THE ECONOMICS OF RETAIL FIRMS

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N° 86 / 12

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Director of Publication:

Charles WYPLOSZ, Associate Dean
for Research and Development

Printed by INSEAD, Fontainebleau
France

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Revised
April, 1986

*The authors are grateful for the comments received at various seminars (INSEAD, University of Maryland, Bell Core., and Marketing Science meetings). Special thanks for their detailed comments are due A. de Fontenay, and John Wallis. Responsibility for errors and misinterpretation remains, of course, with the authors.

I Introduction

Economists' interest in retail firms has been somewhat limited in its scope. Most studies select retail firms to provide 'realism' for one particular feature of a theoretical model which may be relevant in retail environments. These studies range from Hotelling's work on spatial competition (1929) and Chamberlin's work on monopolistic competition (1946) to the recent literature on the economics of information with its search for the lowest priced store (Stiglitz, 1979) or the temporal shifting of storage costs (Varian, 1980). Other studies have explored narrowly defined problems specific to retailing, such as the assortment problem (Baumol and Ide, 1956), resale price maintenance (Gould and Preston, 1965, and Perry and Porter, 1986), or clearance sales (Lazear, 1986). Our analysis differs from these studies in one important respect. We develop a model that offers a comprehensive framework for understanding the operations of a retail firm, including the role of many of the particular aspects emphasized in the previous literature, as an economic institution. Hence, our contribution follows in the tradition started by Coase's (1936) classic paper on the nature of the firm. Indeed, one of our most important insights is the identification of the nature of retail firms and, consequently, of their essential economic function.

We explain that which is common to all forms of retailing by answering the question: what is the economic function of a retail firm? By definition the retailer is a marketing intermediary, and his existence and the nature of his activity depend on the existence and nature of certain distribution costs. Thus, we view the retail firm as offering at least one product to consumers at an observable market price, and providing services that can reduce the distribution costs which consumers would incur if they were to transact directly with producers. We view a product offered at an observable market price as the explicit product and the distribution services as the implicit products or qualities of the retailer. Hence, we regard the retailer as an intrinsically multi-product firm which must determine the optimal levels of the implicit products and the optimal quantity (or price) of at least one explicit product.

In the next section of the paper we discuss the nature of retailing by describing, first, different kinds of distribution costs that consumers can incur and, then, by presenting five types of service outputs that retailers provide to reduce these distribution costs. This section can be characterized, following Nelson and Winter's (1982) terminology, as appreciative theory. It contains the fundamental insights on the nature of retail markets revealed by our research. These insights are somewhat reminiscent of, and to some extent were inspired by the work of Bucklin (1972) characterizing the main function of marketing systems. Other sources useful in developing our conceptualization were Kotler (1984), and Ingene (1984). Our main conclusion is as follows: the fundamental economic function of retail firms is to deliver explicit products or services to consumers <u>together</u> with a variety of distribution services which determine the levels of distribution costs experienced by consumers in their patronage of retailers.

We move from the realm of appreciative theory to formal theory in Section III. That is, we develop a household production model which generates the demand for retail products of a representative household while incorporating explicitly the role of the distribution services provided by any given retailer. The idea of household production goes back to Lancaster (1966) and Becker (1965). Our formulation is an extension of the two stage procedure in Deaton and Muellbauer (1980). Interestingly enough, some of our results for the first stage on the impact of distribution costs are anticipated in a detailed analysis of a single household's demand for storage and shopping trips by Harwitz, Lentnek and Narula (1983). Their approach differs from ours in that the role of the retailer in determining distribution costs is only implicit in their model, the second stage is not analyzed and a number of restrictive assumptions are employed. Nevertheless, their work illustrates one direction in which to proceed for detailed implementation of the demand side of our model. Our main result in this section is the derivation of the demand function faced by the retailer and its main properties with respect to prices, distribution services and full income.

In Section IV we develop a formal model of the costs of supplying explicit products and distribution services to consumers by a retail firm. The essential economic features of the problem are summarized in terms of a multiproduct cost function and its properties, which is the result of applying the duality framework, as in McFadden (1978), to our particular problem. On the substantive side, our specification can allow for joint production and economies of scope with respect to the production of distribution services and the explicit product as well as for the existence of fixed or variable factors. These characteristics are important in the retail environment.

The specifications in the previous two sections are brought together in Section V, where we analyze the behavior of a profit maximizing retail firm. In order to keep the paper within reasonable bounds of length we consider only a firm that views the effects of its actions on competitors as negligible, which puts us in the setting of monopolistically competitive behavior, but extensions of the demand and supply side to the analysis of chain markets or oligopolistic structures, as emphasized by Friedman (1983), are straightforward. After deriving and interpreting the technical results associated with the first-order conditions in this section, we conclude the paper by analyzing in Section VI the main substantive implications of our conceptualization. These implications are summarized in the form of two multi-part propositions.

In the first of these propositions we demonstrate that the existence of distribution costs for consumers and of economies of scale and scope for retailers in the provision of distribution services are the source of profit incentives for retail firms to integrate backwards, provide multiple explicit products, and/or serve multiple segments of a market. These particular incentives of retail firms to become complex organizations through vertical integration have not been recognized in the literature. Indeed, Williamson's (1985) recent book devotes two chapters to vertical integration and even addresses retailing explicitly in his discussion of forward integration (Ch. 5). Yet, the discussion is always from the point of view of a manufacturer integrating into distribution, or into raw materials when discussing backward integration. What is being added by our research is that due to the nature of distribution costs the types of firms that become efficient participants in the retail market are likely to be the ones that integrate backward, provide multiple products and/or operate in more than one retail market.

In the second of these propositions we demonstrate several characteristics of the monopolistically competitive retail firm in long-run equilibrium. In particular, this firm will exhibit excess capacity and is likely to exhibit price dispersion with respect to the explicit product as well as to offer product choice in distribution services. The relation of these results to the recent literature on monopolistic competition is best considered in terms of the two separate strands of the literature identified by Koenker and Perry (1981). One strand, associated with Spence (1976), is illustrated by Perry and Groff's recent anlaysis of forward integration (1985). This approach restricts the nature of the inverse demand functions facing the firm by assuming a CES form for the utility function and no income effects; in addition, it frequently posits an arbitrary fixed factor in the specification of the production side. The other strand in the literature, which is closer in spirit to our approach, flows from the work of Laneaster (1979) and is described in detail by Friedman (1983, Ch. 4), who notes two limitations: namely, the restriction of the analysis to one characteristic or two tightly related characteristics and the assumption of strict noncombinability or perfect combinability in consumption. Our approach is not subject to the limitations of either strand of the literature and our results are quite general, but they are restricted to the behavior of the firm. By contrast, market equilibrium and normative issues with respect to product diversity and vertical integration have been the focus of all of the literature cited in this paragraph. Hence, the extension of our analysis to these issues may prove a fruitful topic for future research.

