The Countervailing Power Hypothesis in Size-Polarized Markets

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May 2, 2011

Abstract

We assess the role of countervailing power in markets characterized by polarization of firm size, i.e. an upstream monopolist selling to a dominant retailer and a competitive fringe. Contrary to the existing literature we show that countervailing power does not affect consumer prices when firms use two-part tariff contracts.Nevertheless it affects consumer prices when firms use price-quantity bundle contracts instead. Such contracts however will never be chosen by the supplier under a weak assumption on the size of the market. We also show that despite the efficiency of the dominant retailer in retailing large quantities, the supplier has no incentive to foreclose the fringe retailers and monopolize the market.

JEL classification: L14; L22; L42;
Keywords: countervailing power, dominant retailer, vertical contract, two-part tariffs.

WORK IN PROGRESS

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1 Introduction

In a vertical relation setting where a monopolist sells an intermediate good to many retailers, it has been argued by Galbraith (1952) and (1954), that a rise of retailers' market power, will end up to higher profits for retailers and lower prices for consumers. Galbraith's hypothesis has been criticized on the basis that retailers once they acquire more power towards the supplier, they have no incentive to pass cost-savings to consumers, in particular when two-part tariffs contracts are available[1].

Galbraith's analysis did not rely on an explicit economic model. The first attempts to formalize his idea were made by Von Ungern-Sternberg (1996) and Dobson and Waterson (1997) who consider an upstream monopolist who sells to many symmetric downstream firms. In these models an increase of retailers' market power is measured by a decrease in their number, that is by the level of concentration. They discard Galbraith's hypothesis showing that higher concentration does not necessarily lead to lower consumer prices, in fact it may drive them up. However there is one exception: a rise in countervailing power lowers consumers prices only when retailers, despite being oligopsonists in the input market, behave as price takers in the retail market.

In a different setting, Chen (2003) considers a model where an upstream monopolist sells to asymmetric firms, a dominant retailer and a competitive fringe. He models countervailing power as the level of bargaining power of the dominant retailer in a bilaterally negotiated contract with the supplier. In contrast to Von Ungern-Sternberg (1996) and Dobson and Waterson (1997), Chen (2003) confirms Galbraith's hypothesis showing that countervailing power does matter, eventhough there is a price setter in the retail market. Nevertheless, he suggests a different explanation on why a rise in countervailing power lowers consumer prices. Quoting Chen (2003): "*A rise in the power of the dominant retailer reduces the share of joint profits accruing to the supplier. In an attempt to make up for lower profits earned from the dominant retailer, the supplier boosts sales to fringe retailers by lowering their wholesale price. The fall in the cost of fringe retailers shifts their supply curve to the right, leading to a lower retail price. Therefore, the fall in retail price is the result not of a dominant retailer passing on cost savings to consumers but of a supplier trying to offset the reduction in profits caused by the rise in countervailing power.*"

We argue that the result of Chen depends crucially on the assumption

[1] For more on buyer power in distribution see Inderst and Mazzarotto (2008).

that the supplier and the dominant retailer bargain over the profits generated by their respective transaction[2]. However these profits constitute only a part of their bilateral or joint profits. In particular, upstream profits originating from transactions with other retailers are not included. An important consequence of this assumption, is that the wholesale price offered to the dominant retailer equals the supplier's marginal cost. If suppier and dominant retailer bargain over the totality of their bilateral profits, then the dominant retailer's wholesale price is higher than the supplier's marginal cost and changes in bargaining power do not affect equilibrium consumer prices, i.e. countervailing power is irrelevant.

What drives our results is the non-profitability of "sales-shifting" among retailers. In the model of Chen (2003), the shifting of sales from the dominant retailer to the fringe retailers, lowered the supplier's profits originating from the dominant retailer (of which the supplier enjoys only a share) and increased the profits originating from the fringe retailers (of which the supplier extracts at a 100% rate). In our model sales-shifting is not profitable, because supplier and dominant retailer bargain after all over industry profits. Any attempt to shift sales so as to increase the profit of the fringe retailers, would benefit or harm both dominant retailer and supplier since they now both share the surplus generated by the fringe retailers. In Chen's (2003) model only the supplier was reaping the profit arising from fringe retailers, since that profit was not part of the bargaining with the dominant retailer and hence their respective bilateral profits.

