restrained, unlike that in the plant world, by conventions, institutions, and laws.

According to Park, the competitive urban land utilization process derives its energy from population and areal expansion occurring in a pattern of concentric rings.

Applying Park's analogies to the city of Chicago, Burgess described a distinctive spatial pattern consisting of activity and residence zones. The first zone encompasses the CBD or central business district. The second zone, encircling the first, is a transition area in which business and light manufacture are encroaching on previously residential land. In other words, this zone represents the outward expansion of the area of industry, commerce, and business to merge with high-density residential dwellings occupied by the poor and other individuals living in "their submerged regions of poverty, degradation, and disease, and their underworlds of crime and vice."²¹ However, the area is also considered by Burgess as "one of regeneration, as witness the mission, the settlement, the artists' colony, radical centers--all obsessed with the vision of a new and better world."²²

The third zone is composed of workingmen's homes whose inhabitants have escaped the transition zone, but desire to live in an area easily accessible to factories and shops. As a second-generation settlement zone, this area represents the outcome of the process of successive land invasion.²³ The fourth zone is a residential area of high-class apartments or of exclusive single-family districts, inhabited by white-collar and professional people. As is clear, increasing distance from the CBD is associated with increasing social

status, viewed in the conventional sense. The fifth concentric ring is the commuters' zone, consisting of satellite cities or suburban areas. In addition, the five basic zones can be further disaggregated into smaller areas according to race, ethnicity, or type of residence. The size and specific character of the zones change over time due to the ongoing processes of invasion and succession.

In general, Burgess's concentric zone theory is purely descriptive, concerned with portraying the processes of urban expansion in terms of extension, succession, and concentration. Burgess postulates a typical pattern for American cities based on Chicago's pattern of spatial differentiation into "natural" economic and cultural areas. However, as Robson has pointed out:

Burgess and all the ecologists recognized that the model was purely conceptual and that certain disturbing influences, such as topography and the disposition of lines of communication, did distort the theoretically concentric circles when applied to specific towns.²⁴

There are several important assumptions underlying the Burgess theory involving both contextual factors and value orientations. As Quinn has pointed out, Burgess assumes:

1. Existence of heterogeneity within the city.
2. Existence of an economic base within the city of mixed commercial and industrial.
3. Existence of certain economic and cultural factors such as private land ownership.
4. Existence of an efficient transportation system which is equally rapid in every direction within the city at the same cost.²⁵

These assumptions, allowing for a deterministic model, render Burgess's theory only a partial description of urban growth and spatial structure. For example, unlike Hurd's recognition of the factors leading to both central and axial growth, Burgess ignores the effect of transportation facilities on urban form. In this respect, Burgess has amplified one aspect of Hurd's discussion while ignoring the other.

Robson has pointed out additional assumptions reflecting the implicit value assumptions of Burgess's theory:

1. Assumption of profit maximization as the motive underlying land acquisition and, correspondingly, of the value placed by businesses on a central location due to its short supply and greater accessibility to the entire urban area.
2. Assumption of the social value placed on residential location at the urban area's periphery, which is thought to stem from the value placed on open space and larger houses with gardens.
3. Assumption of such institutional factors as the existence of economic competition with relatively little institutional intervention.²⁶

These assumptions, not discussed by Burgess, mask the effect of alternative values and institutional arrangements on urban spatial structure. Burgess, like many ecologists and economists, frequently refers to urban growth and locational processes as "natural," implying that urban form results from innate forces. For example, Burgess states:

In all cities, there is the natural tendency for local and outside transportation to converge in the central business district. In the downtown section of every large city we expect to find the department stores, the skyscraper office buildings, the railroad stations, the great hotels, the theaters, the art museum and the city hall. Quite naturally, almost inevitably, cultural and political life centers here.²⁸

It is precisely these "natural" tendencies which must be understood if a theory of urban land use is to be of theoretical or practical significance. Burgess's theory lacks an explanation of the operative factors causing segregation of land uses, central concentration, and residential dispersion. Thus, the principal value of Burgess's concentric zone theory lies less in its contribution to theory per se than in its provision of a generalized spatial diagram allowing for empirical verification and refinement, and providing a simplified framework facilitating the identification of basic spatial determinants.

In addition to the discussion of spatial zones within the context of urban growth, Burgess briefly discusses associated urban processes. As previously noted, Burgess views the process of concentration in the CBD as a "natural" phenomenon. However, he also notes that by the 1920s sub-business centers had formed in outlying zones. In Burgess's words, these subcenters represent "a telescoping of several local communities into a larger economic unity," with Chicago as a whole "undergoing a process of reorganization into a centralized decentralized system of local communities coalescing into sub-business areas visibly or invisibly dominated by the central business district."²⁸ In other words, the subcenters reflect the process of "centralized decentralization," signifying the decreasing importance of the CBD for certain activities.

While Burgess does not explicitly incorporate the existence of sub-business centers into his concentric zone model, his discussion of the interrelated processes of concentration and decentralization

raises several questions concerning the functional relationships between urban subareas and their impact on spatial structure. With the emergence of subcenters, the interrelationships between the CBD and these subcenters undoubtedly signal changes in required lines of communication and movement and in the types of activities requiring a CBD location. Correspondingly, accessibility to the CBD may be of relatively little significance for particular population and industrial subgroups. Since the CBD is the core of Burgess's idealized zonal model, any diminishing of the CBD's importance could thus require fundamental modifications of the model. Does, for example, each subcenter generate an encompassing pattern of concentric zones, and if so, what are the characteristics of "merged" zones where a zone is an outer ring for one center and an inner ring for another? How does the emergence of subcenters impact the size of each activity and residence zone?

In addition to the issue of concentration and decentralization, Burgess emphasizes the importance of mobility, as opposed to movement per se, in the process of urban growth. Burgess proposes mobility "as a measure both of expansion and metabolism, susceptible to precise quantitative formulation, so that it may be regarded almost literally as the pulse of the community."²⁹ Mobility is defined as "a change of movement in response to a new stimulus or situation" where the elements of mobility include "the state of mutability of the person" and "the number and kind of contacts or stimulations in his environment."³⁰ With respect to individual behavior, Burgess

believes mobility to be correlated with the degree of social organization:

Where mobility is the greatest, and where in consequence primary controls break down completely, as in the zone of deterioration in the modern city, there develop areas of demoralization, of promiscuity and of vice.³¹

Measures of mobility, according to Burgess, include increases in the use of communication and transportation facilities at a higher ratio than population increases, and variations in land values.

While changes in mobility clearly can be thought of as a measure of urban growth, Burgess does not make clear why mobility is a significant factor impacting urban spatial structure. As Berry and Horton have pointed out, Burgess fails to recognize the significance of either mobility or intraurban movement in the formation of distinct subareas within an urban area. "The movement of people from one residence to another as the city grows is the very mechanism by which the zones and natural areas (disorganized or organized) are created."³²

In summary, Burgess has developed a deterministic description of urban land use in which land use patterns are thought to vary directly with distance from the CBD. Specifically, growth of the CBD pushes population outward in a ringlike pattern to the extent that distortions do not result from natural or man-made barriers. Subsequent researchers have attempted to identify the factors causing the formation of concentric zones.

THE SECTOR THEORY

The sector theory was advanced by Homer Hoyt in a 1939 study for the Federal Housing Administration as an alternative to Burgess's concentric zone theory.³³ In contrast to Burgess's theory, which deals with both residential and non-residential location patterns, Hoyt's sector theory is primarily concerned with land use patterns resulting from residential development. The basic principle of this theory is that different income groups are segregated into spatial sectors or wedges rather than distributed concentrically around the CBD.

The empirical basis for Hoyt's theory is a study of approximately 142 cities for which block data were gathered on population and housing stock characteristics.³⁴ Hoyt concluded that average block rent is representative of all other housing variables:

Since the average rent of dwelling units in a block reflects the characteristics of the block which can and cannot be measured, patterns of rent may be fully relied upon to serve as a guide to the structure of residential neighborhoods.³⁵

While the appropriateness of Hoyt's reliance on rental data is not above criticism, this reliance does not seem particularly unreasonable in light of the housing characteristics which Hoyt chose to study. These characteristics largely serve to identify the degree of substandard housing by block.

