Bargaining, Third-Party Information and the Division of Profit in the Distribution Channel

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Abstract

The consolidation of power among retailers in recent years has forced many manufacturers to compete in a channel structure in which managing relations with retailers has become just as important as competing with one’s rivals. One consequence of this is that supply terms are now often negotiated individually with each retailer (e.g., wholesale prices, quantity discounts, cooperative advertising, slotting allowances). In this paper we use a bargaining framework to address the question: how do profits get allocated in a distribution channel in which a retailer carries the products of competing manufacturers, and how do these profits change in response to changing market conditions. We find that each manufacturer’s profit depends on its product’s incremental contribution to overall channel profit. In addition, we find that when demand conditions change over time, the type of information/advertising that induces the change (i.e., whether it is product-specific or relates to the whole category, and whether it is of equal relevance to all consumers or affects some consumer groups more than others) is critical in understanding which firms gain and which firms lose.
1 Introduction

The consolidation of power among retailers in recent years has forced many manufacturers to compete in a channel structure in which managing relations with retailers has become just as important as competing with one’s rivals. Retail giants such as Walmart, Toys- R-Us, Krogers, Barnes and Noble, and CompUSA have used their power to pressure manufacturers into granting price concessions (Stern, El-Ansary, Coughlan, 1996). In many instances, these concessions have taken place over non-marginal payments (e.g, slotting allowances, cooperative advertising). In other instances, the concessions have taken place over marginal payments (e.g., wholesale prices). But whatever their form, one thing is certain: negotiating over supply terms has become commonplace. Manufacturers can no longer simply dictate their terms of sale.\footnote{Although many observers believe that the balance of power has shifted in the favor of retailers as a result, and cite as evidence the growing use of slotting allowances, there is some evidence to the contrary. For example, Messinger and Narasimhan (1995) find that relative profits within the channel do not appear to have changed over time. We do not enter into this debate here, as we will take each side’s bargaining power as given. Thus, we focus on short run changes in firms’ profits around whatever long run trend there may or may not be.}

In this paper we analyze some of the factors that determine the outcome of these negotiations. In particular we address the question: what determines how profits get allocated within the channel, and how do these profits change over time in response to changing market conditions? Our first main finding is that a manufacturer’s profit depends on its product’s incremental contribution to overall channel profit, and thus, it depends critically on the prevailing market demand conditions for all products. Thus, we argue that negotiations between a retailer and one manufacturer cannot be analyzed in isolation from what is happening in the marketplace between that retailer and competing manufacturers. For example, our model suggests that the bargaining outcome between Walmart and Procter and Gamble critically depends not only on how well Procter and Gamble’s products are selling, but also on how well Colgate-Palmolive’s products are selling, and how well they would sell if Walmart were to drop some of Procter and Gamble’s products.

Since demand conditions are inherently dynamic and can be affected by advertising and product information to be found on the Internet and other media, we focus in addition on how profits are likely to be affected as demand conditions change over time. In particular, we focus on changes in external demand conditions that are induced by third party information that affects consumers’ product valuations. This leads to our second main finding: when demand conditions change over time, the type of information that induces the change (whether it is product-specific or relates to the whole category, and whether it is of equal relevance to all consumers or affects some consumer groups more than others) is critical in understanding who gains and who loses at contract time—often, the results are counterintuitive.
Intuitions that may apply in a bilateral monopoly setting do not necessarily carry over to contract negotiations among multiple contracting parties. For instance, we find that the profit implications for Apple, Microsoft, and a retailer such as CompUSA, of reports that “the newest upgrade of the MacOS fixes all known bugs in the operating system” qualitatively differ from the profit implications of reports that “more software is available for the MacOS than previously thought.” Since the information in both examples is positive about the MacOS, we find, not surprisingly, that both types of information are beneficial to Apple (maker of the MacOS).

However, one might also expect that in both examples the retailer will share in Apple’s gains—since consumers’ overall valuations for the MacOS have increased—and that Microsoft (Apple’s competitor) will lose—since the increase in consumers’ valuations for the MacOS might cause some consumers to shift from Microsoft to Apple. It turns out that this conjecture is incorrect. We show that the information in the first example is harmful for the retailer and beneficial for Microsoft, while the information in the second example has the opposite effect in that it is beneficial for the retailer and harmful for Microsoft.

The key distinction in these two examples has to do with whether the information is of more relevance to Apple’s core consumers (consumers who are more interested in an operating system’s ease of use) or non-core consumers (consumers who are more interested in the availability of compatible application software). Rival manufacturers always benefit from positive information that is more relevant to its rivals’ core consumers while retailers always benefit from positive information that is more relevant to a manufacturer’s non-core consumers.

In our taxonomy of information types, we also consider the profit implications for channel members of information that is of equal relevance to all consumers (e.g., students who have Apple computers tend to have higher SAT scores), and information that pertains to the product category as a whole (e.g., SAT scores are positively correlated with home use of computers).

Our analysis is relevant to managers in that it helps to clarify key factors that determine the contract terms for which each member of the channel can negotiate, and it suggests when managers will be able to renegotiate for better contract terms in response to changed demand conditions. In particular, our results can help identify when advertising, third-party information, or product innovations shift demand conditions in favor of a specific channel member. In addition, although we focus on the profit implications of different types of information, and treat the information as exogenously supplied by third-parties, our analysis can be easily extended to consider information provision by channel members. If we assume that firms will want to provide information from which they gain, and withhold information (if possible) from which they lose, then our analysis has additional managerial relevance. For example, our analysis suggests that Apple but not Microsoft should be interested in informing consumers that “the
widespread adoption of the Java programming language is accelerating software development and leading to more software across all operating system platforms,” and that Microsoft but not Apple should inform consumers that “the main supplier of color LCD displays for notebook consumers has dramatically improved its screens’ contrast, thus improving the legibility and usability of both MacOS and Windows 95 based notebooks.” In both cases, it is in the interests of computer retailers such as CompUSA to assist in the information dissemination (the information pertains to the category, for which –as we will show– the retailers are primary beneficiaries).

We contribute to the marketing literature in three areas. First, we introduce a bargaining framework between two manufacturers and a retailer and show how channel profits depend on consumer preferences at a point in time. The framework also allows us to analyze how these profits are likely to change over time in response to changes in external demand conditions. Iyer and Villas-Boas (1998) consider bargaining between a single manufacturer and retailer in a bilateral monopoly setting, but this abstracts from the externalities which are present when manufacturers compete in a common channel. These externalities are the focus of our paper. O’Brien and Shaffer (1994) consider bargaining in a game between a single manufacturer and multiple retailers. Their focus is on the implications of the Robinson-Patman Act for the observability of contracts among retailers. In our paper, observability is not an issue, since the contracts are negotiated by the same retailer. Marx and Shaffer (1999) consider the use of below-cost pricing as a means of rent-shifting in a bargaining game in which a common retailer negotiates in sequence with each of two manufacturers. This type of rent-shifting is not possible (and arguably, illegal) if, as in our setting, contracts are negotiated simultaneously.

Second, we derive the effect of different types of information/advertising on the division of channel profits, thereby contributing to the literature on channel management (Jeuland and Shugan, 1983; Mathewson and Winter, 1984; Moorthy, 1987; Shaffer, 1991a; Ingene and Perry, 1995; Chu and Messinger, 1997; Iyer, 1998; Ingene and Perry, 1999). There is a small marketing literature which looks at the two manufacturer-one retailer model, in which a single retailer carries the products of competing manufacturers (Choi, 1991; Lal, 1990; Agrawal, 1996; Lal, Little, and Villas-Boas, 1996). All of this literature restricts attention to supply contracts in which manufacturers specify wholesale prices only. There are also a number of papers that extend the two manufacturer-one retailer model to allow manufacturers to specify two-part tariffs (Lin, 1990; O’Brien and Shaffer, 1993, 1997; Gabrielsen, 1997; Gabrielsen and Sorgard, 1999). However, none of this literature allows for bargaining among the members of the channel.

Third, our results contribute to the literature on the effect of information on firms’ competitive behavior, which considers whether firms should provide information to consumers
(Zettelmeyer 1997, Lynch and Ariely 1998). It extends this literature by examining the effect of information in the context of distribution channels and by considering different types of information.

This paper proceeds as follows. Section 2 presents the model and derives the equilibrium division of profits. Section 3 looks at how different types of product information affect each firm’s profit. It shows that which firms gain and which firms lose depends on whether the information is more relevant to a firm’s core or non-core consumers. Section 4 extends the analysis to category information. Section 5 discusses extensions of the model to downstream competition, information provision, and non-information based changes in consumers’ valuations. Section 6 concludes. The proofs of all propositions can be found in the appendix.

2 Bargaining and the division of channel profits

2.1 Consumers and demand

Consider a spatial model of demand in which consumers are distributed uniformly with unit mass along the line segment between 0 and 1 and purchase at most one unit of a product. Following in the tradition of Hotelling (1929), the line segment can be thought of as representing a single attribute of differentiation or, alternatively, a ratio of two attributes. In many of our examples below, we will make use of the second interpretation.

There are two products, X and Y, which are located at the endpoints respectively. Consumers located at 0 derive a gross utility \( V_x \) from consuming product X and \( V_y - \delta_y \) from consuming product Y. Consumers located at 1 derive a gross utility \( V_x - \delta_x \) from consuming product X and \( V_y \) from consuming product Y. In general, a consumer that is located at \( z \in [0, 1] \) derives a gross utility \( V_x - z\delta_x \) from the consumption of product X and \( V_y - (1 - z)\delta_y \) from the consumption of product Y, where \( \delta_x > 0 \) and \( \delta_y > 0 \) are the rates at which utility decreases as a consumer’s ideal point moves away from the locations of products X and Y. See Figure 1.

As is standard in the Hotelling model, in the absence of product Y, the downward sloping line (left to right) represents the maximum price that can be charged for product X if a quantity \( x \) of product X is to be sold and product Y is not sold. Thus, it is the inverse demand for product X in the absence of product Y. We denote this as \( p_x(x) \equiv V_x - x\delta_x, \) \( x \in [0, 1] \). Similarly, the downward sloping line (right to left) is the inverse demand for product Y in the absence of product X. We denote this as \( p_y(y) \equiv V_y - y\delta_y, \) \( y \in [0, 1] \).

We assume production costs are zero and consider both the case in which a monopolist would want to cover the market (serve all consumers) even if it sold only one product (\( V_i \geq 2\delta_i \)), and the case in which a monopolist would not want to cover the market if it sold only one product
Figure 1: Consumers’ valuations for products X and Y

$$V \approx V - z \delta$$

We assume the market is always covered when both products are sold.

