In this article, the author provides a simple characterization of retailer response to manufacturer trade deals in terms of the consumer demand conditions that the retailer faces. Specifically, the author shows conditions on the curvature of consumer demand functions that make it optimal for a profit-maximizing retailer to pass through greater (less) than 100% of the trade deal amount it gets from a manufacturer. Using these conditions, the author demonstrates that whereas the linear and all concave consumer demand functions lead to less than 100% optimal retail pass-through, there exists a subset of convex consumer demand functions for which a retailer rationally engages in greater than 100% pass-through. This subset contains many commonly used demand functions, such as the constant elasticity demand function, the negative exponential demand function, and many other varying elasticity demand functions.

A Characterization of Retailer Response to Manufacturer Trade Deals

One of the main purposes of manufacturer trade promotions is to induce retailers to pass some of the incentives to the consumers so as to increase retail sales. How much of the manufacturer deal is passed on by retailers to consumers ("pass-through") determines the ultimate success of a trade promotion and is an important input in manufacturers' trade promotions plans (Blattberg and Neslin 1993). Therefore, it is not surprising that prior research on trade promotions has given substantial attention to the construct of retailer pass-through (e.g., Armstrong 1991; Blattberg and Neslin 1990; Chevalier and Curhan 1976; Lal 1990; Lal and Villas-Boas 1998; Neslin, Powell, and Stone 1995; Walters 1989). The empirical findings from some of these articles suggest that retailers pass through varying percentages, ranging from 0% to more than 100%, of the trade deal amounts they receive from manufacturers. For example, Chevalier and Curhan (1976) examine 992 manufacturer trade promotions over a period of six months for a large supermarket chain and find that the retailer pass-throughs range between 0 and 211%, with a mean of 34.6% if all trade deals are included and 126% if only the trade deals with nonzero pass-through are included.2 Walters (1989) studies 202 manufacturer trade deals for a large number of product categories, such as frozen entrees, cake mix and frostings, coffee, pet food, detergent, and so forth, in two supermarket chains. He finds that, though the retailer pass-through was less than 100% for most of the trade deals, it exceeded 100% for many trade deals.3 Armstrong (1991) studies 605 manufacturer trade promotions for a period of two years for four product categories for a large supermarket chain and finds the retail pass-throughs to range between 0 and more than 200%, with means of 143% for the disposable diaper category, 170% for the ground caffeinated coffee category, 267% for the toilet tissue category, and 285% for the canned tuna category. Taken together, these empirical studies demonstrate that retailer pass-through takes not only the intuitive value of less than 100%, but also the rather surprising value of greater than 100%.

The purpose of this article is to provide a simple analytical characterization of retailer's pass-through decisions in terms of the consumer demand conditions it faces. Specifically, I show conditions on the curvature of consumer demand functions that make it optimal for a profit-maximizing retailer to pass through greater (less) than 100% of its trade deal amount. Using these conditions, I demonstrate that whereas the linear and all concave consumer demand functions lead to less than 100% optimal retail pass-through, there exists a subset of convex consumer demand functions...

1Pass-through generally is defined as the ratio of retail price reduction to the manufacturer price reduction, or the percentage of trade deal that is given to the consumers.

2Sethuraman and Tellis (1991) use the range of pass-throughs reported by Chevalier and Curhan (1976) to pick a value of 60% in a numerical example.

3The exact number of such deals is not reported in Walters's (1989) article.
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for which a retailer rationally engages in greater than 100% pass-through. This subset contains many simple, commonly used demand functions, such as the constant elasticity demand function, the negative exponential demand function, and many other varying elasticity demand functions.

That the constant elasticity demand function leads to the seemingly surprising outcome of greater than 100% pass-through has been shown for a quantity-setting firm by Ballow and Pfleiderer (1983) and also is obvious from the textbook formula for a monopolist's markup: \( p = c/(1 + (1/\varepsilon)) \), where \( p \) is the price, \( c \) the marginal cost, and \( \varepsilon \) the demand elasticity (for example, see Pindyck and Rubinfeld 1994). Because \( \varepsilon \) is a constant for the constant elasticity demand function, here, \( dp/dc = 1/(1 + 1/\varepsilon) \), which is greater than 1 as \( \varepsilon < 1 \).

