Non-Credible Information Flows Between Food Manufacturers and Retailers

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Asymmetric information between food manufacturers and retailers constrains the efforts of analysts studying the retail food chain. The problem may be especially pronounced during new product introductions. Manufacturers may have demand information about new products but have incentives to not credibly relay that information. Retailers often lack reliable demand information about new products. Understanding the roots of non-credible information flows within the manufacturer/retailer relationship is important to behavioral modeling in the food chain. This paper provides an analytic derivation to explain sufficient conditions for non-credible information flows leading to asymmetric information and adverse selection problems. Results provide insight about formation of information sharing mechanisms in the retail grocery channel.

Accuracy of retailers' subjective beliefs about new product demand are critical for optimal decision-making in the retail food chain. A retailer's stocking decision is based largely upon demand expectations. When economists or marketing analysts study relationships in the retail food chain, modeling the existence of asymmetric information is important because, as Connor and Ward (1980) argue, complete information is a key input for efficiently functioning markets. Food-marketing literature generally assumes that the retailer/manufacturer relationship does not satisfy the complete information assumption (Chu 1992; Lariviere and Padmanabhan 1997; Kelly 1991; Patterson and Richards 2000). As stated by Chu (1992), "In this uncertain marketplace, how do desperate manufacturers 'credibly' inform harried retailers about anticipated demand for new products? Talk is cheap." Manufacturers often have information about a new product and its expected demand, but they may not be willing to credibly relay that information to retailers. Retailers may therefore lack reliable demand estimates when determining which new products to shelve and the retail prices of those products. Optimal discrimination among goods by retailers is not possible without sufficient, credible information.

Retailers make buying/stocking decisions under asymmetric information about consumer demand for new products. Information from test marketing, market analysis and research, and development of new products is controlled by the manufacturer. Retailers generally have a much-diminished incentive to undergo rigorous test marketing, market analysis and research, and development on every new product brought to them by manufacturers. Conducting market analysis and research for each new product presented to them would be cost- and time-prohibitive, especially if thousands of new products are presented to retailers annually. Alternatively, manufacturers conduct market research only on their own new product or product line. As a result, retailers and manufacturers do not have the same information about the potential profitability of new products. Retailers must find more efficient ways to extract credible information from manufacturers before making buying/stocking decisions.

One result of this asymmetry of information may be adverse selection. Salanié (1997) explains that adverse selection occurs where the uninformed party, called the *principal* (the retailer, in this case), is imperfectly informed or does not know certain characteristics of the informed party, called the *agent* (the manufacturer, in this case). Kreps (1990) argues that adverse selection occurs when one party to a transaction has information pertaining to the transaction that is relevant to but unknown by the second party. Hence the manufacturer having more information about the probability distribution of a new product's demand confronts the retailer with adverse selection problems when stocking decisions are made. Although final consumer demand is not known with certainty by either party, test marketing, market analysis and research, and development

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information controlled by the manufacturer will likely increase the reliability of the subjective probability distribution estimated by the manufacturer.

Obtaining credible information about new products is difficult for retailers. Food manufacturers and retailers may have misaligned or competing incentives surrounding new products. Food manufacturers strive to sell their new products to retailers, thereby gaining shelf access to consumers and transferring risk of possible low consumer demand (low sales) to retailers. Information used by manufacturers in sales presentations works to get products on retail shelves and into the consumer's basket of goods. This information may be persuasively presented by manufacturers to get products on shelves, which may not align with the retailer's profit objective. Retailers want credible demand information on which to base sales estimates and pricing. Realizing that they are assuming the risk of possible low consumer demand from the manufacturers, retailers may use mechanisms such as trade allowances (i.e., slotting allowances and failure fees) to extract credible information for stocking and pricing decisions. Chu (1992) questions the credibility of information given to retailers by saying:

> "*. . . it is possible for manufacturers to report only positive test-market studies (i.e., withhold damaging information and present only favorable information); . . . product pitches are always favorable, yet retailers report high failure rates for new products . . .*" (Chu 1992, 329).