Our result underlines that despite downstream competition among the fringe retailers, countervailing power does not matter for consumers prices irrespectively of the level of bargaining power or fringe size. Moreover, the puzzling result in Chen that an increase in countervailing power would actually decrease the dominant retailer's profit putting in question his incentive to exercise that power, does not appear in our model. We prove our argument by using a simple model where demand and marginal cost functions are linear.

Our work is related to Bedre-Defolie and Shaffer (2011). They argue that when one takes into account the fringe surplus in the joint profits, a rise in countervailing power may lead to a waterbed effect and a higher or lower retail price, depending on the pass-through rate of fringe wholesale price changes to consumer prices. Opposite to their results, in our model countervailing power is irrelevant to prices, irrespectively of the level of pass-through rate. This is due to three major differences between our models.

[2] This is already discussed in Bedre-Defolie and Shaffer (2011).

First we use the standard asymmetric Nash bargaining solution, i.e. the so called "split the difference" and not the "deal-me out bargaining" of Binmore, Shaked and Sutton (1989). Second, in our model, as in Chen's (2003), there is bargaining over the wholesale price, not the consumer price. Third, the fringe profits are not paid upfront to the supplier in the form of a fee but after sales realize, so they are part of the bargaining between the supplier and the dominant retailer.

In the last section we extend the model of Chen(2003) to price quantity contracts instead of two-part tariffs. We show that with price quantity bundle contracts, countervailing power matters. Such contracts however will never be chosen by the supplier under a weak assumption on the size of the market. We also show that despite the efficiency of the dominant retailer in retailing large quantities, the supplier has no incentive to foreclose the fringe retailers and monopolize the market.

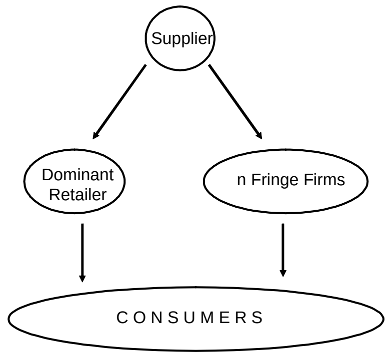
The structure of the paper is the following: we first construct the model and then we calculate the subgame perfect equilibrium and state the irrelevance result. The extension to price-quantity bundle contracts follows.

2 The Model

The structure of the model is the same with Chen (2003). In the upstream level there exists a unique supplier denoted by s who produces and sells an intermediate product to $(1+n)$ retailers, one dominant retailer and a competitive fringe consisting of n retailers. In the downstream level, retailers sell the product to consumers. The market structure is shown in the following diagram:

Without loss of generality, we normalize the supplier's cost for producing the intermediate good to zero.

Let d denote the dominant retailer and f a fringe firm. Firms d and f use one unit of the intermediate good to produce one unit of the final good, nevertheless they differ with respect to retailing technology and market power. The dominant retailer has constant marginal retailing cost $MC_d = c_d$ whereas a fringe firm faces an increasing one, $MC(q_f) = kq_f, k > 0$. The cost function of a fringe firm is given by $TC(q_f) = \frac{1}{2}k(q_f)^2$, where q_f is the quantity of output produced by the fringe retailer. Differences in retailing technology induce differences in size and market power. We shall assume that the dominant retailer has market power as an input buyer towards the supplier and as a final good seller to the consumer as well. In particular we assume that the dominant retailer bargains with the supplier over the input



price and unilaterally sets the consumer price. On the other hand, fringe firms operate more efficiently in a small scale and hence they are price-takers both in the input and the final good market.

We consider the following inverse demand function

$$p(Q) = a - bQ, \qquad a > c_{d,} b > 0 \tag{1}$$

where Q is the quantity demanded.

The timing of the game is the following:

At $t = 1$, the seller makes a "take it or leave it offer" to each one of the fringe retailers. The offer is a two-part tariff contract, that is pair (F_f, w_f) consisting of a fee F_f and a wholesale price w_f for one unit of the intermediate good. This contract is observable to the dominant retailer.