Biattberg and Neslin (1990, p. 456) calculate retail elasticity (for example, see Pindyck and Rubinfeld 1994). Before moving on to the model, I should clarify that by trade deals, I mean temporary price cuts given by manufacturers to retailers with the goal of getting them to give temporary price reductions to consumers, for example, the "off-invoice" and "bill-back" types of trade deals. (For a description of various other types of trade deals, such as operative advertising, display allowances, contests, slotting allowances, and free goods, see Blattberg and Neslin 1990.)

**THE MODEL**

Consider a simple setting in which a manufacturer sells a product to a retailer, which then sells it to the consumers. Let the consumer demand function be \( q(p) \), where \( p \) is the retail price set by the retailer. The only requirements on \( q(p) \) are that it be downward sloping, that is, \( q'(p) < 0 \), and thrice continuously differentiable. In this section, I assume that the manufacturer uses a linear pricing policy and sets its price \( w \) in its role as a Stackelberg price leader. The retailer, in turn, acts as the Stackelberg price follower and sets the retail price \( p \).

The retailer's profit-maximization problem is as follows:

\[
\max_p \left\{ p - w \right\} q(p).
\]

If \( p^* \) is the optimal solution, the first- and second-order conditions are as follows:

1. \( (p^* - w)q'(p^*) + q(p^*) = 0 \),
and
2. \( (p^* - w)q''(p^*) + 2q'(p^*) \leq 0 \).

Differentiating the foc in Equation 1 w.r.t \( w \) provides the following:

\[
(p^* - w)q''(p^*) \frac{dp^*}{dw} + q'(p^*) \left[ \frac{dp^*}{dw} - 1 \right] + q(p^*) \frac{dp^*}{dw} = 0.
\]

Rearranged,

\[
\frac{dp^*}{dw} = \frac{q'(p^*)}{(p^* - w)q''(p^*) + 2q'(p^*)}.
\]

Because \( q' < 0 \) by assumption and the denominator in the preceding expression is negative from the soc in Equation 2, \( dp^*/dw > 0 \) (as expected). Using the value of \( (p^* - w) \) from the foc in Equation 1 provides the following:

\[
\frac{dp^*}{dw} = \frac{\left[ q'(p^*) \right]^2}{2q^2(p^*) - q(p^*)q''(p^*)}.
\]

Thus, whether the retailer pass-through is more than, equal to, or less than 100% depends on whether

\[
\frac{q(p^*)q''(p^*)}{[q'(p^*)]^2} < 1.
\]

However, the retailer's second-order condition also must be satisfied. Using the value of \( (p^* - w) \) from the foc in Equation 1 in the soc in Equation 2 implies the following restriction:

5 I use \( q' \) to represent \( dq/dp \), \( q'' \) to represent \( d^2q/dp^2 \), and so on.

6 The temporal sequence of the setting of manufacturer and retailer prices makes the use of a Stackelberg leader-follower pricing assumption a natural choice.

7 The corresponding expression in a quantity-setting game is \( dp^*/dw = p'(q^*)/[2p'(q^*) + q''(q^*)] \) (Bresnahan and Reiss 1985; Ballow and Pfleiderer 1983).
Next, consider the manufacturer’s problem. The manufacturer’s profit-maximization problem is as follows:

\[ \max_w w q[p^*(p*)] \]

If \( w^* \) is the optimal solution, the first- and second-order conditions are as follows:

\[ \begin{align*}
  w^* q' \frac{dp^*}{dw} + q &= 0, \\
  w^* q'' \frac{d^2 p^*}{dw^2} + q' \frac{dp^*}{dw} + 2q' \frac{dp^*}{dw} &\leq 0.
\end{align*} \]

Because \( \frac{dp^*}{dw} > 0 \), as was shown previously, and \( q' < 0 \) by assumption, \( w^* > 0 \) (an interior solution, as expected). The conditions in Equation 7 requires imposing some conditions on the third-order derivative of the demand function. Specifically, the following is needed:

\[ q''' \leq \frac{3q^2 - 4q''(q')^2 - 4q'(q')^2}{q'} \]

where \( \varphi = qq''/(q')^2 \). The construct \( \varphi \), which plays a central role in the results, measures the responsiveness of a firm’s marginal revenue to a change in its price. Specifically, the more responsive the marginal revenue to a change in price, the lower is the value of this construct.

