Fairness and Channel Coordination*

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Abstract

In this paper, we incorporate the concept of fairness into the conventional dyadic channel to investigate how fairness may affect the interactions between the manufacturer and the retailer. We show that channel coordination in a channel where partners care about fairness does not require any nonlinear pricing scheme such as a two-part tariff and quantity discount. The manufacturer can use a simple wholesale price above its marginal cost to coordinate this channel.

We also show that a two-part tariff or a quantity discount schedule can still coordinate the fair channel. However, the manufacturer cannot use either mechanism to take away all of the channel profit. Indeed, the manufacturer need not even claim the largest share of the channel profit when the channel is so coordinated.

(Keyword: Distribution Channels; Fairness; Channel Coordination; Behavioral Economics)

> "Even profit-maximizing firms will have an incentive to act in a manner that is perceived as fair if the individuals with whom they deal are willing to resist unfair transactions and punish unfair firms at some cost to themselves...willingness to enforce fairness is common."
>
> Daniel Kahneman, Jack L. Knetsch, and Richard H. Thaler (1986)

1 Introduction

Research in behavioral economics in the past two decades has shown that "there is a significant incidence of cases in which firms, like individuals, are motivated by concerns of fairness" in business relationships, including channel relationships (Kahneman, Knetsch, and Thaler 1986). Studies in economics and marketing have long documented many of these cases where fairness plays an important role specifically in developing and maintaining channel relationships (Okun 1981; Frazier 1983; Heide and John 1988; Anderson and Weitz 1992). Through a large scale survey of car dealerships in the US and Netherlands, Kumar, Scheer, and Steenkamp (1995) show convincingly that fairness is a significant determinant of the quality of channel relationships. Many case studies also establish the fact that both manufacturers and retailers may sacrifice their own margins for the benefit of their counterpart all in the name of fairness (Kumar 1996). Some practitioners go as far as to say that "maintaining fairness and balance...should be the supplier's first concern" (McCarthy 1985).

However, fairness has not been the first concern for researchers of channel coordination. Theoretical studies on channel coordination in the past unfailingly assume that all channel members are economically rational in that they care only about their monetary payoffs. This exclusive focus on economic rationality has produced many well-known conclusions. For instance, in a conventional dyadic channel consisting of one manufacturer and one retailer, Spengler (1950) has shown that the channel profit is always sub-optimal when the manufacturer uses only a wholesale price contract due to what he termed as "the problem of double marginalization." The standard remedy for this problem, as prescribed in the theoretical literature, is for the manufacturer to use a nonlinear pricing contract, such as a quantity discount schedule (Jeuland and Shugan 1983 and 1988) or a two-part tariff (Moorthy 1987). One implication of these conclusions is that in the interest of channel coordination, a manufacturer should not use a constant wholesale price.

These conclusions, while offering some important managerial guidelines, are not always descriptive of actual channel practices or conforming with "lay intuitions about human behavior" (Kahneman, Knetsch, and Thaler 1986). In practice, it is fairly common for many supply chain transactions to be "governed by simple contracts defined only by a per unit wholesale price" (Lariviere and Porteus 2001). In the pharmaceutical industry, for instance, a simple wholesale price contract is predominant for a given type of institutions or buyers, and an up front payment from the buyers to a pharmaceutical company as a condition for subsequent purchases is not observed. Across different institutions or buyers, tiered prices are used, but price discounting does not depend on order quantities (Kolassa, 1997, p. 109). In the software industry, the wholesale price contract is the norm in channels (Robinson, 1994). Similarly, in the consumer goods industry and many others, one would be hard pressed to find a two-part tariff contract, although moderate quantity discounts may frequently be present.

In addition, all these prescribed remedies for the double-marginalization problem give the manufacturer a decisive edge in cornering the channel profit. For instance, if the manufacturer in the dyadic channel uses a two-part tariff pricing contract, it can claim all channel profits to itself. This is also the case if the manufacturer employs a quantity discount schedule as a channel coordination mechanism and sets its wholesale price ahead of retailers. However, this extreme outcome does not agree with "lay intuitions," especially considering the fact that power retailers have populated today's retailing landscape (Schiller and Zellner 1992; Kahn and McAlister 1997; *Fortune* 2003). Neither does it agree with available empirical data. In the retailing industry, for instance, power retailers can produce a very high return on shareholder's equity (Stern and El-Ansary 1992, p. 60). In the consumer goods industry, Messinger and Narasimhan (1995) show that the average profitability for the retailers are either comparable with, or higher than, that for manufacturers.

In this paper, we incorporate fairness into a channel relationship and study how such a channel can be coordinated. Although past channel models have devoted considerable attention to channel issues, none of them, to the best of our knowledge, investigate the implications of fairness in a channel context.[1] As a first step, we shall start with the most basic channel structure–the dyadic channel, and incorporate fairness in a simple, tractable way as inequity aversion (Loewenstein, Thompson, and Bazerman 1989; Fehr and Schmidt 1999), a commonly used fairness concept to be discussed shortly. We will refer to this resulting channel structure simply as the "fair channel."

Through analyzing this channel, we address the following basic, yet managerially important questions:

1. Is the double marginalization problem always present in a channel where both monetary payoffs and fairness matter?

2. Can a nonlinear pricing contract, such as a two-part tariff or a quantity discount schedule, play the same channel-coordination role in this fair channel?

3. What are the mechanisms through which a pricing contract coordinate the fair chanel?

4. How do the manufacturer and the retailer fare under a channel coordination mechanism and what are the tradeoffs that the manufacturer needs to weigh in choosing a channel coordination mechanism?

Our analysis shows that when a profit-maximizing manufacturer deals with the fair-minded retailer, the double marginalization problem does not always arise. Said differently, the manufacturer can use a constant wholesale price to align the retailer's interest with the channel's and coordinate

[1] McGuire and Staelin (1983), Coughlan (1985), and Coughlan and Wernerfelt (1989), for instance, examine the manufacturers' choice of channel structure. Gerstner and Hess (1995) investigate the channel coordination role of pull promotions and Weng (1995) examines that of quantity discounts from an operations management perspective, all in the context of a dyadic channel. Ingene and Parry (1995a; 1995b; 2000) and Iyer (1998) study channel coordination in a competitive context. Ho and Zhang (2004) use a reference-dependent approach to study double-marginalization problem in a dyadic channel.

the fair channel with a wholesale price higher than its marginal cost. This surprising conclusion perhaps sheds some light on the apparent popularity of the wholesale price contract in distribution channels. Our analysis further shows that a two-part tariff or a quantity discount schedule can also be used to coordinate the fair channel. However, neither can be used by the manufacturer to claim all channel profit in the presence of the retailer's inequity aversion. Through careful analysis, we also identify the mechanism through which a particular pricing contract coordinates the fair channel and discuss the pros and cons of various pricing contracts for channel coordination. In this regard, we find that our intuitions gained from studying a channel of pure economic rationality often do not carry over to the fair channel, and the management of this channel requires new strategic imperatives.

In the rest of the paper, we first set up our model and discuss how a constant wholesale price above the manufacturer's marginal cost can coordinate the fair channel when the retailer is fair-minded. We then proceed to show how a two-part tariff and a quantity discount schedule can each coordinate the channel and what tradeoffs are involved for the manufacturer to choose a channel coordination mechanism. Finally, we extend our analysis to the case where the manufacturer also cares about fairness, instead of merely reacting to the retailer's fairness concerns, and conclude with suggestions for future research.

2 Constant Wholesale Price and Channel Coordination

Consider a dyadic channel where a single manufacturer sells its product to consumers through a single retailer. We assume that the manufacturer moves first and charges a constant wholesale price w. Then, the retailer sets its price p, taking the wholesale price w as given. For simplicity, we assume that only the manufacturer incurs a unit production cost $c > 0$ in this channel, and the market demand is given by $D(p) = a - bp$, where $b > 0$. It is well-known that the manufacturer cannot coordinate such a channel with only a constant wholesale price, so long as all channel members care about only their monetary payoffs.

In practice, many retailers also care about fairness, besides their monetary payoffs. This implies that while setting its price, the retailer will maximize a utility function $u(w, p)$ that accounts for both the retailer's monetary payoff and its concern about fairness. Later we shall analyze the case where both manufacturer and retailer care about fairness. In general, we can write

$$u(w, p) = \pi(w, p) + f_r(w, p), \tag{2.1}$$

i.e. that the monetary payoff $\pi(w, p) = (p - w)D(p)$ and the disutility due to inequity $f(w, p)$ enter the retailer's utility function in an additive form.[2] We can model fairness as inequity aversion *à la* Fehr and Schmidt (1999), which dictates that the retailer be willing to "give up some monetary payoff to move in the direction of more equitable outcomes." We assume that the equitable outcome for the retailer is a fraction γ of the manufacturer's payoff, or $\gamma\Pi(w, p)$, where $\Pi(w, p) = (w - c)D(p)$. In other words, the retailer's equitable payoff is the payoff it deems deserving relative to the manufacturer's payoff (see also Frazier 1983). Here, $\gamma > 0$ broadly captures the retailer's channel power and is exogenous to our model.

Thus, if the retailer's monetary payoff is lower than the reference payoff, a disadvantageous inequality occurs, which will result in a disutility for the retailer in the amount of α per unit difference in the two payoffs. If its monetary payoff is higher than the reference payoff, an advantageous inequality occurs in the amount of β per unit difference in the payoffs. Algebraically, we have then

$$f_r(w, p) = -\alpha \, \mathtt{max}\{\gamma\Pi(w, p) - \pi(w, p), 0\} - \beta \, \mathtt{max}\{\pi(w, p) - \gamma\Pi(w, p), 0\}. \tag{2.2}$$

With inequity aversion, the retailer is then motivated to reduce the disutility from inequity, whichever form it may take, even if the action reduces the retailer's monetary payoff. Past research has shown that "subjects suffer more from inequity that is to their monetary disadvantage than from inequity that is to their monetary advantage" (Fehr and Schmidt 1999). Accordingly,

[2]To see that this expression is quite general, let player i's utility be given by $U_i(\mathbf{x}) = \varphi_i(\mathbf{x}, \Pi_i(\mathbf{x}))$, where $\mathbf{x}$ is the vector of all n players' decisions $\{x_1, ..., x_n\}$ and $\Pi_i(\mathbf{x})$ is player i's monetary payoff. This utility function is equivalent to $U_i(\mathbf{x}) = \Pi_i(\mathbf{x}) + \varphi_i(\mathbf{x}, \Pi_i(\mathbf{x})) - \Pi_i(\mathbf{x})$. If we denote $\varphi_i(\mathbf{x}, \Pi_i(\mathbf{x})) - \Pi_i(\mathbf{x})$ as $f_i(\mathbf{x})$, then we have $U_i(\mathbf{x}) = \Pi_i(\mathbf{x}) + f_i(\mathbf{x})$ as in the text.

we also assume $\beta \leq \alpha$ and $0 < \beta < 1$. In Table 1, we summarize our model notations for the ease of reference.

