Distribution Services and Economic Power In a Channel

Roger R. Betancourt
Dept. of Economics
University of Maryland
College Park MD 20742

David A. Gautschi
School of Business Administration
University of Washington
Seattle WA 98195-3200

May 1996

Revised November 1997

Acknowledgements: The authors are grateful to Brian Ratchford and two anonymous referees of the *Journal of Retailing* for their careful and constructive critiques of an earlier version of the paper. We also acknowledge with gratitude the useful comments provided by participants of the workshop on Channel Productivity at the University of Mons, October 1996 and the UW Research in Marketing Camp, Seattle, WA September 1997.

Distribution Services and Economic Power in the Channel

Abstract

We explore the consequences of formally acknowledging the influences of distribution services on the economic power of a retailer relative to a manufacturer in a simple channel dyad. The work is in the tradition of the analysis of successive monopolies and features the analysis of the well-known double marginalization problem. We compare two stylized cases of the provision of distribution services, the first exclusively by the downstream agent and the second by the upstream agent. In reference to a standard leader-follower model without acknowledged distribution services, the results of these two cases establish the importance of including distribution services in empirical and analytical investigations of the distribution of power in the channel. Briefly, distribution services may afford the agent that controls their provision unusual opportunities to capture economic power, and benefit consumers in a decentralized channel more than in a vertically integrated one.

Introduction

There has been a growing discussion in the business press and the academic literature revolving around the apparent shift in power in modern channels of distribution. As the argument commonly goes, the inexorably rising scale of retail establishments and enterprises has abetted a growth in monopoly power on the part of these organizations. Empirical investigations of this issue are inconclusive in their findings, and questions of the framing of the problem linger.

In this paper we attempt to contribute three things to this evolving and important debate. First, we seek to understand how the explicit acknowledgment of distribution services influences the analysis of the distribution of economic power in a channel. Using the terminology of Tirole (1988) , this means that we shall attempt to explore the linkages between the various instruments and targets among the independent decision-makers at different levels of the channel in capturing the monopoly rents in the channel. A second intended contribution of the present study addresses the specific consequences of who among the agents in the channel controls the provision of distribution services. Specifically, we seek to understand how prices, services, and profits of the agents compare under different assumptions of channel organization. A final intended contribution is to compare in some depth the special cases of downstream and upstream moral hazard. The former applies to a situation in which the retailer controls the provision of distribution services and the latter is the case in which an upstream agent, such as a manufacturer, can manipulate certain demand-generating services that the downstream agent may not be able to influence or control directly. The latter case is an important benchmark that conforms to conventional structures in which the balance of economic power has traditionally been assumed to reside with the upstream player, and in conventional marketing strategy terms invokes a manufacturer=s attempt to by-pass the retailer to generate final market demand by means of a so-called pull strategy.

The paper is organized as follows: in the next section we briefly review the expanding, relevant literature. For purposes of clarity and ease of comparison we establish three stylized cases. The first of these, the standard leader-follower model, appears in the third section. In the fourth section we explore the special case of downstream moral hazard and in the fifth section of the paper we treat the special case of upstream moral hazard.

Throughout we characterize the channel as a dyad of successive monopolies, and we strive to establish general results that are best interpreted in the context of special cases. In most respects we have adopted the notation and terminology of Tirole [1988] to enhance the integration of our results with the extant literature. The Appendix provides a comprehensive guide to the notation and derivations of key results.

Literature Review

In general economic power can be thought of as the ability to influence an agent=s level of profits or profit margin. A widely cited reference in marketing (Stern and El-Ansary, 1992) defines channel power as:

...the ability to control the decision variables in the marketing strategy of another member in a given channel at a different level of distribution. For this control to qualify as power, it should be different from the influenced member=s original level of control over his own marketing strategy...

We interpret the allusion to power in the second part of the definition as leading one member to influence the outcomes of another member=s choices with respect to marketing strategy. The relevant outcome for our consideration of economic power is profit or profit margin. Since all elements of a marketing strategy must contribute to the costs incurred and the demand generated by its sponsor, the definition of Stern and El-Ansary is consistent with the point of our analysis.

In a number of papers in both the economics and marketing literatures, we have stressed the economic characteristics and the importance of distribution services as outputs of retail activities (cf. Betancourt and Gautschi, 1988,1990, 1993). These outputs can be grouped into five broad categories: accessibility of location, assortment, assurance of product delivery, provision of information, and ambience. Others have made similar, if not complementary, arguments (e.g. Oi , 1992).

In any marketing channel that features a retailer, as a specialized marketing intermediary, any influence on the levels of the distribution services provided in the channel will necessarily influence the profit levels or profit margins. Indeed, we have demonstrated in an earlier paper that the retailer has a profit incentive to integrate backwards under fairly general conditions precisely because of the existence of distribution services (cf. Betancourt and Gautschi, 1988). One of our objectives in this paper is to explore systematically how distribution services function as a mechanism for the capturing of economic power in a channel, a theme consistent with the behavioral perspective expressed by Stern and El-Ansary in the foregoing definition. More precisely, any of these distribution services would serve as elements of marketing strategy.

Economists tend to think of economic power as monopoly power, and the basic concept in analyzing monopoly power is the price-cost margin. Thus, the most widely used graduate textbook in industrial organization analysis (Tirole, 1988) relies heavily on this concept in its analysis of vertical control cast in a simple manufacturer-retailer dyad. Tirole discusses two results relying on this concept which anchor and are generalized in subsequent sections of this paper.

The marketing literature features important work in the analysis of channel profits. One strand of the literature is represented by the widely-cited, comprehensive study of Jeuland and Shugan (1983). The focus of Jeuland and Shugan is the coordination mechanisms among channel members that increase the level of profits in the channel. In addressing this issue, they assume symmetry between the upstream agent and the downstream agent. Specifically, both agents are assumed to control the same number of decision variables: profit margin and product quality are controlled by the manufacturer; profit margin and service are controlled by the retailer.

A complementary strand of the marketing literature addresses the issue of channel member efficiency. McGuire and Staelin (1983) assume an asymmetric relation in which the upstream agent controls the intermediate price and is aware of its influence on the downstream agent=s decision to set retail price. The upstream agent exercises this control by exploiting its knowledge of the final market demand curve--assumed to be linear in price--and the costs facing the downstream agent. The analysis stresses the industry equilibrium that emerges under alternative channel structures in a duopoly.

For most of our analysis we shall assume asymmetric relationships between the upstream and downstream agents in a simple channel dyad, characterized as successive monopolists. We summarize standard representations of the simple channel problem, where the only acknowledged instruments are prices set by the agents at different levels of the channel. Thereafter, we consider the influence of distribution services, first when the services are provided exclusively by the downstream agent and subsequently when they are provided exclusively by the upstream agent. As we introduce asymmetry and distribution services explicitly into our analysis, we view our analysis as complementary to both strands in the literature as represented by Jeuland and Shugan and by McGuire and Staelin.

The question of shifting power in the channel has inspired several recent empirical studies. Messenger and Narasimhan (1995), for example, concentrate on the food industry; Ailawadi, Borin, and Farris (1995) cover a wide variety of consumer goods industries and retail classes. The basic conclusion of both studies is that there is no definitive evidence of a shift in power from manufacturers to retailers although the latter study finds such exceptions as Wal-Mart. These studies are extremely useful, but they address only one of two issues relevant for the study of economic power. Namely, they address the evolution of profits of channel agents, but they are only able to address the critical issue of the distribution of channel profits at the margin under very restrictive assumptions.