Assuming that the condition in Equation 8 is satisfied, the conditions in Equations 4 and 5 provide the necessary conditions for retail pass-through to take different values. Specifically, these lead to the following main results:

**Theorem 1:** Define \( \varphi = qq''/(q')^2 \) for a given consumer demand function \( q(p) \). Then, the retailer pass-through is (a) less than 100% if \( \varphi < 1 \), (b) greater than 100% if \( \varphi = 1 \), and (c) greater than 100% if \( 1 < \varphi \leq 2 \).

This theorem shows the conditions on consumer demand functions facing a retailer that determine the percentage of retailer pass-through. The conditions are easy to compute, and anyone familiar with basic calculus can do a back-of-the-envelope calculation to check the extent of pass-through for any given demand function. For example, consider the commonly used linear demand function \( q = a - bp \). Here, \( q' = -b \), \( q'' = 0 \), and hence, \( \varphi = qq''/(q')^2 = 0 \). Thus, from Theorem 1, the linear demand function would lead to a less than 100% optimal retail pass-through of manufacturer trade deals.

The intuition behind the results in Theorem 1 is simple. A profit-maximizing retailer chooses its price such that its marginal revenue equals its marginal cost. A trade deal reduces the retailer’s marginal cost, and therefore, it must reduce its price to reduce its marginal revenue by the same amount. Then, if the retailer’s marginal revenue (mr) is (1) not much responsive to a change in price (i.e., \( d(mr)/dp < 1 \)), it must reduce its price by more than the amount of its reduction in its marginal cost (leading to greater than 100% pass-through); (2) very responsive to a change in price (i.e., \( d(mr)/dp > 1 \)), it must reduce its price by less than the amount of its reduction in its marginal cost (leading to less than 100% pass-through); or (3) responsive to a change in price such that \( d(mr)/dp = 1 \), it must reduce its price by exactly the amount of its reduction in its marginal cost (leading to 100% pass-through).

To relate this intuition to the conditions in Theorem 1, note that the retailer’s revenue is \( pq(p) \), and its marginal revenue is as follows:

\[ mr = \frac{dq(p)}{dp} = p + \frac{q}{q'}. \]

Thus, the retailer’s marginal revenue changes with its price in the following way:

\[ \frac{d(mr)}{dp} = 1 + \frac{(q')^2 - q''^2}{(q')^2} = 1 + (1 - \varphi) = 2 - \varphi. \]

Then, reducing its marginal revenue by one unit requires the retailer to reduce its price by less than one unit (i.e., have less than 100% pass-through) if \( \frac{d(mr)}{dp} > 1 \), or from Equation 9, if \( \varphi < 1 \). But this is exactly the condition in Theorem 1 for less than 100% retail pass-through. Similarly, reducing its marginal revenue by one unit requires the retailer to reduce its price by more than one unit (i.e., have greater than 100% pass-through) if \( \frac{d(mr)}{dp} < 1 \), or from Equation 9, if \( \varphi > 1 \). And this is exactly the condition in Theorem 1 for greater than 100% retail pass-through.

I next use Theorem 1 to determine the class of demand functions that leads to greater (less) than 100% retail pass-through. Because \( q'' < 0 \) for concave demand functions and \( q'' = 0 \) for the linear demand function, from Theorem 1, the retail pass-through always will be less than 100% for these demand functions. The only case in which the condition in part (c) of Theorem 1 may be satisfied is when the demand function is convex, namely, when \( q'' > 0 \). Thus,

**Corollary 1:** The retail pass-through is always less than 100% for the linear demand function and for all concave demand functions.

**Corollary 2:** The retail pass-through can be greater than 100% for convex demand functions.

Corollaries 1 and 2 predict that less than 100% retail pass-through should occur in many more settings than greater than 100% pass-through, which seems consistent with the empirical findings in marketing literature. Corollary 2 also implies that not all convex demand functions cause greater than 100% retail pass-through. Therefore, next use the con-
A class of convex demand functions that lead to greater than 100% optimal retail pass-through. Solving the differential equation arising from this condition,

\[ q'' - kq^2 = 0, \ 1 < k \leq 2, \]

provides the following result (assuming the manufacturer's price function is of the form that satisfies Theorem 8):

**Corollary 3:** All consumer demand functions of the following form lead to a retailer pass-through of greater than 100%:

\[ q(p) = \left[ c_1(1 - k)(p - c_2) \right]^{1/(1 - k)}, \]

where \( c_1 \) and \( c_2 \) are constants to be eliminated using any initial conditions that the situation warrants on the consumer demand function \( q(p) \), and \( 1 < k \leq 2 \) is the constant from Equation 10.

