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〈General Article〉

Price Elasticity and Pass-Through in the Nash Bargaining Solution in a Common-Retailer Channel[†]

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Abstract

This paper analyzes the role of the industry's price elasticity and the determinants of pass-through in the Nash bargaining solution in a distribution channel with a common retailer. It is shown that the division of the upstream and downstream profits is characterized by (i) the industry's price elasticity, (ii) the Nash bargaining weight, and (iii) the number of upstream firms. I also show that the demand curvature plays an important role in the determination of pass-through rates. These results are generalized if the number of upstream firms is endogenized.

Keywords : distribution channels; bargaining; price elasticity; pass-through; demand curvature

JEL Classification Code : L13; L49; L66

I Introduction

In vertical relationships, a retailer is usually a *multi-product firm* that sells competing brands (Choi 1991, 1996). In this paper, I study the properties of the Nash bargaining solution (Nash 1950) in a distribution channel with such a *common retailer*. First, I analyze the role of the *price elasticity* in the determination of the division of the upstream and downstream profits. It is shown that the common retailer's profit share becomes *lower* if the market demand becomes *less* elastic, holding the bargaining weights fixed. This is because through a negotiation process, an upstream firm can aggressively charge a higher wholesale price because it loses *less* from a sales reduction when the demand is not elastic.

Second, I show that an upstream cost increase is partly absorbed by the common retailer, and how much it is absorbed is determined by the *demand curvature*: if the market demand is "very convex," then the pass-through at the wholesale level is almost passed through to the final price, *irrespective of* the division of upstream and downstream bargaining weights. In this way, I argue the importance of the first- and the second-order demand characteristics in characterizing the Nash bargaining solution in a distribution channel.

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In a similar vein, Aghadadashli, Dertwinkel-Kalt, and Wey (2016) study a model of *one upstream firm and N downstream firms* which bargain over the input price, produce outputs, and quantity-compete, and show that if the downstream firm's demand becomes *less* elastic, then *ceteris paribus*, the upstream monopolist earns a *higher* profit margin from the input price bargaining. Despite the differences in vertical structure and the mode of downstream competition, Aghadadashli, Dertwinkel-Kalt, and Wey (2016) and this paper's model of *one downstream firm and N upstream firms* share a similar intuition.

Ⅱ Model

First, we assume that the number of upstream firms (manufacturers) is $N \geq 1$ and that they are symmetrically differentiated. Each manufacturer is a single-product firm: their marginal cost of production is constant, denoted by $c^U \geq 0$. However, a downstream firm (a common retailer), who is a monopolist in the geographical market, is a multi-product firm in the sense that it transacts with these upstream firms' N products. We denote by $c^D \geq 0$ its constant marginal cost of sales for each product. The common retailer sells the manufacturers' products to the final market by choosing the prices $\mathbf{p} = (p_1, p_2, ..., p_N)$. Then, the demand (in terms of a market share) for product $j \in \mathcal{N} \equiv \{1, 2, .., N\}$ is written as $s_j = s_j(\mathbf{p})$. The common retailer pays the unit price w_j to manufacturer j. Thus, the common retailer's total profit is written as $\Pi^D \equiv \sum_{j \in \mathcal{N}} \Pi_j^D$, where $\Pi_j^D \equiv (p_j - w_j - c^D) s_j(\mathbf{p})$. The first-order condition for p_j is given by

$$s_j(\mathbf{p}) + (p_j - w_j - c^D)\frac{\partial s_j}{\partial p_j} + \sum_{l \neq j}(p_l - w_l - c^D)\frac{\partial s_l}{\partial p_j} = 0. \tag{1}$$

On the other hand, if each manufacturer can directly distribute its product to the final market, then manufacturer j's profit is $\hat{\pi}_j^U \equiv (p_j - c^U - c^D) s_j(\mathbf{p})$, and thus the first-order condition for p_j is given by

$$s_j(\mathbf{p}) + (p_j - c^U - c^D)\frac{\partial s_j}{\partial p_j} = 0.$$

Hence, if $w_j \geq c^U$, then $\sum_{l \neq j}(p_l - w_l - c^D)\frac{\partial s_l}{\partial p_j} > (w_j - c^U)\frac{\partial s_j}{\partial p_j}$ because $\partial s_l / \partial p_j > 0$ for $l \neq j$ and $\partial s_j / \partial p_j < 0$. In the following analysis, I focus on symmetric equilibrium prices p and w, and thus denote by $s(p)$ the per-product market demand corresponding to p: $s(p) \equiv s_j(p, ..., p)$. Then, the equilibrium retail price in a distribution channel, $p^* = p(w)$, is *higher* than the equilibrium price without such a distribution channel, p^0. This is because the monopolistic retailer *internalizes* the effects of changing p_j on not only its own demand s_j but also on the demands for the other products, s_l's.

