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Dealer and manufacturer margins

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When retail dealerships carry only one product line, the size of the dealer margin is crucial to the success of both the manufacturer and the dealer. This article proposes a successive monopoly model of patterns in exclusive dealer and manufacturer margins across a product line. The predictions of the model then are compared with the pricing practices of a major U.S. automobile manufacturer and its dealers. The data support a special case of our theory. Our analysis also indicates that we cannot reject the hypothesis that the retail demand curves for these models are (locally) linear. Finally, we use the margin data to provide updated evidence on the extent to which retail prices depart from list price.

1. Introduction

■ Many firms sell their products through a network of independent dealers. A common form of independent manufacturer-dealer relationship is one where the dealer carries only one manufacturer's product line.[1] In these exclusive dealer arrangements, the manufacturer's profit is affected by the dealer's pricing practices because the dealer's prices determine the volume of final sales. The manufacturer does have some control over what the final price (and volume) will be, but only to the extent that the manufacturer affects the dealer's costs by setting wholesale delivery prices. This vertical supply arrangement between manufacturer and dealer clearly is a situation in which each side would prefer that the other did not have the power to set price independently.

The differences between dealers' and manufacturers' incentives in setting prices, and the inability of most manufacturers to gain control over retail price, raise an intriguing set of questions about the patterns of dealer and manufacturer margins that are observed in the automobile industry. In automobile retailing it is common knowledge that on larger cars, wholesale prices are a smaller percentage of retail prices.[2] Further, there appears to be

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[1] Exclusive dealerships occur in such diverse markets as those for cars, sewing machines, agricultural machinery, and gasoline. For further examples and a discussion of the contractural and marketing practices associated with these relationships, see Ridgway (1969, pp. 117–121).

[2] For example, in 1968 dealer discounts on "full-sized" models were approximately 25%, while those on subcompacts averaged 17%. More recently, dealer discounts have been 12–15% in small-car lines and in the 19–25% range on full-sized or luxury cars. (See White (1971, p. 106), Teahen (1980), and the series of articles by Teahen in the October and November 1976 issues of *Automotive News*.)

a nearly *proportional* relation between the manufacturer's margin and the dealer's margin across the product line.[3] These facts form an interesting puzzle. Whatever one's explanation is for departures from marginal-cost pricing by automobile manufacturers, one must be able to explain why a similar pattern of product-line pricing should be adopted by dealers who often have substantially different profit incentives from those of the manufacturer.[4] In particular, why should the ratio of manufacturer to dealer margins be virtually independent of the size of the car and the relevant price elasticities and cross price elasticities of demand?

This article proposes a market power explanation of rent distribution between dealer and manufacturer. The formal model treats the relationship between manufacturer and dealer as an extension of the canonical successive monopoly problem that is discussed in the vertical integration literature.[5] Our model differs from previous models, however, because it considers the existence of product lines. Under very weak assumptions about the system of demand equations for the products in the entire line, the model provides an equilibrium explanation of the proportionality between automobile manufacturer and dealer margins. Finally, we use data on a major U.S. automobile manufacturer's product line to show that the results of the model are consistent with wholesale and retail automobile pricing. We conclude by providing updated evidence on the extent to which retail prices depart from list prices.

2. The successive monopoly model

■ This section outlines the structure of canonical successive monopoly problems and the economic assumptions underlying our successive monopoly model. The next section contains the analysis of this model.

We begin by assuming that the retail demand for the N products[6] in a manufacturer's product line is described by a vector of N demand functions that are at least twice differentiable,

$$P = D(Q) = (D_1(Q), D_2(Q), \ldots, D_N(Q)), \qquad \text{where} \qquad Q = (Q_1, Q_2, \ldots, Q_N). \quad (1)$$

For simplicity, we assume that there is only one manufacturer and that these are the demand functions of a representative dealer.[7] The manufacturer is assumed to have constant unit costs of production, m_j, for each product, j. The dealer is also assumed to have constant marginal selling costs, s_j, for each product.[8] When setting their prices, the manufacturer and the dealer act sequentially. The dealer is a follower relative to the manufacturer and takes the wholesale prices, w_j, as given. The manufacturer considers the dealer's pricing policies when setting the wholesale price because wholesale prices affect the dealer's costs. Although this leader-follower market power relationship clearly cannot be expected to apply to all exclusive dealer distribution relationships, below we shall indicate that for the most part it matches the institutional features of automobile retailing.

[3] The proportionality of margins will be demonstrated below. For an example of the stylized facts on manufacturer margins, see *The New York Times* (January 20, 1980, p. 1).

[4] Pashigian (1961) and White (1971) discuss this conflict of incentives and the means by which manufacturers have historically sought to provide dealers with the "correct" incentives.

[5] For early definitions of the problem, see Lerner (1934), McKenzie (1951), and Machlup and Taber (1960). More modern treatments appear in Kerr, McGuire, and Staelin (1980), and Greenhut and Ohta (1979). In keeping with this literature, we assume that the "downstream" firm uses the "upstream" firm's output in fixed proportion to its own. (For the importance of this technological assumption, see Waterson (1982).) This technological assumption also is convenient because it allows us to ignore the variability (but not the level) of sales effort in dealer unit costs.

[6] The scope and styling of the product line are assumed fixed.

[7] The extension of the model to multiple dealers is discussed in footnote 13 below.

[8] Fixed costs are assumed to be less than revenues minus variable costs in equilibrium. The results of the theory would be identical with constant marginal costs everywhere replaced by marginal costs evaluated at the equilibrium quantities. In this slightly more general model, however, comparative statics with respect to cost are substantially more complicated.

The independent dealer's decision problem is given by

$$\max_{Q} \Pi^d = \sum_j Q_j(D_j(Q) - w_j - s_j). \tag{2}$$

That is, the dealer chooses an optimal number of units to sell as a function of its costs, $Q = Q(w + s)$. Written in inverse form, $w = W(Q)$ is the vector of demand curves faced by the manufacturer. Note that each of the manufacturer's demand curves will involve marginal revenue terms from the dealer's decision problem. The manufacturer then solves the problem

$$\max_{Q} \Pi^m = \sum_j Q_j(W_j(Q) - m_j) \tag{3}$$

with the dealer's behavior in problem (2) taken as given. Thus, the manufacturer and dealer are in a leader-follower relationship.