Table 1: **Variable Definitions**

Notation	Definition
c	manufacturer's marginal production cost
p, w, F	retail price, wholesale price, and manufacturer-charged flat fee
$D(p) = a - bp$	market demand, $b > 0$
π, Π, Π_c	profit functions respectively for retailer, manufacturer and channel
u, U	utility functions for retailer and manufacturer
f_r, f_m	disutility functions for retailer and manufacturer due to inequity
α, α_0	retailer's and manufacturer's disadvantageous inequality parameters
β, β_0	retailer's and manufacturer's advantageous inequality parameters
γ, μ	retailer's and manufacturer's reference profit parameters
p^*	channel-coordinating retail price, $p^* = \frac{a+bc}{2b}$

2.1 Retailer's Decisions

The introduction of fairness into the dyadic channel does not change the channel's maximum profit, which is given by $\Pi_c(p^*) = (p^* - c)D(p^*)$ where $p^* = arg\mathtt{max}\, \Pi_c(p) = \frac{a+bc}{2b}$. However, the retailer's concern with fairness will affect the interactions between the two channel members and ultimately determines what channel profit is achievable. We now proceed to derive the equilibrium in this channel.

Given wholesale price w, the retailer will choose a retail price p to maximize its utility given by equations (2.6) and (2.10). As this utility function is not everywhere differentiable, we derive the retailer's optimal decision in two steps. First, we derive the retailer's optimal decision conditional on the retailer's monetary payoff being either lower or higher than its reference payoff. In the former case, *i.e.* $\pi(w,p) - \gamma\Pi(w,p) = (p-w)D(p) - \gamma(w-c)D(p) \leq 0$, the retailer experiences disadvantageous inequality. In the latter case, *i.e.* $\pi(w,p) - \gamma\Pi(w,p) = (p-w)D(p) - \gamma(w-c)D(p) \geq 0$, the retailer experiences advantageous inequality. Second, the optimal solutions from both cases are compared to determine the retailer's global optimal solution.

When the retailer effects disadvantageous inequality, $\pi(w,p) - \gamma\Pi(w,p) = (p-w)D(p) - \gamma(w-c)D(p) \leq 0$ or equivalently $p \leq (1+\gamma)w - \gamma c$, the retailer's optimization problem is given below

$$\max_p \quad (p-w)(a-bp) - \alpha[\gamma(w-c) - (p-w)](a-bp), \tag{2.3}$$

$$s.t. \quad p \leq (1+\gamma)w - \gamma c. \tag{2.4}$$

The optimal price and the maximum utility for the retailer, conditional on disadvantageous inequality, are given below

$$p_1 = \begin{cases} \frac{(a+bw)(1+\alpha)+\alpha b\gamma(w-c)}{2b(1+\alpha)} & \text{if } w > w_1 \\ (1+\gamma)w - \gamma c & \text{if otherwise} \end{cases} \tag{2.5}$$

where $w_1 = \frac{a+a\alpha+b\alpha\gamma c+2b\gamma c}{b(1+\alpha+\alpha\gamma+2\gamma)}$. The retailer's utility is given by

$$u_1 = \begin{cases} \frac{[(a-bw)(1+\alpha)-\alpha b\gamma(w-c)]^2}{4b(1+\alpha)} & \text{if } w > w_1 \\ \gamma(w-c)[a-bw-b\gamma(w-c)] & \text{if otherwise.} \end{cases} \tag{2.6}$$

Similarly, if the retailer's pricing decision results in advantageous inequality, its monetary payoff is no lower than its reference payoff, or $\pi(w,p) - \gamma\Pi(w,p) = (p-w)D(p) - \gamma(w-c)D(p) \geq 0$. The retailer's optimization problem becomes

$$\max_p \quad (p-w)(a-bp) - \beta[(p-w) - \gamma(w-c)](a-bp) \tag{2.7}$$

$$s.t. \quad p \geq (1+\gamma)w - \gamma c. \tag{2.8}$$

Define

$$\bar{p}_2 = \frac{(a+bw)(1-\beta) - \beta b\gamma(w-c)}{2b(1-\beta)}, \text{ and } w_2 = \frac{a - a\beta - \beta b\gamma c + 2b\gamma c}{b(1-\beta-\beta\gamma+2\gamma)} \tag{2.9}$$

The retailer's optimal price and the maximum utility in the case of advantageous inequality are given by

$$p_2 = \begin{cases} \bar{p}_2 & \text{if } w \leq w_2 \\ (1+\gamma)w - \gamma c & \text{if } w > w_2 \end{cases} \quad u_2 = \begin{cases} \frac{[(a-bw)(1-\beta)+\beta b\gamma(w-c)]^2}{4b(1-\beta)} & \text{if } w \leq w_2 \\ \gamma(w-c)[a-bw-b\gamma(w-c)] & \text{if } w > w_2. \end{cases} \tag{2.10}$$

As the retailer is in the position to cause either advantageous or disadvantageous inequality, it will choose in a way to maximize its utility. The retailer's optimal decision will depend on whether

u_1 in equation (2.6) is larger than u_2 in equation (2.10). It is straightforward to show that $w_1 > w_2$ always holds and that we have

$$\begin{cases} u_1 \leq u_2 & \text{if } w \leq w_2 \\ u_1 = u_2 & \text{if } w_2 < w \leq w_1 \\ u_1 > u_2 & \text{if } w > w_1 \end{cases} \tag{2.11}$$

This means that for any given w, the retailer's optimal price is given by

$$p(w) = \begin{cases} \frac{a+bw}{2b} - \frac{\beta\gamma(w-c)}{2(1-\beta)} & \text{if } w \leq w_2 \\ \\ w + \gamma(w-c) & \text{if } w_2 < w \leq w_1 \\ \\ \frac{a+bw}{2b} + \frac{\alpha\gamma(w-c)}{2(1+\alpha)} & \text{if } w > w_1 \end{cases} . \tag{2.12}$$

Equation (2.12) reveals something interesting about how the fair-minded retailer makes its pricing decision. At any given w, the price that maximizes the retailer's monetary payoff is given by $\tilde{p} = \frac{a+bw}{2b}$, which is also the optimal price for the retailer if it does not care about fairness. However, because of its fairness concern, the retailer will set a price below $\tilde{p}$ in response to the manufacturer setting a very low wholesale price ($w \leq w_2$). In this case, the prospect of advantageous inequality prompts the retailer to sacrifice its own monetary payoff to reward the manufacturer. In contrast, when the manufacturer charges a very high wholesale price ($w > w_1$), the retailer faces the prospect of disadvantageous inequality if it were to set a price for profit maximization. In this case, the retailer charges a price higher than $\tilde{p}$ and sacrifices its own monetary payoff to punish the manufacturer. When the manufacturer sets a medium wholesale price, the retailer will respond by setting a price that achieves the equitable outcome: neither advantageous nor disadvantageous inequality will occur.

2.2 Manufacturer's Decisions

We assume for now that the manufacturer sets its wholesale price w to maximize its own profit $\Pi(w) = (w - c)[a - bp(w)]$ in anticipation of the retailer's reactions, *i.e.* that $p(w)$ is given in equation (2.12). This assumption allows us to build intuitions about how fairness shapes channel interactions in an analytically simple manner. We will extend our analysis in Section 6 to the case where the manufacturer also cares about fairness, not just reacting to the retailer's fairness concerns. We will note then that this extension will not alter our conclusions, but will yield some additional insights.

Our analysis of the manufacturer's decisions is similar to that for the retailer, proceeding in two steps. First, we determine the most profitable wholesale price for the manufacturer in each of the three price ranges indicated in equation (2.12). Second, we compare the resulting payoffs to determine the globally optimal payoff for the manufacturer. For brevity, we leave the detailed derivations in Appendix A and summarize our results in the following proposition.

Proposition 1 *The manufacturer can coordinate a dyadic channel with a constant wholesale price w if the retailer is sufficiently inequity averse ($\alpha \geq \max\{\frac{\gamma-1}{1+\gamma}, \beta\}$ and $\beta \geq \frac{1}{1+\gamma}$). The manufacturer achieves channel coordination by setting a wholesale price higher than its marginal cost ($w^* = \frac{a+bc+2b\gamma c}{2b(1+\gamma)}$) and obtains a payoff of $\Pi^* = \frac{(a-bc)^2}{4b(1+\gamma)}$. The retailer sets, in response, its price at p^* and gets a payoff of $\pi^* = u^* = \frac{(a-bc)^2\gamma}{4b(1+\gamma)}$.*

Intuitively, the retailer's concern with fairness introduces two unexpected opportunities for channel coordination. First, inequity aversion on the part of the retailer can exacerbate the problem of double-marginalization, as the retailer may mark-up its price excessively to punish the manufacturer for setting an "unfairly" high wholesale price. However, it can also alleviate the problem when the retailer sacrifices its own margin to reward the manufacturer for a "generous" wholesale price. Under the right condition ($\beta = \frac{1}{1+\gamma}$), the manufacturer can be motivated by the reward to charge a wholesale price that is sufficiently low, but still above its marginal cost ($w = w_2 = w^*$) to coordinate the channel. Second, when the manufacturer charges some intermediary wholesale price ($w_2 < w \leq w_1$), the fair-minded retailer is better off effecting an equitable outcome where neither advantageous nor disadvantageous inequality occurs and achieving a payoff of $\gamma\Pi$. As a result, the fair-minded retailer voluntarily aligns its interest with the manufacturer's. In this case, as the manufacturer sets its wholesale price at w^* to maximize its profit Π, it also maximizes the retailer's payoff $\gamma\Pi$ as well as the channel profit $(1+\gamma)\Pi$.

Interestingly, when the channel is coordinated, the manufacturer's wholesale price is above its marginal cost. However, relative to the optimal wholesale price in the corresponding decentralized channel absent of any fairness concerns, *i.e.* $w = \frac{a}{2b} + \frac{c}{2}$, the manufacturer's wholesale price in the fair channel is smaller, weighing less heavily on the demand factors ($\frac{a}{b}$), but more heavily on the marginal cost (c). Thus, Proposition 1 suggests that the retailer's fairness concerns have a tendency to depress a channel's wholesale price while encouraging a more cost-based pricing.

The main significance of Proposition 1 is, however, that it identifies a new channel coordination mechanism. We show that to coordinate a channel, an elaborate pricing contract is not required. A constant wholesale price will do, as long as the retailer is fair-minded. This means that the presence of only a constant wholesale price in a channel is not an indication that the manufacturer lacks interest in channel coordination or that it may be using some other complex but undisclosed pricing contract. Indeed, a manufacturer may even have a good reason to prefer this simple pricing mechanism, as stated in the following proposition.

Proposition 2 *When a channel is coordinated through a constant wholesale price, no inequity exists in the channel. Therefore, a constant wholesale price as a channel coordination mechanism fosters an equitable channel relationship.*

Proposition 2 thus uncovers the lure of a constant wholesale price as the pricing mechanism of choice in distribution channels. It also highlights the importance of an equitable distribution of channel profits in channel management, which the previous literature based on the pure economic rationality overlooks but practitioners may have recognized all along.

3 Two-Part Tariff and Channel Coordination

In a channel where all channel members care only about their monetary payoffs, Moorthy (1987) shows that a two-part tariff can coordinate the channel. The manufacturer can simply set its wholesale price at the marginal cost c to turn the retailer into the "residual claimant" of channel profits (the receiver of any marginal channel profit). Then, the retailer will, driven by its own monetary interest, strive to maximize channel profits. The manufacturer is willing to use the marginal-cost pricing in the first place because it can charge a flat fee to appropriate all channel profits. However, in the fair channel, this "residual clamant" mechanism breaks down, as the retailer no longer pursues the maximization of its own monetary payoff. In addition, a flat fee can no longer be used to appropriate all channel profits, as doing so will result in extreme inequity. Thus, the question naturally arises: can a two-part tariff still play the same channel coordination role when the retailer abhors inequity? If it could still coordinate the channel, through what mechanism is the channel coordination achieved? There is no clear answer *a priori* to any of these two questions.

