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THE EFFECT OF TARIFFS IN MARKETS WITH VERTICAL RESTRAINTS

by

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The Effect of Tariffs in Markets with Vertical Restraints

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Where manufacturers impose vertical restraints on domestic retailers, raising tariffs on international competition may increase domestic welfare, may benefit consumers, and may harm domestic manufacturers. This result is illustrated in a model in which the manufacturer transfers monopoly power to retailers by limiting their number, so as to induce the retailers to provide services to consumers. We derive conditions for each group to benefit from higher tariffs.

1. Introduction

In standard competitive markets, a tariff unambiguously harms consumers by raising the retail prices; however, in markets with vertical restraints, an increase in price due to an increase in tariffs may be more than offset by additional services. We consider a case where the manufacturer has only partial control of its retailers, so that its objective differs from that of the retailers.

The manufacturer sells its product through a network of retailers. The demand facing a retailer, and hence the manufacturer, depends on the retail price and the level of service provided, such as changing rooms for clothing; technical advice for complex equipment such as stereos, televisions, and cameras; and local advertising. The manufacturer cannot supply the service itself nor monitor exactly how much service the retailer provides.

The retailers only provide costly services if they are making positive profits. Since increased services expand sales, the manufacturer willingly gives up some of its market power to the retailers through the use of exclusive territories to induce retailers to provide more services.¹

¹Other vertical restraints, in addition to exclusive dealerships, could be used, including resale price maintenance (manufacturer sets a price floor), quantity forcing (retailers are required to sell a minimum volume of the product), and franchise fees or other two-part pricing (retailer pays a fixed

Competitively supplied foreign products sold in discount stores affect the manufacturer's incentive scheme. These products may constitute a gray market or merely be close substitutes for the manufacturer's product. Consider, for example, a manufacturer of a camera who wants the local retailer to demonstrate the camera to potential customers in the retailer's showroom. If a similar camera can be purchased at a local discount store that lacks a showroom, customers may go to the showroom of the retailer to choose a camera, then buy the camera at the discount outlet at a lower price.

As a result, the retailer must lower its price to meet the discount competition. After lowering its price, however, the retailer cannot afford to maintain as expensive a showroom and staff of skilled demonstrators as before. So, the retailer also reduces or eliminates the services it provides, causing total demand for the manufacturer's cameras to fall.

Thus, foreign competition hurts the manufacturer by reducing indirectly the level of service, but it aids the manufacturer by keeping the retail price low. If the manufacturer can raise its wholesale price and increase its profit margin, it may be a net beneficiary of the foreign competition.

In general, the manufacturer and the retailers are in conflict, with each desiring a larger share of the joint monopoly power.² If sales did not depend on service, the manufacturer would keep all the monopoly power by allowing free entry into its retailer network, thereby driving retailers' profits to

fee for the right to carry the manufacturer's product). See Telser (1960), Smith (1982), Blair and Kaserman (1983), Mathewson and Winter (1984), Marvel and McCafferty (1985), and Perry and Porter (1986). Several of these papers show the equivalence of some or all of these vertical restraints in the presences of various externalities.

²See Steiner (1984) for a theoretical discussion. Smith (1982) provides a welfare analysis of this conflict in the automobile industry.

zero. Where sales do depend on service, the manufacturer must transfer some monopoly power to the retailers in the form of exclusive territories. Foreign competition may allow the manufacturer to regain some of this market power.³

It is the absence rather than the presence of vertical restraints that is responsible for these results. If the manufacturer can use a complete set of vertical restraints equivalent to vertical integration, it controls the retail price and service, appropriating all the joint profits. Foreign competition forces such a manufacturer to reduce the retail price, reducing total profits, but the level of service that maximizes joint profits still is provided.