This formulation of the relationship between manufacturer and dealer clearly makes some assumptions about the nature of intra- and interbrand competition. First, it presumes *exclusive dealing*. Each dealer sells the products of only one manufacturer. Second, it presumes *exclusive territories*. Because the dealer faces the same demand curve at retail as would a manufacturer who owned the dealership, the manufacturer must have granted exclusive market rights to the dealer. Note, however, that this formulation does not presume *literal monopoly*. In an oligopolistic or a monopolistically competitive market, $D(Q)$ can be interpreted as a firm-specific demand curve.[9]

Finally, this formulation also makes assumptions about the kinds of contracts that can arise between manufacturers and dealers. The retail prices that arise in equilibrium are obviously not joint profit-maximizing prices. We do not model the historical, institutional, and legal considerations that prevent manufacturers and dealers from writing contracts to circumvent coordination problems.[10] Indeed, Smith's (1982) analysis suggests that manufacturers and dealers face substantial coordination problems for a variety of historical and legal reasons. We also do not attempt to design optimal incentive contracts when the manufacturer has complete discretion in delegating pricing responsibilities (cf. Lal and Staelin (1981)). Instead, we take the institutional detail as fixed, and attempt to characterize the dealer's and the manufacturer's optimal margin policies.

3. The analysis of the successive monopoly problem

■ The solution of the model is decomposed into two problems: the dealer's selling problem and the manufacturer's pricing problem. The solution to the dealer's problem (2) is the $Q^*(w + s)$ that solves

$$D_i(Q) + \sum_j Q_j \frac{\partial D_j(Q)}{\partial Q_i} = w_i + s_i \qquad \text{for} \qquad i = 1, 2, \ldots, N. \tag{4}$$

That is, retail marginal revenue ($MR_i(Q)$) for the ith product is equal to the dealer's marginal cost, $w_i + s_i$. Note that in this multiproduct setting, MR_i is the derivative of total revenue over all products with respect to Q_i.

Using equation (4), we can now solve for the manufacturer's optimal wholesale price. The dealer's optimum implies that the wholesale demand curve is $w_i = W_i(Q) = MR_i(Q) - s_i$. Thus,

[9] Greenhut and Ohta (1979) provide a proof of this for the single-product case by using two specific oligopoly solution concepts.

[10] Some contractual features that have the appearance of nonlinear pricing, such as "forcing," have occurred in automobile manufacturer-dealer relations in the past. Currently, however, many states prevent these practices with explicit legislation to protect automobile dealers. Smith (1982) provides an excellent discussion of the institutional and agency-theoretic restrictions on manufacturer-dealer relations in the case of automobiles.

$$\Pi^m = \sum_j Q_j(w_j - m_j)$$
$$= \sum_j Q_j(MR_j(Q) - s_j - m_j). \qquad (5)$$

The solution to the manufacturer's problem is

$$MMR_i(Q) = MR_i(Q) - s_i + \sum_j Q_j \frac{\partial MR_j(Q)}{\partial Q_i} = m_i \qquad \text{for} \qquad i = 1, 2, \ldots, N. \qquad (6)$$

Again, this is a first-order condition that sets marginal revenue equal to marginal cost. For convenience, we have labeled the left-hand side the manufacturer's revenue, $MMR_i(Q)$.

Finally, we define the object of the theory, the ratio of the dealer's and the manufacturer's margins. This is

$$\frac{P_i - (w_i + s_i)}{w_i - m_i} = \frac{P_i - MR_i(Q)}{w_i - MMR_i(Q)} = \frac{\sum_j Q_j[\partial D_j(Q)/\partial Q_i]}{\sum_j Q_j[\partial MR_j(Q)/\partial Q_i]} \qquad \text{for} \qquad i = 1, 2, \ldots, N. \quad (7)$$

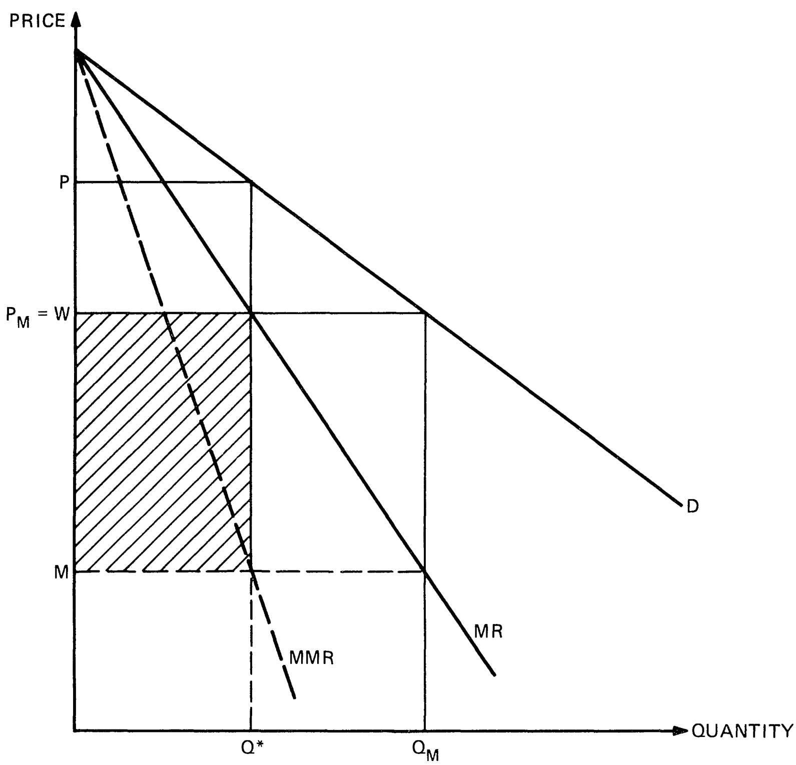
In the next two sections we characterize the properties of retail demand and the manufacturer-dealer leader-follower relationship that affect this summary measure of the distribution of rents.

