

Monopoly and Product Diversity: The Role of Retailer Countervailing Power

by

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Abstract

We analyse a monopolist's choice of product diversity and the effects of retailer countervailing power on that choice. We show that monopoly causes distortion in product diversity even after we take into consideration the effects of monopoly pricing. Specifically, the number of differentiated goods produced by the monopolist is smaller than that of the constrained social optimum. Retailer countervailing power lowers consumer prices but reduces product diversity. Consequently, it alleviates the distortion in prices but exacerbates the distortion in product diversity. In our model the former is outweighed by the latter and countervailing power makes consumers worse off. Therefore, price changes do not tell the whole story about how consumers are affected by countervailing power.

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1. Introduction

Does the market produce socially optimal product diversity? This question has typically been analysed in a framework of monopolistic competition. Chamberlin (1933 page 94) suggested that monopolistic competition equilibrium is “a sort of ideal.” This idea was rigorously examined by Dixit and Stiglitz (1977) and Spence (1976) using models based on a representative consumer formulation. They demonstrate that the equilibrium number of differentiated products can be higher or lower than that of the (constrained) social optimum. The same point is made by Salop (1979) using a model based on spatial competition. Since then both types of models (*i.e.*, representative consumer and spatial competition) have been refined and extended by numerous authors (see, for example, Sattinger 1984, Hart 1985, Perloff and Salop 1985, Jones 1987, Deneckere and Rothschild 1992, Yang and Heijdra 1993, and Anderson *et al.* 1995).

In contrast, the literature on product diversity for the case of monopoly is much thinner. It includes Lancaster (1975), White (1977), Holahan (1978), Katz (1980), and de Meza and von Ungern-Sternberg (1982).¹ Parallel to the monopolistic competition literature, one conclusion from these analyses is that the number of products supplied by a monopolist can be either higher or lower than that of the social optimum (see, in particular, de Meza and von Ungern-Sternberg 1982). It is interesting to note that all of these analyses are based on the spatial competition formulation.² To the best of our knowledge, the Dixit-Stiglitz-Spence representative consumer

¹ Here we only consider the literature on horizontal differentiation. A monopolist’s choice of vertically differentiated products is studied by, for example, Spence (1975), Mussa and Rosen (1978), Gabszewicz *et al.* (1986), and Donnenfeld and White (1988).

² Also worth noting is that some of these analyses, namely Holahan (1978 pages 157 - 158) and Katz (1980 page 531), have emphasized the limited applicability of their models to the issue of product diversity.

approach has not been used to study product diversity in the monopoly case despite its popularity in other areas of economics.³

A common assumption shared by all studies of product diversity cited above is that producers sell their products to consumers directly. In reality, of course, consumer goods are typically sold through retailers. Nevertheless, as a way to simplify analysis this assumption is reasonable provided that retailers are sufficiently small that they have no strategic influence on either equilibrium prices or product diversity.

This last proviso, however, is no longer true today in a retail landscape dominated by large, powerful retail organizations such as Wal-Mart, Home Depot and Staples. The tremendous success of these big-box retailers has enhanced the interest in the effects of retailer countervailing power. The term “countervailing power” was first coined 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.⁴ An example of countervailing power, according to Galbraith, was that of large chain stores at the time (*e.g.*, A&P and Sears Roebuck). By exercising countervailing power, these retailers were able to lower the prices they pay their suppliers. In recent years countervailing power has attracted more

³ Applications of the Dixit-Stiglitz-Spence framework can be found in international trade (*e.g.* Krugman 1980, Ethier 1982, and Grossman and Helpman 1989), growth theory (Romer 1990), and macroeconomics (*e.g.* Blanchard and Kiyotaki 1987).

⁴ In the words of Galbraith (1952), “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.”

attention because the success of the big-box retailers has also been partially attributed to their ability to obtain more favourable trade terms from their suppliers (see, for example, Vance and Scott 1994 page 92).

