

## CHANNEL COORDINATION MECHANISMS FOR CUSTOMER SATISFACTION

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We consider two broad categories of incentives by which a manufacturer can motivate its retailers to provide high customer satisfaction: (1) manufacturer assistance that reduces the retailer's cost of providing customer satisfaction (CS assistance); and (2) customer satisfaction index (CSI) bonus. We show that if a retailer has a long-term orientation, CS assistance is a more effective coordination mechanism that induces the retailer to expend more effort at customer satisfaction. However, if the retailer has a short-term orientation, CSI bonus is a more effective coordination mechanism. We then show that a long-term oriented retailer is more valuable to a manufacturer than a short-term oriented one. Finally, we show that the use of CS incentives results in greater profits for both the manufacturer and the retailer.  
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### 1. Introduction

Many corporations throughout the world have implemented company-wide customer satisfaction programs.<sup>1</sup> Implementation of such programs has gone hand-in-hand with the management's realization that the customer should be thought of as an annuity rather than a one time transaction. The objective then is to make the entire ownership experience, as opposed to just the purchase experience, trouble free and satisfying for the customer.

Customer satisfaction is first-and-foremost the responsibility of the employees of the manufacturer (or the franchiser). However, for many products, the retailer (dealer, or franchisee) represents the manufacturer in front of the customer. Finkelman and Goland (1990) describe this idea well when they state that "As the manufacturer's front line, distribution partners are a critical element in the delivery of customer satisfaction. They often control the sales, service, delivery, and installation experiences of the customer . . . low satisfaction with a retailer quickly translates into low satisfaction with and, therefore low repurchase loyalty to the manufacturer. Happily, the reverse is also true."

Despite the importance of the retailer's role in customer satisfaction, much of the current academic literature has neglected it and instead focused on (i) how consumers

<sup>1</sup> Examples of US manufacturers cited in Hauser, Simester, and Wernerfelt (1994) are GTE, Montgomery Ward, Procter and Gamble, and IBM. Other examples in the automobile industry are Chrysler, Saturn, and Lexus. Japanese manufacturers that have implemented customer satisfaction programs cited in Nihon Keizai Shimbun, March 26, 1992, are Matsushita, Hitachi, Sony, Toyota, Nissan, Kao and Japan Airline among others.

form satisfying or dissatisfying beliefs, (ii) ways to measure customer satisfaction, and (iii) ways to motivate and compensate employees of the manufacturer to provide high customer satisfaction.<sup>2</sup> In this paper we acknowledge the importance of the retailer and examine ways that a manufacturer can help or motivate its retailer to provide an appropriate contribution to customer satisfaction.

### *Customer Satisfaction Incentives*

There is more than one way to motivate retailers to enhance customer satisfaction. Some manufacturers motivate retailers by pointing out the intrinsic satisfaction that comes from serving the customer well. For example, Keounders and Chu (1993) and McGahan and Keller (1995) describe how Saturn convinced its retailer network to buy into its philosophy of providing the highest level of customer satisfaction at the dealership. Toyota's Lexus division's in-house training program stresses that customer satisfaction should be the retailer's key concern.<sup>3</sup> Other manufacturers stress that satisfied customers will repeat purchase from the same retailer. In addition, some manufacturers use monetary rewards under the assumption that the effort to increase the level of customer satisfaction at the retailer level will be most effective if, in addition to intrinsic motivation, the manufacturer can provide specific tangible support and monetary rewards.

Although there exists a seemingly large number of reward mechanisms to motivate the retailer to increase customer satisfaction, we categorize them into two general classes. (The examples are from the automobile industry.)

(1) *Rewards Based on Customer Satisfaction*: Often manufacturers give lump-sum monetary rewards to retailers based on some measure of customer satisfaction (e.g., Chrysler). We refer to them as Customer Satisfaction Index Bonus (CSI bonus).

(2) *Investment Assistance to Improve Customer Satisfaction (CS Assistance)*: A manufacturer's investment to reduce the retailer's cost of improving customer satisfaction. In this broad category, we include incentives such as: investments in training the retailer's employees (e.g. Chrysler, Ford, Lexus, Saturn); "loaning" own employees to help retailers provide high levels of customer service (e.g. Toyota and Nissan in Japan); free consulting services (e.g. Saturn, Lexus), investments in systems to increase parts availability (e.g., Volvo, General Motors), etc.<sup>4</sup>

When the measurement of CSI is very difficult, or equivalently, if there exists large measurement error, CSI bonus may not be feasible and CS assistance will be a more effective method of supporting retailers. However, assuming that CSI bonuses are feasible, the question is what is the proper balance of CSI bonus and CS assistance.

### *Relative Importance of CSI Bonus and CS Assistance*

We examine the issue of the relative importance of CS assistance and CSI bonus in a given CS incentive program. We begin with the assumption, as in Hauser, Simester, and Wernerfelt 1994, that higher customer satisfaction results in greater demand in the future. We also assume that retailers are more short-term oriented (i.e., discount future income more heavily) than the manufacturer. Finally, we assume that demand is linear and that the manufacturer sets a single wholesale price rather than a quantity discount schedule.

<sup>2</sup> See Yi (1990) for a review of how customers form satisfying or dissatisfying beliefs; and Cronin and Taylor (1992) for a review of measurement of customer satisfaction. Peters (1987) discusses ways to motivate employees of the manufacturer, and Hauser, Simester, and Wernerfelt (1994) examine how to compensate them.

<sup>3</sup> Source: Lexus Customer Satisfaction Department's internal document.

<sup>4</sup> Chrysler references are from the *Wall Street Journal* (June 30, 1992) and *Automotive Executive* (September 1992, May 1993); the Saturn reference is from a case study by Keounders and Chu (1993); the Lexus references are from an internal customer satisfaction document and private communication with a Lexus manager at Toyota Motor Sales in California; the Toyota and Nissan references are from private communication with a Toyota manager in Tokyo and a manager at the Japanese Automobile Dealers Association in Tokyo; the Volvo reference is from *Fleet Owner* (February 1993); and the GM reference is from *Communications News* (1991).

Given these assumptions, we show that the proportion of CSI bonus in the CS incentive system should be greater the more short-term oriented the retailer is. We also find that the manufacturer needs a smaller CS incentive program/package as the retailer becomes more long-term oriented.

The intuition for these results is as follows. The retailer incurs costs today while the benefits of customer satisfaction to the retailer come in the future. Therefore, a retailer discounting future income heavily will not exert the proper effort at customer satisfaction. The manufacturer attempts to reduce this disincentive to exert CS effort by rewarding the retailer in the current period for high CSI. Therefore, even though the short-term oriented retailer is not motivated by future rewards from repeat purchase, it is motivated by the CSI bonus in the current period. In contrast, a retailer not heavily discounting the future is willing to exert more effort to achieve high levels of customer satisfaction. For this type of retailer, investments by the manufacturer to reduce the marginal cost of retailer's effort (i.e., CS assistance) will be valued more.

In the automobile industry, certain manufacturers (e.g., Saturn and Lexus) do not pay their retailers bonuses for high CSI; instead, they help their retailers by providing free training and consultation on how to increase customer satisfaction (i.e., CS assistance). These franchises are also those that require the most upfront *long-term* investment from their franchisees before a franchise is awarded. Therefore, it is likely that these retailers are more long-term oriented.<sup>5</sup> This observation seems to be consistent with our intuition that, in equilibrium, manufacturers will tend to use more CS assistance and less CSI bonus when motivating long-term oriented retailers.