II The Nature of Retail Systems

Retail systems provide consumers with goods and services for consumption or purchase activities. In so doing, however, they also provide consumers with various levels of distribution services. Indeed, it is through these different levels of distribution services provided that one can characterize the different retail institutions that exist in the marketplace. In order to expose this essential feature of retail systems as clearly as possible, the following paragraphs identify six types of distribution costs that a consumer can incur when interacting with any part of the retail system. Subsequently, we discuss how a retail firm jointly provides the goods that are the object of purchase activities by consumers and various levels of the distribution services which reduce the distribution costs incurred by consumers[1].

Given the well established importance of time and space considerations in the economics literature, not much needs to be said about the first two types of distribution costs experienced by consumers in their purchase activities: direct time costs and direct transportation costs. The former include the opportunity cost of travel time, as well as that of waiting time inside and outside of a retail establishment. The latter include the monetary cost of transport to and from the purchase site.

Less conspicuous in the economics literature are distribution costs in the form of adjustment costs incurred in purchasing or consumption activities as a result of the unavailability of products or services at the desired time of consumption or purchase. These adjustment costs arise as a result of indirect time and transport costs incurred due to forced search or due to the increased expenditures or lower utility associated with altering the consumption or purchase bundle of goods and services. The latter type of costs could be characterized as the costs of rationing through unavailability. Similarly inconspicuous in the economics literature are the costs inflicted on the consumer utilizing the retail system by undesirable or unappealing characteristics of the retail environment, for example drudgery, anxiety or disagreeable social interactions. These types of costs could be characterized, following the spirit of the literature on retailing, as psychic costs, e.g., Ingene (1984).

Finally, there are two other types of distribution costs that the consumer incurs in using the retail system. One set of such costs are storage costs, for instance in the purchase of household products in bulk, such as those due to purchasing wine in cases rather than in bottles. The last set of costs incurred by the consumer in his interaction with the retail system are information costs with respect to the various dimensions of the goods and services consumed or purchased through the system. Information may be desired with respect to price, availability, physical attributes or performance characteristics of the goods and services provided at the retail level. The acquisition of this information entails costs through the use of time, transport and other resources. While in practice there will be some overlap between this type of distribution cost and some of the others, one should also note that even in a world of perfect information, freely accessible at no cost to the consumer, the other five types of distribution costs would continue to exist.

From our point of view the essential link between these six types of distribution costs is that, over a certain range, they can be shifted between the consumer and the retailer. Hence, different retail forms will in general differ on the amount of each of these distribution costs that they impose on consumers.[2] It is thus useful to discuss how a retail establishment can generate different levels of these costs, which is the task to be considered next.

A retail establishment provides goods or services for purchase but at the same time it provides other outputs, namely distribution services, that are not explicitly sold on the market. By bundling these services with the goods and services offered for sale at explicit prices, the retailer determines the levels of the previously described distribution costs that consumers incur in their purchase activities. There is some degree of arbitrariness in the level of detail at which one chooses to describe these services. Our particular choice of categories and level of aggregation is aimed at: providing a framework in which any particular type of retail establishment can be included, establishing the link between these distribution services and the costs described above, and leaving no doubt that the production of these services requires resources.

The first category of outputs of a pure retail system is, of course, the provision of goods or services for purchase. Examples of retail establishments that specialize in the distribution function are supermarkets, grocery stores, department stores, discount stores, and specialty shops such as video cassettes distribution outlets. In these settings purchase activities dominate. A common characteristic of this type of output in all of the above types of retail establishments lies in the existence of at least one measurable feature which can be clearly identified as a quantity dimension, i.e., the number of goods sold. We shall identify this output as Q_1 in subsequent discussion.

Different types of distribution services comprise the remaining output categories, which are difficult to measure directly. Perhaps the most difficult to measure of these services may be labeled ambiance. It determines the level of "psychic" costs imposed on the consumer by the nature of the environment associated with the retail establishment. While this output may be difficult to measure, it is clear that some types of retail establishments specialize in providing low levels of this output, e.g., discount stores; and the associated lower prices of the goods sold in these establishments are due, at least in part, to the resources thereby saved.

The third category of outputs produced by any retail establishment is the level of product assortment, which for some purposes can be further subdivided into breadth (different product lines) and into depth (different varieties within a product line). This output determines the level of distribution costs incurred by consumers who patronize retail establishments through, for example, its effect on the direct time and transportation costs associated with multiple shopping trips. Examples of retail activities stressing product breadth are department stores, supermarkets, hypermarkets; examples of retail activities stressing product depth are specialty shops of various kinds. For a given number of goods sold, higher levels of product assortment will entail higher costs for the retailer, for instance the costs of labeling and layout.

The fourth type of output is accessibility of location. It affects the level of distribution costs incurred by consumers through its effect on direct time and transport costs per shopping trip. For a given number of goods sold, a retailer may provide greater accesibility to consumers by operating at several retail sites in a given market area, and this decision would entail higher costs for the retailer than operating at a single site.

The fifth type of output is the degree of assurance of immediate product delivery in the desired form, at the desired place and at the desired time. This output affects consumers' distribution costs through its effects on the costs of waiting time inside and outside the retail establishment, on the adjustment costs due to nonavailability and on the storage costs that a consumer might incur if the product is not available in the desired quantities at the desired time. The provision of higher levels of this output also entails higher costs for the retailer, for example storage costs.

The last type of output is the amount of information provided by the retail system to the consumer with respect to the price, availability and other characteristics of the goods and services produced or distributed through the retail system. The provision of greater amounts of this output through advertising, promotional sales, sales personnel, etc., obviously leads to higher costs for the retailer.

At this point the reader should note that there is a certain amount of joint production in the provision of these outputs. For instance, choosing a high level of product assortment through breadth and depth of product lines implies a certain amount of assurance of immediate product delivery, in the sense that the time and transportation costs of adjusting by searching for a close substitute will be smaller than otherwise. Similarly, this choice also provides the consumer with a level of information as to the likely availability of certain product lines on a given shopping trip.