Residential rent areas were mapped for the 142 cities using 1934 data and analyzed for locational regularities. On the basis of this research, Hoyt concludes that high-rent or high-cost residential

areas can be found in distinct sectors within a city with rents decreasing gradually in all directions from these sectors:

. . . it may be concluded that rent areas in American cities tend to conform to a pattern of sectors rather than of concentric circles. The highest rent areas of a city tend to be located in one or more sectors of the city. There is a gradation of rentals downward from these high rental areas in all directions. Intermediate rental areas, or those ranking next to the highest rental areas, adjoin the high rent area on one or more sides, and tend to be located in the same sectors as the high rental areas. Low rent areas occupy other entire sectors of the city from the center to the periphery. On the outer edge of some of the high rent areas are intermediate rental areas.³⁶

Hoyt also concludes that there is no "geometric pattern" representing the location of high and low rent sectors which is applicable to all cities:

Each urban center has a pattern of rent areas that is to a certain extent unique. No two cities have high-rent areas of the same size or shape or in the same location with respect to the center of the city. Topography, rapidity of urban growth, location of industries and transportation lines, the movement of leaders of society, all produce different rental patterns.³⁷

As with Burgess's theory, a principal assumption underlying Hoyt's conclusions is the existence of a single business center as the nucleus of the city. The location of industry is also assumed to be a preemptive factor, although Hoyt does not assume its location in a transition zone encircling the CBD. More importantly, unlike Burgess, Hoyt does not simply assume that high-income individuals prefer to live on the urban periphery for its open space advantages.

Hoyt's observation that there is no upward gradation of rents

from the CBD to the urban fringe in all directions is of particular significance. He shows high rent areas as occupying only part of the outer circumference, with some cities having low rent sectors extending from the center to the periphery. This clearly refutes Burgess's placement of the "better" residential areas in a concentric circle at the farthest distance from the center, assuming that these residential areas are associated with relatively higher rents.

Moreover, Hoyt's conclusion also applies to Chicago, the city on which Burgess based his theory.³⁸ Even accounting for changes in residential patterns between 1923 and 1939, Burgess's description of Chicago in 1923 could not have been entirely accurate if just the basic principles of his theory are accepted and the actual concentric diagram is ignored. Specifically, with the outward expansion associated with urban growth, the movement of low rent areas from an inner urban area in 1923 to the periphery by 1939 is not explainable in Burgess's terms.

It should be noted that Hoyt's investigation of historical changes in urban land uses does reveal that the higher rental areas move outward from the CBD with previous high rent dwellings "filtering" down to lower income families or converted to non-residential usage as the structures deteriorate or become obsolete.³⁹ In other words, the locations of high, low, and intermediate rental areas change with urban growth. Existing neighborhoods experience changes in occupant-types and new neighborhoods are formed.

Thus, Burgess and Hoyt would agree that there is a strong

tendency over time for wealthier households to move outward to the periphery.⁴⁰ However, Hoyt adds a directional component to the distance factor as a means of further differentiating residential spatial structure. He observes that the relocation of a particular type of rental area occurs within the arc of the same sector:

. . . considering the entire city as a circle and various neighborhoods as falling into sectors radiating out from the center of that circle . . . the different types of residential areas tend to grow outward along rather distinct radii, and new growth on the arc of a given sector tends to take on the character of the initial growth in that sector.

Thus if one sector of a city first develops as a low rent residential area, it will tend to retain that character for long distances as the sector is extended through process of the city's growth. On the other hand, if a high rent area becomes established in another sector of the city, it will tend to grow or expand within that sector, and new high grade areas will tend to establish themselves in the sector's outward extension. . . . Generally speaking, different sectors of a city present different characters according to the original types of the neighborhoods within them.⁴¹

In attempting to explain why urban growth and residential land use changes occur in a sectoral pattern, Hoyt suggests that "the movement of the high rent area is in a certain sense the most important because it tends to pull the growth of the entire city in the same direction."⁴² The direction of movement of these high-rent districts is then posited as necessarily outward toward the periphery:

The wealthy seldom reverse their steps and move backward into the obsolete houses which they are giving up. On each side of them is usually an intermediate rental area, so they cannot move sideways. As they represent the highest income group, there are no houses above them abandoned

by another group. They must build new houses on vacant land. Usually this vacant land lies available just ahead of the line of march of the area because, anticipating the trend of fashionable growth, land promoters have either restricted it to high grade use or speculators have placed a value on the land that is too high for the low rent or intermediate rental group. Hence the natural trend of the high rent area is outward, toward the periphery of the city in the very sector in which the high rent area started.⁴³

In concluding that movement is necessarily and "naturally" outward, Hoyt is thus actually relying on social, institutional and business factors as the underlying forces. However, the explanation offered by Hoyt does not explain why the high-rent areas do not appropriate vacant land in the sectoral path of low or intermediate rental areas, perhaps with a suitable buffering zone.

Further, Hoyt lists several "governing" factors determining the direction and pattern of future growth, which either contradict his previous claim of the dominant influence of high-grade rental areas or render his previous explanation of the "natural" sectoral growth tendency largely superficial. For example, Hoyt states that "trends of movement of office buildings, banks, and stores, pull the higher priced residential neighborhoods in the same general direction."⁴⁴ This statement clearly contradicts Hoyt's previous assertion concerning the dominant influence of high rent residential areas on growth patterns. If the non-residential land uses are the main determinant of the direction of higher-priced residential growth, then the existence of sectoral residential growth reflects only the historical fact that those non-residential uses have conveniently located near

existing high-grade neighborhoods. Hoyt's presumption of the necessity of sectoral growth is thus an unfounded conclusion. Moreover, based on Hoyt's premises, banks, offices, and stores could conceivably cause the relocation of high-status neighborhoods outside of existing high-priced residential sectors.

Other "governing" factors underlying growth patterns include:

1. High grade residential areas tend to develop along the fastest transportation lines.
2. The zone of high rent areas tends to progress toward high ground which is free from the risk of floods and to spread along lake, bay, river, and ocean fronts, where such water fronts are not used for industry.
3. The higher-priced residential neighborhood tends to grow toward the homes of the leaders of the community.
4. High grade residential growth tends to proceed from the given point of origin, along established lines of travel or toward another existing nucleus of buildings or trading centers.⁴⁵

These observations help to explain the location of high-rent areas and the existence of sectoral growth, but again they do not suggest the inevitability of such growth trends. Rather, the only possible conclusion is that certain factors, some of which are manipulable, have tended to produce sectoral growth patterns. Clearly, Hoyt's previous "no place else to go" explanation of sectoral growth is, at best, one limiting factor underlying growth trends.

In general, Hoyt has provided a description of residential land use patterns and urban growth tendencies which contrasts rather sharply with the concentric zone theory relative to the location of

different residential rent areas. Hoyt provides evidence on the direction of growth, as well as the location of particular rent areas with respect to each other and to the CBD at particular points in time. He also attempts to identify factors influencing the location of higher-priced residential areas and, following Hurd, notes that these areas determine the subsequent location of lower rent districts.

The principal failing of Hoyt's spatial theory is the lack of an analytical framework integrating the factors identified as impacting the spatial structure of the city. The interaction among social, economic, and institutional factors is not clearly delineated, and the influence of non-residential land uses on residential location and intraurban growth patterns is unclear. The lack of integration may stem from the partial nature of Hoyt's work, since he focuses solely on housing characteristics in general as represented by rental values. Correspondingly, the concentric zone theory is shown only to be erroneous with respect to rent gradients.

The basic dynamic forces of Burgess's and Hoyt's theories are in fact similar, with both men focusing on outward expansion from the CBD with the subsequent filtering process in the residential sections. Hoyt, like Burgess, sees the growth of the residential areas, viewed in the aggregate, as growing concentrically, adding "successive rings of new residential structures."⁴⁶ However, Hoyt also recognizes "vertical and interstitial expansion, axial and central growth, the expansion and coalescence of existing outer nuclei, and the growth of new isolated nuclei on the fringe of the

city."⁴⁷ Thus, in Hoyt's view, concentric expansion may be accompanied or temporarily subordinated by other growth tendencies facilitated by transportation facilities and the existence of vacant land. Overall, Hoyt's view of the form of urban growth, based on evidence from several cities, suggests the need for a theory of urban land use which integrates the causes and outcomes of all the various types of growth.