While many commentators have argued that retailer countervailing power benefits consumers, others have expressed concerns over the longer term effects of such power on product diversity. In particular, they are concerned about that the squeeze on manufacturers' profit margins by large retailers may lead to reduced product choices for consumers (see, for example, Dobson and Waterson 1999, OECD 1999, and USFTC 2001). Such concerns, however, have not been subject to much theoretical analysis in the economics literature. Most of the recent theoretical studies of countervailing power (von Ungern-Sternberg 1996, Dobson and Waterson 1997, Chen 2003, and Erutku 2004) have focussed on the price effects, that is, whether consumer prices will increase or decrease as a result of increased buyer power in the hands of retailers. The only formal analysis that considers the issue of product diversity is by Inderst and Shaffer (2004), who study the impact of a retail merger on product diversity. They show that after a merger of two retailers, the merged entity may have an incentive to delist a product in order to enhance its buyer power. Their treatment of product diversity, however, is rather limited as there are only two products and each retailer sells only one product in their model.

The objective of this paper is to analyse a monopolist's choice of product diversity and how that choice is affected by retailer countervailing power. Among the questions of particular interest are:

- (1) Does the monopolist choose the right product diversity? In particular, does its choice of product diversity cause additional efficiency losses over and above the distortion

arising from monopoly pricing? and

(2) Does retailer countervailing power alleviate or exacerbate the efficiency losses of monopoly?

To answer these questions, we construct a model where a monopolist manufacturer produces and sells a number of differentiated goods to consumers in several retail markets. Consumer preferences are represented by a Dixit-Stiglitz-Spence utility function. Using this model we first consider a benchmark case where the monopolist is vertically integrated into the retail markets and sells directly to consumers. Then we analyse the equilibrium in a situation where the manufacturer sells its products through a retailer in each market and study the effects of an increase in retailer countervailing power.

Our analysis shows that monopoly causes distortion in product diversity even after we take into consideration the effects of monopoly pricing. Specifically, the number of differentiated products offered by the vertically integrated monopolist is smaller than that of the constrained social optimum. Retailer countervailing power lowers consumer prices but reduces product diversity. Consequently, retailer countervailing power alleviates the distortion in prices but exacerbates the distortion in product diversity. In our model the former is outweighed by the latter and countervailing power makes consumers worse off. Social welfare is reduced as well because of the fall in both consumers' welfare and firms' profits. Retailer countervailing power, therefore, is not a remedy for monopoly power.

The paper is organized as follows. The model is presented in section 2. The benchmark case where the manufacturer sells directly to consumers is studied in section 3, while the effects of retailer countervailing power are analysed in section 4. Section 5 concludes.

2. The Model

We consider a situation where a monopolist producer manufactures n differentiated products and sells these products to consumers in m identical geographic markets. Following Dixit and Stiglitz (1977), we assume that the preferences of a representative consumer in each market are captured by the utility function:

$$u = U\left(x_0, \left\{\sum_{i=1}^n x_i^\rho\right\}^{1/\rho}\right), \quad (1)$$

where x_0 is the quantity of a numeraire good and x_i ($i = 1, 2, \dots, n$) is the quantity of differentiated product i . Let y denote the second argument in U . Following Dixit and Stiglitz (1977), we assume that $\rho < 1$ and that U is homothetic and concave in x_0 and y . Let the price of the numeraire good be one, p_i be the price of differentiated product i , and I be the representative consumer's income. Then the consumer's budget constraint is: $x_0 + \sum_{k=1}^n p_k x_k = I$. The first-order condition of the consumer's utility maximization problem is:

$$p_i \frac{\partial U}{\partial x_0} = \left\{\sum_{k=1}^n x_k^\rho\right\}^{1/\rho-1} x_i^{\rho-1} \frac{\partial U}{\partial y}, \quad (i = 1, 2, \dots, n). \quad (2)$$