We also show that a long-term oriented retailer is more valuable to the manufacturer than a short-term oriented one, and that the implementation of customer satisfaction coordination mechanisms results in greater profits for both the manufacturer and the retailer. Finally, we find that a manufacturer is more likely to increase its own efforts at customer satisfaction if the retailer is more long-term oriented.

These results are derived under the assumption that the manufacturer sets a single wholesale price and does not precommit to a future wholesale price. In §4, we show that these results generalize to a more general demand function and a different channel setting. This new setting allows us to use a more general demand function and have the manufacturer use quantity discounts and precommit to a second-period wholesale price. In this way, we are able to focus solely on the customer satisfaction problem because the other issues such as price coordination (i.e., double marginalization) and move sequencing are removed through the use of a quantity discount and wholesale price precommitment. Even in this second model, the equilibrium customer satisfaction coordination mechanisms exhibit most of the characteristics derived in the first model.

#### *Related Literature*

As customer satisfaction management has taken on increasing importance, we have begun to see models that attempt to quantify the relationship between the determinants of customer satisfaction to overall customer satisfaction and those that show the relationship between customer satisfaction and outcome measures such as intention to repurchase and profitability (Churchill and Suprenant 1982; Anderson and Sullivan 1993; Boulding, Kalra, Staelin, and Zeithaml 1993; Anderson, Fornell, and Lehmann 1994; Kekre, Krishnan and Srinivasan 1995). Concurrently, much effort has been made to increase the reliability and validity of customer satisfaction measures (Cronin and Taylor 1992).

Interestingly, only one study, Hauser, Simester, and Wernerfelt (1994; hereafter, HSW) has used these customer satisfaction measures to provide customer satisfaction incentives.

<sup>5</sup> Keonders and Chu (1993) and private communication with a Lexus manager at Toyota Motor Sales in California.

Specifically, they describe the optimal way to provide customer satisfaction incentives to the manufacturer's employees. Starting from the premise that employees have a more short-term orientation than the manufacturer, they first outline desirable properties of a customer-satisfaction based incentive system, and then examine a reward system which is a function of the number of units sold and the customer satisfaction index.

While HSW's focus is on incentive systems for company employees, we focus on those for retailers. There are also other substantial differences between the two models. In our paper, the retailer (or agent) has authority over price-setting, vs. HSW's manufacturer. Also, we model two different types of CS coordination mechanisms (i.e., CS assistance and CSI bonus) vs. HSW's one CSI bonus.

The rest of the paper is organized as follows. Section 2 presents a model of a manufacturer using incentives to induce greater levels of customer satisfying effort from the retailer. Section 3 explores the properties of the equilibrium customer satisfaction incentive mechanisms. Section 4 generalizes results of §3, under a different channel setting where the manufacturer sets a quantity discount schedule and precommits to a future wholesale price. Section 5 discusses the implications of our results and suggests areas of future research.

## 2. A Model of Channel Coordination Mechanisms for Customer Satisfaction

In this section, we consider a model in which a manufacturer charges a wholesale price in each period and cannot precommit to a future wholesale price. This structure is quite realistic, and there are numerous precedents in the marketing channels literature (e.g., McGuire and Staelin 1983, Chu 1992, Purohit and Staelin 1994) for these assumptions.

Since the focus of our model is on incentive systems and not intra-channel competition, we only consider a single manufacturer selling through a single retailer. Our model does not include free-rider problems among multiple retailers. However, our results are not likely to change in the case of a single manufacturer selling through many *noncompeting* retailers.

### *Short-term Selling Versus Customer Satisfying Effort*

The marketing literature suggests that customer satisfaction is the result of consumers' post-purchase evaluation of the consumption experience (Yi 1990; Anderson and Sullivan 1993; Boulding, Kalra, Staelin, and Zeithaml 1993; Anderson, Fornell and Lehmann 1994). Therefore, customer satisfaction affects *future* demand and *future* profitability. To model the effect of present efforts on future sales, we consider a two-period model wherein second period demand increases with first period customer satisfaction.

Similar to HSW, we model two types of selling efforts made by retailers. One type of effort increases short-term sales. Examples of such efforts could be promotion, spot advertisements, and high pressure selling. While such efforts may increase sales in the short run, they do not help future demand of the firm's products. We refer to such effort as short-term selling effort. On the other hand, efforts to provide adequate information about how best to use and maintain the product, quick and safe delivery, quick response to customer problems after the sale has been made may not help current sales, but will increase future demand. We refer to this type of effort as the customer-satisfying effort.<sup>6</sup>

The manufacturer, like the retailer, can influence present and future demand through current actions. Given our focus on CS mechanisms, we consider only the customer-satisfying efforts by the manufacturer.<sup>7</sup> For clarity, we call the effort of the retailer as customer-satisfying effort, and the effort of the manufacturer as simply, manufacturer's

<sup>6</sup> HSW refer to these two types of effort as ephemeral and enduring effort, respectively.

<sup>7</sup> We thank an anonymous reviewer for the suggestion to include the manufacturer's customer-satisfying effort.

effort. Examples of manufacturer's effort could include producing high quality products and increasing brand-building advertising expenditures. We have modeled the manufacturer's effort as being an imperfect substitute for the retailer's customer satisfaction effort. This is more realistic since a manufacturer cannot exactly replicate all the efforts of its retailers. If the manufacturer's efforts are perfect substitutes for the retailer's effort, then only one party needs to undertake CS efforts (see Doraiswamy, McGuire and Staelin 1979 for a model of perfectly substitutable advertising effort).

#### *Present and Future Demands*

First, we assume that the channel system (i.e., manufacturer-retailer system) has been in the market long enough to have established a reputation of  $g$  at the start of period 1. The retailer in period 1 selects price,  $p_1$ , and the levels of short-term selling effort,  $a$ , and customer-satisfying effort,  $b$ . As discussed above, the short-term selling effort has the effect of increasing current demand by shifting the demand function by  $a$ . On the other hand, the customer-satisfying effort increases future demand by  $b$ . Equivalently, we may think of customer-satisfying effort as increasing the reputation of the channel system from  $g$  in period 1 to  $g + b$  in period 2. In period 2, the retailer simply sets price,  $p_2$ .<sup>8</sup> The manufacturer decides on the level of manufacturer's effort,  $e$ , in period 1. For each additional unit of manufacturer's effort  $e$ , the second period demand increases by  $k$  ( $k \geq 0$ ). Therefore, the demand function for periods 1 and 2 are

$$Q_1 = g + a - p_1, \quad (1)$$

$$Q_2 = g + b + ke - p_2, \quad (g > 0, k \geq 0) \quad (2)$$

where  $Q_i$  is units sold in period  $i$  ( $i = 1, 2$ ); and  $p_i$  is price in period  $i$ . The linear demand function has been used quite extensively in modeling channel and marketing phenomena (e.g., Jeuland and Shugan 1983, McGuire and Staelin 1983, Chu 1992, and HSW 1994).

#### *Cost of Effort and the CS Incentive Program*

The cost of both types of retailer's effort is assumed to be convex to capture the notion that the marginal cost of effort is increasing. Said differently, the retailer's total cost of effort and its cost of undertaking an additional unit of effort increase as the effort level increases, viz., we assume the costs of retailer's short-term selling and customer-satisfying efforts to be  $a^2$  and  $b^2$ , respectively, without any manufacturer CS assistance. The cost of the manufacturer's effort is  $e^2$ .