THE MULTIPLE NUCLEI THEORY

In a 1945 article, Harris and Ullman propose a modification to both the concentric zone and the sector theories.⁴⁸ Both Burgess and Hoyt had previously recognized the formation of sub-business centers, although these centers had not been explicitly incorporated into their spatial models.⁴⁹ In contrast, Harris and Ullman suggest that the patterns of land use within a city result from growth around several nuclei, rather than around a single center. Moreover, these nuclei need not be "business" centers. Significantly, Harris and Ullman also suggest that an urban area may originally have more than one center around which growth occurs. Hurd, Burgess, and Hoyt do not recognize that possibility. Other nuclei may form as a city grows, with the number of new centers varying in relation to the size of the city.

Four factors are thought by Harris and Ullman to account for the emergence of distinct nuclei within the city:

1. The interdependency of certain types of activities, requiring physical proximity to specialized facilities such as transportation networks or services.
2. The natural clustering tendency of certain types of activities which enhances profitability.
3. The clustering of activities having no particular affinity for each other, but which are nuisances to other uses.
4. The inability of certain activities to afford the high rents or land costs in certain areas of the city.⁵⁰

These factors are likely to operate in combination during the process of nucleation.

The types or functions of the urban nuclei around which growth occurs are thought to vary among cities. The CBD is, of course, seen as a fairly universal nucleus. Other nuclei may appear in the form of industrial or wholesaling centers, major retail centers, educational centers, suburban centers, or satellite communities. Such land uses as a factory area or a retail district may themselves serve as the original nuclei attracting additional growth. Other districts constituting urban nuclei may result from individual structures or land uses such as railroad stations or beaches.

Harris and Ullman describe, in fairly general terms, the several types of districts which may develop around urban nuclei.⁵¹ Light industrial and wholesaling districts are usually located along railroad lines on sites adjacent to the CBD. These districts do not, however, encircle the CBD. Heavy industrial districts are located near the existing or former periphery of the urban area where land and transportation facilities are available. Residential districts

are segregated by class, with high-class districts in desirable locations lacking environmental nuisances and low-class districts located near factories and railroad districts.

In general, the multiple nuclei theory cannot justifiably be called a "theory." Rather, Harris and Ullman have developed a concept which needs to be empirically investigated with specific patterns of growth distinguished and the spatial interactions between the various nuclei clearly delineated. Further, the factors giving rise to specific types of nuclei need to be differentiated so that potential points of planning intervention can be identified. As Chapin suggests, some nuclei may arise from market forces, others from transportation technologies, and still others from social values or institutional conditions.⁵²

SYNTHESIS OF THE HISTORICAL-MORPHOLOGICAL APPROACHES

The four historical-morphological approaches to land use theory which have been discussed are principally descriptive, generalizing historical growth trends and the resultant land use patterns. With the exception of some of Hurd's work, these theories do not attempt to express specific causal relationships, and thus cannot be used to determine the effects of system changes on land use patterns. Further, these patterns are seen in terms more of the socioeconomic characteristics of the urban area than of actual land use dimensions such as the size of site, intensity and quality of use, or access to various subareas. Thus, the relationship between socioeconomic

variations and land-use dimensions cannot be answered. Moreover, while land use and land values are viewed as closely related, the four theories or principles do not specify the particular aspects of land use which are sensitive to changes in land values.⁵³

However imperfectly, the axial, concentric, sector, and multiple nuclei theories are dynamic in the sense that they deal with growth patterns, as well as describing internal urban structure at a given point in time. Of the four models, the multiple nuclei concept has received the least attention in subsequent research efforts aimed at more fully developing a theory of urban spatial structure. With respect to the axial, concentric zone, and sector theories, there is reportedly a growing consensus that "the three models are independent, additive contributors to the total socioeconomic structuring of city neighborhoods."⁵⁴ Using factor or social area analysis, researchers had demonstrated by 1965 that there are only three dimensions of spatial variation: axial or sectoral variation of neighborhoods by socioeconomic rank; concentric variation of neighborhoods by family structure; and localized segregation of certain ethnic groups.⁵⁵

Socioeconomic rank refers to variations in income, occupation and education. In line with Hurd and Hoyt, the empirical research has shown high-income households to preempt environmentally desirable areas. Family structure refers to such characteristics as type of household, number of employed wives, and incidence of home ownership. Varying radially and thereby creating concentric

zones, this spatial pattern of family structure is considered to reflect Burgess's ideas, although his attention to such population characteristics, is, in fact, more implicit than explicit. Segregation of ethnic or racial groups is considered to be randomly distributed over space in the same sense that Harris and Ullman's nuclei are random and without a consistent spatial pattern within different urban areas. It is interesting to note that these spatial patterns of the distribution of population-types concern themselves solely with residential land use. Researched by urban geographers, these spatial variations assume the exogenously-determined location of nonresidential land uses. This assumption accords with the main emphases of Hoyt and Burgess, while largely ignoring the multiple nuclei concept of Harris and Ullman. The specific relationship between residential and employment locations is thus a relatively unexplored area within the context of the descriptive models.

The four classical theories discussed all suggest factors or assume conditions leading to the observed spatial patterns of land uses. These factors can be classified as topographical, economic, social, technological, and institutional. Topography acts as a natural barrier to urban expansion in some or all directions. The economic factors are, except in the case of Hurd, largely subsumed under the category of "natural" market forces as reflected in land values. Land values themselves are viewed as the outcome of a competitive bidding process among potential land users. The

potentially distorting role played by land speculators and developers in this competitive process is noted by Hurd and Hoyt.

To the extent that social determinants of land use are apparent in the concentric, sector, and multiple nuclei theories, they exist principally in the form of assumptions as to the preferences of the higher-income population groups with respect to residential sites. In a later article, Hoyt also notes that the desire for single-family detached homes is a social force affecting American cities.⁵⁶ Hurd provides the most explicit, albeit brief, discussion of the role of social determinants.

All changes in social customs, such as longer summer absences from the city, shift values of land, as in this instance from the city to the summer resorts. The great interchange of travel throughout the year from one city to another strengthens the radiating influence of the hotels, while the movement from residences to flats and apartments, concentrates population and augments the power of capital to attract.⁵⁷

While Hurd's observations are somewhat dated, the disparities between past and present social customs or values serve to point out the importance of understanding the impact of these factors on spatial patterns. As numerous case studies show, planning which disregards social conditions is bound always to be ineffective in the process of guiding urban development.

Technological factors influencing land use patterns, noted either explicitly or implicitly within the four models, are largely limited to transportation technologies. Burgess simply assumes equally rapid and available transportation services in all directions.

Hurd and Hoyt are more explicit and realistic in their view of the influence of transportation technologies. Hurd, providing the most encompassing portrayal of technological factors, states:

New inventions and new habits and customs will probably cause the most marked future changes other than those due to growth or transportation. All cheapening of the cost of buildings, all improvements in construction, all inventions, tend constantly to destroy the value of existing buildings. All improvement in transportation, such as the trolley, the elevated, the underground, the bicycle, the automobile--and in future possibly the flying machine--tend to destroy the value of these locations which depend on existing transportation.⁵⁸

Similarly, summarizing phenomena considered in his original discussion of the sector theory, Hoyt says:

Cities in the United States have assumed their present form and shape chiefly as a result of a succession of transportation devices beginning with the horse drawn vehicles prior to 1860, suburban railroads in a few cities after 1856, cable street cars in some cities in the 1880's, electric surface cars after 1890, elevated rail lines and subways in the largest cities at the beginning of the 20th Century, and the automobile, which registered its chief effect after 1933.⁵⁹

Hoyt also notes the influence of the steel-frame skyscraper and elevator on the type of expansion experienced in CBD's, i.e., vertical rather than lateral expansion.⁶⁰ These developments reduce the pressures for outward expansion stemming from the CBD.

Institutional factors impacting urban spatial structure, including political, administrative and legal conditions, are not discussed in any depth in the four theories. Burgess, and Harris and Ullman do not, in fact, discuss these factors. Hurd and Hoyt both refer to the private ownership of land and the existence of

restrictions on land use, whether public or private, as important influences. Hoyt, for example, has concluded:

The pattern of American cities is the result of private ownership of property, which cannot be taken by condemnation except for a public use or in a blighted area and for which compensation must be paid when appropriated.⁶¹

Clearly, none of the theories adequately relate the entire range of land use determinants to actual or evolving spatial patterns. Burgess goes to the extreme of holding these factors constant and making a priori assumptions in order to derive a specific spatial structure for the processes of invasion and succession. The others have not fully developed the interrelationships between observed land use patterns and identified spatial determinants. Further, the discussions of these determinants are largely divorced from the actual spatial models which are derived. Hoyt, for example, does not fully explain why a sector pattern exists. If, as he states, urban form is largely the result of transportation facilities and private land ownership, how do these factors cause the emergence of a sector pattern observable on the neighborhood level? Harris and Ullman also provide only an extremely general explanation for the emergence of multiple nuclei. In fact, the model proposed by Harris and Ullman is so flexible that fixed spatial forms cannot be posited, nor can probabilistic outcomes of the interaction between spatial characteristics and identified factors be derived. In general, the inadequacies of the descriptive models point to the need to distinguish the determinants of urban expansion and concentration from the determinants of location and interaction patterns.