When manufacturers (agents) are trying to sell their products, retailers (principals) should expect some misinformation or relay of non-credible information. Manufacturers are competing for shelf space or an entry into the consumer's purchase-decision set. By convincing a retailer to shelve its new product the manufacturer has entered the consumer's decision set and possibly removed a competitor's product from that same purchase-decision set or basket of goods. The manufacturer thereby has an incentive to relay persuasive and possibly non-credible information to the retailer. Hence, retailers are faced with adverse selection problems when choosing new products to stock shelves. Properly constructed incentives to pass credible information could ameliorate adverse selection problems. The food-retailer problem is analogous to the used-car market as explained by Akerlof (1970). When used-car buyers receive credible information they are able to screen lemons (low-quality cars) from peaches (high-quality cars). Likewise, an incentive structure (possibly including a menu of trade allowances or other contract-based incentives) may reduce adverse selection problems surrounding new-product selection for food retailers. Retailers may be able to screen high-expected-demand products from low-expected-demand products when credible information is passed from manufacturers to retailers.

Past studies (e.g., Chu 1992; Lariviere and Padmanabhan 1997) assume that information flows from manufacturer to retailer may be non-credible. As explained above, manufacturers may have competing incentives to misrepresent the demand of new products and transfer demand risk to retailers. However, behavioral models of manufacturer/retailer interactions have not yet been developed to analytically derive sufficient conditions under which information flows can be viewed as non-credible. In this paper, sufficient conditions are derived to support the assumption of non-credible information flows between a single manufacturer and a single retailer. These conditions show how non-credible information may be used to influence retail-pricing decisions and therefore impact demand for a new product. Implications of non-credible information flows lead to application of mechanism- (or contract-) design models for alleviating asymmetric information problems.

Analytic Model and Results

Why would a food product manufacturer not share private information? Anecdotal reasons (with the objective of gaining retail-shelf access while transferring demand risk) have been given why information presented by manufacturers in sales pitches may not be credible (Chu 1992; Lariviere and Padmanathan 1997). Misaligned incentives between principals and agents may be influencing a manufacturer's actions. The model below is a simplified behavioral representation of the principal-agent relationship between a single manufacturer and a single retailer in the food sector. The following notation is used throughout the model:

Q_i = uncertain quantity of product i demanded
P_i = retail price of product i
θ_i = uncertain intercept of the demand curve for i
η_i = uncertain slope of the demand curve for i
R = information set available to the retailer
M = information set available to the manufacturer
π_i = retailer profit from product i
W_i = wholesale price of product i
E = expectations operator
C_i = manufacturer's per-unit marginal cost of product i
ψ_i = manufacturer profit from product i.

I assume a linear product demand curve

$$(1) \qquad Q_i = \theta_i - \eta_i P_i$$

and no cross-product effects. This assumption, which assumes no substitutes or complements for the new product, eases notation and analytical burden but does not affect the qualitative conclusions drawn. As the demand parameters θ_i and η_i are not observed prior to product introduction, they are treated as random variables and are assumed to be independently distributed. Admittedly, brand loyalty, advertising, and other marketing concepts may affect the slope and intercept of the demand curve, but the values of those parameters are not known with certainty prior to product introduction. (In fact, after product introduction only observations from the demand distribution are realized.) The equation

$$(2) \qquad \pi_i = (P_i - W_i)Q_i = (P_i - W_i)(\theta_i - \eta_i P_i)$$

defines uncertain retailer profit from product i. Let R be the information set available to the retailer. Expected retailer profit is conditioned on R:

$$(3) \qquad E[\pi_i] = (P_i - W_i)(E[\theta_i|R] - E[\eta_i|R]P_i).$$

The retailer chooses retail price P_i to maximize expected profit as

$$(4) \qquad \underset{P_i}{\text{Max}}\; E[\pi_i] = (P_i - W_i)(E[\theta_i|R] - E[\eta_i|R]P_i).$$

