Countervailing Power and Product Diversity

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Abstract

To analyse the effects of countervailing power on product variety, I construct a model in which a monopoly manufacturer sells a set of differentiated products through a large retailer and many small, competitive retailers. It is shown that an increase in the countervailing power of the large retailer tends to reduce the number of products manufactured in equilibrium, and the reduction in product variety may be accompanied by a fall in retail prices. Therefore, price changes, on which the existing theoretical analyses are focussed, do not tell the whole story about how consumers will be affected by countervailing power.

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1. Introduction

The tremendous success of powerful big-box retailers such as Wal-Mart, Home Depot and Staples has enhanced the interest in the effects of countervailing power. The term "countervailing power" was first used by Galbraith (1952) to describe the economic power developed by agents on one side of a market to counter the economic power exercised by agents on the other side of the market.[1] An example of countervailing power, according to Galbraith, was that of large chain stores at the time such as A&P and Sear Roebuck. By exercising countervailing power, these retailers were able to lower the prices they pay their suppliers and pass on these savings to their customers. Countervailing power has attracted more attention in recent years because the success of the big-box retailers has been partially attributed to their ability to obtain more favourable trade terms from their suppliers (see, for example, Vance and Scott 1994 page 92).

One of the major concerns expressed by some commentators is that rising retailer power may have adverse effects on product variety. They argue that manufacturers whose profit margins are squeezed by large retailers may be forced to reduce the number of products they

[1] In the words of Galbraith (1952), "To begin with a broad and somewhat too dogmatically stated proposition, private economic power is held in check by the countervailing power of those who are subject to it. The first begets the second. The long trend towards concentration of individual enterprise in the hands of a relatively few firms has brought into existence not only strong sellers, as economists have supposed, but also strong buyers as they fail to see. The two develop together, not in precise step but in such manner that there can be no doubt that the one is in response to the other."

offer.[2] Intuitively, such arguments make sense for the case of small manufacturers who make zero or close to zero economic profits. A squeeze on their margins by a powerful retailer can indeed force some of them to exit. In reality, however, the great majority of consumer products are produced by large manufacturers who, judging by their large market shares and lucrative accounting profits, are most likely earning positive economic profits.[3] It is not obvious that a reduction in profit margins of these manufacturers will cause them to withdraw products from which they still earn positive (albeit smaller) economic profits.

From a theoretical perspective, the situation where a small manufacturer facing a large retailer can be fitted into a model of monopsony power, on which much has been written. Countervailing power, on the other hand, is an appropriate description of the power wielded by large retailers against large manufacturers who themselves possess market power. To my knowledge there has been no formal analysis on the effects of countervailing power on product variety. Recent theoretical analyses of countervailing power (von Ungern-Sternberg 1996, Dobson and Waterson 1997, and Chen 2003) are all focussed on the price effects of countervailing power, that is, whether consumer prices will increase or decrease as a result of increased buyer power in the hands of retailers. Both von Ungern-Sternberg (1996) and Dobson

[2] For example, such concerns were expressed by some panellists at a workshop on slotting allowances organized by the US Federal Trade Commission (USFTC, 2001 page 24).

[3] Take the well-known example of ready-to-eat (RTE) breakfast cereals. In 1999 the top four brands (Kellogg's, General Mills, Post and Quaker Oats) had a combined market share of 89%. This market share number is not much different from the one reported in Scherer (1979 page 113) for the late 1960s. Scherer (page 114) also reports that accounting profits after taxes plus interest averaged 19.8% of assets for the RTE operations of the leading firms between 1958 and 1970, while the comparable figure for all manufacturing corporations was 8.7%.

and Waterson (1997) demonstrate, using a model of oligopolistic retailers, that a rise in countervailing power has ambiguous effect on consumer prices. Chen (2003), on the other hand, show that when the retail market structure is characterized by a dominant firms facing a competitive fringe, an increase in countervailing power does cause consumer prices to fall.

The purpose of this paper is to instill some theoretical rigour into the discussion on the effects of countervailing power on product variety. I model a situation where a large retailer competes against a group of small, competitive retailers. All retailers obtain their supplies of products from a monopoly manufacturer. The contract between the manufacturer and a retailer takes the form of two-part tariff. The manufacturer makes a take-it-or-leave-it contract offer to small retailers, but it has to negotiate a contract with the large retailer because the latter has countervailing power. The manufacturer chooses the number of differentiated products it wants to produce.