To solve our model it is useful first to derive the maximum profit a monopolist can earn by selling only one product. If it sells only product X, the monopolist’s profit is $$p^m_x$$ and $$x^m$$ denote the price and quantity that maximize this profit and let $$\Pi_x$$ denote its maximized value. Then $$p^m_x = V_x/2$$ and $$x^m = V_x/2\delta_x$$ if the market is not covered (i.e., $$\delta_x > V_x/2$$), and $$p^m_x = V_x - \delta_x$$ and $$x^m = 1$$ if the market is covered (i.e., $$\delta_x \leq V_x/2$$), yielding profit $$\Pi_x = p^m_x x^m$$.

In what follows, we refer to $$\Pi_x$$ as the monopoly profit of the retailer and firm X. That is, if firm X produced product X, and the retailer distributed the product to consumers, and if there were no double marginalization in the channel, then $$\Pi_x$$ would represent the amount of profit to be allocated between the retailer and firm X (in the absence of product Y).

Similarly, a monopolist’s maximized profit if it sells only product Y is $$\Pi_y = p^m_y y^m$$, where $$p^m_y$$ and $$y^m$$ are defined analogously to their counterparts when only product X is sold. In what follows, we refer to $$\Pi_y$$ as the monopoly profit of the retailer and firm Y. Its interpretation is analogous to that of $$\Pi_x$$.

These profits are illustrated in Figure 2 for the case in which the two firms are symmetrically differentiated, so that $$p^m_x = p^m_y$$, and in which the market is covered ($$\delta_i \leq V_i/2$$).

In contrast, if a monopolist were to sell both products X and Y, then its profit is maximized by choosing a quantity $$x$$ of product X and a quantity $$y$$ of product Y to solve

$$\max_{x,y} \quad p_x(x)x + p_y(y)y \quad \text{such that} \quad x + y = 1, \quad (1)$$

where we have assumed that products X and Y are substitutes in demand at the monopoly.

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2These conditions can be found by solving for when the marginal revenue of product X (Y) is weakly positive at $$x = 1 \ (y = 1)$$ in the case of full coverage, and when it is negative in the case of incomplete coverage.
prices, i.e., the monopolist serves all consumers located in [0, 1]. Solving yields

\[ p_x^{mm} = V_x - x^{mm}\delta_x, \quad p_y^{mm} = V_y - (1 - x^{mm})\delta_y, \quad \text{and} \quad x^{mm} = (2\delta_y + V_x - V_y) / (2(\delta_x + \delta_y)). \] (2)

At the quantities that maximize the monopolist’s profit, prices are \((p_x^{mm}, p_y^{mm})\), consumers located in \([0, x^{mm})\) purchase product X, and consumers located in \([x^{mm}, 1]\) purchase product Y. Let \(\Pi_{xy} \equiv p_x^{mm}x^{mm} + p_y^{mm}(1 - x^{mm})\) denote the monopoly profit when both products X and Y are sold. This profit is illustrated in Figure 3 for the symmetric case \((p_x^{mm} = p_y^{mm})\).

We will refer to \(\Pi_{xy}\) as the total channel profit. That is, if firm X produced product X, firm Y produced product Y, and the retailer distributed both products to consumers, and if there were no double marginalization anywhere in the channel, then \(\Pi_{xy}\) would represent the amount of profit to be allocated among the retailer, firm X, and firm Y. The following proposition gives the relationship between this profit and the monopoly profit of the retailer with each firm.

**Proposition 1** \(\Pi_{xy}\) is less than the sum of the two monopoly profits when only one product is
sold, but greater than the individual monopoly profit when only one product is sold:

\[ \Pi_x + \Pi_y > \Pi_{xy} \geq \max\{\Pi_x, \Pi_y\}. \]

**Proof:** The first inequality holds since some substitution between products is assumed (if, on the other hand, products are independent, then \( \Pi_{xy} = \Pi_x + \Pi_y \)). The second inequality holds by the definition of \( \Pi_{xy} \) (a monopolist that can sell both products can always mimic the price and quantity decisions of a monopolist constrained to sell only one product). The second inequality holds with equality if the products are perfect substitutes, i.e., if one of the products has no value added. This would be the case, for instance, if \( V_x = V_y \) and \( \delta_i = 0, i \in [x, y] \).

Q.E.D.

Proposition 1 establishes that each product can potentially contribute to total channel profit. In what follows, we refer to \( \Pi_{xy} - \Pi_y \) as the incremental contribution of product X to total channel profit, and to \( \Pi_{xy} - \Pi_x \) as the incremental contribution of product Y to total channel profit. In the next subsection, we will show that, under general conditions, each manufacturer’s profit in a game between two manufacturers and a common retailer will depend on its bargaining power and on its product’s incremental contribution to total channel profit.

### 2.2 Firms and bargaining

We now ‘break up’ the monopolist and consider a game between two manufacturers and a common retailer. We assume that the retailer is a monopolist.\(^3\) The game consists of two stages. In the first stage, the retailer negotiates contract terms with each manufacturer. In the second stage, the retailer chooses how much to buy of products X and Y, and then resells these quantities to consumers. We assume the firms are profit-maximizers, and that each consumer maximizes his/her consumer surplus.

In the first stage we assume the retailer negotiates with each manufacturer on both the marginal price of its product and on how the surplus is to be divided. In particular, we assume they bargain over a wholesale price \( w_i \) and fixed fee \( F_i, i = x, y \). Thus, if \( T_x \) and \( T_y \) denote the contracts negotiated by the retailer with firms X and Y respectively, then

\[
T_x(x \mid w_x, F_x) = \begin{cases} 
  w_xx + F_x, & x > 0 \\
  0, & x = 0
\end{cases}
\quad \text{and} \quad
T_y(y \mid w_y, F_y) = \begin{cases} 
  w_yy + F_y, & y > 0 \\
  0, & y = 0
\end{cases}
\]

Since production costs are assumed to be zero, if the retailer buys quantity \( x \) of product X,

\(^3\)We do not believe that our results depend on this assumption. See page 23 for a discussion.
firm X’s profit is \( T_x(x \mid w_x, F_x) \). If the retailer buys quantity \( y \) of product Y, firm Y’s profit is \( T_y(y \mid w_y, F_y) \). The retailer’s profit is \( p_x(x) x + p_y(y) y - T_x(x \mid w_x, F_x) - T_y(y \mid w_y, F_y) \), where \( x + y \leq 1 \) to reflect the assumption that consumers are distributed with unit mass.

Regarding how the bargaining outcomes are determined, we make minimal assumptions, assuming only that bargaining between the retailer and firm \( i \) results in maximization of the two players’ joint profit, taking as given the retailer’s contract with firm \( j, j \neq i \), and that each firm earns its disagreement payoff (what it would earn if negotiations fail) plus a share of the incremental gains from trade (the joint profit of the retailer and firm \( i \) when they trade minus their joint profit when they do not trade), with proportion \( \lambda_i \in [0, 1] \) going to firm \( i \).

These assumptions on the bargaining outcomes are consistent with the commonly used bargaining solutions (e.g., Nash bargaining, Rubinstein-alternating-offers-bargaining, egalitarian bargaining, and Kalai-Smorodinsky bargaining) which require that players maximize bilateral joint profits and divide the incremental gains from trade.\(^4\) The assumptions are also consistent with the contract equilibrium concept of Cremer and Riordan (1987) and O’Brien and Shaffer (1992), and the pairwise-proof equilibrium in McAfee and Schwartz (1994). Intuitively, our assumptions require that the bargaining outcomes be immune to bilateral recontracting.\(^5\)

Our assumption of a fixed division of the incremental gains from trade admits several interpretations. For example, if the manufacturers make take-it or leave-it offers to the retailer, then \( \lambda_i = 1 \). If the retailer makes take-it or leave-it offers to the manufacturers, then \( \lambda_i = 0 \).

In the bargaining game, the maximum payoffs for the players above their disagreement points are the same, so the Nash bargaining solution and Kalai-Smorodinsky bargaining solution both divide the gains from trade equally, and, by definition, the egalitarian bargaining solution divides the gains from trade equally. Thus, the Nash bargaining solution, the egalitarian bargaining solution, and the Kalai-Smorodinsky bargaining solution all imply \( \lambda_i = 1/2 \).

### 2.2.1 Equilibrium

We solve for the equilibrium strategies of the retailer and firms X and Y by working backwards, taking our assumptions about the outcome of negotiations as given.\(^6\) Thus, the retailer’s profit-maximizing choices in the second stage depend on the wholesale prices and fixed fees that were negotiated in the first stage. If the retailer is indifferent between selling a positive amount of a product and selling zero, we assume the retailer will sell the positive amount.

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\(^4\)See the seminal works of Nash (1950), Kalai and Smorodinsky (1975), and Rubinstein (1982).

\(^5\)This implicitly assumes that if a profitable bilateral deviation were to exist, the two players would want to recontract. See McAfee and Schwartz (1994).

\(^6\)Our solution concept corresponds to subgame perfection in that equilibrium behavior in the first stage is not supported by non-credible threats in the second stage.
**Stage two:** Conditional on the bargaining outcomes, the retailer takes the contracts with the two manufacturers, \( T_x \) and \( T_y \), as given and chooses \( x \) and \( y \) to solve

\[
\max_{x,y \geq 0} p_x(x) + p_y(y) - T_x(x \mid w_x, F_x) - T_y(y \mid w_y, F_y)
\]

such that \( x + y \leq 1 \). (3)

Since the retailer’s revenue, \( p_x(x) + p_y(y) \), is strictly concave and bounded, the maximizers in (3) exist (assuming \( w_i \geq 0 \)) and are uniquely defined when they are both positive. Let \( x^{**}(T_x, T_y) \) and \( y^{**}(T_x, T_y) \) denote these quantities. Two stars denote the equilibrium quantities when contracts are in place with both manufacturers.

We must also consider the possibility (which doesn’t happen in equilibrium) that negotiations with one of the manufacturers may have failed in the first stage. In this case, if bargaining with firm \( Y \) breaks down, the retailer chooses \( x \) to solve

\[
\max_x p_x(x) - T_x(x \mid w_x, F_x)
\]

such that \( x \in [0, 1] \), (4)

and if bargaining with firm \( X \) breaks down, the retailer chooses \( y \) to solve

\[
\max_y p_y(y) - T_y(y \mid w_y, F_y)
\]

such that \( y \in [0, 1] \). (5)

Define \( x^*(T_x) \) and \( y^*(T_y) \) to be the maximizers of (4) and (5) respectively. Since \( p_x(x) \) and \( p_y(y) \) are strictly concave and bounded, if \( w_i \geq 0 \), these maximizers exist and are unique. One star denotes the equilibrium quantities when contracts are in place with one manufacturer.