The manufacturer's incentive program to the retailer consists of two components. The manufacturer can either make investments that will help lower the retailer's cost of providing customer satisfaction (i.e., CS assistance), or the manufacturer can pay the retailer a bonus for a high customer satisfaction index (CSI bonus). We assume that the manufacturer incurs convex costs in providing CS assistance. In particular, the manufacturer invests  $x_b^2$  in reducing the cost of customer-satisfying efforts to the retailer. The benefits of these investments to the retailer is the reduction in its costs by  $bx_b$  for the customer-satisfying effort.<sup>9</sup> We define  $bx_b$  as CS assistance. Thus, the net cost to the retailer of its customer-satisfying effort is:

$$C(b) = b(b - x_b). \quad (3)$$

<sup>8</sup> We can also have the retailer setting the level of short-term selling effort in period 2. However, since our main focus is on the trade-off between short-term selling and customer-satisfying effort in the first period, we simplify our model by not modeling short-term selling effort in the ending period (i.e., period 2). Although the inclusion of short-term selling effort in period 2 would not be difficult, it does not add any additional intuition beyond our current model. Therefore, we have our current formulation. HSW also assume a similar model.

<sup>9</sup> We could also have modeled investments by the manufacturer to reduce the retailer's short-term selling effort; however, since our focus is more on the customer-satisfying effort to improve CS, we did not model such investments.

The second form of CS incentive program, the CSI bonus, is modeled as a lump sum payment from the manufacturer to the retailer that is a function of CSI. Although the manufacturer cannot accurately measure the customer-satisfying effort of the retailer, we assume that CSI is an unbiased estimator of the customer-satisfying effort.<sup>10</sup> Specifically,  $CSI = b + \epsilon$ , where  $\epsilon$  is random error with zero mean. We assume that a manufacturer pays  $\eta$  for each unit of CSI. The amount of CSI bonus, therefore, is  $\eta$  CSI. Since we assume that both the manufacturer and the retailer are risk-neutral, the amount of CSI bonus is represented as  $\eta b$  without further loss of generality.

#### *Differences in Discount Factors*

We assume that the retailer discounts future profits more than the manufacturer. To capture these differences, we normalize the manufacturer's discount factor to 1 and assign a discount factor of  $\delta$  ( $< 1$ ) to the retailer. The retailer may discount future more than the manufacturer for several reasons. For example, the retailer may not be around to collect the rewards of high customer satisfaction if the customer moves to another location. The retailer may be replaced by the manufacturer. It is also possible that the manufacturer may have lower cost of capital due to diversified product portfolio, diversified sources of capital, or larger size.<sup>11</sup>

#### *Manufacturer's and Retailer's Problems*

We now describe the decision problems facing each party. Letting  $w_i$  be the wholesale price in period  $i$  ( $i = 1, 2$ ), the retailer's profit function is

$$\pi = \pi_1 + \delta\pi_2 \quad \text{where} \quad (4)$$

$$\pi_1 = (p_1 - w_1)Q_1 - a^2 - b(b - x_b) + \eta b, \quad \text{and} \quad (5)$$

$$\pi_2 = (p_2 - w_2)Q_2. \quad (6)$$

The term  $(p_1 - w_1)Q_1$  is the gross margin from sales in period 1;  $a^2$  and  $b(b - x_b)$  are the costs to the retailer of short-term selling and customer-satisfying effort net of CS assistance, respectively;  $\eta b$  is the amount of CSI bonus received from the manufacturer ( $\eta \geq 0$ ); and  $\delta(p_2 - w_2)Q_2$  is the present value of second period profit.

Since the manufacturer's cost of production is not the focus of this research, we set it to zero without loss of generality. Thus, the manufacturer's profit function is

$$\Pi = \Pi_1 + \Pi_2 \quad \text{where} \quad (7)$$

$$\Pi_1 = w_1Q_1 - x_b^2 - e^2 - \eta b, \quad \text{and} \quad (8)$$

$$\Pi_2 = w_2Q_2. \quad (9)$$

Since the manufacturer does not discount future revenue,  $w_1Q_1$  and  $w_2Q_2$  are the gross margins from sales in periods 1 and 2, respectively. (Table 1 provides a summary of notation.)

The stages of the game are as follows.

Period 1: Stage 1. The manufacturer sets  $(w_1, x_b, \eta, e)$ . Stage 2. The retailer sets  $(p_1, a, b)$ .

Period 2: Stage 3. The manufacturer sets  $w_2$ . Stage 4. The retailer sets  $p_2$ .

<sup>10</sup> We thank the editor for suggesting that CSI is a fallible measure.

<sup>11</sup> Although we assume that  $\delta < 1$ , there may be cases where the manufacturer's discount factor is smaller than the dealer's discount factor, i.e.,  $\delta \geq 1$ . Fortunately our results do not depend on this assumption. In fact, we can show that as long as  $\delta$  is not much larger than 1, most of our results hold.

TABLE I  
Summary of Notation

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CS:	Customer Satisfaction
CSI:	Customer Satisfaction Index
$a$ :	short-term selling effort
$b$ :	customer-satisfying effort (which directly translates into CSI)
$e$ :	manufacturer's (customer-satisfying) effort
$\eta$ :	amount of bonus paid per unit of CSI
$\eta_b$ :	amount of CSI bonus paid by the manufacturer to its retailer
$x_b$ :	level of CS assistance
$x_b$ :	manufacturer's expenditure for CS assistance
$bx_b$ :	CS assistance (Total amount of cost reduction of customer-satisfying effort: actual benefit received by the retailer)
$bx_b + \eta b$ :	CS incentive program
$a^2$ :	retailer's cost of short-term selling effort
$b(b - x_b)$ :	retailer's net cost of customer-satisfying effort
$Q_i$ :	demand in period $i$
$p_i$ :	(retail) price in period $i$
$w_i$ :	wholesale price in period $i$
$\delta$ :	discount factor used by retailer
$\pi_i$ :	profit of the retailer in period $i$
$\pi$ :	the sum of retailer's profits in period 1 and period 2
$\Pi_i$ :	profit of the manufacturer in period $i$
$\Pi$ :	the sum of the manufacturer's profits in period 1 and period 2

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### 3. Optimal Coordination Mechanism

We solve for a subgame-perfect equilibrium, which stipulates that in each stage of the game, the player making the move accepts the strategies already played as given and optimizes forward. We derive our equilibrium results by solving our game backwards to ensure a subgame-perfect equilibrium (see Kreps 1990 for more details on subgame-perfect equilibrium). That is, we first solve the retailer's problem in Stage 4, treating all the other variables as given. We then substitute the optimal value of retail price in Stage 4, into the manufacturer's problem in Stage 3, and solve for the manufacturer's optimal wholesale price. We then substitute the optimal wholesale and retail price in Stages 3 and 4 into the retailer's problem in Stage 2, and solve for the retailer's problem. Finally, we substitute the optimal strategies of Stages 2, 3, and 4 into the manufacturer's problem in Stage 1, and solve for the optimal manufacturer's strategy. This yields the equilibrium solution in Table 2.

We now state our first proposition.

**PROPOSITION 1.** *In the unique subgame perfect equilibrium, the manufacturer uses both CS assistance and CSI bonus.*

**PROOF.** Both  $x_b^*$  and  $\eta^*$  are positive in Table 2's equilibrium solution.

Proposition 1 shows that the manufacturer uses both CS assistance and CSI bonus to motivate the retailer to make greater customer-satisfying effort. Since the retailer discounts future profits, the retailer will have less incentive to expend customer-satisfying effort today while receiving its benefit in the future. The manufacturer can counter this disincentive by offering CSI bonus in the first period. The CSI bonus transfers the retailer's benefits of high CS from period 2 to period 1. Also, the retailer bears the cost of CS effort while the benefits of high customer satisfaction are shared by both parties. Consequently, the CS assistance reduces the costs of CS effort and motivates the retailer to higher CS effort. Thus, by using both CSI bonus and CS assistance, the manufacturer motivates the retailer to provide a greater level of customer satisfaction.

