Note on the Mathematical Derivation of Incentives in the Channel of Distribution

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OPTIONAL

(Based on past experience, a few 15.810 students express interest in the mathematics of the channel coordination. This material is <u>not</u> necessary for a basic, qualitative understanding of channel coordination and the inherent channel conflicts. It is sufficient that you understand the qualitative discussions that are covered in class. However, for those students interested in the basic mathematics, I provide this note.)

In class we discuss power and conflict in the channel of distribution. One of the central ideas in understanding power and conflict is that the incentives of independent manufacturers and independent retailers are different than the incentives for jointly-owned manufacturers and retailers. In particular, independently owned (and uncoordinated) channels have unilateral incentives to raise prices (margins), reduce service, and reduce quality.

The intuitive reason for this coordination issue is the fact that the fundamental balance equations (for oligopolies) of margin cost = margin revenue are different when the channel is uncoordinated relative to the solution when the channel is coordinated. For example, in an uncoordinated channel, the manufacturer does not share its margin with the retailer, but, by increasing its margin, the manufacturer lowers its sales to the retailer and lowers the retailer's sales to the consumer. In a way, the manufacturer gets all the upside but shares the downside. No wonder the retailer is upset. It shares in the downside but gets none of the upside.

This result can be proven for more complex channels. But it is, perhaps, easiest to see if we assume that there is just one retailer and one manufacturer selling in a monopoly channel as shown in Figure 1. To prove the result, we set up the calculus of "margin cost = marginal revenue" for the coordinated channel (joint maximum). We then examine what these joint conditions imply for the "marginal cost = marginal revenue" conditions faced separately by the manufacturer and the retailer.[1]

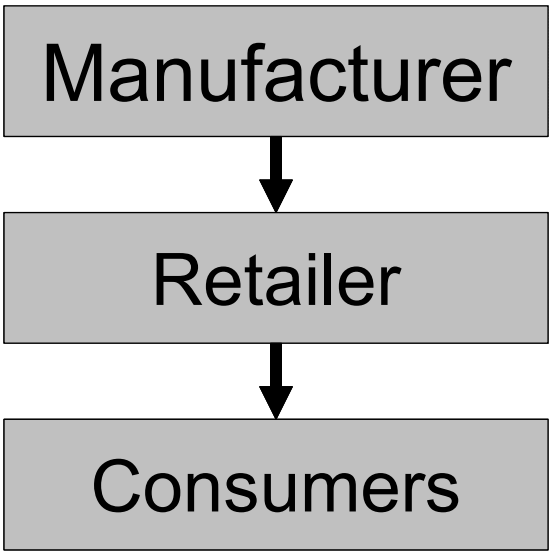

Figure 1. Simple Channel of Distribution

[1] This simple proof was first proposed by Abel P. Jeuland, and Steven M. Shugan, "Managing Channel Profits," *Marketing Science*, 2, 3 (Summer) 1983, 239-272

We begin with the notation. Capital letters indicate the profit, margins, variable costs, and fixed costs for the manufacturer. Lower case letters indicate the corresponding variables for the retailer.

	Manufacturer	Retailer
Profit	Π	π
Margins	G	g
Variable Costs	C	c
Fixed Costs	F	f
Price		p
Demand Equation		D(p)

(Manufacturer) $\Pi = G \cdot D - F$

(Retailer) $\pi = g \cdot D - f$

(Channel) $\Pi + \pi = (G + g) \cdot D - F - f$

(Price) $p = c + g + C + G$

(Joint Maximum) $\partial(\Pi + \pi)/\partial G = \partial \Pi /\partial G + \partial \pi /\partial G = 0$

but $\pi = g \cdot D - f$ implies

$$\partial \pi /\partial G = g \cdot \partial D/\partial G = g \cdot (\partial D/\partial p) \cdot (\partial p/\partial G) \quad (= 1)$$

$$= g \cdot (\partial D/\partial p) \cdot (p/D) \cdot (D/p)$$

$$= (g \cdot D/p) \cdot [(\partial D/D)/(\partial p/p)]$$

$$= -(g \cdot D/p)(\text{price elasticity}) < 0$$

This equation implies that, at the margins which were optimal for a coordinated channel ($\partial(\Pi + \pi)/\partial G = 0$), the following conditions hold for unilateral profit maximization.

$$\partial\pi/\partial G < 0 \quad \text{and} \quad \partial\Pi/\partial G > 0 \quad \text{(by joint maximum)}$$

This implies that the retailer will want the manufacturer to decrease its margins. Unfortunately, the retailer can do nothing about it. The condition also implies that the manufacturer will want to increase its margins because it can earn more profit at a higher margin ($\partial\Pi/\partial G > 0$). The manufacturer thus has unilateral incentives to raise its margins (against the retailer's wishes.) This leads to conflict in the channel.

By symmetry, we can prove the following. (We do this by modifying the above proof with the following changes: switch Π for π, π for Π, G for g, and g for G.)

$$\partial\pi/\partial g > 0 \quad \text{and} \quad \partial\Pi/\partial g < 0$$

We can interpret the equations in words. Relative to the margins that were optimal for a coordinated channel, in an uncoordinated channel.

- The manufacturer has unilateral incentives to raise margin.
- The retailer has unilateral incentives to raise its margin.
- The manufacturer wants the retailer to lower its margin.

- The retailer wants the manufacturer to lower its margin.

The mathematics for service and for product quality are very similar to the mathematics that are used to derive the price equations. If we were to work through the mathematics we would get the following results.

- The manufacturer has unilateral incentive to decrease product quality.

- The retailer has unilateral incentives to decrease retail service.

- The manufacturer wants the retailer to increase service

.

- The retailer wants the manufacturer to increase quality.

Like many of the topics covered in 15.810, these basic ideas have been applied and extended in many academic (and popular press) papers. If you understand the basic intuition, you are well on your way towards managing through this challenge.