At $t = 2$, the seller and the dominant retailer bargain over a two-part tariff $(F_{d,} w_d)$ given an exogenous level of bargaining power $\gamma \in (0, 1)$ of the dominant retailer.

At $t = 3$, the dominant retailer sets the consumer price p_d taking as given the supply function of the fringe and hence his residual demand. Once p_d is set, each one of the fringe retailers chooses how much quantity of the input good q_f to buy at w_f and sell at price p_d after incurring the retailing cost.

In case of a disagreement between the supplier and the dominant retailer at $t = 2$, the dominant retailer becomes inactive. On the other hand, the supplier honors the contracts that has signed with the fringe firms at period $t = 1$ and is committed to deliver any quantity of the intermediate good at wholesale price w_f. In that case the fringe firms sell the final product at the competitive retail price, denoted by p_o.

3 Equilibrium

The concept of equilibrium that we use is that of subgame perfect Nash equilibrium. We proceed by backwards induction.

At $t = 3$, each fringe retailer chooses how much to sell to consumers given the retail price p set by the dominant retailer and the (F_f, w_f) contract offered to him by the supplier. His problem is

$$\max_{q_f} \Pi_f = [p - AC_f(q_f) - w_f]q_f - F_f$$

and the solution gives the supply function of the fringe firm

$$q_f \equiv s(p, w_f) = \frac{(p - w_f)}{k} \tag{2}$$

The dominant retailer faces the following residual demand

$$D(p) - ns(p, w_f) = \frac{a - p}{b} - n\frac{(p - w_f)}{k} \tag{3}$$

where $D(p)$ is given by (1) and $s(p, w_f)$ is given by (2). He chooses the retail price p so that

$$\max_{p} \Pi_d = [p - c_d - w_d][D(p) - ns(p, w_f)] - F_d \tag{4}$$

$$= (p - c_d - w_d)\left(\frac{a - p}{b} - n\frac{p - w_f}{k}\right) - F_d \tag{5}$$

and the solution gives the optimal retail price

$$p_d(w_d, w_f) = \frac{ak + (k + bn)(c_d + w_d) + bnw_f}{2(k + bn)}$$

At $t = 2$ the supplier and the dominant retailer bargain over the (F_d, w_d) contract. We assume that the bargaining outcome is captured by the maximization of the asymmetric Nash bargaining product where the utilities of the players are given by their profit functions. The profit function of the dominant retailer is given by (5) where $p = p_d(w_d, w_f)$, that is taking into the stage 03 optimal pricing decision of the dominant retailer.

$$\Pi_d = [p_d(w_d, w_f) - c_d - w_d][D(p_d) - ns(p_d, w_f)] - F_d \tag{6}$$

The profit of the supplier is

$$\Pi_S = [F_d + (D(p_d) - s_f(p_d, w_f))w_d] + n[F_f + w_f s_f(p_d, w_f)], \tag{7}$$

where the left bracket denotes the profit coming from the supplier's transaction with the dominant retailer and the right bracket the profit coming from the fringe firms.

It remains to specify the players' disagreement payoff in order to write down the Nash bargaining program. In case bargaining breaks down, the dominant retailer gets zero and the price in the retail level is formed competitively. The competitive retail price p_o will be such that total demand $D(p_o)$ equals total supply $ns(p_o, w_f)$ i.e.

$$\begin{aligned} p_o \quad &: \quad \frac{a - p_o}{b} = n\frac{p_o - w_f}{k} \\ &\Rightarrow \quad p_o = \frac{ak + bnw_f}{k + bn} \end{aligned} \tag{8}$$

So the disagreement payoff d_S that the supplier will receive is exactly the fringe profits when demand is covered solely by the fringe at the competitive price p_o

$$d_s = n[F_f + w_f s(p_o, w_f)]$$

and using (8) we obtain

$$d_s(w_f) = nF_f + n\frac{w_f(a - w_f)}{k + bn}$$

The outcome of the bargaining is given by the maximization of the following Nash bargaining product with respect to F_d and w_d

$$(\Pi_s - d_s)^{1-\gamma}(\Pi_d)^{\gamma}, \tag{9}$$

where Π_s is given by (7) and Π_d is given by (6). The term $\Pi_s - d_s$ reduces to

$$\Pi_s - d_s = F_d + [D(p_d) - ns(p_d, w_f)]w_d + nw_f s(p_d, w_f) - nw_f s(p_o, w_f)]$$

since nF_f cancels out.