This analysis identifies two channels through which countervailing power affects product diversity, both tends to reduce the number of products offered by the manufacturer. The first channel is through the effect on the profitability of offering an additional product. A rise in countervailing power reduces the share of joint profit received by the manufacturer. If this also causes a decrease in the marginal profit of offering an additional product, product diversity will be reduced. The second, more subtle channel is through the wholesale prices paid by the small retailers. A rise in countervailing power reduces the manufacturer's profitability of selling to the large retailer. In response, the manufacturer increases the sales through small retailers by lowering their wholesale prices. This, in turn, causes the equilibrium retailer prices to fall. Lower retail prices may allow the manufacturer to withdraw a product without a significant loss in sales because a consumer who has to purchase a product further away from his ideal choice may be compensated by the lower prices.

2. The Model

The situation to be studied is one where a manufacturer produces a set of differentiated products that are sold through competing retailers to final consumers. There are two types of retailers. The first type are small retailers who have no market power against either the manufacturer or downstream consumers. The other type is a large retailer who possesses countervailing power against the manufacturer and market power over consumers. The retail services provided by the two types of retailers are differentiated in the eyes of consumers.

To model the above situation, suppose that (n+1) retailers are located at the two ends of a straight line of unit length. One of these retailers is large and is located at address 0. The remaining n retailers are small and are all located at address 1. Consumers are uniformly located along the line. The density of consumers at each location on the line is denoted by μ.

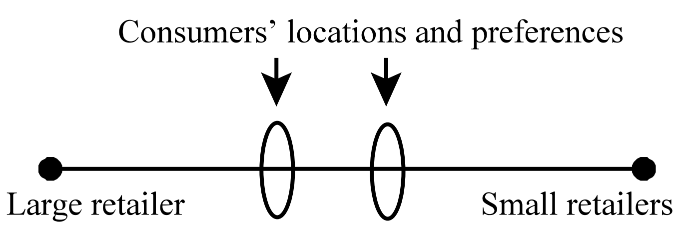

Figure 1.

Furthermore, consumers at each location have heterogenous preferences over different product variants. Such preferences are represented by points along Salop's (1979) circular road (hereafter the "Salop Circle"). The circumference of the circle is equal to 1 and consumers' most preferred products are uniformly distributed along the circle. Therefore, each consumer has a most-preferred product, and he will have to incur a mismatch cost if he buys a different product. To purchase any product, moreover, he has to travel to a retailer, thus incurring a transportation cost. This situation is illustrated in Figure 1.

Suppose each consumer buys at most a unit. Consider a consumer who is located at address a on the line and whose most preferred product is v. His utility from buying a unit of product x_j at price P_j from a retailer located at r_i (i = 0, 1) is:

$$U_{av} = V - \tau|v - x_j| - P_j - t|a - r_i| \qquad \textbf{(1)}$$

In (1) $\tau|v - x_j|$ represents the mismatch cost and $t|a - r_i|$ the transportation cost. The unit transportation cost t measures the degree of competition between the large retailer and small retailers.

On the technology side, the cost of producing a unit of a differentiated product is constant and normalized to zero. The manufacturer has to incur a fixed cost θ for each product it produces. The total cost of producing m products, then, is $m\theta$. In addition to paying the manufacturer for the products it wants to sell, a retailer also has to incur a retailing cost for each unit sold. Let C_L be the per unit retailing cost of the large retailer, and C_S that of a small retailer. Assume that $C_L < C_S$; that is, the large retailer is more efficient than a small retailer. This assumption on cost difference is motivated by the assumed difference in size and market power of these retailers. The large retailer has become large and gained market power because it is more efficient than all other retailers.

The manufacturer and the retailers play the following four-stage game. At stage 1 the manufacturer chooses the number of products to be produced and the locations of these products on the Salop Circle. At stage 2 the manufacturer announces a take-it-or-leave-it contract for all small retailers. At stage 3 the manufacturer and the large retailer negotiate a contract. At stage 4 retailers compete in prices and consumers make their purchase decisions.

