STORE LOCATION IN SHOPPING CENTERS: THEORY & ESTIMATES

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Abstract

Existing research on the economic characteristics of shopping centers has focused on the nature of lease structures (e.g., Chun, 1996), tenant mix (e.g., Anikeeff, 1996), investment performance (e.g., Pagliari and Webb, 1996), inter-store externalities in demand behavior (e.g., Brueckner, 1993), and location and size decisions (Vandell and Carter, 1996). Only informal attention has been paid to the more micro-level spatial aspects of store location within shopping centers (Brown, 1991, Mulvihill, 1992). Yet, an understanding of such location behavior within the mall can aid considerably in optimizing design, space allocation, and tenanting decisions. This paper develops a formal theory of store location within shopping centers built on bid rent theory. A bid rent model is specified and solved with an objective function of profit maximization in the presence of comparative, multi-purpose, and impulse shopping behavior. Several hypotheses result from this exercise about the optimal relationships between store type, size, rents, sales, and distance from the mall center. The hypotheses are tested using data from a sample of 849 leases in nine regional and super-regional shopping centers. They are confirmed, suggesting that a bid rent explanation is consistent with observed location patterns in malls: smaller, higher- sales-density stores, such as the food court and jewelry stores, tend to locate close in to the center of the mall, while lower-sales-density stores, such as housewares and women's apparel, tend to locate further out near the anchors.

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1) Introduction

Since 1990 some interesting non-locational studies on shopping centers have explored the microeconomic foundations of lease price discrimination and store space allocation (Benjamin, Boyle and Sirmans, 1992; Brueckner, 1993; Eppli and Shilling, 1995; Pashigan and Gould, 1998). All of these articles were based on the concept of inter-store externalities; thus, any expansion of these studies to include location aspects would necessarily be based on agglomeration economies.

At the same time two more applied circulation studies on customer traffic in shopping centers (Brown, 1991; Sim and Way, 1989) suggested use of bid rent theory to explain location characteristics of stores. Both authors suggested that a bid rent-style model would appropriately describe customer circulation in a regional or super-regional shopping center. A seminal working paper in the economics tradition also suggested a bid rent foundation be used to explain store location in shopping centers (Fisher and Yezer, 1993).

In this paper we deal with the spatial aspects of shopping centers using bid rent theory, leaving the more difficult approach using agglomeration economies for subsequent efforts.[1]

Pashigan and Gould (1998) suggest that the failure or inability to internalize

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[1] According to Arnott, Anas, and Small (1997):

> "Agglomeration economies have resisted attempts to fully understand their microfoundations. This is illustrated by urban economists' lack of confidence in forecasting the effects of the communications revolution on urban spatial structure. On the theoretical side, we do not know the scale at which the various forces work or what kinds of equilibria the simultaneous interaction of many forces will produce; nor do we have reliable models of dynamic growth paths with random shocks. We also do not know which external economies will be internalized through private initiative. On the empirical side, despite the increasing sophistication of studies relating a firm's productivity to the size and industrial composition of the city in which it is located, we do not know the specific forces that produce these relationships, or just how they depend on industry mix, local public goods, or zoning." 55-56

externalities contributed to the decline of the central business district (CBD) and the rise of shopping centers. So shopping centers are worthy of study generally if for no other reason than for the dramatic way they have reshaped retailing. Post-World-War II suburbanization, economic growth and mass ownership of the automobile were necessary before shopping centers could thrive. But shopping centers experienced a sudden dramatic rise in growth when developers became convinced of the success of the enclosed mall concept in the late 1950's and early 1960's. By 1989, shopping centers captured 55.2 percent of all non-automotive retail sales in the United States.

The goals of this article are to provide economic explanations for location patterns of non-anchor stores in regional and non-regional shopping centers, relying on bid rent theory to explain optimal store location. Several issues were immediately recognized as complicating factors that needed to be dealt with. These included 1) the fact that Alonso's bid rent model operates only in perfectly competitive markets and 2) the transportation costs of the bid rent model are absent in the context of shopping centers. What is important and novel is the treatment of inter-store location in the shopping center in the context of urban spatial structure.

This article is divided into six parts. Background literature on the shopping center industry, including characteristics of shopping center layout and design and mall tenants, appears in the second part. Part three sets out the formal bid rent model as modified for a shopping center context. In part four, testable hypotheses regarding relative locations of stores by type, size, rent and sales are proposed for mall tenants that maximizes profits for both tenants and the mall developer. Hedonic equations based on Rosen (1974) are estimated to determine the economic impact from mall centers on store rent. The multiple regression equations employ a unique lease data set containing eight hundred and forty nine observations. The leases are from regional (five) and super-regional (four) shopping centers scattered throughout the United States. The empirical results provide strong support for the theory that stores' location and size follow Alonso's basic bid rent pattern. Part five concludes.

2) Industry Wisdom and the Nature of Shopping Centers

Since shopping centers internalize externalities through their leasing arrangements, and the process reveals itself through rent discrimination and mall space allocation, further manifestation of the process should be discoverable, including spatial evidence. The optimal decisions of the shopping center developer as the "perfectly discriminating monopolist" should be revealed through other spatial characteristics, particularly those related to store location. Characteristics of stores, i.e., size, sales per square foot, and rent per square foot, as they relate to location, should be important. Secondarily, size, shape and general layout of shopping centers place constraints on store location and therefore are also relevant to overall store location.

The most common configuration for shopping centers is linear. Parking is provided in the rear, at the sides, or in front. Commonly, most or all of the area around regional or super-regional centers will be devoted to parking, unless a multi-level parking structure is provided for customer use.[2] The presence of two anchor[3]

[2] Regional shopping centers in the U.S. range in size from 300,000 to 900,000 square feet of gross leaseable area (GLA). Customer driving time for goods and services at regional centers is about 20 minutes; market areas extend about 8 miles around the center and serve populations of more than 150,000. Super-regional centers are larger in GLA and serve a larger population.

[3] "Anchor" stores are most often large department stores, such as Sears, J.C. Penney, Montgomery Ward, Dillard's or Nordstrom in the U.S. These are always "anchors" for regional and super-regional centers. Other classifications of tenants can be anchors, especially for other types of malls. ULI (1985): 4-9

The International Council of Shopping Centers (ICSC) lists "anchors" as national mass merchandise stores, conventional department stores, discount department stores and other types of anchors. ICSC (1992): 43, 93

The basic idea is that "anchor" stores have customer drawing power. They are most often destinations for customers coming to the mall. Kimball (1991) stores, each placed at an end of the center, is recommended so that they will draw shopper traffic through the center. A large linear center, such as a regional center, will have separated anchors, for example the principal anchor in the middle with two smaller anchors at the ends.[4] Regional and super-regional centers almost always have a foodcourt area reserved for food service, and this area is normally contained near the center of the mall area.

Larger, regional and super-regional centers are more likely to be nonlinear in shape. Comfortable walking distances between anchors in these centers is about 400 feet, though some successful malls have had walking distances between anchors of 750 feet.[5] An obvious reason for a non-linear layout for a center is to make fullest use of a square site. Other reasons for the use of non-linear shapes are "to improve the visual effect and provide shorter sight distances."[6]

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[4] ULI (1985): 149

> "Anchor stores should be placed at opposite ends of the mall and far enough from entrances to pull shoppers past small mall shops or placed at ends of side wings of the mall, or, if the mall is huge, spaced throughout." Muliville (1992): 22

> "(T)he 'received wisdom' of the industry ... (includes) ... such well-known rules of thumb as: (1) Place the magnet (anchor) stores at opposite ends of the mall and line the intervening space with smaller outlets; (2) Ensure that the main entrances and anchor stores are sufficiently far apart to pull shoppers past the unit shops;...

> ......

> "C.Darlow, Enclosed Shopping Centers (London: Architectural Press, 1972); I. Northern and M. Haskell, Shopping Centers: A Developers' Guide to Planning and Design (Reading: Center for Advanced Land Use Studies, 1977); N. Beddington, Design for Shopping Centres (London: Butterworth Scientific, 1982); B. Maitland, Shopping Malls:

[5] ULI (1985): 61

[6] ULI (1985): 62

Nothing like a representative inventory has ever been taken of shopping mall shapes. In his doctoral dissertation, Mark Eppli collected shopping center data on 54 regional and super-regional centers. Of these 54 centers, 17 or 31% were linear, 16 or 29% were a "T" design, 15 or 28% were an "X" design, and 6 or 12% were an "L" design. Eppli reported

> "Overall, the subject represents a diversity of regional and super-regional shopping centers that is reflective of the database reported in the ULI's Dollars and Cents of Shopping Centers. Although the sample of 54 malls is only a percentage of the total population, the sample database is reflective of the marketplace and represents a broad diversity of store locations and shapes." Eppli (1992): 104

Typical mall widths range from 30 to 40 feet, though wider areas that are 60 feet or more in width can be introduced to serve as courts or other special areas. One such area is the foodcourt, which, according to the Urban Land Institute (ULI), should be treated as an anchor tenant and located so it can draw people past other shops.[7] Its usual spot in the central area of the mall therefore puts the foodcourt in a very good location for this purpose.

Store sizes vary dramatically, from large anchor stores taking up 200,000 square feet to kiosks, which are freestanding booths of 100 square feet or so placed in the trafficked area of a mall. Store depth of regular tenants is said to vary from 40 to 120 feet; store width of regular tenants varies as widely as store size.

The industry literature emphasizes that store types tend to vary by gross sales obtained per square foot, amount of rent paid per square foot, and amount of space occupied. The literature also emphasizes that close watch should be made to assure tenants are not leased too much space. Certain tenant types should be leased so much space and no more otherwise they will obtain "insufficient sales to justify the rent."[8] Summary figures from Dollars and Cents of Shopping Centers shows that both sales and rent per square foot tend to decrease with store size and store types tend to fit into distinct size ranges. Figure 1 sets out graphs of the figures which demonstrate sales/rent/size relationships for regional and super-regional shopping centers – both for ULI data and the database used in this study.

The authors collected many site plans in the course of their research. This collection of 28 site plans for regional and super-regional malls located throughout the United States is as follows: 17 or 61% were linear, 3 or 10% were an "L" design, 3 or 10% were a "T" design, 2 were a "4-cornered" design, while "X," "Y," and "S" designs were represented by one center each (4% each).

[7] ULI (1985): 91

[8] Vernor and Rabianski (1993): 150

The graphs show that merchandise types with smaller stores tend to maintain higher sales per square foot, and vice versa. For instance, for regional centers both jewelry and "candy & nuts" stores had relatively high per square foot sales, but maintained relatively small stores, while both women's apparel and toy stores had relatively low average per square foot sales but occupied larger stores. In addition to diminishing returns (sales) to scale, the graphs also show that rent tends to follow sales.

Two store location measures were deemed important because mentioned in the industry literature: 1) "main aisles" versus "side aisles" and 2) central versus peripheral.[9] A simple view for a linear, regional mall would be that stores abutting the aisle between anchors located on opposite ends of the mall are the "main aisles" while stores abutting aisles leading to exits are "side aisles." "Central" would be near the middle or in the area of the entrance to the foodcourt. "Side aisles" are more peripheral than "main aisles" since exits are commonly some distance from the central area of the mall.

The best high trafficked areas, then, are between the anchors, but toward the middle -- what professionals call "past the quarter point" of the length of the mall.[10] Food courts are high trafficked areas.

Measures of stores' distances to the centers were made. A formal definition for mall "center" was needed and distances required normalizing so that they could be compared between malls. Figure 2 graphs these measures. Generally, results show definite trends for smaller store types to locate nearer mall centers and to generate higher sales per square foot there. The square footage-distance relationship is less

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[9] ULI (1985): 156; Stambaugh (1978): 36

[10] Ehrlich (1994)

erratic than the square footage-sales relationship. (See the appendix for a discussion of how center distance measures were made.)

Industry literature is unanimous on the issue of anchors: anchors should be equidistant from each other, the idea being that they draw shopper traffic through the mall and past nonanchor tenants. High trafficked areas, like "main aisles" or "central" areas, should be reserved for impulse business, for instance fast food stores. Areas less trafficked, like "side aisles" close to entrances or exits, should be reserved for service tenants, such as banks, travel agencies, opticians, and dry cleaners, because they are destination stores. (Unlike anchor stores, which are also generally thought of as destination stores, service tenants are thought to have much less spillover effect on other mall tenants' sales. Drug stores and "high class" restaurants also fall into this category.)

3) Application of Economic Theory to Optimal Store Location

A) Generally

For bid rent theory assume a shopping mall as a bounded linear region one unit in length with anchor stores at each end. The mall is symmetric about its center at distance t = 0. There are *n* types of mall tenants and each type of mall tenant *i* has the following profit function:

$$P_i = p_i \alpha_i u_i(A_i) d(t) A_I - C_{Fi} - C_{Mi} A_i - C_{Li} \alpha_i u_i (A_i) d(t) A_i - rA_i$$

where

P = total profit
p = price per unit of good sold
α = quantity of goods sold per purchasing customer visit
A = store area
$u_i(A_i)$ = proportion of customer traffic per unit store area that purchases
d(t) = density of customer traffic as a function of distance t from the center
C_{Fi} = fixed costs unrelated to store area or sales volume (such as overhead)
C_{Mi} = quasi-fixed costs unrelated to sales volume per unit but dependent on store area (i.e., maintenance, utilities, tenant finish-out)

C_{Li} = labor and operating costs dependent both upon sales volume per unit and store area
C_{oi} = cost of goods sold, dependent both upon sales volume per unit area and store area
r = rent

The total number of purchases for a store area A_i and a given level of customer traffic density, represented by the relationship $u_i(A_i)A_i$ exhibits decreasing returns to scale (i.e. $\partial u_i(A_i) / \partial A_i > 0$ but $\partial^2 u_i(A_i) / \partial A_i^2 < 0$). Thus stores have the incentive to limit size to a level where marginal revenue from adding an additional square foot of space is just offset by the marginal cost.