**Stage one:** In stage one, the retailer bargains with each firm simultaneously. In bargaining with firm \( X \) over contract \( T_x \), the retailer and firm \( X \) take \( T_y \) and the retailer’s equilibrium behavior in stage two as given and choose \( w_x \) to maximize their joint profit,

\[
\max_{w_x} p_x(x^{**})x^{**} + p_y(y^{**})y^{**} - T_y(y^{**} \mid w_y, F_y)
\]

and \( F_x \) to divide the incremental gains from trade so that each earns as profit its disagreement payoff (what it could earn if negotiations failed) plus a share of the gains from trade, with proportion \( \lambda_x \) going to firm \( X \). Thus, \( F_x \) is chosen so that firm \( X \’s \) profit is

\[
\lambda_x \left( p_x(x^{**})x^{**} + p_y(y^{**})y^{**} - T_y(y^{**} \mid w_y, F_y) - (p_y(y^*)y^* - T_y(y^* \mid w_y, F_y)) \right),
\]

where the first set of terms on the right side of (7) is the retailer’s joint profit with firm \( X \) and
the second set of terms, \( p_y(y^*)y^* - T_y(y^* | w_y, F_y) \), is the retailer’s disagreement payoff.

In bargaining with firm \( Y \) over contract \( T_y \), the retailer and firm \( Y \) take \( T_x \) and the retailer’s equilibrium behavior in stage two as given and choose \( w_y \) to maximize their joint profit,

\[
\max_{w_y} \ p_x(x^{**})x^{**} + p_y(y^{**})y^{**} - T_x(x^{**} | w_x, F_x),
\]

and \( F_y \) to divide the incremental gains from trade with proportion \( \lambda_y \) going to firm \( Y \). Thus, \( F_y \) is chosen so that firm \( Y \)’s profit is

\[
\lambda_y (p_x(x^{**})x^{**} + p_y(y^{**})y^{**} - T_x(x^{**} | w_x, F_x) - (p_x(x^*)x^* - T_x(x^* | w_x, F_x)))) ,
\]

where the first set of terms on the right side of (9) is the retailer’s joint profit with firm \( Y \) and the second set of terms, \( p_x(x^*)x^* - T_x(x^* | w_x, F_x) \), is the retailer’s disagreement payoff.

2.3 Solution and Discussion

Given our assumptions, the maximizers of (6) and (8) exist and are uniquely defined. Substituting the equilibrium \( w_x, w_y \) into (7) and (9) and solving yields the following proposition.

**Proposition 2** There exists a unique equilibrium to the bargaining game. In this equilibrium, the negotiated contracts, \( T_x^e \) and \( T_y^e \), induce \( x^{**}(T_x^e, T_y^e) = x^{mm} \) and \( y^{**}(T_x^e, T_y^e) = y^{mm} \). If \( \pi_x, \pi_y, \) and \( \pi_r \) denote firm \( X \), firm \( Y \), and the retailer’s equilibrium profit, then,

\[
\pi_x = \lambda_x (\Pi_{xy} - \Pi_y) \\
\pi_y = \lambda_y (\Pi_{xy} - \Pi_x) \\
\pi_r = \Pi_{xy} - \pi_x - \pi_y.
\]

The first thing to notice about the bargaining equilibrium is that the retailer’s quantity choices in equilibrium are the same quantities that a fully integrated monopolist would choose to maximize total channel profit. This implies that the bargaining in stage one proceeds in a manner that eliminates any double marginalization. The reason is that the contracts are sufficiently general to allow efficiency considerations in the sense of joint profit maximization to be separated from how the surplus is divided. Thus, Proposition 2 extends the results in Moorthy (1987). Moorthy showed that with take-it or leave-it offers, a two-part tariff contract was sufficient to eliminate double marginalization in a bilateral monopoly setting. Proposition 2 generalizes this to the case of two manufacturers that sell through a common retailer, and to a bargaining framework that subsumes as a special case take-it or leave-it contract offers.
The second thing to notice is that the total profit to be divided among channel members is \( \Pi_{xy} \) (this is a consequence of the retailer’s quantity choices being efficient). Of this profit, firm \( i \) earns \( \lambda_i \) times the difference between total channel profit and the monopoly profit of the retailer and its rival. Using Proposition 1, this means that firm \( i \)’s profit is strictly positive in equilibrium, unless it has zero bargaining power (\( \lambda_i = 0 \)) or unless products \( X \) and \( Y \) are perfect substitutes. Intuitively, conditional on its bargaining power, each firm captures what is unique about its product. If products \( X \) and \( Y \) are undifferentiated, the retailer earns \( \Pi_{xy} \) and each manufacturer earns zero. As the products become more differentiated (less substitutable), each manufacturer’s profit increases and the retailer’s profit decreases.

The third thing to notice, however, is that the two manufacturers cannot extract everything from the retailer no matter how differentiated their products become, as long as they are not independent. With any amount of substitution, Propositions 1 and 2 imply that the retailer earns positive profit—even if \( \lambda_x = \lambda_y = 1 \) (i.e., even if it has no bargaining power). See Figures 2 and 3 for a graphical depiction of the components of each firm’s profit in the case of full market coverage and symmetry.

The bargaining parameter \( \lambda_i \) admits several interpretations. For example, if the manufacturers make take-it or leave-it offers to the retailer, then \( \lambda_x = \lambda_y = 1 \). In this case, each manufacturer earns exactly its product’s incremental contribution to total channel profit:

\[
\pi_x = \Pi_{xy} - \Pi_y, \quad \pi_y = \Pi_{xy} - \Pi_x, \quad \pi_r = \Pi_x + \Pi_y - \Pi_{xy}.
\]

Interestingly, the retailer’s profit in this case, for a given \( \Pi_x, \Pi_y \), is decreasing in total channel profit. If the retailer makes take-it-or-leave-it offers to the manufacturers, then \( \lambda_x = \lambda_y = 0 \). In this case, the retailer captures the entire channel profit and each manufacturer earns zero:

\[
\pi_x = 0, \quad \pi_y = 0, \quad \pi_r = \Pi_{xy}.
\]

Lastly, if the retailer and firm \( i \) share equally in the gains from trade, then \( \lambda_x = \lambda_y = 1/2 \). This is the case, for instance, in a simultaneous Nash bargaining game. In this case, we have:

\[
\pi_x = \frac{1}{2} (\Pi_{xy} - \Pi_y), \quad \pi_y = \frac{1}{2} (\Pi_{xy} - \Pi_x), \quad \pi_r = \frac{1}{2} (\Pi_x + \Pi_y).
\]

The interesting thing about this case is that, for a given \( \Pi_x, \Pi_y \), the retailer is indifferent to changes in total channel profit, since these changes accrue solely to the manufacturers.

Proposition 2 thus encompasses a wide variety of bargaining outcomes. It holds for any distribution of bargaining power, symmetric or asymmetric. It also holds for any degree of substitution between products \( X \) and \( Y \) and any amount of demand asymmetry subject to a
monopolist selling both products in equilibrium. But despite these different scenarios, there is one important commonality; the negotiations between a retailer and one manufacturer cannot be determined in isolation from the negotiations between that retailer and competing manufacturers. To see this, suppose firm $X$ and the retailer were to negotiate their contract as if product $Y$ were not around, and suppose further that they were to split their joint profit with proportion $\lambda_x$ going to firm $X$. Then, firm $X$ would earn profit $\lambda_x \Pi_x$. In contrast, we know from Proposition 2 that firm $X$ earns $\lambda_x (\Pi_{xy} - \Pi_y)$. Comparing the difference, we have

$$\lambda_x \Pi_x - \lambda_x (\Pi_{xy} - \Pi_y) = \lambda_x (\Pi_x + \Pi_y - \Pi_{xy})$$

which, if $\lambda_x > 0$, is strictly positive from Proposition 1. This implies that while firm $X$ is better off bargaining in isolation, the retailer is not, and in fact the retailer would strictly lose if it did so. This suggests that important externalities are present whenever a retailer sells the products of competing manufacturers. In equilibrium, the bargaining outcome between a manufacturer and retailer such as Procter and Gamble and Walmart cannot be separated from the bargaining outcome between Walmart and a competing manufacturer such as Colgate-Palmolive. Each manufacturer’s profits depend not just on how well its own product is selling, but also on how well its competitor’s product is selling and on how well it would sell if the retailer were to drop its product. Thus, our results imply that a thorough understanding of these relationships is critical for understanding how profit is allocated in the channel.

3 Product Information and the division of channel profits

In the next two sections, we consider how the bargaining outcome in Proposition 2 is affected as market conditions change over time. In particular, we focus on changes in external demand conditions that are induced by third-party sources of information of the kind typically found on the Internet and other media. In section 5, we consider how the model can be extended to include informative and persuasive advertising by the channel members themselves.

Our main finding is that when demand conditions change over time, the type of information that induces the change (whether it is product-specific or relates to the whole category, and whether it is of equal relevance to all consumers or affects some consumer groups more than others) is critical in understanding who gains and who loses at the time of recontracting. Thus, we distinguish between information that is equally relevant to all consumers and information that affects consumers unequally. In the latter case, we distinguish between information that is more relevant to firm $X$’s core consumers and information that is more relevant to firm $X$’s non-core consumers. Formally, under our assumption that firm $X$ is located at 0, we define
firm $X$’s core consumers as those consumers who are located between 0 and 1/2, and we define firm $X$’s non-core consumers as those consumers who are located between 1/2 and 1.\footnote{We define things relative to firm $X$’s perspective to avoid confusion. Note that whether a consumer is firm $X$’s core consumer or firm $X$’s non-core consumer does not imply anything about which product that consumer will actually purchase. The core vs. non-core distinction is a function only of a consumer’s location in product space, whereas the same consumer’s actual purchase decision is a function, in addition, of the prices of each firm.}

### 3.1 Information Types

We conceptualize information as having three components to its content, namely (1) the products to which the information pertains, (2) the consumers to whom the information is relevant, and (3) the effect that the information has on these consumers’ valuations. The first component captures whether the information affects consumers’ valuations for all products in the category, or just one product. We call the former type *category information* and the latter type *product information*. The second component captures whether the information affects all consumers’ valuations equally or whether there are some groups of consumers whose valuations are more affected than others, i.e., whether the information is more relevant to firm $X$’s core consumers or non-core consumers. The third component captures whether consumers’ gross utilities for the product(s) to which the information pertains increases or decreases. We say that the information is *positive* if valuations increase and *negative* if valuations decrease.

Our spatial model of demand captures each of these information components. Suppose that information pertains to product $X$. If the information primarily affects consumers who are located close to $X$ (product $X$’s *core consumers*), we rotate the curve denoting consumers’ valuations of product $X$ around its intersection with the vertical line at 1, thereby inducing a larger change in utility for those consumers located closer to 0 (mathematically this corresponds to an equal change in $V_x$ and $\delta_x$). If the information primarily affects consumers located far from $X$ (product $X$’s *non-core consumers*), we rotate the curve denoting consumers’ valuations of product $X$ around its intersection with the vertical line at 0, thereby inducing a larger change in utility for those consumers located far from 0 (this corresponds to a change $\Delta \delta_x$). If the information affects all consumers equally, we combine the two rotations; this is equivalent to a parallel shift of all consumers’ valuations of product $X$. For positive information, we shift/rotate consumers’ valuations for the respective product upward. For negative information, we shift/rotate consumers’ valuations for the respective product downward.