The maximization of (9) gives us the following contract

$$w_d(w_f) = \frac{bnw_f}{k + bn}$$

and

$$\begin{aligned} F_d(w_f) &= \frac{A}{4bk(k+bn)}, \\ A &= [ak + c_d(k+bn)]^2(1-\gamma) + 4bkn(w_f^2 + kVP + bnVP)\gamma \\ & \quad -2ak[c_d(k+bn)(1-\gamma) + 2bnw_f\gamma] \end{aligned} \tag{10}$$

where VP is the variable part of the supplier's disagreement payoff

$$VP = nw_f s(p_o, w_f) = n\frac{w_f(a-w_f)}{k+bn}.$$

which is taken as fixed during this stage.

At $t = 1$,the supplier decides about the "take it or leave it" offer to propose to the fringe retailers, taking as given $p_d(w_{d,}w_f)$, $s(p_d, w_f), w_d(w_f)$ and $F_d(w_f)$ from the previous stages. At this stage the supplier can affect the level of disagreement payoff $d_s(w_f)$, which will be taken as fixed at period $t = 2$, by choosing the level of w_f appropriately. From (10) we observe that w_f has also an indirect effect on $F_d(w_f)$ through VP. The supplier's problem is

$$\begin{aligned} \max_{w_f} \Pi_S &= [F_d(w_f) + (D(p_d) - s(p_d, w_f))w_d(w_f)] + n[F_f + w_f s(p_d, w_f)] \\ st \qquad F_f &= \Pi_f = [p_d - \frac{k}{2}s(p_d, w_f) - w_f]s(p_d, w_f) \end{aligned} \tag{11}$$

The solution to (11) is

$$w_f^* = \frac{1}{4}\left(2a - \frac{2c_d(k+bn)}{k+2bn}\right) \tag{12}$$

Once we found w_f we can calculate the equilibrium values of prices and fees:

$$w_d^* = \frac{bn}{2(k+bn)}\left(a - \frac{c_d(k+bn)}{k+2bn}\right), \tag{13}$$

$$F_d^* = \frac{[ak - c_d(k+bn)]^2(1-\gamma)}{4bk(k+bn)}, \tag{14}$$

$$F_f^* = \frac{c_d^2(k+bn)^2}{2k(k+2bn)^2}, \tag{15}$$

$$p^* = \frac{1}{4}\left(2a + c_d + \frac{c_d k}{k+2bn}\right). \tag{16}$$

It can be shown that equivalently to (11), w_f^* maximizes the supplier's share of the joint profits:

$$\begin{aligned}\max_{w_f} \Pi'_S &= (1-\gamma)\left[(p_d - c_d)[D(p_d) - ns(p_d, w_f)] + n[F_f + w_f s(p_d, w_f)]\right] \\ st \qquad F_f &= \Pi_f = [p_d - \frac{k}{2}s(p_d, w_f) - w_f]s(p_d, w_f).\end{aligned}$$

Proposition 1 *When the supplier and the dominant retailer bargain over two-part tariff contracts, countervailing power is irrelevant to equilibrium prices, quantities and industry profits. A change in bargaining power results only to a reallocation of profits between the supplier and the dominant retailer.*

Proof. The irrelevance regarding prices is evident from (12), (13) and (16). Obviously from (2) , $\partial q_f/\partial\gamma = 0$ and hence $\partial Q/\partial\gamma = 0$. At equilibrium the fringe retailers make zero profit so the industry profits are

$$\Pi_s^* + \Pi_d^* = \frac{a^2k(k+2bn) - 2ac_dk(k+2bn) + c_d^2(k+bn)(k+3bn)}{4bk(k+2bn)}.$$

Consequently bargaining power γ has no effect on industry profits, nevertheless an increase in bargaining power increases the dominant retailer's share of industry profits since $\partial F_d/\partial\gamma < 0$. ∎

4 Extension: Equilibrium with Price-Quantity Contracts

We proceed as before by backwards induction.