In terms of the profit function above, this is where (suppressing the subscript):

$$\partial P/\partial A = 0 = \alpha u(A)d(t)[p - C_L - C_O] - C_M - r + A\{\alpha d(t)[\partial u / \partial A] [p - C_L - C_O]\}$$

$$= \alpha d(t) [p - C_L - C_O] [u(A) + A\, \partial u/\partial A] - C_M - r$$

$$= \alpha d(t) [p - C_L - C_O] \partial [u(A)A] / \partial A - C_M - r$$

$$\text{or} \quad = \partial [u(A) A]/ \partial A = (C_M + r)/[p - C_L - C_O] \alpha d(t)] \qquad (1)$$

In addition to optimizing their consumption of space, store owners also want to locate at a distance t from the center such that they can maximize their profit from operations. In a competitive market excess profits are bid away by increases in land rent to the point where profit $P_i = 0$. In terms of the profit function, this is where:

$$P = 0 = \alpha u(A)Ad(t)[p - C_L - C_O] - C_F - C_M A - rA$$

$$\text{or} \quad r = \alpha u(A) d(t) [p - C_L - C_O] - C_M - C_F / A \qquad (2)$$

Relationships (1) and (2) may be combined to solve for the optimal space consumption A* and rent schedule as a function of distance t from the center. If we assume $u(A)A = k_1 A^{k2}$, where $0 < k_2 < 1$ represents decreasing returns to scale, then

$$\partial [u(A)A] / \partial A = k_1 k_2 A^{k2-1} = (C_M + r) /[(p - C_M - C_O) \alpha d(t)$$

$$\text{and} \quad r = \alpha k_1 A^{k2-1} d(t) [p - C_L - C_O] - C_M - C_F / A$$

solving for A* yields

$$A^* = [C_F / \alpha \, d(t) \, k_1(p - C_L - C_O)(1 - k_2)]^{1/k2} \tag{3}$$

and for r* yields

$$r^* = C_F [k_2 /(1 - k_2)][\alpha \, k_1(1 - k_1) \, d(t) \, (p - C_L - C_O) / C_F]^{1/k2} - C_M$$

$$= C_F [k_2 /(1 - k_2)] / A^* - C_M \,. \tag{4}$$

The comparative statics of (3) are that optimal store area A* decreases with increased density of customer traffic d(t). Hence stores decrease in size as they locate closer to the mall center. Also, optimal store area A* decreases in size with increases in price per unit of good sold p. This accounts for the relatively small size of jewelry stores and other luxury goods stores in the mall. On the other hand, A* increases with increases in fixed costs, i.e., overhead, C_F, labor costs, C_L, and costs of goods sold, C_O. Further significant comparative statistics with regard to (3) are as follows:

1) A* decreases with an increase in α, the quantity of goods sold per purchasing customer visit. All other things being equal, destination/service stores like dry cleaners, banks and shoe repair need less space than other store types.

2) A* is independent of C_M, costs such as maintenance and utilities that are unrelated to sales volume per unit area but dependent on store area.

The relationships between A* and d(t), p, C_F, C_L, C_O and α are all at the rate $1/k_2$.

The comparative statics of (4) are that optimal rent r* increases with density of customer traffic d(t). Hence store rent is highest at the center and drops off at a rate $1/k_2$ with customer density. Optimal rent r* increases with an increase in price per unit of good sold p (again an intuitive result in luxury goods cases such as jewelry goods stores). This accounts for the relatively high rents for jewelry stores in the mall. But r* decreases with increases in fixed costs, i.e., overhead, C_F, labor costs, C_L, and costs of goods sold, C_O. So all other things being, increased expenses lessen the amount of rent – the relatively lower rent paid by these stores will be predominantly due to lower traffic density at those stores' locations.

The relationship between r* and C_M (costs such as maintenance and utilities, unrelated to sales volume) is also inverse, as is the case with the relationship between r* and C_L and C_O and C_F. However C_M is a 1:1 relationship while other costs vary at a rate $1/k_2$. Relationships between r* and d(t), p, C_F, C_L, C_O and α vary at the rate $1/k_2$. Thus C_M, being unrelated to sales volume, varies at a different rate with r* than do sales-related costs.

It should be noted that certain conditions are assumed which may limit the applicability of the model. These include no inter-store externalities among tenants that may affect densities of customer traffic and probabilities in more complex ways than under the model. There is perfect competition, i.e., tenants bid for space and location in a way that maximizes their profits (reaching zero profits in competition). Here the mall developer would not locate tenants in a way that maximizes overall center profit at the cost of reducing any individual store's profits, or reduce rents for an individual store below what would have existed in perfect competition.

Another assumption made here is that customer density d(t) is exogenous when it in fact is endogenous to the location and size of tenants. This could be handled by assuming an iterative process where a prior $d_0(t)$ is assumed, locations are allocated, and a new distribution $d_1(t)$ results. The process is repeated until it converges at a stable distribution d*(t) in equilibrium. We shall assume this distribution is known a priori and so the solution of the model represents a global optimum, not an optimum for only a specific distribution of customer densities. The results would be affected only if d(t) were not downward sloping with distance t from the center.

B) <u>d(t) is Downward Sloping</u>

There is significant evidence that d(t) is downward sloping. The customer circulation study by Brown (1991) mentioned above was particular persuasive. The other circulation study (Sim and Way (1989)) and the general observations of Fisher and Yezer (1993) also showed the highest concentration of shoppers at the mall center and the tapering off of shopper concentration toward the anchors.

This density distribution can also be demonstrated by simulating customer traffic under a set of reasonable assumptions. Consider a linear shopping center with anchors at either end that have *w* times the customer generating power of mall tenants. Assume customers can enter the mall anywhere along its length and that each customer makes *n* visits to stores, whether for comparison or multipurpose shopping. Also assume that visits are random with respect to store type, i.e., store type has nothing to do with customer density along the mall.[11]

The probability of visiting a store is in proportion to its statistical customer generating power shown in Figure 3 as relative customer traffic. Figure 3 provides the pattern of customer density, i.e., the probable average number of customers passing by or visiting the store, for eight mall stores and two anchors, with anchor customer generating power equal to twice that of a mall store. (The two anchors act as two additional mall tenants making for ten mall stores.) Note that $\partial\, d(t)/\partial\, t$ and $\partial d^2(t)/\partial t^2 < 0$. Different customer visitation assumptions will create different customer density relationships with distance from the mall center (visits remaining

[11] Customer travel costs between stores are negligible so distances traveled between stores are not important. But costs incurred in "sampling," looking over and choosing goods at stores limits visits/purchases by customers. The simulation set out in Figure 3 assumes 3 stores per visit. Three stores per visit would seem a reasonable average. Stillerman, Jones and Company (1994): 8 reports an average of three store visits per shopping trip for their survey sample of shopping centers over a seven year period. Notice Figure 3 is a distribution of sampling over a bounded linear parent population where n = 3. Figure 3 is the probability distribution of the average of the store locations for random picks of three stores where ten stores are numbered one through ten, and where there is twice the probability of picking one or ten (w = 2).

random). The results in virtually every case is a downward sloping customer density relationship with distance from the mall center.

C) <u>Competition Among Stores for Location</u>

So far a "closed city" bid rent model has been assumed for the location of stores in a shopping mall. Competition among store types necessitates on "open city" model where not all tenant types may be able to locate in a mall. A tenant type can be dominated by others to the extent that its bid rent curve is everywhere below that of a competitor or competitors.

Consider the above results for optimal space consumption and shape of the bid rent relationship for tenants with different characteristics and what it would mean for equilibrium of two or more tenant types. Following results from differentiating the optimal bid rent relationship (3) and (4) with respect to distance from the center (t):

$$\partial A^*/\partial t = \partial A^*/\partial d * \partial d/\partial t = -A^*/d * \partial d/\partial t = -A^* \partial d/\partial t * t/d * 1/t =$$

$$-A^*/t * \partial d/\partial t \quad (\partial d/\partial t = \text{elasticity of d with respect to t}) \qquad (5)$$

$$\partial r^*/\partial t = \partial r^*/\partial d * \partial d/\partial t = (-C_F K_2)/(1 - K_2)\, A^{*2} * -A^*/d * \partial d/\partial t * 1/d =$$

$$(-C_F K_2)/(1 - K_2)/A^* * \partial d/\partial t * 1/d = -C_F K_2/(1 - K_2)A^{*2} * \partial A^*/\partial t \qquad (6)$$

Let $\Gamma = -C_F K_2/(1 - K_2)\, A^{*2} * \partial A^*/\partial t$, and the store types in the shopping center Γ_1, Γ_2, Γ_3,... Γ_n. If $\Gamma_1 > \Gamma_2$, then it implies store type Γ_1 will have higher rent. Also, $\partial^2 r^*/\partial t^2 < 0$ and the rent gradient for Γ_1 will be steeper than for Γ_2.[12]

Store types with high sales response to customer traffic, high-priced goods, and lower costs (or high margins) will tend to have smaller stores and to locate closer to the mall center, since they are able to bid the highest rent per square foot for that right and have the steepest bid rent curves. These store types include jewelry stores

[12] Note that K_2 as well as the cost elements are specific to store type.

(high price per item) and the food court (high sales response to customer traffic). Those at the other extreme of sales response to density, with lower-priced goods relative to their costs (lower margins), will tend to locate at the periphery, near the anchors. Examples here would include family apparel and housewares. The point of indifference between two store types would be the distance at which the rent for one store type equals that for the other type, or where

$r_1^* = r_2^*$

From (4), to solve the relationship for the point of transition t^*:

$r^* = R = C_F[k_2/(1-k_2)][\alpha k_1 (1-k_2) d(t)(p - C_L - C_O)/C_F]^{1/k2} - C_M =$

$C_F[k_2/(1-k_2)]/A^* - C_M =$

$(C_F/1-k_2)^{(k2+1/k2)} k_2(\alpha d(t) k_1 (p - C_L - C_O))^{1/k2} - C_M$

$\therefore R(t)^{(i)} = \theta(t)\Gamma_i^{1/k2} - C_M$, where $\theta(t) = (C_F/1-k_2)^{(k2-1/k2)} k_2(\alpha d(t) k_1(p - C_L - C_O))$ and Γ_i denote store types, as before

Choosing $\Gamma_1 > \Gamma_2$, then $R(t)^1 = R(t)^2 = \theta(t)[\Gamma_1^{1/k2} - \Gamma_2^{1/k2}]$. This result holds for all variables in A^*, except k_2, C_M, and C_F. The k_2 parameter is interpreted as being different for store types and so a separating equilibrium occurs. The k_2 parameter is the proportion of customer traffic per unit store area that purchases. Differentiating store types this way creates bid rent equilibria. Stores more sensitive to customer volume go to the center and those not so sensitive locate at the periphery.

4) <u>Empirical Tests of the Bid Rent Model of Store Location</u>

According to relationships (3) and (4) above (between equilibrium rent and store size and distance from the mall center for various store characteristics), these models are suggested:[13]

[13] Pursuant to the last section, revenue or sales ($p\alpha d(t)u(A)A$) is a function of a price (p), customer density at some distance from the center (d(t)), proportion of customer traffic per store area that

Rent $(r) = f(p_i, \alpha_i, A_i, u_i(A_i), d(t), C_{Li}, C_{Oi}, C_{Fi}, C_{Mi})$

where $\partial r/\partial t < 0$, $\partial r/\partial d(t) > 0$, $\partial r/\partial C_L, C_O, > 0$, $\partial r/\partial C_F$ & $C_M = 0$, $\partial r/\partial p > 0$, and $\partial r/\partial \alpha > 0$, and where it is assumed $u_i(A_i)A_i = k_i A_i^{k2}$, where $0 < k_2 < 1$ (representing decreasing returns to scale)

Store Size $(A) = f(p_i, \alpha_i, A_i, u_i(A_i), d(t), C_{Li}, C_{Oi}, C_{Fi}, C_{Mi})$

where $\partial A/\partial t > 0$, $\partial A/\partial d(t) < 0$, $\partial A/\partial C_L, C_O, C_M > 0$, $\partial A/\partial C_F = 0$, $\partial A/\partial p < 0$, and $\partial A/\partial \alpha < 0$, where it is assumed $u_i(A_i)A_i = k_i A_i^{k2}$, where $0 < k_2 < 1$ (representing decreasing returns to scale)

These models were estimated using collected data from the databases described in the appendix. Regression analysis is now used to empirically examine predictions of the bid rent model.

Hypotheses

1) Non-anchor store rents per square foot will decline at different rates with distance from the center of the mall, both for stores generally and by store type.