The contract between the manufacturer and a retailer of type i ($i = S, L$) takes the form of a two-part tariff, (W_{ij}, F_{ij}), where W_{ij} is the per unit wholesale price and F_{ij} the lump sum fee for product j.

3. Subgame Perfect Equilibrium

To simplify presentation, note at the outset the following symmetry property of a subgame perfect equilibrium. That is, in equilibrium the manufacturer will choose to locate its products symmetrically along the Salop Circle and charge a retailer the same wholesale price for all products. This is because consumers' preferences over variety are uniformly distributed along the circle, and, as a result, every product enters the manufacturer's profit function in a symmetric way. Hence, in the following analysis we focus on just one representative product and drop the subscript j in the contract between the manufacturer and a retailer and write (W_i, F_i).

In this section we will discuss only the equilibrium where both types of retailers are active and all consumers are served. In the next section we will consider the possibilities that smaller retailers, because of their higher retailing costs, make no sales and that some consumers, because of their high mismatch costs, are not served.

Each consumer in this model has two purchase-related decisions to make: which product to buy and from which retailer to buy. Since the mismatch cost and the transportation cost are separable in the consumer's utility function, he can make these decisions separately. That is, he can first decide which retailer to patronize, and then once there choose which product to buy. First, consider the consumer's choice of retailer. He can either buy from the large retailer or from a small retailer. Given the assumption that both the large and small retailers make positive sales, the marginal consumer who is indifferent between the two types of retailers is determined by the condition: $P_{jL}+ta = P_{jS}+t(1-a)$. Solve this equation for a,

$$a_c = \frac{1}{2} + \frac{P_{jS}-P_{jL}}{2t}. \tag{3}$$

Consumers located in the interval $[0, a_c)$ buy from the large retailer while consumers located in the interval $(a_c, 1]$ buy from the small retailers.

Second, consider the consumer's choice of product. Given the assumption that every consumer is served, the marginal consumer who is indifferent between product x_j and product x_{j+1}

is determined by $\quad P_j + \tau(x_{jc+} - x_j) = P_{j+1} + \tau(x_{j+1} - x_{jc+}),\quad$ where x_{jc+} is this consumer's most

preferred point on the circle. Solving this equation to obtain:

$$x_{jc+} = \frac{P_{j+1} - P_j}{2\tau} + \frac{x_{j+1} - x_j}{2}. \tag{5}$$

Using the same method, we can solve the position of the marginal consumer between product x_j and product x_{j-1}, denoted by x_{jc-}. The fraction of consumers who buy product j then is equal to

$$x_{jc+} - x_{jc-} = \frac{P_{j+1} + P_{j-1} - 2P_j}{2\tau} + \frac{x_{j+1} - x_{j-1}}{2}. \tag{6}$$

The demand for product j facing the large retailer is then equal to

$$Q_{jL} = \mu a_c(x_{jc+} - x_{jc-}) = \mu[\frac{1}{2} + \frac{P_{jS} - P_{jL}}{2t}][\frac{P_{j+1} + P_{j-1} - 2P_j}{2\tau} + \frac{x_{j+1} - x_{j-1}}{2}]. \tag{7}$$

The aggregate demand for product j facing all small retailers is:

$$Q_{jS} = \mu(1 - a_c)(x_{jc+} - x_{jc-}) = \mu[\frac{1}{2} + \frac{P_{jL} - P_{jS}}{2t}][\frac{P_{j+1} + P_{j-1} - 2P_j}{2\tau} + \frac{x_{j+1} - x_{j-1}}{2}]. \tag{8}$$

In the equilibrium at stage 4, price competition among small retailers drives their retail prices to marginal costs, that is, $P_{jS} = W_S + C_S$. Anticipating this, the large retailer solves the following profit-maximization problem,

$$\max_{P_{jL}} \pi_L = \sum_{j=1}^{m} [(P_{jL}-C_L-W_L)\mu(\frac{1}{2}+\frac{W_S+C_S-P_{jL}}{2t})(\frac{P_{(j+1)L}+P_{(j-1)L}-2P_{jL}}{2\tau}+\frac{1}{m})-F_L] \qquad \textbf{(9)}$$

Solving the first order conditions we can obtain the prices charged by the large retailer,

$$P_{jL} = P_L = \frac{t+W_S+C_S+W_L+C_L}{2} \quad \text{for all } j = 1,2,...m. \qquad \textbf{(10)}$$

At stage 3, the manufacturer and the large retailer negotiate the contract (W_L, F_L). In this model we follow Nash's axiomatic approach to bargaining problem and suppose that the contract resulted from the negotiation process satisfies the following two properties:

(1) the contract is efficient in the sense that the surplus (joint profit) from this transaction is maximized; and

(2) the surplus from this contract is divided according to the sharing rule γ.