It has been derived by Dixit and Stiglitz (1977 page 299) that when all differentiated products are sold at the same price p , the demand for product i solved from (2) can be written in the form

$$x_i = x(p, n) = \frac{Is(q)}{pn}, \quad (3)$$

where $s(q)$ is a function that depends on the form of U , and q is a price index defined as:

$$q = \left\{ \sum_{k=1}^n p_k^{-\rho/(1-\rho)} \right\}^{-(1-\rho)/\rho} = pn^{-(1-\rho)/\rho}. \quad (4)$$

Since all n differentiated products are symmetric in the consumer's utility function, in equilibrium the manufacturer and retailers will treat them symmetrically. We will thus drop the subscript i in x_i and p_i .

Substituting (3) and the consumer's budget constraint into (1) we can write the consumer's indirect utility function as

$$V(p, I, n) = U[I - np x(p, n), n^{1/\rho} x(p, n)]. \quad (5)$$

The function $V(p, I, n)$ will be used to measure consumer welfare. Using the envelope theorem, we can easily show that $\partial V/\partial p < 0$ and $\partial V/\partial I > 0$. Moreover, we have

$$\frac{\partial V}{\partial n} = \frac{px(1-\rho)}{\rho} \left(\frac{\partial U}{\partial x_0} \right) > 0, \quad (6)$$

that is, consumers benefit from more product diversity, *ceteris paribus*.

By assuming that profits are distributed evenly to the representative consumers in m markets, we can rewrite (5) to obtain a social welfare function:

$$W(p, n) = V(p, I_0 + \Pi_T/m, n) = U[I_0 + \Pi_T/m - np x(p, n), n^{1/\rho} x(p, n)], \quad (7)$$

where Π_T is the joint profits of the manufacturer and all retailers and I_0 is the consumer's income from other sources. In (7) Π_T is divided by m because U is the utility of the representative consumer in one of m markets.

Let $\theta(q)$ be the elasticity of the function $s(q)$, *i.e.*, $-qs'(q)/s(q)$. As will be elaborated below in section 3, we assume $s' < 0$ in order to ensure the existence of an interior solution to the standard monopoly pricing problem.⁵ This assumption implies that $\theta(q) > 0$. Furthermore, we assume that

$$\theta(q) < \frac{\rho}{1-\rho}. \quad (8)$$

As shown in Dixit and Stiglitz (1977 page 299), (8) is needed to ensure that the Chamberlinian dd curve is more elastic than the DD curve (Chamberlin 1933).

The above assumptions imply that

$$\frac{\partial x}{\partial p} = - \frac{Is(\theta+1)}{np^2} < 0, \quad (9)$$

i.e., the demand curve represented by (3) is downward sloping, and that

$$\frac{\partial x}{\partial n} = \frac{Is[\theta(1-\rho)/\rho-1]}{n^2p} < 0, \quad (10)$$

i.e., demand for each product is smaller when the number of products increases. Note that (8) is crucial in determining the sign of (10).

On the production side, each differentiated product is manufactured at constant marginal cost, normalized to zero. In addition, the production of each product involves a fixed cost f .

⁵ It is easy to verify that the price elasticity of demand implied by (3) is greater than one if and only if $s' < 0$. It is well-known that a monopolist only operates on the elastic portion of a demand curve.

The total costs of producing n products are then nf . The retail cost of selling a unit of any product is c .

There is a total of m retailers, one in each market. The manufacturer determines the number of products to be manufactured, while retailer j ($j = 1, 2, \dots, m$) sets the retail prices in market j . The manufacturer and each retailer negotiate the terms under which goods are sold to the retailer. To be more specific, the manufacturer and each retailer play the following three-stage game. At stage 1 the manufacturer chooses the number of products. At stage 2 the manufacturer and each retailer negotiate a contract. We model the negotiation process as a generalized Nash bargaining problem (Harsanyi and Selton 1972). The contract between the manufacturer and the retailer in market j takes the form of a two-part tariff, (w^j, T^j) , where w^j is the per unit wholesale price and T^j the lump sum fee.⁶ At stage 3 each retailer sets the retail prices in its market and consumers make their purchase decisions.