2) Non-anchor store size will increase from the center of the mall, both for stores generally and by store type.

Consistent with bid rent theory, rents and size are assumed to be related to distance from the mall center (DISTANCE). Other tenant (TENANT) and (LEASE) variables shown in the literature to effect rent and size were added (CHN, TERM, SF and SF^2), as were tenant (TENANT) and location (LOCATION) variables hypothesized to be related to rent and size (COMP, EXIT, SAME and VACA). Rents and size are therefore assumed to be related to the four factor types DISTANCE, TENANT, LEASE, and LOCATION, where rent is measured on a per square foot basis for shopping center j during the ith time period:

$$RENT_{jt} = f(DISTANCE_j, TENANT_j, LEASE_j, LOCATION_j)$$

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purchases (u(A)), and quantity of goods sold per purchase (α). Two types of costs vary with sales (C_L and C_O), and one is unrelated to either sales or area (C_F).

$SIZE_{jt} = f\,(DISTANCE_j, TENANT_j, LEASE_j, LOCATION_j)$

The ordinary least squares (OLS) equations are estimated in the semi-log form[14] for the two models and tests are made for heteroscedasticity following White (1980). The hypothesis that regression errors are homoscedasitic is rejected for each of the equations (i.e., p-values less than 0.025), indicating weighted least squares (WLS) is appropriate. Examination of plots of residual errors of the independent variables shows that error variance is related to effective purchasing power of the market area of each shopping center.[15]

Multicollinearity among independent variables of the regression equations was not a problem.[16] Heteroscedasticity was eliminated after application of WLS regression to the models.[17] R-square typically rises after application of WLS.

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[14] This is consistent with the use of the semi-log form in urban economics research, such as the negative exponential density functions used by Mills (1972) and Mills (1969) to describe how population density falls, i.e., at a decreasing rate, with distance from a city center.

The function is generally, for any variable V, $V = V_O e^{-\Gamma u}$, where u = distance and Γ describes the slope of the curve. Taking logs, ln V =

Linear and log-linear forms generally produced lower R-square, F-statistic, and t-ratio results. See footnote

Kennedy (1981) has shown that estimation using a log-linear functional form with dummy variables causes a degree of bias in the estimated coefficients. Any adjustments suggested by Kennedy did not lead to economically meaningful changes.

[15] Heteroscedasticity often arises in the context of hedonic pricing models for residences when separate models are not used for neighborhoods. A wider variance for the error term results for higher priced properties, showing that higher priced properties tend to sell over a broader range of independent variables (i.e., square footage, number of bathrooms, etc.) than lower priced properties.

In the instant case heteroscedasticity is a problem for much the same reason. Tenants with high rents and sales exist over a broader range of independent variable characteristics than tenants with low rents and sales. A shopping center in San Francisco is the equivalent of a house in an upper class neighborhood, while a shopping center in Memphis is the equivalent of a house in a lower class neighborhood. Only general

See, e.g., Gatzlaf, Sirmans and Diskin (1994): 103; also, Guidry and Sirmans (1993)(error variance approximately proportional to shopping center size when malls in same city)

[16] The conclusion of lack of multicollinearity is based on variance inflation factors, condition indices, and eigenvalue and tolerance limits procedures outlined by Belsley, Kuh, and Welsh (1980). A check was also made for outliers/influential observations using the Belsley, Kuh, and Welsh statistics DFFITS. Regression results were robust, i.e., outliers/influential observations deleted yielded comparable results.

A) Individual Stores

Research on determinants of mall store rents has been undertaken by Benjamin, Boyle, and Sirmans (1990, 1992). Borrowing from their research, and adding location and other variables, two semi-log empirical models were estimated regressing non-anchor store rents and size in square feet on tenant, lease, and location characteristics, as follows:

$$\ln TRNT_i = \alpha_O + \beta_1 CHN_i + \beta_2 SF_i + \beta_3 SF2_i + \beta_4 TERM_i + \beta_5 COMP_i + \beta_6 SAME_i + \beta_7 CENTER_i + \beta_8 VACA_i + \beta_9 LOCATION_i + e_i$$

$$\ln SF_i = \alpha_O + \beta_1 CHN_i + \beta_2 TERM_i + \beta_3 COMP_i + \beta_4 EXIT_i + \beta_5 SAME_i + \beta_6 CENTER_i + \beta_7 VACA_i + \beta_8 TRNT_i + \beta_9 LOCATION_i + e_i$$

where:

TRNT:	total rent (base rent plus percentage rent)
CHN:	a dummy variable = 1 if a tenant is a member of a national or regional chain
SF:	size in square feet
SF^2:	square feet squared
TERM:	length of lease
COMP:	a dummy variable = 1 if a tenant is a comparison store type, 0 otherwise
SAME:	feet distance to the nearest same type store
CENTER:	feet distance from the mall's center (normalized)
VACA:	feet distance to the nearest vacant store
EXIT:	feet distance to the nearest mall exit
LOCATION:	location dummy variables for the nine malls

Folllowing Benjamin, Boyle, and Sirmans (1992), Guidry and Sirmans (1993) and Gatzlaf, Sirmans and Diskin (1994), dummy variables for location (LOCATION) were added to capture location characteristics of the malls.

[17] Weighted least squares was applied using the standard practice of weighting by the reciprocal of the variance of the observations' error terms to stabilize the variance of e and satisfy the regression assumption of homoscedasticity. A more involved but perhaps better method would be to weight observations by the effective purchasing power of the market area of the mall in which the stores are located. See, Gatzlaff, Sirmans, and Diskin (1994).

SF, SF^2, TERM, and CHN were independent variables used in regression Models estimated in Benjamin, Boyle, and Sirmans (1992). Following that study, SF was added as in independent variable to allow for economics of scale in leasing space to tenants requiring large amounts of space; SF2 was added because the effects of economies of scale was not linear but decreased at a decreasing rate. According to Benjamin, Boyle, and Sirmans (1992), tenants belonging to a national or regional chain (CHN) were likely to generate higher sales and pay less rents; also tenants with longer lease terms (TERM) were likely to pay lower rents. Lower rents in these instances is a landlord's discount for lower default probability. Higher sales result from name recognition of national and regional claims by consumers.

COMP was a dummy variable for comparison store type. Eppli and Shilling (1995) hypothesized (but could not prove) that comparison stores were a second source of customer traffic generation for shopping centers (in addition to anchors). The most obvious comparison store types were chosen using the second database.[18] Comparison stores consisted of men's apparel, jewelry, and men's and women's shoes.

Nearest distance 1) to the mall center (CENTER), 2) to a vacant store (VACA) and 3) to the nearest same type store (SAME) were measured for all malls.[19]

Distances were measured as shortest walking distances within malls. SAME and VACA were added as location variables to pick up variations in sales and rents based on clustering/dispersion of store types and negative externalities associated with vacant stores, respectively.[20]

[18] See appendix. Comparison shopping takes place more frequently at men's apparel, jewelry, and men's and women's shoes stores than at other types of stores.

[19] CENTER distances were normalized ((distance/square root of mall area) x 1000).

Results of the multiple regressions using TRNT and SF as dependent variables are summarized in Tables 1 and 2, respectively. The effects of distance from the shopping mall's center (CENTER) on total rents per square foot (TRNT) are negative and significant; the effects of distance from the mall's center on store size (SF) is positive and significant. This demonstrates a bid rent process. Non-anchor stores successfully bidding for location have higher rents the closer they locate to the mall's

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[20] Comparison of results varying functional forms for the two regression models as as follows:

independent variable	dependent variable SALES semi-log	linear	log-linear	dependent variable TRNT semi-log	linear	log-linear
CONSTANT	6.170687	476.9169	7.3119714	4.088436	49.137020	5.457207
	(67.198)	(15.478)	(18.043)	(54.315)	(17.862)	(12.981)
CHN	0.113280	35.57438	0.153442	0.016724	0.423844	0.025376
	(2.796	(2.617)	(3.656)	(0.504)	(0.349)	(0.583)
SF	- 0.000110	- 0.033857	- 0.522515	- 0.000109	- 0.002664	- 0.65002
	(- 11.039)	(- 10.112)	(- 1.961)	(- 13.285)	(- 8.912)	(- 2.354)
SF2	.00000000257	.000000954	.0986667	.00000000219	.0000000714	0.154659
	(6.121)	(6.763)	(0.735)	(6.349)	(5.666)	(1.112)
TERM	0.000255	0.039778	0.065540	- 0.001184	- 0.027336	0.135827
	(0.527)	(0.246)	(0.993)	(- 2.992)	(- 1.890)	(1.987)
COMP	- 0.026478	20.038300	0.043409	0.002607	1.398189	0.089348
	(- 0.583)	(1.314)	(0.961)	(0.070)	(1.027)	(1.909)
EXIT	- 0.000372	- 0.088369	0.011610	- 0.000166	- 0.005497	- 0.037302
	(- 3.325)	(- 2.355)	(0.418)	(- 1.815)	(- 1.641)	(- 1.296)
SAME	0.000377	0.040311	0.017006	- 0.000176	- 0.007272	- 0.054408
	(2.165)	(0.690)	(0.736)	(- 1.232)	(-1.394)	(- 2.271)
CENTER	- 0.340180	- 96.885787	- 0.105365	- 0.243631	- 8.041333	- 0.07588
	(- 6.083)	(- 5.163)	(- 4.551)	(- 5.315)	(- 4.800)	(- 3.163)
VACA	0.0000422	0.052652	0.038886	- 0.000327	- 0.006317	0.041102
	(0.238)	(0.886)	(1.667)	(-2.255)	(- 1.191)	(1.700)

R-square	.4035
Adj. R-sq	.3893
F-statistic	28.413

N = 689; t-ratios are in parentheses; LOCATION dummy variables not shown

It should be noted that the two models can be treated using application of two-stage least squares. In the simultaneous equations the case is one of overidentification and SF and TRNT are assumed endogenous. Consequently, improvement would be obtained by using a two-stage model. Initial two-stage least squares regression output showed estimates similar to those set out for both models.

A weighted instrumental variable methodology was not employed nor were the data transformed to semi-log form and these procedures would need to be undertaken to properly apply the two-stage model. See, Gatzlaff, Sirmans, & Diskin (1994) center. An approximate 4% increase in rents is expected for every 100 feet closer to the mall's center a store locates.[21] As expected, factor substitution occurs and square footage of stores (SF) increases significantly at a decreasing rate (SF2), with increases in rents[22]. CHN was insignificant in the TRNT regression, and so does not contradict the finding of Benjamin, Boyle, and Sirmans (1992) that chain stores generally have better credit and receive a rent discount from landlords for lower default probability. A positive, significant coefficient for CHN in the SF regression is of course expected.

TERM was negative and significant in the TRNT regression and positive and significant in the SF regression. According to Benjamin, Boyle, and Sirmans (1992), this represents a rent discount for lower default probability of chain stores that generally hold longer leases. Larger stores farther from the mall center would reasonably be more likely to have longer leases.

SAME was negative and insignificant in both the TRNT and SF regressions. VACA was negative and significant in the TRNT regression and insignificant in the SF regression. COMP and EXIT were both positive and insignificant in both regressions (though EXIT was significant at the 10% level).

Regression results of these last four variables suggest two processes. Significant results for VACA and EXIT (at the 10% level) reflects lower rent levels and larger stores with distance from mall centers (vacancies are more plentiful at the periphery). Results of COMP and SAME may show a lack of overall clustering among stores of the same type. Comparison stores seem to gain little by the fact that their customers frequent stores of the same type more than stores of any other type -- if higher rent can be expected for an environment conducive to comparison shopping.

[21] These results follow from interpreting the semi-log regression after transforming the normalized distances for CENTER.

[22] The same effect of TRNT on SF and SF2 was found by Benjamin, Boyle, and Sirmans (1992).

Likewise, lack of extra rent paid for proximity to stores of the same type suggests it is unimportant.

B) Store Types

The bid rent model developed below is further illustrated by focusing on store types rather than individual stores, i.e., Alonso's "families of bid rent curves." Readily noticeable are 1) different rates at which store type rents decline with distance from the mall center, 2) different intercepts at which store type rents begin to decline and 3) a constant factor-substitution-generated rate of increase in size of store types with distance from the mall center.

1) Store Type Rents

Rents per square foot were regressed against stores' (normalized) distances from the mall center and the store type dummies to measure how rents per square foot for store types varied with distance from the center. Results are reported in Table 3. Figure 4 is a graph of the response curves representing average rents of store types with distance from the mall center.[23]

The curves reflect average rent paid by store types at various distances from the mall center. Store types paying rent at the center have steeper response curves and vice versa.

[23] Variation in rent for each store type over distance was obtained by adding the coefficients of the dummy variables to 1) the intercept coefficient and 2) the coefficient for CENTER.

The response curves are not actual bid rent or demand curves.

"(T)he hedonic interpretation of the gradient leads to further questions about the actual demand curve for location. Hedonic functions are not demand (or supply) curves, and the demand for location has not been calculated. That would require the instrumental variable estimation laid out in Epple (1987) and elsewhere." Coulson (1991)

2) Store Type Size

To measure how square footage for store types varied with distance from the mall center, square footage was regressed against stores' (normalized) distance to the center and the store type dummies. Results are reported in Table 4.[24] A graph of these response curves, representing average square footage by store type with distance to the mall center, is presented in Figure 5. The response curves indicate how store types expand and contract with changes in location relative to the mall center. The slopes are positive and constant and so all store types can be expected to increase in size at about the same rate with distance from the mall center.