In this section, we investigate the role of the two-part tariff in coordinating a fair channel by allowing the manufacturer first to set a wholesale price w and a fixed payment F. The retailer then sets its price p after observing $(w,\ F)$. We maintain all other assumptions in the previous section. The payoff for the manufacturer and the retailer's utility function are now respectively given by

$$\Pi(w,F,p) = (w-c)D(p)+F, \tag{3.1}$$

$$u(w,F,p) = \pi(w,F,p)+f_r(w,F,p) = (p-w)D(p)-F+f_r(w,F,p), \tag{3.2}$$

where $f_r(w,F,p) = -\alpha\ \mathtt{max}\{\gamma\Pi(w,F,p)-\pi(w,F,p),0\} - \beta\ \mathtt{max}\{\pi(w,F,p)-\gamma\Pi(w,F,p),0\}$.

3.1 Retailer's Decisions Under Two-Part Tariff

We can proceed to analyze the retailer's decision for any given (w,F) in the same way as in the previous section, although the analysis here becomes more complex. As we show in Appendix B, the retailer can once again effect either advantageous or disadvantageous inequity through its choice of the retail price p. The retailer's optimal price for any (w,F) is given by

$$p(w,F) = \begin{cases} \frac{a+bw}{2b}+\frac{\alpha\gamma(w-c)}{2(1+\alpha)} & \text{if } \triangle < \frac{1}{(1+\alpha)^2}b^2\gamma^2(w-c)^2 \\ \frac{a+bw+b\gamma(w-c)-\sqrt{\triangle}}{2b} & \text{if } \frac{1}{(1+\alpha)^2}b^2\gamma^2(w-c)^2 \le \triangle \le \frac{1}{(1-\beta)^2}b^2\gamma^2(w-c)^2 \\ \frac{a+bw}{2b}-\frac{\beta\gamma(w-c)}{2(1-\beta)} & \text{if } \triangle > \frac{1}{(1-\beta)^2}b^2\gamma^2(w-c)^2 \end{cases} \tag{3.3}$$

where $\triangle = [a - bw - b\gamma(w-c)]^2 - 4b(1+\gamma)F$. Note that should the retailer decide to participate in the channel, its optimal price hinges on the flat fee it has to pay, in contrast to a model of pure economic rationality, because of its fairness concerns.

3.2 Manufacturer's Design of Two-Part Tariff

The manufacturer chooses (w, F) to maximize its own payoff $\Pi(w, F) = (w - c)[a - bp(w)] + F$, where $p(w)$ is given in equation (3.3). This is a non-trivial optimization problem because of the non-linear price response from the retailer to the manufacturer's decisions (w, F). However, as we show in Appendix B, the manufacturer can indeed use a two-part tariff to coordinate the channel. We summarize this analysis in the following proposition.

Proposition 3 *For any $\alpha \geq \beta$, $0 \leq \beta < 1$, and $\gamma > 0$, the manufacturer optimally chooses the two-part tariff $[c, \frac{(a-bc)^2(1+\alpha)}{4b(1+\alpha+\alpha\gamma)}]$ to coordinate the fair channel. However, in contrast to a model of pure economic rationality, the manufacturer can no longer take all channel profit as long as the retailer abhors any disadvantageous inequity ($\alpha > 0$).*

Unexpectedly, the two-part tariff coordinates the fair channel through a rather elegant mechanism. By setting its wholesale price at the marginal cost c, the manufacturer effectively uses one stone to kill two birds. On the one hand, the manufacturer removes the double marginalization problem in the channel so that the retailer becomes the residual claimant of the channel profit. More concretely, the channel profit is now the same as the retailer's and is given by $\pi(c, F^*, p)$, $F^* = \frac{(a-bc)^2(1+\alpha)}{4b(1+\alpha+\alpha\gamma)}$. Therefore, the retailer wants to maximize the channel profit for any given level of inequality in payoffs. On the other hand, by setting $w = c$, the manufacturer makes no contribution from its sales, which effectively takes away the retailer's incentive to rectify any payoff inequity through distorting its own pricing decision. In fact, to alleviate inequity under the two-part tariff contract contained in Proposition 3, all that the retailer can do is to increase its own profitability. We can see this from Equation (3.2) where the disutility from inequity is given by $f_r(c, F^*, p) = -\alpha(\gamma F^* - \pi(c, F^*, p))$. This means that when $w = c$, the utility maximization for the retailer becomes maximizing $(1+\alpha)\pi(c, F^*, p) - \alpha\gamma F^*$. Thus, the retailer is driven by both profit and fairness motives to maximize its own as well as the channel profit.

However, the manufacturer may not obtain more monetary payoff than the retailer due to the presence of perceived inequity in the distribution of channel profits, as stated in the following proposition.

Proposition 4 *When the manufacturer uses a two-part tariff to coordinate the fair channel, the retailer suffers from disadvantageous inequality for which the manufacturer must compensate the retailer in order for the latter to become a willing participant of the channel. As a result, the retailer can obtain more monetary payoff than the manufacturer under the two-part tariff contract if* $\frac{\alpha\gamma}{1+\alpha} > 1$.

Proposition 4 is straightforward to prove. When the manufacturer sets (c, F^*) in Proposition 3, the retailer suffers disadvantageous inequality as measured by $f(c, p^*) = -\alpha[\gamma F^* - \pi(c, p^*)]$, which is strictly negative. To satisfy the retailer's participation constraint, the manufacturer must set F^* such that the retailer's monetary payoff plus disutility from disadvantageous inequality must be exactly equal to zero, or $\pi(c, p^*) - \alpha[\gamma F^* - \pi(c, p^*)] = 0$. This implies that we have $\pi(c, p^*) = \frac{\alpha\gamma}{1+\alpha} F^*$. Recall that F^* is also the manufacturer's profit. Thus, the retailer makes more profit than the manufacturer if $\frac{\alpha\gamma}{1+\alpha} > 1$.

Note that in a dyadic channel where only monetary payoffs matter, a two-part tariff allows the manufacturer to monopolize all channel profits. In the fair channel, as Proposition 4 suggests, this does not happen. What emerges is a channel relationship where both the manufacturer and the retailer can get ahead in terms of claiming the channel profit, depending on the perceived equitable division of channel profits and on the retailer's tolerance for inequity. Thus, it is not surprising, in light of Proposition 4, that retailers could fare better than manufacturers in practice, as noted in the Introduction.

4 Quantity Discount and Channel Coordination

Jeuland and Shugan (1983) have shown that a quantity discount schedule can coordinate a dyadic channel where only monetary payoffs matter. Could the same pricing mechanism profitably coordinate the fair channel? Furthermore, relative to the two-part tariff, is the quantity discount schedule a superior channel coordination mechanism for the manufacturer? We investigate those questions in this section.

In order for the retailer to choose the channel coordinating retail price $p^* = \frac{a+bc}{2b}$, the manufacturer needs to use its wholesale price schedule $w(D)$ to transform the retailer's utility function into a function directly related to the channel profit. In the context of the fair channel, this transformation is possible, *à la* Jeuland and Shugan (1983), if a $w(D)$ exists so that we have

$$u(w,p) = [p - w(D)]D(p) - f_r(w,p) = k_1(p-c)D(p) + k_2 \tag{4.1}$$

where $f_r(w,p) = -\alpha \; \mathtt{max}\{\gamma\Pi(w,p) - \pi(w,p), 0\} - \beta \; \mathtt{max}\{\pi(w,p) - \gamma\Pi(w,p), 0\}$, $\beta \leq \alpha$, and $0 \leq \beta < 1$.

Intuitively, to maximize its own profit, the manufacturer never wants to use its quantity discount schedule to induce advantageous inequality in the channel. Doing so would hurt its own profitability while also aggravating the retailer.[3] Thus, the quantity discount schedule that coordinates this fair channel can be found, if it exists, from the following equation

$$u(w,p) = (p-w)D(p) - \alpha[\gamma(w-c)D(p) - (p-w)D(p)] = k_1(p-c)D(p) + k_2. \tag{4.2}$$

Indeed, such a schedule exists and is unique, as stated in the following proposition.

Proposition 5 *The channel-coordinating quantity discount schedule takes the form of* $w(D) = \frac{1}{1+\alpha+\alpha\gamma}[(1-k_1+\alpha)p(D) + \alpha\gamma c + k_1 c - \frac{k_2}{D}]$.

Under this schedule, the retailer sets p^*, orders the quantity of $a - bp^*$ from the manufacturer,

[3] It is straightforward to offer a rigorous proof to rule out this scenario.

and pays a discounted wholesale price of

$$w = \frac{(1+\alpha)(a+bc)+2\alpha b\gamma c}{2b(1+\alpha+\alpha\gamma)}. \tag{4.3}$$

The manufacturer's payoff is given by

$$\Pi = \frac{(a-bc)^2(1+\alpha)-[(a-bc)^2k_1+4bk_2]}{4b(1+\alpha+\alpha\gamma)} \tag{4.4}$$

Of course, the manufacturer will choose k_1 and k_2 to maximize its own payoff and the maximum payoff for the manufacturer is given by

$$\Pi = \frac{(a-bc)^2(1+\alpha)}{4b(1+\alpha+\alpha\gamma)}. \tag{4.5}$$

The retailer's monetary payoff under the quantity discount schedule is given by

$$\pi = \frac{(a-bc)^2\alpha\gamma}{4b(1+\alpha+\alpha\gamma)}. \tag{4.6}$$

Surprisingly, both the manufacturer and the retailer get the same monetary payoffs under the quantity discount schedule as under the two-part tariff (recalling Proposition 3). Indeed, the retailer's experience under the quantity discount schedule is also the same, suffering from the same level of disadvantageous inequality. However, the mechanism through which the quantity discount schedule coordinates the fair channel is different. The quantity discount schedule coordinates the fair channel by making sure that the retailer has a fixed share of the channel profit and faces the marginal wholesale price equal to c, the marginal cost to the channel. This mechanism is implemented such that the retailer's marginal profit and marginal disutility from disadvantageous inequality are both proportional to the marginal channel profit (all with respect to price) with the former dominating.[4] Thus, as the retailer maximizes its utility, it also maximizes the channel profit.

[4] It is straightforward to show that under $w(D)$ in Proposition 5, we have $\frac{\partial\pi}{\partial p} = \frac{\alpha\gamma+k_1}{1+\alpha+\alpha\gamma}(a+bc-2bp)$ and $\frac{\partial f_r}{\partial p} = \frac{(\gamma-\gamma k_1-k_1)\alpha}{1+\alpha+\alpha\gamma}(a+bc-2bp)$.

5 Manufacturer's Choice of Channel Coordination Mechanisms

Our analysis has thus shown that in the fair channel, the manufacturer has more ways to coordinate the channel when the retailer is fair-minded. A well-selected wholesale price or two-part tariff or quantity discount schedule can all coordinate such a channel. The consequence of channel coordination is no longer limited to the size and division of channel profits and the manufacturer must weigh various tradeoffs in order to choose its channel coordination mechanism.

