follow, we will examine two quite different approaches to this problem, both of which take their start in some of the considerations of central place theory.

A. Conceptual Bases For Retail Models

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This presentation is designed to sketch the main conceptual bases of retail models, and to indicate the problesm encountered in making these bases operational. The thoughts come from several years of work on the commerical structure of rural regions and of cities conducted at the University of Chicago.

Presumably, a complete retail model should be a relatively self-contained module which can be incorporated into larger urban models, deriving exogenous inputs from other segments of the model and feeding back into them, or capable of being run alone given certain exogenous forecasts and with the intent of predicting the retail system that is a necessary consequence of those forecasts. The predictions should include locations and sizes of business centers and other retail conformations, sizes and shapes of market areas, and the main elements closely dependent upon the others in an hierachical retail system. Consistent with the concept of consumer orientation that is the most basic idea in all retail modelling, the exogenous inputs should comprise the spatial distribution of consumers and their income characteristics, with some indications of the highway system, travel times and points of superior local access.

Yet existing retail models fall far short of this goal. The simplest which have been developed and used are based quite crudely upon the concept of consumer orientation. A good example is the Berman-Chinitz-Hoover model for New York, reported in Projection of a Metropolis. This model regresses number of employees in each of a duzen two-digit S.I.C. retail sectors upon population, using counties as the units of observation. The results look astoundingly good, with correlations everywhere exceeding 0.90, but are specious. If the same regressions are run using smaller units of observation the correlations diminish, and they approach zero as the spatial units of observation approach block size, although the decline is less rapid for convenience than for shopping or specialty goods.

The problem lies in the units of observation, not in the concept of consumer orientation. The concept has a corollary ignored in the New York model: that consumer orientation implies an equilibrating adjustment of retail distributions to that of purchasing power. Stability is thus brought to the simple cross-sectional regressions if the correct ecological units are established and compared. These units are established and compared. These units are business centers on the one hand, and their market areas on the other. Equilibrium on the part of business incorporates two elements: (a) activities localized in the centers; and (b) ribbon uses. To establish an overall business adjustment to a given market area requires establishing first the size of the needed business center, and thereafter the complement of ribbon uses providing additional facilities not requiring center location.

Yet even regressions with proper ecological observational units fall far short of the complete goal of specifying locations of centers and sizes of

markets, etc. Some recourse can be had to the best body of retail location theory, the central place theory of Christaller and Lösch, to enrich models. Realistically, central place theory predicts agglomerations of retail uses spatially organized into a hierarchy of centers and of complementary market areas. From it, however, one develops a fundamental dilemma, as follows. Where

P is the population served
B is the size of a business center
d is population density
D is the maximum distance consumers will travel to a business center

then the theory argues

$$B = f(P)$$

and

$$D = f(B)$$

but from the following identities

$$d = P / D^2$$

$$P = d \ D^2$$

then

$$P = f(D)$$

which leads to circularity. Of course, the circularity comes from the interdependence of size of center and consumer behavior, but the theory offers no guides as to how to overcome the circular chain of reasoning and forecast simultaneously locations of centers and their market areas. Further the theory is static, not dynamic, and under assumptions of an isotropic plain locations are not unique; the equilibrium postulates can be satisfied under an infinite number of rotations on the plain. Given a set of market areas, the theory will predict center sizes, or given sizes it will predict center spacing and market areas, but not both and not center locations.

Given a set of locations, gravity models can also be used to predict market areas very precisely, thus emphasizing the role of centrality of centers to their tributary areas in the same sense as locations theory. But again, the models will not predict the center locations, which must be prescribed beforehand, as in the Lakshmanan-Hansen formulation to be reviewed later by Britton Harris.

One feels, then, real dissatisfaction with the current state of retail modelling. The existing kinds of models work will if one set of inputs is given: center locations and market area sizes to predict center size; or center locations and sizes to predict market areas. But they cannot derive a complete system. They are perfectly effective when, given an existing retail system, the need is to estimate the marginal effects of market area change on that system, whether it be decline or growth. Even in such applications the parameters used in the models have only very short-run applicability, however,

and the "trending" of parameters on the basis of analysis of successive time periods is probably inappropriate because of the discontinuous and "lumpy" nature of retail change. Witness the jump from the unplanned business center in which the developmental unit was the single store to the planned shopping plaza which is designed, constructed and managed as a unit.

What conceptual bases may be carried through, then, as improved retail models are developed and used? Three should be emphasized:

(a) Consumer orientation. This stresses the basic equilibrating mechanism, but must be enriched by specification of the proper ecological units within which that equilibrium works.

(b) Agglomerative effects. The larger the center (whether numbers of kinds of business, establishments, space occupied, etc. -- all are collinear), the greater the market area needed for support. But also, the larger the center, the greater the consumer willingness to travel to it, indicating considerable external economies to firms located in retail nucleation. Part of these economies represent the transfer from the consumer to the firm of cost savings associated with the multiple-purpose ample-variety trip to larger centers with a more varied and ample industry mix.

(c) Local Access. Centers must be located centrally to the areas served, at points of maximum local accessibility.

Models which are developed will if complete have to consider each of these bases simultaneously, and simultaneously produce from exogenous forecasts of the spatial distributions of consumers and their incomes and the patterns and the patterns of local access locations and sizes of centers and confermations of market areas nested into proper ecological balance -- into a state of equilibrium.

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