Economists argue that to investigate the distribution of channel profits--thus, the distribution of power at the margin--one must measure the ratio of profit margins between two agents at different levels of the channel. Profit margins depend on marginal costs, and marginal costs are notoriously difficult to measure. Not surprisingly, neither the study of Messenger and Narasimhan nor that of Ailawadi et al incorporates measures of marginal costs into the empirical analyses. Indeed, the Ailawadi et al study is especially valuable because it considers every sensible empirical measure of profits. Yet, their study can address the issue of distribution of economic power at the margin only if one assumes for both agents not only that marginal costs are constant, but equal to average costs. Our analysis complements this empirical work by showing that the ratio of profit margins depends critically upon who controls the level of distribution services. Hence, one potential benefit from the analysis reported here is that it may suggest avenues for empirical analyses to bypass the measurement problem.

As we consider the case of successive monopolies, our approach may be contrasted with other recent studies in the literature. Most notably, the study of Lal and Narasimhan (1996) derives pertinent results for the consideration of relative economic power between the manufacturer and the retailer. However, the results of Lal and Narasimhan are derived from a condition of competition in the downstream market, and they do not incorporate distribution services into their analysis.

Finally, the industrial organization literature explores the consequences for consumer welfare stemming from the organization of the channel. Comparing optimal retail price levels in decentralized and vertically integrated structures, Tirole (1988), for example, demonstrates that optimal retail prices are higher in the former.

Thus, consumer welfare suffers when the channel dyad is not integrated. When distribution services enter into the analysis, the welfare result is not so clear-cut. Applying the logic of Wernerfelt=s (1994) efficiency criterion for marketing design, for any given retail price level, the level of distribution services resulting from the exercise of economic power will determine whether consumer welfare rises or falls. Our analysis provides conditions under which distribution services rise or fall in the context of alternative forms of channel organization.

Standard Leader-Follower Case

In this section we present the well-established case of a monopolistic retailer following the lead of a monopolistic manufacturer. Restricted versions of this case have been explored by Spengler (1950), Hawkins (1950), Bresnahan and Reiss (1985), Tirole (1988, pp. 174-176, 198) and Waterson (1984, Chapter 4). As there are no acknowledged distribution services in the standard case, only the final price, p, of a single good or retail item[1] serves as the argument of final demand, i.e. q = D(p), and we assume firms to be price, rather than quantity, setters.

The Channel Dyad

Taking as a parameter the wholesale price, w, set by the manufacturer, the retailer sets final price so as to maximize the profit function

$$\pi_R = (p - w)\, D(p) - \phi(D(p)) \qquad (1)$$

where $\phi(.)$ is the cost of retailing expressed as a function of quantities demanded. The first-order condition associated with the retailer=s profit maximization may be expressed as:

$$D(p) + (p-w)\, D_p - \phi_D D_p = 0 \qquad (2)$$

where D_p is the derivative of final demand with respect to final price, and ϕ_D is the derivative of the cost of retailing with respect to the level of final demand.
From (2), we derive the following three equivalent conditions:

$$(p - w - \phi_D) = -D / D_p \qquad (2')$$

$$p [(\varepsilon - 1)/ \varepsilon] = w + \phi_D \qquad (2'')$$

$$(p - w - \phi_D) = p / \varepsilon \qquad (2''')$$

where ε denotes the absolute value of the price elasticity of final demand. So long as π_R is concave in p, then (2) and its equivalent expressions establish that p*, the final price that maximizes π_R, is a function of w.
Knowing the retailer's decision-rule and D(p), the manufacturer chooses w so as to maximize the profit function

$$\pi_M = w D(p) - \psi (D(p)) \qquad (3)$$

where, assuming that all quantities manufactured are cleared in the retail market and that there are no inventories, $\psi(.)$ is the cost of manufacture expressed as a function of final demand.

Because the manufacturer chooses w before the retailer chooses p = p* that maximizes π_R and knows that the retailer takes w as a parameter in setting p, (3) may be written equivalently as

$$\pi_M = w D(p(w)) - \psi (D(p(w))) \qquad (3')$$

From (3') we express the first-order condition for the manufacturer's profit maximization assuming his knowledge of p*, the optimal price for the retailer given w, as

$$D(p^*(w)) + (w - \psi_D) D_p (dp^*(w)/dw) = 0 \qquad (4)$$

or, equivalently,

$$w- \psi_D = - D / D_p \, (dp^*(w)/dw) \qquad (4=)$$

where ψ_D is the derivative of the cost of manufacture with respect to final demand.

Generalizing from results obtained by Tirole (1988, p.198) and Bresnahan and Reiss (1985) [2] for the case of constant marginal costs, the following proposition presents the conditions that dictate the distribution of economic power between the retailer and the manufacturer in the standard leader-follower case.

Proposition 1: In a channel dyad characterized as successive monopolies in which the manufacturer leads the retailer, without acknowledged distribution services, the distribution of economic power as measured by the ratio of profit margins, depends on the curvatures of the final demand curve and the cost curve of the retailer.

Define ρ as the ratio of profit margins, using the expressions in (2=) and (4=), namely

$$\rho = (p^* - w - \phi_D) / (w- \psi_D) = (-D / D_p) / (- D / D_p (dp^*(w)/dw)) = dp^*/dw \qquad (5)$$

The ratio is defined at the optimal values of p and w and at marginal costs corresponding to the optimum. Thus, the ratio of profit margins or, equivalently, the marginal distribution of economic profits in the channel in the standard case reduces to the sensitivity of the retailer=s optimal price to an adjustment in the wholesale price that maximizes the manufacturer=s profit. This is the standard measure of the distribution of economic power in the economics literature, as mentioned in Section 2.

A proof of Proposition 1 (with equations 6, 7, and 8) is in the Appendix and the result is best interpreted in the context of nine special cases relating to the curvatures of the demand and cost functions of the retailer. These cases are summarized in Table 1 where the distribution of economic power [ρ] revolves around a value of 1/2. The conditions under the first column correspond to Tirole=s analysis. Generally, in the standard leader-follower case, the retailer=s economic power relative to the manufacturer=s waxes (wanes) with convex (concave) final demand or concave (convex) retail costs, and it would seem that assuming leadership for the manufacturer introduces a tendency for greater economic power to reside with the manufacturer.

[See Table 1 at the End of the Paper]

As convex demand curves are commonly regarded as the normal case (cf. Newberry and Stiglitz, 1980, Chapter 4), and as optimization is commonly assumed in the range of the cost function where marginal costs are increasing, the middle cell [convex demand-convex costs] would appear to be the normal situation to consider. This means that if the slope of marginal cost is greater (less) than the demand elasticity, then the retailer=s power relative to that of the manufacturer is different from (same as) the linear case.[3] Whether the retailer would enjoy more economic power than the manufacturer in the latter circumstance would depend on the relative degrees of convexity of the demand and cost curves. As (7) is positive by the second-order condition, there are limits on how convex demand (D_{pp}) can be.

A Reformulation

We emphasize that the standard leader-follower case assumes complete information in the sense that the manufacturer knows D(p) and hence, ε, as well as $\phi(D)$. This point, though perhaps subtle, requires some formalization, and we present the following corollary to Proposition 1 to establish the concept of pass-through.