Foreign competition lowers price to consumers, but also results in lower levels of service. If sales depend heavily on service, tariffs may aid consumers by preventing free-riding. Thus, an increase in tariffs may increase welfare.⁴

In recent cases concerning gray markets, claims were made that foreign competition benefits the manufacturer and harm consumers by decreasing service.⁵ Domestic retailers of trademarked goods claim that gray market import-

³In this paper, we concentrate on foreign competition. At least in the computer industry, however, domestic sources have created gray markets. See Lisa L. Spiegelman, "Vendors try to stem price war between dealers, distributors," Info World 9, March 30, 1987, 27 and Rachel Parker, "Makers try to keep hardware out of gray market," Info World 9, July 27, 1987, 33. Apparently, manufacturers are more likely to try to prevent domestic gray markets than foreign ones.

⁴The desirability of tariffs over free trade results from reducing the free rider problem and not from the increase in monopoly power by manufacturers. See Melvin and Warne (1973).

⁵This paper does not deal with gray markets in the traditional sense. That is, we assume that the imports are not necessarily those of the manufacturer. We only assume that the products are close enough substitutes that importers can free ride on domestic retailers' service, forcing them to match the import price.

ers discount the product and free ride on the services provided by authorized retailers, which results in the elimination of promotional efforts and warranties in the long run. In several cases, the court concluded that free-riding was damaging to the U. S. trademark owner and ruled against gray markets.⁶

In many cases the manufacturer can prevent gray markets by relabeling goods when sold in other countries, using different product specifications, using complex pricing mechanisms, or refusing to provide after-sales warranties on gray market goods.⁷ That manufacturers do not use these techniques indicates that the loss of sales from free riding is more than offset by the gains in disciplining the retailers.⁸

⁶See Bell and Howell: Mamiya Co. vs. Masel Supply, 548 F.Supp 1063 (E.D.N.Y. 1982) and Osawa vs. Bell & Howell Photo, 589 F. Supp 1163 (S.D.N.Y. 1984).

⁷In May 1987, however, American Warranty Co. of Princeton, N. J. started selling importers service contracts on brand-name equipment including televisions, CD players, and cameras. See "New protection for goods in the gray market," Consumer Reports 52, September 1987, p. 525.

⁸This argument was used in Osawa vs. Bell & Howell Photo, 589 F. Supp 1163 (S.D.N.Y. 1984) and in Coalition to Preserve the Integrity of American Trademarks vs. United States, 790 F.2d 903 (D.C. Cir. 1986) to show that free riding was not a major problem. In the latter case, the court agreed and ruled to authorize gray market imports. Other appeals courts ruled that U. S. laws cannot be used to block gray market imports (see, Bell and Howell: Mamiya Co. vs. Masel Supply Co., 719 F. 2d 42 (2d Cir. 1983) and Olympus vs. U. S., 792 F. 2d 315 (2d Cir. 1986) on photographic equipment, and NEC Electronics vs. Cal Circuit Abco, 810 F. 2d 1506 (1987) on semiconductors).

That retailers and manufacturers have inconsistent objectives also is illustrated in other markets where retailers but not manufacturers call for tariffs. In a few cases, manufacturers have called for the elimination of tariffs.⁹

We start by presenting a relatively general model to outline the basic problem.¹⁰ After some analytical results are obtained from the general model, we use a special case due to Mathewson and Winter (1984) to illustrate additional results through simulation.

2. The Basic Model

The manufacturer sells its product through a network of retailers with exclusive territories. Assuming that consumers are uniformly distributed, information about the exclusive territories can be summarized fully by specifying the number of (equally spaced, identical) retailers, n . The manufacturer also sets a wholesale price, q .

The demand facing each retailer is $x(p,s,n)$, where s is the level of services provided by each retailer and p is the equilibrium retail price determined by the imperfect competition among retailers. The demand facing a retailer decreases with price, $x_p < 0$ and increases with service, $x_s > 0$.

⁹Wall Street Journal, March 18, 1987, p. 51. Harley Davidson asked the International Trade Commission to cancel the tariff protection it had been enjoying.

¹⁰This model is based on Steven C. Salop's unpublished lecture notes.

Retailers are unable to charge separately for the service. The manufacturer has very high costs of providing services directly or monitoring the level of services provided by a particular retailer, and hence does neither. Similarly, vertical integration into the retail market is too costly to be attractive.