To conclude, the discussion of the nature of a retail system presented here reveals two fundamental characteristics of such systems: consumers interacting with a retail system experience various types of distribution costs (six if our typology is exhaustive); firms participating in these systems exert substantial influence over the levels of these costs through their choices of implicit products or quality dimensions of output. While this discussion suggests the potential richness and diversity of retail systems, it also reveals the fundamental economic function of all retail firms: To deliver explicit products or services to consumers <u>together</u> with a variety of distribution services.

III. A Formalization: The Demand Side

In this section we develop a formal model that expresses the demand for retail products in a form that can capture the potential shifting of distribution costs between consumers and retailers. The principal technical results needed for applications of the model are highlighted in terms of three related propositions. For simplicity of exposition, the specification presented below is tailored to the subsequent applications i.e., the analysis of retail firms which sell a single explicit product in atomistic markets. Hence other applications of the analysis, for instance to firms with multiple physical product or firms that operate in oligopolistic markets, may require minor modifications or extensions of the demand specification. Some of these modifications will be mentioned at the relevant points in the argument.

The demand faced by a specific retailer will be seen as the result of the behavior of a representative consumer, who makes choices in the context of a household production model. This 'representative' household produces various commodities or characteristics that provide satisfaction through the use of market goods and services and its own time, given the levels of distribution services provided by the retailers it patronizes and the other environmental characteristics associated with the representative household. In this conceptualization, the behavior of the representative household can be characterized in terms of a two stage decision procedure.[3] In the first stage, the household minimizes the costs of attaining exogenously given levels of the commodities that yield satisfaction through its choice of the quantities of market goods and time, including the physical goods sold by a retailer and given the levels of services provided by this retailer. In the second stage, the household selects the levels of the commodities that yield satisfaction in order to maximize utility subject to the constraint that full income be at least equal to the cost minimizing levels of expenditures associated with the chosen levels of the commodities.

This process is most easily understood with the use of some notation. The result of the optimization procedure in the first stage leads to a cost function of the following form:

$$C^h = C^h(p^*, \bar{p}; Q, E, Z), \qquad (1)$$

where p^* is the retail price of the market goods that the household purchases from a particular retailer to produce the commodities that provide satisfaction. $\bar{p}$ is a vector of the prices of other goods and services, including the opportunity cost of labor services used in consumption activities. Q is a vector of different distribution services or quality outputs provided by the particular retailer; hence, $Q = (Q_2,\ldots Q_6)$. Z is a vector of the characteristics or commodities that yield satisfaction, including the amount of time that is not spent working or in consumption activities. E is a vector of environmental characteristics associated with the representative household, which may include in some applications the vector of distribution services provided by other relevant retailers.

By construction this cost function has the following properties: nondecreasing, linear homogeneous and concave in prices (p^*, $\bar{p}$); increasing in the elements of Z and in at least one price; and nonincreasing in the elements of Q. The last property follows from the fact that we are treating the levels of the quality outputs provided by the retailer as fixed inputs into the production functions of the representative household. The conditional demand function for the explicit product sold by the retailer can be obtained via Shephard's lemma, which yields

$$Q_1 = \frac{\partial C^h}{\partial p^*} = C_{p^*}(p^*, \bar{p}, Q, E, Z) \qquad (2)$$

Since this demand function is conditional on the levels of the commodities, it is a constant utility or Hicksian demand function; hence, it allows us to derive what may be called the <u>direct production effects of</u> changes in the arguments of the demand function. The main ones are summarized in the following proposition.

Proposition 1: The household's conditional demand function for a retailer's explicit product will be nonincreasing in the retail price of the product (p^*), nondecreasing in the levels of the quality outputs of the retailer (Q_j), and nondecreasing in the levels of the commodities that yield satisfaction directly (Z_i).

The elements of Proposition 1 can be restated as follows:

$$[(\partial Q_1/\partial p^*)|Z] \leq 0 \tag{2a}$$

$$[\partial Q_1/\partial Q_j|Z] \geq 0, \quad \text{for } j = 2,\ldots 6. \tag{2b}$$

$$[\partial Q_1/\partial Z_i] \geq 0, \quad \text{for all } i. \tag{2c}$$

Inequality (2a) follows from the concavity of the household's cost function; inequality (2c) follows from the increasing in output property of the cost function and the assumption that Q_1 is not a regressive input into the household's production functions. Inequality (2b) follows from the definition of the distribution services provided by the retailer as fixed inputs into the household's production functions and the plausible assumption that the retailer's physical product and its distribution services (Q_j) are complementary inputs, or at least independent inputs, in the household's production functions.[4]

While the economic theorist is interested in (2) and its properties, a more useful demand function from the retailer's viewpoint is one that incorporates the choices made in the second stage of the household's decision making procedure. The optimality conditions that determine the choices in the second stage are derived from choosing the commodities (Z_i) to maximize a quasi-concave utility function subject to the restriction that full income (W) be able to cover the costs given by (1). That is, choose Z to maximize $U(Z) + \lambda[W-C^h(p^*, \bar{p}, Q, E, Z)]$. The resulting conditions are:

$$U_i(Z) = \lambda C_i^h(p^*, \bar{p}, Q, E, Z) \qquad i = 1,\ldots,n \tag{3}$$

$$\text{and } C^h(p^*, \bar{p}, Q, E, Z) = W, \tag{4}$$

where $U_i = \partial U/\partial Z_i$ and $C_i^h = \partial C^h/\partial Z_i$.

Solving (3) and (4) leads to the following set of demand functions for the commodities

$$Z_i = Z_i(p^*, p, Q, E, W) \qquad i = 1,\ldots,n. \tag{5}$$

Hence, substitution of (5) into (2) yields a new demand function for the retailer's product, i.e.,

$$Q_1 = C_{p^*}(p^*, \bar{p}; Q, E, Z) = C_{p^*}(p^*, \bar{p}, Q, E, Z\,(p^*, \bar{p}, Q, E, W)), \tag{6}$$

which can be rewritten as

$$Q_1 = G(p^*, \bar{p}, Q, E, W) \tag{7}$$

This demand function is the one relevant from the retailer's point of view; therefore, it is also useful to summarize and establish its main properties.