Corollary 1. In a vertical channel characterized as successive monopolies in which the manufacturer leads the retailer, without acknowledged distribution services, the manufacturer=s choice of the profit-maximizing wholesale price, w*, is determined, in part, by a pass-through elasticity, $\eta = (dp/dw)w/p$, defined on the interval (0,1) such that the intermediate price elasticity, $\varepsilon_w = -(\_D/\_w)(w / D(p(w)))$, equals $\eta\,\varepsilon$ and $\varepsilon_w < \varepsilon$.

Proof. Re-arranging (4), we may obtain

$$w\,D_p\,(dp/dw) + D - \psi_D\,D_p\,(dp/dw) = (w - \psi_D)\,D_p(dp/dw) + D = 0 \qquad (4@)$$

Hence,

$$w\,(1 - 1/\varepsilon_w) = w\,(1 - 1/\eta\varepsilon) = \psi_D, \text{ or } (w - \psi_D) = 1/\eta\varepsilon \qquad (4@=)$$

As usual, since from (2) the retailer=s marginal costs are positive, then $\varepsilon > 1$. Thus,
$1/\eta\varepsilon < 1$ in order for $w > \psi_D$. This means that $0 < \eta < 1$, hence ε_w must be less than ε. Q.E.D.

Vertical Integration

The literature documents the issue of a vertical externality arising as a result of both the retailer and the manufacturer taking successive margins in their respective optimizations. The benchmark for comparison is a vertically integrated channel in which only one margin is taken in the optimization. The vertical externality arises in the channel characterized by the standard leader-follower model of successive monopolies because the retailer fails to take into account how choice of the profit maximizing retail price would influence the manufacturer=s choice of the wholesale price. This externality is the marginal profit featured in (4:), namely, $(w - \psi_D) D_p$. The vertically integrated firm would avoid this externality by implicitly pricing at marginal cost, i.e. $w = \psi_D$.

Profits for the vertically integrated firm would always be at least as high as total profits in the decentralized structure because the vertically integrated firm can always choose the optimal values of the decision variables in the decentralized structure. Thus, if the vertically integrated firm were not to choose values corresponding to the optimal values of the decentralized structure, it would have to do so because it could earn higher profits at different values of the decision variables.

In the standard case, the only decision variable is price. Thus, for purposes of understanding the consequences for consumer welfare arising from channel organization, one would seek to ascertain relative levels of optimal retail price in the channel dyad versus the vertically integrated firm. Tirole (1988; pp. 174-175) presents an explicit example in the case of linear demand, linear retail cost, and linear cost of manufacture where optimal retail price in the decentralized structure is greater than the optimal retail price in the vertically integrated structure. To consider the generality of this result, let the manufacturer=s profit maximizing wholesale price and corresponding marginal cost be denoted as w^* and $\psi_D{}^*$, respectively. From (2@) the retailer=s profit maximizing price, given the manufacturer=s choice of w^*, is $p^* = \varepsilon^* / (\varepsilon^* - 1) (w^* + \phi_D{}^*)$

where $\phi_D{}^*$ and ε^* are the retailer=s marginal cost and the retail price elasticity corresponding to final demand, respectively, at the point that maximizes π_R. By comparison the vertically integrated firm chooses retail price that maximizes the profit function $\pi_I = pD(p) - \phi(D(p)) - \psi(D(p))$ so that the profit maximizing price, p:, is a function of marginal costs (ϕ_D' and ψ_D') and price elasticity (ε') corresponding to the final demand level at the point that maximizes π_I. That is, $p' = [\varepsilon'/(\varepsilon'-1)] (\phi_D' + \psi_D')$.

Tirole concludes that because of the successive marginalizations, the retailer's price, p*, is higher than the vertically integrated firm's price, p'. To generalize the conditions of Tirole's illustration, linear costs mean that $\phi_D^* = \phi_D'$, $\psi_D^* = \psi_D'$, and linear demand means that $\varepsilon^* > \varepsilon'$ if $p^* > p'$ and that $[d\varepsilon/dp] < 0$ and $d[\varepsilon/(\varepsilon-1)]/dp > 0$. Hence by (4@') as $w^* > \psi_D^* = \psi_D'$, it is consistent that p* would be greater than p'. With linear demand, consistency is also preserved with concave costs, as then both marginal costs and price elasticity of the retailer are greater than their corresponding constructs for the integrated firm.

However, for demand convex in p, dε/dp can be positive, negative, or zero so that when dε/dp _ 0 costs must be either concave or linear in order to preserve Tirole's contention that $p^* > p'$. Even if costs are convex, Tirole's result would hold so long as the ratio of elasticities increases as price increases faster than marginal costs decrease as demand decreases. Thus, Tirole's result is, indeed, quite general although exceptions are possible in principle, and we summarize the result with the following Corollary.

Corollary 2. [Tirole, 1988] In a vertical channel characterized as successive monopolies in which the manufacturer leads the retailer, without acknowledged distribution services, the optimal retail price will generally be higher than the profit maximizing retail price of a vertically integrated firm.

In the following sections, we explore the generality of this result when distribution services are explicitly incorporated into the analysis in two different ways. We begin with the case closest to our conventional argument of the economics of retailing, as cited in Section 2 of the paper.

Downstream Moral Hazard Case

Consider the stylized case where the retailer provides a demand generating distribution service, s, that the manufacturer cannot control directly. The final demand function, thus, has two arguments, p and s, and may be written generally as $q = D(p,s)$. Demand is downward sloping in retail price and increasing in the level of the distribution service; thus $D_p < 0$ and $D_s > 0$. We shall assume, as in the standard case, that the manufacturer can observe the demand that the retailer faces, and we assume that the manufacturer can observe the retailer=s cost of producing the distribution service, namely $\phi(D(p,s), s)$.

The Channel Dyad Solution

Taking as a parameter the wholesale price set first by the manufacturer, the retailer chooses retail price and a distribution service level to maximize the following profit function:

$$\pi_R = (p - w) D(p,s) - \phi(D(p,s), s) \qquad (9)$$

There are now two first-order conditions associated with the maximization of retail profit, namely,

$$D(p, s) + (p-w) D_p - \phi_D D_p = 0 \qquad (10)$$

$$(p - w) D_s - \phi_D D_s - \phi_s = 0 \qquad (11)$$

(10) is identical to (2) from which the equivalent expressions (2=), (2@), and (2@=) may be derived. (11) may be written in terms of the retailer=s profit margin, that is

$$(p - w - \phi_D) = \phi_s / D_s \qquad (11')$$

The manufacturer chooses w to maximize the profit function expressed as follows:

$$\pi_M = w\, D(p,s) - \psi\, (D(p,s)) \qquad (12)$$

which, given the manufacturer's ability to observe the retailer's choices, may be written with demand as a composite function of w as follows

$$\pi_M = w\, D(p(w), s(w)) - \psi\, (D(p(w), s(w))) \qquad (13)$$

Hence, the value of w that maximizes π_M solves the following first-order condition

$$D + w \{D_p (\_p^*/\_w) + D_s (\_s^*/\_w)\} - \psi_D \{D_p (\_p^*/\_w) + D_s (\_s^*/\_w)\} = 0 \qquad (14)$$

which yields an expression for the manufacturer's profit margin, namely,

$$w - \psi_D = - D / \{D_p (\_p^*/\_w) + D_s(\_s^*/\_w)\} = -D/\{\_p^*/\_w + (D_s / D_p)(\_s^*/\_w)\} D_p \qquad (15)$$

The manufacturer's margin in this case can be expressed in terms of elasticities as follows

$$w - \psi_D = w / \{\varepsilon\, [\eta - (\varepsilon_s / \varepsilon)\, \eta_s]\} \qquad (15')$$

where ε_s is the demand elasticity with respect to distribution service and $\eta_s = (w/s)\, (\_s/\_w)$ is the elasticity of the retailer's choice of distribution service level with respect to an adjustment in the manufacturer's decision on w. Because the margin is defined on the positive real domain, the term in brackets on the right hand side of (15=) must be positive; hence $\varepsilon_s \eta_s < \varepsilon$ because $0 < \eta < 1$ so that $(\varepsilon_s / \varepsilon)\, \eta_s < \eta < 1$. Additionally, unlike η which is defined on the interval (0,1), η_s may take on any value in the positive real domain inferior to $\varepsilon / \varepsilon_s$.