Property (1) can be justified by that renegotiation would take place if joint profit were not maximized. Property (2) represents the idea of countervailing power. It is reasonable to expect that the large retailer will receive a larger share of the surplus if it gains more countervailing power against the manufacturer. The parameter γ, therefore, measures the amount of countervailing power of the large retailer.[4] It is assumed that $\gamma \in (0, 1)$.

[4] The same approach is used in Chen (2003).

Using (7) and (10), one can write the joint profit from the transaction between the large retailer and the manufacturer as:

$$\Pi = \sum_{j=1}^{m} (P_{jL} - C_L) Q_{jL} = \frac{\mu}{8t}[(t + W_S + C_S - C_L)^2 - W_L^2]. \tag{11}$$

It is easy to show that to maximize (11) it must be true that $W_L = 0$. This implies that the manufacturer and the large retailer will set the wholesale price at the marginal cost of production (which has been normalized zero). This result is not surprising because of the presence of double-markup problem in this situation. The manufacturer, therefore, extracts profit from the large retailer in the form of fixed fees:

$$F_L = (1-\gamma)\frac{\Pi}{m} = \frac{(1-\gamma)\mu}{8tm}(t + W_S + C_S - C_L)^2. \tag{12}$$

At stage 2, the manufacturer sets W_S and F_S. In equilibrium the value of F_S is set at zero because competition among small retailers forces their retail prices down to marginal costs, *i.e.* $P_S = W_S + C_S$. As a result, it is not possible to impose a positive fixed fee that would allow the small retailers break-even. The manufacturer has no incentives to make a lump-sum payment to the retailers (i.e. $F_S < 0$), either. Consequently, $F_S = 0$. The manufacturer then sets W_S to maximize its total profits from both types of retailers.

To derive the total profit of the manufacturer, use (10) to rewrite (8), the demand for product *j* facing all small retailers:

$$Q_{jS} = \frac{\mu}{4tm}(3t - W_S - C_S + C_L). \quad \textbf{(13)}$$

The manufacturer's total profit can then be written as:

$$\pi_M = mF_L + \sum_{j=1}^{m} W_S Q_{jS} - m\theta = \frac{\mu}{8t}[(1-\gamma)(t + W_S + C_S - C_L)^2 + 2W_S(3t - W_S - C_S + C_L)] - m\theta. \quad \textbf{(14)}$$

Maximizing the above function by choosing W_S, one obtains,

$$W_S^* = \frac{(4-\gamma)t - \gamma(C_S - C_L)}{1+\gamma}. \quad \textbf{(15)}$$

Using (3), (10) and (15), we derive the equilibrium values of P_L and a_c:

$$P_L^* = \frac{5t + C_S + (1+2\gamma)C_L}{2(1+\gamma)}; \quad a_c^* = \frac{5t + C_S - C_L}{4t(1+\gamma)}. \quad \textbf{(16)}$$

Recall that all the results so far are derived under the assumption that both types of retailers are active. This implies that $a_c^* < 1$, or equivalently, $(4\gamma - 1)t > C_S - C_L$. In other words, the above equilibrium prevails only if $\gamma > 1/4$ and $t > (C_S - C_L)/(4\gamma - 1)$.