5) Summary and Conclusions

Alonso's (1964) original model of residential location considered both business volume and transportation costs in determining location relative to a city center. Here business volume is a function of customer traffic density and there are no transportation costs. Stores (firms) can increase sales depending on such parameters as quantity of goods sold per purchasing customer visit (α), price per unit of good sold (p), and proportion of customer traffic per unit store area that purchases (u(A)). Costs are both fixed (unrelated to both sales volume and areas) and variable (varying with both area and sales volume).

The shopping center model depends on a downward sloping customer density function (d(t)) from the mall center. Empirical evidence from customer circulation studies and the general observations of Fisher and Yezer (1993) both support this requirement. Competition for store location was demonstrated theoretically for both a "closed city" and an "open city" model. Store area and proximity to the mall center

[24] T-ratios for interaction terms were all insignificant, so a main effects model was used.

were shown to be affected by such parameters as sales response to customer density ($u(A)$), price of goods (p), low costs (or high margins), and quantity of goods sold per purchasing visit (α).

Store types such as jewelry stores, food court, family apparel and housewares are shown to fit the results of the model well. Rents and rent gradients are shown to vary to demonstrate the bid rent process among store types. Also distances from the mall center are shown to vary by store type.

A) Filling a Vacant Store

Insights into the theory can be applied to examine a problem that landlords routinely face, namely, how to fill a vacancy in the center. In particular, we ask whether the landlord should add an additional outlet of one store type or another. This will depend on the stores' bid rent characteristics and distance from the mall center, especially its $\partial A^* / \partial t$ and $\partial r^* / \partial t$. Whichever alternative store type fits best will take the location. Since an "open city" context is used here, certain stores seeking to fill a vacancy may not be proper contenders for the spot.

B) Main Findings

The study confirms that non-anchor stores in a shopping center behave similarly to urban firms in a CBD. The process in the CBD is one of tradeoff between the desire for space and recognition of commuting (or transportation) costs (or distance from the mall center). In shopping centers it is the recognition of customer density effects on sales and costs that is important. Regressions indicate that total rents and store size with respect to the mall center behave just as urban firms with respect to distance from a city center. This was shown for both individual and market equilibria.

C) Future Research

Theoretically, future research in this area should concentrate on the incompatibility of agglomeration economies with bid rent theory. This is a sizable task. Empirical tests of the bid rent model for shopping centers could use some improvement where mentioned. Some improvements in data measurement and methodology might also be considered.

References:

Alonso, W., Location and Land Use, Cambridge, Mass.: Harvard University Press (1964)

Arnott, R., A. Anas, and K. Small, "Urban Spatial Structure," working paper, Boston College (1997)

Bean, J., C. Noon, S. Ryan, and G. Salton, "Selecting Tenantsin a Shopping Mall," Interfaces18(20 (1988): 1-9

Belsley, D., E. Kuh, and R. Welsch, Regression Diagnostics, New York: John Wiley & Sons (1980)

Benjamin, J., G. Boyle, and C. Sirmans, "Retail Leasing: The Determinants of Shopping Center Rents," AREUEA Journal 18, 302-312 (1990)

__________, "Price Discrimination in Shopping Center Leases," Journal of Urban Economics 32, 299-317 (1992)

Brown, S., "Tenant Placement in Planned Shopping Centres: Implications of an Observation Survey," Journal of Property Research 8, 179-187 (1991)

__________, "Retail Location at the Micro-scale: Inventory and Prospect," The Service Industry Journal 14(4)(1994): 542-574

Brueckner, J., "Inter-store Externalities and Space Allocation in Shopping Centers," Journal of Real Estate Finance and Economics 7, 5-16 (1993)

Chun, G., "Theory of Percentage Lease Contracts: The Case of Shopping Centers," doctoral dissertation, University of Wisconsin-Madison (1996)

Epple, D., "Hedonic Prices and Implicit Markets: Estimating Demand and Supply Functions for Differentiated Products," Journal of Political Economy 95(1)(1987): 59-80

Eppli, M., and J. Shilling, "Large-scale Shopping Center Development Opportunities," Land Economics 71, 35-41 (1995)

Fisher, J. and A. Yezer, "Spatial Structure and Rents in Shopping Centers," working paper, Indiana University (1993)

Gatzlaff, D., G. Sirmans and B. Diskin, "The Effect of Anchor Tenant Loss on Shopping Center Rents," Journal of Real Estate Research 9(1), 99-110 (1994)

Guidry, K. and C. Sirmans, "The Determinants of Shopping Center Rents," Journal of Real Estate Research 8(1), 107-115 (1993)

Mills, E., Studies in the Structure of the Urban Economy, Baltimore, Md.: The Johns Hopkins Press (1972)

Muth, R., Cities and Housing, Chicago: University of Chicago Press (1969)

Pashigan, B. and E. Gould, "Internalizing Externalities: The Pricing of Space in Shopping Malls," Journal of Law and Economics, XLI: 1 (April 1998): 115-142

Sim, L. and C. Way, "Tenant Placement in a Singapore Shopping Centre," International Journal of Retailing 4, 4-16 (1989)

White, H., "A Heteroscedasticity-consistent Covariance Matrix Estimator and a Direct Test for Heteroscedasticity," Econometrica 48 (1980): 817-838

Appendix:

Average distance to the mall center by store type (both actual and normalized[25]) is set out as part of the anchor and nonanchor store characteristics of shopping malls making up the database, following. A common definition for mall "center" was also needed. Review of previous research showed that common sense definitions of city centers were used for purposes of locating central points of metropolitan areas.[26] Spatial patterns of nonanchor store gross sales, rents, and square footage were viewed for each of the centers to see what the data showed. In each case primary high points for gross sales and rents near a low point for square footage were were evident after graphing these characteristics against distances along each mall's length and width. These three points always with fair close proximity to the foodcourt (within 100 feet). "Centers" are marked for each of the malls as part of the site plans, also following.

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[25] Normalized distance equals actual distance divided by the square root of the mall area in which the distance is measured x 1000.

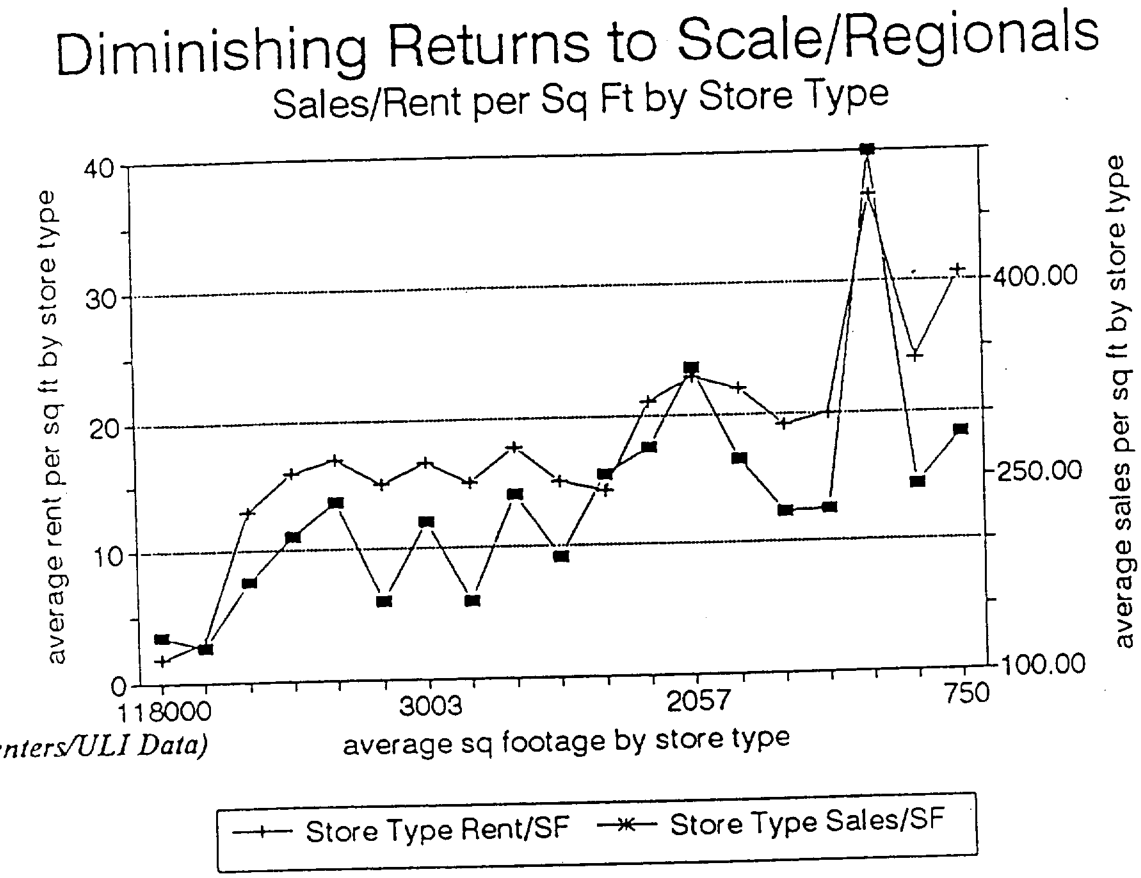
[26] Examples: Ihlanfeldt, K. and M. Raper, "The Intrametropolitan Location of New Office Firms," Land Economics 66(2)(1990): 182-198, "... linear distance from center of tract to center of tract containing 'Five Points' (Atlanta, Georgia)"; N. Coulson, "Really Useful Tests of the Monocentric Model," Land Economics 67(3)(1991): 299-307, "... distance to the CBD was measured from the center of the development to the edge of the university campus (of Penn. State University in University Park, Penn.)";

Peiser, R., "The Determinants of Nonresidential Land Values," Journal of Urban Economics 22 (1987): 340-360 (measured the CBD for Dallas, Texas as a roughly rectangular area bounded by the five highways having downtown off-ramps); Johnson, M. and W. Rages, "CBD Land Values and Multiple Externalities," Land Economics 63(4) (1987): 337-347:

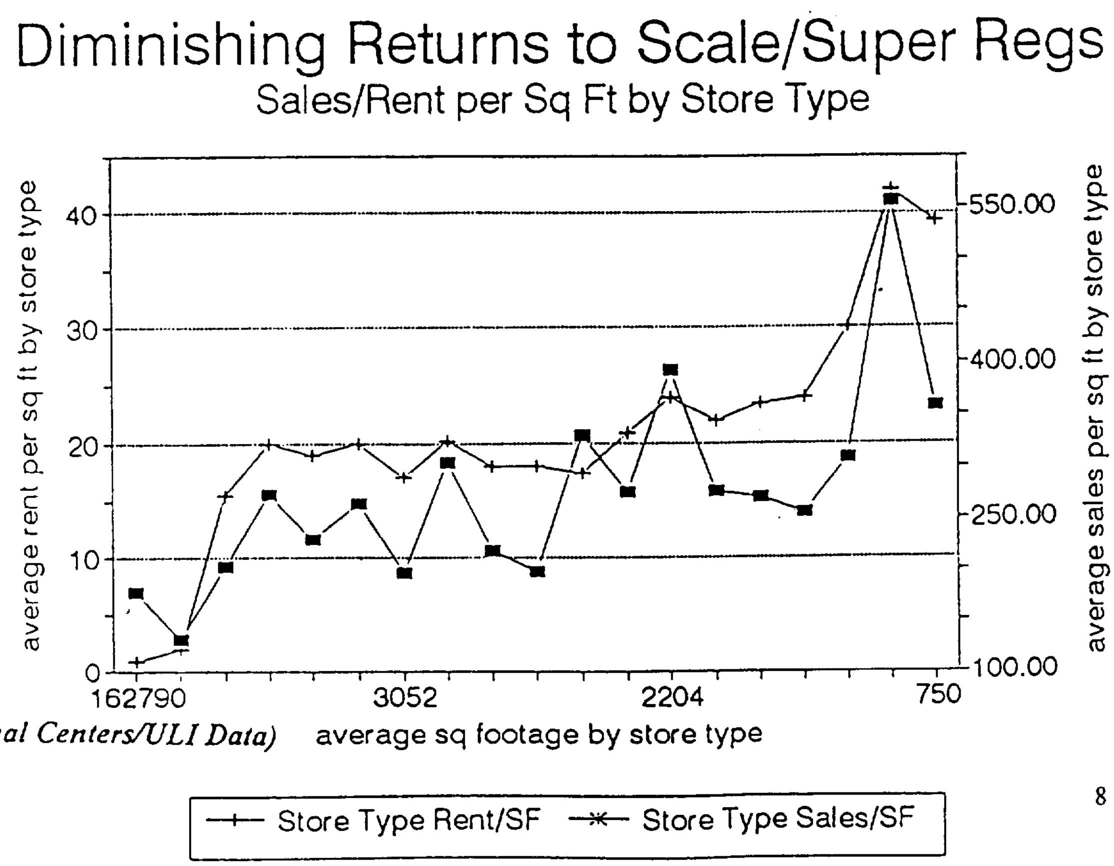
"Distances from the central point of the CBD (CENDIS) is measured from the square block with the maximum employment density as of 1978. The tallest building within the CBD subsequently began construction in 1983 within one block of this point, suggesting a good degree of stability of the measure of centrality (New Orleans)."