As the number of retailers increases, there is a positive "network" effect that causes total demand to increase. For example, as consumers see more Hyundai dealers the car achieves a legitimacy and moreover the consumer believes that finding someone to repair the car will be easier.¹¹ Thus, we expect total demand to be increasing in the number of retailers, $\partial(nx)/\partial n = x + nx_n > 0$, though, perhaps, at a decreasing rate. The demand facing any one retailer tends to fall with increased competition and smaller territories: eventually, $x_n < 0$.

For simplicity, we assume that the retailers use Loschian conjectures in determining their optimal behavior.¹² In equilibrium, all the identical retailers charge the same price and choose the same level of service.

¹¹In the Mathewson and Winter (1984) spatial model, as the number of firms increases, most consumers' transportation costs fall, so that firms may charge higher prices.

¹²See Mathewson and Winter (1984) who, in a similar model, define Loschian conjectures (p. 29): "Each outlet assumes that its market area is invariant to changes in its prices; equivalently, each outlet assumes that neighboring outlets will exactly match its price changes."

Unlike the manufacturer, the many foreign firms do not have a dealer network and have no market power to share with retailers.¹³ Their products are sold by discount houses that provide no service. As the foreign products are identical to the manufacturer's (or a price adjustment will make them effectively identical), they too benefit by the service provided by the manufacturer's retailer network.¹⁴ Their product is sold at a price of z that reflects all manufacturing and transportation costs as well as any tariff.

The Retailer's Problem

Each retailer in the network tries to maximize its profits through its choice of its price, p , and service level, s :

$$\begin{aligned} \max_{p,s} \pi^r &= (p - q) x(p, s, n) - s, & (1) \\ \text{s.t.} \quad & p \leq z \end{aligned}$$

where, by choosing the units of service appropriately, we have normalized the cost of service to equal one, so the last term is the total cost of providing service. Notice that service is a "public good" in the sense that the cost of

¹³The manufacturer may be a low-cost firm or an innovator. For example, IBM faces many foreign firms that produce personal computer clones. IBM sells through a limited number of retailers, whereas the clones are sold by any low-cost retailer who is willing to carry them. An alternative story is that the importers face higher costs so that they cannot practically provide services and hence choose to free-ride on the dealer network's service.

¹⁴A price adjustment will make two products effectively identical if the products differ in overall-quality such as lifespan. For example, if product A lasts 1 year and sells for \$100, and product B lasts a half of a year, it must sell for \$50 (ignoring discounting).

providing this service is independent of the number of units, x , sold. The constraint, $p \leq z$, says that the retailers cannot charge more than the price of the foreign products.

The first-order conditions, where λ is the Lagrangian multiplier associated with the constraint, are:

$$(p - q)x_p + x = \lambda, \quad (2a)$$

$$(p - q)x_s = 1, \quad (2b)$$

$$\lambda(p - z) = 0, \lambda \geq 0, p \leq z. \quad (2c)$$

Equation (2a) says that price is set so that marginal profits with respect to price equal 0 if there is no foreign competition, and are positive if foreign competition is binding (the retailer would set a higher price were it possible). Equation (2b) says that the marginal benefit from increased service (profits per unit, $p - q$, times the number of extra units sold, x_s) equals the marginal cost of service. Equation (2c) is the Kuhn-Tucker condition: either the constraint does not bind, $\lambda = 0$ and $p - z > 0$, or it does bind and $\lambda > 0$ and $p - z = 0$.

We assume that each retailer has nonnegative profits and the second-order conditions hold.¹⁵ By solving equations (2), the retailer's reaction may be written as a function of parameters set by the manufacturer and by foreign competition:

¹⁵That is, we assume $(p - q)x_{pp} + 2x_p < 0$, $(p - q)x_{ss} < 0$, and $(p - q)[(p - q)x_{pp} + 2x_p]x_{ss} - [(p - q)x_{ps} + x_s]^2 > 0$. Assuming that retailers make positive profits, these conditions imply that $x_{ss} < 0$.

$$p = p(q, n, z), \quad (3a)$$

$$s = s(q, n, z). \quad (3b)$$

Where foreign competition is not binding ($p < z$), we can write $p = p(q, n)$ and $s = s(q, n)$. Where foreign competition is binding, $p = z$, so the retailer's only decision is the level of s to provide, where $s = s(q, n, z)$.