To explore the distribution of economic power in the channel, we construct the ratio of profit margins as in (5), but in the case of downstream moral hazard distribution services feature explicitly in the determination of this index. We summarize the consequences for the distribution of economic power in this instance with the following proposition.

Proposition 2: In a channel dyad characterized as successive monopolies in which the manufacturer leads the retailer, and the retailer controls the provision of distribution service, the distribution of economic power as measured by the ratio of profit margins, depends on the curvatures of the final demand curve of the retailer. One of the consequences of the demand characteristics is the sensitivity of the choice of optimal distribution service level in response to the manufacturer=s choice of the optimal wholesale price, given the manufacturer=s knowledge of the final demand. Under certain circumstances the retailer=s ability to provide distribution services that are not subject to the direct control of the manufacturer can enhance the retailer=s relative economic power as compared to the situation of the standard leader-follower model in which distribution services are not acknowledged or to a situation in which distribution services cannot be varied; and the more are distribution services demanded by consumers, the greater the relative economic power of the retailer.

In this case, the expression for ρ is obtained directly from (10) and (15).

$$\rho = (p - w - \phi_D) / (w - \psi_D) = \{[-D/D_p]/[-D/D_p]\}[(\_p^*/\_w) + (D_s / D_p)(\_s^*/\_w)] \quad (16)$$

which reduces to

$$\rho = \_p^*/\_w + (D_s / D_p)(\_s^*/\_w) \quad (16=)$$

The first term on the right hand side of (16=) is analogous but not equivalent to the solution underpinning Proposition 1 because in this instance it is the consequence of the retailer=s joint optimization of p and s given w. We note that ρ will rise or fall depending on the relative sensitivities of consumers to service and price, weighted by the retailer=s sensitivity in choosing s in response to the manufacturer=s choice of w. We may express ρ in elasticity terms as follows

$$\rho = (p/w) [\eta + (\varepsilon_s / \varepsilon)(\eta_s)] \quad (16@)$$

The signs of all terms in (16=) and (16@) are usually positive except for that of _s/_w, which is usually negative and determines the sign of η_s. This is demonstrated in the appendix to this section. The distribution of economic power shifts to (away from) the retailer as _s/_w or η_s is negative (positive).

Under the assumptions that marginal costs with respect to D are constant and independent of those with respect to s, we obtain the following three results for the cases of linear demand and a constant elasticity of demand.

Result 1: Since $\_s^*/\_w < 0$ in these cases, the second term in (16=) is positive. This means that allowing distribution services to vary would improve the relative profit margin of the retailer compared to a situation in which the distribution service is constant.

Result 2: Since _s*/_w < 0 in these cases and in (16=) D_s is positive while D_p is negative, we have that as the marginal demand for distribution services (D_s) increases, the distribution of power in the channel moves in favor of the retailer.

Result 3: The absolute position of the retailer in the channel dyad is better than the case in which distribution services do not exist. That is, ρ[in (16)]] > ρ [in (5)], even though distribution services are costly to provide.

We turn now to a comparison of the situation of the retailer in the channel dyad to the situation of the vertically integrated firm. In doing so, we are especially interested in the consequences of acknowledging distribution services in the downstream moral hazard case. The standard result, attributed to Tirole (1988; p. 178), is that retail prices of the channel dyad would be higher than retail prices of the vertically integrated firm and that distribution services provided by the former would be lower than those provided by the latter. In what follows we investigate the generality of this result.

Vertical Integration

The double marginalization persists in the case of downstream moral hazard, as the retailer and manufacturer add successive mark-ups in setting their prices, and the retailer does not account for the influence of the final price decision in the manufacturer=s optimization. That is, as in the standard case, in setting p the retailer does not acknowledge $(w - \psi_D) D_p$ that would affect the manufacturer=s choice of w.

There is a second externality in the case of downstream moral hazard that does not feature in the standard case. In the successive mark-ups, the retailer does not take into account the marginal profit realized by the manufacturer that is attributed to the demand generated by the service level set by the retailer, namely, $(w - \psi_D) D_s$ which is incorporated in (15).

How does introducing s into the analysis change the comparison between the vertically integrated firm and the retailer in terms of profit margins and levels of the decision variables?

We express the difference in profit margin of the retailer and that of the vertically integrated firm corresponding to their respective profit maximizing points as follows:[4]

$$\delta_{RI} = (p^* - w^* - \phi_D^*) - (p' - \psi_D' - \phi_D') \qquad (18)$$

There are two first order conditions that enable the comparison, the first with respect to price is of the form in (2@). For the retailer, (2@) applies directly; for the vertically integrated firm, (2@) applies where ψ_D' is substituted for wholesale price. The second first order condition with respect to service is (11′).
If we assume costs to be linear-additive in D, marginal costs with respect to D are constant, which implies $\phi_D^* = \phi_D'$ and, thus,

$$\delta_{RI} = (p^* - p') - (w^* - \psi_D') \qquad (18')$$

From (15′), $(w-\psi_D') = w/[\varepsilon\eta - \varepsilon_s\eta_s]$ so that $w^* = \psi_D' [\varepsilon\eta - \varepsilon_s\eta_s]/[\varepsilon\eta - \varepsilon_s\eta_s - 1] = \psi_D' \alpha$, where $\alpha > 1$ in order for $w^* > \psi_D'$. Hence, we may rewrite (18′) as

$$\delta_{RI} = (p^* - p') - (\psi_D' \alpha - \psi_D') = (p^* - p') + \psi_D' (1 - \alpha). \qquad (18'')$$

Because $(1 - \alpha) < 0$ it is necessary that $p^* > p'$ so long as $\delta_{RI} > 0$. It is still possible for $p^* > p'$ even when $\delta_{RI} < 0$. Hence, observing higher retail prices in the channel dyad is consistent with both higher and lower marginal profits.

To compare the levels of distribution services for the retailer and the vertically integrated firm, we begin by noting from the first order conditions alternatively for price [from (10)] and for distribution service [from (11)] that the difference in marginal profits in (18) may be expressed as

$$\delta_{RI} = p^* / \varepsilon^* - p^{=} / \varepsilon^{=} = \phi_s^* / D_s^* - \phi_s^{=} / D_s^{=} \qquad (18=)$$

To explore the consequences for distribution services under different scenarios of relative price levels, we consider the two special cases of the earlier discussion.

Linear Demand in Price and Distribution Services.