4. The single-product case

■ Several important features of this successive monopoly framework and equation (7) are most easily illustrated by considering the theory of successive monopoly when there is only one product. Figure 1 shows how the dealer's price policy and manufacturer's wholesale

FIGURE 1

THE MANUFACTURER'S PRICING PROBLEM



price policy interact. (In this figure the dealer's selling cost, s, is assumed to be zero.) From equation (5) we see that the manufacturer optimally sets its wholesale price by taking the dealer's (retail) marginal revenue curve as its demand schedule. In Figure 1 this decision is represented by the manufacturer's choosing w to maximize the shaded rectangle. Figure 1 also shows that the equilibrium outcome is not joint profit maximizing for the dealer and the manufacturer. The dealer sets a retail price that is based on the costs of w. In fact, production costs are only m, so that a retail price reduction would increase joint profits. A more precise statement of this "double margin" result can be obtained by specializing equation (7) to the single-product case. Upon doing so, we obtain a simple ratio measure of relative market power,

$$\frac{P-(w+s)}{w-m} = \frac{Q[dD(Q)/dQ]}{Q(dMR/dQ)}$$

$$= \frac{\textit{slope of the demand curve}}{\textit{slope of the marginal revenue curve}}$$

$$= \frac{\textit{slope of the dealer's demand curve}}{\textit{slope of the manufacturer's demand curve}}. \tag{8}$$

In other words, in equilibrium both manufacturer and dealer have market power in proportion to the slopes of the demand curves that they face. To see that equation (8) is a ratio measure of market power, one can transform (8) into a ratio of Lerner indexes. That is, by dividing the numerator and denominator of equation (8) by the effective demands (P and MR), we obtain a ratio of the elasticities of the dealer's and manufacturer's demand curves.

By further transforming equation (8), we obtain a more simple expression for the ratio of margins

$$\frac{Q(dD/dQ)}{2Q(dD/dQ) + Q^2(d^2D/dQ^2)} = \left(2 + Q\frac{d^2D/dQ^2}{dD/dQ}\right)^{-1} = \frac{1}{2+\eta}, \tag{9}$$

where η is the quantity elasticity of the slope of the demand schedule.[11] Thus, the curvature of the retail demand function, as summarized by η, determines how far the dealer's margin is from the manufacturer's margin. From this equation we deduce a simple characterization of the distribution of rents between manufacturer and dealer.

Proposition 1. In a single-product manufacturer-dealer pricing arrangement, if the retail demand schedule is strictly convex (concave), then the dealer's margin over unit costs is greater (less) than one-half the manufacturer's margin.

Figure 2 provides a graphical interpretation of this proposition and equation (9). In this figure we have drawn for comparison a convex retail demand schedule and a linear demand schedule such that they are tangent at Q^*. At Q^* the slopes of the two different retail demand curves are the same, and the two retail (dealer's) marginal revenue schedules cross. Now consider the difference between the manufacturer's marginal revenue curve, MMR, and the dealer's marginal revenue curve, MR, for these two demand curves:

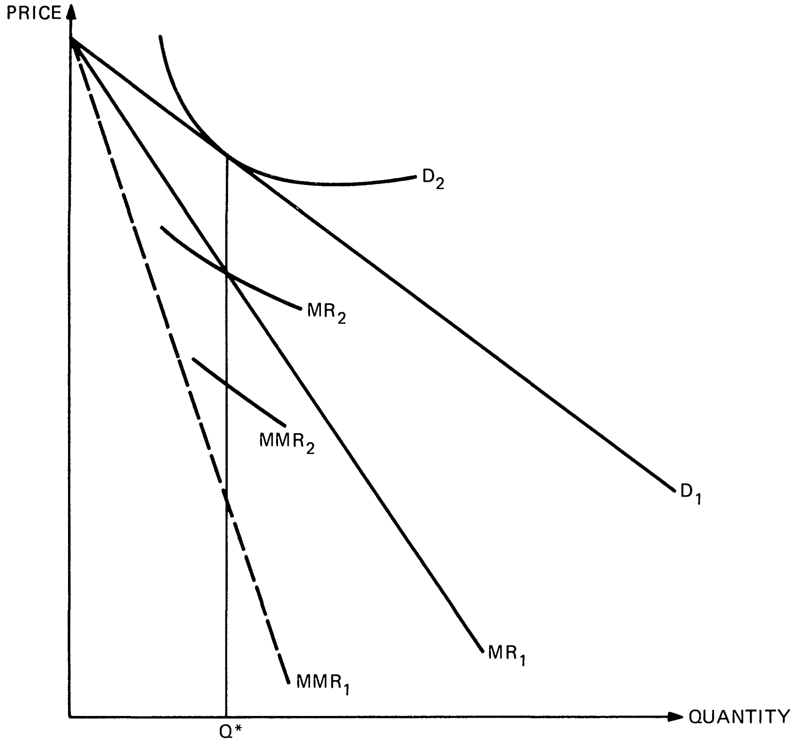
$$MMR(Q^*) - MR(Q^*) = Q^*\left(2\frac{dD(Q^*)}{dQ} + Q^*\frac{d^2D(Q^*)}{dQ^2}\right) < 0. \tag{10}$$

From (10) it is clear that the more convex the demand schedule at Q^*, the larger the last term in (10), and therefore the closer the manufacturer's marginal revenue function is to the dealer's marginal revenue function. Thus, an increase in the convexity of the demand schedule will tend to decrease the manufacturer's margin relative to the dealer's margin.

[11] Note that η is a local measure of the curvature of the retail demand curve. From expression (9) we can see that η is zero when the demand curve has no curvature (i.e., demand is linear). We also note that η will be a constant when the demand curves have the form $P = a + bQ^c$, where a, b, and c are constants.

FIGURE 2

MARGINAL REVENUE SCHEDULES FOR A LINEAR AND A CONVEX DEMAND CURVE



We can also compare our equation (8) with a result in Bulow and Pfleiderer (1982). They examined the comparative statics of a single-product monopolist who experiences a shift in his constant marginal cost function. They showed that the derivative of equilibrium price with respect to marginal cost was equal to the slope of the demand curve divided by the slope of the marginal revenue curve. Differentiating equation (4) in the single product case yields

$$\frac{\partial Q^*(w+s)}{\partial w} = \frac{\partial Q^*(w+s)}{\partial s} = \frac{1}{2(dP/dQ) + Q(d^2P/dQ^2)}. \tag{11}$$

We therefore conclude the following:

Proposition 2. In a single-product manufacturer-dealer pricing arrangement

$$\frac{P^* - (w^* + s)}{w^* - m} = \frac{\partial P^*(w)}{\partial w} = \frac{\partial P^*(s)}{\partial s}. \tag{12}$$

That is, at the optimum the ratio of the margins is equal to the change in the dealer's price when the manufacturer either changes its wholesale price (the dealer's unit cost) or the dealer's selling costs are changed.