STRUCTURAL-BEHAVIORAL APPROACHES

In contrast to the descriptive nature of the classical models of urban land use, the structural-behavioral approaches aim at providing an analytic explanation of the basic relationships thought to influence spatial structure. Specifically, the focus of inquiry is the behavior of households, businesses, industry, and public institutions, with these individual units viewed as decision-makers. Following Alonso's discussion of historical versus structural theories, the term "structural" refers here to the adoption of an ahistorical framework in which the passage of time is unimportant. In other words, it is assumed that time or the aging process will not alter basic spatial patterns.⁶²

Within this context, intraurban land-use theory has been best developed as an economic explanation. The basic premise of the economic approach has been aptly summed up by Goodall:

As urbanization is largely an economic phenomenon it follows that the internal organization of urban areas reflects economic forces which facilitate the functioning of the economic sub-systems involved. A rational pattern of land use develops within any urban area which mirrors the differing requirements of the various economic activities and classes of residences.⁶³

The market place is thus seen as the clearinghouse for location decisions, and spatial structure is understood in terms of the outcome of a competitive bidding process.

Non-economic behavioral approaches remove the reliance on the market place as the basic organizing rationale for explaining urban spatial structure. In line with Hurd's recognition of the causative force of social customs and values, these approaches attempt to replace economic determinism with a holistic framework integrating the social, economic, physical, and other factors influencing spatial structure. A variety of frameworks have been advanced which differ widely with respect to the organizing concepts used to derive linkages between the identified spatial determinants. Examples of concepts suggested as regulating location decisions include accessibility, communications, goals, and interaction.⁶⁴

The following sections discuss the work of various urban researchers within the context of either the economic or non-economic behavioral approach. Both approaches offer insights into the relationship between urban spatial patterns and resource utilization.

VON THUNEN'S THEORY OF AGRICULTURAL LOCATION

In 1826, von Thunen developed a conceptual framework for agricultural location patterns which has been further articulated by Weber, Losch, Isard, and others. This framework provides a theory of location rent differentials which has since been adapted to

urban land use. The basic principle of the theory is that activities compete for space, thereby allocating land efficiency.

In developing his theory, von Thunen assumes the existence of a uniformly flat plain having equal land fertility at all points. Isolated from the rest of the world, the plain contains one population center which has the capability of providing transportation services equally in all directions. This center or "central town" functions as the only market place in the area, with all commodities selling for fixed prices. Each landowner is assumed to act in a manner which maximizes profits derived from use of the land. Labor is assumed to be perfectly mobile, such that the purchasing power of wages is uniform regardless of the site of production. No locational interdependencies between producers are assumed.

Given these assumptions, von Thunen concludes that different crops and other agricultural commodities will tend to be produced in concentric zones around the central town. Each zone contains a particular commodity or combination of commodities whose location in a certain zone is determined by essentially three factors:

1. The cost of transporting one unit of a commodity over a unit of distance.
2. The agricultural yield and production cost per unit of land area.
3. The final price per unit of commodity or the barter ratio.⁶⁵

Thus, the crop or other commodity chosen for a site located at a specific distance from the center would yield the highest possible

rent per acre, where land rent is defined as the difference between a product's market value and its transportation and production costs. The resulting intensity of land use is determined simultaneously with the choice of location or specific land use. This is derived directly from the assumption of the perfect mobility of labor. In order for the purchasing power of wages to be everywhere the same, more gain must be produced per unit of labor as distance from the center increases. In other words, using the marginal-productivity theory of labor remuneration, von Thunen concludes that the marginal productivity of labor varies directly with distance from the central town. For the marginal productivity of labor to increase with distance, the land must be utilized less intensively in terms of labor per unit of land. Thus, total production costs decrease with distance from the center, as does revenue per acre.

The actual emergence of concentric zones results from a competitive process which determines the price of space at a given distance from the center. Various agricultural land users bid for land around the population center with the winners bidding the highest price. The amount that can be bid by any potential land user is the savings in transportation cost offered by a particular site in contrast to sites at a greater distance from the center. In the assumed absence of variations in physical, technological or social factors, producers of the same commodity will thus locate at the same distance from the center, resulting in concentric zones characterized by specialized land uses at "optimal" intensity levels.

When the assumptions are relaxed to allow for non-uniform topography and soil fertility, and differences in the availability and quality of transportation facilities, the concentric zone pattern may not be spatially observable in terms of segregated land uses. However, as pointed out by Isard, the concentric zone pattern could still exist in terms of time-cost distance or other concepts recognizing total regularities.⁶⁶

In general, von Thunen's theory is based on the assumption that there are regularities in the variations of costs and prices over space. These regularities are derived from the fact that transportation costs are a function of distance. Based on perceived transportation savings at various locations, different types of land users bid for land, thereby allocating it efficiently according to the criteria of private profit-maximization. Given von Thunen's assumptions of land conditions and production factors, the resulting spatial configuration is a series of concentric zones. What isn't explained is the specific impact of different normative, environmental, technological, and social conditions on spatial patterns. Given different and more realistic conditions, transportation savings may prove to be a less significant explanatory variable of intraurban land use patterns. Interdependence among economic units, for example, undoubtedly affects urban spatial structure.

Von Thunen's theory has been adapted to urban location and land use, with the central town becoming the CBD and the agricultural commodities becoming urban land uses. As previously discussed, Hurd

made the first attempt to derive a von Thunen-type theory of urban land use. In the early 1960s, Wingo and Alonso more systematically developed urban land use models based on von Thunen's work. Their models are commonly cited as representative of the basic economic approach to urban land use theory.

VON THUNEN-TYPE MODELS OF URBAN LAND USE

The von Thunen approach dominates economic research on intra-urban location patterns. As initiated by Alonso and Wingo, this research is based on market equilibrium theory and involves the use of fairly rigid assumptions to simplify the analysis. These assumptions mirror those of von Thunen and allow the formulation of the concentric zone model in mathematical terms. In contrast, the sector and multiple nuclei theories have not been rigorously developed from the economic perspective.

In general, the von Thunen-type economic models assume the existence of a single focal point for access. Access is measured in radial distance from that point, defined as the only center of economic activity. Land is assumed uniform with respect to topography, amenity, and environmental conditions. The main tradeoff for any urban activity is assumed to be between access and space, with particular types of land users sharing similar preferences for trading space for access.⁶⁷

In addition, these von Thunen-type models are static and space is assumed to be continuous. They are also only "partial"

equilibrium models, since the location of one type of land use is explained, given the assumed location of other land use types or urban activities. In other words, only the location of one type of land use is explained. Space is allocated according to competitive supply and demand relationships, with each land user seeking to minimize location costs. For spatial equilibrium to be achieved, all users must maximize profits, users in the same income or business category must earn the same economic returns regardless of location, and all land at the same distance from the center must receive the same rent.

Emphasis on the space-access tradeoff reflects the historical tradition of viewing land use patterns as a minimization of "the costs of friction." These costs are defined as "the sum of transportation costs and site rentals, for the aggregate of all necessary land uses."⁶⁸ In this sense, space itself is devoid of positive attributes and is seen strictly in terms of quantity and location relative to the urban center.