A Special Case

If the demand function is weakly (multiplicatively) separable,

$$x(p, s, n) = X(p)g(s)f(n), \quad (4)$$

then the retailer's problem can be solved sequentially.¹⁶ For example, where there is no foreign competition ($z = \infty$ and $\lambda = 0$), equation (2a) becomes $(p - q)X'(p) + X(p) = 0$. Thus, this equation can be solved for p as a function solely of q : $p = p(q)$. The resulting p can be substituted in equation (2b) to obtain s : $(p - q)X(p)g'(s)f(n) = 1$, or $s = s(q, n)$.

That is, if demand is weakly separable and there is no foreign competition, retail price depends only on the wholesale price, q , and not on the number of retailers, n . Service, however, depends on both the wholesale price

¹⁶The necessary and sufficient conditions for profit maximization to hold are: $X' < 0$, $g' > 0$, $f' < 0$, $(d/dn)(nf) = f + nf' > 0$, $g'' < 0$, $(p - q)X'' + 2X' < 0$.

and the number of retailers.¹⁷ In the presence of binding foreign competition, p is independent of n and q , but s depends on them.¹⁸ In the remainder of this paper, we assume that demand is weakly separable.

The Manufacturer's Problem

The manufacturer takes the behavior of the retailers and foreign competitors as given and attempts to maximize its profits through its choice of q and n :

$$\max_{q,n} \pi^m = (q - c) n x(p(q,n,z), s(q,n,z), n) \quad (5)$$

where c is the manufacturer's average and marginal cost of production. The manufacturer is a Stackelberg-leader with respect to the dealer network. We assume that the manufacturer has an interior maximum with respect to both q and n : $q = q(z)$ and $n = n(z)$. If z is high, so that foreign competitors can be ignored, there is a unique profit maximum at (q^*, n^*) that is independent of z . Each retailer has a corresponding profit maximum at (p^*, s^*) .

Where demand is weakly separable, the manufacturer's first-order conditions are:

¹⁷Explicitly, $\partial p / \partial q = X' / [(p - q)X'' + 2X'] > 0$, $\partial p / \partial n = 0$, $\partial s / \partial q = g' / [(p - q)g''] < 0$, $\partial s / \partial n = -g'f' / [gf''] < 0$. Where foreign competition is not binding, if the manufacturer increases the wholesale price, q , the retailer's cost of losing customers from raising the retail price or decreasing service declines, so the retail price rises and service falls. An increase in the number of retailers, n , reduces a retailer's sales at constant s , so that service is reduced. A change in n , and the induced change in s , does not change the price elasticity of demand, so p is held constant.

¹⁸Here, $\partial s / \partial q = g' / [(z - q)g''] < 0$ and $\partial s / \partial n = -g'f' / [gf''] < 0$.

$$\frac{\partial \pi^m}{\partial q} = [nx] + nx(q - c) \left[\frac{X'(p)}{X(p)} \frac{\partial p}{\partial q} + \frac{g'(s)}{g(s)} \frac{\partial s}{\partial q} \right] = 0, \quad (6a)$$

$$\frac{\partial \pi^m}{\partial n} = [x(q - c)(1 + n \frac{f'(n)}{f(n)})] + [nx(q - c) \frac{g'(s)}{g(s)} \frac{\partial s}{\partial n}] = 0, \quad (6b)$$

where,

$$p < z \text{ and } \frac{\partial p}{\partial q} = \frac{X'}{(p - q)X'' + 2X'} > 0 \quad \text{if } q < \underline{q} \quad (7a)$$

$$p = z \text{ and } \frac{\partial p}{\partial q} = 0 \quad \text{if } q \geq \underline{q}, \quad (7b)$$

$$\frac{\partial s}{\partial q} = \frac{g'(s)}{(p - q)g''(s)}, \quad s = g'^{-1} \left(\frac{1}{(p - q)X(p)f(n)} \right), \quad \text{if } q < \underline{q} \quad (8a)$$

$$\frac{\partial s}{\partial q} = \frac{g'(s)}{(z - q)g''(s)}, \quad s = g'^{-1} \left(\frac{1}{(z - q)X(z)f(n)} \right), \quad \text{if } q \geq \underline{q}. \quad (8b)$$

$$\frac{\partial s}{\partial n} = \frac{-g'f'}{gf''}. \quad (9)$$

In equations (6a) and (6b), the term in the first set of brackets has a positive sign and represents the direct gain to the manufacturer generated by an increase in the wholesale price (6a) or number of outlets (6b). The term in the second set of brackets has a negative sign and represents the loss due to the reaction of retailers who reduce service or raise the retail price.