In line with Aghadadashli, Dertwinkel-Kalt, and Wey (2016) and many others, the following assumption is made: N "delegates" are dispatched by the common retailer, and each of them negotiates with one of the N upstream firms "secretly" in the sense that each bargaining procedure is unobserved by no other players. In addition, we also assume that any player believes that equilibrium is played (regarding the wholesale price) outside of their confronting bargaining procedure.[1)] In particular, the players holds the belief that the symmetric equilibrium $\{w, p\}$ is played. Then w_j maximizes the Nash product, $[\Pi^D - \underline{\Pi}^D]^\lambda [\pi_j^U]^{1-\lambda}$, where $\lambda \in (0,1)$ is the common retailer's *Nash bargaining weight*, $\Pi^D = (p - w_j - c^D)s(p) + (N-1)(p - w - c^D)s(p)$ is the common retailer's total profit, $\underline{\Pi}^D$ is its *disagreement profit* that it obtains when the bargaining with manufacturer j breaks down, and $\pi_j^U = (w_j - c^U)s(p)$ is manufacturer j's profit from the wholesale bargaining. Here, note that the bargaining game is played by manufacturer j and the delegate of the common retailer, and they have a passive belief that the equilibrium is still played, in particular, the symmetric retail price p will still be chosen by the common retailer. Accordingly, the common retailer's disagreement payoff is perceived as $\underline{\Pi}^D = (N-1)(p-w-c^D)\tilde{s}(p)$, where $\tilde{s}(p)$ is the market share of product $j' \neq j$ when product j is removed. As a standard assumption in the literature, the retail prices are not reoptimized in such an event, and thus consumers still face the same price p for each product (except for the removed product j). This implies that $\Pi^D - \underline{\Pi}^D = N(p - w_j - c^D)[s(p) - \frac{N-1}{N}\tilde{s}(p)]$.

One last caveat here is that, as usually assumed in the empirical literature of vertical bargaining mainly for computational reasons, a pair of the wholesale and final prices, $\{w, p\}$, is determined *simultaneously*.[2)] This assumption would be best fitted if wholesale and retail prices are revised at a similar frequency. The vertical structure considered in this paper particularly resembles Grennan's (2013, 2014) setting, where one downstream firm (hospital) transacts with multiple upstream firms (medical device suppliers).

Ⅲ Analysis

Recall that the demand for each product under symmetric pricing is defined by $s(p) \equiv s_j(p, p, ..., p)$. Then, the relationship, $s'(p) = \frac{\partial s_j}{\partial p_j} + (N-1)\frac{\partial s_j}{\partial p_l}$ holds. As usual, *the industry's price elasticity* of demand is defined by $\epsilon(p) \equiv -ps'(p)/s(p) > 0$.

1 The role of the industry's price elasticity

Then, the following proposition shows how the bargaining relationship is related to the demand conditions in the final market.

Proposition 1. *Each upstream firm's share of the total profits, measured in terms of the final price, is expressed as*

$$\frac{w - c^U}{p} = N\left(\frac{1-\lambda}{\lambda}\right)\left[\frac{1}{\epsilon(p)}\right]. \tag{2}$$

1) This type of assumption is often called a "passive beliefs" assumption (Katz and Shapiro 1985; McAfee and Schwartz 1994).

2) See, e.g., Draganska, Klapper, and Villas-Boas (2010), Meza and Sudhir (2010), Crawford and Yurukoglu (2012), Grennan (2013, 2014), Gowrisankaran, Nevo, and Town (2015), Ho and Lee (2017), Crawford, Lee, Whinston, and Yurukoglu (2018), Hayashida (2020), and De los Santos, O'Brien, and Wildenbeest (2021). A theoretical study by Iozzi and Valletti (2014) considers a richer structure of timing and information.