This corollary can be used to get some specific demand functions that satisfy Equation 11 and therefore lead to greater than 100% retail pass-through. For example, consider the class of demand functions \( q(p) \) that cut the p-axis at some point \( \bar{p} \) and the q-axis at some point \( \bar{q} \). In other words, \( q(p = 0) = \bar{q}, \) and \( \exists \bar{p} < \infty \) s.t. \( q(p \geq \bar{p}) = 0. \) Using these conditions to eliminate constants \( c_1 \) and \( c_2 \) from Equation 11 leads to the following:

\[ q(p) = \bar{q} \left[ \frac{1}{\bar{p}} (\bar{p} - p) \right]^{1/(1 - k)}, \ 1 < k \leq 2, \]

which in turn implies that the following class of demand functions satisfies the greater than 100% retail pass-through criterion:

\[ q = [a + bp]^{\beta}, \ \beta < -1. \]

Note that a different set of conditions can be imposed on Equation 11 to eliminate constants \( c_1 \) and \( c_2 \) and obtain different demand functions that lead to greater than 100% pass-through.

**Two-Part Manufacturer Pricing**

In the previous section, I assumed that the manufacturer uses a linear pricing policy and showed demand conditions that lead to greater (less) than 100% retail pass-through. The results were in terms of necessary conditions because it had to be assumed that the manufacturer's second-order condition in Equation 8 (in terms of the third-order derivative of the demand function) was satisfied. In this section, I show that if the manufacturer uses a two-part pricing policy and charges the retailer a per unit price \( w \) and a fixed fee \( F \), all the necessary conditions in the results in the previous section also become sufficient conditions.

Let the manufacturer's marginal cost be \( c \), its per unit price \( w \), and the fixed fee \( F \). The manufacturer's optimal policy then is to set its price \( w \) equal to its marginal cost \( c \) to eliminate the problem of double-marginalization and to set its fixed fee \( F = (p - c)q \) to extract the whole of the retailer's profit. This optimal pricing rule is fixed, and there is no separate first- or second-order profit-maximization condition for the manufacturer (apart from the retailer's conditions, as shown subsequently).

The retailer's problem is as follows:

\[ \max_{p} [p - w]q - F. \]

Because the manufacturer sets \( w = c \), the retailer's problem becomes

\[ \max_{p} [p - c]q - F. \]

The term for the fixed fee \( F \) drops out of the following first-and second-order conditions for the retailer:

\[ (p^* - c)q'(p^*) + q(p^*) = 0, \]

and

\[ (p^* - c)q''(p^*) + 2q'(p^*) \leq 0. \]

But these are exactly the same conditions as in Equations 1 and 2 in the previous section, which were used to derive all the results. The only difference now is that there is no need for any separate second-order condition for the manufacturer. Thus,

**Theorem 2:** If the manufacturer uses a two-part pricing policy, the conditions necessary for the results in Theorem 1 and Corollaries 1 and 2 become both necessary and sufficient.

For example, \( 1 < \varphi \leq 2 \) now becomes both a necessary and sufficient condition for a greater than 100% retail pass-through.

**Examples**

I next provide a few specific demand functions that lead to greater than 100% retail pass-through, assuming a linear pricing policy for the manufacturer. It is clear from the results in the previous section that the illustrations also would hold for a two-part manufacturer pricing policy.

**Example 1:** The negative exponential demand function:

\[ q = \exp(-p\beta). \]

The equilibrium value of \( \varphi \) in the Stackelberg leader–follower pricing game discussed in the model setup can be checked as \( = [1 - \beta + \beta \Omega^{1/3}]^{1/2} \), where \( \Omega = (1/\beta + 1/V^3) \). Thus, the greater than 100% retail pass-through criterion in Theorem 1 \( (1 < \varphi \leq 2) \) is satisfied for \( 0 < \beta < 1 \), along with the manufacturer's second-order condition. Therefore, negative exponential demand functions with parameter \( 0 < \beta < 1 \) yield a retail pass-through of more than 100%.