If demand is linear in distribution service, then $D_s^* = D_s^{=} = D_s$ and $\delta_{RI} = [\phi_s^* - \phi_s^{=}] / D_s$. Hence from (18=) $[\phi_s^* - \phi_s^{=}] / D_s = p^* / \varepsilon^* - p^{=} / \varepsilon^{=}$. Recalling from our earlier discussion of the linear demand case, cost must be convex in distribution services in order to satisfy the second order conditions [i.e. $\phi_{ss} > 0$]. Thus, if we assume $\delta_{RI} > 0$, then $\phi_s^* > \phi_s^{=}$, which, by the convexity of the cost function, means that $s^* > s^{=}$. As in the standard case, retail price is higher in the channel dyad than in the vertically integrated firm so that in this respect consumer welfare is lower in the case of the channel dyad.[5] However, the significance of the result is that it distinguishes the case of downstream moral hazard from the standard case in which distribution services are not acknowledged. That is, in the downstream moral hazard case with linear demand the retailer provides higher levels of distribution services than the vertically integrated firm so that in this respect consumer welfare is higher in the channel dyad. This result is contrary to the assertion of Tirole [1988, p. 177-8]. [6]

Nonlinear Demand in Price and Distribution Services

As before, we use the same general form of a power function $D(p,s) = a\ p^{b}\ s^{c}$ such that b is the price elasticity of demand and c is the service elasticity of demand. To simplify matters, we assume linear cost in distribution service, hence $\phi_s{}^* = \phi_s{}^{=} = \phi_s$. From (18$^{\equiv}$) we have $(p^* - p^{=})/\ \varepsilon = \phi_s\ [D_s{}^{=} - D_s{}^*]/\ D_s{}^*\ D_s{}^{=}$ or that $(p^* - p^{=}) = \varepsilon\ \phi_s\ [D_s{}^{=} - D_s{}^*]/\ D_s{}^*\ D_s{}^{=}$.

If $\delta_{RI} > 0$, then $p^* > p^{=}$ as in the standard case in which distribution services are not acknowledged. Moreover, $D_s{}^{=} > D_s{}^*$, and by the concavity of demand in distribution service, this means that $s^* > s^{=}$. That is, this is the same mixed result in terms of consumer welfare that we obtained in the linear demand case above.

In all cases of downstream moral hazard, as in the standard case, the vertically integrated firm will earn total profits at least as great as the total profits of the channel dyad. This follows from the fact that the vertically integrated firm always has the option to set retail price and distribution service at the levels chosen by the retailer in the channel dyad. In fact the only reason the vertically integrated firm would deviate from the optimal values of the channel dyad would be to earn higher profits, which is what the vertically integrated firm does.

We summarize formally the conclusions of the discussion of vertical integration with the following result.

Result 4: As total profits of the vertically integrated firm exceed those of the channel dyad, the integrated solution always benefits producers. However, the benefits for consumers stemming from the integrated solution can be smaller than those flowing from the channel dyad, as the retailer who controls the provision of distribution services [downstream moral hazard] may offer higher levels of distribution services than the vertically integrated firm.

Upstream Moral Hazard.

We now consider the stylized case in which the manufacturer provides a final demand generating distribution service, s, that the retailer cannot control. As before the final demand function has two arguments, p and s, and may be written generally as $q = D(p,s)$. Demand is downward sloping in retail price and increasing in the level of the distribution service; thus $D_p < 0$ and $D_s > 0$. As in the standard case, we assume that the manufacturer can observe D and, hence, p. We assume that the retailer cannot vary distribution services in the optimization, hence the cost of producing these services at fixed levels is included in the overhead of the firm. We assume, as well, that the demand generating effect of the fixed distribution services of the retailer is constant.

The Channel Dyad Solution

Taking as a parameter the wholesale price, w, and the distribution service, s, both set first by the manufacturer, the retailer chooses retail price to maximize profit. We emphasize that although the retailer cannot control the manufacturer=s choice of s, the retailer can observe s. In short, the retailer is a price taker in the wholesale market, and a price setter in the retail market. Additionally, the retailer may be thought of as an agent bound by a contract to take the distribution service from the manufacturer at no explicit cost, delivering it in its entirety to the retail market in recognition of its demand generating capability.[7] Hence the retailer knows D(p,s). The retailer=s profit function is as follows:

$$\pi_R = (p - w)\, D(p,s) - \phi(D(p,s)) \qquad (19)$$

There is now only one first-order condition associated with the maximization of retail profit that appears equivalent to (10), namely,

$$D(p, s) + (p\text{-}w)\, D_p - \phi_D D_p = 0 . \qquad (20)$$

The manufacturer sets the two instruments, w and s, to induce the retailer to set final price so that the manufacturer's profit is maximized. The manufacturer's profit may be expressed as:

$$\pi_M = w\, D(p, s) - \psi\, (D(p, s)) \qquad (21)$$

Because the manufacturer views the effect of s and w on the retailer's choice of final price, the manufacturer's profit may be expressed as the following composite function

$$\pi_M = w\, D(p(w,s), s) - \psi\, (D(p(w, s), s) \qquad (21')$$

The manufacturer must satisfy two first-order conditions; the first is with respect to w, the second with respect to s, namely,

$$D + w\, D_p\, (\_p^*/\_w) - \psi_D\, D_p\, (\_p^*/\_w) = 0 . \qquad (22)$$

$$w\, (D_p\, (\_p^*/\_s) + D_s) - \psi_D\, (D_p\, (\_p^*/\_s) + D_s) - \psi_s = 0 \qquad (23)$$

Thus, from (22) and (23) the manufacturer's margin may be expressed as

$$w - \psi_D = - D / D_p\, (\_p^*/\_w) = \psi_s / (D_p\, (\_p^*/\_s) + D_s) . \qquad (24)$$

(22) may be expressed, as before, in elasticity terms involving the pass-through elasticity,

$$w\, (1 - 1 / \eta\varepsilon) = \psi_D . \qquad (22')$$

(23) may be expressed in elasticity terms as

$$(w - \psi_D)\ (\varepsilon_s - \mu_s \varepsilon) = \psi_s\, s\ /\ D \qquad (23=)$$

where $\mu_s = (s/p^*)\ (\_p^*/\ \_s)$ is the elasticity of the retailer=s choice of price with respect to an adjustment in the manufacturer=s decision on s.

Using (20) and (24) we may express the relative economic power of the retailer to the manufacturer as

$$\rho = (p - w - \phi_D)\ /\ (w - \psi_D) = [\,-D\ /\ D_p\,]\ /\ [-D/\ D_p\ [(\_p^*/\_w)] = \_p^*/\_w \qquad (25)$$

or, equivalently,

$$\rho = (p - w - \phi_D)/(w - \psi_D) = [-\ D\ /\ D_p]/[\psi_s\ /\ (D_p\ (\_p^*/\_s) + D_s\ ] \qquad (25=)$$

$$= -[D/\ \psi_s\ ]/\{D_p\ /[D_s\ + (\_p^*/\_s)\ D_p\ ]\}$$

$$= [D/\ \psi_s]\ [(-D_s\ /\ D_p\ ) - (\_p^*/\_s)]$$

Equating (25) and (25=) means that

$$\rho = \_p^*/\_w = [D/\ \psi_s\ ][(-D_s\ /\ D_p\ ) - (\_p^*/\_s)] > 0\ , \qquad (26)$$

thus, $\_p^*/\_s < -\ D_s\ /\ D_p$.

From (25) we note that allowing the manufacturer to control one more instrument (namely, s) as compared to the standard case of Section 3 or the downstream moral hazard case of Section 4 does not endow him with any greater ability to exercise power over the retailer at the margin. The result in (26) merely establishes the redundancy in the two instruments that the manufacturer can use to influence the level of the target (namely, p*).

A comparative statics analysis of (25) yields the same result as in (5) and Table 1 applies.

We summarize the situation for the manufacturer with the following proposition.