### 3.2 Illustrative example

An example illustrates how we decompose and model different types of information. Suppose that consumers’ preferences with respect to operating systems are horizontally differentiated.
Consumers located at 0 care primarily about the usability of the operating system, consumers located at 1 care primarily about the availability of application software. A consumer located at 1/2 cares equally about usability and the availability of application software. Assume that Apple computer’s MacOS is located at 0 and Microsoft’s Windows 95 is located at 1.

Now suppose consumers learn that more software is available for the MacOS than they had previously thought. We would describe this type of information as positive product information (the information pertains only to the MacOS and consumers’ utilities increase in the availability of software) that is of more relevance to Apple’s non-core consumers (the consumers who care the most about the availability of application software). Figure 4 depicts the change in consumers’ valuations of product X. The dashed line \( V_x - z\delta_x \) represents consumers’ valuations for the MacOS before learning the information. After learning the information, their new, higher valuations are given by the solid line \( V_x - z(\delta_x + \Delta\delta_x) \), where \( \Delta\delta_x < 0 \).

![Figure 4: Example of positive information of relevance to X’s non-core consumers](image)

Suppose consumers learn instead that the newest upgrade of the MacOS fixes all known bugs in the operating system, thus increasing stability and usability. We would describe this type of information as positive product information that affects primarily the MacOS’s core consumers (consumers who are more concerned about the availability of application software will be less affected than those consumers who find the usability and hence stability of the operating system relatively more important). See Figure 5. The dashed line \( V_x - z\delta_x \) is now replaced by the solid line \( V_x + \Delta V_x - z(\delta_x + \Delta\delta_x) \), where \( \Delta\delta_x = \Delta V_x > 0 \).

Finally, suppose consumers learn that the SAT scores of children whose families own a Macintosh are on average higher than the SAT scores of children without a Macintosh. We would describe this type of information as positive product information about the MacOS that affects all consumers equally (the study pertains both to the MacOS and the associated utility increase is uncorrelated with usability or the availability of application software). See Figure 6. The dashed line \( V_x - z\delta_x \) is now replaced by the solid line \( V_x + \Delta V_x - z\delta_x \), where \( \Delta V_x > 0 \).
3.3 Core vs. non-core information

The three information examples appear to be very similar. Whether consumers learn that more software is available for the MacOS than they had previously thought, whether they learn that the newest upgrade of the MacOS fixes all known bugs in the operating system, or whether they learn of the positive correlation between SAT scores and Macintosh ownership, the information in each example is positive about the MacOS. Not surprisingly, we will show that the information in all three examples increases Apple’s profits. It is less obvious, however, what happens to the other channel members’ profits. Intuitively, one might expect that the retailer would gain in all three examples (since consumers’ overall valuations have increased) and that Microsoft would lose (since the increase in consumers’ valuations for the MacOS may shift some customers from Microsoft to Apple). However, this intuition is incorrect.

The three examples are distinguished by the fact that the information in the first example is more important to Microsoft’s customers, the information in the second example is more important to Apple’s customers, and the information in the third example is equally relevant.
to all consumers. This distinction has a dramatic effect on the division of channel profits. In particular, we will show that the information in the first and third examples is beneficial for the retailer and harmful for Microsoft while the information in the second example has the opposite effect, it is beneficial for Microsoft and may be harmful for the retailer. This suggests that, conditional on there being good news for Apple, Microsoft would prefer that the news have more of an effect on Apple’s core consumers than on Apple’s non-core consumers.

To derive these results, we need to know how the information affects total channel profit ($\Delta \Pi_{xy}$) and how the information affects the monopoly profits of the retailer and each firm ($\Delta \Pi_x$ and $\Delta \Pi_y$). Knowing these changes in profits, we can then use Proposition 2 to determine who gains and who loses. For example, to analyze the impact on firm i’s profit it suffices to compute $\Delta \Pi_{xy} - \Delta \Pi_j$, i.e., the change in total channel profit minus the change in the monopoly profit of the retailer and rival firm. We illustrate our results using a symmetric benchmark.

3.3.1 Product information of primary relevance to non-core consumers

We begin with information about product X that is of primary relevance to firm X’s non-core consumers (see Figure 4 on page 14). To analyze the effect of this type of information, note first that the retailer will increase its price on products X and Y (decrease its prices if the information is negative) to reflect the increase in consumers’ valuations. This causes total channel profit to increase and implies that $\Delta \Pi_{xy} > 0$. As for the effect of the information on $\Pi_x$ and $\Pi_y$, we can see from Figure 4 that the retailer’s monopoly profit with firm Y is unchanged ($\Pi_y = 0$), but its monopoly profit with firm X increases. In particular, $\Delta \Pi_x = |\Delta \delta_x| > 0$.

Since the retailer cannot raise equilibrium prices by $|\Delta \delta_x|$ without causing some consumers to drop out of the market, $\Delta \Pi_x > \Delta \Pi_{xy}$. Thus, for positive information about product X that is of primary relevance to firm X’s non-core consumers, we have $\Delta \Pi_x > \Delta \Pi_{xy} > \Delta \Pi_y$.

**Proposition 3** Suppose consumers learn positive (negative) information about product X that is of primary relevance to firm X’s non-core consumers. Then, firm X and the retailer’s profit increases (decreases), and firm Y’s profit decreases (increases).

Firm X gains because it is the beneficiary of positive product information and because the monopoly profit of the retailer and firm Y is unchanged. Thus, $\Delta \pi_x = \lambda_x \Delta \Pi_{xy} > 0$. Firm Y is not as fortunate. Although total channel profit increases, the increase in the retailer’s monopoly profit with firm X is larger, implying that $\Delta \pi_y = \lambda_y (\Delta \Pi_{xy} - \Delta \Pi_x) < 0$. As for the retailer’s profit, there are two sources of change. Writing the change in the retailer’s profit as $\Delta \pi_r = (1 - \lambda_x) \Delta \Pi_{xy} - \Delta \pi_y$, we see that the retailer stands to capture some of the increase.

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8 We present the case in which $\delta_x \leq V_x/2$. For $\delta_x > V_x/2$ the argument proceeds with $\Delta \Pi_{xy} < \Delta \Pi_x < |\Delta \delta_x|$. 16
in total channel profit (unless \(\lambda_x = 1\)) and, in addition, there is a redistribution of profit away from firm \(Y\) reflecting the retailer’s enhanced bargaining power. As a result, the retailer may experience a larger profit increase than firm \(X\). This would be the case, for example, if \(\lambda_x = 1/2\), so that firm \(X\) and the retailer divide equally the increase in channel profit.

Compare this to the case of positive information about product \(X\) that is of equal relevance to all consumers (see Figure 6 on page 15). In this case, a similar result and intuition applies.

**Proposition 4** Suppose consumers learn positive (negative) information about product \(X\) that is of equal relevance to all consumers. Then, firm \(X\) and the retailer’s profit increases (decreases), and firm \(Y\)’s profit decreases (increases).

This information leads to an increase in total channel profit (\(\Delta \Pi_{xy} > 0\)) since the utility of the marginal consumer has increased. However, the retailer cannot raise prices by \(\Delta V_x\) without causing some consumers to drop out of the market; consequently total channel profit increases by less than \(\Delta V_x\). If the retailer were selling only product \(X\), profit would rise by \(\Delta V_x\).\(^9\) If the retailer were selling only product \(Y\), profit would be unchanged. Thus, as in the previous example, we have \(\Delta \Pi_x > \Delta \Pi_{xy} > \Delta \Pi_y\), implying that the qualitative results are the same.

### 3.3.2 Product information of primary relevance to core consumers

The previous two examples accord with most people’s intuition, which suggests that firm \(X\) gains because the information is positive about its own product, the retailer gains because it stands to gain from increases in consumers’ valuations (it can adjust its pricing to reflect the higher valuations), and firm \(Y\) loses since the information will cause some consumers to switch to product \(X\). However, our bargaining equilibrium suggests that in a world of multi-party contracting, a critical component of the change in each firm’s profit is the change in the retailer’s disagreement payoff. If this increases by less than the increase in total channel profit, then a firm can be better off even if the information is about its rival’s product.

This is the case for positive information about product \(X\) that is of primary relevance to firm \(X\)’s core consumers (see Figure 5 on page 15). Here the retailer’s monopoly profit with each manufacturer is unchanged, \(\Delta \Pi_x = \Delta \Pi_y = 0\), but \(\Delta \Pi_{xy} > 0\).\(^10\)

**Proposition 5** Suppose consumers learn positive (negative) information about product \(X\) that is of primary relevance to firm \(X\)’s core consumers. Then, firm \(X\) and \(Y\)’s profit increases (decreases), and the change in the retailer’s profit is \(\Delta \pi^*_r = (1 - \lambda_x - \lambda_y)\Delta \Pi_{xy}\).

\(^9\)We present the case in which \(\delta_x \leq V_x/2\). For \(\delta_x > V_x/2\) the argument proceeds with \(\Delta \Pi_{xy} < \Delta \Pi_x < \Delta \delta_x\).

\(^10\)We present the case in which \(\delta_x \leq V_x/2\). For \(\delta_x > V_x/2\), \(\Delta \Pi_x > 0\), \(\Delta \Pi_y = 0\), and the retailer’s profit is \(\Delta \pi^*_r = (1 - \lambda_x - \lambda_y)\Delta \Pi_{xy} + \lambda_y \Delta \Pi_x\). The proposition holds generally for firm \(X\) and firm \(Y\)’s profit.
With this type of information, the retailer’s profit increases only if it captures some of the increase in total channel profit. If the retailer can make take-it or leave-it offers \((\lambda_x = \lambda_y = 0)\), then \(\Delta \pi_r = \Delta \Pi_{xy}\) and the retailer clearly gains. If the retailer splits the gains from trade with each firm \((\lambda_x = \lambda_y = 1/2)\), then \(\Delta \pi_r = 0\) and the retailer’s profit is unchanged, while if the manufacturers can make take-it or leave-it offers \((\lambda_x = \lambda_y = 1)\), then \(\Delta \pi_r = -\Delta \Pi_{xy}\) and the retailer loses. At first, it may seem surprising that both manufacturers can gain at the expense of the retailer. To understand it, notice that since the marginal consumers’ valuation for product X increases when the retailer sells both products, the retailer can profitably raise prices, thus increasing total channel profit. However, the retailer cannot raise prices if it only sells one product, since the marginal consumer’s valuation is then unchanged. This means that total channel profit increases only if the retailer sells both products and, as a result, both manufacturers are in a position to bargain for better contract terms.