TABLE 2  
Equilibrium

Stage 1:	wholesale price	$w_1^* = g/2$
	level of CS assistance	$x_\delta^* = 8g(2 + \delta)/(416 - 32\delta - 56k^2 - \delta^2k^2)$
	bonus per unit of CSI	$\eta^* = 2g(24 - 16\delta + \delta^2)/(416 - 32\delta - 56k^2 - \delta^2k^2)$
	manufacturer's effort	$e^* = gk(56 + \delta^2)/(416 - 32\delta - 56\delta^2 - \delta^2k^2)$
Stage 2:	price in period 1	$p_1^* = (2g + w_1)/3$
	short-term selling effort	$a^* = (g - w_1)/3$
	customer-satisfying effort	$b^* = (\delta g + \delta ke + 8\eta + 8x_\delta)/(16 - \delta)$
Stage 3:	wholesale price in period 2	$w_2^* = (g + b + ke)/2$
Stage 4:	retail price in period 2	$p_2^* = (g + b + ke + w_2)/2.$

### The Impact of Discount Factor

We may further characterize the nature of the optimal coordination mechanism as follows.

**PROPOSITION 2.** *The proportion of CSI bonus in the equilibrium CS incentive program increases as the retailer becomes more short-term oriented. On the other hand, the proportion of CS assistance in the CS incentive program increases as the retailer becomes more long-term oriented.*

**PROOF.** See Appendix A.

This proposition states that as the retailer becomes more long-term oriented, the magnitude of CSI bonus ( $\eta^*b^*$ ) will decrease while CS assistance ( $b^*x_\delta^*$ ) will become more prominent in the CS incentive program ( $\eta^*b^* + b^*x_\delta^*$ ).

The intuition for this proposition is as follows. The retailer needs to incur costs today while the benefits of customer satisfaction come in the future. The smaller the value of  $\delta$ , the more averse the retailer is to exerting efforts at customer satisfaction. One way that the manufacturer can reduce this disincentive is to reward the retailer in the current period for high CSI. Even though the retailer with small  $\delta$  is not motivated by future sales caused by increasing period 1's customer satisfaction, he is motivated by period 1 CSI bonus, which is a measure of this satisfaction.

On the other hand, when  $\delta$  is large, the retailer is motivated by future rewards from repeat purchase. For such a retailer, a direct reward from CSI bonus is not as essential as it is with a short-term oriented retailer. Also, a long-term oriented retailer is willing to exert more effort than a short-term oriented retailer to achieve high levels of customer satisfaction. Therefore, investments by the manufacturer to reduce the marginal cost of effort of the retailer will be valued more by the long-term oriented retailer than a short-term oriented one. In this way, the long-term oriented retailer prefers a higher level of CS assistance and a lower level of CSI bonus.

We can also show that the relative value of retailers to the manufacturer depends on  $\delta$ .

**PROPOSITION 3.** *The manufacturer's profit is an increasing function of the retailer's discount factor,  $\delta$ .*

**PROOF.** See Appendix A.

Proposition 3 indicates that the retailer's long-term orientation is valuable to the manufacturer. The intuition is that *ceteris paribus*, if the retailer is more long-term oriented, the manufacturer can induce the same amount of customer-satisfying effort with a lower level of external reward.

This proposition suggests that the manufacturer's efforts to make the retailer more long-term oriented will pay off in terms of higher profits for the manufacturer. Possible

ways to increase this long-term orientation are requiring franchisees to invest in transaction-specific assets; requiring retailers to advertise; and helping retailers with family succession problems.

#### *Manufacturer's (Customer-Satisfying) Effort*

The manufacturer's effort also varies with  $\delta$ .

PROPOSITION 4. *The manufacturer's equilibrium effort is an increasing function of the retailer's discount factor  $\delta$ .*

PROOF. See Appendix A.

The intuition for this result is the following. The manufacturer's effort also affects second period demand. Higher effort by the manufacturer, *ceteris paribus*, increases the second period demand, and enables the retailer to enjoy a higher per-unit profit margin. Therefore, the manufacturer's effort (in stage 1) *indirectly* affects the retailer's choice of second period price (stage 4) and first-period customer-satisfying effort (stage 2). In particular, higher customer-satisfying effort by manufacturer allows both parties to enjoy higher per unit profit margins and encourages the retailer to make greater customer-satisfying effort. These effects become stronger as the retailer's discount factor increases. The manufacturer takes into account these effects while choosing its effort. As a result, though the manufacturer does not discount future, its choice of its effort is indirectly affected by the retailer's discount factor.

#### *Pareto-improving Function of the CS Incentive Program*

Finally, we prove that the use of CSI bonus and CS assistance increases the profit of both the manufacturer and the retailer.

PROPOSITION 5. *Both the manufacturer and the retailer benefit from the use of CSI bonus and CS assistance.*

PROOF. See Appendix A.

It is easy to see that adding CS assistance and CSI bonus to the list of manufacturer's options increases the degree of freedom in the manufacturer's actions and results in a positive gain for the manufacturer. However, for the retailer, more degrees of freedom in the manufacturer's strategies could imply a greater ability of the manufacturer to extract the retailer's surplus. Fortunately for the retailer, this is not the case here. The reason is that the total channel profits increase with the use of CS package. Moreover, neither CSI bonus nor CS assistance directly transfers profits from the retailer to the manufacturer.

In the next section we examine the characteristics of customer satisfaction coordination mechanisms under a more general demand function.

### 4. A Model with Quantity Discounts and Precommitment

In the previous section we used a linear demand function to derive our results. In this section we consider a more general demand function and examine a model where the manufacturer uses a two-part tariff and precommits to a future wholesale price. We consider a model with two-part tariff and precommitment for several reasons. First, in the model of §§2 and 3, the customer satisfaction problem, the focus of this paper, cannot be separated from other channel problems such as price coordination (double marginalization) and move sequencing. The model in this section allows us to isolate the customer satisfaction problem from these other problems. In addition, using the two-part tariff also simplifies channel interactions between the manufacturer and the retailer and allows us to generalize our findings to a more general demand function. Finally, it also allows

us to analyze the role of CS incentives when the manufacturer can use two-part tariffs. We discuss the final point in more detail below.

Two-part tariffs can be viewed as a form of a quantity discount since the average price of the product is decreasing as more quantity is purchased (Dolan 1987). Dolan (1987) not only explores the theoretical properties of different types of quantity discounts, but also gives many real-world examples of them. Several marketing papers (Jeuland and Shugan 1983, McGuire and Staelin 1986, Moorthy 1987, Desai and Srinivasan 1995) have examined properties of two-part tariffs in resolving channel coordination problems. An important finding of these papers is that the manufacturer can solve downstream coordination problems when the manufacturer can transfer all rents from the retailer by a fixed fee.<sup>12</sup> In particular, by making the retailer "residual claimant," the manufacturer can motivate the retailer to take effort that maximizes the channel profits. In such a setting, the manufacturer also has incentives to set appropriate price schedule because its profit is identical to the total channel profit. Moorthy and Fader (1990) and Lee and Staelin (1995) extend the framework of Bulow et al. (1985) of strategic substitutes and strategic complements to vertical interactions between manufacturers and retailers. They define vertical strategic substitutability as a vertical strategic interaction in which if a manufacturer (retailer) raises its margin, the retailer (manufacturer) finds it optimal to lower its margin. Lee and Staelin (1995) find that price leadership is more profitable to the manufacturer when the environment is characterized by vertical strategic substitutability.