The first-order condition for this maximization problem is

$$(5) \quad \frac{\partial E[\pi_i|R]}{\partial P_i} = E[\theta_i|R] - E[\eta_i|R]P_i) - (P_i - W_i)E[\eta_i|R] = 0.$$

Solving for the optimal retail price P_i^* yields

$$(6) \quad P_i^* = \frac{E[\theta_i|R] + E[\eta_i|R](W_i)}{2E[\eta_i|R]}.$$

The second-order condition requires concavity of the direct-profit function in the neighborhood of P_i^*. This condition is necessary to assure expected profit is at a maximum. The third condition, namely the total condition, requires profits be positive at P_i^* (Beattie and Taylor 1985; Silberberg 1990). If returns at P_i^* do not exceed variable cost, profits are not possible in the short run. Assuming that these two conditions hold, equation (6) defines "optimal" retail price given retailer's imperfect information.

In a simplified model representing a one manufacturer-one retailer relationship, retail sales (i.e., quantity demanded) of the product are determined by the price chosen by the retailer. Furthermore, manufacturer profit—which is also uncertain—is a function of retail price:

$$(7) \qquad \psi_i|P_i^* = (W_i - C_i)(\theta_i - \eta_i P_i^*)$$

and expected manufacturer profit is given as

$$(8) \qquad E[\psi_i|P_i^*] = (W_i - C_i)(E[\theta_i|M] - E[\eta_i|M](P_i^*)$$

where M is the information set available to the manufacturer. Substituting the "optimal" retail price found in equation (6) gives

$$(9) \quad E[\psi_i|P_i^*] = (W_i - C_i)\left(E[\theta_i|M] - E[\eta_i|M]\left(\frac{E[\theta_i|R] + E[\eta_i|R](W_i)}{2E[\eta_i|R]}\right)\right).$$

Taking the partial derivatives with respect to the intercept and slope of the demand curve of product i conditioned on retailer expectations gives us

$$(10) \quad \frac{\partial(\cdot)}{\partial E[\theta_i|R]} = (W_i - C_i)\left(-\frac{E[\eta_i|M]}{2E[\eta_i|R]}\right) < 0.$$

and

$$(11) \quad \frac{\partial(\cdot)}{\partial E[\eta_i|R]} = -(W_i - C_i)E[\eta_i|M]\left(-\frac{E[\theta_i|R]}{2(E[\eta_i|R]^2)}\right) > 0.$$

Discussion

Understanding the economic implications of equations (10) and (11) requires an analysis from both retailer and manufacturer perspectives. The partial derivative of manufacturer profit from product *i* with respect to the intercept parameter is less than zero, shown by equation (10). The equation is less than zero because the first term (W_i-C_i) is assumed to be positive (because manufacturers typically do not sell products for less than the marginal cost of producing the products) and the expectation terms will be negative because the demand curve for normal goods is downward sloping. Consequently, retailer expectations of higher intercepts lead to higher estimated "optimal" retail prices. Higher retail prices induce less quantity demanded for normal goods. For the manufacturer, less quantity demanded decreases quantity demanded of his product and profit from product sales. Expected manufacturer profit therefore decreases as retailer expectations about the demand-intercept parameter increase. This assumes constant wholesale price (i.e., no portion of increased retail price will be passed on to the manufacturer or, alternatively, no "volume discount" on wholesale price will be given to retailer for increased volume of product sales).

The partial derivative of manufacturer profit from product *i* with respect to the slope parameter is greater than zero, shown by equation (11). This equation is greater than zero based on assumptions (as discussed for equation (10)) that manufacturers receive returns above marginal production costs and that the expectation terms are negative for normal goods. When a retailer believes price sensitivity is higher for a product, a lower "optimal" retail price is chosen by the retailer to achieve greater quantity demanded. The manufacturer's expected profit is determined in part by the quantity of sales or quantity of units demanded multiplied by manufacturer margin per unit. If a lower retail price per unit is chosen by the retailer, higher quantity demanded occurs and manufacturer expected profit benefits from larger quantity of sales. Therefore, manufacturer expected profit increases as retailer expectations about price sensitivity of demand increase. Once again, this result assumes constant wholesale price.