Another way of thinking about why both manufacturers can benefit from information that is of primary relevance to firm X’s core consumers is that the information tends to make the products less substitutable, which is generally good for the manufacturers and bad for the retailer. However, depending on its bargaining power, the retailer may be able to capture some of the resulting increase in channel profit, and thus it is possible that all three firms may gain.

3.4 Discussion

We have shown that positive information about a rival’s product need not be harmful to a firm if the information is of primary relevance to the rival’s core consumers.\(^{11}\) For example, Apple may benefit if consumers learn of more software titles for Windows 95 because CompUSA can only take advantage of the increase in consumers’ valuations for Microsoft if it also sells Apple computers. In contrast, Apple would be harmed by information about increased stability in the release of Windows 98. Such information would decrease the retailer’s dependence on Apple to serve consumers who care primarily about the ease of use of an operating system.

We have also shown that a retailer with little bargaining power can lose from information that increases consumers’ valuations for one of its products, even if it increases total channel profit. CompUSA, for example, need not benefit if consumers learn of more software titles for Windows 95. In contrast, CompUSA would benefit if consumers learn of more software for the MacOS since this information is of primary relevance to Apple’s non-core consumers. Intuitively, the channel members’ incentives are intertwined in a multi-product price discrimination that better segments consumers and allows all three firms to enjoy positive profits. How this

\(^{11}\)The analogue to this is that negative information about a rival’s product need not be beneficial to a manufacturer if the information is of primary relevance to the rival’s core consumers.
profit is allocated among the channel members depends in part on the role each party plays in segmenting the market. In the example of positive information about product X that is of relevance to firm X’s core consumers, the retailer is unable to use the information to further increase channel profit unless it sells both manufacturers’ products. This is what enables manufacturer Y to have the upper hand in negotiations with the retailer.

The distinction between core and non-core information thus has a dramatic effect on the division of profit among the members of a channel. Positive non-core information about product X hurts manufacturer Y and helps the retailer while positive core information about product X has the opposite effect in that it benefits manufacturer Y and can hurt the retailer.

4 Category information and the division of channel profits

The distinction between core and non-core information is also important in understanding how category information (i.e, information that is relevant to all products in the category) affects channel profits. Suppose consumers learn that the widespread adoption of the Java programming language is accelerating software development and leading to more software across all operating system platforms. Who gains and who loses? Compare this with a second example in which consumers learn that the main supplier of color LCD displays for notebook computers has dramatically improved its screens’ contrast, thus improving the legibility and usability of both MacOS and Windows 95 based notebooks. Do the same firm/s gain? Do the same firm/s lose? In both examples, the information is positive about all products in the category. Notice, however, that the information in the first example is more important to Microsoft’s customers, while the information in the second example is more important to Apple’s customers.

Since each manufacturer always gains from positive product information about its own product, one might think that both manufacturers would stand to gain from these examples and that, if anyone loses, it would be the retailer. Alternatively, one might think that Microsoft would be better off in the example with more software and that Apple would be better off in the example with improved LCD displays. Instead, the opposite is true. In many cases, Apple’s profit decreases and Microsoft’s profit increases when the information is more important to Apples’ customers and vice versa when the information is more important to Microsoft’s customers. The retailer is the only sure winner. It’s profit always increases in these examples.

4.1 Category information: The core vs. non-core distinction

We model the effect of category information that is more relevant to firm X’s core consumers as a rotation of both products’ consumers’ valuation curves around their intersections with the vertical line at 1 (this corresponds to shifting consumers’ valuations of product X and product
Y such that the new curves become $V_x + \Delta V_x - z(\delta_x + \Delta \delta_x)$ and $V_y - z(\delta_y + \Delta \delta_y)$, where $\Delta \delta_y < 0$ and $\Delta V_x = \Delta \delta_x = -\Delta \delta_y$. See Figure 7 for the case in which $\delta_i \leq V_i/2$.

Proposition 6 Suppose consumers learn positive (negative) category information that is of primary relevance to firm X’s core consumers. Then firm Y and the retailer’s profit increases (decreases) and firm X’s profit decreases (increases).

The price the retailer will charge when selling only product Y is determined by the marginal consumer located at 0, i.e., the consumer who cares most about usability. This consumer is the one whose valuation will rise most as a result of the new information, raising the value to the retailer of selling only product Y by $\Delta V_x$. Thus, $\Delta \Pi_y = \Delta V_x > 0$. The prices the retailer charges when it sells both products, however, must rise by less than $\Delta V_x$, for otherwise some consumers would drop out of the market. This implies that $\Delta \pi_x = \lambda_x (\Delta \Pi_{xy} - \Delta \Pi_y) < 0$. Firm Y gains from the increase in total channel profit and, since the information does not affect the marginal consumer located at 1, $\Delta \Pi_x = 0$. This implies that $\Delta \pi_y = \lambda_y (\Delta \Pi_{xy} - \Delta \Pi_x) > 0$.

The retailer’s profit can be written as $\Delta \pi_r = (1 - \lambda_x - \lambda_y) \Delta \Pi_{xy} + \lambda_x \Delta \Pi_y$, which is positive regardless of the distribution of bargaining power. If $\lambda_x = \lambda_y = 1$, then the retailer gains solely from the redistribution of profit with firm X. Otherwise, the retailer both gains from a redistribution of profit with firm X and captures some of the increase in total channel profit.

Since category information affects all products, the analysis of the core case is identical to the analysis of the non-core case with only the names of firms X and Y interchanged.

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If $V_i/2 < \delta_i \leq V_i/\sqrt{2}$ then the qualitative results remain unchanged. However, if $\delta_i > V_i/\sqrt{2}$, then whether firm X gains or loses depends on the size of the valuation changes (see the appendix). For large valuation changes, the change in firm X’s profit is the same as in Proposition 6, but for small valuation changes, firm X’s profit increases with positive information. The proposition holds generally for firm Y and the retailer’s profit.
Proposition 7 Suppose consumers learn positive (negative) category information that is of primary relevance to firm X’s non-core consumers. Then firm X and the retailer’s profit increases (decreases) and firm Y’s profit decreases (increases).\textsuperscript{13}

Propositions 6 and 7 imply that a manufacturer can lose from positive information about its product if this information increases consumers’ valuations for the rival’s product as well. Manufacturers gain if the category information is more relevant to their non-core consumers and lose if the information is more relevant to their core consumers. This begs the question of which firms would gain if the information is of equal relevance to all consumers.

4.2 Category information of equal relevance to all consumers

We model the effect of category information that is of equal relevance to all consumers as an equal upward shift in consumers’ valuations for products X and Y (this corresponds to shifting consumers’ valuations of product X and product Y such that the new curves become $V_x + \Delta V_x - z\delta_x$ and $V_y + \Delta V_y - (1 - z)\delta_y$, where $\Delta V_x = \Delta V_y > 0$). See Figure 8. For example, suppose consumers learn that the SAT scores of children who have a personal computer at home are on average higher than the SAT scores of children without a personal computer. This type of information affects all consumers equally; the study pertains both to the MacOS and to Windows 95 and the associated utility increase is uncorrelated with usability or the availability of application software. How does this affect the profit of each firm?

Proposition 8 Suppose consumers learn positive (negative) category information of equal relevance to all consumers. In the case of full market coverage ($\delta_i \leq V_i/2$), firm X and Y’s profits are unchanged and the retailer captures the entire increase (decrease) in channel profits. In the case of incomplete coverage ($\delta_i > V_i/2$), all channel members’ profits increase (decrease).

![Figure 8: Change in consumers’ valuations for products X and Y](image)

\textsuperscript{13}The proposition reports the results for $\delta_i \leq V_i/2$. For the case of $\delta_i > V_i/2$, see the previous footnote.
The increase in $V_x$ and $V_y$ shifts all consumers’ gross utilities from consuming products X and Y upward by $\Delta V = \Delta V_x = \Delta V_y$. Since the retailer will set prices in equilibrium to make the marginal consumer just indifferent between purchasing and not, we know that both prices will rise by $\Delta V$, resulting in an increase in total channel profit of $\Delta \Pi_{xy} = \Delta V > 0$.

If the retailer were to sell only one firm’s product, we distinguish between two cases, depending on whether a retailer would serve all consumers ($\delta_i \leq V_i/2$) or would leave some consumers unserved ($\delta_i > V_i/2$). If $\delta_i \leq V_i/2$, the retailer would raise prices by $\Delta V$, leading to an identical increase in its monopoly profit with manufacturer $i$, $\Delta \Pi_x = \Delta \Pi_y = \Delta V$. Hence, neither manufacturer can appropriate any of the added channel profit since $\Delta \pi_i = \lambda_i(\Delta \Pi_{xy} - \Delta \Pi_j) = 0$, $i \neq j$, and thus the retailer is the sole beneficiary of the shift in consumers’ valuations. On the other hand, if $\delta_i > V_i/2$, a price increase would only lead to increased revenues from a subset of consumers. Thus, each firm would be able to appropriate some of the added channel profit.\footnote{Proposition 8 holds when the shift in consumers’ valuations is symmetric. However, if the new information leads to an asymmetric increase in one of the products’ valuations, then it can be shown that one firm will gain and the other firm will lose despite the fact that the information is positive for all consumers.}

4.3 Discussion

The case in which information affects consumers unequally accentuates a key distinction between product and category information. In the case of product information about firm $X$, the core vs. non-core distinction determines whether firm $Y$ or the retailer gains, while in the case of category information, the distinction determines which of the two manufacturers gain.

We have found that a manufacturer always benefits from positive category information if such information primarily affects its rival’s core consumers. Apple, for example, benefits from news about the release of new software development tools that cut development times and increase the number of software titles on both operating systems. While such news also increases consumers’ valuations for Windows 95, the information increases CompUSA’s dependence on Apple to serve consumers whose primary concern is the ease of use of an operating system.

In both examples, the retailer gains irrespective of the consumer group for whom the information is most important. The parallel to this in the case of product information is that the manufacturer about whom the information is positive always benefits. However, for category information, these examples show that positive information about a manufacturer’s product does not imply that the manufacturer is better off. In fact, if the information is of equal relevance to all consumers, for instance, it may be that the retailer is the sole beneficiary.
5 Extensions and limitations

In this section, we consider extensions of the model to downstream competition, advertising and consumer learning, information provision, and non-information based changes in consumers’ valuations.

5.1 Retail competition

We have analyzed a model in which two manufacturers sell through a common retailer, and assumed that the retailer was a downstream monopolist. This allowed us to illustrate our results using simple diagrams. It also captures a common feature in retailing; many retailers carry a broad product line, often selling the products of competing manufacturers. Nonetheless it is useful to consider how the model extends to the case of downstream competition.