If the monetary payoff is the manufacturer's sole criterion, the manufacturer's choice is quite simple. Our analysis shows that the two-part tariff and the quantity discount schedule are equivalent pricing mechanisms for channel coordination. They all deliver the same monetary payoff to the manufacturer and the payoff is strictly higher than if a constant wholesale price is used, as long as $\gamma > 0$. This does not mean, however, that the manufacturer should always switch to one of the nonlinear pricing schedules if it is currently using the channel-coordinating wholesale price. As testable implications, we can conduct the comparative statics on the percentage gain in payoffs from such switching $\frac{\gamma}{1+\alpha+\alpha\gamma}$, which increases with γ but decreases with α. In other words, in a channel where the manufacturer dominates such that the equitable payoff for the retailer is small (a small γ) or where the retailer is sensitive to disadvantageous inequality (a large α), there is less a gain from such switching.

Indeed, the superiority of the two-part tariff and the quantity discount schedule in delivering monetary payoffs to the manufacturer comes at the cost of channel harmony. As our analysis has shown, under either pricing mechanism, the retailer suffers from disadvantageous inequality: the retailer perceives to get a less than equitable share of the channel profit. Thus, the retailer may rightfully become suspicious of and resentful to, any upstream nonlinear price contract. In contrast, when a constant wholesale price is used to coordinate the channel, an equitable division of channel profits is achieved and the manufacturer's and the retailer's interests are aligned harmoniously. Thus, to promote channel harmony, a constant wholesale price trumps the two-part tariff or the quantity discount schedule as a channel coordination mechanism.

Operationally, when a constant wholesale price is used to coordinate the fair channel, the manufacturer essentially uses its wholesale price to invoke the retailer's sense of fairness and equity to align the retailer's interest with the channel's. The implementation of the price contract is direct and intuitive. When the two-part tariff is used to coordinate the fair channel, the manufacturer must succeed in convincing the retailer to pay an upfront fee in order to join the channel membership. It must also convince the retailer that it makes no profit from the sales of its product such that the retailer has no reason to distort its pricing decision out of its fairness concerns. In the case of the quantity discount schedule, the manufacturer must design it in a way that would give the retailer a fixed share of the channel profit so as to motivate the retailer to maximize the channel profitability. In addition, the schedule must be so designed that the marginal price facing the retailer at the channel-coordinating sales level is the marginal cost for the entire channel. Thus, arguably, the implementation of the latter two nonlinear pricing mechanisms requires more influence, persuasion, and even coercion.

In a dynamic marketplace, the manufacturer may also want to consider how the changes in the market environment may impinge upon its profitability under different channel coordination mechanisms. Through comparative statics, it is easy to see that the manufacturer's profitability varies less under the constant wholesale price than under any of the two nonlinear pricing mechanisms, when channel profitability varies due to the changes in the demand and cost factors. In addition, under the constant wholesale price, the manufacturer's payoff is independent of α, while it is not otherwise, thus immunizing the manufacturer from the whim of the retailer's sensitivity to disadvantageous inequality. However, the impact on the manufacturer's profitability of a changing standard on the "equitable" division of the channel profit (γ) is larger under the constant wholesale price than under any of the two alternatives, unless the retailer is both "powerful" and "sensitive" ($\gamma > 1$ and $\alpha > \frac{1}{\gamma^2-1}$).

Therefore, for the fair channel, the manufacturer's choice of the channel coordination mechanism is quite consequential, not only in terms of the monetary payoff it may gain, but also in terms of maintaining a healthy channel relationship. To the extent that the monetary payoff is more important for the channel relationship that is temporary and asymmetric in favor of the manufacturer, one would expect that a nonlinear pricing contract is more likely to emerge from it. When the channel relationship is for the long haul with a powerful retailer, one would expect that a constant wholesale price is more likely to be the channel coordination mechanism of choice.

6 Extensions

The analysis we have conducted so far is in the spirit of examining whether "profit maximizing-firms will have an incentive to act in a manner that is perceived as fair if the individuals with whom they deal are willing to resist unfair transactions and punish unfair firms at some cost to themselves" (Kahneman, Knetsch, and Thaler 1986). However, in practice, the manufacturer may be fair-minded, too, and the fair-minded manufacturer and retailer may not share a common criterion for fairness. Could such a channel be coordinated with any pricing mechanism discussed previously? Could a fair relationship emerge in such a channel?

We investigate those questions in this section by allowing the manufacturer also to be fair-minded. For that purpose, we assume that the manufacturer considers a payoff of $\mu\pi$ as the fair payoff to itself, where $\mu > 0$ is a positive, exogenous parameter analogous to γ in our basic model and π is the retailer's monetary payoff. With its fairness concerns, the manufacturer no longer strives to maximize only its monetary payoff. Its objective is to maximize its utility defined as

$$U(X, p) = \Pi(X, p) + f_m(X, p), \tag{6.1}$$

where X is the manufacturer's decision variable(s) and

$$f_m(X, p) = -\alpha_0 \ \mathtt{max}\{\mu\pi(X, p) - \Pi(X, p), 0\} - \beta_0 \ \mathtt{max}\{\Pi(X, p) - \mu\pi(X, p), 0\}.$$

For the same reason as in our basic model, we assume $\beta_0 \leq \alpha_0$ and $0 \leq \beta_0 < 1$. Note that our basic model is a special case of the extended model with $\alpha_0 = 0$ and $\beta_0 = 0$.

We first analyze this extended model with the manufacturer only charging a constant wholesale price. When both channel members care about fairness, what they each consider as fair is an important barometer for gauging the outcome of channel interactions. On the one hand, the retailer considers a payoff of $\gamma\Pi$ as equitable. This means that the retailer considers $\frac{\gamma}{1+\gamma}\Pi_c$ to be the equitable share of the channel profit for its participation in the channel. On the other hand, the manufacturer considers its own equitable share to be $\frac{\mu}{1+\mu}\Pi_c$. The sum of these two equitable shares is the minimum profit that the channel has to produce in order to satisfy both channel members' desire for an equitable outcome. We refer to this minimum channel profit as the Equity-Capable Channel Payoff (*ECCP*). We have

$$ECCP = \frac{\gamma}{1+\gamma}\Pi_c + \frac{\mu}{1+\mu}\Pi_c = \frac{\mu\gamma + \mu + \gamma + \mu\gamma}{\mu\gamma + \mu + \gamma + 1}\Pi_c. \tag{6.2}$$

In the case where $ECCP > \Pi_c$ for a channel, or $\mu\gamma > 1$, we shall refer to this channel as the *acrimonious channel*. In this channel, the two channel members jointly desire more monetary payoffs than what the channel is capable of producing and hence either upstream or downstream inequity will surface regardless of whether the channel is coordinated or how it is coordinated. In the case where $ECCP \leq \Pi_c$ or $\mu\gamma \leq 1$, we shall refer to this channel as the *harmonious channel*. For this channel, an equitable division of channel profits is feasible. We summarize our analysis of the case where the manufacturer only uses a constant wholesale price in the following proposition.[5]

Proposition 6 *The manufacturer can use the same wholesale price as contained in Proposition 1 to coordinate an acrimonious channel as long as it is not too averse to its own disadvantageous inequality or* $\alpha_0 \leq \frac{1}{\mu\gamma-1}$. *It can do the same to coordinate a harmonious channel as long as it is not sufficiently averse to its own advantageous inequality, or* $\beta_0 \leq \frac{1}{1+\mu}$ *if* $\beta = \frac{1}{1+\gamma}$ *and* $\alpha \geq \max\{\frac{\gamma-1}{1+\gamma}, \beta\}$ *and* $\beta_0 < 1$ *if* $\beta > \frac{1}{1+\gamma}$ *and* $\alpha \geq \max\{\frac{\gamma-1}{1+\gamma}, \beta\}$.

[5]The detailed analysis for the extension and proofs for all propositions in this section are contained in Optional Appendix C and it is available from authors upon request.

Intuitively, when charging a constant wholesale price to coordinate the channel, the manufacturer must rely, as we have discussed before, on the retailer's desire to effect an equitable outcome to align the retailer's interest with the channel's. In turn, this means that the manufacturer must be willing to make the sacrifice and bear any disadvantageous (advantageous) inequity when dealing with the acrimonious (harmonious) channel, since the retailer must not bear any. That is why α_0 (β_0) must be sufficiently small when facing the acrimonious (harmonious) channel.

In the case where the manufacturer uses a nonlinear pricing mechanism, we can analogously distinguish, from the perspective of the manufacturer, the acrimonious channel from the harmonious channel by testing whether $\mu\gamma > 1 + \frac{1}{\alpha}$. We summarize our analysis in the following proposition.

Proposition 7 *The manufacturer will use the same two-part tariff (quantity discount) schedule as in the basic model to coordinate the acrimonious channel if $\alpha_0 \leq \frac{1+\alpha}{\alpha\mu\gamma-1-\alpha}$ and the harmonious channel if $\beta_0 \leq \alpha_0$ and $\beta_0 < 1$ ($\beta_0 \leq \frac{1}{1+\mu}$).*

Intuitively, facing an acrimonious channel, the manufacturer will once again have to suffer disadvantageous inequality itself to coordinate the channel and thus must have some tolerance for it to embrace channel coordination. When facing a harmonious channel, the manufacturer must suffer advantageous inequality to bring about channel coordination and hence it needs to have a sufficient tolerance for it. In either case, the retailer suffers from disadvantageous inequality as in our basic model.

Thus, our analysis of the extended model suggests two important conclusions. First, the results from our basic model are not qualitatively altered when the manufacturer also becomes fair-minded. From a technical perspective, this conclusion is rather expected as the retailer makes its decision after the manufacturer. Second, a harmonious or equitable channel relationship is harder to come by when all channel members are averse to inequity. This outcome may seem counter-intuitive at first, but it is quite reasonable upon some reflection. It captures the fact that it is harder to build harmony when each channel member views equity from their own parochial perspective. In effect, fairness concerns can become a source of friction in channel relationships.

7 Conclusion

In this paper, we take the first step to incorporate fairness concerns into the theoretical literature on channel coordination. Past studies in behavioral economics and in marketing have shown that fairness is an important norm that motivates and regulates channel relationships, and fairness concerns on the part of practitioners often shape and govern their on-going channel interactions. Therefore, for the sake of realism and relevance, it is important for theoretical research on channel coordination to include fairness concerns and to explore their implications for designing a channel coordination mechanism. Indeed, our analysis shows convincingly that fairness can alter channel interactions and relationships in four significant ways.

First, because of the retailer's concerns with fairness, the problem of double marginalization need not always be present in a channel. This means that past research focusing exclusively on monetary payoffs has, on the one hand, exaggerated the problem of double marginalization in distribution channels and, on the other hand, underestimated the extent to which fair-minded channel members align their interests and cooperate with each other for the common good of the channel. Said differently, because of fairness concerns, there are more ways to coordinate the conventional channel, as a constant wholesale price can also do the job.

Second, the mechanism through which a specific pricing contract coordinates the conventional channel in the presence of fairness concerns is quite different from that in their absence. With fairness concerns, the retailer has an incentive to effect an equitable outcome based on which channel coordination can be achieved through a constant wholesale price. In the case of using a nonlinear pricing mechanism, the manufacturer must heed the retailer's incentive to distort its price out of fairness concerns. Because of these new incentives, the managerial intuitions we have gained from past research need to be re-calibrated.