In line with the historical focus on accessibility as a primary determinant of land use patterns, Alonso's Location and Land Use and Wingo's Transportation and Urban Land provide transportation-based explanations of residential rent gradients.⁶⁹ Using the von Thunian approach with its monocentric, radially symmetric plain, both Alonso and Wingo suggest that land rent and density must decrease with distance from the urban center. This empirically observable pattern of urban rent and density gradients is portrayed as a function

of consumer preferences in the housing market and of the resources possessed by different income groups. Households are presumed to substitute journey-to-work costs for savings in housing costs or site rentals. Thus, as stated by Wingo, accessibility or the "quality of location" is "a relative quality accruing to a parcel of land by virtue of its relationship to a transportation system operating at some specified level of service."⁷⁰

Specifically, Wingo's model of urban land use focuses on the impact of transportation costs on land rent and the demand for residential land. This emphasis on transportation is based on his belief that "the spatial organization of the city was a direct consequence of the manner in which the movement of goods and persons was organized."⁷¹ Correspondingly, the journey-to-work is seen as "the technological link between the labor force and the production process." Households are then assumed to substitute journey-to-work costs for residential space costs until the marginal saving in transportation costs equals the marginal value of forfeited residential space or the disutility of increased residential density.

This substitution process can thus be thought of as the mechanism underlying residential land use patterns. The principal factors determining the costs and quantities of transportation and space, and thereby explaining the amount, distribution, and value of residential land, are identified by Wingo as:

1. The spatial pattern of employment centers.
2. The organization and technology of transportation.

3. The total population of households.
4. The marginal valuation of leisure by the householder.
5. The marginal valuation of residential space by the households.⁷²

The first four factors determine the costs of movement from any residential location to the employment sites. The fifth factor, individual household demand for land, is assumed to be dependent on the rental value of land, given a constant elasticity of demand. By assuming that household demand for space is uniform for the entire urban population, with space having diminishing utility, the conclusion follows that higher unit rents result in the consumption of fewer units of space. Thus, Wingo directly relates the cost of space to variations in density.

As indicated above, Wingo views the costs of movement as being determined by the type of transportation move used, commuting distance, and commuting time. Correspondingly, access is measured in terms of the dollar cost of a trip, both in time and in direct money-outlays, from an outlying point to the employment site. Transportation costs are substituted for space costs until total location costs are minimized. The price of any location is, as Wingo states, "the annual savings in transportation costs compared to the highest cost location in use."⁷³

While Wingo postulates that the spatial income of the substitution process in any urban area depends on the above five factors, he provides little insight into land use patterns resulting from different combinations of factor characteristics. In fact, the

actual mathematical model developed by Wingo is of little interest to this discussion, since he assumes all factors uniform except distance to a single urban center. Households are assumed homogeneous with respect to the value placed on space and leisure, and unit transportation costs are assumed equal for all travelers.

Wingo does develop semi-models incorporating assumptions more accurately paralleling realistic conditions. However, each of these models relaxes only one assumption, so that land use patterns derived from the realistic interaction of all five basic determinants are unspecified. For example, Wingo shows that if households are not assumed to be homogeneous in terms of space-access preferences and incomes, the concentric zone pattern emerges from the substitution process. However, this result requires the assumptions of one urban center and equal unit transportation costs for all households.⁷⁴

In considering the case of two employment centers, Wingo shows that land densities and values between the two centers decline from the level applicable to a one-center situation, with the exception of an increase in the area immediately surrounding the additional center. The accessibility provided by the in-between land is of less relative value. Conversely, the land between the additional center and the urban periphery commands higher rents than in the case of only one urban center, reflecting the increased access for households in the vicinity. Wingo's discussion, however, assumes the homogeneous population and equal unit transportation costs.⁷⁵ The land use pattern resulting from the interactions of a heterogeneous population in a

multi-center urban area with a variety of transportation modes cannot be determined.

Another deficiency of Wingo's discussion of spatial determinants is the assumption of perfect competition. As Wingo himself notes, land use patterns are affected by such institutional factors as:

1. The legal qualities of the land.
2. Land marketability.
3. The structure of land ownership.
4. Public regulations.
5. The organization of the housing market and construction industry.⁷⁶

Further, Wingo does not believe that the journey-to-work is the sole factor underlying the location decision of households. Other factors include the distribution and quality of the housing stock, neighborhood prestige, and variations in the quality of public services. Thus, Wingo's model does not reflect his recognition of the fact that "Complex substitutional effects are certain to take place among these factors if rational behavior asserts itself at all."⁷⁷

In general, Wingo's behavioral framework, focusing on the substitution process between space and access, is significant for its identification and theoretical integration of five principal spatial determinants. While the interaction of these determinants is developed only in the simplest case, Wingo provides the conceptual basis for subsequent empirical research and identifies additional factors impacting spatial structure which may be amenable to

incorporation into an expanded formula of the substitution process.

This substitution process will necessarily need to be re-valuated and reformulated as technological, institutional, and social conditions change over time. For example, as private transportation costs decrease in suburban areas, thereby reducing the economic advantages of central location, Wingo believes that the amenity level of the physical environment replaces transportation cost as the dominant land use determinant. The availability of public services and the "selective gregariousness of social groups" are considered the next most important spatial determinants.⁷⁸ Wingo's basic land use model may thus be more applicable to the explanation of historical land use patterns than of the present process of land utilization.

Alonso's Location and Land Use posits an urban land use theory which is very similar to Wingo's model in terms of identified spatial determinants. His theory, however, serves to correct certain technical errors in Wingo's model, and is considered to be the most complete model of urban location theory. As in Wingo's theory, accessibility to the employment site is taken to be the main influence on the choice of residential location. However, unlike Wingo, while households are assumed to share the same general utility function, Alonso does not assume that incomes are uniform nor that total expenditures on housing and transportation are the same for all households. The consumer is allowed to substitute other goods and services for housing and transportation. Thus, households maximize utility from housing, goods, and distance from the urban center, subject to a budget constraint.

Locational equilibrium is achieved when it is not possible to increase utility by changes in location and/or in the consumption of goods and services. Wingo's equilibrium condition, achieved by equating transportation cost saving to land rent, is correct only when housing and transportation are the only goods and services and where some commuting costs are budgetary.⁷⁹

In Alonso's model, utility maximization by households results in a bid price function which shows the land rent a household can pay at each distance from the urban center to attain the desired utility level, consistent with the household budget. Land rent, and housing and transportation costs, are a function of distance from the center. Prices of other goods and services are assumed to be independent of location. Price structure curves show the market price of land at each distance from the center, with land rents density assumed to decrease with distance. A household's equilibrium location is given at the point of tangency between the price structure curve and the bid price function.⁸⁰

Similarly, firms maximize profits with respect to production and location. A firm's bid price function shows land rent at each distance from the center which yields the desired total profit level, assuming profit-maximizing production occurs at each location. The point of tangency between the price structure and the firm's bid price function again determines locational equilibrium.⁸¹ Market equilibrium in the urban land market results in households and firms with steeper bid prices located closer to the urban center. However,

as noted by Mills, this situation can be achieved only in the case of perfect competition.⁸²

As described by Alonso, increases in income may result in bid prices favoring location at a greater distance from the center, enabling the consumption of more land. In other words, higher income households may buy less accessibility with increasing income, allowing them to locate on cheaper land than that available to lower income households. As Alonso states:

Given a strong appetite for land, so that the holdings of land vary greatly with income, the wealthier are affected relatively less by the costs of commuting because they spread these costs over larger sites. Consequently, the rich are price-oriented whereas the poor are location-oriented.⁸³

Differential space-access preferences are thus identified as significant spatial determinants, in line with Wingo's view.

It is important to note that different space-access preferences may not be the sole or most important cause of observed land use patterns where the wealthier households locate on less expensive land at or near the urban periphery. As Hoyt and Harris have suggested, these patterns may result more from a social impulse toward income segregation. Higher income households move outward as lower income groups expand their area of occupancy. However, the location choices of higher income households may also result from the desire for newer housing and cleaner neighborhoods. As Harris states:

As a matter of historical accident, American cities that have grown rapidly under changing technical conditions exhibit a coincidence between age, deterioration, and obsolescence on the one hand and high

densities on the other. The presumed space preferences of the population is therefore a reflection of historical accident, and masks an altogether different preference.⁸⁴

Thus, until observed spatial patterns can be more definitely be explained, any policy attempt to affect land use patterns may prove fruitless, due to a misinterpretation of the specific impacts of various spatial determinants.

Overall, the models developed by Wingo and Alonso suffer from the rigid assumptions used to enable a mathematical formulation of urban location decisions. By modelling the concentric zone pattern, urbanization economies in public service provision can be ignored. By assuming a single urban center to be treated en masse, the models can ignore locational interdependencies among economic units. Further, the recognized impact of multiple urban centers on bid rents also suggests, as noted by Mills, that housing and employment locations should be determined simultaneously.⁸⁵ Finally, these models are deficient in that they focus on the costs associated with location decisions without direct consideration of the economic and social benefits of particular spatial patterns or location decisions.