The use of two-part tariffs allows the firms to eliminate the double-marginalization problem, and, thus, in equilibrium the manufacturer and each retailer will set the contract terms in such a way to maximize their joint profits. A retailer that uses its countervailing power to obtain more favourable terms will receive a larger share of the joint profits. Therefore, we define countervailing power as the ability of a retailer to capture a larger share of the joint profits.⁷

⁶ In practice, contracts between manufacturers and retailers are complex and highly non-linear (Inderst and Wey 2004 page 6). The two-part tariff in this model is a way to approximate such complex non-linear contracts.

⁷ This definition is consistent with Galbraith's notion of countervailing power. He argues that the quest for countervailing power is motivated by the reward "in the form of a share of the gains of their opponents' market power" (Galbraith 1952 page 119). The same definition of countervailing power is used in Chen (2003).

3. The Benchmark: Manufacturer Selling Directly to Consumers

Before we consider retailer countervailing power, we consider as the benchmark case a situation where the manufacturer sells directly to consumers. In other words, the manufacturer controls both the production and retailing of its products and consequently determines the number of products as well as the prices charged to consumers. This is the situation typically studied in the existing literature on product diversity. The analysis of this case will tell us the effects of monopoly on product diversity in the absence of any retailer countervailing power. It also serves as the benchmark with which the equilibrium under retailer countervailing power will be compared.

Since all markets are identical, a vertically integrated manufacturer will choose the same price and quantity for all markets. Its profit-maximization problem can then be written as:

$$\max_{p,n} \Pi_T(p,n) = m(p-c)nx - nf = \frac{m(p-c)Is(q)}{p} - nf. \quad (11)$$

Note that the choice over p is a standard monopoly pricing problem. Thus, setting $\partial \Pi_T / \partial p = 0$ we obtain the standard first-order condition:

$$\frac{p-c}{p} = - \frac{x}{p(\partial x / \partial p)} = \frac{1}{1 - qs'/s}. \quad (12)$$

To ensure that an interior solution exists, it is necessary to assume that $s' < 0$. In addition, we assume that $s'' < 0$ to ensure that the second-order condition is satisfied.

With regard to the number of products, we ignore that n is an integer and treat it as if it

were a continuous variable. This allows us to use calculus and obtain the following first-order condition for n :

$$\frac{\partial \Pi_T}{\partial n} = -m(p-c)Is' \frac{(1-\rho)}{\rho} n^{-1/\rho} - f = 0. \quad (13)$$

Let p^m , x^m and n^m be the price, quantity and the number of products chosen by the vertically integrated monopolist.

One question we are interested in is whether the equilibrium number of products is “optimal.” Because the manufacturer is a monopolist, there is the conventional distortion arising from monopoly pricing. The monopoly equilibrium is clearly not first-best optimum. Let (p^*, x^*, n^*) be the solution that maximizes the social welfare function (7). Then,

Proposition 1. Compared with the first-best optimum, a vertically integrated monopolist sets higher prices and produces fewer products. The quantity of each product, however, is the same. That is, $p^m > p^*$, $n^m < n^*$, $x^m = x^*$.

Proof. Note that the profit of the vertically integrated monopolist is $\Pi_T = m(p - c)nx(p, n) - nf$.

The first-order conditions associated with the maximization of (7) are:

$$\frac{\partial W}{\partial p} = \frac{\partial U}{\partial x_0} (p-c)n \frac{\partial x}{\partial p} = 0. \quad (14)$$

$$\frac{\partial W}{\partial n} = \frac{\partial U}{\partial x_0} \left[(p-c)n \frac{\partial x}{\partial n} + \frac{px}{\rho} - \frac{f}{m} - cx \right] = 0. \quad (15)$$

In deriving (14) and (15) consumer optimization condition (2) has been used. Condition (14) yields the familiar condition that prices equal to marginal cost, $p = c$. Using this condition in (15), we obtain:

$$f = \frac{(1-\rho)mcx(c,n^*)}{\rho}. \quad (16)$$

The monopolist's profit-maximization conditions, (12) and (13), imply that $f = (1-\rho)mcx(p^m, n^m)/\rho$. A comparison of this condition with (16) suggests $x(p^m, n^m) = x(c, n^*)$. Since $p^m > c$ from (12), we know that $n^m < n^*$.