**Example 2:** The varying elasticity demand function:

\[ q = (1 + p)^{\beta}. \]

The equilibrium value of \( \varphi \) can be checked as \( = (\beta - 1)/\beta \), and thus, the greater than 100% retail pass-through condition on \( \varphi(p) \) at the equilibrium price.

10Whereas the condition on \( \varphi(p) \) in Equation 10 is required to be satisfied only at the equilibrium price, Equation 11 characterizes the demand functions that satisfy this condition everywhere on the demand function. Thus, there can exist demand functions other than those characterized by Equation 11 that also lead to greater than 100% pass-through. One such illustration is provided subsequently.

11As mentioned in footnote 10, this demand function is not of the form given in Equation 11, but it meets the greater than 100% pass-through condition on \( \varphi(p) \) at the equilibrium price.
through criterion in Theorem 1 \((1 < \phi \leq 2)\) is satisfied for \(\beta < -1\). A graphical depiction of the pass-through as a function of parameter \(\beta\) appears in Figure 2.

**Example 3:** The constant elasticity demand function: \(q = p^\beta\). The equilibrium value of \(\phi\) can be checked as \(= (\beta - 1)/\beta\), and thus, the greater than 100% retail pass-through criterion in Theorem 1 is satisfied for \(\beta < -1\).

**EXTENSIONS AND OTHER ISSUES**

**Modeling Manufacturer Price Promotion**

In the model, I did not provide any reason for the change in the price \(w\) that the manufacturer charges the retailer. There are several reasons a manufacturer might indulge in price promotion. An increase in competitive intensity at the manufacturer level may lead to a reduction in the price a manufacturer charges the retailer, or a change in a manufacturer’s own input costs may lead it to reduce its price to the retailer.\(^\text{12}\)

I first model the manufacturer’s pricing decision in a monopoly setting. If a monopolist manufacturer’s input cost is \(c\), its price \(w\), and its demand function \(g(w)\), its profit-maximization problem leads to the following relationship: \(w^* = c - g(w)/g'(w)\). Thus, any change in manufacturer’s input cost \(c\) (due to some exogenous reasons; see footnote 12) leads the manufacturer to change its price \(w\) to the retailer.

To model the manufacturer’s price change due to competitive reasons, assume that there are \(n\) manufacturers selling to the retailer. The simplest model in which competition among these \(n\) manufacturers determines the retail price is the Cournot model.\(^\text{13}\) Let the inverse demand function for the manufacturers be \(w = g(Q)\), where \(Q = \sum_{i=1}^{n} q_i\), and \(q_i\) is the output of the \(i\)th manufacturer. The profit-maximization problem for these manufacturers leads to the following relationship: \(w^* = c - q^* g''(Q)\), where \(q^*\) is the equilibrium output of each manufacturer and \(c\) their common marginal cost. Any temporary drop in \(c\) leads the manufacturer price to drop temporarily. Also, because \(dq^*/dn < 0\) and \(g'' < 0\) (downward sloping demand function), entry of a new manufacturer, that is, an increase in \(n\), also leads to a reduction in the price \(w\) that the retailer pays.\(^\text{14}\)

Even if this explicit modeling of the manufacturer price decrease decision is included in the main model, the necessary conditions for the results in Theorem 1 still remain valid. For example, the pass-through still will be less than 100% for all concave demand functions and the linear demand function and greater than 100% for only a subset of convex demand functions (those satisfying the \(1 < \phi(p) \leq 2\) condition).