Proposition 3. In a channel dyad characterized as successive monopolies in which the manufacturer leads the retailer, and the manufacturer controls the provision of distribution service, the distribution of economic power as measured by the ratio of profit margins, depends on the curvatures of the final demand curve of the retailer. One of the consequences of the demand characteristics is the retailer's sensitivity in choosing optimal retail price in response to the manufacturer's choices of the optimal wholesale price and optimal distribution service level, given the manufacturer's knowledge of the final demand.

The manufacturer's ability to provide distribution services that are not subject to the direct control of the retailer has a limited effect on the manufacturer's relative power over the retailer since the manufacturer has been assumed to be the leader in the vertical relationship. As Table 1 applies, in contrast to the case of downstream moral hazard, there is no effect on the distribution of power at the margin stemming from the manufacturer's control of the distribution service in the case of linear demand.

Vertical Integration

As before, one should expect that profits of the vertically integrated firm should be at least as great as the total profits of the channel dyad because the vertically integrated firm always has the opportunity to set price and distribution service at values corresponding to the optimal values in the channel dyad. Marginal profits for the manufacturer in the channel dyad may be higher than marginal profits for the integrated firm. Taking the foregoing linear and nonlinear demand cases, we seek to understand possible pricing and service level consequences of vertical integration in comparison to the channel dyad. In this comparison the vertically integrated firm has a profit function of the form $\pi_I = p^{=} D (p^{=}, s^{=}) - \psi (D^{=}, s^{=}) - \phi (D^{=})$.

Linear Demand in Price and Distribution Service

We express the difference in profit margin of the manufacturer in the channel dyad and that of the vertically integrated firm corresponding to their respective profit maximizing points as follows:

$$\delta_{MI} = (w^* - \psi_D^*) - (p^{=} - \psi_D^{=} - \phi_D^{=}) \qquad (27)$$

Assuming that costs are linear in quantities demanded, (27) simplifies to

$$\delta_{MI} = (w^* + \phi_D^*) - p^{=} \qquad (27^{=})$$

If we conjecture that marginal profits are greater in the channel dyad, then $\delta_{MI} > 0$ and $(w^* + \phi_D^*) > p^{=}$. From the retailer=s first-order condition in (20) $p^* > (w^* + \phi_D^*)$. Hence, under these conditions $p^* > p^{=}$. If we relax the conjecture on marginal costs, then from (24) $\delta_{MI} > 0$ implies that $[p^*/ p^{=}] > \varepsilon^* (\_p^*/\_w) / \varepsilon^{=}$ and it is possible--though not required--that $p^* > p^{=}$.[8]

To explore the consequences of vertical integration for distribution service, we use the expression on the far right-hand side of (24). We know, as well, from the first order condition for the vertically integrated firm $p^{=} - \psi_D^{=} - \phi_D^{=} = \psi_s / D_s$; hence

$$\delta_{MI} = [\psi_s^*/ (D_p^* \; \_p^*/\_s + D_s^*)] - [\psi_s^{=}/ D_s^{=}] = [\psi_s^*/ (D_s - \alpha)] - [\psi_s^{=}/ D_s]$$

where $D_s^* = D_s^{=}$ and α = - D_p^* _p*/_s > 0.   If $\delta_{MI} > 0$, then $\psi_s^*/\psi_s^{=} > (D_s - \alpha)/D_s$ and $s^* > s^{=}$ is possible if cost is convex in s.[9] Conversely, if $\delta_{MI} < 0$, then $s^{=} > s^*$ if cost is convex in s.

Nonlinear Demand in Price and Distribution Service

For purposes of illustration, we take the case of demand as a general form of the power function or constant elasticity of demand model. Hence, $\varepsilon^* = \varepsilon^{=} = \varepsilon$. From the first-order condition (20) for the retailer, we have $w^* = -p^*/\varepsilon + p^* - \phi_D^*$.   From the first order condition of the vertically integrated firm, we have $p^{=} - \psi_D^{=} - \phi_D^{=} = p^{=}/\varepsilon$ so that $\psi_D^{=} = (p^{=}(\varepsilon-1)/p^{=}) - \phi_D^{=}$. If $\delta_{MI} > 0$, then substituting for w^* and $\psi_D^{=}$ into (27) and re-arranging terms, we obtain $p^* > p^{=}(\varepsilon/(\varepsilon-1)) + (\psi_D^* + \phi_D^*)(\varepsilon/(\varepsilon-1))$ which must be greater than $p^{=}$. Thus, in this case, $p^* > p^{=}$. If $\delta_{MI} < 0$, then $p^* > p^{=}$ is still possible although not required.

From ($23^{=}$) we have $(w^* - \psi_D^*) = [\psi_s^* s^* / D^*] / (\varepsilon_s - \mu_s \varepsilon)$ and for the vertically integrated firm $p^{=} - \phi_D^{=} - \psi_D^{=} = [\psi_s^{=} s^{=}/D^{=}]/\varepsilon_s$, where $(\varepsilon_s - \mu_s \varepsilon) < \varepsilon_s$. The numerators of the expressions for the margins may be interpreted as the average cost of distribution service per unit sold at either s^* or $s^{=}$. If the average cost at s^* is greater than the average cost at $s^{=}$, assuming profit maximizing points in the region of rising marginal costs above minimum average cost, then $s^* > s^{=}$ and $\delta_{MI} > 0$. If $\delta_{MI} < 0$, s^* is clearly less than $s^{=}$ because $(\varepsilon_s - \mu_s \varepsilon) < \varepsilon_s$.

Both illustrations of linear and nonlinear demand establish the upstream moral hazard analogy to Result 4. That is, although the manufacturer in the channel dyad may earn higher marginal profits than the vertically integrated firm and induce the retailer in the channel dyad to charge a higher retail price than the vertically integrated firm, the manufacturer may provide higher levels of distribution service to consumers than would the vertically integrated firm.

Summary.

We have explored three stylized cases that provide insight into the distribution of economic power between agents in a channel dyad characterized as successive monopolies. Three important results would seem to emerge from the analysis.

First, giving one of the agents in the channel dyad the opportunity to control a demand generating distribution service can have a substantially different effect on the marginal distribution of profits in the downstream case relative to the upstream case, when both are compared to the standard leader-follower model without acknowledged distribution services. Under the same assumptions about demand and costs, control of a demand generating service moves the distribution of economic power at the margin substantially in favor of the retailer in the downstream moral hazard case but not in favor of the manufacturer in the upstream moral hazard case.

Second, in general the sensitivity of the distribution of economic power between the two agents in the channel dyad depends critically on characteristics of the demand and cost functions. Thus, for empirical analyses of the question of shifting of power in contemporary channels of distribution, it may be useful to specify functional forms prior to estimation. For empirical purposes, it is also useful to identify important distribution services in any particular channel and who controls them, since the distribution of economic power depends on these characteristics.

Finally, in comparing the optimal levels of prices and distribution services of the channel dyad and the vertically integrated firm, we discover that under certain conditions it is possible for distribution services to be higher in the former. The significance of this result lies in its implication for the welfare of consumers under vertically integrated and decentralized channels. The conventional argument is that because of the double marginalization inherent in the successive optimizations in a decentralized channel, prices would be higher and services would be lower than corresponding levels of these variables for the vertically integrated firm. We have shown that this is not necessarily the case under the two stylized scenarios of downstream and upstream moral hazard.