At $t = 3$, the market clearing price is

$$p(q_d, q_f) = a - b(q_d + nq_f)$$

At $t = 2$ the supplier and the dominant retailer bargain over the (F_d, q_d) contract. We assume that the bargaining outcome is captured by the maximization of the asymmetric Nash bargaining product where the utilities of the players are given by their profit functions. The profit function of the dominant retailer is given by

$$\Pi_d = [p(q_d, q_f) - c_d]q_d - F_d \tag{17}$$

The profit of the supplier is

$$\Pi_S = F_d + nF_f, \tag{18}$$

The disagreement payoff of the dominant retailer is zero and that of the supplier's is exactly the total price corresponing to the quantity nq_f sold to the fringe retailers:

$$d_s = nF_f$$

The outcome of the bargaining is given by the maximization of the following Nash bargaining product with respect to F_d and q_d

$$(\Pi_s - d_s)^{1-\gamma}(\Pi_d)^{\gamma}, \tag{19}$$

which reduces to

$$(F_d)^{1-\gamma}[(p(q_d, q_f) - c_d)q_d - F_d]^{\gamma}$$

The maximization of (19) gives us the following contract

$$q_d(q_f) = \frac{a - c_d - bnq_f}{2b}$$

and

$$F_d(q_f) = \frac{(-a + c_d + bnq_f)^2(1-\gamma)}{4b}$$

At $t = 1$,the supplier decides about the "take it or leave it" offer to propose to the fringe retailers, taking as given $p_d(q_d,q_f)$, $q_d(q_f)$ and $F_d(q_f)$ from the previous stages. The supplier's problem is

$$\begin{aligned} \max_{q_f} \Pi_S &= F_d(q_f) + nF_f \\ st \qquad F_f &= \Pi_f = [p(q_d, q_f) - \frac{k}{2}q_f]q_f \end{aligned} \tag{20}$$

The solution to (20) is

$$q_f^* = \frac{2c_d(2-\gamma) + a\gamma}{2k + bn(1+\gamma)} \tag{21}$$

Once we found q_f we can calculate the equilibrium values of prices and fees:

$$q_d^* = \frac{2k(a - c_d) + bn(a - 3c_d)}{2b[2k + bn(1+\gamma)]}, \tag{22}$$

$$F_d^* = \frac{[2k(a - c_d) + bn(a - 3c_d)]^2(1-\gamma)}{4b[2k + bn(1+\gamma)]^2}, \tag{23}$$

$$F_f^* = \frac{[c_d(2-\gamma) + a\gamma][a(bn - k(-2+\gamma)) + c_d(k\gamma + bn(-1+2\gamma))]}{2[2k + bn(1+\gamma)]^2}, \tag{24}$$

$$p^* = \frac{2(a - c_d)(k + bn\gamma) + bn(a + c_d)}{2b[2k + bn(1+\gamma)]}. \tag{25}$$

Proposition 2 *When the supplier and the dominant retailer bargain over price-quantity contracts, countervailing power matters. A change in countervailing power affects the equilibrium consumer price, quantities and firm and industry profits.*

Proof. The relevance is evident from (22)-(25). At equilibrium, profits are

$$\Pi_s^* = \frac{Z}{4b[2k+bn(1+\gamma)]}$$
$$Z = a^2[bn-2k(-1+\gamma)]+c_d^2[bn(5-4\gamma)-2k(-1+\gamma)] +2ac_d[2k(-1+\gamma)+bn(-1+2\gamma)]$$
$$\Pi_d^* = \frac{[2k(a-c_d)+bn(a-3c_d)]A}{4b^2[2k+bn(1+\gamma)]^2}$$
$$A = [a(2k(1+b(-1+\gamma))+bn(1+b(-1+\gamma)+2\gamma)) +c_d(bn(1+b-2\gamma-5b\gamma)-2k(1+b+b\gamma))]$$

Changes in bargaining power γ affect industry profits $\Pi_s^*+\Pi_d^*$. ■

5 Comparison

Comparing the equilibrium with bargaining over a two-part tariff contract against the one with bargaining over a price-quantity contract we conclude thats the two modes of contracting are not equivalent. We also conclude that countervailing power matters only when there is bargaining over price-quantity contracts. Given this non-equivalence it is of interest to ask what type of contract would arise at equilibrium. The choice of contract may be made unilaterally by either the dominant retailer or the supplier, or bilaterally by a common agreement as a result of bargaining between the two. Here we will assume that the supplier, being a monopolist chooses the type of contract. In that case, we have the following proposition:

Proposition 3 *If the market size with respect to the dominant retailer's marginal cost is large enough, i.e* $a > (7/5)c_d$*, then the supplier will always choose a two-part tariff contact instead of a price quantity contract, irrespectively of the level of bargaining power of the dominant retailer.*

Proof. Let $\Pi_s^*(2P)$ and $\Pi_s^*(PQ)$ be the supplier's profit under a two-part tariff contract and a price-quantity contract respectively. We will show that for any $0 < \gamma < 1$, if $a > (7/5)c_d$, then $\Pi^*_S(PQ) < \Pi^*_S(2P)$.

$$\Pi^*_S(PQ) - \Pi^*_S(2P) = \frac{nB}{2k(k+bn)[(a+c_d)k + b(2a+c_d)n][2k+bn(1+\gamma)]}$$

where

$$\begin{aligned} B &= (a-c_d)^2k^3(-2+\gamma)\gamma + b^3c_d^2 2n^3(1+\gamma)(-3+2\gamma) \\ &+ b(a-c_d)k^2n\gamma[cd(7-4\gamma)+a(-5+2\gamma)] \\ &+ b^2kn^2[-2a^2\gamma - 4ac_d(-2+\gamma)\gamma + c_d^2(-3+\gamma(-6+5\gamma))] \end{aligned}$$

The denominator is positive, so we have to show that $B < 0$. In fact we will show that B is a sum of strictly negative terms when $a > (7/5)c_d$. Starting from left to right in expression B, the sum of the first two terms $(a-c_d)^2k^3(-2+\gamma)\gamma + b^3c_d^2 2n^3(1+\gamma)(-3+2\gamma)$ is negative since $0 < \gamma < 1$. The third term $b(a-cd)k^2n\gamma[c_d(7-4\gamma)+a(-5+2\gamma)]$ is negative because $c_d(7-4\gamma)+a(-5+2\gamma) < 0$ for $a > (7/5)c_d$. The sign of the last term in B depends on the sign of $-2a^2\gamma - 4ac_d(-2+\gamma)\gamma + c_d^2(-3+\gamma(-6+5\gamma))$ which is negative for $a > (7/5)c_d$. ■

6 Exclusion

Up to now the market structure was taken as given. In this section, we would like to ask whether it is always to the benefit of the supplier to trade with either the fringe or the dominant retailer or both. Recall that the dominant retailer is more efficient when he is able to sell large quantities, in contrast to the fringe retailers who are more efficient when they operate in a small scale. We have shown that when the supplier sells to both, he chooses a two-part tariff contract. Nevertheless, the choice of the type of contract is irrelevant when the supplier deals exclusively with one type of retailer, i.e contracts are equivalent.

Proposition 4 *If the supplier trades exclusively either with the dominant retailer or with the fringe retailers, the choice of type of contract is irrelevant.*

Proof. First, suppose the supplier trades with the dominant retailer only and excludes the fringe retailers. The model then becomes a bilateral monopoly one with two periods. In the first period supplier and dominant retailer bargain over the two-part tariff contract. In the second period the dominant retailer chooses the retail price and consumption occurs.

At $t = 2$, the dominant retailer faces the inverse demand given by (1) and chooses the retail price so as to maximize profits.

$$\begin{aligned}\max_p \Pi_d &= (p - c_d - w_d)Q(p) - F_d \\ &= (p - c_d - w_d)\frac{a-p}{b} - F_d\end{aligned}$$

and the solution gives the optimal retail price

$$p_d(w_d) = \frac{1}{2}(a + c_d + w_d)$$

At $t = 1$ the supplier and the dominant retailer bargain over the (F_d, w_d) contract anticipating the consumer price $p_d(w_d)$. The profit of the dominant retailer is

$$\Pi_d = [p_d(w_d) - c_d - w_d]Q(p_d) - F_d$$

and that of the supplier

$$\Pi_S = [F_d + Q(p_d)w_d].$$

The oucome of the bargaining is given by the maximization of the following Nash bargaining product