"NEW" URBAN ECONOMIC MODELS (SECOND-GENERATION)

The "new urban economics" is a term referring to the fairly recent development of economic theories to explain the growth, composition, and spatial form of urban areas. Previously, urban economics was principally concerned with analyses of specific problems such as housing, poverty, and transportation. Alonso's theory is viewed as

a first-generation model in which the principal focus is on the effect of income on household location decisions.⁸⁶

The second-generation models differ from the earlier models in their greater complexity and policy orientation, whether implicit or explicit. These later models essentially date from 1967, when Mills developed a general equilibrium model recognizing land competition between production, housing, and intracity transportation.⁸⁷ Mills models the supply and demand for these activities in order to determine the boundary between the CBD and the residential area. Although the assumptions underlying the model are quite restrictive, the model serves to draw attention to the trade-off between transportation diseconomies and economies in city size resulting from increasing returns to scale in production. Increasing returns in production is, in fact, seen as a major factor explaining the existence of cities. In this respect, increasing returns can be viewed as a determinant of the size of an urban center and of the degree of spatial concentration in urban subareas. As explained by Mills, constant returns to scale eliminate the need for the spatial concentration of economic activity. With greater spatial dispersion of production, transportation costs may be minimized. This conclusion, however, is somewhat premature, since Mills did not consider interdependence among firms. Further, as Mills later noted, "Economists have few ideas as to the way scale economies are affected by proximity or distance."⁸⁸

Other second-generation models attempting to identify and

explain spatial determinants focus on urban externalities. The major externality that has been examined for its effects on land use is traffic congestion. While Wingo discusses congestion in the context of increased commuting costs in his 1961 model, rigorous formulation of models incorporating congestion were not developed until 1971.⁸⁹ Several of these models show that in the absence of a congestion toll or corrective pricing, an urban area will become more suburbanized, with overinvestment in transportation facilities around the CBD. Here again, however, the results are dependent on the assumption of a single urban center, a fixed amount of residential land for each household, and varying assumptions with respect to profit maximization in the private and public sectors. Further, the boundary of the urban area or city is determined endogenously. In contrast, if we assume an exogenously fixed urban boundary and an increased supply of residential land, we can conclude that congestion leads to a more compact city.⁹⁰ Despite congestion costs associated with increased density, average household commuting costs are also shown to decline. This suggests that, at least in the case of a closed city with a single urban center, a sufficient number of households move inward to counteract increased congestion costs.

Overall, externalities can be viewed as negative spatial determinants in the sense that they result in inefficient land use patterns derived from the divergence between the private and social costs of location decisions. The results of the externality models tentatively suggest that public action in delimiting an urban boundary

beyond which development cannot occur will increase density gradients and congestion costs, while lowering aggregate private transportation costs as the population increases. The distribution of rents and densities will, however, depend on such factors as the number and location of employment sites, and on transportation service facilities. Externality or congestion pricing would presumably have the same effect as institutionalized urban boundaries. Any action to counter the land use effects of traffic congestion would, however, have to take into account the density externality. No models appear to have considered both types of externalities jointly.

The idea of "efficient" land use patterns has led some researchers to the conclusions that, given the presence of indivisibilities and economic interdependencies, a competitive market will not result in an efficient spatial structure. The models discussed have all assumed continuous space without locational interdependencies and production indivisibilities. However, it has been shown that in the presence of one or both conditions, a competitive land market will result in inefficient land use patterns.⁹¹ The degree or distribution of spatial inefficiency is, however, not clearly understood.

In general, the second-generation models have aimed at greater realism in order to provide policy guidelines. In addition to the incorporation of externalities, interdependencies, and production indivisibilities as spatial determinants, modellers have attempted to introduce factor substitutability, the supply of public goods, and differences in household utility functions. However, economic

theoreticians have not sought to incorporate environmental, social, or institutional factors into their models. Thus, to the extent that actual land use patterns do not reflect the "rational" outcome of market forces, the economic models are less than reliable guides for policy-makers.

Further, although some work has been done using optimizing techniques, the heavy reliance on equilibrium theory results in static models which are largely ineffectual in explaining the land use consequences of changes in the characteristics of spatial determinants over time. And, as Solow points out:

To study the locational equilibrium of a city almost seems silly. Buildings, streets, subways are among the most durable objects we make, and it is very expensive to move them or even to remove them. Existing patterns of location must therefore have been determined in large part by decisions that were made and events that happened under conditions that ruled long ago. It seems far fetched to expect that what now exists will bear much relation to what would now be an equilibrium.⁹²

However, as should be clear from the above discussion, equilibrium models have helped to identify significant variables impacting urban spatial structure and have provided insights into the direction of change through the exogenous manipulation of those variables. Most of the identified variables or spatial determinants are related to the concept of accessibility, either directly or indirectly.

In summary, location factors identified by the economic approach to urban land use theory can be categorized, following Hoover, as follows:

1. "Given" or exogenously determined locations: location depends on the suitability of physical land features or accessibility to other urban areas.
2. Access linkages: facilities determining the need for physical proximity.
3. Agglomerative factors: economic incentives favoring concentration and clustering of similar or complementary activities.⁹³

These location features can be further disaggregated into the following categories:

1. Technological (transportation and communications facilities; factor input ratios; production indivisibilities).
2. Topographical and environmental (excludes amenity levels).
3. Economic (availability of input factors for production; profit-maximization objective, consumer demand; locational interdependencies).

CHAPIN AND WEISS'S "NORTH CAROLINA" BEHAVIORAL APPROACH

The Chapin and Weiss approach to urban land use theory has been termed "decision analysis."⁹⁴ Developed at the University of North Carolina, the organizing concept consists of a "values-behavior-patterns-consequences" framework for use in explaining urban spatial structure. Spatial structure, composed of physical forms, is thought to represent the consequences of behavior patterns which, in turn, are explainable in terms of values and attitudes. Compared to the economic perspective, this approach is sufficiently generalized to enable the incorporation of both economic and non-economic factors

as spatial determinants. Further, the framework allows all spatial phenomena to be ultimately explained in terms of social values, as originally proposed by Hurd.

Within this context, behavior patterns are defined as "rational and overt forms of interaction" occurring between and among individuals, households, and firms. These interaction patterns, whether activities or communications, may be of short or long duration, with more durable patterns reflected in stationary physical forms. The practical focus is largely on clustering behavior patterns, since, according to Chapin, "to get at the elements of urban spatial structure we are particularly interested in the way duplicating or clustered patterns build up in space . . . and in a time sense."⁹⁵ Correspondingly, the consequences of behavior patterns are composed of "spaces" and "interconnecting channels," reflecting the functional requirements of interaction.

As in the economic approach, the location decisions of households, firms, industry, and government are seen as the operative force translating interaction patterns into concrete forms. Chapin thus describes the land development process in terms of both "primary" and "secondary" decisions, with the former stimulating the occurrence of smaller-scale secondary decisions. A decision to construct a freeway or planned community, for example, leads to decisions by households concerned with relocation activities. However, while these relocation activities may physically account for most of the subsequent development pattern, the primary decision has functioned to predetermine the distribution and intensity of land development.

The significant characteristic of the North Carolina approach to urban location theory, distinguishing it from the economic perspective; is the view of the decision process as "growing out of needs and desires of day-to-day forms of interaction."⁹⁶ The North Carolina approach thus goes a step further than the economic theory of land use by necessitating an explanation of the economic factors themselves in terms of human interaction needs. As Chapin states, his work "in effect substitutes the urban social system for the market place as the medium which regulates location decisions."⁹⁷

In developing a forecasting model treating the land development process as a flow of decisions, Chapin and Weiss deal only with the consequences of decisions as observable in physical terms. Decision variables themselves are excluded, and thus the model does not demonstrate how political and social factors impact and bound the land development process.⁹⁸ Rather, the model attempts to simulate secondary residential location decisions given exogenously specified priming actions. These actions may include the implementation of public policies and location decisions by major employers. Based on such actions, the model forecasts the distribution and density of development.