These results indicate that in our model the manufacturer may be able to resolve customer satisfaction coordination by being the Stackelberg leader and using two-part tariffs. However, it is not clear if the manufacturer would need customer satisfaction incentives in addition to two-part tariffs. More importantly, if the manufacturer finds it optimal to use any customer satisfaction incentives, how would it balance CSI bonus and CS assistance?

We develop a model with a more general demand function and two-part tariffs to address these issues. The difference between our earlier model and the model in this section can be described as follows.

- (1) The manufacturer sets a two-part tariff  $w_i$  and  $f_i$  ( $i = 1, 2$ ) where  $f_i$  is the fixed fee.
- (2) The manufacturer precommits to second period tariff  $(w_2, f_2)$  in stage one.

Therefore, the game proceeds in three stages.

Period 1: Stage 1. The manufacturer sets  $(w_1, f_1, w_2, f_2, x_b, \eta, e)$ . Stage 2. The retailer sets  $(p_1, a, b)$ .

Period 2: Stage 3. The retailer sets  $p_2$ .

- (3) We allow for a more general demand function with the following characteristics.

- (i) The demand in each period is negatively affected by the price in that period.

$$\frac{\partial q_1}{\partial p_1} < 0, \quad \frac{\partial q_2}{\partial p_2} < 0.$$

- (ii) First-period demand increases at a decreasing rate as the short-term selling effort  $a$  increases. Similarly, second-period demand increases at a decreasing rate as customer-satisfying effort of the retailer  $b$  and the manufacturer's effort  $e$  increase.

$$\begin{aligned} \frac{\partial q_1}{\partial a} > 0, & \quad \frac{\partial q_2}{\partial b} > 0, & \quad \frac{\partial q_2}{\partial e} > 0. \\ \frac{\partial^2 q_1}{\partial a^2} < 0, & \quad \frac{\partial^2 q_2}{\partial b^2} < 0, & \quad \frac{\partial^2 q_2}{\partial e^2} < 0. \end{aligned}$$

<sup>12</sup> Retailer profit in excess of its reservation utility is called rent.

(iii) The demand function in period 1 is separable in  $p_1$ , and  $a$ , while the demand function in period 2 is separable in  $p_2$ ,  $b$ , and  $e$ .

$$\frac{\partial^2 q_1}{\partial p_1 \partial a} = 0, \quad \frac{\partial^2 q_2}{\partial p_2 \partial b} = \frac{\partial^2 q_2}{\partial p_2 \partial e} = \frac{\partial^2 q_2}{\partial b \partial e} = 0.$$

By restricting our attention to demand functions separable in price and efforts, we rule out multiplicative and exponential demand functions. Moorthy and Fader (1990) and Lee and Staelin (1995) show that these two demand functions do not show vertical strategic substitutability.<sup>13</sup>

(4) We consider general cost functions where the costs of  $a$ ,  $b$  and  $e$  are  $v(a)$ ,  $v(b)$  and  $v(e)$ , respectively. The function  $v(\cdot)$  increases at an increasing rate as its argument increases:  $v(0) = 0$ ,  $v'(\cdot) \geq 0$ ,  $v''(\cdot) \geq 0$ . The manufacturer's cost of CS assistance is  $c(x_b)$  which also increases at an increasing rate as  $x_b$  increases:  $c(0) = 0$ ,  $c'(\cdot) \geq 0$ ,  $c''(\cdot) > 0$ . The benefit of CS assistance to the retailer is  $i = i(b, x_b)$ , which increases at a decreasing rate as  $b$  and  $x_b$  increase.

$$i = 0 \quad \text{if } x_b = 0 \text{ or } b = 0 \quad \text{and} \quad \frac{\partial i}{\partial x_b} = 0 \quad \text{if } x_b = 0 \text{ or } b = 0.$$

(5) Since the manufacturer can extract all the retailer's profits with a fixed fee, the retailer will agree to this game only if it is guaranteed a minimum profit. Therefore, the manufacturer must guarantee a minimum profit of  $\bar{\pi}$  to the retailer in each period, or its equivalent amount in net present value terms.

(6) Since we are working with general demand functions, we assume that the profit functions of the retailer and the manufacturer are concave in their arguments such that (a) the set of first-order conditions characterize the maximum and (b) a solution to the first-order conditions exist.

We show that this price schedule maximizes the joint payoffs (total channel profit).

**PROPOSITION 6.** *When the manufacturer sets a quantity discount schedule and it precommits its wholesale prices, the equilibrium strategies of the channel members maximize the total channel profit.*

**PROOF.** See Appendix B.

In this equilibrium, total channel profit is maximized because the two-part tariff solves the double marginalization problem and the customer satisfaction incentive issue is solved by the manufacturer's ability to precommit its wholesale price and its use of CS incentives. It should also be stated that in the above equilibrium, the problem arising from retailer's short-termism is solved entirely. This is because the manufacturer can transfer money without changing the retailer's incentives through a fixed fee. As a result, the manufacturer pays the retailer for both periods in the first period, while paying the retailer zero in the second period. We now explore the characteristics of this coordinated equilibrium further.

**PROPOSITION 7.** *In the coordinated equilibrium, (a) the manufacturer uses both CSI bonus and CS assistance; (b) the proportion of CSI bonus in the CS incentive program is a decreasing function of the discount factor; (c) total channel profits are increased by the use of CSI bonus and CS assistance.*

**PROOF.** See Appendix B.

In Proposition 7, we are able to replicate Propositions 1 through 3 of our first model. We are also able to argue that Proposition 5 is replicated, if we assume that the manufacturer and the retailer agree to share additional profits that arise from the implementation

<sup>13</sup> Recall that Lee and Staelin (1995) show that price leadership is profitable only in vertical strategic substitutability environments.

of CS incentives. The intuition for Proposition 7 is the same as that of Propositions 1 through 3, and 5, and they will not be repeated here.<sup>14</sup>

Propositions 6 and 7 also have interesting implications for channel efficiency. Wernerfelt (1994) develops an "efficiency criterion" to compare different structures through which a manufacturer and a retailer could conduct trade. Wernerfelt (1994) defines a gameform as "a specific product design, an allocation of manufacturing tasks, and a process (a game)" through which a seller and a buyer may explore possibilities of trade. An equilibrium fails Wernerfelt's efficiency criterion if (1) there exists an equilibrium of the given gameform that Pareto dominates the given equilibrium, or (2) there exists another gameform with an equilibrium that Pareto dominates the given equilibrium.<sup>15</sup> In other words, an equilibrium is not efficient if the trading parties can find a gameform and equilibrium thereof in which both parties are better off. Since finding a gameform and an equilibrium that meet the efficiency criterion is difficult, Wernerfelt (1994) suggests that if side payments are feasible, and if transaction and monitoring cost are zero, the efficiency criterion is equivalent to joint payoff maximization. Since the equilibrium in this section maximizes the total channel profits, it meets the efficiency criterion proposed by Wernerfelt (1994).

The possibility of side payments also has interesting implications for the retailer's equilibrium profit. Since the retailer can get its reservation utility ( $\bar{\pi}$ ) in any other outcome, it has no reason to play the above equilibrium unless the manufacturer lets it have a profit more than  $\bar{\pi}$ . Therefore, in the above equilibrium, the retailer will get a profit (weakly) greater than  $\bar{\pi}$ .

In summary, the results of the previous section generalize to a model with more general demand function and two-part tariffs.