Proposition 2: The household's demand function for a retailer's physical product will be nonincreasing in the retail price of the product (p^*), and nondecreasing in the levels of the distribution services of the retailer (Q_j) and in the household's full income (W).

The elements of proposition (2) can be restated as follows:

$$\partial Q_1/\partial p^* = \partial G/\partial p^* \leq 0 \tag{7a}$$

$$\partial Q_1/\partial Q_j = \partial G/\partial Q_j \geq 0 \qquad \text{for } j = 2,\ldots 6 \tag{7b}$$

$$\partial Q_1/\partial W = \partial G/\partial W \geq 0 \tag{7c}$$

In order to establish (7a) - (7c), note that from (6) and (7)

$$\partial G/\partial p^* = [(\partial Q_1/\partial p^*)|Z] + \sum_i (\partial Q_1/\partial Z_i)\,(\partial Z_i/\partial p^*) \tag{8a}$$

$$\partial G/\partial Q_j = [(\partial Q_1/\partial Q_j)|Z] + \sum_i (\partial Q_1/\partial Z_i)\,(\partial Z_i/\partial Q_j) \tag{8b}$$

$$\partial G/\partial W = \sum_i (\partial Q_1/\partial Z_i)\,(\partial Z_i/\partial W) \tag{8c}$$

These equations show that the effect of p^*, Q_j and W on Q_1 can be decomposed into a direct production effect (the first term), which has been analyzed in connection with proposition 1, and a consumption effect (the second term). To preserve the continuity of the exposition, the detailed arguments showing that, when the Z_i's are normal goods, the consumption effect reinforces the production effect in (8a) and (8b) and leads to a positive effect in (8c) are presented in an Appendix.

For analysis of monopolistic market behavior, the demand function for the retailer's product is more conveniently expressed in terms of inverse demand functions; hence, from (7) and the associated demand functions for the other goods and services employed by the representative household, we obtain:

$$p^* = G^{-1}(Q_1, \bar{q}; Q, E, W) \equiv f(Q_1, \bar{q}; Q, E, W) \tag{9}$$

where $\bar{q}$ is a vector of goods and services other than those purchased from the retailer. From the properties established with respect to (7), it follows that (9) will have the following properties:

$$\partial p^*/\partial Q_1 = \partial f/\partial Q_1 \leq 0 \tag{9a}$$

$$\partial p^*/\partial Q_j = \partial f/\partial Q_j \geq 0 \qquad j = 2,\ldots,6 \tag{9b}$$

$$\partial p^*/\partial W = \partial f/\partial W \geq 0 \tag{9c}$$

These properties are conveniently summarized in terms of Proposition 3.

Proposition 3: The inverse demand function of the representative household will be nonincreasing in the quantity of the explicit product (Q_1) sold by the retailer, nondecreasing in the distribution services (Q_j) and in full income.

The equality in (9a) is the reciprocal of the equality in (7a) and, therefore, it must have the same sign. The sign of (9b) can be established from the following experiment: consider a situation in which price is given but the quantity of the retailer's product and one of the distribution services are allowed to change. From (9) we have:

$$dp^* = (\partial p^*/\partial Q_1)dQ_1 + (\partial p^*/\partial Q_j)dQ_j = 0.$$

Hence

$$\partial Q_1/\partial Q_j = - \frac{(\partial p^*/\partial Q_j)}{(\partial p^*/\partial Q_1)} \tag{10}$$

By (7b) equation (10) must be nonnegative; since the denominator on the RHS of (10) must be negative, by (9a), the numerator, $- \partial p^*/\partial Q_j$, must be nonpositive and the sign of (9b) is established. All this result means is that, if the retailer's explicit product and his distribution services are complements in the household's production function, the consumer is willing to pay a higher price for the explicit product when it comes in a bundle with higher levels of distribution services.

Finally, the sign of (9c) can be determined from an experiment similar to the previous one. That is, if all prices are constant and we allow only full income and the quantity of the explicit product sold by the retailer to change, equation (9) implies the following relationship.

$$\partial Q_1/\partial W = - (\partial p^*/\partial W)/(\partial p^*/\partial Q_1). \tag{11}$$

Since equation (11) is nonnegative, by (7c), and the denominator in (11) must be negative, by (9a), weak inequality (9c) must hold.

In summary, equations (7) and (9) provide a rigorously developed basis for the analysis of market behavior which is capable of capturing one of the fundamental features of retail systems stressed in Section II, namely, the experiencing of different levels of distribution costs by consumers in their patronage of retailers.

IV A Formalization: The Production Side

Fortunately the model underlying the production side is clearly established in the literature. Consequently, it can be developed in more succint fashion than the one underlying the demand side. Indeed the main technical result needed for subsequent applications can and will be highlighted in terms of a single proposition. Moreover, the specification of the cost side presented below is consistent with a variety of market structures and extensions to deal with multiple explicit products or operations in more than one market are relatively straightforward.

Just as any other firm, the retailing firm will employ resources or inputs in order to produce the given levels of outputs desired by its customers. In contrast to other firms, however, the retailers must produce these outputs jointly to some extent. That is, regardless of the type of retailer one wishes to analyze, any retail enterprise has to produce at least some minimal level of each of the six outputs described before. In order to do so, the retailer will employ land, capital, and labor of various types, as well as various types of intermediate products, material inputs, purchased goods from suppliers and working capital. Some of these inputs may be specific to the production of certain outputs, for instance labor, materials and equipment devoted to promotional and advertising activities; some of these inputs may be common to the production of two or more of the outputs, for example equipment, such as computers, that can be used in the provision of information, assurance of product delivery and product assortment. These common inputs may be private, public or quasi-public in the terminology suggested by Baumol, Panzar, and Willig (1982).

For the analysis below, it is not necessary to distinguish certain characteristics of the inputs that may be of importance in some detailed applications. For instance, an important issue in some practical applications would be the number and characteristics of specific sites. At the present level of analysis, however, the nature of this input can be easily captured by associating a site with the services of a specific land input and, more specifically, differentiating sites by the rent per unit of services of land. With these considerations in mind, the retailing firm's problem can be generally described as

$$\text{Minimize } v'x \text{ subject to } H(Q_1, Q, x) = 0,$$

where v' is a transposed vector of input prices, x is a vector of input services, and H is a continuous transformation function increasing in x and decreasing in Q_1, Q. The solution to this optimization problem, when it exists, is a set of conditional input demand functions which can be inserted into the cost equation to yield the joint cost function of the retail firm. This joint cost function is the dual of the transformation function, McFadden (1978), and it will be written as

$$C(v, Q_1, Q) \tag{12}$$

The function has the usual properties associated with a cost function, which are summarized in terms of the following proposition:

Proposition 4: The retailer's cost function is nondecreasing, linear homogeneous and concave in input prices, increasing in at least one price and in the explicit product and the distribution services provided by the retailer.