At stage 1 the manufacturer chooses the number of products. Using the above solution for W_S, we can write the manufacturer's profit as:

$$\pi_M = \frac{\mu}{8t(1+\gamma)^2}\{(1-\gamma)(5t+C_S-C_L)^2+2[(4-\gamma)t-\gamma C_S+\gamma C_L][(4\gamma-1)t-C_S+C_L]\} - m\theta. \quad \textbf{(17)}$$

It is clear that π_M is decreasing in m, the number of products. This implies that the manufacturer will choose the smallest possible m. Note, however, that a reduction in the number of products will increase the mismatch costs of consumers. Given the retail prices, some consumers may stop buying if the number of products is too small. If the manufacturer wants to have every consumer served, it will choose the smallest m such that the surplus of the consumer with the highest transportation and mismatch costs is zero or is close to zero. That consumer is located at a_c and his mismatch cost is τ/2m. Therefore, in an equilibrium where all consumers are served, the number of products is the smallest integer that satisfies $V - \tau/2m - ta_c^* - P_L^* \geq 0$. Using (16) to solve this inequality we obtain,

$$m^* \geq \frac{2(1+\gamma)\tau}{4(1+\gamma)V-15t-3C_S-(1+4\gamma)C_L} \quad \textbf{(18)}$$

4. Effects of Countervailing Power

While the analysis in the previous section is done only for the scenario where both types of retailers are active and all consumers are served, other equilibrium scenarios are possible under certain conditions. For completeness, the effects of countervailing power on product variety will be analysed for all possible scenarios. Specifically, there are a total of four scenarios we need to consider:

(1) both types of retailers are active and all consumers are served;

(2) only the large retailer is active and all consumers are served;

(3) only the large retailer is active and some consumers are not served;

(4) both types of retailers are active and some consumers are not served.

It turns out that scenario 2 will not arise in equilibrium. Therefore, we will combine the discussion of scenarios 2 and 3 in the same subsection.[5]

Recall that the countervailing power of the large retailer is measured by the parameter γ. Therefore, here we consider how a change in γ affects the equilibrium.

4.1. Both types of retailers are active and all consumers are served

In this case the effects of countervailing power can be determined from equations (15), (16) and (18).

Proposition 1. Suppose both types of retailers are active and all consumers are served in equilibrium. An increase in γ reduces W_S*, a_c*, P_L* and P_S*. In other words, an increase in the countervailing power of the large retailer will reduce the wholesale prices paid by small retailers, the market share of the

[5] There is no need to consider the scenario where the large retailer is not active. Because the large retailer is more efficient and $\gamma < 1$, the manufacturer always wants to make some sales through the large retailer.

large retailer, and all retail prices.

Proof: By inspection of (15) and (16) it is obvious that $\partial W_S^*/\partial\gamma < 0$ and $\partial a_c^*/\partial\gamma < 0$. A reduction in W_S^* causes P_S^* to fall because $P_S = W_S + C_S$ in equilibrium. Differentiation of P_L^* in (16) yields:

$$\frac{\partial P_L^*}{\partial\gamma} = -\frac{5t+C_S-C_L}{2(1+\gamma)^2} < 0. \qquad \textbf{(19)}$$

QED

The intuition behind Proposition 1 is as follows. An increase in the countervailing power of the large retailer reduces the share of joint profit received by the manufacturer. In response, the manufacturer boosts the sales through small retailers by reducing their wholesale prices. This reduces the large retailer's market share and causes the retail prices to fall.[6]

The analysis of product variety is complicated by the fact that *m* is an integer, and as such it changes discretely. Accordingly, a small increase in γ may have no effect on *m*; only a sufficiently large change in γ will cause a discrete change in *m*. As a result, we can only talk about the tendency of *m* to change in response to a small change in γ.

Proposition 2. Suppose that both types of retailers are active and all consumers are served in equilibrium. An increase in the countervailing power of the large retailer tends to

[6] These effects of countervailing power are similar to those in Chen (2003).

reduce the equilibrium number of products. The tendency is stronger when the unit transportation cost (t) or the unit mismatch cost (τ) is larger.