The Differentiability of the Retailers' Reaction Functions

The retailers' reaction function for p is not differentiable everywhere; whereas, their reaction function for s is everywhere differentiable. As noted above, when demand is weakly separable and there is no foreign competition, p is an increasing function of q , but is independent of n : $p = p(q)$. Define \underline{q} by $z = p(\underline{q})$. Equation (7) shows that $\partial p / \partial q > 0$ for $q < \underline{q}$, and $\partial p / \partial q = 0$ for $q \geq \underline{q}$.

As a result, the retailers' reaction function for p is continuous, but nondifferentiable at \underline{q} . Thus, the manufacturer may have to compare two possible solutions implied by equations (6), corresponding to high and a low values of q , to determine which provides the highest profit level.

The retailers' reaction function for service is differentiable. At $q = \underline{q}$, $z = p(\underline{q})$, and both equations (8a) and (8b) have the same value.

The Manufacturer's Profits

To illustrate what happens to the manufacturer's profits, we consider demand curves where the optimal n is independent of z so that we can plot profits as a function of q alone.¹⁹ We can graph two profit functions for the manufacturer. Let π^m_1 be the profit function when there is no foreign competition, which is independent of z by definition, and let π^m_2 be the function when z is binding.

In Figures 1a and 1b, which show examples of these two functions, the profit functions are well-behaved and have a unique maximum. The unconstrained profit curve, π^m_1 , reaches its maximum at point A. The constrained

¹⁹An example is presented below.

profit curve, π^m_2 , reaches its peak at point B. The two curves meet at point C, where $q = \underline{q}$. Since at C the slope of π^m_2 is greater than the slope of π^m_1 , π^m_2 lies above π^m_1 to the right of C.²⁰

The manufacturer cannot operate on π^m_1 to the right of C, since for such a wholesale price q , an unconstrained retailer would choose a price higher than z . That is, the manufacturer's feasible profit curve is the unconstrained curve up to point C and the constrained curve to the right of point C.

It is possible that the foreign competition is everywhere binding, so that only the constrained profit curve is relevant. Indeed, so long as $z < p(q^*)$, the manufacturer's choice of q becomes a moot issue.

Both Figures 1a and 1b show cases where the manufacturer has two possible strategies: choose a q such that the retailer is not constrained, $p(q) < z$, or choose a q such that the retailer is constrained, $p(q) = z$. Which strategy dominates depends on the demand function and z .

Figure 1a shows a case where the manufacturer's profits are highest at A, in the unconstrained portion of the profits envelope. In contrast, Figure 1b shows the case where profits are greatest at B, in the constrained section. Here, the optimal strategy for the manufacturer is to choose a relatively high q so that the retailers face foreign competition.

Because cases such as that shown in Figure 1b are feasible, then the following counterintuitive result holds:

Theorem 1: There exist some values of z such that foreign competition raises the manufacturer's profits.

²⁰At $q = \underline{q}$, $\pi^m_1 = \pi^m_2$. While $\partial s/\partial q$ is the same along both curves, $\partial p/\partial q (= 0)$ is smaller along the π^m_2 curve, by (7a) and (7b). Thus, from (6a), $\partial \pi^m_1/\partial q < \partial \pi^m_2/\partial q$.