Why should the ratio of the dealer's unit profit to the manufacturer's unit profit be equal to the sensitivity of the dealer's price to the manufacturer's wholesale price? The simplest way to understand this relation is to consider the manufacturer's choice of w. At the margin the manufacturer maximizes profits by choosing w so that

$$\Delta Q(w - m) = -Q\Delta w,$$

where Δ denotes a small change in the relevant variable. Or, in words, the change in sales volume due to a change in the wholesale price just equals the change in revenue due to inframarginal customers. The dealer confronts a similar profit maximization tradeoff. The dealer must balance volume against a retail price change

$$\Delta Q(P - w - s) = -Q\Delta P.$$

Given that the manufacturer and dealer are in a leader-follower relationship, it follows that equation (12) is simply the ratio of these two conditions. In words, if the manufacturer chooses to change its wholesale price in equilibrium, then the relative costs of such an increase to the dealer and the manufacturer must exactly balance the relative gains to each. In this sense equation (12) is a measure of the dealer's market power relative to the manufacturer's market power.

Finally, we note that these single-product results provide one possible interpretation of the proportionality of automobile manufacturer-dealer margins noted in the Introduction. If the products in the manufacturer's product line are independent in demand (that is, $P_i = D_i(Q_i)$), then

Proposition 3. If the quantity elasticity of D_i is the same for all products and the products are independent in demand, then the ratio of the dealer's margin to the manufacturer's margin is the same for all i.

5. The multiple-product case

■ When the product line consists of several products that are related in demand, both the manufacturer's and the dealer's problem grow more complex. Each must now take into account the relevant cross elasticities of demand. For example, the manufacturer must consider the dealer's price-setting behavior on all products when setting wholesale price on any particular product. Despite this added complexity, this section shows that, as in the single-product case, there is a readily interpretable curvature term that is central to the dealer-manufacturer margin ratio. Also, the precise relationship between the margin ratios and the comparative statics of the vertically integrated case still hold. The key difference in interpreting the results of the multiple-product case is that the conceptual experiments defining η now turn on making *proportional* changes in all quantities.

In the multiple-product case we assume symmetry[12] of the demand system. (That is, $[\partial D_j(Q)/\partial Q_i] = [\partial D_i(Q)/\partial Q_j)]$.) Then equation (7) expands to

$$\frac{P_i - (w_i + s_i)}{w_i - m_i} = \frac{\sum_j Q_j[\partial D_j(Q)/\partial Q_i]}{2\sum_j Q_j[\partial D_j(Q)/\partial Q_i] + \sum_j \sum_k Q_j Q_k[\partial^2 D_j(Q)/\partial Q_i \partial Q_k]}. \quad (13)$$

Instead of taking the simple ratio form of (slope of demand)/(slope of MR), this expression has a more general weighted slope interpretation. Equation (13) also has an interpretation parallel to that of equation (9). Let

[12] Not all multiproduct demand functions have this property. In our application, the feature of automobile demand that implies symmetry is the 0–1 nature of demand by any single buyer. Each buyer's demand decision can be thought of as a large discrete-choice problem (see, for example, McFadden (1976)) over all of the possible types of automobiles. The demand for each type is given by the number of buyers for whom it is the most preferred car. Indexing the features of individual buyers that vary in the population by θ, we can express the demand for car j (as compared with other cars indexed by k) as: $Q_j = \int_{U_j(P_j,\theta)\geq U_k(P_k,\theta)\ \forall k} f(\theta)d\theta$, where $U_j(P_j, \theta)$ is the (indirect) utility of a buyer of type θ choosing car j and $f(\theta)$ is the density function of θ in the population of buyers. (The function $f(\theta)$ is not a probability density.) The derivative of Q_j with respect to P_i is $\partial Q_j/\partial P_i = \int_{U_j(P_j,\theta)=U_i(P_i,\theta)}[\partial U_i/\partial P_i]f(\theta)d\theta$. This derivative is equal $\partial Q_i/\partial P_j$ if the bracketed term in the integral is the same for i and j. This bracketed term, however, is the marginal utility of money conditional on buying car i. Since the marginal utility of money is evaluated at a point of equal utility (conditional on i or on j), symmetry follows.

$$\eta_i = \frac{\sum_j \sum_k Q_j Q_k [\partial^2 D_j(Q)/\partial Q_i \partial Q_k]}{\sum_j Q_j [\partial D_j(Q)/\partial Q_i]}. \tag{14}$$

Then

$$\frac{P_i - (w_i + s_i)}{w_i - m_i} = \frac{1}{2 + \eta_i}. \tag{15}$$

In the single-product case η was the quantity elasticity of the slope of the demand curve. In this multiple-product case there is a similar interpretation. Define $\xi_j = \tau Q_j$ and $\xi = (\xi_1, \ldots, \xi_N)$. Variations in τ are equivalent to equiproportional changes in all quantities. Defining a new variable, f_i, as the quantity-weighted sum of the slopes of all the demand curves with respect to Q_i allows us to rewrite η in elasticity form using the following expressions:

$$f_i = \sum_j Q_j \frac{\partial D_j(\xi)}{\partial Q_i}$$

and

$$\frac{\partial f_i}{\partial \tau} = \sum_j \sum_k Q_j Q_k \frac{\partial^2 D_j(\xi)}{\partial Q_i \partial Q_k}.$$

Evaluating this expression at $\tau = 1$ and converting it to an elasticity give

$$\left.\frac{\partial f_i \tau}{\partial \tau f_i}\right|_{\tau=1} = \frac{\sum_j \sum_k Q_j Q_k [\partial^2 D_j(Q)/\partial Q_i \partial Q_k]}{\sum_j Q_j [\partial D_j(Q)/\partial Q_i]} = \eta_i. \tag{16}$$

That is, η_i is the elasticity of f_i with respect to a proportional change in all quantities. If an equiproportional increase in all sales increases all of the f_i by the same percent, then η_i will not depend on i.