In order to forecast, the model requires three types of data: identification of available land suitable for residential use within prescribed density levels; specification of land values for each grid cell (23 acres) as a reflection of the land's attractiveness in terms of relative accessibility and amenity; and specification of the land's

attractiveness for residential development after certain improvements and policies have been implemented.⁹⁹ The last requirement can be satisfied through the use of multiple regression analysis. This analysis, done by Chapin and Weiss for three urban areas, provides the behavioral basis for the model.

Using regression analysis with the 23-acre grids as the unit of observation, fourteen factors or variables were investigated for their explanatory value in explaining total land in urban use and dwelling density. These included:

- Marginal land not in urban use
- Travel distance to nearest major street
- Availability of sewerage
- Distance to nearest elementary school
- Zoning protection
- Assessed value
- Accessibility to work areas
- Proximity to nonwhite areas
- Proximity to blighted areas
- Total travel distance to high value corner
- Proximity to mixed uses
- Distance to nearest recreation area
- Distance to nearest convenience shopping area
- Residential amenity¹⁰⁰

Of these variables, seven were found to be statistically significant in explaining the distribution and density of urban land use:

- Most important: Marginal land not in urban use
- Accessibility to work areas
- Assessed value
- Next important: Travel distance to nearest major street
- Distance to nearest available elementary school
- Residential amenity
- Availability of sewerage¹⁰¹

With the exception of marginal land and assessed value, these explanatory variables are used as "conditioning factors" in the forecasting model, determining the relative attractiveness of land in light of conditions amenable to policy manipulation. In terms of Chapin and Weiss's conceptual framework, these variables constitute the primary decisions stimulating a series of secondary location choices. They are exogenously introduced, in addition to changes in land values and density constraints, into the forecasting model's iterative distribution process of households.

The North Carolina model is of particular significance, since it explicitly suggests that consumer space/access preferences may be less significant in residential location decisions than government policies and the decisions of private developers. As Goodall has noted in reference to the North Carolina model:

Thus, since the desires of the customer are only one factor, customer satisfaction is dependent on the developer's interpretation of the market. In this respect, the outward expansion of residential development is seen as an ad hoc process with the development process proceeding relatively unsystematically and with imperfect information.¹⁰²

Thus, in attempting to explain the land use consequences of this ad hoc process, the attitudes of different decision-makers must be identified and related to observed activity patterns. As Chapin notes, identification of these attitudes can also help to determine the stability of those patterns.¹⁰³

In general, the North Carolina approach to a theory of urban

land use, by explicitly incorporating value systems into the explanatory framework, eliminates the theoretical need for von Thunian assumptions as a means of isolating spatial determinants. Chapin and Weiss recognize both the government and the private market place as mechanisms mediating urban location decisions. The factors believed to influence location decisions can be classified as activity-, property-, and environmental- or site-related conditions.¹⁰⁴ However, these factors, defined specifically for use in a forecasting model, are essentially the empirical consequences of more fundamental conditions which can be classified as technological, institutional, economic, and environmental. Travel distance to the nearest major street, for example, is a reflection of existing transportation technology and public policy on the location of roads and highways. The explanatory value of the forecasting model as a whole suffers precisely from the fact that it aims at forecasting. The trade-offs between different spatial qualities or conditions in location decisions are not clearly specified.

FOLEY AND WEBBER'S "GENERALIZED" BEHAVIOR MODELS

Like Chapin and Weiss, Foley and Webber focus on patterns of interaction as the explanatory basis for a theory of urban land use. Their conceptual frameworks are of particular value for explicitly specifying systems of interrelationships which need to be investigated if such a theory is to be adequately developed. In this

respect, Webber's approach is unique for giving recognition to the influence of conditions outside the boundaries of an urban area on the spatial patterns within those boundaries.

Specifically, Foley develops a conceptual framework which draws attention to the interrelationships between the spatial and aspatial aspects of urban land use, and between values and the physical environment.¹⁰⁵ The term "spatial" is used to refer to the distribution of activities in space, while "aspatial" encompasses aspects of metropolitan structure analyzed independently of spatial distributions.

Factors influencing metropolitan structure, from both spatial and aspatial perspectives, are classified into three categories: normative or cultural aspects; functional organizational aspects; and physical aspects. These categories can be further subdivided into aspects of form and process. This framework can then be used to formulate hypotheses of the interrelationships between different types of metropolitan structure. These hypotheses would be based on some specified system of concepts. For example, one system of concepts amenable to investigation might involve the conversion "from functional interdependencies to such interdependencies in space to the spatial arrangement of activities to a formal view of the physical environment to accommodate these activities."¹⁰⁶

The twelve aspects of metropolitan structure identified by Foley are summarized in Figure 1. As the diagram suggests, the functional organizational aspects, consisting of activity systems and subsystems, are viewed as mediating the interrelationships between values and the physical environment.

Figure 1

	<u>Spatial Aspects</u>		<u>Aspatial Aspects</u>	
	<u>Form</u>	<u>Process</u>	<u>Form</u>	<u>Process</u>
1. Normative or Cultural Aspects	--	---	--	---
2. Functional organizational aspects	--	---	--	---
3. Physical environmental aspects	--	---	--	---

Webber develops two conceptual frameworks which, when combined, portray urban spatial structure as the composite result of interaction patterns within bounded urban territories and of communication patterns between groups of people physically separated in space.¹⁰⁷ This twofold perspective is based on recognition of both "the urban place" and "the nonplace urban realm" where interaction patterns do not require propinquity. The two concepts together comprise the

spatial field within which people act. While Webber does not actually integrate the two conceptual schemes, he suggests that one type of community cannot be completely understood if the other is ignored:

The spatial structure of urban settlements and urban regions and the spatial structure of the urban realms are closely related: each is in some way a function of the other.¹⁰⁸

The spatial structure of an urban place is basically conceptualized as a four-component subset of Foley's schema: the functional interdependencies or linkages among activities, as modified by spatial distribution; the spatial patterns of human interactions, conceived of as flows; the spatial form of communication and transportation channel networks, and of space adapted for housing activities; and the locations of activity places. Since functional interdependencies can only be empirically identified on the basis of physically observable flows of people, information, and objects, the first component can be subsumed by the second. Noticeably absent in Webber's framework, in contrast to that of Foley, is the role of social values as spatial determinants. In this respect, Webber's approach to the explanation of urban spatial structure is of a more intermediate, and hence partial, nature.

Webber expands his three-component perspective of urban spatial structure into a descriptive classification scheme. Six dimensions of each component--human interactions, physical plant, and activity locations--are suggested:¹⁰⁹

1. Size of phenomena
2. Tendency toward concentration in concentric forms
3. Tendency toward concentration in subcenters
4. Degree of pile-up or concentration per unit
5. Relative spatial "togetherness" of similar phenomena
6. Relative degrees of mixture of unlike phenomena

This classificatory scheme thus suggests the types of measurements required for describing the dimensions of spatial structure and for forecasting future changes. The use of this classification system as the basis for a behavioral model of urban spatial structure is not, however, spelled out in terms of the analytical means of translating description into a system of interrelationships between the identified dimensions of spatial structure. A behavioral analysis must specify the impact of various dimensions on each other and the relationships between components.

Webber's conceptual framework for describing and explaining the nonplace urban realm is based on the measurement of communication flows between identified interest-communities. While less rigorously developed than the framework for urban places, the basic conceptual focus on interaction patterns permits the urban realm framework to be conceived of in similar, but territorially unlimited, dimensions.

In general, the conceptual frameworks developed by Foley and Webber provide the theoretical foundation for systematic behavior analyses of urban spatial structure. Viewed compositely, these frameworks identify broad classes of spatial structure and delineate

spatial dimensions amenable to measurement. As Webber notes, comparative measurements can help improve "understanding of the relations between the functional processes of urban societies and the locational-physical forms of the settlements."¹¹⁰

SYNTHESIS OF THE STRUCTURAL-BEHAVIORAL APPROACHES

Where the historical-morphological approaches explain and classify patterns of urban land use, the structural-behavioral models attempt to provide insights to the forces that shape spatial structure. The focus of analysis is the behavior of economic agents: households, businesses, industry, and public institutions. The common element to these models, as Alonso has suggested, is that they rely on an ahistorical framework to explain the process of spatial formation.¹¹¹ Emphasis is on the behavior of economic institutions, and the decision-making processes that they adhere to. While many of the models are termed "dynamic," in that they describe situations over periods of time, they do not incorporate time itself as an independent variable altering spatial structure. Being ahistorical, these models tend toward high levels of abstraction often associated with microeconomic analysis. The framework provides for the analysis of economic behavior in the marketplace, and spatial structure is seen as the result of market activity.