No proof of this proposition is necessary here, since these properties of joint cost functions are well established in the literature. On the other hand, it is worth reiterating that Proposition 4 encompasses one of the fundamental features of retail systems stressed in section II. Namely, increases in the implicit products or distribution services by a retailer entail increases in costs.

V. The Profit Maximizing Retail Firm

In this section we analyze the implications of the previous specification of the demand and cost side of retail activities for the operations of profit maximizing firms. We will assume that the firm is a price taker in the market for the goods that it buys from suppliers. We will also assume that the firm takes the behavior of its competitors as given. Considerations of interdependent behavior can be easily included in the analysis by including competitors price and output vectors in the environmental variables of the representative household. Nevertheless, such considerations are deferred to future research in order to present the essential implications of our conceptualization of retail markets in as simple a framework as possible. In this section we derive and interpret two technical propositions (5 and 6) that underlie the main substantive implications of the analysis, which are discussed in Section VI.

Under the usual assumption of profit maximizing behavior, the firm's objective function is given by

$$\pi = p^*Q_1 - C(v, Q_1, Q) - pQ_1 \qquad (13)$$

where p represents the price that must be paid by the retailer for the goods that it buys from suppliers. Thus, the firm's problem is to choose the levels of Q_1, Q that maximize profits. The first-order conditions for this problem are given by

$$\partial\pi/\partial Q_1 = p^*(1-\varepsilon_1) - C_1 - p = 0 \tag{14}$$

$$\partial\pi/\partial Q_j = (\partial p^*/\partial Q_j)Q_1 - C_j = 0 \qquad j = 2,\ldots,6, \tag{15}$$

where $\varepsilon_1 = -(\partial p^*/\partial Q_1)(Q_1/p^*)$. We assume that the firm operates on the elastic portion of the demand curve, thus $0 < \varepsilon_1 < 1$.

These first-order conditions lead to the following proposition:

Proposition 5: The single-product retail firm will choose the level of the explicit product it distributes to ensure that the net marginal revenues from the sale of the explicit product equal the marginal cost of selling the product; this firm will also choose the levels of each of the distribution services to ensure that the contribution of each of these outputs to marginal revenues equals its contribution to marginal cost.

This proposition follows from simple manipulations of (14) and (15), which lead to:

$$(p^*-p) - p^*\varepsilon_1 = C_1 \tag{14)'$$

$$(\partial p^*/\partial Q_j)Q_1 = C_j \tag{15)'$$

Proposition 5 brings to the fore the essential nature of the retail firm. This firm, just as any other profit-maximizing firm, optimizes by equating the marginal benefits and costs of providing a given level of the explicit product it sells. In contrast to other firms, however, the retail firm must equate the marginal costs of providing distribution services to consumers with the indirect marginal benefits it receives from consumers, due to the higher price they are willing to pay in order to purchase an explicit product that comes in a bundle with higher quality outputs.

It is convenient to introduce at this point the concept of multi-product returns to scale which has been employed earlier by Laitinen and Theil (1978) and Baumol, Panzar, and Willig (1982), among others. If we denote multi-product returns to scale as SE, that is the proportionate effect on costs of increasing all outputs in the same proportion, we have:

$$SE = \textstyle\sum_{j=1}^{6} C_j Q_j / C = \sum_{j=1}^{6} S_j, \qquad (16)$$

where S_j represents the contribution of the jth output to multi-product returns to scale and C is total cost. This concept will be subsequently related to the following proposition:

Proposition 6: The first-order conditions also require that for the profit maximizing retail firm total marginal revenues from retail activities must equal total marginal costs of retail activities.

In order to establish this proposition, we first rewrite (15)' as follows:

$$\varepsilon_j Q_1 p^* = C_j Q_j \qquad j = 2, \ldots, 6, \qquad (15)''$$

where $\varepsilon_j = (\partial p^*/\partial Q_j)(Q_j/p^*)$. If we multiply both sides of (14)' by Q_1, and add up over all six first-order conditions, we obtain

$$(p^*-p)Q_1 + p^*Q_1[\sum_{j=2}^{6} \varepsilon_j - \varepsilon_1] = \sum_{j=1}^{6} C_j Q_j \qquad (17)$$

The first term on the LHS of (17) is total net revenue from retailing at a given (p^*,p) and the second term on the LHS of (17) is the contribution to total marginal revenue of a change in p^* induced by changes in $Q_j(\varepsilon_j \geq 0)$ and a change in $Q_1(\varepsilon_1 \geq 0)$. Hence, the LHS of (17) is total marginal revenues. The RHS of (17) is total marginal cost.

Dividing both sides of (17) by the total cost of retailing $C(v,Q_1,\dots,Q_6)$, one obtains the following relation to multiproduct returns to scale:

$$\frac{(p^*-p)Q_1}{C} + \frac{p^*Q_1}{C}\left[\sum_{j=2}^{6}\varepsilon_j - \varepsilon_1\right] = SE \tag{18}$$

Each of the three terms in (18) has an intuitive economic interpretation. The first term is simply an alternative way of expressing the zero profit condition for the firm. That is, if the first term is greater (smaller) than unity the firm is experiencing above (below) normal profits. When this term is equal to unity, the retail firm is experiencing zero profits. The third term in (18), of course, is simply the multiproduct returns to scale concept defined in (16). While the second term in (18) is an unfamiliar concept, its interpretation is intuitively appealing. It represents the condition for a representative household to be willing to pay a higher, equal or lower price (as$[\sum \varepsilon_j-\varepsilon_1] \gtreqless 0$) for the retail product when all elements in the bundle $(Q_1,\dots Q_6)$ are increased in the same proportion. Hence, it corresponds on the demand side to the same conceptual experiment that generates multiproduct returns to scale on the cost side.