Proof: Define the right-hand side of (18) as N(γ, t, τ). It is straightforward to show that

$$\frac{\partial N}{\partial \gamma} = -\frac{\tau(15t+3C_S-3C_L)}{8(1+\gamma)^2(V-P_L^*-ta_c^*)^2} < 0 \tag{20}$$

Thus, an increase in γ reduces N and relaxes the constraint on m in (18).

$$\frac{\partial^2 N}{\partial t \partial \gamma} = -\frac{15\tau}{8(1+\gamma)^2}\left[\frac{1}{(V-P_L^*-ta^*)^2}+\frac{15t+3C_S-3C_L}{2(1+\gamma)(V-P_L^*-ta^*)^3}\right] < 0. \tag{21}$$

$$\frac{\partial^2 N}{\partial \tau \partial \gamma} = -\frac{(15t+3C_S-3C_L)}{8(1+\gamma)^2(V-P_L^*-ta_c^*)^2} < 0 \tag{22}$$

These negative derivatives imply that as t (or τ) increases, the effect of γ on N, which is negative, becomes larger.

QED

It is useful to note the channel through countervailing power affects the product variety.

Given that the model's parameters are within the range where all consumers are served in equilibrium, marginal profit from an additional variety is zero at $m = m^*$ for the manufacturer (see equation (17)). A small increase in the retailer's countervailing power has no effect on that marginal profit. In fact, the tendency to reduce the number of products in response to increased countervailing power is directly related to the fall in retail prices. In the case we study here, the manufacturer picks just the minimum number of products that keeps every consumer served. Lower retail prices relaxes this constraint. This may allow the manufacturer to remove a product without losing any consumers.

4.2. Only the large retailer is active.

From section 3 we know that only the large retailer will be active if its countervailing power is not too large ($\gamma < 1/4$) or if there is fierce competition between the two types of retailers ($t < (C_S - C_L)/(4\gamma-1)$). In such a situation, the manufacturer and the large retailer are bilateral monopoly. With the help of two-part tariff, the manufacturer and the large retailer can act as a joint monopolist and maximize the joint profit from the whole market.

The first issue that needs to be determined in this case is whether the joint monopolist will want to have all consumers served.

Lemma 1. In an equilibrium where only the large retailer is active in equilibrium, some consumers are not served.

Proof: If the joint monopolist wants to keep all consumers served, the retail price will be set in such a way that the surplus of the consumer with the highest transportation and mismatch cost falls to zero. Since none of the small retailers are active, this consumer is located at address 1 and has a mismatch costs of $\tau/2m$. Thus, this limit price that keeps all consumers served is: $P_{jL}' = V - t - \tau/2m$.

The proof then will proceed as follows. We will first derive the joint profit of the manufacturer and the large retailer under the assumption that some consumers are not served. Then we will show that at the retailer price P_{jL}', the total profit is an increasing function of retail price, implying that the retailer will set a higher price.

Let a_1 be the solution to $V - ta_1 - \tau/2m - P_{jL} = 0$. Then given retail price P_{jL}, all consumers located in the interval $[0, a_1]$ are served, but some consumers located in the interval $(a_1, 1]$ are not. Then the total demand for product j is,

$$\begin{aligned} Q_j &= \int_0^{a_1} \mu(x_{jc+} - x_{jc-})da + \int_{a_1}^{1} \frac{2\mu}{\tau}(V - P_{jL} - ta)da \\ &= \frac{\mu}{t}(V - \frac{\tau}{2m} - P_{jL})[\frac{P_{(j+1)L} + P_{(j-1)L} - 2P_{jL}}{2\tau} + \frac{1}{m}] + \frac{\mu}{t\tau}[\frac{\tau^2}{4m^2} - (V - P_{jL} - t)^2]. \end{aligned} \tag{23}$$

The joint profit is equal to $\Pi = \sum_{j=1}^{m} (P_{jL} - C_L)Q_{jL}$. The first-order condition for the joint-profit maximization, after using $P_{jL} = P_L$ for all $j = 1, ..., m$, is

$$\frac{\partial \Pi}{\partial P_{jL}} = Q_j + \frac{2\mu(P_L - C_L)}{\tau t}[V - P_L - t - \frac{\tau}{2m}] = 0. \tag{25}$$

Evaluating the above derivative at P_{jL}', we obtain $\partial\Pi/\partial P_{jL} = \mu/m > 0$. This implies that the solution to (25) will be greater than P_{jL}'.

QED

In the standard model of bilateral monopoly with two-part tariff, a change in the distribution of total profit has no effect on equilibrium price and quantity. In our model, however, this is not necessarily true.