## 5. Conclusions

Corporations increasingly realize that keeping a customer is less costly than attracting a new customer. An important way to retain present customers is to provide a high level of customer satisfaction. As a result, ways to achieve high customer satisfaction are gaining increasing attention. In this paper, we have considered the problem of motivating retailers to provide high levels of customer satisfaction. Retailers' efforts at customer satisfaction are especially important in situations where the manufacturers have limited direct contact with its customers. In such situations, retailers often represent the whole corporation in front of the customers.

Unfortunately, there is a large gap in the academic literature on the role of retailers in ensuring customer satisfaction. This paper has attempted to fill the gap by explicitly considering means to motivate the retailer to provide high customer satisfaction.

We first consider a model with uniform pricing and two broad classes of mechanisms (i.e., a CS assistance and a CSI bonus). We derive the following important results.

- We find that a manufacturer is better-off using both CS assistance and CSI bonus. Our results indicate a manufacturer should use a higher proportion of CSI bonus when its retailers are more short-term oriented. On the other hand, when retailers are more long-term oriented, a manufacturer should use a higher proportion of CS assistance.
- Our results also indicate that manufacturers are better-off with more long-term oriented retailers. A manufacturer can assess its retailers short/long termism through frequent contacts with them, and can screen out retailers with very short-term orientation by asking for high initial investments. It is unlikely that retailers with very short-term orientation would agree to high initial investments.

<sup>14</sup> Unfortunately, we have not been able to generalize Proposition 4, because of mathematical intractability.

<sup>15</sup> An outcome Pareto dominates another outcome if all relevant parties are (weakly) better off with the former.

- We find that a retailer is also better-off with CSI bonus and CS assistance incentives. This is especially important in that the manufacturer's use of more instruments results in an increase in the total channel profit. Retailers sometimes resent manufacturers' efforts to develop customer satisfaction programs (see, for example, *Wall Street Journal* June 30, 1992). Our results indicate that CSI bonus and CS assistance do not adversely affect the retailer.

Most of our results also generalize to a model with more general demand and cost functions in which the manufacturer can use fixed fees in addition to wholesale prices.

Finally, we may see analogous phenomena to the one we have modeled in other areas of marketing. For example, a brand manager may have a conflict between investing in short-term selling effort (e.g., promotional activity) versus long-term brand-building effort (e.g., advertising). A salesperson can invest in selling to current customers or prospecting for new customers. Also, a top manager may have a conflict between maximizing current period profits versus investing in R&D, which increases future profits. In the analysis of these phenomenon, Hauser, Simester, and Wernerfelt's (1994) or our model may serve as a useful starting point.

In this paper, we only examined the economic mechanisms associated with motivating a retailer to provide greater customer satisfaction. However, equally important is how the manufacturer can make its retailer "buy into" its philosophy regarding customer satisfaction. It seems that more research into this issue is needed. In looking at this issue of "value sharing," perhaps a sociological or macro-organizational approach will provide more insight than a purely economic one.<sup>16</sup>

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#### Appendix A: Uniform Pricing Model

The solution in Table 2 is derived using the first-order conditions. Using the Table 2 values, we prove propositions 2-5 as follows.

**PROOF OF PROPOSITION 2.** Let  $R = \eta^*b^*/(\eta^* + x_b^*)b^*$ . Substituting the values from Table 2,

$$R = \frac{24 - 16\delta + \delta^2}{32 - 12\delta + \delta^2}, \quad \frac{\partial R}{\partial \delta} = \frac{4(-56 + 4\delta + \delta^2)}{(8 - \delta)^2(4 - \delta)^2} < 0. \quad \text{Q.E.D.}$$

**PROOF OF PROPOSITION 3.** The manufacturer's optimal profit  $\Pi^*$  after substituting the values from Table 2 is

$$\Pi^* = \frac{g^2(752 - 32\delta + 6\delta - 56k^2 + \delta^2k^2)}{6(416 - 32\delta - 56k^2 + \delta^2k^2)}.$$

$$\frac{\partial \Pi^*}{\partial \delta} = \frac{32g^2(56 + 26\delta - \delta^2)}{(416 - 32\delta - 56k^2 + \delta^2k^2)^2} > 0 \quad \text{for} \quad \forall \delta \in (0, 1). \quad \text{Q.E.D.}$$

**PROOF OF PROPOSITION 4.**

$$e^* = \frac{gk(56 + \delta^2)}{(416 - 32\delta - 56k^2 - \delta^2k^2)}.$$

Note that the numerator is increasing in  $\delta$  and the denominator is decreasing in  $\delta$ . Therefore,  $e^*$  increases with  $\delta$ . Q.E.D.

**PROOF OF PROPOSITION 5.** The manufacturer can do no worse than not using  $x_b$ , and  $\eta$  since it can always set these to zero. The retailer's profit as a function of  $\{w_1, \eta, x_b, e\}$  is  $\pi^* = A/B$  where  $B = 3(16 - \delta)$  and

$$A = (16 + 2\delta)g^2 + (6\delta gk + 3\delta k^2 e) - (32g - 2g)w_1 \\ + (16 - \delta)w_1^2 + (3\delta g + 3ke + 12\eta)\eta + (3\delta g + 3\delta ke + 24\eta + 12x_b)x_b.$$

It is easy to see that  $\pi^*$  increases with  $x_b$  and  $\eta$ . Q.E.D.

#### Appendix B: Efficient Contract

**PROOF OF PROPOSITION 6.** We first consider the total channel profit to characterize the channel optimal levels of prices and efforts.

The total channel profit is

$$\Pi^c = p_1 q_1 - v(a) - v(b) + i(x_b, b) - c(x_b) - v(e) + p_2 q_2.$$

The optimal prices and efforts are characterized by the following first-order conditions:

$$\frac{\partial \Pi^c}{\partial p_1} = (p_1) \frac{\partial q_1}{\partial p_1} + q_1 = 0, \quad (\text{B1})$$

$$\frac{\partial \Pi^c}{\partial p_2} = (p_2) \frac{\partial q_2}{\partial p_2} + q_2 = 0, \quad (\text{B2})$$

$$\frac{\partial \Pi^c}{\partial a} = (p_1) \frac{\partial q_1}{\partial a} - v'(a) = 0, \quad (\text{B3})$$

$$\frac{\partial \Pi^c}{\partial b} = (p_2) \frac{\partial q_2}{\partial b} - v'(b) + \frac{\partial i}{\partial b} = 0, \quad (\text{B4})$$

$$\frac{\partial \Pi^c}{\partial x_b} = \frac{\partial i}{\partial x_b} - c'(x_b) = 0, \quad (\text{B5})$$

$$\frac{\partial \Pi^c}{\partial e} = (p_2) \frac{\partial q_2}{\partial e} - v'(e) = 0. \quad (\text{B6})$$

Now we consider the contract with precommitted wholesale prices, fixed fees, CS assistance and CSI bonus. We show that the optimal contract with this contractual form maximizes the total channel profit. The manufacturer's profit

$$\Pi = w_1 q_1 + f_1 - \eta b - c(x_b) - v(e) + w_2 q_2 + f_2.$$

The retailer profits  $\pi = \pi_1 + \delta \pi_2$  where

$$\pi_1 = (p_1 - w_1)q_1 - v(a) - v(b) + (\eta)b + i(b, x_b) - f_1 \quad \text{and} \quad \pi_2 = (p_2 - w_2)q_2 - f_2.$$