The above results now enable us to state multiple-product generalizations of the single-product results summarized in Proposition 1.[13]

Proposition 4. In a multiproduct manufacturer-dealer pricing arrangement, the ratio of the dealer's to the manufacturer's margin on each product is determined by η_i. If the demand system is linear, the dealer's margin will be one-half the manufacturer's margin on each product. If a proportional increase in all quantities would increase (decrease) the weighted impact of Q_i on the prices of all products, then the dealer's margin on product i will be (less) greater than one-half of the manufacturer's margin.

6. An example with dealer price discrimination

■ This section discusses an application of the theory to the pricing of automobile options. This example illustrates how the theory can be applied to situations where dealers and manufacturers use product options to extend product lines.

Many multiproduct firms choose to offer different quality levels to price discriminate among customers. Quality variations and product bundling are profitable strategies if, for example, those customers who are most willing to pay for the basic product are also those

[13] It is also possible to prove an analogue of Proposition 2. The extension of the model to multiple dealers, however, is tedious and requires further assumptions about the degree of spatial competition among dealers. It is possible, however, to show that the basic form of equation (9) is readily preserved if price is reinterpreted as the price of a particular dealer. Because the manufacturer's margin in the denominator is (approximately) uniform across dealers, it is also possible to reinterpret the average dealer margin as a form of average of the η's of the individual dealer demand curves. This inverse form of averaging affects the interpretation of η in equation (9) if there is substantial heterogeneity in the curvatures of individual dealer's demand curves. We return to this issue of potential spatial variations in dealer market power below in the empirical section.

consumers most willing to pay for the added quality or optional equipment (see, for example, Adams and Yellen (1976)). In automobile retailing, it is well known that automobile dealers' pricing policies are coordinated with the bundling of optional equipment. The question we consider here is what the manufacturer's margin policies on optional equipment are, given that the manufacturer supplies the dealer not only with the basic car but also with the optional equipment.

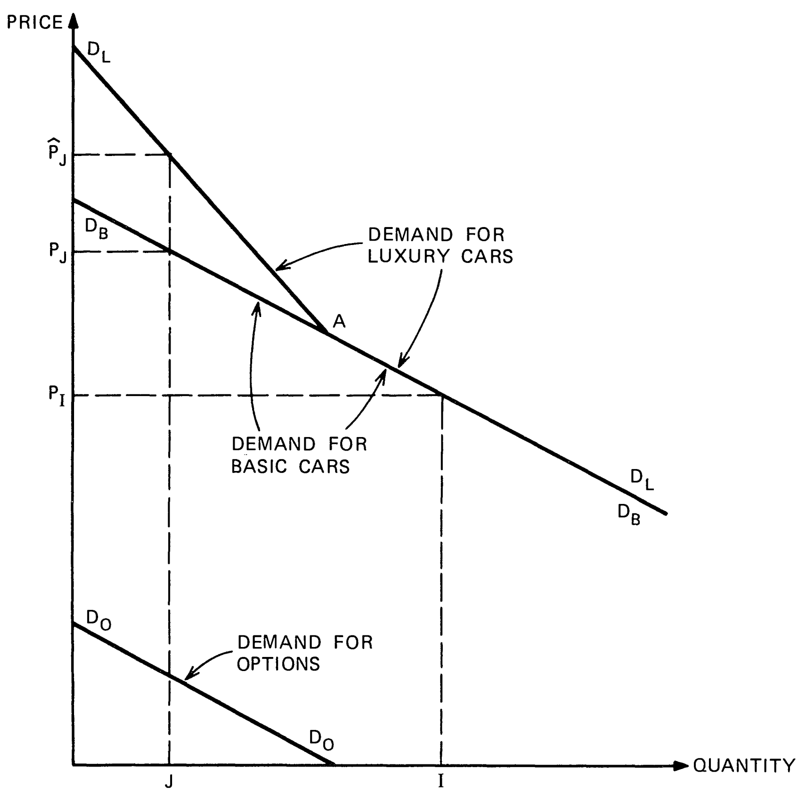
Let us assume that there are two basic products supplied by a dealer, "basic" cars and "luxury" cars. Let the demand curves for either only the basic or only the luxury car be piecewise linear as depicted in Figure 3. The demand curve $D_B - A - D_B$ represents the demand curve if only the basic car is offered. The demand curve $D_L - A - D_L$ represents the demand if only the luxury car is offered. By assuming that consumers' willingnesses-to-pay for each car are perfectly correlated, we obtain the joint demand curve pictured in Figure 3. To see the demand function for both cars (assuming they are both offered) note that the Jth-most willing-to-pay consumer values the basic car at P_J and the luxury car at $\hat{P}_J$. Similarly, the Ith most willing-to-pay customer would offer P_I for either a basic or a luxury car.

One way to analyze how the dealer and the manufacturer go about pricing the two cars (or the standard car and the optional equipment) is to apply directly the theory of the last few sections. If the manufacturing and distributing costs are such that both the basic and the luxury model are sold in equilibrium, and the demand system is (locally) linear, then we know that

$$\frac{P_B - (w_B + s_B)}{w_B - m_B} = \frac{P_L - (w_L + s_L)}{w_L - m_L} = \frac{1}{2}. \tag{17}$$

FIGURE 3

THE DEMAND FOR LUXURY OPTIONS



(Here the subscript B refers to the basic car and the subscript L refers to the luxury car.) That is, the manufacturer's and dealer's margins would be in the same proportion over the product line.

Another way to think about this problem, however, is to note that the perfect correlation of the demands for the two cars enables us to separate the standard/luxury-car pricing problem into a car-pricing problem and an option-pricing problem. That is, if $Q_L > 0$, we can write

$$P_L - P_B \equiv P_O = D_O(Q_O)$$

as the relationship between the price of the option (the device that allows the consumer to "step up" to the better product) and the quantity of options sold. Similarly, if $Q_B > 0$, we can express the relationship between the price and the quantity of cars (standard cars plus luxury cars) sold as

$$P_B = D_B(Q_L + Q_B) \equiv D_C(Q_C) \equiv P_C,$$

where the function D_C is the same as D_B, and the price and quantity of cars take on the obvious definitions.