"The New Orleans CBD is a small geographic area of rectangular shape 8,200 feet in length and 4,700 feet in width. The boundaries of the rectangle can be approximated by expressways, the Mississippi River, and the French Quarter. These boundaries are generally recognized in the marketplace."

Figure 1



(Regional Centers/ULI Data)



(Super-Regional Centers/ULI Data)

Figure 1 (continued)

(continued): Sales per Square Foot & Rent per Square Foot Versus Average Square Footage by Merchandise Type (Database)

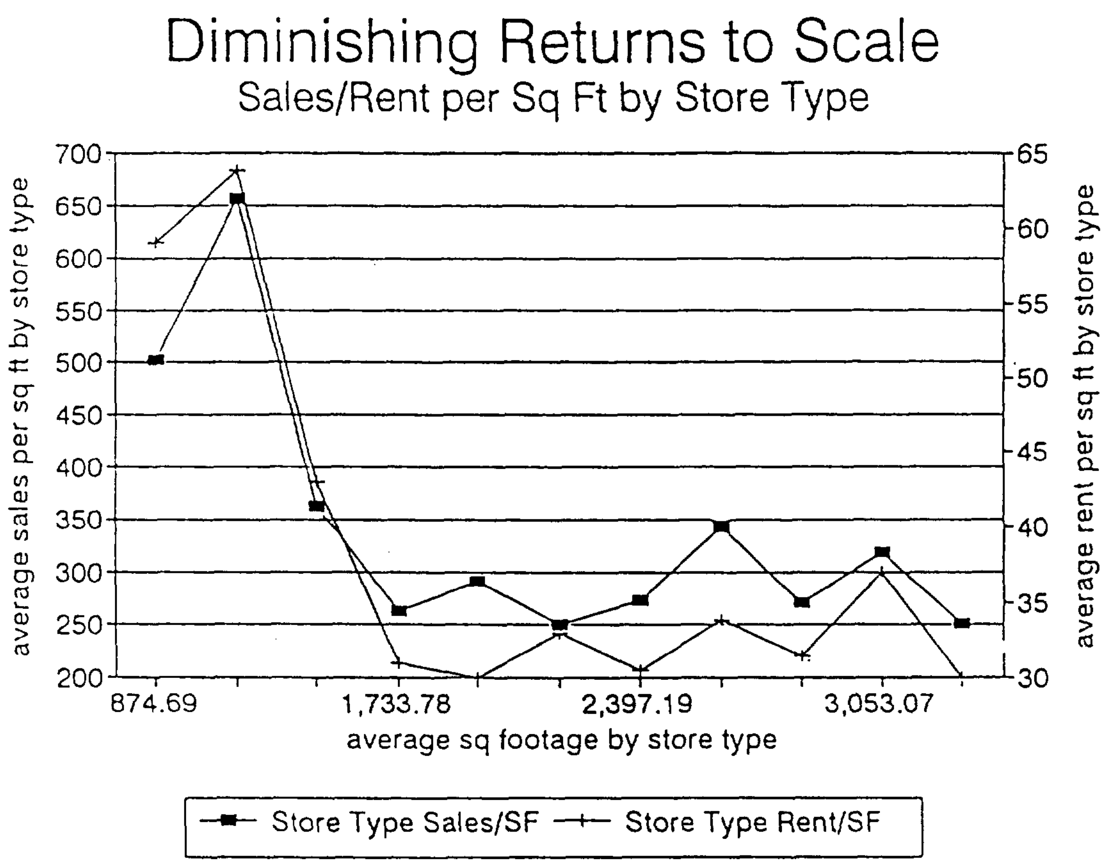
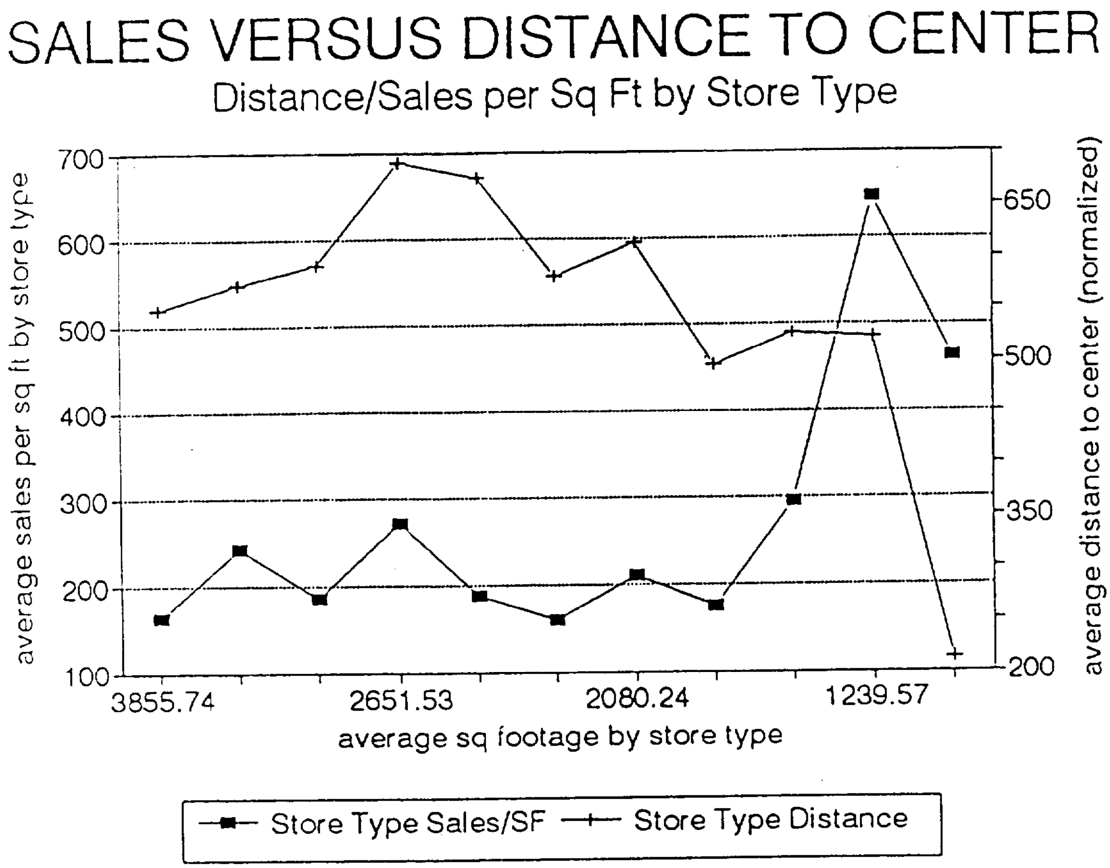


Figure 2 Sales/Rents per Square Foot & Distance to Mall Center Versus Sq. Footage by Merchandise Type (Regional & Super-Regional Malls)



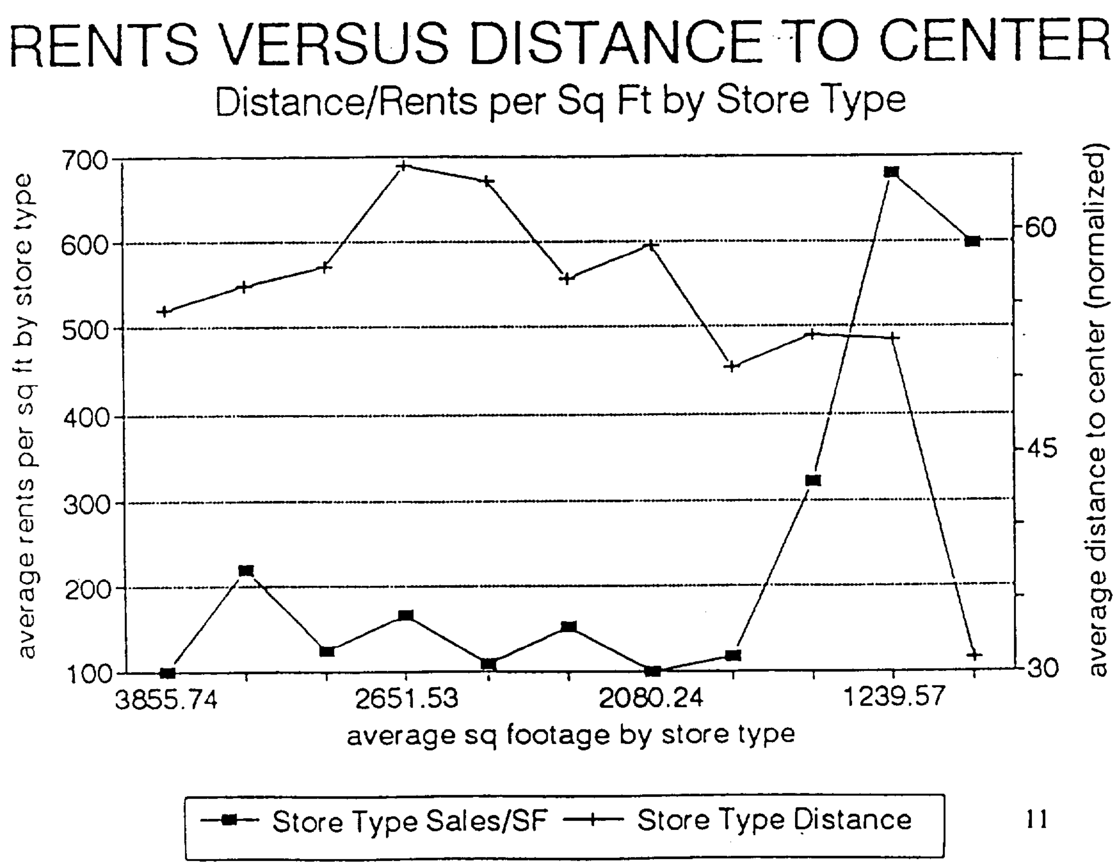


Figure 3 Customer Traffic Along Linear Mall

The x axis represents 10 stores in a linear mall where stores 1 & 10 represent anchors. Numbers 1 - 10 then represent the parent population of the possible stores to visit. Because numbers 1 and 10 are anchors, they are each represented twice in the parent population (they are double weighted). If 200 random samples of 3 stores are chosen and the numbers for each sample are averaged, the sampling distribution would be represented by the y axis.

Parent Population: 1,1,2,3,4,5,6,7,8,9,10,10
Possible Random Samples: 3, 5, 10 w/average = 6; 1, 3, 2 w/average = 2

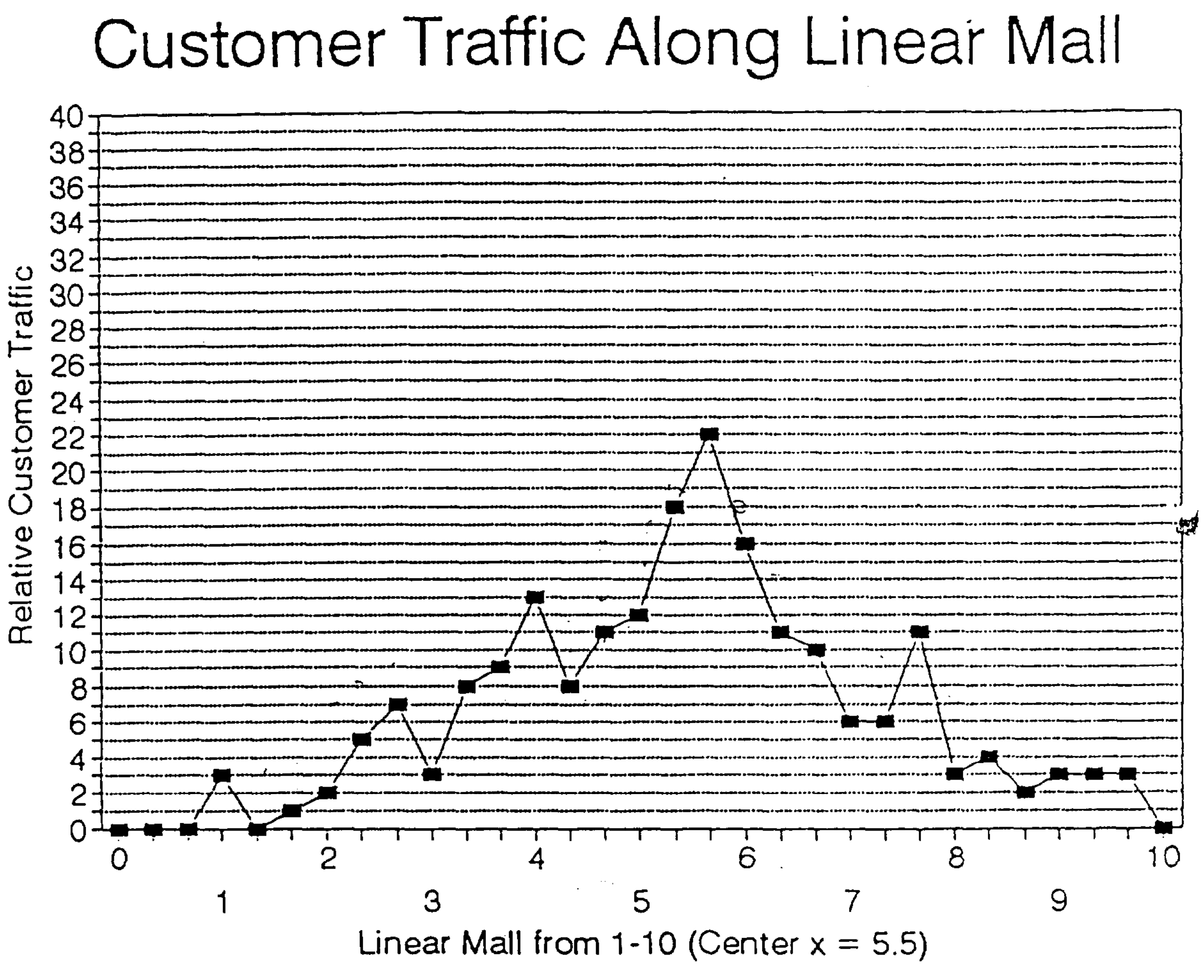


Table 1 Nonanchor Rent per Square Foot Regressed on Distance, Tenant, Lease and Locational Characteristics (semi-log functional form; weighted)