**Difference Between Price Elasticity and Promotion Elasticity**

Some empirical research in marketing (for a review and references, see Blattberg and Neslin 1990) has found that the magnitude of promotion elasticity (deal discount elasticity) is higher than the magnitude of price elasticity (cf. Guadagni and Little 1983). For example, Blattberg and Neslin (1990) report that the deal elasticities on average are more than double the price elasticities in four product categories—flour, tuna fish, bathroom tissue, and margarine. If these findings are interpreted to mean that the demand curve

\(^\text{12}\)For example, temporary changes in the financial health of part suppliers in Malaysia (say, due to current currency crises in parts of Asia) lead to temporary changes in the input costs of U.S. furniture manufacturers, which in turn temporarily drop their prices to U.S. furniture retail outlets, which leads to large number of price promotions by retail furniture outlets. In coffee markets, temporary changes in weather conditions in Brazil affect the input prices of U.S. coffee manufacturers, which in turn leads to temporary changes in coffee manufacturers’ prices to retail outlets.

\(^\text{13}\)The same results can be shown in a Bertrand setting.

\(^\text{14}\)To obtain comparative statics results in any partial equilibrium model, there must be an exogenous change in some element of the system. In this case, I have modeled the manufacturer’s price change by considering exogenous change in (1) input cost of manufacturer(s) and (2) degree of competition among the manufacturers. The articles cited previously as providing empirical evidence of greater than 100% retail pass-through do not report the reasons the manufacturers gave trade deals to retailers. Thus, it is unclear whether the potential reasons modeled here for manufacturer trade promotions apply to the empirical examples previously discussed.
is actually \( q(p, d) \), instead of \( q(p - d) \) as is used here, then how do the results change? The condition for greater (less) than 100% pass-through explained in the previous section will remain the same: The retailer's marginal revenue should decrease by less (more) than one unit for each unit increase in the deal amount \( d \). The only difference is in the decision variable through which the retailer changes its marginal revenue. Whereas it changed \( p \) in the setup in the main model, it would change \( d \) in this modified setup. Specifically, consider the case in which the retailer receives a trade deal when the system is in equilibrium (i.e., the equilibrium retail price \( p^* \) is as defined by Equations 1 and 2) and must decide the amount of consumer deal \( d \). The retailer determines the optimal size of consumer deal \( d \) by equating its marginal revenue to its changed marginal cost. Here, the retailer's revenue is \( (p - d)q(p, d) \), the marginal revenue is \( p - d + q(p, d)[[[1/qp(p, d)] - [1/qq(p, d)]] \), and the change in marginal revenue w.r.t. deal amount \( d \) is \[ -2 + \frac{q^2_qq_{dd} - q^2_p}{q^2_pq^2_d} \], where all the expressions are evaluated at \( p = p^* \), as defined by Equations 1 and 2. Then, whenever this expression is less (more) than unity, the optimal consumer deal amount is greater (smaller) than the trade deal amount and there is greater (less) than 100% retailer pass-through.

Is the Construct of Price Elasticity Sufficient to Determine Degree of Pass-Through?

Price elasticity is undoubtedly the most commonly used and reported demand-related construct in empirical work. It is therefore useful to know if the results can be given in terms of price elasticity of demand functions alone. For example, is it possible to determine whether high/low price elasticities are related to more than equal to less than 100% retail pass-through? Because price elasticity \( (q'q/pq/pq/p) \) puts no restriction on the second-order derivative \( q''(p) \), which, from Theorems 1 and 2, is involved in determining the degree of pass-through, price elasticity alone cannot be used to classify the degree of retail pass-through. For example, from Corollary 1, the pass-through never can be greater than 100% for a linear or a concave demand function, irrespective of the magnitude of its price elasticity.

Thus, the absence of the second-order derivative \( q''(p) \) in the construct of price elasticity means it has less "information" than the construct \( \varphi = q(p)q'(p)/q'(p) \), shown here to determine whether a product will have an optimal greater (less) than 100% pass-through. To understand the difference between the two constructs, notice that, whereas the construct of price elasticity relates change in price to change in demand, the construct \( \varphi \) relates change in price to change in marginal revenue.

Does a Product with Optimal Greater than 100% Pass-Through Also Make a Good Loss Leader?

Prior literature has shown several determinants of the choice of a product as a loss leader. For example, Lal and Matutes (1994) show in a two-product model that the product with the lower reservation price is a better choice for a loss leader. Products that are frequently purchased and that cannot be stockpiled by consumers also are desirable loss leaders (Lal and Matutes 1994; Nagle 1987; Walters and Rinne 1986). Therefore, it is useful to know if a product meeting the greater than 100% pass-through criterion shown here also makes a more appropriate loss leader.  