This reformulation leads to a second interpretation of Figure 3. The demand for cars is linear and depends only on P_C. Thus, the MR and MMR curves associated with $D_B - A - D_B$ determine the dealer's margin on cars. The demand curve $D_O - D_O$, obtained as the vertical subtraction of D_L and D_B, gives the demand for options and depends only on P_O. As long as prices are such that cars are sold both with and without options, this demand curve is linear. Thus, the dealer's margin on the price-discrimination device will also be half that of the manufacturer's margin. Therefore, in this example we can think of the dealer and the manufacturer either as being in an iterated monopoly relationship over the product line or as having both an iterated monopoly and an iterated price-discrimination relationship.

Finally, it is worth noting that the special assumptions of perfect correlation in consumers' willingnesses-to-pay and the existence of two products are not crucial to this example. For example, suppose that a multiproduct iterated monopoly has two specific products, i and j, that differ because one has an extra option. Suppose also that the demand curves are such that $\eta_i = \eta_j$. Then we know from the model that in equilibrium

$$\frac{P_i - (w_i + s_i)}{w_i - m_i} = \frac{P_j - (w_j + s_j)}{w_j - m_j} = \frac{1}{2 + \eta}. \tag{18}$$

That is, the markup ratio on the two products is the same. Therefore,

$$\frac{P_i - (w_i + s_i) - P_j + (w_j + s_j)}{w_i - m_i - w_j + m_j} = \frac{P_O - (w_O + s_O)}{w_O - m_O} = \frac{1}{2 + \eta}. \tag{19}$$

That is, the markup ratio on the option or price discrimination device is the same. Thus, the dealer's access to price discrimination devices such as options does not necessarily change the analysis if the price discrimination devices are bought from the manufacturer. In automobile retailing some of the most profitable price discrimination devices—engines, trim, and air conditioning—come from the manufacturer.[14]

7. Conclusion: evidence from the automobile market

■ Our theory of iterated monopoly has a number of idiosyncratic predictions. The most striking is that the ratio of the dealer's to the manufacturer's margin depends on the quantity

[14] There are other price discrimination devices, such as weatherproofing and other dealer "packs," that do not come from the manufacturer. These options, like the dealer's assessment of the buyer's income or eagerness, only affect retail and not wholesale price discrimination.

elasticity of the slope of the demand curve (the curvature of demand) and not on the slope of the demand curve. This is striking because if the curvature of the demand curve is held constant while the demand curve becomes steeper (for example, demand is linear or constant elasticity), then the dealer and the manufacturer share proportionately in the profits of this increased market power. We also know from the theory how this factor of proportionality varies with the curvature of demand. If demand is convex (concave), then the factor of proportionality is greater (less) than or equal to one-half. In this section we examine some of these empirical implications of the theory with automobile dealer and manufacturer margin data. In particular, we are interested in analyzing manufacturer and dealer margins across new car size classifications. We also report estimates of the extent of manufacturer and dealer discounting by size of the car, as well as some evidence that relative margins do not vary by size of the car.

Before describing margin policies in detail, we need to consider whether the characteristics of domestic new car distribution relationships match the assumptions of our model. In particular, it is necessary to question why manufacturers do not simply limit dealer market power by forcing cars on the dealer, crowding geographic areas with dealers, terminating dealers, and restricting supply. (Any of these practices, if effective, would suggest interesting alternative models of automobile margin data.) In essence, the reason automobile manufacturers do not engage in these practices is that in most states these practices are prohibited by law (see, for example, the discussion by Smith (1982)). Manufacturers are not allowed to own their own dealerships. Additionally, manufacturers may not legally terminate dealers without sufficient cause and cannot arbitrarily ration supply in the absence of work stoppages or acts of God. Although manufacturers do have some discretionary means for disciplining dealers, such as advertising allowances and service requirements, typically these are small components of the dealers' overall level of operations (see, for example, Pashigian (1961) or White (1971)).[15] The potentially powerful incentive device of putting selected dealers "on allocation" is also prevented by enhanced Robinson-Patman-type acts at the state level. Manufacturers typically must also show state licensing boards economic need before a new dealership can be established.[16]

In applying our successive monopoly interpretation to automobile manufacturer and dealer margins, it is also important to consider several other assumptions of our model. First, we assume that automobile dealers are exclusive dealers. Those dealerships that carry more than one domestic product line—so-called domestic intercorporate "duals"—are mostly found in small rural markets where the fixed costs of a dealership must be spread over many automobiles.[17] Nonrural dual dealers overwhelmingly carry a domestic brand and an import brand to offer a full line of automobiles; in the 1970s a "full line" came to include fuel-efficient models, largely supplied by import manufacturers. A second potential problem in proceeding from the theory to the data is potential heterogeneity in retail demand. The constant relative margin results of the theory do not generalize to a case in which dealers face different demand curves and manufacturers charge the same wholesale price to all dealers. The demand curve for a particular domestic brand of car is likely to be quite different in urban and rural markets, since the income, demographic, and car-use patterns of these areas are quite distinct. Because major metropolitan areas account for approximately four-fifths of total domestic car sales, however, we are willing to treat nationwide averages as approximating metropolitan area market margins.

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[15] Pashigian (1961, pp. 243–244) claims that selling costs often do not influence retail decisions because manufacturers encourage dealers to engage in "service absorption." Service absorption is a practice whereby dealers' gross margins on parts and initial service are set to cover the overall joint costs of selling the product line.

[16] As a result, dealers typically have exclusive territorial rights. See Smith (1982, pp. 132–137) for a discussion of dealers' successes in lobbying state governments into preserving territorial monopolies.

[17] On a nationwide basis 5.4% of GM dealers are dualled with a competitive domestic brand. For Ford and Chrysler these figures are 2.5% and 6.9%, respectively (Polk, 1983; U.S. Department of Commerce, 1983).

Finally, although the successive monopoly model does not presume literal monopoly, it does presume that the nature of competitive interactions is the same at the retail level as at the manufacturing level. Despite state laws that prevent manufacturers from proliferating dealerships at the expense of existing dealers, individual dealers in a metropolitan area may face flatter demand curves than would a manufacturer who vertically integrated to serve the entire metropolitan market. The theory in the previous sections can easily be expanded to deal with this possibility. Such competition only implies that dealer margins may be a smaller fraction of manufacturer margins (and does not necessarily affect proportionality of margins across the product line).