Variable	Coefficient	T-Ratio	Prob.	Variance Inflation
Intercept	4.088436	54.315	0.0001	0.0000
Chain Store (CHN)	0.016724	0.504	0.6147	1.0950
Nonanchor Square Feet (SF)	- 0.000109	- 13.285	0.0001	7.7037
Nonanchor Sq. Ft. Squared (SF2)	0.00000000219	6.349	0.0001	7.6351
Lease Term (TERM)	- 0.001184	- 2.992	0.0029	1.1495
Comparison Shopping Store (COMP)	0.002607	0.070	0.9442	1.1589
Distance from Nearest Exit (EXIT)	- 0.000166	- 1.815	0.0700	1.2744
Distance from Nearest Same Type Store (SAME)	- 0.000176	1.232	0.2183	1.1586
Distance from Center (CENTER)(normalized)	- 0.243631	- 5.315	0.0001	1.4146
Distance from Nearest Vacancy (VACA)	- 0.000258	- 2.255	0.0245	1.4336
Mall Dummy Variables (location dummies)	- 0.554397	10.104	0.0001	2.1544
	- 0.369036	- 6.586	0.0001	2.0544
	0.080423	- 1.465	0.1433	2.0204
	- 0.544279	- 9.120	0.0001	2.0705
	- 0.386312	- 5.816	0.0001	2.0810
	0.176863	2.986	0.0029	2.5006
	- 0.381439	- 6.340	0.0001	2.0302

N = 689

R-Square = .6879 Adj. R-Square = .6804 F Value = 92.555

Table 2 Nonanchor Size in Square Feet Regressed on Distance, Tenant, Lease and Locational Characteristics (semi-log functional form; weighted)

Variable	Coefficient	T-Ratio	Prob.	Variance Inflation
Intercept	7.745112	54.168	0.0001	0.0000
Chain Store (CHN)	0.344455	6.462	0.0001	1.0810
Lease Term (TERM)	0.001881	3.153	0.0017	1.1717
Comparison Shopping Store (COMP)	- 0.029767	- 0.517	0.6053	1.0934
Distance from Nearest Exit (EXIT)	- 0.000299	1.773	0.0767	1.2478
Distance from Nearest Same Type Store (SAME)	- 0.000188	- 0.766	0.4438	1.1520
Distance from Center (CENTER)(normalized)	0.193096	3.478	0.0005	1.6223
Distance from Nearest Vac-ancy (VACA)	- 0.000330	1.364	0.1729	1.4785
Mall Dummy Variables (location dummies)	- 0.032116	- 0.348	0.7280	2.1058
	- 0.186923	- 1.907	0.0569	1.9217
	- 0.051661	- 0.567	0.5711	1.9509
	- 0.133907	- 1.195	0.2324	1.795
	- 0.378550	- 3.542	0.0004	2.0810
	0.058695	0.562	0.5746	2.5006
	- 0.018798	- 0.175	0.8611	2.0302

N = 689

R-Square = .3722   Adj. R-Square = .3573   F Value = 24.901

Table 3 Rent Variation by Store Type with Distance from Center

Type of Store	Parameter	Rent at Center	T- Ratio	Prob.
Intercept (Fast Food)		$64.37	23.994	0.0001
CENTER	- 0.055629		- 4.901	0.0001
Family Apparel	- 18.36	$46.37	- 3.460	0.0006
Men's Apparel	- 24.66	$49.07	- 3.727	0.0002
Leisure & Entertainment	- 17.83	$46.91	- 4.743	0.0001
Houseware	- 27.15	$37.58	- 5.447	0.0001
Men's Shoes	- 28.23	$36.50	- 4.521	0.0001
Women's Shoes	- 23.74	$40.99	- 3.758	0.0002
Specialty Food	- 13.60	$51.14	- 2.610	0.0093
Jewelry	10.45	$75.18	1.835	0.0670
Cards & Gifts	- 27.14	$37.59	- 4.380	0.0001
Women's Apparel	- 34.92	$29.81	- 8.881	0.0001
CENTER * Family Apparel	0.0299		- 1.746	0.0814
CENTER * Men's Apparel	0.0385		1.921	0.0552
CENTER * Leisure & Ent.	0.0347		2.611	0.0093
CENTER * Houseware	0.0468		2.934	0.0035
CENTER * Men's Shoes	0.0471		2.676	0.0076
CENTER * Women's Shoes	0.0321		1.495	0.1354
CENTER * Specialty Food	0.0409		2.384	0.0174
CENTER * Jewelry	0.0281		1.443	0.1496
CENTER * Cards & Gifts	0.0510		2.821	0.0050
CENTER * Women's App	0.0543		4.254	0.0001

N = 689

R-Square = 0.4468 Adj. R-Square = 0.4216 F Value = 17.681

Note: Model included the same dummy variables used in the first two models to control for intercenter variations. Most were significant.

Figure 4

Responses for Select Store Types (Average Rent with Distance from Center)

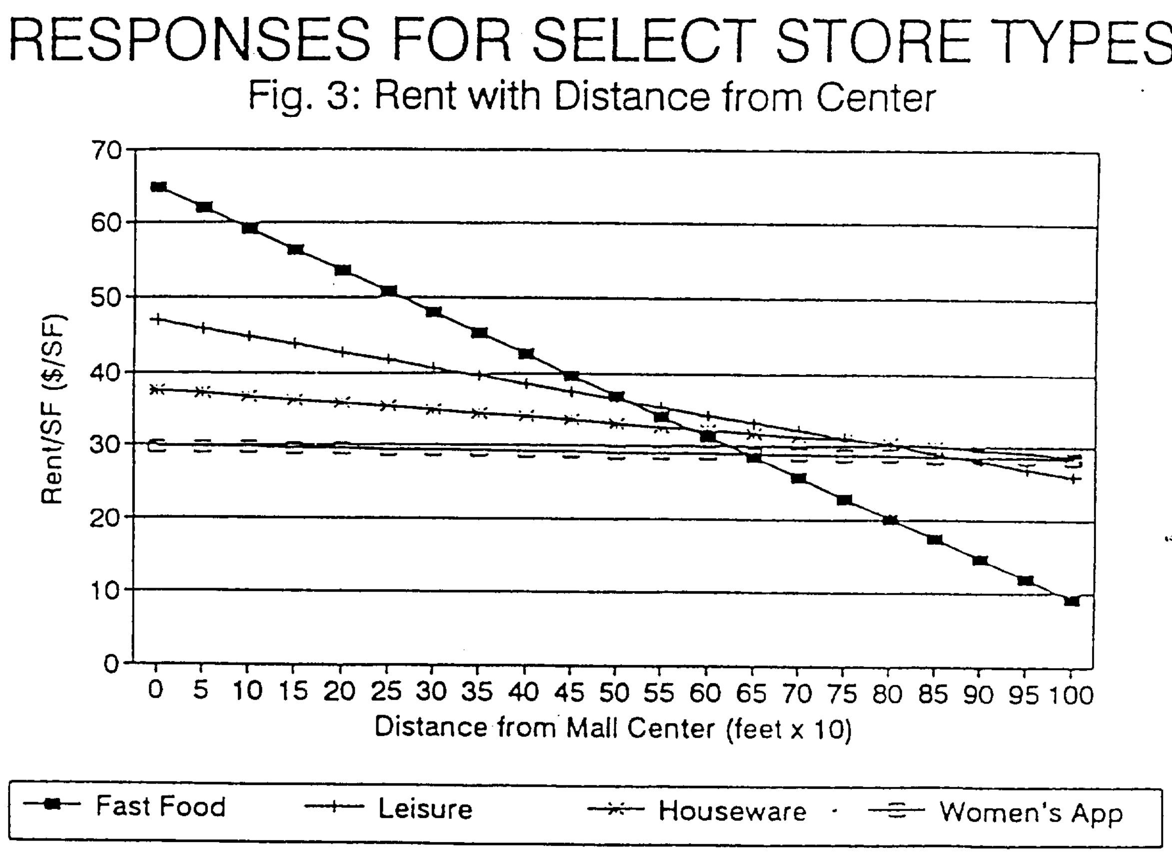


Table 4 Size Variation by Store Type with Distance from Center

Type of Store	Parameter	Size (SF) at Center	T- Ratio	Prob.
Intercept (Fast Food)		666.75	68.339	0.0001
CENTER	1.0004		2.927	0.0035
Family Apparel		2132.22	10.264	0.0001
Men's Apparel		1673.43	7.641	0.0001
Leisure & Entertainment		1593.14	9.251	0.0001
Houseware		1438.47	6.403	0.0001
Men's Shoes		1702.73	7.967	0.0001
Women's Shoes		1391.80	5.526	0.0001
Specialty Food		931.54	2.828	0.0048
Jewelry		932.44	2.862	0.0043
Cards & Gifts		1512.95	7.018	0.0001
Women's Apparel		2720.31	15.121	0.0001

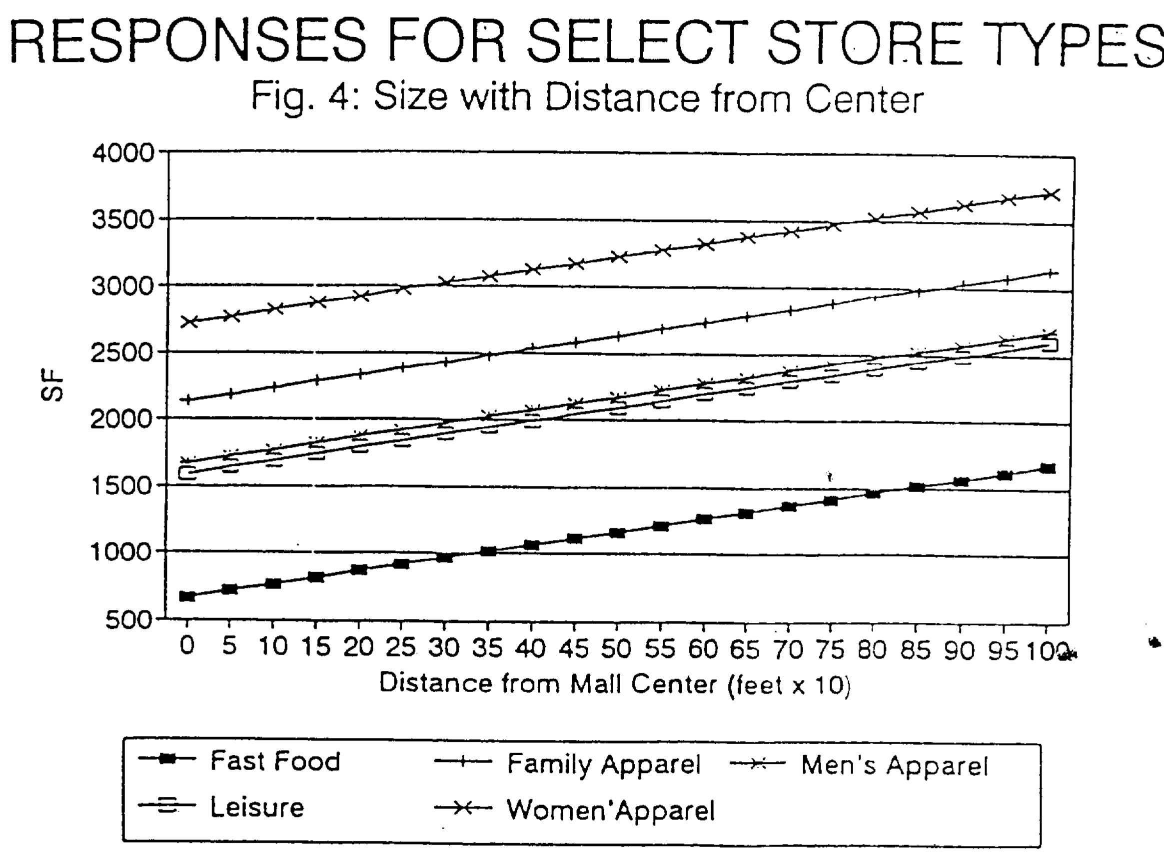
N = 689

R-Square = 0.3461 Adj. R-Square = 0.3303 F Value = 21.922

Note: Model included the same dummy variables used in the first two models to control for intercenter variations. Most were significant.