Proposition 3. Suppose only the large retailer is active in equilibrium. An increase in the countervailing power of the large retailer tends to reduce the number of products offered. Countervailing power has no effect on retailer prices unless it changes the number of products. Retail prices fall with the reduction in the number of products if $V > \tau/2 + 2t + C_L$.

Proof: Let P_L^s be the solution to the first-order condition (25) and Π^s the resulting maximum of joint profit. The profit of the manufacturer can then be written as:

$$\pi_M = (1-\gamma)\Pi^s - m\theta = (1-\gamma)m(P_L^s - C_L)\frac{\mu}{t\tau}\left[\frac{\tau}{m}\left(V - \frac{\tau}{2m} - P_L^s\right) + \frac{\tau^2}{4m^2} - (V - P_L^s - t)^2\right] - m\theta. \quad \textbf{(26)}$$

If we treat m as a continuous variable, we can use the Envelope Theorem to derive the manufacturer's optimization condition with regard to product variety:

$$\frac{\partial\pi_M}{\partial m} = (1-\gamma)(P_L^s - C_L)\frac{\mu}{t\tau}\left[\frac{\tau^2}{4m^2} - (V - P_L^s - t)^2\right] - \theta = 0. \quad \textbf{(27)}$$

Comparative statics on the above condition yields,

$$\frac{\partial m}{\partial \gamma} = -\frac{\mu}{(\partial^2\pi_M/\partial m^2)t\tau}\left[\frac{\tau^2}{4m^2}-(V-P_L^s-t)^2\right] < 0. \tag{28}$$

The sign of the above derivative is determined using the second-order condition for the manufacturer's profit-maximization problem and that $P_L^s > P_{jL}'$. If m were a continuous variable, it would be a decreasing function of γ. In fact, m is an integer. Equation (28) then implies that an increase in countervailing power tends to reduce the number of products manufactured in equilibrium.

To determine the effects on retail prices, note that equation (25) is independent of γ. Thus, countervailing power can affect equilibrium retail prices only through a change in m. Comparative statics on (25) yields,

$$\frac{\partial P_L^s}{\partial m} = -\frac{\mu}{tm^2(\partial^2\Pi/\partial P_{jL}^2)}\left[2P_L^s-V-C_L+\frac{\tau}{2m}\right]. \tag{29}$$

The condition $V > \tau/2 + 2t + C_L$ implies that $P_{jL}' > (1/2)[V + C_L - \tau/2m]$. Since $P_L^s > P_{jL}'$, we have $[2P_L^s - V - C_L + \tau/2m] > 0$. The second-order condition for the joint profit maximization problem and (29) then imply that $\partial P_L^s/\partial m > 0$.

QED

Intuitively, the analysis of this case highlights another channel through which countervailing power affects product diversity. When some consumers are not served, the manufacturer's profit from an additional product is tied directly to m. An increase in countervailing power lowers the manufacturer's marginal profit from an additional product and thus reduces the incentive to produce more products.[7]

4.3. Both types of retailers are active and some consumers are not served

The analysis on this third and final case allows us to unify the results obtained from subsections 4.1 and 4.2. These results suggest two sources of incentives that cause the manufacturer to reduce product diversity in response to rise in countervailing power. The first one is the consequence of lower wholesale prices for small retailers. And the second one is the direct result of lower marginal profit from offering an additional product. As will be shown below, both incentives are at work in this third case,

Based on the above analysis, it is not difficult to determine the equilibrium conditions at each of the four stages of the game. The key difference between the analysis here and that in subsection 4.1 is that here the demand for each product facing the retailers is always a function of m. In the equilibrium at stage 4, competition among small retailers ensures that $P_S = W_S + C_S$. The price of the large retailer, on the other hand, depends on W_L, W_S, and m, denoted by $P_L(W_L, W_S, m)$. At stage 3, because of the double-markup problem, the wholesale price of the large retailer remains at marginal cost, *i.e.* $W_L = 0$. At stage 2, the manufacturer chooses W_S to

[7] Note that the channel discussed in subsection 4.1 is not present here because the small retailers are not active.

maximize its profit, which yields W_S as a function of m and γ, denoted by $W_S(m, \gamma)$. Using these results, we can write the profit function of the manufacturer at stage 1 as:

$$\pi_M(m,\gamma) = I_M(W_S(m,\gamma),m,\gamma) - m\theta. \tag{30}$$

where $I_M(W_S, m, \gamma)$ is the firm's gross profit before the fixed costs of variety are deducted.[8] The analysis in the previous two subsections suggests that I_M changes with m as long as $m < m^*$. If $m \geq m^*$, on the other hand, all consumers will be served and (30) will be the same as (14), in which case I_M is independent of m.