The von Thunen model relies on an abstract representation of market behavior to describe how spatial competition determines

rents and land use. Through competition, agricultural production occurs to insure that the crop grown on a site located at a specific distance from the trading center will yield the highest possible rent per acre. Given several restrictive assumptions, spatial competition for land generates a concentric pattern of agricultural land use. Rent-paying ability determines land use patterns. The von Thunen framework "collapses" space into two dimensions of transportation distance and cost. As a consequence, it does not incorporate natural, institutional, and nonmarket forces that shape land utilization patterns.

Von Thunen's framework was applied to urban contexts with little thought given to the inapplicability of such a transfer.¹¹² The Alonso and Wingo models establish a research approach based solely on rent-bid explanations of urban spatial structure. The simplicity of the von Thunen framework allows these urban applications, through the use of equilibrium analysis, to explain the spatial formation of urban areas. These models rely on competitive supply/demand relationships to achieve spatial equilibrium, a condition where all land-using activities maximize profits and where the sum of transportation costs of friction are minimized.¹¹³ With the rigid assumption of a monocentric uniform plain, the competitive bidding for accessibility insures that land rents and densities fall as distance from the urban center increases.

The outcomes of these models result largely from their restrictive assumptions. The assumptions of monocentricity, spatial

uniformity, perfect information, rationality, and the insignificance of nonmarket values allow for the mathematical modeling of the urban form. Recognizing these flaws in the initial development of urban land rent and spatial structure models, more recent attempts have been made to increase complexity and policy relatedness.¹¹⁴ Competition among land use activities was specified to draw attention to locational trade-offs and the play of economies and diseconomies of scale associated with urban growth. Other extensions include the incorporation of externalities, indivisibilities, and scale effects, and their effect on location decisions. Unfortunately, most applications of externalities have focused on negative aspects and not on positive external effects. While second generation models have aimed at greater realism, they have not attempted to incorporate environmental, social, or institutional factors into their analysis. Thus, the logic of model operation is still grounded on the principles of economic rationality, and as such still does not reflect non-market locational considerations. These extensions of the von Thunen-type models reflect the concern and familiarity with economic behavior and the desire to increase their ability accurately to mirror reality. The new models are very much economic ones: they ignore aspects of the location process that fall beyond the boundaries of economic thought. It is, then, not surprising that the next (chronologically) extension of our understanding of location decisions comes not from economists but from planners.

The behavioral approach of the North Carolina school attempts

to identify the decision-making process of actors and institutions engaged in land development. Their framework is much more a generalized one than that of Alonso and Wingo, and they incorporate non-economic factors in the analysis. Further, since they are more exploratory, they include values and behaviors that are not capable of precise mathematical formulation. Attention is given to the probabilistic aspects of locational decision-making and with the interaction of households, firms, and institutions. Value systems are included in the explanation of the use of space. In this regard, the Chapin and Weiss approach is much like the historical framework, except that its focus is on describing behavior and its causes, not an historical description of spatial structure. Their approach would combine well with the Alonso framework. Since it identifies nonmarket values and the interplay of locational decision-makers, it would increase the explanatory power of the Alonso-Wingo models and their extensions. Such integration would require either significant empirical work on behavioral modeling, or the relaxing of the logical requirements of the structural approach.¹¹⁵

Foley and Webber continue the tradition of the Chapin and Weiss approach, but expand their focus of inquiry. Both examine the interaction between land use activities and develop a theory of urban land use. Their work could be used to extend the modeling domain of the structural model, since they explicitly outline relationships of spatial interaction. Foley develops a framework that differentiates aspatial and spatial aspects of land use, values, and physical aspects

of the environment. Such a conceptual scheme might be useful in framing future research. Webber's work is more of an exploration of the spatial and nonspatial aspects of interaction and communication. His dichotomy is useful in that it firmly drives a wedge between the spatial and nonspatial components of locational decision-making. He outlines six attributes of urban spatial structure: size, concentric concentration, subcenter concentration, degree of concentration, spatial "togetherness," and relative mixture of diverse land use activities. Distinguishing these aspects of the urban environment is useful in two respects: they suggest a classification scheme for the measurement and definition of urban form, and they suggest areas for future research on urban spatial structure. The Foley-Webber conceptual schemes, like the behavioral approaches of their North Carolina contemporaries, could be used to extend the development of the Alonso-Wingo-type models into areas that lie outside the traditional domain of economic inquiry.

SUMMARY

This essay has attempted to bring together the literature on the theories of urban form and land use. Its orientation has been nontechnical so that a wide audience could be reached. The scope of the literature reviewed has not been exhaustive; rather, works have been presented to give the reader a balanced and representative view of this broad area. This review has had as its primary purpose the presentation of two distinct conceptual frameworks for explaining land use and urban form. Our objective has been to illustrate that each provides limited insight to the process of urban spatial structure. Individually neither is capable of sufficiently explaining the play of forces that determine the urban use of space.

Historical-morphological approaches stress the effect of topographical, economic, social, technological, and institutional factors in determining urban spatial structure. This historical mode has predisposed the analysis to be limited to description and not prediction. None of the approaches adequately relate the entire range of land use determinants to the process of spatial development.

The structural-behavioral models jettison most of the descriptive baggage in favor of an abstract portrayal of urban development.

Reliance is placed on the role of economic markets and the competitive bidding process to determine spatial allocations. Such a theoretical framework allows for the development of models that provide insights to existing and future location patterns. Whereas the morphological-historical approach pays for its rich descriptive detail with the inability to identify the process of spatial formation, the structural-behavioral approach balances its abstraction and logical rigor with its lack of realism and policy relevance and limited predictability.

While this is not the place to discuss the attributes of "good" models or conceptual schemes, the juxtaposition of these two distinct styles of inquiry force mention of the roles that models play in theory building and policy formation and analysis.¹¹⁶ In some ways, we are at a crossroads in developing theoretical models to explain urban spatial structure and land utilization. Further refinement of the "new urban economic models" are not likely to provide insights to the process of spatial formation. This is due partly to the fact that most modelers are economists, and that they fail to consider noneconomic factors of land development. Further, microeconomic analysis has relied too long on a naive conception of consumer and institutional behavior, without expanding its understanding of microeconomic behavior, so that further breakthroughs in urban spatial modeling seem unlikely.¹¹⁷ Little attention has been focused on the effect of uncertainty in urban development, the effect of government intervention, and the role of technological change on the process of urban development and land utilization.

The earlier research tradition of the social ecologists, along with the work of the behavioralists and emerging Marxist theories of urban development, could provide an excellent basis for future research on urban form.¹¹⁸ By identifying noneconomic factors that affect development and location, this body of literature suggests many avenues for work. The greatest difficulty in generating this line of investigation lies in identifying a cognitive style for analysis. Emerging trends do suggest that some blend of case-study/survey research will be the main line of future inquiry.¹¹⁹

FOOTNOTES

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11. Ibid., pp. 77-78.
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13. Ibid., pp. 79-80.
14. Ibid., p. 150.
15. Ibid., p. 159.
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31. Ibid., pp. 126-127.
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34. Eight variables: average rental for the block; percentage of residential structures of 35 years and over; percentage of dwelling units owner-occupied; percentage of residential structures needing major repairs or unfit for occupancy; percentage of dwelling units having no private bath; percentage of non-whites; percentage of dwelling units having no central heat; percentage of dwelling units that are overcrowded. Ibid., p. 28.
35. Ibid., p. 72.
36. Ibid., p. 76.
37. Ibid., p. 73.
38. Hoyt shows Chicago's 1934 periphery to include sections with rents of \$10-19.99, as well as sections with rents of \$50 and over.
39. Hoyt, op. cit., p. 112.
40. Hoyt notes that the development of "de luxe apartment areas" in old residential areas is an exception to this outward movement. Ibid., p. 116.
41. Ibid., p. 114.
42. Ibid.
43. Ibid., p. 116.
44. Ibid., p. 117.
45. Ibid., pp. 117-118.
46. Ibid., p. 95.
47. Ibid., p. 99.
48. Chauncey D. Harris and Edward L. Ullman, "The Nature of Cities," The Annals of the American Academy of Political and Social Sciences (November 1945), pp. 7-17.
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51. Ibid., pp. 15-16.

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83. Alonso, op. cit., p. 109.
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