Because the main purpose of a loss leader is to generate store traffic, the desirability of a product as a loss leader depends on how many people it can bring to the store. This in turn is a function of how responsive the product demand is to a decrease in product price, not how responsive the product marginal revenue is to a decrease in product price (the construct that determines the degree of pass-through). Thus, knowing that a product is suitable to receive greater than 100% pass-through indicates nothing about its suitability as a good loss leader. It is possible that a product that does not meet the greater than 100% pass-through criterion (e.g., a product with concave demand function) is a good candidate for a loss leader to generate store traffic.

Empirical Plausibility of the Conditions for Greater than 100% Pass-Through (1 < \( \varphi \) ≤ 2)

The results show that, absent other incentives such as traffic building, greater than 100% pass-through can arise only for a subset of convex demand functions, specifically, when \( 1 < \varphi \leq 2 \). I present some evidence to show the empirical plausibility of this condition. Bolton (1989) compares the fit of linear, log-log, and semi-log demand functions on data from many stores for the frozen waffle, liquid bleach, toothpaste, and ketchup categories and finds the log-log demand function to be the best in approximately one-third of all cases. Because the log-log demand function satisfies the \( 1 < \varphi \leq 2 \) condition, the condition for greater than 100% pass-through probably is met in at least some cases. In addition, the following empirical studies also employ the log-log demand function: Stout (1969) for several food categories; Urban (1969) for four undisclosed consumer nondurable products; Montgomery and Rossi (1998) for the orange juice category; and Hoch and colleagues (1995) for a large number of categories such as soft drinks, canned soup, frozen entrees, dairy cheese, cereal, laundry detergent, toothpaste, fabric softener, and paper towels. Similarly, Armstrong (1991), who reports greater than 100% retail pass-through for the disposable diaper, ground caffeinated coffee, toilet tissue, and canned tuna categories, also uses the log-log demand function. Although these studies (except for Bolton 1989) do not test whether the log-log demand function is the best fitting demand function for their data, the extensive empirical use of this demand function by so many researchers

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16 In a strict sense, loss leadership means selling a brand at less than its marginal cost. However, similar to Nesiin, Powell, and Stone (1995), I use the term to denote a temporary price decrease (not necessarily less than marginal cost) to bring in store traffic.

17 Log-log demand function is \( q = \alpha p^\beta, \beta < 0 \). Here, \( q'(p) = \alpha \beta p^{\beta - 1} \), \( q''(p) = \alpha \beta(\beta - 1)p^{\beta - 2} \), and \( \varphi = (1 + \beta)/\beta \). Because own price elasticity \( \beta < -1 \), the \( 1 < \varphi \leq 2 \) condition is satisfied.
suggests that the $1 < \phi \leq 2$ condition might not be implausible for at least some common product categories.\(^{18}\)

**CONCLUDING REMARKS**

This article shows classes of consumer demand functions for which the optimal retailer pass-through is greater (less) than 100%. The intuition behind the results—that (1) a firm responds to a change in its marginal cost by using its decision variable, such as price, to change its marginal revenue so that it equals the changed value of its marginal cost and (2) how marginal revenue responds to a change in a decision variable such as price affects how much the decision variable must be changed—follows from the textbook definition of profit maximization but seems not to have been noticed in the marketing literature on retailer response to manufacturer trade deals. Thus, this article contributes to the existing marketing literature on retailer promotion decision.

There are several limitations in the model used here. For example, it has only one retailer and one product. Further research could examine multiproduct settings. A multiproduct model would enable researchers to model other issues, such as category management, traffic building, and so forth, and examine the effect of relationships between different products on the retailer response to manufacturer trade deals. In a multiproduct setting, the retailer aims to maximize profits from all the products it sells and therefore must consider the relative margins and cross-price elasticities among all products in its pricing decisions. Thus, the retailer response to a trade deal on a particular product depends not only on how its marginal revenue from this product responds to a change in price for this product, but also on how the sales of complementary or substitutable products respond to a price change for this product. Further research also could model the forward buy/inventory behavior of retailers, which would enable researchers to discriminate better between off-invoice types of trade deals and the relatively more modern bill-backs, scan-backs, and other pay-for-performance types of trade deals.\(^{19}\)

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