We have gathered data on manufacturing costs, wholesale prices, dealer selling costs, and retail list prices for fifteen (distinct) models in a single domestic manufacturer's product. These data reflect prices in effect during February, 1977. The manufacturing cost data are (nationwide) accounting marginal cost. Wholesale prices are the contractual nationwide transfer prices. These prices have been adjusted for the 2–3% "hold back" provision.[18] These figures were also standardized to include only engines and trim options. When one of the 15 models was available with more than one type of body style, trim, or engine, we calculated quantity-weighted average prices and costs. Thus, the manufacturer margins we calculate are very close to the constructs of the theory.

Dealer costs and prices are, of course, more difficult to quantify in this industry. Inventory costs are a substantial component of dealer marginal costs. These vary substantially by the size of the car. On average, dealers' variable costs are 35% of the dealer's gross margin (Davisson and Taggart, 1974, Chap. 3). This average was adjusted by the time models in each segment spend on the lot.[19] That is, we set $s_i = \lambda DI_i(P_i - w_i)$, where DI_i represents the average day's inventory of models in product i's segment and λ is set to ensure that the average s_i is 35% of $P_i - w_i$.[20] This adjustment accounts for most of the variation in dealer marginal costs by size of the car. Finally, our measure of dealer marginal cost, s_i, does not allocate dealer fixed costs across car lines.

We measured average retail price in two different ways. The first retail price series consists of suggested list prices in late February, 1977, adjusted for manufacturer rebates. The second retail price series consists of the lowest advertised prices for new cars in the San Jose, California, metropolitan area during three Sundays in Winter, 1977.[21] Clearly, neither list prices nor advertised prices are perfect indicators of average transactions prices. Below we discuss the limitations of these different price series and present some evidence that suggests that, even though list prices and advertised prices may depart from transactions prices, they do not do so in a way that affects our conclusions.

We now turn to an examination of the two stylized facts mentioned in the Introduction: dealer discounts are larger in percentage terms on more expensive models, and manufacturer's price-cost margins are substantially higher on the more expensive models.[22] Table 1 reports

[18] The "hold back" is a percentage of the dealer's price and is often held by the manufacturer until the car is actually sold.

[19] This average was calculated for February from 1975 to 1979 from figures published in *Automotive News.*

[20] The effect of this calculation is to raise dealer marginal costs for full-size models and to lower them for small-size cars (compared with a constant 35%).

[21] San Jose is a large city in Northern California. The San Jose metropolitan area presently has a population of 1.3 million. The advertisements used in this study were placed in the area's largest paper, *The San Jose Mercury News.* These advertised prices are reasonably good estimates of retail prices because California dealers must have the advertised car on the lot and must be willing to sell the car at the advertised price. Because some cars that were advertised had noncomparable trimline and option packages, we adjusted w_i, m_i, and s_i to be the appropriate figure for that particular package. We did not attempt to value advertised interest rates or dealer contests ("Win a trip to Mazatlan" at one dealer and "Over $2500 in prizes" at another). Finally, the California prices differ from those in the first two columns by the "add-on" for California emissions equipment. (These add-ons amounted to between $60 and $80, depending on the model.) These add-ons were included in the P_i, m_i, and w_i used to construct the Table 2 regression.

TABLE 1 Descriptive Dealer and Manufacturer Margin Regressions*

Dependent Variable	log $(w - m)$	log $(P - w - s)$
Constant	−7.77	−8.94
	(.988)	(.654)
log (w)	1.73	1.84
	(.119)	(.079)
R^2	.94	.98
N	15	15

* Coefficient standard errors are in parentheses. Retail prices are Spring 1977 U.S. average list retail prices adjusted for rebates. Wholesale prices are Spring 1977 contract prices, adjusted for the "holdback" described in the text. The source for both wholesale and retail prices are 1976 and 1977 issues of *Automotive News*. The manufacturer average variable cost figures are from manufacturer accounting data. Finally, dealer selling costs are constructed according to the procedures described in the text. (In constructing these selling costs we allocated transportation charges and dealer preparation charges according to the convention that they are part of the manufacturer's marginal cost. Both manufacturer and dealer accounting conventions treat them this way, as the manufacturer essentially "pays" the dealer for the preparation charges.)

a cross section summary regression of manufacturer and dealer (list) margins on wholesale prices. Column 1 is a descriptive regression of the manufacturer's margin on log(w_i). Column 2 is the same regression for the average dealer's margin. This table documents the stylized fact noted in the Introduction: the average dealer margin increases with the size of the car. Indeed, the results indicate that the dealer margins expand much more than proportionately relative to wholesale prices (as opposed to the wholesale margin discussed in our model). Table I also shows that the manufacturer's margin increases with the size (value) of the car, again more than proportionately. The conclusion we draw from Table 1 is that for this manufacturer and its average dealer the stylized facts about the *level* of the margins are true: both the dealer's market power and the manufacturer's market power vary substantially across the product line, with both dealer and manufacturer tending to have substantially more market power in the high-value vehicles. In fact, both dealer and manufacturer (list) margins are more than ten times as large on very expensive cars as on the most cheap subcompact models.

Given that manufacturer and dealer margins expand more than proportionately with the size of the car, we can now examine the stylized fact that the ratio of the dealer's to the manufacturer's margin is a constant. Table 2 presents a regression test of the proportionality in margins. We measure departures from proportionality by estimating the following logarithmic form (see equation (15)):

$$P_i - w_i - s_i = \alpha(w_i - m_i)^\beta,$$

where departures from proportionality are measured by a β different from unity. If we initially assume that η_i is the same constant across the model line, then an estimate of η

[22] These regularities occur because the demand curves for models in the more expensive "full-sized" and "luxury" segments are steeper than those for "intermediates." The intermediates' demand curves in turn are typically steeper than those for "compact" or "subcompact" models. (See Bresnahan (1981) for an investigation of these margins.) Margins are larger for the full-size cars because they are less close substitutes for one another than compacts and subcompacts. (Presumably, the high fixed costs of design and tooling prevent the introduction of more large cars.)