QED

A more interesting question is whether the number of products chosen by the monopolist is second-best in the sense that it is socially optimal subject to the constraint of monopoly pricing condition (12). To answer this question, we write the social welfare function (7) as a function of n . Let $p(n)$ be the solution to p from (12); it is the monopoly price taking as given the number of products. Substituting this into (3) and (11) we obtain the quantity consumed and the manufacturer's profits as functions of n , $x(n)$ and $\Pi_T(n)$. Then the representative consumer's income is $I = I_0 + \Pi_T(n)/m$. Given the monopoly price $p(n)$, the social welfare function (subject to condition (12)) becomes

$$\hat{W}(n) = U(I_0 + \Pi_T(n)/m - np(n)x(n), n^{1/\rho}x(n)). \quad (17)$$

The second-best n is the one that maximizes $\hat{W}(n)$.⁸ The concavity assumption on U implies that $\hat{W}(n)$ is concave in n .

Proposition 2. The number of products chosen by a vertically integrated monopolist is less than that of the constrained optimum.

Proof. It can be shown that when evaluated at the monopoly solution n^m ,

$$\hat{W}'(n^m) = p^m x^m \frac{\partial U}{\partial x_0} \left[\frac{1-\rho}{\rho} - \frac{n^m p'(n^m)}{p^m} \right] \quad (18)$$

which is positive because

$$\frac{np'(n)}{p} = \frac{(p-c)(s''q+s')n^{-(1-\rho)/\rho}}{s'q+(p-c)(s''q+s')n^{-(1-\rho)/\rho}} \left[\frac{1-\rho}{\rho} \right] < \frac{1-\rho}{\rho}. \quad (19)$$

Since $\hat{W}(n)$ is concave in n , this suggests that the number of products supplied by the manufacturer is less than the second-best.

QED

Propositions 1 and 2 suggest that monopoly causes distortions in both prices and product diversity. Moreover, the distortion in product diversity is not merely a by-product of monopoly pricing. Monopoly causes efficiency losses even after the effects of monopoly pricing are taken into consideration. The question we want to explore next is whether retailer countervailing

⁸ In the literature it is common to study the second-best properties of a monopolist's choice of product diversity taking either price or quantity as fixed (*e.g.* Holahan 1978 and Katz 1980). The approach we use here is somewhat more sophisticated in that it takes into consideration the fact that the monopolist's choice of price and quantity is affected by its choice of product diversity.

power alleviates or exacerbates these distortions.

4. Retailer Countervailing Power

Now we return to the case where the manufacturer sells its products through retailers. We will first derive the subgame perfect equilibrium of the game between the manufacturer and the retailers, followed by an analysis of the effects of retailer countervailing power.

4.1. Subgame Perfect Equilibrium

We derive the subgame perfect equilibrium of this game using backward induction. We will use superscript j to denote the variables in market j ($j = 1, 2 \dots m$). At stage 3 the retailer in market j sets its price by solving:

$$\max_{p^j} \pi_R^j = \left[(p^j - c - w^j) \left(\frac{Is(q^j)}{p^j n} \right) - T^j \right] n \quad (20)$$

The first-order condition is:⁹

$$(p^j - c - w^j) \frac{I(s'q^j - s)}{(p^j)^2} + \frac{Is}{p^j} = 0. \quad (21)$$

Let $p^j(w^j, n)$ be the solution to (21). Comparative statics on (21) shows that

⁹ It is straightforward to verify that the second-order condition for the profit-maximization problem is satisfied.