Proof. Let $\Delta\Pi^D(w_j, \mathbf{w}_{-j}) \equiv \Pi^D - \underline{\Pi}^D = [(p - w_j - c^D) + (N-1)(p - w_{j'} - c^D)][s(p) - \frac{N-1}{N}\tilde{s}(p)]$. Then, the first-order condition for w_j is given by

$$\begin{aligned}&\lambda[\Delta\Pi^D]^{\lambda-1}\left[\frac{\partial\Delta\Pi^D}{\partial w_j}\right][(w_j - c^U)s(p)]^{1-\lambda}\\&+(1-\lambda)[(w_j - c^U)s(p)]^{-\lambda}[s(p)][\Delta\Pi^D]^{\lambda} = 0,\end{aligned}$$

which determines the symmetric w:

$$\begin{aligned}&\lambda\pi^U\left[1 - \frac{N-1}{N}\frac{\tilde{s}(p)}{s(p)}\right] = (1-\lambda)\Delta\Pi^D\\\Leftrightarrow\quad &\lambda(w - c^U) = N(1-\lambda)(p - w - c^D)\end{aligned}$$

Accordingly, the first-order condition for pricing (Equation 1) can rewritten as

$$\begin{aligned}&s(p) + (p - w - c^D)\left[\frac{\partial s_j}{\partial p_j} + (N-1)\frac{\partial s_j}{\partial p_l}\right] = 0\\\Leftrightarrow\quad &s(p) + (p - w - c^D)s'(p) = 0,\end{aligned}$$

where the common retailer takes care of the "industry" as a whole: it takes into account not only its own price effect, $\partial s_j/\partial p_j$, but also the aggregate spillover effects on other products, $(N-1)(\partial s_j/\partial p_l)$. Equation (2) is then obtained by combining these two equations. □

Equation (2) shows that if the upstream firm's bargaining weight becomes larger (i.e., $(1-\lambda)$ becomes larger), then, with other things unchanged, the upstream firm's share of profits also becomes larger. More importantly, if the industry's price elasticity of demand becomes *less* elastic (i.e., ϵ becomes smaller), then the upstream profit share becomes, *ceteris paribus*, *larger*. Intuitively, this is because the upstream firm loses *less* from a sales reduction by aggressively charging a high wholesale price to common retailer through the bargaining process.

The result above is even clearer if the "Holmes decomposition" is used. As Holmes (1989) shows, under symmetric pricing, the relationship, $\epsilon_F(p) = \epsilon(p) + \epsilon_C(p)$ holds. That is, *the firm's own price elasticity* is equal to the sum of the industry's price elasticity and *the cross price elasticity*, where $\epsilon_F(p) \equiv -(p/s(p))\partial s_j(\mathbf{p})/\partial p_j|_{\mathbf{p}=(p,\ldots,p)}$ and $\epsilon_C(p) \equiv (N-1)(p/s(p))\partial s_l(\mathbf{p})/\partial p_j|_{\mathbf{p}=(p,\ldots,p)}$ for any distinct pair of indices j and l. Thus, an increase in the degree of competition (due to less product differentiation and/or an increase in N) *raises* the upstream firm's profit share, holding the final price p fixed. This result is, again, in line with the intuition above: the upstream firm loses *less* from an aggressive attitude in the bargaining because it already faces a severe level of competition. The total effect is less unambiguous, though, because the final price p would also be lower by a higher level of competition. In contrast, the effect of ϵ_F is exactly the opposite: if the own price elasticity is very elastic, then the upstream firm has to be less aggressive because an increase in w, and thus the associated increase in p, significantly reduces the demand.

Now, from Equation (2) above, the wholesale price is obtained by

$$w = c^U + N\left(\frac{1}{\lambda} - 1\right)\left[\frac{s(p)}{-s'(p)}\right],$$

which leads to the following equation:

$$p = c^U + c^D + N\left(\frac{1}{\lambda} - \frac{N-1}{N}\right)\left[\frac{s(p)}{-s'(p)}\right]. \tag{3}$$

2 Pass-Through

Next, I define three different types of *cost pass-through*: the *wholesale* and the *final price pass-throughs of the upstream cost*, $\partial w/\partial c^U$ and $\rho^U \equiv \partial p/\partial c^U$, respectively, and *price pass-through of the downstream cost*, $\rho^D \equiv \partial p/\partial c^D$. I also define the *demand curvature* by $\sigma(p) \equiv ss''/[s']^2$. Among others, Adachi and Ebina (2014), Chen and Schwartz (2015), and Gaudin (2016) show that for the optimum it is necessary that $2 > \sigma$, and furthermore, $s(p)$ should not be "too convex," that is, s'' is sufficiently small that $1 > \sigma$. As Chen and Schwartz (2015) argue, many classes of demand functions satisfy this condition. Therefore, I also assume this restriction. Then, the following proposition is obtained.