Third, with fairness concerns in a channel, the manufacturer is not in a position to claim all channel profits, even as the initiator of channel coordination who cares only about monetary payoffs. Indeed, as our analysis has shown, the monetary payoffs to the retailer can be higher than to the manufacturer, even when a nonlinear pricing contract is used. Therefore, the division of channel profits will depend not only on whether the channel is coordinated, but also on what constitute an equitable payoff to the retailer and how averse the retailer is to inequity. The latter two factors add two new dimensions to channel management and can significantly expand the scope of future theoretical research on channel coordination.

Fourth, fairness concerns do not always bring an equitable outcome in a channel, as part of a firm's objective is to maximize its monetary payoffs. Indeed, our analysis shows that a harmonious channel relationship is an exception rather than a norm, especially when all channel members are fair-minded. In a coordinated channel, the manufacturer may suffer from either advantageous or disadvantageous inequality, while the retailer suffers from disadvantageous inequality. Our normative analysis puts in a new perspective the frictions and conflicts commonly observed in the channel context—perhaps they are all the necessary evil associated with pursuing the maximum channel profit!

While we believe that our analysis has generated some significant new insights, it is important to point out some important limitations of our model that future research can investigate further. First, we take it for granted that a firm's concern with fairness is an "automated," non-strategic behavior. We do not look into the process through which such fairness concerns may be formed in a channel context. Presumably, repeated interactions, which we do not model here, may be conducive to their formation, through punishing any opportunistic behavior. Second, in our analysis, we take as exogenous the equitable payoffs for each channel member. However, what is considered equitable and what is not can have a significant impact on the division of channel profits. Therefore, it is important for future research to investigate how such equitable payoffs are formed and accepted in a channel context. Third, we do not look into how imperfect information may affect channel interactions in the presence of fairness concerns. Potentially, this is a very fruitful area for future research. Finally, much more research is required to explore the implications of fairness in different channel structures.

Notwithstanding those limitations, we hope that this initial step we have taken will sparkle more interest in pursuing this exciting line of research in the future.

Appendix A

Proof of Manufacturer's Decisions for Constant Wholesale Price. When the manufacturer sets a wholesale price w, the retailer will choose $p(w)$ as in equation (2.12). If the manufacturer chooses a wholesale price from range $w \leq w_2$, then the manufacturer's optimization problem is given by

$$\max_w \quad (w-c)(a-bp), \tag{A1}$$

$$s.t. \quad \begin{cases} p = \frac{a+bw}{2b} - \frac{\beta\gamma(w-c)}{2(1-\beta)} \\ w \leq w_2 \end{cases} \tag{A2}$$

The optimal wholesale price and the manufacturer's profit are given below

$$w = \begin{cases} \bar{w}_I & \text{if } 0 \leq \beta \leq \frac{1-2\gamma}{1+\gamma} \\ w_2 & \text{otherwise} \end{cases} \quad \text{and} \quad \Pi = \begin{cases} \frac{(a-bc)^2(1-\beta)}{8b(1-\beta-\beta\gamma)} & \text{if } 0 \leq \beta \leq \frac{1-2\gamma}{1+\gamma} \\ \frac{(a-bc)^2(1-\beta)\gamma}{b(1-\beta-\beta\gamma+2\gamma)^2} & \text{otherwise} \end{cases} \tag{A3}$$

where $\bar{w}_I = \frac{(a+bc)(1-\beta)-2\beta b\gamma c}{2b(1-\beta-\beta\gamma)}$.

If the manufacturer chooses a wholesale price from range $w_2 < w \leq w_1$, then the manufacturer's optimization problem is given by

$$\max_w \quad (w-c)(a-bp), \tag{A4}$$

$$s.t. \quad \begin{cases} p = w + \gamma(w-c) \\ w > w_2 \\ w \leq w_1 \end{cases} \tag{A5}$$

The optimal wholesale price and the manufacturer's profit are given below

$$w = \begin{cases} w_2 & \text{if } 0 \leq \beta \leq \frac{1}{1+\gamma} \\ \bar{w}_{II} & \text{otherwise} \end{cases} \quad \text{and} \quad \Pi = \begin{cases} \frac{(a-bc)^2(1-\beta)\gamma}{b(1-\beta-\beta\gamma+2\gamma)^2} & \text{if } 0 \leq \beta \leq \frac{1}{1+\gamma} \\ \frac{(a-bc)^2}{4b(1+\gamma)} & \text{otherwise} \end{cases} \tag{A6}$$

where $\bar{w}_{II} = \frac{a+bc+2b\gamma c}{2b(1+\gamma)}$.

If the manufacturer chooses a wholesale price from range $w > w_1$, then the manufacturer's optimization problem is given by

$$\max_w \quad (w-c)(a-bp), \tag{A7}$$

$$s.t. \quad \begin{cases} p = \frac{a+bw}{2b} + \frac{\alpha\gamma(w-c)}{2(1+\alpha)} \\ w > w_1 \end{cases} \tag{A8}$$

The optimal wholesale price and the manufacturer's profit are given below

$$w = \begin{cases} \bar{w}_{III} & \text{if } 0 \le \alpha \le \frac{2\gamma-1}{1+\gamma} \\ w_1 & \text{otherwise} \end{cases} \quad \text{and} \quad \Pi = \begin{cases} \frac{(a-bc)^2(1+\alpha)}{8b(1+\alpha+\alpha\gamma)} & \text{if } 0 \le \alpha \le \frac{2\gamma-1}{1+\gamma} \\ \frac{(a-bc)^2(1+\alpha)\gamma}{b(1+\alpha+\alpha\gamma+2\gamma)^2} & \text{otherwise} \end{cases} \tag{A9}$$

where $\bar{w}_{III} = \frac{(a+bc)(1+\alpha)+2\alpha b\gamma c}{2b(1+\alpha+\alpha\gamma)}$.

Therefore, the manufacturer will compare the resulting payoffs to determine the globally optimal payoff. The globally optimal wholesale price and profits are given by

$$\begin{cases} w^* = \bar{w}_I, \ \Pi^* = \frac{(a-bc)^2(1-\beta)}{8b(1-\beta-\beta\gamma)} & \text{if } 0 \le \beta \le \frac{1-2\gamma}{1+\gamma} \text{ and } \alpha \ge \beta \\ w^* = \bar{w}_{III}, \ \Pi^* = \frac{(a-bc)^2(1+\alpha)}{8b(1+\alpha+\alpha\gamma)} & \text{if } \frac{1-2\gamma}{1+\gamma} < \beta < \frac{1}{1+\gamma} \text{ and } \beta \le \alpha < \bar{\alpha} \\ w^* = w_2, \ \Pi^* = \frac{(a-bc)^2(1-\beta)\gamma}{b(1-\beta-\beta\gamma+2\gamma)^2} & \text{if } \frac{1-2\gamma}{1+\gamma} < \beta < \frac{1}{1+\gamma} \text{ and } \alpha \ge \mathtt{max}\{\bar{\alpha}, \beta\} \\ w^* = \bar{w}_{III}, \ \Pi^* = \frac{(a-bc)^2(1+\alpha)}{8b(1+\alpha+\alpha\gamma)} & \text{if } \beta = \frac{1}{1+\gamma} \text{ and } \beta \le \alpha < \frac{\gamma-1}{1+\gamma} \\ w^* = w_2, \ \Pi^* = \frac{(a-bc)^2}{4b(1+\gamma)} & \text{if } \beta = \frac{1}{1+\gamma} \text{ and } \alpha \ge \mathtt{max}\{\frac{\gamma-1}{1+\gamma}, \beta\} \\ w^* = \bar{w}_{III}, \ \Pi^* = \frac{(a-bc)^2(1+\alpha)}{8b(1+\alpha+\alpha\gamma)} & \text{if } \frac{1}{1+\gamma} < \beta < 1 \text{ and } \beta \le \alpha < \frac{\gamma-1}{1+\gamma} \\ w^* = \bar{w}_{II}, \ \Pi^* = \frac{(a-bc)^2}{4b(1+\gamma)} & \text{if } \frac{1}{1+\gamma} < \beta < 1 \text{ and } \alpha \ge \mathtt{max}\{\frac{\gamma-1}{1+\gamma}, \beta\} \end{cases} \tag{A10}$$

where $\bar{\alpha} = \frac{(1-\beta-\beta\gamma-2\gamma)^2-8\beta\gamma^2}{8\gamma^2-(1-\beta-\beta\gamma-2\gamma)^2}$. It is straightforward to calculate the retailer's utility and profits, given equations (A10) and (2.12). Furthermore, the retail price equals the channel coordinating retail price $p = p^* = \frac{a+bc}{2b}$ in the fifth and seventh cases in equation (A10), *i.e.*, $\beta \ge \frac{1}{1+\gamma}$ and $\alpha \ge \mathtt{max}\{\frac{\gamma-1}{1+\gamma}, \beta\}$. In both cases the retailer's utility and profit are given by $\pi^* = u^* = \frac{(a-bc)^2\gamma}{4b(1+\gamma)}$.

Appendix B

Proof of Retailer's Decisions for Two-Part Tariff. The analysis of the retailer's decisions proceeds in three steps. 1). We determine the retail price and the retailer's utility when it has disadvantageous inequality, *i.e.*, when the retailer's profit is lower than its reference profit $\gamma\Pi$. 2). We determine the retail price and utility when the retailer has advantageous inequality. 3). We compare the resulting utility to determine the optimal retail price and utility for the retailer.

Disadvantageous Inequality. The retailer has disutility from disadvantageous inequality if the retailer chooses a retail price such that its profit is not higher than its reference profit, *i.e.*, $\pi(w, F, p) - \gamma\Pi(w, F, p) = (p - w)(a - bp) - F - \gamma[(w - c)(a - bp) + F] \le 0$. This is equivalent to $\phi(p) = bp^2 - [a + bw + b\gamma(w - c)]p + aw + a\gamma w - a\gamma c + (1 + \gamma)F \ge 0$. Therefore, the retailer's optimization problem, conditional on disadvantageous inequality, is given by

$$\max_p \quad u(p) = (p-w)(a-bp) - F - \alpha\{\gamma[(w-c)(a-bp)+F] - [(p-w)(a-bp)-F]\}, \tag{B1}$$

$$s.t. \quad \phi(p) \geq 0 \tag{B2}$$

The optimal retail price and the maximum utility for the retailer, conditional on disadvantageous inequality, are given below

$$p = \begin{cases} \bar{p}_1 & \text{if } \triangle < \frac{1}{(1+\alpha)^2} b^2\gamma^2(w-c)^2 \\ \tilde{p}_1 & \text{otherwise} \end{cases} \quad \text{and} \quad u = \begin{cases} u(\bar{p}_1) & \text{if } \triangle < \frac{1}{(1+\alpha)^2} b^2\gamma^2(w-c)^2 \\ u(\tilde{p}_1) & \text{otherwise} \end{cases} \tag{B3}$$

where $\bar{p}_1 = \frac{a+bw}{2b} + \frac{\alpha\gamma(w-c)}{2(1+\alpha)}$, $\tilde{p}_1 = \frac{a+bw+b\gamma(w-c)-\sqrt{\triangle}}{2b}$, and $\triangle = [a-bw-b\gamma(w-c)]^2 - 4b(1+\gamma)F$.