Figure 5

Responses for Select Store Types (Average Size with Distance from Center)



Shopping Center Characteristics

Shopping Center Characteristic	A	B	C	D	E	F	G	H	I
Center Size in Leasable Area (x 000 s f) Total Area/Mall & Common Area	697.3 269	815.1 351.5	768.9 342.6	1,004.4 283.6	805.6 403.7	613.4 332.3	989.6 366	910.5 368.5	1,047.7 373.7
Average: 828.6									
Levels	2	1	1	1	1	1	2	1	3
Design	Linear	Linear	"T"	"S"	"L"	Linear	Linear	Linear	(Bent)
Number of Anchors	2	4	3	4	3	4	6	3	3
Average: 3.56									
Number of Nonanchors (Including Vacancies)	158	141	117	127	117	113	139	110	144
Average: 129.22									
Number of Kiosks (Including Vacancies)	0	8 4 Vacant	2 1 Vacant	0	4 0 Vacant	6 1 Vacant	0	7 2 Vacant	0
Parking Ratio (# of Stalls per 1,000 s f of Shopping Area)	5.35	5.52	5.54	5.38	5.62	5.35	5.37	5.45	5.53
Year Completed	1952	1981	1981	1978	1972	1986	1990	1969	1980
Average Age: 16.0 Eppli's Average Age: 18.9									
Year Renovated	1987	None	None	None	None	None	None	None	None

Nonanchor Tenant Lease Characteristics (overall averages are weightedaverages)

Shopping Center	A	B	C	D	E
Average Annual Non-anchor Sales (x 000)	$798,533	$594,502	$618,096	$704,080	$712,480
Average Size (per S.F.)	2,251	2,154	2,907	2,248	2,797
Overall Average: 2,415					
Average Base Rent (per S.F.)	$40.03	$44.81	$24.13	$39.51	$19.37
Overall Average: $32.69					
Average Total Rent (per S.F.)	$41.13	$46.17	$25.51	$39.96	$24.21
Overall Average: $34.06					
Average Percentage Rent Rate	6.25%	6.46%	6.50%	6.65%	6.31%
Overall Average: 6.41%					
Average Sales (per S.F.)	$435	$340	$266	$386	$306
Overall Average: $357					
Average Natural Breakpoint (for % rent)	$1,199,912	$785,726	$870,204	$1,988,702	$896,045
Non-anchors Paying % Rent	14/11%	23/14%	21/18%	17/13%	38/32%
% Rent as Proportion of Total Rents	2.2%	2.1%	8.0%	3.8%	15.0%
Base Rent as Proportion of Total Rents	97.8%	97.9%	92.0%	96.2%	85.0%
Vacancy Count	15	6	20	11	20
Vacancy as Proportion of Mall	3.30%	1.91%	4.79%	2.70%	4.83%
Overall Average: 3.13%					
Average Distance to Center (ft.)	138	384	304	293	359
Overall Average: 273					
Frequency of Observations	110	134	97	119	93
Usable Data	94	122	89	108	83
Unusuable Data	16	12	8	11	10

Shopping Center	F	G	H	I
Average Annual Nonanchor Sales (x 000)	$502,806	$886,825	$738,641	$689,949
Average Size (per S.F.)	1,642	2,504	2,595	2,234
Average Base Rent (per S.F.)	$27.86	$43.59	$25.37	$29.58
Average Total Rent (per S.F.)	$28.55	$43.72	$26.50	$30.79
Average Percentage Rent Rate	6.89%	6.59%	6.04%	6.24%
Average Sales (Per Square Foot)	$324	$421	$381	$358
Average Natural Breakpoint (for % rent)	$626,870	$1,385,70 0	$1,353,62 5	$934,896
Non-anchors Paying % Rent	17/14%	8/5%	16/18%	35/24%
% Rent as Proportion of Total Rents	4.0%	1.4%	4.4%	4.2%
Base Rent as Proportion of Total Rents	96.0%	98.6%	95.6%	95.8%
Vacancy Count	7	13	20	13
Vacancy as Proportion of Mall	0.42%	3.43%	3.89%	2.87%
Average Distance to Center (ft.)	336	206	293	141
Frequency of Observations	110	115	87	145
Usable Data	91	66	70	126
Unusuable Data	19	49	17	1

Nonanchor Tenant Lease Characteristics by Franchise

Nonanchor Characteristic	All Stores	National & Regional Chain Stores	Local Stores
Average Annual Sales (per S. F.)	$364.34	$364.15	$364.68
Standard Dev.	$222.13	$217.79	$230.08
Maximum	$1,632	$1,588	$1,632
Minimum	$33	$33	$67
Average Size (in S. F.)	2,415.18	2,795.33	1,746.45
Standard Dev.	2,405.80	2,680.63	1,625.08
Maximum	27,561	27,561	11,958
Minimum	120	192	120
Average Lease Age (in years)	10.57	11.00	9.78
Standard Dev.	3.13	3.08	3.06
Maximum	30	30	20.5
Minimum	2.83	2.83	3
Number of Observations	849	533	316
Frequency of Observations	100%	63%	37%

Nonanchor Tenant Characteristics by Merchandise Type*

Type of Retail Merchandiser	Mean Sales per S.F.	Rank	Mean Rent per S.F.	Rank	Mean Size in S.F.	Rank
All Stores	$363.72		$37.75 ($21.52)		2,417.06	
1) Jewelry	$656.37 ($367.42)	1	$63.84	1	1,239.57 (679.90)	10
2) Cards & Gifts	$292.52 ($199.18)	6	$30.00	10	2,080.24 (1,219.88)	7
3) Women's Apparel	$252.01 ($130.19)	10	$30.00	10	3,855.74 (2,505.82)	1
4) Fast Food	$503.18 (268.42)	2	$59.05	2	874.69 (859.13)	11
5) Family Apparel	$318.48 ($185.04)	5	$36.97	4	3,053.07 (1,861.71)	2
6) Men's Apparel	$249.80 ($148.33)	11	$32.97	6	2,384.16 (1,575.56)	6
7) Leisure & Ent.	$343.01 ($200.40)	4	$33.85	5	2,651.53 (3,107.16)	4
8) Home Furnishings	$270.83 ($201.08)	8	$31.40	7	2,6 2,666.49 (3,857.35)	3

Type of Retail Merchandiser	Mean Sales per S.F.	Rank	Mean Rent per S.F.	Rank	Mean Size in S.F.	Rank
9) Men's & Boys' Shoes	$273.21 ($162.10)	7	$30.43	9	2,397.19 (1,173.98)	5
10) Women's Shoes	$263.46 ($144.51)	9	$30.95	8	1,733.78 (993.58)	8
11) Specialty Food	$362.52 ($224.06)	3	$43.00	3	1,272.51 (1,033.13)	9

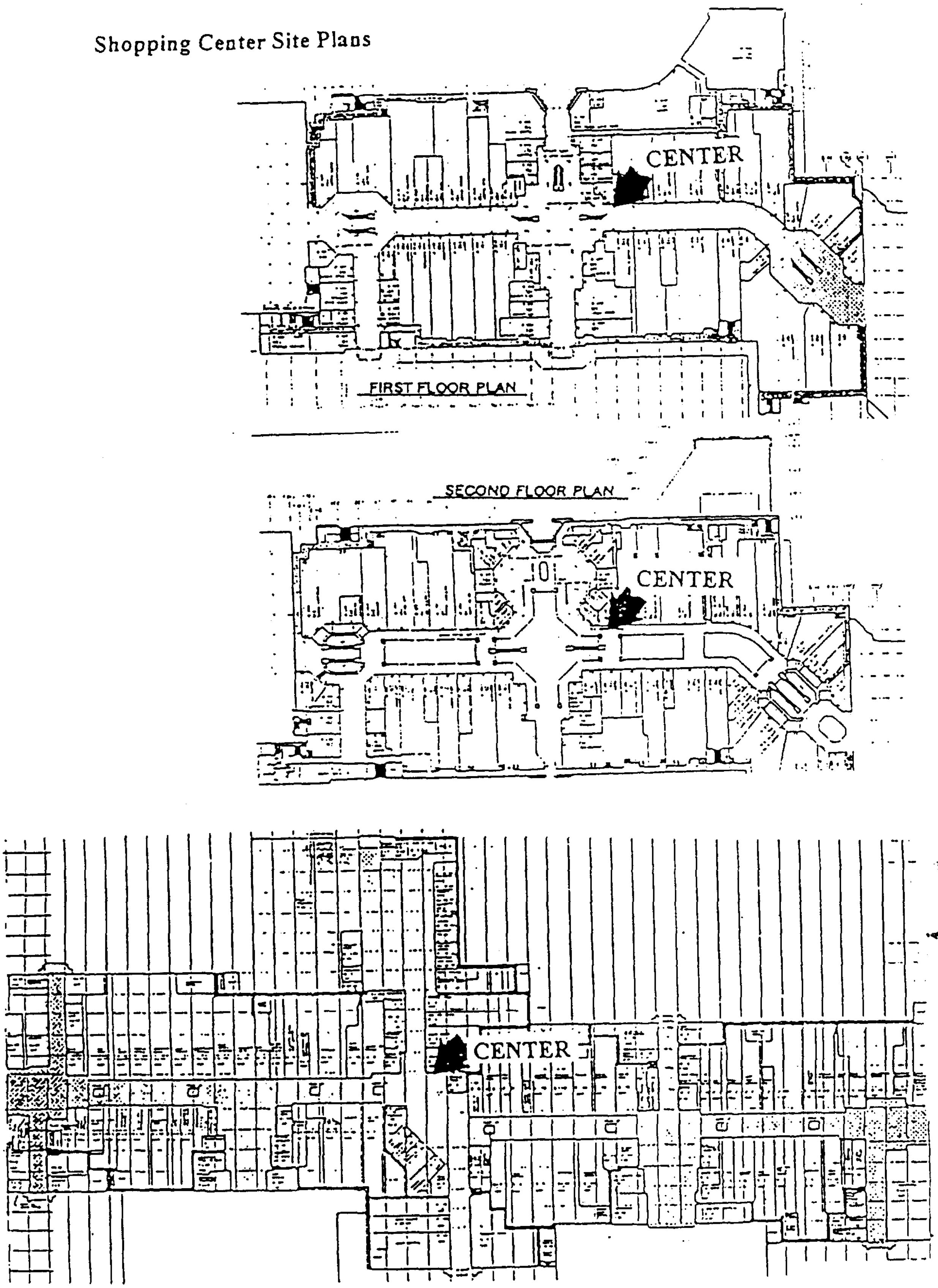
*Standard deviations are in parenthesis.

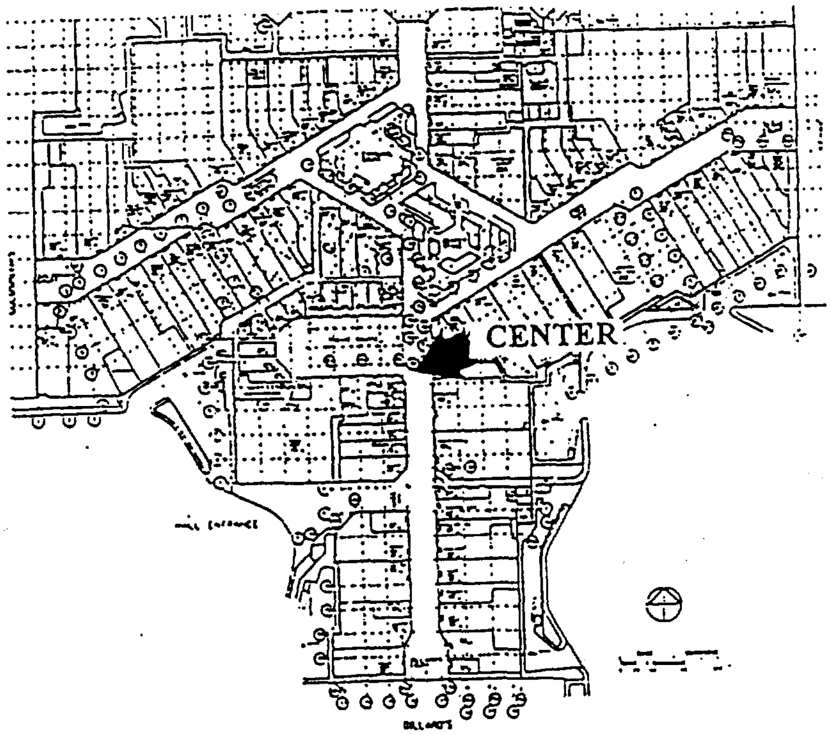
Type of Retail Merchandiser	Mean Distance to Center (feet)	Rank	% of Observations	Rank
All Stores (unweighted)	295.2 (517.8)		100.0%	
1) Jewelry	281.6 (485.4)	3 (3)	6.2%	8
2) Cards & Gifts	347.1 (596.7)	9 (9)	6.5%	6
3) Women's Apparel	312.7 (519.8)	5 (5)	18.5%	2
4) Fast Food	70.5 (115.4)	1 (1)	11.0%	3
5) Family Apparel	330.2 (547.9)	6 (6)	7.0%	4
6) Men's Apparel	336.0 (556.6)	7 (7)	6.3%	7
7) Leisure & Entertainment	405.1 (688.7)	11 (11)	22.0%	1
8) Home Furnishings	326.7 (571.4)	8 (8)	6.2%	8
9) Men's & Boys' Shoes	396.6 (670.4)	10 (10)	6.7%	5
10) Women's Shoes	273.0 (453.7)	2 (2)	5.0%	11
11) Specialty Food	294.4 (489.8)	4 (4)	6.2%	8