Proof: Consider the case where the foreign competition becomes binding at $z = p(q^*)$. That is, point A and point C are identical, so $q(z) = q^*$. Since q^* maximizes π^m_1 , $\partial\pi^m_1/\partial q(q^*) = 0$. However, $\pi^m_1/\partial q(q) < \pi^m_2/\partial q(q)$ (as shown above). Thus, $\partial\pi^m_2/\partial q(q^*) > 0$. By choosing an $\epsilon > 0$ small enough, we have $\pi^m_2(q^* + \epsilon) > \pi^m_2(q^*) = \pi^m_1(q^*)$.

Heuristically, when z is only slightly higher than p^* , the manufacturer can increase its profits by raising q high enough so that z is binding on the retailers, since the foreign competition prevents the retailers from raising p when q increases.²¹ There are three ranges of z where the manufacturer's optimal policies differ:

- (1) If z is much higher than p^* , foreign competition is irrelevant (or binds at a q so high as to lower the manufacturer's profits, so the manufacturer will not choose a high enough q to cause foreign competition to bind). Here, the manufacturer picks (q^*, n^*) and retailers choose (p^*, s^*) , Figure 1a.
- (2) If z is only slightly higher than p^* , it pays for the manufacturer to raise q above q^* so that the foreign competition is binding, Figure 1b.
- (3) If z is lower than p^* , the manufacturer has no choice, so it uses a strategy where the foreign competition constrains the retailers. The manufacturer benefits from this foreign competition if z is close to p^* , but loses if z is much lower than p^* .

²¹In our figures, we have assumed that n is held constant. If n can also be varied, these results are reinforced: the manufacturer has an even greater incentive to operate where the foreign competition is binding.

The important factor in this result is that the manufacturer is not directly constrained by foreign competition, but is affected only through the change in the retailer's reaction function. In the absence of foreign competition, the manufacturer chooses (p^*, n^*) to balance the direct positive effect of increasing q on profits against the indirect negative effects from the retailers raising p and lower s . In the presence of foreign competition, the retailers cannot increase their sales price, so their ability to react to changes in q are more constrained. The initial equilibrium is a second-best from the manufacturer's stand-point, since the manufacturer cannot directly control p and s , so that the new second-best equilibrium may produce either higher or lower profits. Simply put, the foreign constraint affects the retailers' profits (market power) more than the manufacturer's.

3. An Example

To demonstrate that the manufacturer's profits can rise when foreign competitors enter the market we use a special case of the general model, due to Mathewson and Winter (1984). Consumers are uniformly distributed along a circle of length 2. Each consumer buys a quantity,

$$Q(p, s, l) = s^\mu e^{-[p+tl]/a}, \quad (10)$$

where l is the distance to the closest retailer, p and s are the price charges and the services provided by that retailer, t is the transportation cost per mile and per unit of product, and μ is the elasticity of demand with respect to service ($0 < \mu < 1$).

Each retailer buys the product from the manufacturer at price q , sets its sale price and promotes its sales by providing a service. If R denotes a retailer's market radius, a retailer faces a demand function:

$$x(p,s,R) = 2 \int_0^R Q(p,s,l)dl = \frac{2a}{t} s^\mu e^{-p/a} (1 - e^{-tR/a}). \quad (11)$$

Each retailer believes that its market area is independent of its own price and service, either because the manufacturer enforces exclusive territories or because the retailer believes that its neighbors will match perfectly any change in its price and service (Loschian conjectures). Thus R is independent of s and p , and is equal to $1/n$.

As a result, we can write x as a function of p , s , and n :

$$x(p,s,n) = \frac{2a}{t} s^\mu e^{-p/a} (1 - e^{-t/[an]}). \quad (12)$$

As before, x is multiplicatively separable, with $x_p < 0$, $x_s > 0$, $x_n < 0$, and $\partial(nx)/\partial n > 0$.

We have assumed that the service provided by a retailer does not influence the sales of another retailer: a consumer has no incentive to use the service of a retailer and buy at another retailer, since in equilibrium, all stores charge the same price and provide the same service. Importers of foreign goods, however, do not provide services, either because of greater expense or lack of market power. Their strategy is to free ride on the services provided by domestic retailers.

Consequently, the importers either locate their discount stores near each retailer, or distribute their products through mail order, so that consumers can use the service provided by a domestic retailer and buy from the importer. In the presence of such competition, the retailers must match the foreign price z .