Advantageous Inequality. The retailer has disutility from advantageous inequality if the retailer chooses p such that $\pi(w,F,p) - \gamma\Pi(w,F,p) \geq 0$, or $\phi(p) \leq 0$ where $\phi(p)$ is same as in disadvantageous inequality section above. Therefore, the retailer's optimization problem, conditional on advantageous inequality, is given by

$$\max_p \quad u(p) = (p-w)(a-bp) - F - \beta\{[(p-w)(a-bp)-F] - \gamma[(w-c)(a-bp)+F]\}, \tag{B4}$$

$$s.t. \quad \phi(p) \leq 0 \tag{B5}$$

The optimal retail price and the maximum utility for the retailer, conditional on advantageous inequality, are given below

$$p = \begin{cases} \tilde{p}_1 & \text{if } 0 \leq \triangle \leq \frac{1}{(1-\beta)^2} b^2\gamma^2(w-c)^2 \\ \bar{p}_2 & \text{otherwise} \end{cases} \quad \text{and} \quad u = \begin{cases} u(\tilde{p}_1) & \text{if } 0 \leq \triangle \leq \frac{1}{(1-\beta)^2} b^2\gamma^2(w-c)^2 \\ u(\bar{p}_2) & \text{otherwise} \end{cases} \tag{B6}$$

where $\bar{p}_2 = \frac{a+bw}{2b} - \frac{\beta\gamma(w-c)}{2(1-\beta)}$, and both $\tilde{p}_1$ and $\triangle$ are same as in disadvantageous inequality section.

The retailer's optimal decision will depend on whether its utility u in equation (B3) is larger than that in equation (B6). From equations (B3) and (B6), we can show that the retailer's optimal price and utility are given by

$$\begin{cases} p(w,F) = \bar{p}_1, \; u(w,F) = u(\bar{p}_1) & \text{if } \triangle < \frac{1}{(1+\alpha)^2} b^2\gamma^2(w-c)^2 \\ p(w,F) = \tilde{p}_1, \; u(w,F) = u(\tilde{p}_1) & \text{if } \frac{1}{(1+\alpha)^2} b^2\gamma^2(w-c)^2 \leq \triangle \leq \frac{1}{(1-\beta)^2} b^2\gamma^2(w-c)^2 \\ p(w,F) = \bar{p}_2, \; u(w,F) = u(\bar{p}_2) & \text{if } \triangle > \frac{1}{(1-\beta)^2} b^2\gamma^2(w-c)^2 \end{cases} \tag{B7}$$

Proof of Manufacturer's Decisions for Two-Part Tariff. Given the retailer's price $p(w,F)$, the manufacturer will determine its optimal two-part tariff (w,F) through the comparison of resulting payoffs for the three ranges of $\triangle$ in equation (B7). We first derive the manufacturer's optimal (w,F) and compute its maximum payoff conditional on $\triangle < \frac{1}{(1+\alpha)^2}b^2\gamma^2(w-c)^2$, then we show that such payoff will always be larger than that in each of the other two ranges. That is, the manufacturer will always prefer to choose (w,F) such that $\triangle < \frac{1}{(1+\alpha)^2}b^2\gamma^2(w-c)^2$.

If the manufacturer chooses $\triangle < \frac{1}{(1+\alpha)^2}b^2\gamma^2(w-c)^2$, then its optimization problem is given below

$$\max_{w,F} \quad \Pi(w,F) = (w-c)(a-bp) + F, \tag{B8}$$

$$s.t. \quad \begin{cases} u(p) \geq 0 \\ p = \bar{p}_1 \\ \triangle < \frac{1}{(1+\alpha)^2}b^2\gamma^2(w-c)^2 \end{cases} \tag{B9}$$

Since $\Pi(w,F)$ is increasing in F and the retailer's price $\bar{p}_1$ is independent of F, the manufacturer will choose the highest F while keeping the retailer a willing participant of the channel and then choose the optimal w to maximize its payoff. It is straightforward to show that such a fixed payment is given by $F = \frac{(\bar{p}_1-w)(a-b\bar{p}_1)(1+\alpha)-\alpha\gamma(a-b\bar{p}_1)(w-c)}{1+\alpha+\alpha\gamma}$. The optimal (w,F) and the manufacturer's payoff are therefore given by

$$\begin{cases} w^* = c \\ F^* = \frac{(a-bc)^2(1+\alpha)}{4b(1+\alpha+\alpha\gamma)} \\ \Pi^* = \frac{(a-bc)^2(1+\alpha)}{4b(1+\alpha+\alpha\gamma)} \end{cases} \tag{B10}$$

Notice that when the manufacturer chooses (w,F) as in equation (B10), the retail price equals the channel coordinating price $p = \bar{p}_1 = \frac{a+bc}{2b} = p^*$. Therefore the channel profit in this scenario is equal to the maximum channel profit Π_c^*. Since the retailer has disadvantageous inequality for $\triangle < \frac{1}{(1+\alpha)^2}b^2\gamma^2(w-c)^2$, *i.e.*, $\gamma\Pi > \pi$, the manufacturer's payoff satisfies $\Pi > \frac{1}{1+\gamma}\Pi_c^*$. If the manufacturer chooses a two-part tariff (w,F) such that $\triangle \geq \frac{1}{(1+\alpha)^2}b^2\gamma^2(w-c)^2$, the retailer will have either no inequality or advantageous inequality. That is, $\gamma\Pi \leq \pi$, or $\Pi \leq \frac{1}{1+\gamma}\Pi_c \leq \frac{1}{1+\gamma}\Pi_c^*$. The manufacturer will get strictly lower payoff by choosing $\triangle \geq \frac{1}{(1+\alpha)^2}b^2\gamma^2(w-c)^2$ than choosing

$\triangle < \frac{1}{(1+\alpha)^2} b^2\gamma^2(w-c)^2$. As a result, the manufacturer's optimal two-part tariff and payoff are given by equation (B10).

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Optional Appendix C

Fair Minded Manufacturer and Retailer with Single Wholesale Price w

We first check whether manufacturer's concern of fairness could change the channel coordination conditions in single wholesale price regime, and, if yes, how. Since the retailer makes decisions solely based on wholesale price w, given w the retailer's decisions are still given by

$$p(w) = \begin{cases} \bar{p}_2 = \frac{a+bw}{2b} - \frac{\beta\gamma(w-c)}{2(1-\beta)} & \text{if } w \leq w_2 \\ p_0 = w + \gamma(w-c) & \text{if } w_2 < w \leq w_1 \\ \bar{p}_1 = \frac{a+bw}{2b} + \frac{\alpha\gamma(w-c)}{2(1+\alpha)} & \text{if } w > w_1 \end{cases} \tag{C1}$$

which is same as equation (2.12).

Proposition 1 shows that the players will choose the channel-coordinating actions for $\beta \geq \frac{1}{1+\gamma}$ and $\alpha \geq \mathtt{max}\{\frac{\gamma-1}{1+\gamma}, \beta\}$ when only the retailer cares about fairness, i.e., $\alpha_0 = \beta_0 = 0$. More specifically, the manufacturer will choose $w = w_2 = \frac{a-a\beta-\beta b\gamma c+2b\gamma c}{b(1-\beta-\beta\gamma+2\gamma)}$ for $\beta = \frac{1}{1+\gamma}$ and $\alpha \geq \mathtt{max}\{\frac{\gamma-1}{1+\gamma}, \beta\}$ and choose $w = \bar{w}_{II} = \frac{a+bc+2b\gamma c}{2b(1+\gamma)}$ for $\beta > \frac{1}{1+\gamma}$ and $\alpha \geq \mathtt{max}\{\frac{\gamma-1}{1+\gamma}, \beta\}$, and the retailer will choose $p = p^*$. We will check whether the current wholesale price is still optimal for the manufacturer when the manufacturer cares about fairness.

(a) $\beta = \frac{1}{1+\gamma}$ **and** $\alpha \geq \mathtt{max}\{\frac{\gamma-1}{1+\gamma}, \beta\}$**.**

When $\beta = \frac{1}{1+\gamma}$ and $\alpha \geq \mathtt{max}\{\frac{\gamma-1}{1+\gamma}, \beta\}$, the manufacturer will choose $w = w_2$ in the scenario of $w \leq w_2$ if it does not care about fairness and the retailer will choose $p = \bar{p}_2$ as shown in equation (2.12). At the point of $w = w_2 = \frac{a-a\beta-\beta b\gamma c+2b\gamma c}{b(1-\beta-\beta\gamma+2\gamma)} = \frac{a+bc+2b\gamma c}{2b(1+\gamma)}$, we have

$$\mu(\bar{p}_2 - w) - (w-c) = \frac{(a-bc)(\mu\gamma-1)}{2b(1+\gamma)} \begin{cases} > 0 & \text{if } \mu\gamma > 1 \\ \leq 0 & \text{if } \mu\gamma \leq 1 \end{cases} \tag{C2}$$

Case 1. Acrimonious channel: $\mu\gamma > 1$. In an acrimonious channel, the manufacturer's utility is given by

$$U(w) = (w-c)(a-b\bar{p}_2) - \alpha_0[\mu(\bar{p}_2 - w) - (w-c)](a-b\bar{p}_2) \tag{C3}$$

and we have

$$\begin{cases} \frac{dU}{dw} = \frac{(a-bc)}{2}(1+\alpha_0+\alpha_0\mu) > 0 \\ \\ \frac{d^2U}{dw^2} = 0 \end{cases} \tag{C4}$$

Since $w \leq w_2$, the manufacturer will still choose $w = w_2$ if w_2 provides it with non-negative utility.

Its utility by choosing $w = w_2$ is given below

$$U(w=w_2) = \frac{(a-bc)^2(1+\alpha_0-\alpha_0\mu\gamma)}{4b(1+\gamma)} \begin{cases} \geq 0 & \text{if } \alpha_0 \leq \frac{1}{\mu\gamma-1} \\ < 0 & \text{if } \alpha_0 > \frac{1}{\mu\gamma-1} \end{cases} \tag{C5}$$

Case 2. Harmonious channel: $\mu\gamma \leq 1$. In a harmonious channel, the manufacturer's utility is given by

$$U(w) = (w-c)(a-b\bar{p}_2) - \beta_0[(w-c) - \mu(\bar{p}_2 - w)](a-b\bar{p}_2) \tag{C6}$$

and we have

$$\begin{cases} \frac{dU}{dw} = \frac{(a-bc)}{2}(1-\beta_0-\beta_0\mu) \\ \\ \frac{d^2U}{dw^2} = 0 \end{cases} \tag{C7}$$

Since $w \leq w_2$, the manufacturer will choose w as follows

$$w = \begin{cases} w_2 & \text{if } \beta_0 \leq \frac{1}{1+\mu} \\ < w_2 & \text{if } \beta_0 > \frac{1}{1+\mu} \end{cases} \tag{C8}$$

and its utility is given by

$$U(w=w_2) = \begin{cases} \frac{(a-bc)^2(1-\beta_0+\beta_0\mu\gamma)}{4b(1+\gamma)} & \text{if } \beta_0 \leq \frac{1}{1+\mu} \\ > \frac{(a-bc)^2(1-\beta_0+\beta_0\mu\gamma)}{4b(1+\gamma)} & \text{if } \beta_0 > \frac{1}{1+\mu} \end{cases} \tag{C9}$$