In order to establish this result, consider the differential of the inverse demand function, equation (9), when the retailer's explicit product and distribution services change with everything else constant, i.e.,

$$dp^* = \partial p^*/\partial Q_1 \; dQ_1 + \sum_{j=2}^{6} (\partial p^*/\partial Q_j) dQ_j \quad , \qquad (19)$$

which can be rewritten as

$$dp^*/p^* = \sum_{j=2}^{6} \varepsilon_j \; dQ_j/Q_j - \varepsilon_1 \; dQ_1/Q_1 \quad . \qquad (20)$$

If all outputs are required to change in the same proportion, $dQ_j/Q_j = dQ_1/Q_1 = dQ/Q$, (20) becomes

$$(dp^*/p^*/dQ/Q) = \sum_{j=2}^{6} \varepsilon_j - \varepsilon_1 \qquad (21)$$

To summarize, the retail firm's behavior will be determined by three different types of internal economic considerations: the direct profit incentive, captured by the first term in (18); the ability to generate additional profits through consumers willingness to pay a higher price for an explicit product that comes in a bundle with higher levels of distribution services, captured by the second term in (18); and the ability to generate additional profits through the exploitation of economies of scale and scope in the provision of the explicit product and distribution services to the consumer, captured by the term on the RHS of (18).

VI Implications

We shall discuss the main insights offered by the preceding analysis for the explanation of the behavior of retail firms in terms of two propositions. These propositions provide a new perspective on several topics that have been addressed recently in the economics literature and/or bring to the fore economic issues relevant for retail firms which, to our knowledge, have not been addressed in the literature.

Proposition 7: The retail firm is likely to i) integrate backwards, ii) offer multiple explicit products to consumers and/or iii) operate in more than one segment of the market.

In order to bring out the main incentives for backward integration, it is convenient to manipulate (18) into the following form

$$[(p^*-p) - p^*\varepsilon_1 - C_1] + [p^*\sum\varepsilon_j - (C/Q_1)\ SE^*] = 0, \qquad (18)'$$

where $SE^* = \sum S_j(j=2,\ldots,6)$, i.e., multiproduct returns to scale in the provision of distribution services. Thus, by definition $SE = S_1 + SE^*$. The first term in (18)' represents marginal profits in the provision of the explicit product and the second term represents marginal profits in the provision of all distribution services (per unit of the explicit product). In short-run equilibrium both terms must equal zero.

If the retail firm is able to just cover the costs of producing the explicit product while selling the product to itself at a lower price than what prevails in the suppliers market, it will have an economic incentive to integrate backwards. That is, a decrease in (p) will initially increase total profits, as can be seen from (13), total marginal profits, the first term in (18), and marginal profits, the first term in (18)'. Whatever adjustments the firm makes, these adjustments must increase profits further, because the firm always has the option of not changing the variables it controls. Hence, the direct profit incentive for backward integration is always positive under these conditions. By how much the adjustments generated by the lowering of p increase profits further will depend on two additional considerations that would also seem to favor backward integration by many types of retail firms. These are best brought out by considering (18)'.

Suppose the firm adjusts to a lowering p by increasing Q_1 and lowering p* so that the first term in (18)' is zero; hence, the short-run first-order condition for Q_1 is satisfied. The second term in (18)' represents the sum of the first-order conditions for distribution services and, except by accident, it is unlikely to be satisfied as a result of these changes. In order to have this second term satisfied, it is necessary to change distribution services. An increase in these services (Q_j's) will shift upward the average cost of producing the explicit product (C/Q_1) as well as the demand for the explicit product (p*). If retail firms exhibit substantial multiproduct returns to scale and/or economies of scope in the provision of distribution services (SE* is small), for example due to joint production and the existence of fixed costs, a given increase in Q_j's <u>shifts</u> average cost per unit of Q_1 by a <u>small</u> amount. Thus, it increases the marginal costs of providing distribution services per unit of the explicit product by a small amount. Consequently, it generates larger profits than would otherwise be the case at a given level of demand conditions ($p^*\sum\varepsilon_j$). Since some types of retail firms provide distribution services that are highly valued by consumers (high $\sum\varepsilon_j$'s), a given increase in distribution services by these firms <u>shifts</u> the demand curve outwards by a large amount. Consequently, it generates higher profits at a given level of cost conditions [$(C/Q_1)SE^*$]. Therefore, economies of scale and scope in the provision of distribution services and strong demand by consumers for these services generate additional economic incentives for backward integration by retail firms.

Exactly the same type of considerations determine the incentive for retail firms to offer additional explicit products or to move into new segments of the market. In order to establish these two other parts of proposition (7), it is convenient to present the equivalent of proposition

(18)' for a firm that offers a second explicit product for sale or that operates in a second market for the same explicit product. Equation (18)' becomes

$$[(p_1^*-p_1) - p_1^*\varepsilon_1 - C_{11}] + [(p_2^*-p_2) - p_2^*\varepsilon_2 - C_{12}]Q_{12}/Q_{11} + [p_1^* \sum_j \varepsilon_{1j} + p_2^* \sum_j \varepsilon_{2j}(Q_{12}/Q_{11}) - (C/Q_{11})SE^*] = 0 \qquad (18)''$$

where the subscript 2 can represent either the new product or the new market for the same product. The only additional assumption made in obtaining (18)" is that there are no demand interdependencies between the products or the markets. It is easy to relax these assumptions, but it is not necessary for our present purposes. For Q_{1j} and C_{1j} the first subscript is always unity and the term always refers to an explicit product or market, e.g. C_{12} means the marginal cost of the second explicit product or the marginal cost of the explicit product in the second market. For ε_{ij} the first subscript identifies the explicit product or market and the second subscript the distribution service $(j=2,...6)$.

Adding either a new product or a new market segment can be viewed as a move from (18)' to (18)". Analytically the same considerations as before apply. The second term in (18)" represents the marginal profits from adding a new product or new market segment (per unit of the original explicit product). Similarly, the third term in (18)" now contains the additional marginal revenue generated by distribution services (per unit of original explicit product) for the additional product or market. If $Q_{12} = 0$, (18)" collapses to (18)'. As before there are three types of consideration, the direct profit incentive, $[(p_2^*-p_2)(Q_{12}/Q_{11})$, the consumers valuation of distribution services for the new product or in the new market, $[p_2^* \sum_j \varepsilon_{2j}(Q_{12}/Q_{11})]$, and the degree of multiproduct returns to scale in the production of distribution services for both products or in both markets $[(C/Q_{11})SE^*]$.