$$\max_{F_d, w_d} [\Pi_d(F_d, w_d)]^\gamma [\Pi_S(F_d, w_d)]^{1-\gamma} \tag{26}$$

since the disagreement payoff is zero for both players. The oprimal fee is

$$F'_d = Q(p_d)[(p_d(w_d) - c_d)(1-\gamma) - w_d]$$

Substituting F'_d in the profit functions of the retailer and the supplier we obtain the following profits

$$\begin{aligned}\Pi_d(F'_d, w_d) &= \gamma[p_d(w_d) - c_d]Q(p_d) \\ \Pi_S(F'_d, w_d) &= (1-\gamma)[(p_d(w_d) - c_d)]Q(p_d)\end{aligned}$$

and the problem reduces to

$$\begin{aligned}&\max_{w_d}[\Pi_d(F'_d, w_d)]^\gamma[\Pi_S(F'_d, w_d)]^{1-\gamma} \\ =\ &\max_{w_d} \left[\gamma^\gamma(1-\gamma)^{1-\gamma}\right] [(p_d(w_d) - c_d)]Q(p_d)\end{aligned}$$

The solution to the above problem gives us

$$w_d^* = 0$$

and so we obtain the following equilibrium values

$$
\begin{aligned}
p_d^* &= \frac{a+c_d}{2}, &(27)\\
Q^* &= \frac{a-c_d}{2b}, &(28)\\
F_d^* &= (1-\gamma)\frac{(a-c_d)^2}{4b}, &(29)\\
\Pi_d^* &= \gamma\frac{(a-c_d)^2}{4b}, &(30)\\
\Pi_s^* &= F_d^* = (1-\gamma)\frac{(a-c_d)^2}{4b}. &(31)
\end{aligned}
$$

Notice that at equilibrium supplier and dominant retailer share the monopoly profit.

Next we shall show that the equilibrium above is also an equilibrium with price-quantity contracts.

At $t = 2$, the dominant retailer will sell all the quantity q_d he has purchased at period $t = 1$ at price

$$p(q_d) = a - bq_d$$

At $t = 1$ the supplier and the dominant retailer bargain over the (F_d, q_d) contract taking into account the shape of the demand curve. The profit of the dominant retailer is

$$\Pi_d = [p(q_d) - c_d]q_d - F_d$$

and that of the supplier

$$\Pi_S = F_d$$

The oucome of the bargaining is given by the maximization of the following Nash bargaining product

$$\max_{F_d, q_d}[\Pi_d(F_d, q_d)]^\gamma[\Pi_S(F_d, q_d)]^{1-\gamma}$$

since the disagreement payoff is zero for both players. The oprimal fee is

$$F_d' = (1-\gamma)q_d(a - bq_d - c_d)$$

Substituting F_d' in the profit functions of the retailer and the supplier we obtain the following profits

$$
\begin{aligned}
\Pi_d(F_d', q_d) &= \gamma q_d(a - bq_d - c_d)\\
\Pi_S(F_d', q_d) &= (1-\gamma)q_d(a - bq_d - c_d)
\end{aligned}
$$

and the problem reduces to

$$\begin{aligned} & \max_{q_d}[\Pi_d(F_d', q_d)]^{\gamma}[\Pi_S(F_d, q_d)]^{1-\gamma} \\ = & \max_{q_d}\left[\gamma^{\gamma}(1-\gamma)^{1-\gamma}\right][q_d(a - bq_d - c_d)]. \end{aligned}$$

The solution to the above problem gives us

$$q_d^* = \frac{a - c_d}{2b}$$

which is the same total equilibrium quantity Q that can be obtained with a two-part tariff contract. Indeed price, fee and profits are the same with (27) to (31), and so we have shown that price-quantity contracts and two part tariffs are equivalent when the competitive fringe is excluded from trade.

To complete the proof we have to show further that the two types of contract are equivalent when the dominant retailer is exluded, that is, when the supplier sells only to the fringe retailers.