*Normalized distances are in parenthesis.((distance/square root of mall area) x 1000)

Measured "Centers" of Shopping Malls in the Database

Shopping Center Site Plans

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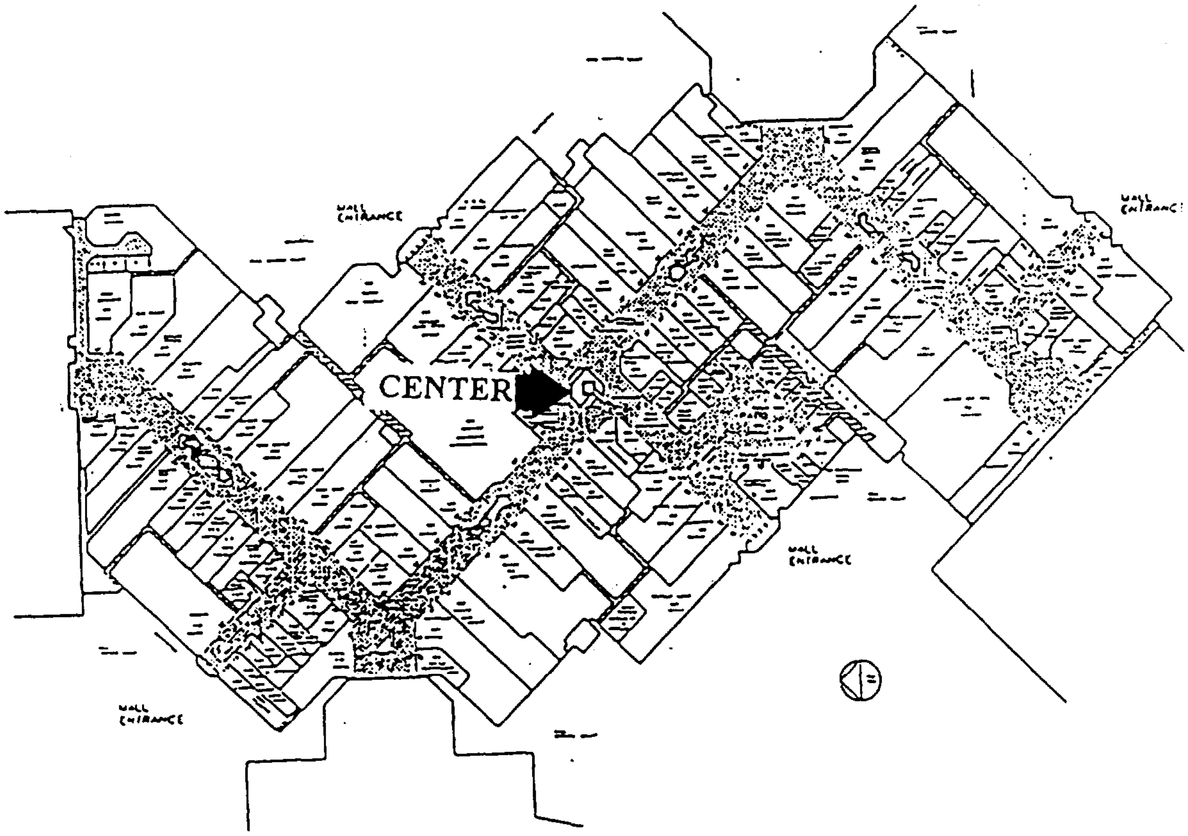
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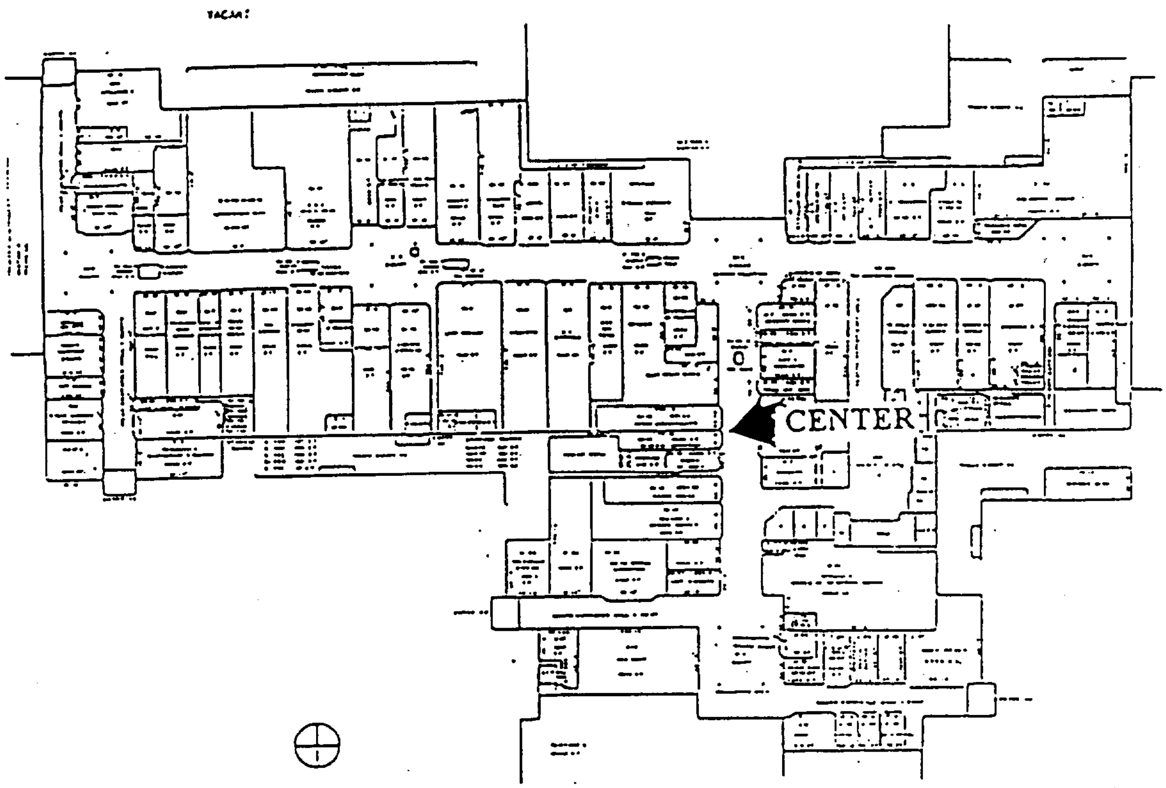
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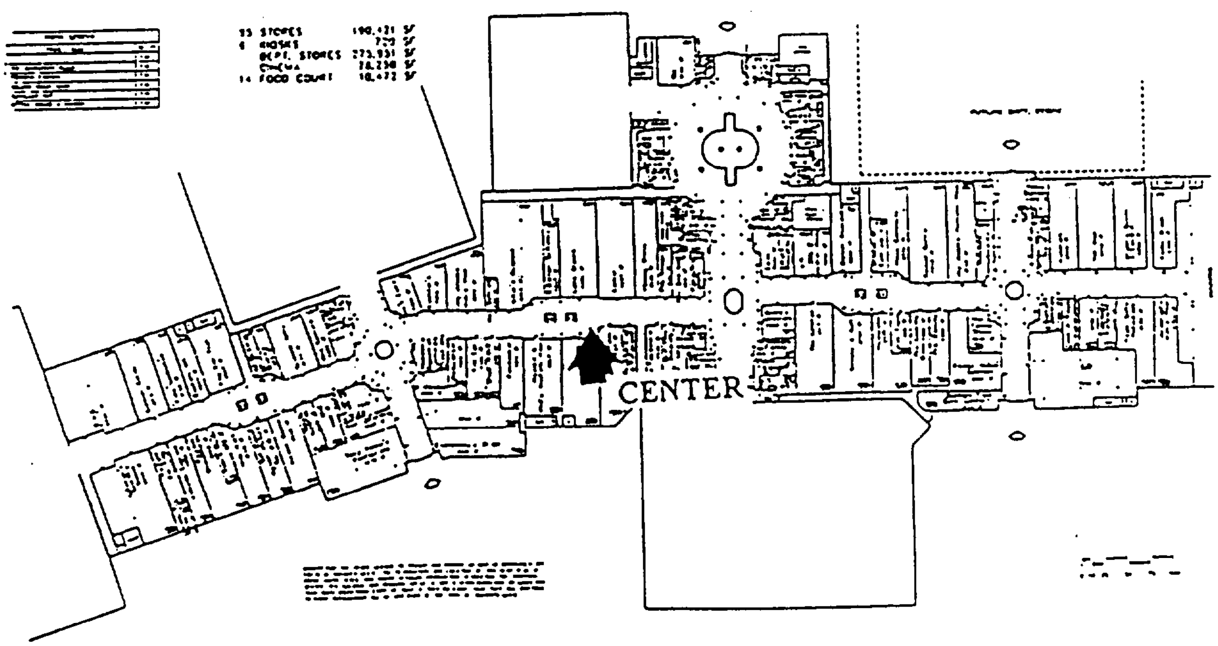
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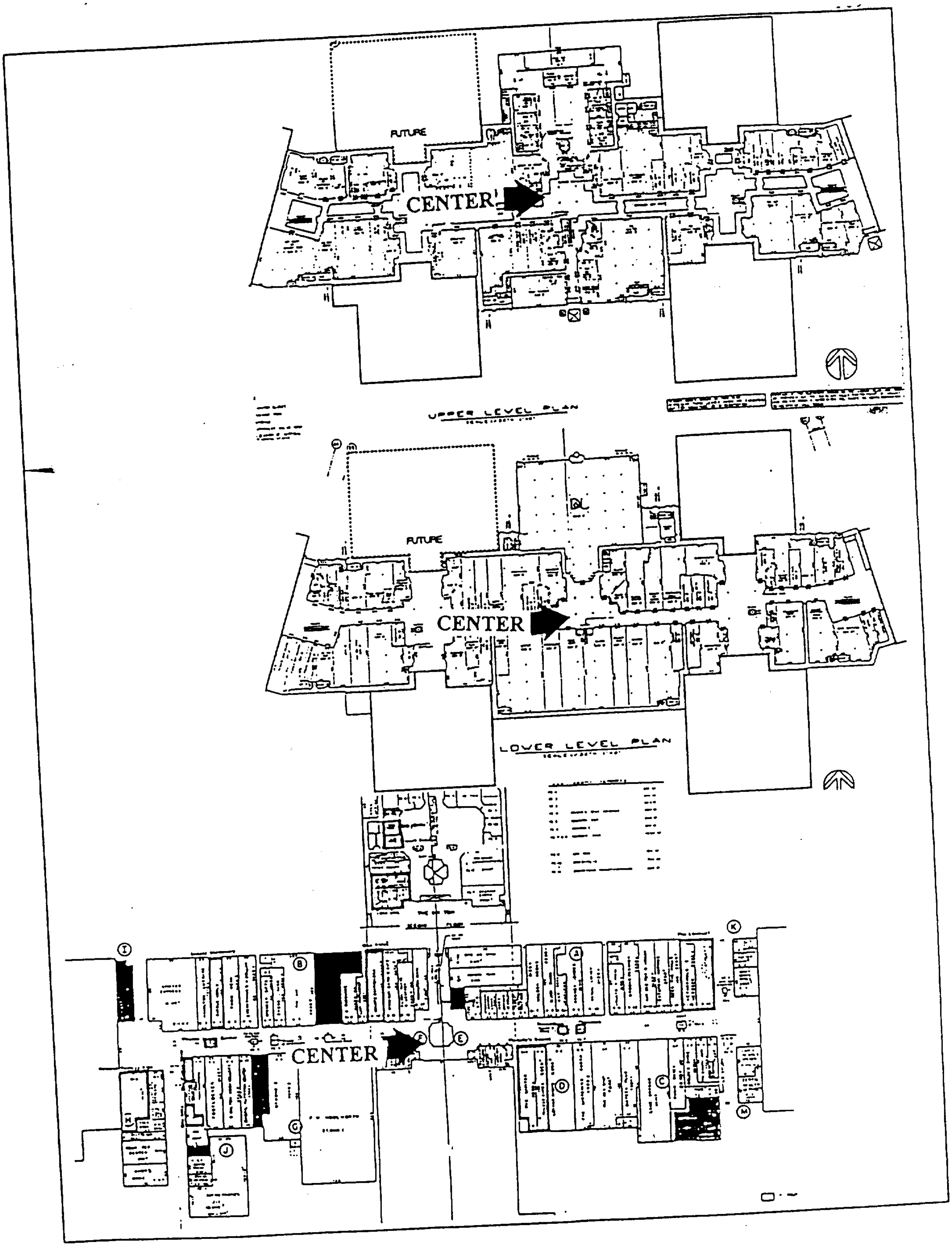
FUTURE
CENTER
UPPER LEVEL PLAN
FUTURE
CENTER
LOWER LEVEL PLAN
CENTER