In most of the literature in which two manufacturers compete, manufacturers are assumed to sell through exclusive retailers (see McGuire and Staelin, 1983; Coughlan, 1985; Vickers, 1985; Fershtman and Judd, 1987; Bonanno and Vickers, 1988; Lin, 1988; Moorthy, 1988; Coughlan and Wernerfelt, 1989; Gal-Or, 1990, 1991; Shaffer, 1991b; Katz, 1991; and Gupta and Loulou, 1998). Recently this literature has been extended by Gabrielsen and Sorgard (1999).

Gabrielsen and Sorgard show that the division of profit that we identify, in which each manufacturer earns its product’s incremental contribution to overall channel profit, is robust to downstream competition. In their model, two manufacturers simultaneously choose their retail distribution system. The manufacturers can choose to sell through a common retailer, or the manufacturers can each choose to sell through an independent retailer. In the latter case, each retailer can choose from which manufacturer to buy. In both subgames (the subgame with the common retailer and the subgame with exclusive retailers) Gabrielsen and Sorgard show that, with take-it or leave-it offers, each manufacturer earns its product’s incremental contribution to overall channel profit. In particular in the subgame with exclusive retailers, each manufacturer’s profit is equal to the difference between the overall channel profit and the monopoly profit of the retailers with its rival if its product is not sold.

This is analogous to our findings in Proposition 2 for the case in which the manufacturers have all the bargaining power, with one difference. In our model, overall channel profit is maximized by the common retailer who internalizes all pricing decisions. In their model, downstream competition prevents overall channel profit from being maximized. Thus, the baseline of overall channel profit is different in the two models. Nonetheless, this difference is not crucial for our comparative static results, since these results rely only on the changes in each firm’s incremental contribution to channel profit, and not on the absolute level of total channel profit. This suggests that our model can extended in an important way to allow for
downstream competition.

Ideally, however, we would want to have a model with multiple upstream and downstream firms in which each retailer could sell the products of competing manufacturers. This turns out to be a difficult problem to solve in theory, and thus is a limitation of the model.\(^{15}\)

### 5.2 Provision of Information

We have assumed that information is supplied by third-parties. Our analysis can be extended, however, to consider the provision of this information by the channel members themselves. If one assumes that firms will provide information from which they gain, and withhold information (if possible) from which they lose, then our analysis has additional managerial relevance.

Table 1 summarizes the profit implications of each of the information types we consider. This leads to some generalizations about which channel members benefit from which type of information and hence which members would have an incentive to provide the information.

<table>
<thead>
<tr>
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<th>(\Delta \pi_y)</th>
<th>(\Delta \pi_r)</th>
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<td>− or +</td>
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<tr>
<td>all consumers equally</td>
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<td>−</td>
<td>+</td>
</tr>
<tr>
<td>primarily Y’s core consumers</td>
<td>+</td>
<td>−</td>
<td>+</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Positive category information affects (cases of less than full market coverage in parentheses)</th>
<th>(\Delta \pi_x)</th>
<th>(\Delta \pi_y)</th>
<th>(\Delta \pi_r)</th>
</tr>
</thead>
<tbody>
<tr>
<td>primarily X’s core consumers</td>
<td>− (+)</td>
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<tr>
<td>all consumers equally</td>
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<td>0 (+)</td>
<td>+</td>
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<tr>
<td>primarily Y’s core consumers</td>
<td>−</td>
<td>− (+)</td>
<td>+</td>
</tr>
</tbody>
</table>

Table 1: Profit implications of information

- Manufacturers always benefit from positive product information about their own product. Retailers always benefit from positive category information.
- A manufacturer benefits from positive product information about its rival’s product, and from positive category information, if such information pertains to its rival’s core consumers.
- Retailers benefit from positive product information if such information pertains to all consumers equally or to the product’s non-core consumers.

Thus, our analysis suggests that Apple but not Microsoft should be interested in informing consumers that “the widespread adoption of the Java programming language is accelerating

\(^{15}\)Chang (1992), Dobson and Waterson (1996), Lal and Villas-Boas (1996) and Lee and Staelin (1997) consider a two manufacturer-two retailer model in which each retailer can sell both manufacturers’ products. However, these papers restrict attention to supply contracts in which manufacturers specify wholesale prices only.
software development and leading to more software across all operating system platforms,”
and that Microsoft but not Apple should inform consumers that “the main supplier of color
LCD displays for notebook consumers has dramatically improved its screens’ contrast, thus
improving the legibility and usability of both MacOS and Windows 95 based notebooks.” In
both cases, it is in the interest CompUSA to assist in the information dissemination (the
information pertains to the category, from which the retailers are primary beneficiaries).

There are some limitations, however, of extending the analysis to consider the incentives of
each firm to provide information. In particular, it is based on three implicit assumptions. First,
it implicitly assumes that there is an information asymmetry between consumers and firms with
regard to the information in question. This may be violated in practice since firms sometimes
have no control over whether information becomes known to consumers or not. Second, it
implicitly assumes that the information provided by firms is verifiable, so that it is credible
to consumers. In reality, however, not all information that is provided by firms is believed by
all consumers. This is more problematic if the information comes from an interested party,
such as a manufacturer or retailer, but less problematic if consumers receive the information
from a credible third-party. To the extent that information provided to consumers is not
credible, this would obviously mitigate the effects of the information. Third, it implicitly
assume that consumers do not draw conclusions about possible negative information from the
fact that a firm withholds information from them. If this assumption is relaxed, firms would
be pressured to release more information than they would ideally want to give (to avoid any
negative connotations). Hence, our results should be interpreted with these cautions in mind.

5.3 Advertising, information, and consumer learning

We have categorized information by its effect on consumers’ valuations. Since the model does
not rely on a specific process by which information influences consumers’ valuations, our re-
sults apply to any advertising message (e.g., persuasive or image) that may affect consumers’
valuations. For example, Apple computer’s “Think Different” advertising campaign is clearly
targeted towards consumers who derive some utility from being non-conformist in their choice
of computer platform. Although the “Think Different” advertising message has little or no in-
formational value for consumers, its intended purpose is nonetheless to increase the valuations
of consumers that like to “be different,” presumably Apple’s core consumers. If it does so, then
the effect of such an advertising message corresponds to that of positive product information
of primary relevance to Apple’s core consumers, which our analysis suggests may be good for
Microsoft and may be good or bad for retailers depending on their bargaining power.

While modelling information this way allows for many processes by which advertising can
affect consumers’ valuations, it raises the question of whether one can derive the shifts in consumers’ valuations from first principles in a model in which information leads to consumer learning. It turns out that this is straightforward to do using a model of Bayesian updating in which consumers are uncertain about the true “quality” (maximum valuation) $V_x, V_y$ and true “fit” (rate at which utility decreases) $\delta_x, \delta_y$ for products X and Y, respectively.\footnote{We are happy to provide this analysis on request.}

5.4 Non-information based changes in consumers’ valuations

Evaluating the effect of information shocks on the division of profit in the distribution channel is a two-step process. First, we modelled the effect of new information on consumers’ valuations for all products in the market. Second, we performed comparative statics on each firm’s profit. The separation of these two steps enhances the applicability of the model. Since the division of channel profits depends on consumers’ valuations, we can analyze the effect on channel profits of other variables that influence consumers’ valuations for products in the market. For example, our framework can be used to analyze the profit implications of a new product introduction by a firm. Or we can use the framework to assess any value added that a retailer might offer.

Consider the latter possibility. In our model, the retailer did not add any value of its own. Suppose, instead, that retailers perform services that add to consumers’ valuations of each manufacturer’s product an amount equal to $\Delta V$.\footnote{We thank Anne Coughlan for raising this issue.} To analyze who gains and who loses, one can think of the retailer’s value added as corresponding to the case of positive category information that is equally relevant to all consumers. In this case, the retailer is the sole beneficiary of the change in consumers’ valuations. This has some interesting implications. It suggests that any value added by the retailer that is not biased between manufacturers’ products can be fully captured by the retailer. On the other hand, if the value added of the retailer is product specific, say it benefits Apple’s products but not Microsoft’s products, then we know from the analogous case of positive product information of equal relevance to all consumers that the retailer and Apple will share in the gains but that Microsoft will lose. In order to induce the appropriate level of retail service (from Apple’s perspective), therefore, it may be necessary for Apple to engage in cooperative subsidies with the retailer. We leave these topics for future research, but stress that a variety of such extensions can be handled within our framework.
6 Concluding remarks

This paper analyzes the factors that determine the outcome of manufacturer–retailer supply contract negotiations. We show that each manufacturer’s profit is a function of its product’s incremental contribution to total channel profit and its bargaining power vis-a-vis the retailer. Since a product’s incremental contribution is defined as the difference between overall joint profit and the monopoly profit of the retailer and rival firm, the bargaining outcome between a retailer and a manufacturer depends critically on the prevailing demand conditions of all products. This implies that the outcome of negotiations between a retailer and one manufacturer cannot be analyzed in isolation from the negotiations of that retailer with competing manufacturers.

In addition, we analyze the effect on each firm’s profit of changes in demand conditions that are induced by third-party information and advertising. We conceptualize information as having three components to its content, namely (1) the products to which the information pertains, (2) the consumers to whom the information is relevant, and (3) the effect that the information has on these consumers’ valuations. Which firms gain and which lose as a result of the information depends on the groups of consumers to whom the information is of primary relevance. We find that while a manufacturer always benefits from positive information about its own product, the core–non-core distinction determines whether the manufacturer’s rival or the retailer gain. In the case of positive category information, this distinction determines which of the two manufacturers gain, leaving the retailer always to benefit. Manufacturers benefit from information that increases consumers’ valuations for their respective core product and retailers benefit from information that increases non-core consumers’ valuations.

In addition to its managerial relevance, this paper makes two main theoretical contributions. First, we introduce to the literature the equilibrium division of profits between competing manufacturers selling through a common retailer using a bargaining framework. This framework allows us to analyze the interaction between firms’ bargaining power and changes to external demand. Second, we are the first to derive the effect of information provision on the division of channel profits, thereby contributing to the literature on channel management. To this purpose, we introduce a simple way of decomposing information and highlight the importance of distinguishing which firms’ core consumers are the primary targets of information. These results help understand the effect of advertising messages on different members of the channel and thus predicts which firms have incentives to choose specific types of advertising content.
APPENDIX

Proof of Proposition 2

Let $g_y(T_x, T_y)$ denote the retailer’s incremental gains from trade with firm $Y$:

$$p_x(x^{**})x^{**} + p_y(y^{**})y^{**} - T_x(x^{**} | w_x, F_x) - (p_x(x^*)x^* - T_x(x^* | w_x, F_x)). \tag{A-1}$$

Then, $F_y$ is chosen so that firm $Y$’s profit is equal to $\lambda_y g_y(T_x, T_y)$.