We begin with the calculation of equilibrium when the supplier uses a two-part tariff contract. The timing of the game is the following. At $t = 1$ the supplier offers a "take it a leave it" contract to the fringe retailers. If they accept, they sell the final good at $t = 2$ at the competitive price. The supply function of a fringe retailer is given by (2) and the competitive price is given by (8). At $t = 1$, the supplier maximizes

$$\begin{aligned} \Pi_s &= n[F_f + w_f s_f(p_o, w_f)] \\ st \qquad F_f &= \Pi_f = (p_o - AC_f - w_f)s_f(p_o, w_f) \end{aligned}$$

or equivalently

$$\max_{w_f} n[(p_o - AC_f)s_f(p, w_f)].$$

The solution to the above problem gives

$$w_f^* = \frac{abn}{k + 2bn}.$$

Then we may calculate the two-part tariff equilibrium values

$$p_o^* = \frac{a(k + bn)}{k + 2bn}, \tag{32}$$

$$Q^* = n\frac{a}{k + 2bn}, \tag{33}$$

$$F_f^* = \frac{a^2 k}{2(k + 2bn)^2}, \tag{34}$$

$$\Pi_s^* = \frac{a^2 n}{2(k + 2bn)}, \tag{35}$$

We shall now calculate the equilibrium where the supplier chooses a price quantity bundle. At $t = 1$, the supplier makes an (F_f, q_f) contract offer to the fringe retailers. If they accept, they sell all the purchased quantity at the market clearing price at $t = 2$. So the retail price at $t = 2$ is $p = a - bnq_f$. At $t = 1$, the supplier maximizes

$$\begin{aligned} \Pi_s &= nF_f \\ st \qquad F_f &= \Pi_f = (p - AC_f)q_f \end{aligned}$$

or equivalently

$$\max_{q_f} n(a - bq_f - kq_f)q_f.$$

The solution to the above problem gives

$$q_f^* = \frac{a}{k + 2bn}.$$

If we calculate the rest of the equilibrium values, we obtain the same as in (32)-(32) and so we complete the proof. ■

When is it the case that the supplier would like to trade exclusively with the fringe retailers? If the number of fringe firms is large enough, then each fringe retailer buys a small quantity of the intermediate good and hence he may end up having a lower marginal cost than the dominant retailer. In fact the supplier would sell exclusively to the fringe retailers when the profit he is making by selling to both of them is less than the profit when he sells only to the fringe.

Proposition 5 *If the number of fringe retailers $n > k(a - c_d)/(bc_d)$, then the supplier will exclude the dominant retailer.*

Proof. Let $\Pi_s^*(2P)$, $\Pi_s^*(PQ)$ be the supplier's profit under a two-part tariff contract, a price-quantity contract respectively. Let Π_{so} be the profit when the supplier sells exclusively to the fringe retailers. Then for $n = k(a - c_d)/(bc_d), \Pi_s^*(2P) = \Pi_{so}^*$. It remains to check that the function $\Pi_s^*(2P) - \Pi_{so}^*$ is monotonically decreasing in n.(INCOMPLETE) ■

Proposition 6 *For any fringe size and for any level of bargaining power of the dominant retailer, it is never optimal for the supplier to exlude the fringe retailers.*

Proof. Let $\Pi_s^*(2P)$, $\Pi_s^*(PQ)$ be the supplier's profit under a two-part tariff contract, a price-quantity contract respectively when the supplier sells to all retailers. Let $\Pi_{s/d}$ be the profit when the supplier sells exclusively to the dominant retailer. We have already shown that the type of contract does not matter in this case, that is $\Pi_{s/d}(PQ) = \Pi^*_{s/d}(2P) = \Pi^*_{s/d}$. We will show that for any n, $\Pi^*_{s/d} < \Pi^*_s(2P)$ and $\Pi^*_{s/d} < \Pi^*_s(PQ)$. Indeed

$$\begin{aligned}
\Pi^*_s(2P) - \Pi^*_{s/d} &= n\frac{a^2k(k+2bn)\gamma + c_d^2[k(2-\gamma) + bn(3-2\gamma)]}{4k(k+bn)(k+2bn)} > 0, \\
\Pi^*_s(PQ) - \Pi^*_{s/d} &= \frac{n[cd(\gamma-2) - a\gamma]^2}{4[2k + bn(1+\gamma)]} > 0.
\end{aligned}$$

■

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