A retailer's profits are

$$\pi^r = (p - q) \frac{2a\mu}{t} e^{-p/a} (1 - e^{-t/[an]}) - s. \quad (13)$$

Solving the retailer's first-order conditions gives us:

$$p = q + a, \text{ if there is no foreign competition } (z > q + a) \quad (14a)$$

$$p = z, \quad \text{if there is foreign competition } (z \leq q + a)$$

$$s = \left\{ \frac{2a\mu}{t} e^{-p/a} (p - q) (1 - e^{-t/[an]}) \right\}^{1/[1-\mu]}. \quad (14b)$$

The manufacturer maximizes its profits using the reaction functions for p and s from above. The manufacturer sets

$$q = c + (1 - \mu)a, \text{ if it is not optimal to constrain the retailers} \quad (15a)$$

$$q = (1 - \mu)z + \mu c, \text{ if it is optimal to constrain the retailers}$$

$$n = \frac{t}{av}, \quad (15b)$$

where v is the positive solution of $e^v - 1 - v/(1-\mu) = 0$. Since v is an increasing function of μ (v ranges from 0 when $\mu \rightarrow 0$ to ∞ when $\mu \rightarrow 1$), n is a decreasing function of μ .

From (14b), the elasticity of supply of service with respect to the retailer's margin is $1/(1-\mu)$, so the elasticity of the manufacturer's sales with respect to the retailer's margin is $\epsilon = \mu/(1-\mu)$. When $\mu \rightarrow 0$ (hence $\epsilon \rightarrow 0$), the manufacturer has no incentive to leave any profit margin to the retailer. That is, the manufacturer sets $q = z$ if there is foreign competition and $q = c + a$ in the absence of foreign competition, and lets $n \rightarrow \infty$. In contrast, when $\mu \rightarrow 1$ ($\epsilon \rightarrow \infty$), the manufacturer willingly reduces its own profit margin to induce the retailer to maintain a high level of service: $q \rightarrow c$ and $n \rightarrow 1$.

The manufacturer's policy depends on z . If the optimal (unconstrained) $q^* = c + (1-\mu)a$ is greater than $\underline{q} = z - a$, the manufacturer has no other choice than constraining the retailers by choosing $q = (1-\mu)z + \mu c$. If $q^* < \underline{q}$, then the manufacturer must determine if its profits would be higher at a q such that the retailers are constrained or at the lower q^* where they are not constrained.

By equating the profits under the two regimes, we can derive limits on z , z_1 and z_2 , that determine which regime the manufacturer will choose. The various possibilities are illustrated in Figure 2. If $z > z_1$, the manufacturer chooses the optimal unconstrained q^* , as in Figure 1a. If $z \leq z_1$, the manufacturer chooses a q such that retailers are constrained by foreign competition, and hence $p = z$. So long as $z_1 < z < z_2$, the manufacturer receives higher profits than if unconstrained, as in Figure 1b. The existence of a region between z_1 and z_2 shows that Theorem 1 holds. If $z < z_2$, the manufacturer profits are lower than if unconstrained.

The more sensitive sales are relative to service (the larger μ), the smaller the range of z such that the manufacturer will benefit from competition. At the limit when $\mu \rightarrow 1$, service will decrease so much as soon as the retailers are constrained that the manufacturer cannot gain ($z_1 = z_2$).

4. Welfare

In the vertical restraint equilibrium, national welfare is lower than in the social planner's first-best equilibrium. As a result, tariffs may increase national welfare when vertical restraints are used. For this discussion, we define national welfare as consumer welfare plus the profits of the retailers and the manufacturer.²²

We define consumer surplus as

$$CS(p, s, n) = \int_p^{\infty} nx(u, s, n) du. \quad (16)$$

Thus, welfare is

$$W = CS + n\pi^r + \pi^m \quad (17a)$$

$$= \int_p^{\infty} nx(u, s, n) du + n[(p - q)x - s] + n(q - c)x \quad (17b)$$

$$= \int_p^{\infty} nx(u, s, n) du + n[(p - c)x - s] \quad (17c)$$

²²We assume that the discount houses that sell imports make zero profits, and hence ignore them in the discussion of welfare.