As explained, equations (10) and (11) show that the manufacturer has incentives to misinform the retailer about demand parameters. Retailer subjective expectations about new-product demand (or information available to the retailer about product demand) are used when the retailer maximizes expected profit and determines "optimal" retail price. "Optimal" retail price (which is a function of retailer beliefs) is used to calculate expected profit of the manufacturer. Hence, manufacturer expected profit is directly affected by retailer choices and provides incentive for manufacturers to influence retailer decisions.

Implications and Applications

As the economic discussion implies, because equations (10) and (11) are not equal to zero, expected manufacturer profit depends upon the retailer's beliefs about the slope and intercept-demand parameters as transmitted through the retailer's estimate of "optimal" price. Manufacturer expected profit will increase or decrease based upon the retailer's beliefs about demand slope and intercept parameters given the model assumptions. If a manufacturer can influence the retailer's beliefs about the size or direction of the demand parameters, he will be influencing "optimal" retail price and ultimately his expected profit. Given the incentive to increase expected profit, a manufacturer can be expected to influence retailer's beliefs, possibly through persuasive marketing tactics. In practice, a manufacturer's sales representative can try to influence a retailer's beliefs about demand parameters through sales presentations. Pertinent test-market results and market analysis can be relayed, or not relayed, to influence those beliefs. While the marketing function incurs costs, the cost to present sales information in a manner benefitting the manufacturer is assumed to not add additional expense to the routine sales presentation. In other words, no added transactions costs are incurred by a sales representative choosing to present only positive test-market or focus-group results.

Manufacturers will try to influence retailer beliefs about demand parameters, but, admittedly, there may be a point at which such tactics prove counterproductive. For example, a manufacturer may want a retailer to believe her product is price sensitive so that a lower "optimal" retail price is chosen. In theory, with a lower retail price more quantity is demanded of normal goods, hence greater product sales occur. But a possible scenario may occur where the retailer determines a product is too price sensitive. While there is no published "benchmark" level of price sensitivity, a retailer may question the feasibility of shelving such a product when a minimal increase in price may severely decrease quantity demanded. Without mechanisms to reliably transmit credible information, manufacturers must determine appropriate levels of persuasiveness, while retailers must try to extract truthful information.

Manufacturers may exhibit strategic behavior to ensure a product is shelved, but one must remember that in practice retailers are the primary gate-keepers to consumers (excluding direct-marketing, Internet, and other outlets). Retailers understand the risk (of possible low consumer demand) they are assuming when shelving new products. In practice, retailers use trade allowances such as ex-ante slotting allowances and ex-post failure fees as mechanisms for transferring or sharing some of this risk with manufacturers. Theoretically, as shown by Chu (1992) and Lariviere and Padmanabhan (1997), slotting allowances for new products may be a direct result of information asymmetry leading to adverse selection. This body of literature alleviates adverse selection problems by screening or sorting through mechanism-design modeling. Essentially, a product will be shelved if it is expected to return positive profit (or a reservation profit level) after paying a slotting allowance. When the manufacturer chooses to pay a slotting allowance to shelve a new product, the manufacturer's privately held information (namely, the product's subjective probability distribution estimated by the manufacturer) is revealed.