$$\frac{\partial p^j}{\partial w^j} = \frac{\theta(\theta+1)}{\theta^2 + (c+w^j)\theta'n^{-(1-\rho)/\rho}} > 0. \quad (22)$$

$$\frac{\partial p^j}{\partial n} = \frac{p^j(c+w^j)\theta'[(1-\rho)/\rho]q^j}{np^j\theta^2 + n(c+w^j)\theta'q^j} > 0. \quad (23)$$

Equation (23) suggests that a retailer will raise the price of each product when there are more products. Intuitively, this is because (3) implies that the demand for each product becomes less elastic as the number of products increases.¹⁰

At stage 2 the outcome of negotiation between the manufacturer and a retailer is determined by the generalized Nash bargaining solution. Since the manufacturer and retailer j are bilateral monopoly in market j , each would earn no profit from this market if they fail to reach an agreement. The disagreement point, therefore, is (0,0). Let Π^* denote the maximum joint profits of the manufacturer and retailer j and π_M^j denote the manufacturer's profits from selling in market j . Then the generalized Nash bargaining problem can be written as:

$$\max_{\pi_R^j, \pi_M^j} (\pi_R^j)^\gamma (\pi_M^j)^{(1-\gamma)} \quad s.t. \quad \pi_R^j + \pi_M^j = \Pi^*. \quad (24)$$

It is easy to show that the bargaining solution is $\pi_R^j = \gamma \Pi^*$ and $\pi_M^j = (1-\gamma)\Pi^*$. Therefore, parameter γ^j determines the retailer's share of the joint profits. Since countervailing power is the ability of a retailer to capture a larger share of the joint profits, γ^j is the parameter that measures

¹⁰ Keep in mind that the demand function here is that facing a monopolist. The elasticity of demand facing an individual firm in a monopolistically competitive industry, on the other hand, is constant at $1/(1-\rho)$ (see Dixit and Stiglitz 1977 page 299).

the countervailing power that retailer j has against the manufacturer.

The joint profits from sales in market j are maximized by solving

$$\Pi^{j*} = \max_{w^j} \Pi^j = [p^j(w^j, n) - c] \left[\frac{Is(q^j)}{p^j(w^j, n)n} \right] n. \quad (25)$$

The first-order condition implies that

$$(p^j - c) \frac{I(s'q^j - s)}{(p^j)^2} + \frac{Is}{p^j} = 0. \quad (26)$$

Comparing (26) with (21), we see that the manufacturer and the retailer will agree to set $w^j = 0$. This implies that the manufacturer will extract profits from retailer j in the form of a lump sum fee: $T^j = (1 - \gamma^j) \Pi^{j*}$. Recall that the manufacturer's marginal cost of production is normalized to 0. Thus, what we have here is the familiar result that as a way to solve the double-marginalization problem an upstream firm and a downstream firm set the unit price to marginal cost and divide up the profits through a lump sum payment.

Given that $w^j = 0$ is the same across markets, all retailers set the same price $p^j(w^j, n) = p^j(0, n)$. Define $p(n) = p^j(0, n)$. The price index q^j can then be written as a function of n alone, $q^j = q(n) = p(n)n^{-(1-\rho)/\rho}$. Since they are the same for all markets, from now on we drop all superscript j on p and q .

At stage 1 the manufacturer sets the number of products to maximize its total profits from selling into m markets:

$$\max_n \pi_M = \sum_{k=1}^m (1-\gamma^k) \Pi^{k*} - nf = \sum_{k=1}^m (1-\gamma^k) n [p(n)-c] \frac{Is(q(n))}{p(n)n} - nf. \quad (27)$$

The first-order condition is:

$$- [p(n)-c] Is'(q(n)) \left(\frac{1-\rho}{\rho} \right) n^{-1/\rho} \sum_{k=1}^m (1-\gamma^k) = f. \quad (28)$$

Moreover, it can be shown that the second-order condition for a maximum is satisfied, that is,

$$\partial^2 \pi_M / \partial n^2 < 0.$$

4.2. Effects of Countervailing Power

Recall that the countervailing power of retailer j is measured by parameter γ^j . Note that we allow γ^j to be different across retailers. In other words, retailers in different markets may possess different amounts of countervailing power against the manufacturer. We want to study what will happen if one of these retailers gains additional countervailing power.