For ease of discussion, treat m as a continuous variable. Function $\pi_M(m, \gamma)$ is continuous but not differentiable at $m = m^*$. Equation (30) implies that some consumers will be left unserved in equilibrium if

$$\lim_{m \to m^{*-}} \left[\frac{\partial I_M}{\partial W_S}\frac{\partial W_S}{\partial m} + \frac{\partial I_M}{\partial m}\right] < \theta. \tag{31}$$

In other words, if the left-side limit of marginal profit from an additional product at $m = m^*$ is less than the fixed costs of adding an additional product, the manufacturer will produce fewer than m^* products and leave some consumers unserved.

[8] The specific form of $I_M(W_S, m, \gamma)$ is yet to be worked out.

Suppose condition (31) holds.[9] The manufacturer's profit-maximizing m satisfies:

$$\frac{\partial I_M}{\partial W_S}\frac{\partial W_S}{\partial m} + \frac{\partial I_M}{\partial m} = \theta. \tag{32}$$

An increase in γ will affect this condition through two channels, as represented by the two terms on the left-hand side of (32) . The first term represents the channel identified in subsection 4.1. That is, an increase in countervailing power will encourage the manufacturer to lower small retailers' wholesale prices. The second term represents the channel discussed in subsection 4.2. That is, an increase in countervailing power will directly lower the marginal profit of an additional variety.

Notice that in the case analysed in subsection 4.1. the second term in (32) is identically equal to 0 because I_M is independent of m. Thus, the second effect does not exist. In the case studied in subsection 4.2, the first term is absent because the small retailers are not active. Only in this third case both of these two effects are present.

5. Concluding Remarks

This paper is a work in progress. The preliminary analysis shows that an increase in the countervailing power of a large retailer tends to reduce the number of products manufactured in equilibrium. This reduction in product variety may be accompanied by a fall in retail prices.

[9] Intuitively, we expect that this condition will hold if μ (the density of consumers at each location) is small relative to θ. The exact condition will be derived later as the work on this paper continues.

Therefore, the existing theoretical analyses that are focussed on the price effects of countervailing power do not tell the whole story. The gains to consumers brought about by lower prices may be offset, at least partially, by the reduction in product variety.

References

Chen, Zhiqi (2003) "Dominant Retailers and the Countervailing Power Hypothesis," *RAND Journal of Economics*, vol. 34, No. 4, Winter 2003

Dobson, P.W. and M. Waterson (1997) "Countervailing Power and Consumer Prices," *Economic Journal*, 107: 418 - 430

Economides, N. (1989) "Symmetric Equilibrium Existence and Optimality in Differentiated Product Market," *Journal of Economic Theory*, 47 (1989), 178 - 194

Galbraith, J.K. (1952) *American Capitalism: The Concept of Countervailing Power*, New York: Houghton Mifflin

Salop, S.C. (1979) "Monopolistic Competition with Outside Goods," *Bell Journal of Economics*, 10: 141 - 56

Scherer, F.M. (1979) "The Welfare Economics of Product Variety: An Application to the Ready-to-Eat Cereals Industry," *The Journal of Industrial Economics*, vol. 28, No. 2, December 1979, 113 - 134

Schmalensee, R. (1978) "Entry Deterrence in the Ready-to-Eat Breakfast Cereal Industry," *Bell Journal of Economics*, 9 (1978): 305 - 327

USFTC (2001) "Report on the Federal Trade Commission Workshop on Slotting Allowances and Other Marketing Practices in the Grocery Industry," February 2001

Vance, S.S. and R.V. Scott (1994) *Wal-Mart: A History of Sam Walton's Retail Phenomenon*, New York: Twayne Publishers

von Ungern-Sternberg, T. (1996) "Countervailing Power Revisited," *International Journal of Industrial Organization*, 14: 507 - 20