Let $g_x(T_x, T_y)$ denote the retailer’s incremental gains from trade with firm $X$:

$$p_x(x^{**})x^{**} + p_y(y^{**})y^{**} - T_y(y^{**} | w_y, F_y) - (p_y(y^*)y^* - T_y(y^* | w_y, F_y)). \tag{A-2}$$

Then, $F_x$ is chosen so that firm $X$’s profit is equal to $\lambda_x g_x(T_x, T_y)$.

**Lemma 1** The unique equilibrium $T^*_y$ has $w_y = 0$ and $F_y(w_x) \equiv \lambda_y g_y(T_x, (0, 0)) > 0$.

**Proof.** Since $F_y(w_x)$ is less than or equal to the incremental gains from trade between the retailer and firm $Y$, an increase in the fixed fee from zero to $F_y(w_x)$ does not cause the retailer to stop purchasing product $Y$, i.e., $g_y(T_x, (0, F_y(w_x))) > 0$. Define $\bar{x}(\omega) \equiv x^{**}(w_x, \omega, F_x, F_y(w_x))$ and $\bar{y}(\omega) \equiv y^{**}(w_x, \omega, F_x, F_y(w_x))$. We show that $w_y = 0$ maximizes the joint profit of the retailer and firm $Y$, given in (8). Suppose not. Then there exists $\bar{w}_y \neq 0$ such that

$$p_x(\bar{x}(\bar{w}_y))\bar{x}(\bar{w}_y) + p_y(\bar{y}(\bar{w}_y))\bar{y}(\bar{w}_y) - T_x(\bar{x}(\bar{w}_y) | w_x, F_x) > \tag{A-3}$$

$$p_x(\bar{x}(0))\bar{x}(0) + p_y(\bar{y}(0))\bar{y}(0) - T_x(\bar{x}(0) | w_x, F_x).$$

However, the definition of $x^{**}$ and $y^{**}$ implies that the first line in (A-3) is less than or equal to the second line. This establishes a contradiction. Since $g_y(T_x, (0, F_y(w_x))) > 0$, then $\bar{y}(0) > 0$, which implies that 0 is the unique maximizer in (8). Thus, $w_y = 0$. Since supplier $Y$’s disagreement payoff is zero, it is clear that, when $w_y = 0$, $F_y(w_x)$ gives supplier $Y$ its disagreement payoff plus proportion $\lambda_y$ of the gains from trade. Q.E.D.

**Lemma 2** The unique equilibrium $T^*_x$ has $w_x = 0$ and $F_x(w_y) \equiv \lambda_x g_x((0, 0), T_x) > 0$.

**Proof.** The proof of this lemma is analogous to the proof of the preceding lemma. Q.E.D.
We now use the results from the preceding lemmas to derive each firm’s equilibrium profit. Since each firm’s wholesale is zero, its equilibrium is equal to the fixed fee it negotiates with the retailer. Using lemmas 1 and 2, firm X’s profit is $F_x(0) = \lambda_x g_x((0, 0), (0, F_y(0)))$ and firm Y’s profit is $F_y(0) = \lambda_y g_y((0, F_y(0)), (0, 0))$. Note that since the unique equilibrium wholesale prices in stage one are zero, the retailer’s problem in (3) simplifies to

$$
\max_{x, y \geq 0} p_x(x)x + p_y(y)y - F_x(0) - F_y(0)
$$

such that $x + y \leq 1$.

The unique solution yields $x^{**} = x^{mm}$ and $y^{**} = y^{mm}$, i.e., the same quantities that maximize total channel profit. In addition, the retailer’s choice of $x$ if it were constrained not to sell product $Y$ would be $x^* = x^m$, and its choice of $y$ if it were constrained not to sell product $X$ would be $y^* = y^m$, i.e., the same quantities that maximize the monopoly profit of the retailer with each firm. Substituting these quantities into $F_x(0)$ and $F_y(0)$ yields $\pi_x = \lambda_x (\Pi_{xy} - \Pi_y)$, $\pi_y = \lambda_y (\Pi_{xy} - \Pi_x)$, and $\pi_r = \Pi_{xy} - \pi_x - \pi_y$, as was to be proved. Q.E.D.

**Proof of Propositions 3 through 8**

Recall from equation 2 on page 6 that in equilibrium the retailer prices at $p^{mm}_{x} = V_x - x^{mm} \delta_x$, $p^{mm}_{y} = V_y - (1 - x^{mm}) \delta_y$, where $x^{mm} = (2 \delta_y + V_x - V_y)/(2(\delta_x + \delta_y))$. The maximum revenue of the retailer or total channel profit is given by $\Pi_{xy} = p^{mm}_{x} x^{mm} + p^{mm}_{y} (1 - x^{mm})$.

Substituting equilibrium prices and market shares and after some simplifications we obtain:

$$
\Pi_{xy}(V_x, V_y, \delta_x, \delta_y) = \frac{(V_x - V_y)^2 + 4 V_x \delta_y - 4 \delta_x (V_y + \delta_y)}{4(\delta_x + \delta_y)}
$$

$$
\Pi_{x}(V_x, V_y, \delta_x, \delta_y) = \begin{cases} 
V_x^2/4 & \text{for } \delta_x > V_x/2 \\
V_x - \delta_x & \text{otherwise}
\end{cases}
$$

$$
\Pi_{y}(V_x, V_y, \delta_x, \delta_y) = \begin{cases} 
V_y^2/4 & \text{for } \delta_y > V_y/2 \\
V_y - \delta_y & \text{otherwise}
\end{cases}
$$

Let $\Delta \Pi_{xy} = \Pi_{xy}(V_x, V_y, \delta_x, \delta_y) - \Pi_{xy}(V_x + \Delta V_x, V_y + \Delta V_y, \delta_x + \Delta \delta_x, \delta_y + \Delta \delta_y)$ and define $\Delta \Pi_x$ and $\Delta \Pi_y$ analogously. Using proposition 2 we can then write the profit changes of each firm.
as a function of information induced changes in $V_x, V_y$ and $\delta, \delta_y$.

\[
\begin{align*}
\Delta \pi_x(\Delta V_x, \Delta V_y, \Delta \delta_x, \Delta \delta_y) &= \lambda_x(\Delta \Pi_{xy} - \Delta \Pi_y), \\
\Delta \pi_y(\Delta V_x, \Delta V_y, \Delta \delta_x, \Delta \delta_y) &= \lambda_x(\Delta \Pi_{xy} - \Delta \Pi_x), \\
\Delta \pi_r(\Delta V_x, \Delta V_y, \Delta \delta_x, \Delta \delta_y) &= \lambda_x \Delta \Pi_x + \lambda_y \Delta \Pi_y + (1 - \lambda_x - \lambda_y) \Delta \Pi_{xy}.
\end{align*}
\] (A-6)

By the assumption that a multiproduct monopolist serves all consumers located in $[0,1]$, $V_z > 1 - V_z$, which is equivalent to $V > \delta$ in the benchmark case. It can be easily shown that this condition also implies that the multiproduct monopolist serves all consumers after the valuation shifts considered in the propositions.

Propositions 3 to 8 specify the effect of information on consumers’ valuations as a change in $V_x, V_y, \delta_x$, and $\delta_y$. Evaluating (A-6) with the arguments corresponding to each proposition yields after some simplifications the following profit changes.

**Proposition 3** Let \(\{\Delta V_x, \Delta V_y, \Delta \delta_x, \Delta \delta_y\} = \{0, 0, -\mu, 0\}, \mu > 0\). We assume non-negative demand for product $i$ if the retailer sells product $i$ only, which is equivalent to a restriction on information shocks applied to the benchmark case, $\mu < \delta$.

Assume $V < 2\delta, \mu < \delta - V/2$. Then \(\Delta \pi_x, \Delta \pi_y, \Delta \pi_r = \{\frac{\delta \mu}{4\delta - 2\mu}, \frac{\delta \mu}{4\delta - 2\mu} + \frac{V^2 \mu}{4\delta^2 - 4\delta \mu} - \frac{\delta \mu}{4\delta^2 + 2\mu} + \frac{V^2 \mu}{4\delta^2 - 4\delta \mu}\}\). By $\mu < \delta$, $\Delta \pi_x > 0$. Also, $\partial \Delta \pi_y / \partial \mu < 0$ by $V > \delta$ and $\mu < \delta$. Hence, $\Delta \pi_y < 0$. Since $\Pi_y = 0$, $\Delta \pi_r = -\Delta \pi_x > 0$.

Assume $V < 2\delta, \mu \geq \delta - V/2$. Then \(\Delta \pi_x, \Delta \pi_y, \Delta \pi_r = \{\frac{\delta \mu}{4\delta - 2\mu}, -V + \frac{V^2 \mu}{4\delta^2 + 2\delta \mu} + \frac{\delta \mu}{4\delta^2 - 2\mu}, \frac{V^2 \mu}{4\delta^2 + 2\delta \mu} - \mu + \frac{\delta \mu}{4\delta^2 - 2\mu}\}\). By $\mu < \delta$, $\Delta \pi_x > 0$. Also, $\partial \Delta \pi_y / \partial \mu < 0$ by $\mu < \delta$. Evaluate $\Delta \pi_y$ at the smallest admissible $\mu = \delta - V/2$. The resulting function has a unique minimum at $V^*$ where $\delta < V^* < 2\delta$. Hence, the function is maximized at one of the endpoints $V = \delta, V = 2\delta$. Evaluating $\Delta \pi_y$ at $V = \delta, V = 2\delta$ shows $\Delta \pi_y < 0$. Since $\Pi_y = 0$, $\Delta \pi_r = -\Delta \pi_y > 0$.

Assume $V \geq 2\delta$. Then \(\Delta \pi_x, \Delta \pi_y, \Delta \pi_r = \{\frac{\delta \mu}{4\delta - 2\mu}, \left(-1 + \frac{\delta}{4\delta^2 - 2\mu}\right) \mu + \frac{\delta \mu}{4\delta^2 - 2\mu}\}\). By $\mu < \delta$, $\Delta \pi_x = \Delta \Pi_{xy}, \Delta \pi_y < 0$, and $\Delta \pi_r = -\Delta \pi_y > 0$. Hence the proposition holds.

**Proposition 4** Let \(\{\Delta V_x, \Delta V_y, \Delta \delta_x, \Delta \delta_y\} = \{\mu, 0, 0, 0\}, \mu > 0\).

Assume $V < 2\delta, \mu < 2\delta - V$. Then \(\Delta \pi_x, \Delta \pi_y, \Delta \pi_r = \{\frac{\mu (4\delta + \mu)}{8\delta}, -(\mu (4V - 4\delta + \mu)), \frac{\mu (4V - 4\delta + \mu)}{8\delta}\}\). $\Delta \pi_x > 0$ by inspection. By $V > \delta$, $\Delta \pi_y < 0$ and $\Delta \pi_r > 0$.