Undoubtedly, retailers have rational expectations about a manufacturer's claims. In practice, retailers may discount claims to some extent. But the fact remains that new-product failure rates remain high. Patterson and Richards (2000) state that the percentage of new products that do not meet sales targets within six months is over 95 percent. If current retailers are precisely discounting claims, the new-product failure rate should not be so high. One plausible explanation is that retailers do not fully discount manufacturers' new-product claims during sales presentations due to adverse selection problems and the relay of non-credible information. The results given here suggest that behavioral modeling of the manufacturer-retailer relationship should include asymmetric information, possibly through game-theoretic or mechanism-design modeling. Mechanism-design modeling allows manufacturer choice of incentive-compatible contracts, whereby manufacturer information is revealed and a retailer does not need to "guess" an appropriate way to discount marketing claims.

One goal of various trade allowances—slotting allowances, for example—is to enhance the relay of information between manufacturers and retailers. Slotting allowances are used frequently during the shelving of new products in the grocery industry (Weir 1999; Partch 1999; Bloom, Gundlach, and Cannon 2000). As explained by one international grocery retail executive, retailers may request slotting allowances because of the risk associated with shelving new products about which retailers have limited information (Sussman 2000). In practice these allowances may be a form of insurance against product failure or a way of recouping probable costs of low-demand products. This industry behavior is consistent with finding ways to compensate for information asymmetry between manufacturers and retailers.

The impetus behind slotting allowances in the grocery industry parallels a lender's quest to learn more about new borrowers in finance and credit industries. In practice, loan contracts are designed to extract more information about prospective borrowers and thus to manage adverse selection problems for banks and other lenders. By choosing among a menu of contract terms, borrowers reveal their true risk (of loan default) positions by choosing an incentive-compatible price and non-price contract (Bester 1985). Price and non-price terms in banking may include, for example, different interest rates, points, downpayment amounts, and collateral combinations. Similarly, the insurance industry uses a menu of contract terms, chosen by the insured, to reveal a true risk position. In the grocery industry, such mechanisms for information revelation may include slotting allowances, failure fees, and other contract terms.

Conclusions

This paper introduces a stylized profit-maximization model, given certain assumptions, that explores information asymmetry and adverse selection in the retail food chain. This result builds upon past behavioral or anecdotal comments by analytically showing economic justification for a manufacturer to try to increase her own expected profit by attempting to influence retailers' beliefs about demand parameters. In practice, a manufacturer is behaving rationally by persuading retailers, sometimes with non-credible claims. As shown, objectives are not always perfectly aligned between manufacturers and retailers, so incentives exist for manufacturers to relay non-credible information. Hence it is also rational for retailers to seek alternative means, sometimes through an array of trade allowances, to induce the credible relay of information by manufacturers. Models assuming perfect and symmetric information between a manufacturer and a retailer do not incorporate the complexities of non-credible information flows. Game-theoretic or mechanism-design modeling may offer food-industry researchers opportunities for incorporating information asymmetry into behavioral modeling of the retail food channel.

While this study models a single profit-maximizing manufacturer selling to a single profit-maximizing retailer, the simplified model provides a catalyst for explaining non-credible information flows as they extend from asymmetric information and adverse selection in the grocery industry. Admittedly, this model abstracts from reality by focusing on a single relationship, or one-product interaction between manufacturer and retailer. Further studies may model multiple product introductions or "repeated games" to assist retailers in weighing the credibility of a manufacturer's claims. Also, further analysis could generalize the analytic results to multiple manufacturers selling to multiple retailers.

Applying methodologies from other disciplines and industries can strengthen modeling of the food industry. Opportunities for studying asymmetric information, adverse selection and non-credible information flows in the retail food channel parallel similar work in other industries. Food-industry analysts and researchers can look to mechanism design applications in insurance and credit as a catalyst for further research. In practice the food industry can implement asymmetric information into decision-making about introducing, shelving, and pricing new products. Understanding the elements of adverse selection and non-credible information flows provides an impetus for food-industry manufacturers and retailers to construct menus of trade-allowance terms. When a manufacturer chooses a contract package with specific slotting allowance and other contract terms, credible information is revealed by the manufacturer. While slotting-allowance literature has begun to explain these theoretical and modeling advances, more opportunities exist for industry application.

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