Proposition 2. *The wholesale pass-through is larger than the upstream cost pass-through and the downstream cost pass-through, which are equal:*

$$\frac{\partial w}{\partial c^U} = (2-\sigma)\rho^U > \rho^U = \rho^D > 0.$$

Proof. Let $F(p, w; c^D) \equiv s(p) + (p - w - c^D)s'(p)$ and $G(p, w; c^U, \lambda) \equiv \lambda(w - c^U)\epsilon(p) - N(1-\lambda)p$. Essentially, our simplifying assumptions make it unnecessary to consider the dependence of p on w: the retail prices and the wholesale prices are simultaneously determined. Then, these two equilibrium conditions, $F(p, w; c^D) = 0$ and $G(p, w; c^U, \lambda) = 0$, can be utilized to develop implications for the three types of pass-through. First, the *wholesale* and the *final price pass-throughs of the upstream cost*, $\partial w/\partial c^U$ and $\rho^U \equiv \partial p/\partial c^U$, satisfy

$$\begin{bmatrix} \frac{\partial F}{\partial p} & \frac{\partial F}{\partial w} \\ \\ \frac{\partial G}{\partial p} & \frac{\partial G}{\partial w} \end{bmatrix}\begin{bmatrix} \rho^U \\ \\ \frac{\partial w}{\partial c^U} \end{bmatrix} = -\begin{bmatrix} \frac{\partial F}{\partial c^U} \\ \\ \frac{\partial G}{\partial c^U} \end{bmatrix}.$$

Now, let the determinant be defined by $|D| \equiv \left(\frac{\partial F}{\partial p}\right)\left(\frac{\partial G}{\partial w}\right) - \left(\frac{\partial F}{\partial w}\right)\left(\frac{\partial G}{\partial p}\right)$. Then

$$\begin{aligned} |D| &= s'\left\{\lambda\left(2 - \frac{ss''}{[s']^2}\right)\epsilon + N(1-\lambda)\left(\frac{p\epsilon'}{\epsilon} - 1\right)\right\} \\ &= s'\epsilon\left\{\lambda\left(2-\sigma\right) + N(1-\lambda)(1-\sigma)\right\} < 0 \end{aligned}$$

for all $\lambda \in (0, 1)$, because $\epsilon' = -\{s's + p\left[s''s - (s')^2\right]\}/s^2$ so that

$$\begin{aligned} \frac{p\epsilon'}{\epsilon} - 1 &= \left(-\frac{ps'}{s}\right)\left(1 - \frac{ss''}{[s']^2}\right) \\ &= \epsilon(1-\sigma). \end{aligned}$$

Now, it is proceeded as

$$\begin{bmatrix} \rho^U \\ \\ \dfrac{\partial w}{\partial c^U} \end{bmatrix} = \frac{-1}{|D|} \begin{bmatrix} \dfrac{\partial G}{\partial w}\dfrac{\partial F}{\partial c^U} - \dfrac{\partial F}{\partial w}\dfrac{\partial G}{\partial c^U} \\ \\ -\dfrac{\partial G}{\partial p}\dfrac{\partial F}{\partial c^U} + \dfrac{\partial F}{\partial p}\dfrac{\partial G}{\partial c^U} \end{bmatrix},$$

which implies that

$$\begin{aligned} \rho^U &= \left(\frac{s'}{|D|}\right)\lambda\epsilon \\ &= \frac{\lambda}{\lambda(2-\sigma)+N(1-\lambda)(1-\sigma)} > 0, \end{aligned}$$

and

$$\begin{aligned} \frac{\partial w}{\partial c^U} &= \left(\frac{s'}{|D|}\right)(2-\sigma)\lambda\epsilon \\ &= \frac{\lambda(2-\sigma)}{\lambda(2-\sigma)+N(1-\lambda)(1-\sigma)} > 0. \end{aligned}$$

Similarly, the *price pass-through of the downstream cost*, $\rho^D \equiv \partial p/\partial c^D$, is obtained by

$$\begin{aligned} \rho^D &= \frac{-1}{|D|}\left\{\frac{\partial G}{\partial w}\frac{\partial F}{\partial c^D} - \frac{\partial F}{\partial w}\frac{\partial G}{\partial c^D}\right\} \\ &= \left(\frac{s'}{|D|}\right)\lambda\epsilon = \rho^U. \end{aligned}$$