Assume $V < 2\delta, \mu \geq 2\delta - V$. Then \(\Delta \pi_x, \Delta \pi_y, \Delta \pi_r = \{\frac{\mu (4\delta + \mu)}{8\delta}, \frac{2V^2 + 8\delta^2 + \mu^2 - 4\delta (2V + \mu)}{8\delta}, \frac{V - \delta + \mu - 2V^2 + \mu^2}{8\delta}\}\). $\Delta \pi_x > 0$ by inspection. Under the assumptions, $\partial \Delta \pi_y / \partial \mu < 0$. Evaluate $\Delta \pi_y$ at the smallest admissible $\mu = 2\delta - V$. The resulting function has a unique minimum at $V = 4/(3\delta)$. Hence, the function is maximized at one of the endpoints $V = \delta, V = 2\delta$. Evaluating $\Delta \pi_y$ at $V = \delta, V = 2\delta$ shows $\Delta \pi_y < 0$. Since $\Pi_y = 0$, $\Delta \pi_r = -\Delta \pi_y > 0$. 

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Assume $V \geq 2\delta$. Then $\{\Delta \pi_x, \Delta \pi_y, \Delta \pi_r\} = \{(\frac{4(\delta+\mu)}{8\delta}, \frac{\mu(-4(\delta+\mu))}{8\delta}, -(\frac{\mu(-4(\delta+\mu))}{8\delta})\}$. To avoid degenerate solutions assume $|\Delta x^{mm}| < 1/2$. Since $x^{mm} = \mu/(4\delta)$, $\mu < 2\delta$. Thus, $\Delta \pi_x = \Delta \Pi_{xy}$, $\Delta \pi_y < 0$, and $\Delta \pi_r = -\Delta \pi_y > 0$. Hence the proposition holds.

**Proposition 5** Let $\{\Delta V_x, \Delta V_y, \Delta \delta_x, \Delta \delta_y\} = \{\mu, 0, \mu, 0\}, \mu > 0$.

Assume $V < 2\delta$. Then $\{\Delta \pi_x, \Delta \pi_y, \Delta \pi_r\} = \{\frac{\mu}{4}, \frac{(-V+\delta)^2}{4(\delta+\mu)} - \frac{(-V+\delta)^2\mu}{4(\delta+\mu)}\}$. $\Delta \pi_x, \Delta \pi_y > 0$, and $\Delta \pi_r < 0$ by inspection.

Assume $V \geq 2\delta, \mu \geq V-2\delta$. Then $\{\Delta \pi_x, \Delta \pi_y, \Delta \pi_r\} = \{\frac{\mu}{4}, \frac{(-V+\delta)^2}{4(\delta+\mu)} - \frac{(-V+2\delta+\mu)^2}{4(\delta+\mu)}\}$. $\Delta \pi_x > 0$ by inspection. Also, $\frac{\partial \Delta \pi_x}{\partial \mu} > 0$. Evaluated at the smallest admissible $\mu = V-2\delta$, $\Delta \pi_y \geq 0$ by $V \geq 2\delta$. Since $\Pi_y = 0$, $\Delta \pi_r = -\Delta \pi_y > 0$.

Assume $V \geq 2\delta, \mu < V-2\delta$. Then $\{\Delta \pi_x, \Delta \pi_y, \Delta \pi_r\} = \{\frac{\mu}{4}, \frac{-\mu}{4}\}$. Clearly, $\Delta \pi_x = \Delta \pi_y = \Delta \Pi_{xy}$ and $\Delta \pi_r = -\Delta \pi_x = -\Delta \pi_y < 0$. Hence the proposition holds.

**Proposition 6** Let $\{\Delta V_x, \Delta V_y, \Delta \delta_x, \Delta \delta_y\} = \{\mu, 0, \mu, -\mu\}, \mu > 0$. We assume non-negative demand for product $i$ if the retailer sells product $i$ only, which is equivalent to a restriction on information shocks applied to the benchmark case, $\mu < \delta$.

Assume $V < 2\delta, \mu < \delta - V/2$. Then $\{\Delta \pi_x, \Delta \pi_y, \Delta \pi_r\} = \{\frac{\mu}{4} + \frac{\mu}{8\delta}, \frac{\mu}{4} + \frac{\mu}{8\delta}\}$. $\Delta \pi_x < 0$ at the largest admissible $\mu$. Let $\delta < V < \sqrt{2}\delta$. One can easily show that there exists exactly one $\mu^* > 0$ such that $\Delta \pi_x = 0$ at $\mu^*$. Also, $\frac{\partial \Delta \pi_x}{\partial \mu} > 0$ at $\mu = 0$. Let $\sqrt{2}\delta \leq V < 2\delta$. Then there is no $\mu^* > 0$ such that $\Delta \pi_x = 0$ at $\mu^*$. Also, $\frac{\partial \Delta \pi_x}{\partial \mu} \leq 0$ at $\mu = 0$. The claims regarding $\Delta \pi_x$ hold by continuity of $\Delta \pi_x$. $\Delta \pi_y$ is minimized at $V = \delta$. Evaluating $\Delta \pi_y$ at $V = \delta$ shows $\Delta \pi_y > 0$. The numerator of $\Delta \pi_r$ is minimized in the admissible parameter range at $V = \delta$ and is positive. By $\mu < \delta$, $\Delta \pi_x > 0$.

Assume $V < 2\delta, \mu \geq \delta - V/2$. Then $\{\Delta \pi_x, \Delta \pi_y, \Delta \pi_r\} = \{\frac{2V^2 + 8\delta^2 + \mu^2 - 4\delta(2V + \mu)}{8\delta}, \frac{\mu(2V^2 - 4V\delta + 4\delta^2 + 3\delta \mu + 2\mu)}{8\delta(\delta + \mu)}\}$. $\Delta \pi_x < 0$ at the largest admissible $\mu$. Let $\delta < V < 10\delta/9$. One can easily show that there exists exactly one $\mu^* \geq \delta - V/2$ such that $\Delta \pi_x = 0$ at $\mu^*$. Also, $\Delta \pi_x > 0$ at $\mu = \delta - V/2$. Let $10\delta/9 \leq V < 2\delta$. Then there is no $\mu^* > \delta - V/2$ such that $\Delta \pi_x = 0$ at $\mu^*$. Also, $\frac{\partial \Delta \pi_x}{\partial \mu} < 0$ at $\mu = \delta - V/2$. The claims regarding $\Delta \pi_x$ hold by continuity of $\Delta \pi_x$. $\Delta \pi_y$ is minimized at $V = \delta$. Evaluating $\Delta \pi_y$ at $V = \delta$ shows $\Delta \pi_y > 0$. Approximating $\frac{\partial \Delta \pi_x}{\partial \mu}$ from below using $\delta - V/2 \leq \mu < \delta$ and $V < 2\delta$ shows $\frac{\partial \Delta \pi_x}{\partial \mu} > 0$. Evaluate $\Delta \pi_r$ at the smallest admissible $\mu = \delta - V/2$. The denominator of the resulting function is negative by $V < 2\delta$. The numerator is negative for $\delta < V < 2\delta$. Hence, $\Delta \pi_r > 0$.

Assume $V \geq 2\delta, \mu \geq V - 2\delta$. Then $\{\Delta \pi_x, \Delta \pi_y, \Delta \pi_r\} = \{\frac{\mu(-4\delta + \mu)}{8\delta}, \frac{2(-V+2\delta+\mu)^2}{8(\delta+\mu)} - \frac{\mu^2(4\delta+\mu)}{8\delta}\}$. $\Delta \pi_x < 0$ by $\mu < \delta$. $\frac{\partial \Delta \pi_x}{\partial \mu} \geq 0$ by $\mu \geq V - 2\delta$. Evaluate $\Delta \pi_y$ at
the smallest admissible $V = 2\delta$ shows $\Delta \pi_y > 0$. \[ \frac{\partial \Delta \pi_x}{\partial \mu} \leq 0 \text{ by } \mu \geq V - 2\delta. \] Notice that by $\delta > \mu \geq V - 2\delta$ and $V \geq 2\delta$, $2\delta \leq V < 3\delta$. Evaluate $\Delta \pi_r$ at the largest admissible $V = 3\delta$. This shows $\Delta \pi_r > 0$.

Assume $V \geq 2\delta, \mu < V - 2\delta$. Then \( \{ \Delta \pi_x, \Delta \pi_y, \Delta \pi_r \} = \{ \mu(-4\delta + \mu), \frac{\mu(4\delta + \mu)}{8\delta}, \frac{\mu(-4\delta + \mu)}{8\delta} \} \).

Since $\mu < \delta$, $\Delta \pi_y = \Delta \Pi_{xy}$, $\Delta \pi_x < 0$, and $\Delta \pi_r = -\Delta \pi_x > 0$. Hence the proposition holds.

**Proposition 7** The analysis is identical to that in Proposition 6 with only the names of firms X and Y interchanged.

**Proposition 8** Let \( \{ \Delta V_x, \Delta V_y, \Delta \delta_x, \Delta \delta_y \} = \{ \mu, \mu, 0, 0 \}, \mu > 0. \)

Assume $V < 2\delta, \mu < 2\delta - V$. Then \( \{ \Delta \pi_x, \Delta \pi_y, \Delta \pi_r \} = \{ \mu - \frac{\mu(2V + \mu)}{4\delta}, \mu - \frac{\mu(2V + \mu)}{4\delta}, \frac{\mu(2V - 2\delta + \mu)}{2\delta} \} \).

\[ \frac{\partial \Delta \pi_i}{\partial \mu} > 0, i = x, y, r. \]

Assume $V < 2\delta, \mu \geq 2\delta - V$. Then \( \{ \Delta \pi_x, \Delta \pi_y, \Delta \pi_r \} = \{ \frac{(V - 2\delta)^2}{4\delta}, \frac{(V - 2\delta)^2}{4\delta}, \frac{2V^2 - 2\delta - 2\delta + \mu}{2\delta} \} \).

$\Delta \pi_x, \Delta \pi_y > 0$ by inspection. Also $\frac{\partial \Delta \pi_r}{\partial \mu} = 1$. Evaluated at the smallest admissible $\mu = 2\delta - V$, $\Delta \pi_r > 0$ by $\delta < V < 2\delta$.

Assume $V \geq 2\delta$. Then \( \{ \Delta \pi_x, \Delta \pi_y, \Delta \pi_r \} = \{ 0, 0, \mu \}. \) Clearly, $\Delta \pi_x = \Delta \pi_y = 0$ and $\Delta \pi_r = \Delta \Pi_{xy} > 0$. Hence the proposition holds.

Q.E.D.
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