TABLE 2 **Hypothesis Tests***

	Dependent Variable			
	$\log(P - w - s)$ (1)	$\log((P - w - s)/(w - m))$ (2)	$\log(P^a - w - s)$ (3)	$\log(P^a - w - s)$ (4)
Constant	−.347 (.439)	1.445 (1.361)	−.457 (.937)	−.406 (.865)
$\log(w - m)$	1.0197 (.066414)		1.042 (.152)	1.150 (.129)
Segment		.0677 (.057)		
$\log(w)$		−.104 (.184)		
R^2	.94	.15	.82	.83

* Coefficient standard errors are in parentheses. The retail price series are based upon the following sample periods and sources:

Columns (1) and (2): The sample period and variables are the same as those in Table 1.
Column (3): The sample period and the variables are the same as those in Table 1 except list prices have been replaced with a lowest advertised retail price. The lowest advertised retail price is the average of lowest advertised prices on February 20 and 27, 1977, in the San Jose, California, metropolitan area. An average was used because not all models were advertised on either of these days. (Source: *The San Jose Mercury News.*)
Column (4): The same variables as in column 3, except the average advertised price series is replaced with the lowest advertised price for January 23, 1977. (Source: *The San Jose Mercury News.*)

can also be recovered from the intercept. In the first column we report this regression. The hypothesis of proportionality in (list) margins is strongly supported. The coefficient of the manufacturer's margin is almost unity, and is very precisely estimated. The implied estimate of the ratio of the margins is .71, and we cannot reject the null hypothesis that the ratio is one-half, a situation where the implied demand curves are (locally) linear.

As a second test, we sought to detect whether any departures from proportionality were systematically related to size or segment class. The second column reports a regression that asks whether the ratio of dealer margins varies systematically with size or segment class. The dependent variable is the natural logarithm of the dealer's over the manufacturer's margin. The exogenous variables that measure size and segment class are $\log(w_i)$ and *SEG*, a variable which takes on the value 1 for subcompacts, 2 for compacts, and so on, up to 5 for luxury cars. Neither of these variables, both of which are highly correlated with the two margins, predicts the ratio of the margins. An additional regression that contained only dummy variables representing the segment classes indicated that there were no differences (at a 5% significance level) in the implicit estimates of the η's. We conclude that (at least for this manufacturer) the (list) dealer margin is proportional to the manufacturer margin across the product line.

An obvious criticism of these results is that they rely on list prices. Extensive discounting by dealers would confound our analysis if dealer discounts from list price were correlated with wholesale price margins. The third column of Table 2 shows our results when list prices, P_i, are replaced by lowest advertised prices, P_i^a, from *The San Jose Mercury News* for two Sundays in late February, 1977. We picked this time period because it immediately follows an adjustment of wholesale and retail (list) prices by manufacturers. Thus, it is likely that the normal, long-run equilibrium relationships between wholesale and retail transactions prices were in effect at this time. The lower intercept in column 3 suggests that Silicon Valley car shoppers could indeed find bargains in this period. There is, however, no important departure from proportionality: $\beta = 1.042$. Thus, margins calculated from advertised prices, as well as list prices, exhibit proportionality.[23]

A reasonable sceptic could argue at this point that neither lowest advertised prices nor list prices are transactions prices (though California law makes it a near certainty that at least one car was actually sold at the advertised price). Clearly the law of one price does not hold for retail automobile markets, and there is substantial variation across buyers in transactions prices. But the reasonable sceptic needs to believe more than this. For our results to be biased, *both* list and advertised prices need to depart systematically from transactions prices in the same direction for either large or small cars. It is quite easy to construct an argument in which list prices are farther from transactions prices (in percentage terms) on the larger car models. But it will be quite difficult to make the same argument for advertised prices. For example, the average lowest advertised price in our data is about 94% of list. For the same period the average car sold nationwide retailed at 95% of list.[24]

Finally, we have some indirect evidence on the relationship between advertised and transactions prices that suggests that they are quite similar. This evidence also helps to explain why there are so many anecdotes about differences between list and transactions prices for automobiles. We picked late February, 1977, because list prices had just been adjusted to changing demand. The demand for large, fuel inefficient cars was unexpectedly strong in late 1976 and early 1977. Automobile manufacturers became capacity constrained in their large car lines and shut down their small car lines for inventory adjustment. During February, manufacturers either offered rebates on small cars or instituted permanent price increases on large cars and permanent price reductions on small cars. (See the February 7 and 14, 1977, stories in *Automotive News.*) In column 4 of Table 2, we reestimated our advertised-price margins regression by using data from just before this price adjustment. At that time, list retail prices (and thus wholesale prices) appeared to be out of equilibrium. The regression shows that dealer margins (on advertised prices) increased much more than proportionately to manufacturer margins in late January. This result is consistent with a shift in demand to large cars that was in turn reflected in retail prices.

This temporary phenomenon is confirmed by the experience of a journalist (Anderson, 1977). In the first week of February, he (anonymously) shopped extensively for new car prices at Los Angeles automobile dealers. He found dealers much more likely to offer discounts from "sticker" price on small cars than on large ones. At that time sticker prices reflected list prices that were set in November or December, 1976, when most of these cars were made. Thus, his investigation of dealer's offer prices is consistent with what we observed in the San Jose advertised price data. In particular, the advertised prices and proffered transactions prices depart from list in very similar ways. We, therefore, tentatively conclude that the successive monopoly theory provides an adequate description of long-run pricing policy in the automobile market. There remain, however, substantial fascinating puzzles in the short-run data. Among them are why list prices are so infrequently changed and why manufacturers let dealers earn such substantial rents on shifts in demand for such a long time.

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[23] It should be noted that the lowest advertised prices are usually more variable than list prices, as can be seen by the fact that the standard error of β is considerably higher in column 3.

[24] If every new car sold in 1977 through a dealer had been sold exactly at list, dealer's gross margins would have been nearly 19%. That is, total retail revenues of the sector would have been 1.189 times as large as total wholesale revenues. In that same year the average new car dealer earned a gross margin of just under 14% according to both the Accounting Corporation of America and the National Automobile Dealers Association. (There are several steps to this calculation. First, we calculated retail and wholesale revenues as the (weighted) sum of quantities sold times their list price. This calculation valued all trimlines and option packages at list price. To make this number comparable to February, 1977, we were forced to assume that the mix of trimlines and options sold over time (within 1977) was a constant. The calculation also adjusts for changes in the mix of models over time using monthly data on sales.)

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