Since $2-\sigma > 1$, $\partial w/\partial c^U > \rho^U = \rho^D$. □

This proposition shows that the common retailer absorbs the upstream cost shocks by $100 \times [(1-\sigma)/(2-\sigma)]\%$. Here, the demand curvature plays an important role: if the industry's demand becomes "very convex" (σ becomes close to one), then the wholesale price increase is almost passed through to the final price, irrespective of the common retailer's bargaining weight, λ.[3] However, as λ increases, both ρ^U and $\partial w/\partial c^U$ also increase because

$$\frac{\partial \rho^U}{\partial \lambda} = \frac{\partial \rho^D}{\partial \lambda} = \frac{N(1-\sigma)}{[\lambda(2-\sigma)+N(1-\lambda)(1-\sigma)]^2} > 0,$$

and

$$\frac{\partial\left(\frac{\partial w}{\partial c^U}\right)}{\partial \lambda} = \frac{N(1-\sigma)(2-\sigma)}{[\lambda(2-\sigma)+N(1-\lambda)(1-\sigma)]^2} > 0.$$

Again, the latter is larger than the former.

3) On the other hand, an increase in the retailer's marginal cost c^D *lowers* the wholesale price:

$$\frac{\partial w}{\partial c^D} = -\frac{(1-\lambda)(1-\sigma)}{\lambda(2-\sigma)+N(1-\lambda)(1-\sigma)} < 0.$$

Next, the direct effects of λ on the retail and the wholesale prices are obtained by

$$\begin{bmatrix} \dfrac{\partial p}{\partial \lambda} \\ \\ \dfrac{\partial w}{\partial \lambda} \end{bmatrix} = \frac{-1}{|D|} \begin{bmatrix} -\dfrac{\partial F}{\partial w}\dfrac{\partial G}{\partial \lambda} \\ \\ \dfrac{\partial F}{\partial p}\dfrac{\partial G}{\partial \lambda} \end{bmatrix},$$

which indicates that

$$\frac{\partial p}{\partial \lambda} = -\left(\frac{s'}{|D|}\right)\left(\frac{Np}{\lambda}\right) < 0$$

and

$$\frac{\partial w}{\partial \lambda} = -\left(\frac{s'}{|D|}\right)\left(\frac{Np}{\lambda}\right)(2-\sigma) < 0.$$

Interestingly, as the common retailer's bargaining weight increases for all upstream manufacturers, the final price *decreases*. This is because the common retailer can lower the wholesale price though the bargaining, still maintaining product competition. If the common retailer loses its bargaining weight, the loss from less product competition becomes larger than the gain from elimination of double marginalization.

Finally, Equation (3) yields:

$$\begin{aligned} p &= c^U + c^D + N\left(\frac{1}{\lambda} - \frac{N-1}{N}\right)\frac{p}{\epsilon(p)} \\ \Leftrightarrow \quad & p = \frac{c^U + c^D}{1 - \dfrac{N\left(\frac{1}{\lambda} - \frac{N-1}{N}\right)}{\epsilon(p)}}, \end{aligned}$$

which implies that

$$\rho^U = \rho^D = \frac{1}{1 - \dfrac{N\left(\frac{1}{\lambda} - \frac{N-1}{N}\right)}{\epsilon}}.$$

As a summary, a higher bargaining weight of the common retailer (λ) *raises* the upstream cost and the downstream cost pass-throughs (ρ^U and ρ^D), and *lowers* the final price (p), suppressing the degree of double marginalization.

Ⅳ Free Entry of Upstream Firms

Now, I introduce entry cost for upstream firms. The number of firms is continuous, and each firm is indexed by $\theta \in [0, N]$. I assume that the entry cost is increasing in θ and differentiable: $f(\theta)$, where $f' > 0$. I also assume that $f(0) = 0$ and $f(N)$ is sufficiently large to ensure an interior n^*. The entry cost is sunk at the time of bargaining with the common retailer, implying that the determination of p and w is the same as above.[4)] However, the fringe firm n^*'s profit is down to

4) I assume that the common retailer does not price discriminate among upstream firms based on index θ.

zero in equilibrium due to free entry. Thus, the equilibrium (p, w, n) (superscript $*$ is suppressed) satisfies

$$\begin{cases} F(p,w,n;c^D) \equiv s(p) + (p - w - c^D)s'(p) = 0 \\ \\ G(p,w,n;c^U,\lambda) \equiv \lambda(w - c^U)\epsilon(p) - n(1-\lambda)p = 0 \\ \\ H(p,w,n;c^U) \equiv (w - c^U)s(p) - f(n) = 0. \end{cases}$$