It is fairly obvious that the higher the price at which the retail firm can sell the new product, or the old product in the new market, over the cost it must pay suppliers, the greater the incentive for such a move. What is far less obvious is that retail firms have powerful incentives for such moves due to consumers' valuation of distribution services and the existence of multiproduct returns to scale in the provision of these services. Let us consider the addition of a new product first. Assuming it is profitable to add the new product at a given level of Q_{11}, the level of Q_{12} can be chosen so that the second term in (18)" is zero and thus the first-order condition for Q_{12} is satisfied. The third term in (18)", however, is not likely to be zero, as required, for two reasons. Since one of the distribution services, product assortment, has changed, C will increase at a given level of Q_{11}. As the Q_j's change the increase in marginal cost per unit of the initial explicit product $[(C/Q_{11})SE^*]$ will be smaller the greater are economies of scale and scope in the provision of distribution services (the lower the value of SE^*). These economies are likely to exist for retail firms whenever there is slack in the usage of fixed factors of production, e.g., parking lots, storage space, work force, computer equipment, that can be allocated to the new products. Therefore, the increases in the marginal costs of providing distribution services per unit of Q_{11} will be smaller than if these multiproduct economies did not exist. Secondly, there is a new factor in the third term of (18)" that did not exist before, namely $p_2^* \sum \varepsilon_{2j} Q_{12}/Q_{11}$. This factor represents the additional marginal revenues (per unit of Q_{11}) generated by the new product as a result of the distribution services provided by the retail firm. When distribution cost savings by consumers are important, as in the case of recurrent purchases such as those associated with grocery stores, the addition of a new product line is likely to profitable, because the term $p_2^* \sum \varepsilon_{2j}(Q_{12}/Q_{11})$ is likely to be large relative to the new cost conditions.

Similar considerations apply to a move into a new market segment by retail firms. What is likely to differ here from the previous case is the relative strength of the two factors uniquely associated with retail firms. Just as before the direct profit incentive must be positive. In contrast to the previous case, however, one would expect that the demand effects in moving to a new market $(p_2^* \sum \varepsilon_{2j} Q_{12}/Q_{11})$ would be far more powerful as a profit incentive than the ability to prevent the costs of providing distribution services from increasing as a result of economies of scale. The reason is that the number of fixed factors with slack capacity is likely to be considerably smaller in this situation than in the addition of a new product.

To conclude, all three parts of proposition (7) suggest that retail firms have powerful economic incentives to become complex organizations. Two of the three considerations in determining these incentives for all three parts of the proposition flow from our conceptualization of the essential economic function of retail firms, namely as suppliers of the distribution services demanded by consumers. Interestingly enough, those economists who have analyzed the related issue of vertical integration have ignored these considerations. Those approaching the vertical integration issue from an organizational theory or "transaction cost" perspective have emphasized transaction cost for suppliers in the context of forward integration into retailing, e.g., Williamson (1985, Ch. 5). Those approaching the problem from a more neoclassical perspective have emphasized the welfare implications of either forward integration by suppliers under monopolistic competition, Perry and Groff (1985), or alternative strategies to forward integration such as resale price maintenance or exclusive territories, Perry and Porter (1986).

Proposition 8: In long-run equilibrium firms in atomistic retail markets will exhibit i) excess capacity in the provision of the explicit product, ii) price dispersion across market segments, iii) a greater degree of excess capacity the greater is the representative household's valuation of distribution services, iv) and product choice in distribution services.

The first of the four statements in proposition (8) follows straight - forwardly from the standard result for monopolistic competition. That is, the short-run equilibrium condition for the explicit product, (14)', implies that $C_1 = (p^*-p) - p^*\varepsilon_1$; but the long-run equilibrium condition of zero profits implies $C/Q_1 = (p^*-p)$. Hence, average cost must be above marginal cost, since $\varepsilon_1 > 0$, which implies increasing returns to scale in the production of Q_1, i.e., $S_1 = C_1/[C/Q_1] < 1$. Thus, there is excess capacity relative to the minimum average cost of producing Q_1 for any level of distribution services, including the optimal levels.

Establishing the next two statements in proposition (8) requires the second term in (18)', which is rewritten below as

$$p^* \sum \varepsilon_j = SE^*(C/Q_1). \qquad (22)$$

Imposing the zero profit condition on (22), we obtain

$$\sum \varepsilon_j/SE^* = (p^*-p)/p^* < 1. \qquad (23)$$

This relation implies that in long-run equilibrium the representative household's valuation of all the distribution services provided by the representative firm has to be less than the degree of multiproduct returns to scale experienced by the firm in the provision of these services.

Consider now equilibria in two retail markets, A & B, where consumers differ in their valuation of distribution services. Let us say that $(\sum \varepsilon_j)^A > (\sum \varepsilon_j)^B$; hence consumers in market A are willing to pay a higher price for these services than in market B, perhaps because the opportunity cost of time is higher in A than in B. Let us also suppose that the process of entry and exit has market B in equilibrium and that the technologies of the firms in both markets are the same and subject to constant multi-product returns with respect to distribution services, i.e. $SE^* = 1$. The process of entry and exit in market A will then lead to an equilibrium in which the profit rate in A must be higher than in B. This will be accomplished by producing higher levels of Q_j and lower levels of Q_1, since it can be shown that $\partial[(p^*-p)/p^*]/\partial Q_j = [p/(p^*)^2][\partial p^*/\partial Q_j] > 0$ and $\partial[(p^*-p)/p^*]/\partial Q_1 = [p/(p^*)^2][\partial p^*/\partial Q_1] < 0$. Hence, other things equal, in those markets where consumers have a higher valuation of distribution services firms in long-run equilibrium will charge higher prices and sell a smaller amount of the explicit product than in those markets where consumers have a lower valuation of the distribution services.