As distribution services are intrinsic to retail markets, it is important to recognize that acknowledging their presence in the analysis of the channel matters. Indeed, distribution services matter not only in terms of their demand generation consequences but also in terms of the distribution of economic power among economic agents that interact in creating the ultimate, final retail market. For purposes of marketing analysis, in which non-price instruments are a central focus, the standard leader-follower model of Section 3 provides incomplete--if not misleading--guidance.

Appendix 1 Notation

D (.) final demand function

D_p , D_s partial derivatives of demand with respect to final price and distribution service , respectively

D_{pp} , D_{ss} second partial derivatives with respect to price and service, respectively

D_{ps} cross partial with respect to service of the partial with respect to price

D_w , partial derivative of demand with respect to wholesale price

ϕ (.) cost of retailing

ϕ_D ϕ_s ϕ_{DD} ϕ_{ss} ϕ_{Ds} partial derivatives, second partial derivatives, and cross partials of the cost of retailing

$\psi(.)$ cost of manufacture

ψ_D ψ_s ψ_{DD} ψ_{ss} ψ_{Ds} partial derivatives, second partial derivatives, and cross partials of the cost of manufacture

p final or retail price

w wholesale price

ε price elasticity of final demand

ε_w intermediate price elasticity of demand

ε_s service elasticity of final demand

η pass-through elasticity

η_s elasticity of retailer=s service adjustment in response to manufacturer=s adjustment in wholesale price

Appendix 2 Proofs.

Section 3. Standard case.

Proof of Proposition 1. By taking the total derivative of the first order condition in (2), we may ultimately solve for dp*(w)/dw as follows:

(6) $D_p(dp^*(w)/dw) + (p-w)D_{pp}(dp^*(w)/dw) + D_p(dp^*(w)/dw) - D_p - \phi_D D_{pp}(dp^*(w)/dw) - D_p \phi_{DD} (dD/dw) = 0$

Thus, collecting terms in (6) and solving for dp*(w)/dw yields the following

(7) $dp^*(w)/dw = D_p / [2D_p + (p-w- \phi_D) D_{pp} - D_p^2 \phi_{DD}]$

As the denominator on the right hand side of (7) must be negative by the second order condition for profit maximization, then (7) must be positive. From (2=) we may substitute for $(p-w- \phi_D)$ in the denominator of (7) and express the numerator, D_p , of the right hand side as the denominator of the denominator to obtain

(8) $dp^*(w)/dw = 1 / [2- (D D_{pp} / D_p^2) - D_p \phi_{DD}]$.

Q.E.D.

As D and D_p^2 are positive in the second term in the denominator, the sign of this term depends on the sign of D_{pp} , which is positive (negative) if demand is convex (concave) in final price. Similarly, as D_p is negative in the third term of the denominator, then the sign of this term depends on the sign of ϕ_{DD} which is positive (negative) if retail costs are convex (concave) in quantities demanded. As (8) must be positive, then there are limits on how convex demand ($D_{pp} > 0$) can be.

Section 4. Downstream Moral Hazard.

Proof of Proposition 2. Expressions for _p*/_w and _s*/_w may be obtained by taking the total differentials of (10) and (11) and solving for dp and ds, respectively, as explicit functions of dw. The total differentials of (10) and (11) are:

(17) $[2D_p + (p - w - \phi_D)D_{pp} - \phi_{DD} D_p^2]dp + [D_s + (p - w - \phi_D)D_{ps} - \phi_{Ds} D_p - \phi_{DD} D_p D_s]ds = D_p\, dw$

$[(p - w - \phi_D)D_{sp} + D_s - \phi_{DD}D_pD_s - \phi_{sD}D_p]dp + [(p - w - \phi_D)D_{ss} - \phi_{DD}D_s^2 - \phi_{Ds}D_s - \phi_{ss}]ds = D_s\, dw$

which can be expressed compactly as

(17=) h(1,1) dp + h(1,2) ds = h(1) dw

h(2,1) dp + h(2,2) ds = h(2) dw

As the general expressions for the solutions are difficult to interpret, it is expedient to explore here the consequences of two special cases to prove the proposition. We explore two commonly applied special cases, namely, one of demand linear in price and distribution services and one of demand convex in price and concave in distribution services. In both cases we shall assume for simplicity that marginal costs with respect to quantities are constant and independent of of the level of services.

I. Linear demand in price and distribution services.

This case of linear-additive demand in price and service has been analyzed by Tirole (1988; pp177-8). In this case, we have $D_{pp} = D_{ss} = D_{sp} = D_{ps} = 0$, and let $D = a + bp + cs$ where $a > 0$, $b < 0$, $c > 0$. Thus, the coefficients of the differentials in (17) simplify to the following expressions:

$h(1,1) = 2D_p - \phi_{DD} D_p^2 = 2b - \phi_{DD} (b^2) < 0$

$h(1,2) = D_s - \phi_{Ds} D_p - \phi_{DD} D_p D_s = c - \phi_{Ds} b - \phi_{DD} (bc) = h(2,1)$

$h(2,2) = - \phi_{DD} D_s^2 - \phi_{Ds} D_s - \phi_{ss} = - \phi_{DD} (b^2) - \phi_{Ds} c - \phi_{ss} < 0$

For second order conditions for profit maximization to be satisfied in the linear additive demand case, we note that the cost function cannot be linear additive in both D and s. In fact, although retail cost may be linear additive in D such that $\phi_{DD} = \phi_{Ds} = 0$, it must be convex in s [i.e. $\phi_{ss} > 0$] to ensure that h(1,1) and h(2,2) are both strictly negative, a requirement that is not well-known.

The principal minor of the determinant comprised of the coefficients in (17=) is expressed as $H = [-\phi_{ss} 2b - c^2]$ which is strictly positive by the second order conditions.

Hence, solving for _p*/_w and _s*/_w , we have

_p*/_w = [1/H][h(2,2) h(1) - h(2,1) h(2)] = $(-\phi_{ss} b - c^2) / (-\phi_{ss} 2b - c^2)$

which is strictly positive so long as $[-\phi_{ss} b] > c^2$; and

_s*/_w = [1/H] [-h(2,1)h(1) + h(1,1)h(2)] = $bc/ [-\phi_{ss} 2b - c^2]$

which is strictly negative. Thus, from (16=) we have

$\rho = [-\phi_{ss} b - c^2 + (c/b)(bc)] / [-\phi_{ss} 2b - c^2] = 1/\{2 + [c^2/ \phi_{ss} b]\} > 1/2$.

Since $\rho > 0$, _p*/_w > 0, which implies $-\phi_{ss} b > c^2$.

II. Non-linear demand in price and distribution service.

For illustrative purposes, let us take the common case of demand convex in price and concave in distribution service; thus $D_{pp} > 0$ and $D_{ss} < 0$. Consider demand as a general form of a power function $D(p,s) = a\, p^{b}\, s^{c}$, where under the assumption of convexity in price and profit maximizing behavior, $b < -1$, and under the assumption of concavity in distribution service, $0 < c < 1$ so that $D_{ps} = D_{sp} < 0$.

Hence, $D_p = bD/p$, $D_s = cD/s$,

$D_{pp} = b(b-1)D/p^2$, $D_{ss} = c(c-1)D/s^2$, $D_{sp} = D_{ps} = bcD/ps$. To simplify the exposition, we shall also assume constant marginal costs, such that $\phi_D = \beta$, $\phi_s = \gamma$, $\phi_{DD} = \phi_{ss} = \phi_{sD} = 0$ for some $\beta, \gamma > 0$.