It is well-known that if a two-part tariff is used in the textbook model of bilateral monopoly, the relative bargaining power affects only how the joint profits are allocated between the upstream firm and the downstream firm. It has no real impact on consumers and social welfare. In our model, this will also be the case if the number of products is taken as fixed.

Lemma 1. Given the number of products n , countervailing power has no impact on retail prices and social welfare.

Proof. From (21), (25) and that $w^j = 0$ we see that retail price p and joint profits Π^* are independent of γ^j (for a given n). Thus, social welfare is independent of γ^j as well.

QED

Our interest here, of course, is precisely in how the equilibrium number of products will change and how that change will affect consumers and social welfare. But Lemma 1 serves to confirm that the welfare effects will be driven solely by the change in product diversity.

Note that (28) is identical to (13) if $\gamma^k = 0$ for all $k = 1, 2, \dots, m$. This implies that if none of the m retailers has any countervailing power, the manufacturer will choose the same price, quantity, and number of products as that of a vertically integrated monopolist. The question is, then, what will happen if γ^k is positive for at least one retailer.

Proposition 3. An increase in the countervailing power of a retailer reduces the equilibrium number of products and retail prices in all markets. The quantity of each product sold in a market is larger.

Proof. Comparative statics on the first-order condition (28) yields

$$\frac{\partial n}{\partial \gamma^j} = - \frac{(p-c)(1-\rho)Is/n^{-1/\rho}}{\rho(\partial^2 \pi_M / \partial n^2)} < 0. \quad (29)$$

Then (29) and (23) imply that $\partial p / \partial \gamma^j = (\partial p / \partial n)(\partial n / \partial \gamma^j) < 0$, and (29) along with (9) and (10) imply that $\partial x / \partial \gamma^j = (\partial x / \partial p)(\partial p / \partial \gamma^j) + (\partial x / \partial n)(\partial n / \partial \gamma^j) > 0$.

QED

Intuitively, an increase in a retailer's countervailing power reduces the profits the manufacturer can extract from the retailer. This, in turn, reduces the manufacturer's marginal gain from producing an additional product. The resulting reduction in the number of products forces retailers to cut their retail prices as the demand for each remaining product becomes more

elastic (see equation (23)).

Note that the prices in all geographic markets fall even though the change in countervailing power occurs in only one market and the demands in these markets are independent of each other. This is because the same set of products is sold in all markets, and consequently a reduction in product diversity affects all markets.

Proposition 4. An increase in the countervailing power of retailer j reduces the manufacturer's profits as well as the profits of all retailers other than retailer j . It causes the joint profits of all firms to fall as well. It raises retailer j 's profits as long as its countervailing power is relatively small in the sense that

$$\frac{\gamma^j}{\sum_{k=1}^m (1-\gamma^k)} < \frac{pq\theta'}{p\theta^2+cq\theta'} + \frac{1}{\theta} \left[\frac{\rho}{1-\rho} - \theta \right]. \quad (30)$$

Proof. Applying the envelope theorem to (27), we obtain, $\partial\pi_M/\partial\gamma^j = -\Pi^{j*} < 0$. The effect on the profits of a retailer k ($k \neq j$) is:

$$\frac{\partial\pi_R^k}{\partial\gamma^j} = -\gamma^k(p-c) \left(\frac{1-\rho}{\rho} \right) I_S' n^{-1/\rho} \left(\frac{\partial n}{\partial\gamma^j} \right) < 0. \quad (31)$$