Since $w = w_2$ is a corner solution for $w \leq w_2$ when $\beta = \frac{1}{1+\gamma}$ and $\alpha \geq \mathtt{max}\{\frac{\gamma-1}{1+\gamma}, \beta\}$, we also need to check whether $w = w_2$ is a stable solution within the $w_2 < w \leq w_1$ regime. When the manufacturer chooses a close to w_2 wholesale price in the scenario of $w_2 < w \leq w_1$, the retailer will choose $p = p_0 = w + \gamma(w - c)$ as shown in equation (C1). At the point of $w = w_2 = \frac{a - a\beta - \beta b\gamma c + 2b\gamma c}{b(1-\beta-\beta\gamma+2\gamma)} = \frac{a+bc+2b\gamma c}{2b(1+\gamma)}$, we have

$$\mu(p_0 - w_2) - (w_2 - c) = (\mu\gamma - 1)(w_2 - c)\begin{cases} > 0 & \text{if } \mu\gamma > 1 \\ \leq 0 & \text{if } \mu\gamma \leq 1 \end{cases} \tag{C10}$$

Case $1'$. *Acrimonious channel:* $\mu\gamma > 1$. In an acrimonious channel, the manufacturer's utility is given by

$$U(w) = (w - c)(a - bp_0) - \alpha_0(\mu\gamma - 1)(w - c)(a - bp_0) \tag{C11}$$

and we have

$$\begin{cases} \frac{dU}{dw} = (1 + \alpha_0 - \alpha_0\mu\gamma)(a + bc - 2bw - 2b\gamma w + 2b\gamma c) \\ \frac{d^2U}{dw^2} = -2b(1+\gamma)(1 + \alpha_0 - \alpha_0\mu\gamma) \end{cases} \tag{C12}$$

Since $w2 < w \leq w_1$, the manufacturer will choose w as follows

$$w = \begin{cases} w_2 & \text{if } \alpha_0 \leq \frac{1}{\mu\gamma - 1} \\ > w_2 & \text{if } \alpha_0 > \frac{1}{\mu\gamma - 1} \end{cases} \tag{C13}$$

and its utility is given by

$$U(w = w_2) = \begin{cases} \frac{(a-bc)^2(1+\alpha_0-\alpha_0\mu\gamma)}{4b(1+\gamma)} & \text{if } \alpha_0 \leq \frac{1}{\mu\gamma-1} \\ > \frac{(a-bc)^2(1+\alpha_0-\alpha_0\mu\gamma)}{4b(1+\gamma)} & \text{if } \alpha_0 > \frac{1}{\mu\gamma-1} \end{cases} \tag{C14}$$

Case $2'$. *Harmonious channel:* $\mu\gamma \leq 1$. In a harmonious channel, the manufacturer's utility is given by

$$U(w) = (w - c)(a - bp_0) - \beta_0[(w - c) - \mu(p_0 - w)](a - bp_0) \tag{C15}$$

and we have

$$\begin{cases} \frac{dU}{dw} = (1 - \beta_0 + \beta_0\mu\gamma)(a + bc - 2bw - 2b\gamma w + 2b\gamma c) \\ \frac{d^2U}{dw^2} = -2b(1+\gamma)(1 - \beta_0 + \beta_0\mu\gamma) < 0 \end{cases} \tag{C16}$$

Since $w_2 < w \leq w_1$, the manufacturer will choose $w = w_2$ and its utility is given by

$$U = \frac{(a-bc)^2(1-\beta_0+\beta_0\mu\gamma)}{4b(1+\gamma)} > 0 \tag{C17}$$

From Cases $1, 2$ and Cases $1', 2'$, we could have the following conclusion for $\beta = \frac{1}{1+\gamma}$ and $\alpha \geq \mathtt{max}\{\frac{\gamma-1}{1+\gamma}, \beta\}$.

(i). If $\mu\gamma - 1 > 0$, then

$$\begin{cases} w^* = w_2,\ p = p^*,\ U^* = \frac{(a-bc)^2(1+\alpha_0-\alpha_0\mu\gamma)}{4b(1+\gamma)} & \text{if } \alpha_0 \leq \frac{1}{\mu\gamma-1} \\ w^* > w_2,\ p > p^*,\ U^* > \frac{(a-bc)^2(1+\alpha_0-\alpha_0\mu\gamma)}{4b(1+\gamma)} & \text{if } \alpha_0 > \frac{1}{\mu\gamma-1} \end{cases}. \tag{C18}$$

(ii). If $\mu\gamma - 1 = 0$, then

$$w^* = w_2,\ p = p^*,\ U^* = \frac{(a-bc)^2}{4b(1+\gamma)}. \tag{C19}$$

(iii). If $\mu\gamma - 1 < 0$, then

$$\begin{cases} w^* = w_2,\ p = p^*,\ U^* = \frac{(a-bc)^2(1-\beta_0+\beta_0\mu\gamma)}{4b(1+\gamma)} & \text{if } \beta_0 \leq \frac{1}{1+\mu} \\ w^* < w_2,\ p = p^*,\ U^* > \frac{(a-bc)^2(1-\beta_0+\beta_0\mu\gamma)}{4b(1+\gamma)} & \text{if } \beta_0 > \frac{1}{1+\mu} \end{cases}. \tag{C20}$$

(b) $\beta > \frac{1}{1+\gamma}$ and $\alpha \geq \mathtt{max}\{\frac{\gamma-1}{1+\gamma}, \beta\}$.

When $\beta > \frac{1}{1+\gamma}$ and $\alpha \geq \mathtt{max}\{\frac{\gamma-1}{1+\gamma}, \beta\}$, the manufacturer will choose $w = \bar{w}_{II} = \frac{a+bc+2b\gamma c}{2b(1+\gamma)}$ in the scenario of $w_2 < w \leq w_1$ if it does not care about fairness and the retailer will choose $p = p_0 = w + \gamma(w-c)$ as shown in equation (2.12). At the point of $w = \bar{w}_{II} = \frac{a+bc+2b\gamma c}{2b(1+\gamma)}$, we have

$$\mu(p_0 - w) - (w-c) = (\mu\gamma - 1)(w-c) \begin{cases} > 0 & \text{if } \mu\gamma > 1 \\ \leq 0 & \text{if } \mu\gamma \leq 1 \end{cases} \tag{C21}$$

Case 1. Acrimonious channel: $\mu\gamma > 1$. In an acrimonious channel, the manufacturer's utility is given by

$$U(w) = (w-c)(a-bp_0) - \alpha_0(\mu\gamma-1)(w-c)(a-bp_0) \tag{C22}$$

and we have

$$\begin{cases} \frac{dU}{dw} = (1+\alpha_0-\alpha_0\mu\gamma)(a+bc-2bw-2b\gamma w+2b\gamma c) \\ \\ \frac{d^2U}{dw^2} = -2b(1+\gamma)(1+\alpha_0-\alpha_0\mu\gamma) \end{cases} \tag{C23}$$

The manufacturer will still choose $w = \bar{w}_{II}$ if $\bar{w}_{II}$ provides it with non-negative utility. Its utility by choosing $w = \bar{w}_{II}$ is given below

$$U(w = \bar{w}_{II}) = \frac{(a-bc)^2(1+\alpha_0-\alpha_0\mu\gamma)}{4b(1+\gamma)} \begin{cases} \geq 0 & \text{if } \alpha_0 \leq \frac{1}{\mu\gamma-1} \\ < 0 & \text{if } \alpha_0 > \frac{1}{\mu\gamma-1} \end{cases} \tag{C24}$$

Case 2. Harmonious channel: $\mu\gamma \leq 1$. In a harmonious channel, the manufacturer's utility is given by

$$U(w) = (w-c)(a-bp_0) - \beta_0(1-\mu\gamma)(w-c)(a-bp_0) \tag{C25}$$

and we have

$$\begin{cases} \frac{dU}{dw} = (1-\beta_0+\beta_0\mu\gamma)(a+bc-2bw-2b\gamma w+2b\gamma c) \\ \\ \frac{d^2U}{dw^2} = -2b(1=\gamma)(1-\beta_0+\beta_0\mu\gamma) < 0 \end{cases} \tag{C26}$$

The manufacturer's utility by choosing $w = \bar{w}_{II}$ is given by

$$U(w = \bar{w}_{II}) = \frac{(a-bc)^2(1-\beta_0+\beta_0\mu\gamma)}{4b(1+\gamma)} > 0 \tag{C27}$$

From Cases 1 and 2 above, we could have the following conclusion for $\beta > \frac{1}{1+\gamma}$ and $\alpha \geq \mathtt{max}\{\frac{\gamma-1}{1+\gamma}, \beta\}$.

(i). If $\mu\gamma - 1 > 0$, then

$$\begin{cases} w^* = \bar{w}_{II},\ p = p^*,\ U^* = \frac{(a-bc)^2(1+\alpha_0-\alpha_0\mu\gamma)}{4b(1+\gamma)} & \text{if } \alpha_0 \leq \frac{1}{\mu\gamma-1} \\ w^* \neq \bar{w}_{II},\ p \neq p^*,\ U^* > \frac{(a-bc)^2(1+\alpha_0-\alpha_0\mu\gamma)}{4b(1+\gamma)} & \text{if } \alpha_0 > \frac{1}{\mu\gamma-1} \end{cases}. \tag{C28}$$

(ii). If $\mu\gamma - 1 = 0$, then

$$w^* = \bar{w}_{II},\ p = p^*,\ U^* = \frac{(a-bc)^2}{4b(1+\gamma)}. \tag{C29}$$

(iii). If $\mu\gamma - 1 < 0$, then

$$w^* = \bar{w}_{II},\ p = p^*,\ U^* = \frac{(a-bc)^2(1-\beta_0+\beta_0\mu\gamma)}{4b(1+\gamma)}. \tag{C30}$$

We can see that manufacturer's concern for fairness will not affect the coordination of an acrimonious channel, unless the manufacturer is very averse to its own disadvantageous inequality. This leads to Proposition 6.

Fair Minded Manufacturer and Retailer with Two-Part Tariff (w, F)

Again, the manufacturer's inequity aversion parameters are given by $\beta_0 \le \alpha_0$ and $0 \le \beta_0 < 1$. Given manufacturer's decisions (w, F), the retailer will choose retail price p as follows

$$p(w,F) = \begin{cases} \bar{p}_1 = \frac{a+bw}{2b} + \frac{\alpha\gamma(w-c)}{2(1+\alpha)} & \text{if } \triangle < \frac{1}{(1+\alpha)^2}b^2\gamma^2(w-c)^2 \\ \tilde{p}_1 = \frac{a+bw+b\gamma(w-c)-\sqrt{\triangle}}{2b} & \text{if } \frac{1}{(1+\alpha)^2}b^2\gamma^2(w-c)^2 \le \triangle \le \frac{1}{(1-\beta)^2}b^2\gamma^2(w-c)^2 \\ \bar{p}_2 = \frac{a+bw}{2b} - \frac{\beta\gamma(w-c)}{2(1-\beta)} & \text{if } \triangle > \frac{1}{(1-\beta)^2}b^2\gamma^2(w-c)^2 \end{cases}, \tag{C31}$$

where $\triangle = [a - bw - b\gamma(w-c)]^2 - 4b(1+\gamma)F$.