In each period, the manufacturer can transfer the retailer's profit above  $\bar{u}$  through the fixed fee without affecting the retailer's price or effort decisions. Therefore,

$$f_1^* = (p_1 - w_1)q_1 - v(a) - v(b) + (\eta)b + i(b, x_b) - \bar{u} \quad \text{and} \quad f_2^* = (p_2 - w_2)q_2 - \bar{u}.$$

After substituting the values of  $f_1^*$  and  $f_2^*$  in the manufacturer's profit function, the manufacturer's maximization problem is as follows:

$$\text{Max } p_1 q_1 + p_2 q_2 - v(a) - v(b) - v(e) + i(b, x_b) - c(x_b) - 2\bar{u} \quad (\text{B7})$$

$$\text{s.t. } (p_1 - w_1) \frac{\partial q_1}{\partial p_1} + q_1 = 0, \quad (\text{B8})$$

$$(p_2 - w_2) \frac{\partial q_2}{\partial p_2} + q_2 = 0, \quad (\text{B9})$$

$$(p_1 - w_1) \frac{\partial q_1}{\partial a} - v'(a) = 0, \quad (\text{B10})$$

$$\delta(p_2 - w_2) \frac{\partial q_2}{\partial b} - v'(b) + \eta + \frac{\partial i}{\partial b} = 0. \quad (\text{B11})$$

The constraints (B7)–(B11) represent the retailer's price and effort decisions after accepting the contract. The manufacturer takes the retailer's choices in consideration while designing the contract offer and recommending price and effort levels. These constraints are called incentive compatibility constraints in the principal-agent literature.

The Lagrangean for the manufacturer's maximization problem is

$$L = p_1 q_1 + p_2 q_2 - v(a) - v(b) - v(e) + i(b, x_b) - c(x_b) - 2\bar{u} - m_1 \left[ (p_1 - w_1) \frac{\partial q_1}{\partial p_1} + q_1 \right] \\ - m_2 \left[ (p_2 - w_2) \frac{\partial q_2}{\partial p_2} + q_2 \right] - m_3 \left[ (p_1 - w_1) \frac{\partial q_1}{\partial a} - v'(a) \right] - m_4 \left[ \delta(p_2 - w_2) \frac{\partial q_2}{\partial b} - v'(b) + \eta + \frac{\partial i}{\partial b} \right],$$

where  $m_1, m_2, m_3, m_4$  are the Lagrangean multipliers for the constraints (B8)–(B11). The first-order conditions for the manufacturer's maximization problem are characterized by (B12)–(B20) below.

$$\frac{\partial L}{\partial \eta} = -\delta m_4 = 0. \quad (\text{B12})$$

Therefore,  $m_4 = 0$ .

$$\frac{\partial L}{\partial w_2} = -m_2(-1) \left( \frac{\partial q_2}{\partial p_2} \right) - m_4(-1) \delta \left( \frac{\partial q_2}{\partial b} \right) = 0 \quad \text{or} \quad m_2 = 0 \quad (\text{from (B12)}), \quad (\text{B13})$$

$$\frac{\partial L}{\partial x_b} = \frac{\partial i}{\partial x_b} - c'(x_b) - m_4 \frac{\partial^2 i}{\partial b \partial x_b} = 0 \quad \text{or} \quad \frac{\partial i}{\partial x_b} - c'(x_b) = 0, \quad (\text{B14})$$

$$\frac{\partial L}{\partial p_2} = p_2 \frac{\partial q_2}{\partial p_2} + q_2 = 0, \quad (\text{B15})$$

$$\frac{\partial L}{\partial b} = p_2 \frac{\partial q_2}{\partial b} - v'(b) + \frac{\partial i}{\partial b} = 0, \quad (\text{B16})$$

$$\frac{\partial L}{\partial p_1} = p_1 \frac{\partial q_1}{\partial p_1} + q_1 - m_1 \left[ (p_1 - w_1) \frac{\partial^2 q_1}{\partial p_1^2} + 2 \frac{\partial q_1}{\partial p_1} \right] = 0, \quad (\text{B17})$$

$$\frac{\partial L}{\partial a} = p_1 \frac{\partial q_1}{\partial a} - v'(a) - m_1 \left( \frac{\partial q_1}{\partial a} \right) - m_3 \left[ (p_1 - w_1) \frac{\partial^2 q_1}{\partial a^2} - v''(a) \right] = 0, \quad (\text{B18})$$

$$\frac{\partial L}{\partial w_1} = m_1 \left( \frac{\partial q_1}{\partial p_1} \right) - m_3 \left( \frac{\partial q_1}{\partial a} \right) = 0, \quad (\text{B19})$$

$$\frac{\partial L}{\partial e} = (p_2) \frac{\partial q_2}{\partial e} - v'(e) = 0. \quad (\text{B20})$$

Comparing (B9) and (B15),  $w_2 = 0$ .

From (B8),

$$p_1 \frac{\partial q_1}{\partial p_1} + q_1 = w_1 \frac{\partial q_1}{\partial p_1}.$$

As  $w_1 \geq 0$  and  $\partial q_1 / \partial p_1 < 0$ ,  $p_1(\partial q_1 / \partial p_1) + q_1 \leq 0$ . From (B17),

$$m_1 \left[ (p_1 - w_1) \frac{\partial^2 q_1}{\partial p_1^2} + 2 \frac{\partial q_1}{\partial p_1} \right] = p_1 \frac{\partial q_1}{\partial p_1} + q_1.$$

Therefore,

$$w_1 \frac{\partial q_1}{\partial p_1} = m_1 \left[ (p_1 - w_1) \frac{\partial^2 q_1}{\partial p_1^2} + 2 \frac{\partial q_1}{\partial p_1} \right] \leq 0.$$

Since

$$(p_1 - w_1) \frac{\partial^2 q_1}{\partial p_1^2} + 2 \frac{\partial q_1}{\partial p_1}$$

is negative for the retailer's second-order condition to be satisfied,  $m_1 \geq 0$ . Also,

$$w_1 = m_1 \left[ 2 + \frac{(p_1 - w_1) \frac{\partial^2 q_1}{\partial p_1^2}}{\partial q_1 / \partial p_1} \right].$$

Therefore,  $w_1 \geq m_1$ . Rearranging (B18),

$$m_3 \left[ (p_1 - w_1) \frac{\partial^2 q_1}{\partial a^2} - v''(a) \right] = (p_1 - m_1) \frac{\partial q_1}{\partial a} - v'(a).$$

As  $w_1 > m_1$ ,

$$m_3 \left[ (p_1 - w_1) \frac{\partial^2 q_1}{\partial a^2} - v''(a) \right] = (p_1 - m_1) \frac{\partial q_1}{\partial a} - v'(a) \geq (p_1 - w_1) \frac{\partial q_1}{\partial a} - v'(a).$$

As

$$(p_1 - w_1) \frac{\partial q_1}{\partial a} - v'(a) = 0 \quad \text{from (B10),}$$

$$m_3 \left[ (p_1 - w_1) \frac{\partial^2 q_1}{\partial a^2} - v''(a) \right] = (p_1 - m_1) \frac{\partial q_1}{\partial a} - v'(a) \geq 0.$$

Since

$$(p_1 - w_1) \frac{\partial^2 q_1}{\partial a^2} - v''(a) \leq 0$$

for the retailer's second-order conditions to be satisfied, the above implies that  $m_3 \leq 0$ . But from (B19) and the fact that  $m_1 \geq 0$ , we get  $m_3 \geq 0$ . Therefore,  $m_3 = 0$ . This in turn also implies that  $m_1 = 0$  (from B19). Therefore, comparing (B8) and (B17), we get,  $w_1^* = 0$ . Thus, the contract is characterized by  $w_1^* = 0$ ,  $w_2^* = 0$ .