The combined profits of all firms are equal to $\Pi_T = \sum_{k=1}^m \Pi^{k*} - nf$. Using the first-order conditions from stages 1 and 3, we obtain:

$$\frac{\partial \Pi_T}{\partial \gamma^j} = -\sum_{k=1}^m \gamma^k (p-c) \left(\frac{1-\rho}{\rho} \right) I s' n^{-1/\rho} \left(\frac{\partial n}{\partial \gamma^j} \right) < 0. \quad (32)$$

The effect on firm j 's profits is more complex.

$$\frac{\partial \pi_R^j}{\partial \gamma^j} = (p-c) n x \left[1 + \frac{\theta(p-c) s' (p\theta^2 + c\theta' q) (1+\theta) (1-\rho) \gamma^j}{[p^2 \theta^2 s' (1-\rho) - s' p (p\theta^2 + c\theta' q) (1-(1+\theta)(1-\rho))] \sum_{k=1}^m (1-\gamma^k)} \right], \quad (33)$$

which will be positive if the terms in the square brackets are positive. Reorganizing and using (12) and the definition of θ , we can show that $\partial \pi_R^j / \partial \gamma^j > 0$ if (30) is satisfied.

QED

Note that the right-hand side of (30) is positive because of (8) and $\theta'(q) > 0$. Thus, (30) is satisfied if $\gamma^j = 0$. That is, starting from a situation where a retailer possesses no countervailing power, gaining a little power always benefits the retailer. Furthermore, (30) is also satisfied if $\gamma^k = 0$ for all $k \neq j$ and m is sufficiently large. In other words, more countervailing power helps retailer j if it is the only one with countervailing power among a large number of retailers.¹¹

Proposition 5. An increase in the countervailing power of a retailer reduces both consumer welfare and social welfare in all markets.

¹¹ Proposition 4 raises the question what will retailer j do if condition (30) is violated. Obviously, retailer j will commit to refrain from exercising the full extent of its countervailing power provided that such commitment is possible. Otherwise, the negative consequence of countervailing power may dissuade the retailer from acquiring additional power.

Proof. Differentiating (5) and recognizing that p and n are functions of γ^j in equilibrium, we obtain,

$$\frac{\partial V(p, I, n)}{\partial \gamma^j} = \frac{x(1-\rho)\theta^2}{\rho[p\theta^2+(c+w)\theta'q]} \left(\frac{\partial u}{\partial x_0} \right) \left(\frac{\partial n}{\partial \gamma^j} \right) < 0. \quad (34)$$

Taking into consideration the change in income as a result of change in profits, we determine the effects on social welfare:

$$\frac{\partial \mathcal{W}}{\partial \gamma^j} = \frac{\partial V}{\partial \gamma^j} + \left(\frac{\partial U}{\partial x_0} \right) \left(\frac{\partial \Pi_T}{\partial \gamma^j} \right) \frac{1}{m} < 0. \quad (35)$$

QED

Intuitively, consumers benefit from lower prices but they are hurt by reduced product diversity. Here, the effects of reduced product diversity dominate and consumers lose. Social welfare is reduced because both consumer welfare and total profits are down. Recall from the benchmark case that monopoly causes two distortions in our model due to higher prices and reduced product diversity. What we have shown here is that retailer countervailing power alleviates one distortion (by bringing down the retail prices) but exacerbates the other (by further reducing product diversity). Overall, however, society is worse off.

5. Concluding Remarks

In this paper we have studied a monopolist's choice of product diversity and the effects of retailer countervailing power on that choice. It perhaps comes as no surprise that the monopolist does

not choose the right product diversity. What is surprising, however, is that retailer countervailing power does not make things any better; in fact, it exacerbates the distortions in product diversity. What is perhaps even more surprising is that the magnitude of these additional efficiency losses is, in our model, larger than that of the gains from lower retail prices brought about by the same countervailing power. Therefore, changes in prices, which have been the focus of the existing theoretical analyses, do not tell the whole story about how consumers are affected by countervailing power.

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