If we now interpret the previous example as representing two potential equilibria within the same market, we can establish the third statement in proposition (8). To show this result, it is convenient to rewrite equation (18) with the zero profit condition imposed. To wit,

$$1 + \left(\sum \varepsilon_j - \varepsilon_1 \right) p^*/(p^*-p) = SE^* + S_1 \tag{24}$$

We can now use (23) to simplify (24) to

$$(1-S_1) = \varepsilon_1 p^*/(p^*-p) \tag{25}$$

From the previous discussion we know that in the equilibrium associated with A the right hand side of (25) will be lower than in the equilibrium associated with B, assuming ε_1 is the same in both cases. Therefore, for (25) to be satisfied, the left-hand side of (25) must be smaller at A which implies S_1 must also be smaller at A; hence, there will be a higher degree of 'excess capacity' at A than at B. To conclude this discussion, we note a particular restriction on the example which stems from (24) and generalizes to other situations. Since in this example we have assumed that SE* = 1, (24) shows that $\sum \varepsilon_j - \varepsilon_1 > 0$ in both situations, A and B. More generally, if the retail firm operates in the demand region where a proportionate increase in distribution services and the explicit product allows it to charge a higher (same) [lower] price, it must then operate in the region of the multiproduct technology that exhibits decreasing (constant) [increasing] returns to scale. That is, $(\sum \varepsilon_j-\varepsilon_1) \gtreqless 0$, implies $SE \gtreqless 1$.

To some extent the last statement in proposition (8) has already been established. That is, if the representative consumer's valuation of distribution services differs across market segments or across price equilibria within the same market, there will be product choice in distribution services across the market segments or between the different equilibria within the same market. What we want to show now is that differential cost conditions are sufficient to generate product choice in distribution services within the same market at the same price equilibrium. To see this possibility, let us impose the zero profit condition on (15)', which leads to

$$(p^*-p)/p^* = \varepsilon_j/S_j < 1 \quad (j=2,\ldots,6) \tag{26}$$

This condition corresponds to (23) applied to each distribution service. The simplest way of illustrating the result is to consider the case in which $\varepsilon_j = k_j$ for $j=2,\ldots,6$, i.e., where the elasticities are constant. Consider two firms, A and B, that differ in their costs: If firm B is in long-run equilibrium at $(p^*)^o$, is it possible for firm A to also be in long-run equilibrium at the same price $(p^*)^o$? The answer is yes if the two firms have differential cost conditions, so that (26) can hold in this case for different sets of Q_j's. All this requires on the demand side is that if some Q_j increases in going from firm A to firm B then another Q_j must decrease in going from A to B, as can be seen from (20). Product choice in distribution services can also exist at a given price equilibrium if the price elasticities of distribution services vary with the Q_j's.

Appendix: Proof of Proposition 2. Equation (8a) shows that the effect of a change in the price of the retailer's physical product on the representative household's demand can be decomposed into two terms: the first term or direct production effect, which is nonpositive as established in discussing (2a); and the second term or consumption effect, which is negative as demonstrated below. This consumption effect is the sum of elements, each of which has two components. The first component is the effect of an increase in the level of a commodity on the quantity demanded of the retailer's product. This component will always be nonnegative, positive if the household employs the retailer's product in the production of a particular Z_i, as established in the discussion of (2c). The second component, however, will always be negative if the commodities (Z_i) are assumed to be normal goods. For, a change in p* has an income and a substitution effect on the Z_i's. The income effect can be seen from (4). If the consumer is purchasing the retailer's product an increase in p* increases the cost function or left-hand side of (4). Since the right-hand side does not change, this effect is equivalent to an income decrease which reduces the levels of all the Z_i's. In addition, a change in p* increases the right hand side of (3) for those commodities which employ Q_1 as an input, relative to those that do not employ Q_1; hence, it generates the usual substitution effects of consumer demand theory, leading to a decrease in the quantity demanded of these commodities and to an increase in the quantity demanded of those commodities that do not use Q_1 as an input, i.e., for which $\partial Q_1/\partial Z_i = 0$. Therefore both the income and the substitution effect lead to the consumption effect being nonpositive. To conclude, both the direct production effect and the consumption effect lead to the strict inequality in (7a) holding whenever the representative household is purchasing the retailer's product.

By the previous argument, we can also establish that inequality (7c) prevails. That is, a change in full income generates no direct production effect and the consumption effect, which is explicitly shown in (8c), will be positive when the consumer is purchasing the retailer's product, if one assumes, as in the preceding paragraph, that the commodities (Z_i) are normal goods.

Equation (8b) shows that a change in the levels of transaction services provided by the retailer also has a direct production effect (the first term) and a consumption effect (the second term) on the household's demand for the retailer's physical product. As the discussion of (2b) shows, the direct production effect is nonnegative. Furthermore, the consumption effect is a sum of elements composed of two nonnegative parts: the first part, $(\partial Q_1/\partial Z_i)$, is always nonnegative as shown above; and the second part, $(\partial Z_i/\partial Q_j)$, will be shown here to be nonnegative. For instance, an increase in the level of one of the fixed inputs provided by the retailer to the household will have two effects on the second stage optimization which increase, or at least do not decrease, the levels of the commodities demanded by the household. First, such an increase must either decrease or leave unchanged the LHS of (4), since an increase in a fixed input can not increase the cost function; hence, such an increase acts as an income effect on all the commodities whenever the household is using the fixed input in the production of a commodity. Secondly, such an increase generates a relative decrease in the RHS of (3) for those commodities which use the retailer's explicit product as an input and for which this input is complementary with the fixed input (Q_j). Therefore, by lowering the opportunity cost of producing these commodities an increase in their demand is induced. To conclude, both the direct production and the consumption effect will be in general nonnegative and usually positive.

FOOTNOTES

[1]For simplicity in this paper we concentrate on a pure retailing situation. That is, on consumers who patronize a retail establishment with the purpose of purchasing goods rather than for on site consumption of goods or services, and on retail firms that engage in the distribution of goods rather than in the production of goods or services for direct consumption.

[2]Some of the costs we are identifying as distribution costs are also referred to in the literature as transaction costs. We use the word distribution because of its greater generality. Our conceptualization applies to costs which result from exchanges that take place through markets as well as within different economic organizations, including households. Hence if one identifies transaction costs as the costs of transferring goods and/or services across space, time, ownership states and, more generally, potential states of nature, regardless of whether or not these transfers take place through markets, one can substitute the word transaction for the word distribution wherever it appears in the paper

[3]Deaton and Muellbauer (1980, pp. 245-254) provide an insightful discussion of this two-stage procedure.

[4]That is, if two inputs are complementary or independent, $(\partial X_i/\partial p_j) = (\partial X_j/\partial p_i) \leq 0$. The equality follows from the concavity of the cost function which implies continuity and thus symmetry. The inequality follows from the definition of Hicks-Allen complements. Since an increase in the quantity of an input will always take place when there is a decrease in price (by concavity), if other things are indeed equal, complementary inputs must always exhibit a corresponding increase, or the definition of complementarity will be violated.

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