Now we rewrite Equation (B17) with  $w_1^* = 0$ ,  $w_2^* = 0$ , and  $m_i = 0$ ,  $i = 1, 2, 3, 4$ .  $(p_1)(\partial q_1 / \partial p_1) + q_1 = 0$ . This equation is identical to (B1). (B15) is identical to (B2). After substituting for the values of the Lagrangean multipliers and the optimal wholesale prices in (B18), we get:

$$(p_1) \frac{\partial q_1}{\partial a} - v'(a) = 0 \quad (\text{identical to (B3)}).$$

(B16) is identical to (B4).

(B14) is identical to (B5).

(B20) is identical to (B6).

Thus, the solution to the above program can replicate the channel optimal solution described by (B1)–(B6). Therefore, the solution to the above maximization problem maximizes the total channel profit. Q.E.D.

PROOF OF PROPOSITION 7(a). From (B11),

$$\eta^* = -\delta(p_2) \frac{\partial q_2}{\partial b} + v'(b) - \frac{\partial i}{\partial b}. \quad (\text{B21})$$

In (B16)  $\partial q_2 / \partial b > 0$ . Therefore,

$$\delta p_2 \frac{\partial q_2}{\partial b} - v'(b) + \frac{\partial i}{\partial b} \leq 0 \quad \text{or} \quad \eta^* \geq 0. \quad \text{Q.E.D.}$$

From (B11),

$$\delta p_2 \frac{\partial q_2}{\partial b} - v'(b) = -\eta - \frac{\partial i}{\partial b} - w_2 \frac{\partial q_2}{\partial b} < 0. \quad (\text{B22})$$

From (B16),

$$\frac{\partial i}{\partial b} = -\left( p_2 \frac{\partial q_2}{\partial b} - v'(b) \right).$$

Therefore, from (B22),  $\partial i / \partial b > 0$ . Therefore,  $x_b^* > 0$ . Q.E.D.

PROOF OF PROPOSITION 7(b). From (B21),  $\eta^*$  is decreasing in  $\delta$  and  $x_b^*$  is independent of  $\delta$ . Let  $R = \eta^* b^* / (\eta^* + x_b^*) b^*$ . Clearly,  $1/R = 1 + x_b^* / \eta^*$  is increasing with  $\delta$ . Therefore,  $R$  decreases with an increase in  $\delta$ . Q.E.D.

PROOF OF PROPOSITION 7(c). Since the efficient contract maximizes total channel profits, our proof follows from Proposition 6. (It is easy to show that when the CS incentives are not used, total channel profits are lower.) Q.E.D.

## References

- Anderson, Eugene W. and Mary Sullivan (1993), "The Antecedents and Consequences of Customer Satisfaction for Firms," *Marketing Science*, 12 (Spring), 125-143.
- , Claes Fornell, and Donald R. Lehmann (1994), "Customer Satisfaction, Market Share, and Profitability: Findings from Sweden," *Journal of Marketing Research*, 58 (July), 53-66.
- , "Automotive Executive," "Changing the Game," September 1992.
- , "Team CSI," May 1993.
- Boulding, William, Ajay Kalra, Richard Staelin, and Valerie Zeithaml (1993), "A Dynamic Process Model of Service Quality: From Expectations to Behavioral Intentions," *Journal of Marketing Research*, 30 (February), 7-27.
- Bulow, J., J. Geanakoplos, and P. Klemperer (1985), "Multimarket Oligopoly: Strategic Substitutes and Strategic Complements," *Journal of Political Economy*, 93, 488-511.
- Churchill G. and C. Suprenant (1982), "An Investigation into the Determinants of Customer Satisfaction," *Journal of Marketing Research*, 19, 491-504.
- Chu, W. (1992), "Demand Signalling and Screening in Channels of Distribution," *Marketing Science*, 11 (Fall), 327-347.
- , *Communications News* (1991), General Motors to Launch World's Largest VSAT Network, 28 (March), 6.
- Cronin, J. J. and S. A. Taylor (1992), "Measuring Service Quality: A Reexamination and Extension," *Journal of Marketing*, 56 (July), 55-68.
- Desai P. and K. Srinivasan (1995), "Demand Signalling Under Unobservable Effort in Franchising: Linear and Nonlinear Price Contracts," *Management Science*, 41 (October).
- Dolan, R. J. (1987), "Quantity Discounts: Managerial Issues and Research Opportunities," *Marketing Science*, 6 (Winter), 1-22.
- Doraiswamy, K., T. McGuire, and R. Staelin (1979), "An Analysis of Alternative Advertising Strategies In a Competitive Franchise Framework," in Beckwith et al. (Eds.) 1979 *Educators Conference Proceedings*, Chicago: American Marketing Association.
- Finkelman, D. P. and A. R. Golland (1990), "How not to Satisfy your Customers," *The McKinsey Quarterly* (Winter), 2-12.
- , *Fleet Owner*, "New Volvo. GM Head Pushes Customer Focus," February 1992.
- Hauser, J. R., D. I. Simester, and B. Wernerfelt (1994), "Customer-Satisfaction Based Incentive Systems," *Marketing Science*, 13 (Fall), 327-350.
- Jeuland, A. and S. M. Shugan (1983), "Managing Channel Profits," *Marketing Science*, 2 (Summer), 239-272.
- Keounders, C. and W. Chu (1993), "A Case Study of Saturn's Distribution Strategy," *International Motor Vehicles Program Working Paper*, Cambridge, MA: MIT.
- Kekre, S., M. Krishnan, and K. Srinivasan (1995), "Drivers of Customer Satisfaction for Software Products: Implications for Design and Service Support," *Management Science*, 41 (September).
- Kreps, D. (1990), *A Course in Microeconomic Theory*, Princeton, NJ: Princeton University Press, 421-425.
- Lee, Eunkyu and Richard Staelin (1995), "Toward a Generalized Theory of Channel Management Strategy," Working Paper, Durham, NC: Duke University.
- McGuire, T. W. and R. Staelin (1986), "Channel Efficiency, Incentive Compatibility, Transfer Pricing and Market Structure: An Equilibrium Analysis of Channel Relationships," in *Research in Marketing*, L. P. Bucklin and J. M. Carman (Eds.), Vol. 8, Greenwich, CT: JAI Press.
- McGahan, A. and G. Keller (1995), "Saturn: A Different Kind of Car Company," *Harvard Business School Case 9-795-010*, Boston, MA: Publishing Division Harvard Business School.
- Moorthy, K. S. (1987), "Managing Channel Profits: Comment," *Marketing Science*, 7 (2), 375-379.
- and P. Fader (1990), "Strategic Interaction Within a Channel," in *Retail and Marketing Channels: Economic and Marketing Perspectives on Producer Distributor Relationships*, L. Pellegrini and S. K. Reddy (Eds), New York: Routledge.
- Peters, T. (1987), *Thriving on Chaos*, New York, NY: Harper Collins Publishers, 220-223.
- Purohit, D. and R. Staelin (1994), "Rentals, Sales and Buybacks: Managing Secondary Distribution Channels," *Journal of Marketing Research*, 31, 325-338.
- , *Wall Street Journal* (1992), "For LH Models, Chrysler Maps New Way to Sell," (June 30), B1.
- Wernerfelt, B. (1994), "An Efficiency Criterion for Marketing Design," *Journal of Marketing Research*, 31, 462-470.
- Yi, Youjae (1990), "A Critical Review of Consumer Satisfaction," in *Review of Marketing*, Valerie A. Zeithaml (Ed.), Chicago, IL: American Marketing Association, 68-123.