Under the assumptions of this case, the coefficients of the differentials in (17) simplify to the following

$h(1,1) = 2 D_p - (p-w-\phi_D)D_{pp} = (2bD/p) + (-D)(p/bD)\, b(b-1)D/p^2 = D (b+1)/p < 0$

$h(1,2) = D_s + (p-w-\phi_D)D_{ps} = cD/s + (-D)(p/bD)\,(bcD/ps) = 0 = h(2,1)$

$h(2,2) = (p-w-\phi_D)\, D_{ss} = (-D)(p/bD)\,(c(c-1)D/s^2) = -D(p/b)c(c-1)/s^2 < 0$

where at the optimum $(p-w-\phi_D) = -D/D_p$ [from (10)]. The principal minor of the determinant of coefficients in (17=) is $H= (-D^2/b)(b+1)c(c-1)/s^2 < 0$. Thus, the second order conditions are satisfied, and the solutions in this case for _p*/_w and _s*/_w are:

$\_p^*/\_w = [1/H]\, [(-p/b)(c(c-1)D/s^2)][(b/p)D] = [1/H]\, [-D^2 c(c-1)/s^2]$

which is strictly positive and

$\_s^*/\_w = [1/H]\, [(D(b+1)/p)(Dc/s)] = [1/H]\, [D^2 c(b+1)/ps]$

which is strictly negative. Thus, from (16=)

$\rho = \_p^*/\_w + (D_s / D_p)(\_s^*/\_w) = \_p^*/\_w + (cp)/(bs)(\_s^*/\_w)$

where both terms in the summation on the right-hand side are positive.

Under our assumptions for this nonlinear case, ρ in (16) would be greater than ρ in (5) since (< 0) and b<0. More generally, so long as costs are convex in D and s, this result will hold. Even if

Unlike in the previous case of linear additive demand, constant marginal costs satisfy the second-order conditions in this case.

there are increasing returns with respect to D or s (concave costs in either D or s), the result may hold if the demand generating effects of s exceed the cost effects.

These two special cases of linear and non-linear demand establish the elements of the proposition, namely, that the distribution of economic power in the downstream moral hazard case depends upon the final market demand sensitivity to distribution services provided by the retailer. As we have demonstrated in cases I and II there are circumstances in which the ability of the retailer to provide distribution services would permit the retailer to wield greater economic power [a] in comparison to the standard leader-follower case of Section 3 in which distribution services are not acknowledged, [b] in comparison to the case in which distribution services are invariant, and [c] as the marginal demand for distribution services rises (c in case I or II increases).   Q.E.D.

References

Ailawadi, Kusum L., Norm Borin, and Paul L.Farris (1995) AMarket Power and Performance: A Cross-Industry Analysis of Manufacturers and Retailers@, *Journal of Retailing*, **71** (3): 211-248.

Betancourt, Roger R. and David A. Gautschi (1988) AThe Economics of Retail Firms@, *Managerial and Decision Economics*, **9** (June): 133-142.

_____ (1990) ADemand Complementarities, Retail Assortments, and the Household Production Function@, *Marketing Science*, **9** (Spring) : 146-161.

_____ (1993) AThe Outputs of Retail Activities: Concepts, Measurement, and Evidence from U.S. Census Data@, *Review of Economics and Statistics* (May) : 294-301.

_____(1993) ATwo Characteristics of Retail Markets and Their Economic Consequences@ *Journal of Economic Behavior and Organization* **21**: 277-294.

_____ (1997) *The Economics of Retail Systems*. book manuscript, in preparation.

Bresnahan, Thomas and Paul Reiss (1985) ADealer and Manufacturer Margins@, *Rand Journal of Economics* **16**: 253-268.

Hawkins, E. R. (1950) AVertical Price relationships@ in Reavis Cox and Wroe Alderson (eds.) *Theory In Marketing*. R.D. Irwin: Chicago.

Jeuland, Abel P. and Steven M. Shugan (1983) AManaging Channel Profits@ *Marketing Science*, **2** (Summer): 239-272.

Lal, Rajiv and Chakravarthi Narasimhan (1996) AThe Inverse Relationship Between Manufacturer and Retailer Margins: A Theory@, *Marketing Science* **15** (No.2): 132-151.

Lilien, Gary L., Philip Kotler, and K. Sridhar Moorthy (1992) *Marketing Models.* Englewood Cliffs, New Jersey: Prentice-Hall.

McGuire, Timothy W. and Richard Staelin (1983) AEffects of Channel Member Efficiency on Channel Structure@ in David A. Gautschi (ed.) *Productivity and Efficiency in Distribution Systems*. New York: North-Holland

Messenger, Paul and Chakravarthi Narasimhan (1995) AHas Power Shifted in the Grocery Channel@, *Marketing Science*, **14** (2):189-223.

Oi, Walter (1992) AProductivity in the Distributive Trades: The Shopper and the Economies of Massed Reserves@ in Zvi Griliches (ed.) *Output Measurement in the Service Sector.* Chicago: University of Chicago Press.

Spengler, John (1950) AVertical Integration and Anti-Trust Policy*@, Journal of Political Economy*, **58**: 347-352.

Stern, Louis W. and Adel El-Ansary (1992) *Marketing Channels*, 4th Edition, Englewood Cliffs, New Jersey: Prentice-Hall.

Tirole, Jean (1988) *The Theory of Industrial Organization*, Cambridge MA : MIT Press.

Waterson, Michael (1984) *Economic Theory of the Industry*. Cambridge: Cambridge University Press.

Table 1 Distribution of Economic Power in the Channel: Standard Leader-Follower Case

Retail Cost as a Function of Quantities Demanded

		Linear	Convex	Concave
Retail Demand as a Function of Retail Price	Linear	1/2	<1/2	> 1/2
	Convex	> 1/2	if a > b => > 1/2 if a < b => < 1/2	>> 1/2
	Concave	< 1/2	<< 1/2	if a>b=> 1/2 if a<b=> >1/2

Note:
$a = |(D\ D_{pp}) / D_p^2|$
$b = |\ D_p\ \phi_{DD}\ |$

Notes

1.
[1] One can think of the single good as a composite or standard basket of goods provided by the retailer, an artifice to simplify the exposition.

2.[2] Bresnahan and Reiss analyze the case of quantity setting firms.

3.[3] That is, if marginal costs are sufficiently increasing [›b= in Table 1] to dominate the influence of the curvature of the demand function [›a= in Table 1], then economic power definitely will be distributed in the manufacturer=s favor. Alternatively, if demand is sufficiently convex to dominate the influence of moderately increasing marginal costs, then the economic power is shifted more to the advantage of the retailer.

[4.4] Equation (17) is in the proof of Proposition 2 in the Appendix.

[5.5] If $\delta_{RI} < 0$, a mixed result in terms of consumer welfare is still possible. That is, although ϕ_s* must be less than ϕ_s= given constant marginal demand, p* can also be less than p= depending on the relative magnitudes of ε* and ε= where ε* < ε= because of the linearity of demand

[6.6] Note that we are comparing the two channel structures at the optimal levels of the decision variables whereas Tirole is keeping prices constant.

[7.7] Such arrangements are not difficult to imagine, as in the case of a manufacturer=s warranty.

[8.8] Similarly, if $\delta_{MI} < 0$, then p= > (w* + ϕ_D*) and it is possible--though not required--that p* > p=. With linear demand and costs linear in quantities, [p*/ p=] > ε*/2ε=.

[9.9] In the linear demand case if costs are linear in quantities demanded, they must be convex in distribution services to satisfy the second-order conditions.