Proposition 3 shows that the manufacturer will choose (w, F)=$[c, \frac{(a-bc)^2(1+\alpha)}{4b(1+\alpha+\alpha\gamma)}]$ when it does not care about fairness. We would like to check whether the solution is still optimal when the manufacturer does have fairness concern.

At the current solution $[c, \frac{(a-bc)^2(1+\alpha)}{4b(1+\alpha+\alpha\gamma)}]$, $\triangle < \frac{1}{(1+\alpha)^2}b^2\gamma^2(w-c)^2$ is satisfied, and we have

$$\mu[(\bar{p}_1 - w)(a - b\bar{p}_1) - F] - [(w-c)(a-b\bar{p}_1) + F] = \frac{(a-bc)^2(\mu\gamma\alpha - 1 - \alpha)}{4b(1+\alpha+\alpha\gamma)} \begin{cases} > 0 & \text{if } \mu\gamma > 1 + \frac{1}{\alpha} \\ \le 0 & \text{if } \mu\gamma \le 1 + \frac{1}{\alpha} \end{cases}$$

Case 1. Acrimonious channel: $\mu\gamma > 1 + \frac{1}{\alpha}$. In an acrimonious channel, the manufacturer's utility is given by

$$U(w,F) = (w-c)(a-b\bar{p}_1) + F - \alpha_0[\mu(\bar{p}_1 - w)(a - b\bar{p}_1) - \mu F - (w-c)(a-b\bar{p}_1) - F] \tag{C32}$$

The manufacturer chooses a fixed payment $F = \frac{(\bar{p}_1-w)(a-b\bar{p}_1)(1+\alpha)-\alpha\gamma(a-b\bar{p}_1)(w-c)}{1+\alpha+\alpha\gamma}$ to let the retailer be a willing participant of the channel. We have

$$\begin{cases} \frac{dU}{dw} = \frac{b(1+\alpha+\alpha\gamma)(w-c)(\alpha_0\alpha\mu\gamma-\alpha-\alpha_0\alpha-1-\alpha_0)}{2(1+\alpha)^2} \\ \frac{d^2U}{dw^2} = \frac{b(1+\alpha+\alpha\gamma)(\alpha_0\alpha\mu\gamma-\alpha-\alpha_0\alpha-1-\alpha_0)}{2(1+\alpha)^2} \end{cases} \tag{C33}$$

Therefore,

$$\begin{cases} w^* = c,\ p = p^*,\ U^* = \frac{(a-bc)^2(1+\alpha+\alpha_0+\alpha_0\alpha-\alpha_0\alpha\mu\gamma)}{4b(1+\alpha+\alpha\gamma)} & \text{if } \alpha_0 \leq \frac{1+\alpha}{\alpha\mu\gamma-1-\alpha} \\ w^* > c,\ p > p^*,\ U^* > \frac{(a-bc)^2(1+\alpha+\alpha_0+\alpha_0\alpha-\alpha_0\alpha\mu\gamma)}{4b(1+\alpha+\alpha\gamma)} & \text{if } \alpha_0 > \frac{1+\alpha}{\alpha\mu\gamma-1-\alpha} \end{cases} \tag{C34}$$

Case 2. Harmonious channel: $\mu\gamma \leq 1 + \frac{1}{\alpha}$. In a harmonious channel, the manufacturer's utility is given by

$$U(w,F) = (w-c)(a-b\bar{p}_1) + F - \beta_0[(w-c)(a-b\bar{p}_1) + F - \mu(\bar{p}_1-w)(a-b\bar{p}_1) + \mu F] \tag{C35}$$

Again, the manufacturer will choose a fixed payment $F = \frac{(\bar{p}_1-w)(a-b\bar{p}_1)(1+\alpha)-\alpha\gamma(a-b\bar{p}_1)(w-c)}{1+\alpha+\alpha\gamma}$ in order for the retailer to be willing to participate in the channel. We have

$$\begin{cases} \frac{dU}{dw} = -\frac{b(1+\alpha+\alpha\gamma)(w-c)(\alpha-\alpha\beta_0+1-\beta_0+\beta_0\alpha\mu\gamma)}{2(1+\alpha)^2} \\ \frac{d^2U}{dw^2} = -\frac{b(1+\alpha+\alpha\gamma)(\alpha-\alpha\beta_0+1-\beta_0+\beta_0\alpha\mu\gamma)}{2(1+\alpha)^2} < 0 \end{cases} \tag{C36}$$

Therefore,

$$w^* = c,\ p = p^*,\ U^* = \frac{(a-bc)^2(1-\beta_0+\alpha-\alpha\beta_0+\beta_0\alpha\mu\gamma)}{4b(1+\alpha+\alpha\gamma)} > 0 \tag{C37}$$

Similar with the results in the single wholesale price case, the manufacturer's concern of fairness will not change its choice of (w,F) in an acrimonious channel, unless it is very adverse to its own disadvantageous inequality, *i.e.,* $\alpha_0 > \frac{1+\alpha}{\alpha\mu\gamma-1-\alpha}$. In an acrimonious channel in which the manufacturer is not too averse to disadvantageous inequality or in a harmonious channel, the manufacturer will always offer the contract (w,F)=$[c, \frac{(a-bc)^2(1+\alpha)}{4b(1+\alpha+\alpha\gamma)}]$, which induces the retailer to choose the channel coordinating retail price p^*.

Fair Minded Manufacturer and Retailer with Quantity Discount

When the manufacturer would like to use quantity discount to induce the retailer to choose the channel coordinating retail price p^* and the manufacturer cares about fairness, it will use the following quantity discount scheme:

$$w = \frac{1}{1+\alpha+\alpha\gamma}[(1-k_1+\alpha)p(D)+\alpha\gamma c+k_1 c-\frac{k_2}{D}], \tag{C38}$$

with the constraints that the retailer has non-negative utility and that the retailer is having disadvantageous inequality utility at the channel coordinating retail price $p = p^*$

$$\begin{cases} k_2 \geq \bar{k}_2^0 \\ w > \frac{p^*+\gamma c}{1+\gamma} = \frac{a+bc+2b\gamma c}{2b(1+\gamma)} \end{cases}, \tag{C39}$$

where we define $\bar{k}_2^0 = -k_1\frac{(a-bc)^2}{4b}$. If the manufacturer does not have concern of fairness, it will choose $k_2 = \bar{k}_2^0$ and the maximum payoff for the manufacturer is given by equation (4.5).

If the manufacturer cares about fairness, the difference between its profit and reference profit is given by

$$[\mu(p^*-w)-(w-c)]D(p^*) = \frac{4b(1+\mu)k_2+(k_1-1-\alpha+\mu\alpha\gamma+\mu k_1)(a-bc)^2}{4b(1+\mu)} \begin{cases} >0 & \text{if } k_2 > \bar{k}_2 \\ =0 & \text{if } k_2 = \bar{k}_2 \\ <0 & \text{if } k_2 < \bar{k}_2 \end{cases}$$

where $\bar{k}_2 = -\frac{(k_1-1-\alpha+\mu\alpha\gamma+\mu k_1)(a-bc)^2}{4b(1+\mu)}$.

Case 1. Acrimonious channel: $\mu\gamma > 1+\frac{1}{\alpha}$, i.e., $1+\alpha-\mu\gamma\alpha < 0$. In an acrimonious channel, we have $k_2 \geq \bar{k}_2^0 > \bar{k}_2$ for any $k_1 > 0$. That is, the manufacturer will have disadvantageous inequality for any $k_1 > 0$. Since $\frac{\partial U}{\partial k_2} = -\frac{1+\alpha_0\mu+\alpha_0}{1+\alpha+\alpha\gamma} < 0$, the manufacturer will choose $k_2 = \bar{k}_2^0$ and its utility will be given by

$$U = \frac{(a-bc)^2(\alpha_0+\alpha+\alpha_0\alpha+1-\alpha_0\mu\alpha\gamma)}{4b(1+\alpha+\alpha\gamma)} \begin{cases} \geq 0 & \text{if } \alpha_0 \leq \frac{1+\alpha}{\alpha\mu\gamma-1-\alpha} \\ <0 & \text{if } \alpha_0 > \frac{1+\alpha}{\alpha\mu\gamma-1-\alpha} \end{cases}. \tag{C40}$$

Therefore,

$$\begin{cases} k_2^* = \bar{k}_2^0,\ p = p^*,\ U^* = \frac{(a-bc)^2(\alpha_0+\alpha+\alpha_0\alpha+1-\alpha_0\mu\alpha\gamma)}{4b(1+\alpha+\alpha\gamma)} & \text{for } \alpha_0 \le \frac{1+\alpha}{\alpha\mu\gamma-1-\alpha} \\ p \ne p^*,\ U^* > \frac{(a-bc)^2(\alpha_0+\alpha+\alpha_0\alpha+1-\alpha_0\mu\alpha\gamma)}{4b(1+\alpha+\alpha\gamma)} & \text{for } \alpha_0 > \frac{1+\alpha}{\alpha\mu\gamma-1-\alpha} \end{cases}. \tag{C41}$$

That is, if $\mu\gamma > 1 + \frac{1}{\alpha}$ and $\alpha_0 \le \frac{1+\alpha}{\alpha\mu\gamma-1-\alpha}$, then the fair minded manufacturer will still choose both the quantity discount scheme as given by equation (C38) and $k_2 = \bar{k}_2^0$ as it does without concern of fairness. If $\mu\gamma > 1 + \frac{1}{\alpha}$ and $\alpha_0 > \frac{1+\alpha}{\alpha\mu\gamma-1-\alpha}$, however, the manufacturer will not choose the quantity discount scheme (C38) since even the optimal solution $\bar{k}_2^0$ will provide it with negative utility.

Case 2. Harmonious channel: $\mu\gamma \le 1 + \frac{1}{\alpha}$. In a harmonious channel, we have $\bar{k}_2 \ge \bar{k}_2^0$. If choosing $k_2 \ge \bar{k}_2$, the manufacturer gets a utility $U = \frac{(a-bc)^2\mu}{4b(1+\mu)}$. If choosing $k_2 < \bar{k}_2$, the manufacturer is having disutility from advantageous inequality and we have

$$\begin{cases} k_2^* = \bar{k}_2^0,\ p = p^*,\ U^* = \frac{(a-bc)^2(1+\alpha-\alpha\beta_0-\beta_0+\beta_0\mu\alpha\gamma)}{4b(1+\alpha+\alpha\gamma)} > 0 & \text{if } \beta_0 \le \frac{1}{1+\mu} \\ k_2^* = \bar{k}_2,\ p = p^*,\ U^* = \frac{(a-bc)^2\mu}{4b(1+\mu)} > 0 & \text{if } \beta_0 > \frac{1}{1+\mu} \end{cases} \tag{C42}$$

Therefore, the fair minded manufacturer will still choose $k_2^* = \bar{k}_2^0$ as it does in $\alpha_0 = \beta_0 = 0$ scenario, if it has small inequality aversion parameters α_0 and β_0. Only in an acrimonious channel with $\alpha_0 > \frac{1+\alpha}{\alpha\mu\gamma-1-\alpha}$ or in a harmonious channel with $\beta_0 > \frac{1}{1+\mu}$, it will deviate from $k_2 = \bar{k}_2^0$. In the latter case, however, it will still use the proposed quantity discount scheme with $k_2^* = \bar{k}_2$, which induces the retailer to choose the channel coordinating retail price p^*.