Now, the effects of a change in the common retailer's bargaining weight λ are obtained by

$$\begin{aligned} \begin{pmatrix} \dfrac{\partial p}{\partial \lambda} \\ \dfrac{\partial w}{\partial \lambda} \\ \dfrac{\partial n}{\partial \lambda} \end{pmatrix} &= \begin{pmatrix} \dfrac{\partial F}{\partial p} & \dfrac{\partial F}{\partial w} & \dfrac{\partial F}{\partial n} \\ \dfrac{\partial G}{\partial p} & \dfrac{\partial G}{\partial w} & \dfrac{\partial G}{\partial n} \\ \dfrac{\partial H}{\partial p} & \dfrac{\partial H}{\partial w} & \dfrac{\partial H}{\partial n} \end{pmatrix}^{-1} \begin{pmatrix} \dfrac{\partial F}{\partial \lambda} \\ \dfrac{\partial G}{\partial \lambda} \\ \dfrac{\partial p}{\partial \lambda} \end{pmatrix} \\ &= \begin{pmatrix} \dfrac{\partial F}{\partial p} & \dfrac{\partial F}{\partial w} & \dfrac{\partial F}{\partial n} \\ \dfrac{\partial G}{\partial p} & \dfrac{\partial G}{\partial w} & \dfrac{\partial G}{\partial n} \\ \dfrac{\partial H}{\partial p} & \dfrac{\partial H}{\partial w} & \dfrac{\partial H}{\partial n} \end{pmatrix}^{-1} \begin{pmatrix} 0 \\ (w - c^U)\epsilon + np \\ 0 \end{pmatrix}, \end{aligned}$$

which implies that

$$\begin{pmatrix} \dfrac{\partial p}{\partial \lambda} \\ \dfrac{\partial w}{\partial \lambda} \\ \dfrac{\partial n}{\partial \lambda} \end{pmatrix} = -\frac{(w - c^U)\epsilon + np}{|E|} \begin{pmatrix} s'f' \\ \{2s' + (p - w - c^D)s''\}f' \\ \{2s' + (p - w - c^D)s''\}s + (w - c^U)[s'']^2 \end{pmatrix}$$

where

$$\begin{aligned} |E| &= \underbrace{(-f')}_{<0}\underbrace{(s'\epsilon)\{\lambda(2-\sigma) + n(1-\lambda)(1-\sigma)\}}_{<0} \\ &\quad + (1-\lambda)p[s']^2 \left\{(w - c^U) + (2-\sigma)\frac{s}{s'}\right\} \end{aligned}$$

is the determinant and is assumed to be negative with the additional assumption that $(w - c^U) + (2-\sigma)(s/s') < 0$.[5)] It is thus verified that $\partial p/\partial\lambda < 0$ and $\partial w/\partial\lambda < 0$ as above. However, whether $\partial n/\partial\lambda$ is positive or negative depends on the sign of

$$\underbrace{\{2s' + (p - w - c^D)s''\}s}_{<0} + \underbrace{(w - c^U)[s'']^2}_{>0},$$

5) This is further written as

$$w - c^U < \frac{(2-\sigma)[1 + \epsilon(1-\sigma)]}{\epsilon}$$

from the fact that $p/\epsilon = [1 + \epsilon(1-\sigma)]/\epsilon$.

although it is negative if $1 > s''/s'$ is satisfied because

$$
\begin{aligned}
& \{2s' + (p - w - c^D)s''\}s + (w - c^U)[s'']^2 \\
< \;& (2-\sigma)s's + (2-\sigma)\left(-\frac{s[s'']^2}{s'}\right) \\
= \;& (2-\sigma)s\left(s' - \frac{[s'']^2}{s'}\right),
\end{aligned}
$$

and $2 > \sigma$. Note that this is true if the demand is linear because $s'' = 0$. In sum, if the inequality above holds, the number of entering upstream firms is *smaller* if the common retailer is *more aggressive* in bargaining.

V Concluding Remarks

In this paper, I characterize the Nash bargaining division of the profits between upstream firms and a common retailer in terms of the industry's price elasticity (Proposition 1) and the different types of cost pass-through (Proposition 2). Lastly, note that Adachi (2020) exhibits how downstream competition can be incorporated in a model of vertical relationships to cast doubt on the plausibility of Galbraith's (1952) countervailing power. Further investigation, especially in relation to first- and second-order elasticities, would be fruitful (Adachi and Fabinger 2022; Adachi 2023).

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