²³This definition holds in the spatial model if retailers and consumers are uniformly distributed.

Differentiating (17c) gives the necessary conditions for the first-best welfare maximum solution:

$$\frac{\partial w}{\partial p} = n(p - c)x_p = 0 \quad (18a)$$

$$\frac{\partial w}{\partial s} = \left[\int_p^{\infty} nx_s(u, sn, n) du + n(p - c)x_s \right] - n = 0 \quad (18b)$$

$$\frac{\partial w}{\partial n} = \left[\int_p^{\infty} (nx_n + x)(u, s, n) + (p - c)(nx_n + x) \right] - s = 0 \quad (18c)$$

The first-best equilibrium is obtained when the marginal welfare from one more unit of the product, one more unit of service, or one more retailer are equal to their respective marginal costs. The marginal welfare of the product can be measured by the market price, but the marginal welfare of service or an additional retailer do not have explicit prices. In (18b), the term in the brackets is the marginal welfare of service, while the cost of all retailers providing an additional unit of service is n . In (18c), the term in the brackets is the marginal welfare of an additional retailer, while the cost of providing an additional retailer who provides the same level of services is s (we ignore fixed costs).

By differentiating (17b), and using the first-order conditions (2a), (2b), and (6b), we obtain the vertical restraint partial derivatives of welfare that are analogous to equations (18):

$$\frac{\partial w}{\partial p} = \underset{(-)}{-nx} + n \underset{(-)}{(q - c)x_p} = 0 \quad (19a)$$

$$\frac{\partial w}{\partial s} = \int_p^{\infty} \underset{(+)}{nx_s}(u, sn, n) du + n \underset{(+)}{(q - c)x_s} = 0 \quad (19b)$$

$$\frac{\partial w}{\partial n} = \int_p^\infty (nx_n + x)(u, s, n) + (p-q)(nx_n + x) - s + n(q-c)x_s \frac{\partial s}{\partial n} = 0 \quad (19c)$$

(+)
(+)
(-)
(+)

While all three partial derivatives are equal to zero in the first-best, in the vertical restraint equilibrium $\partial w/\partial p < 0$, $\partial w/\partial s > 0$, and $\partial w/\partial n$ has an ambiguous sign (though probably positive).

The vertical restraint second-best equilibrium has a lower level of welfare than the first-best equilibrium due to the separation of decisions by the various groups. Each group ignores the externalities of its decisions on the other groups.

The effects of these externalities can be summarized as:²⁴

- Retailers set too high a price [$\partial w/\partial p < 0$ in equation (19a)], because they compare their cost of selling additional x (through lower price) to their marginal revenue, therefore ignoring the gain to consumers and to the manufacturer from a lower price and higher sales. This distortion results from their local monopoly power and the wedge between q and society's cost c .

- Retailers provide too low a level of service [$\partial w/\partial s > 0$ in equation (19b)], because they compare their cost of providing additional s to their marginal revenue, ignoring the gains to consumers and to the manufacturer from more sales.

²⁴In the following discussion, "too high" ("too low") means that, holding all other variables constant, a decrease (increase) in the value of the variable would increase welfare. Thus, too high does not necessarily imply that the variable is higher (lower) in the vertical restraint equilibrium than in the first-best equilibrium.

The effects with respect to n are ambiguous. Several externalities tend to induce too few retailers. When setting n , the manufacturer ignores the benefits (at constant p and s) to the retailers as a group and to the consumers from higher sales due to another retailer. Moreover, the manufacturer balances its gain from an increase in n with its loss due to the reaction of retailers, although, from society's viewpoint, the manufacturer's loss is offset by gains to retailers and consumers. There is an offsetting effect leading to too many retailers since the manufacturer ignores the cost of providing service s borne by the marginal retailer.

Mathewson and Winter (1986) show how integration of the manufacturer and retailers, if feasible, would internalize one of these externalities, and hence might bring society "closer" to the first-best solution. If the costs of regulation are low, society can increase welfare by regulating such an industry.

One, albeit inefficient, way to control the industry is to allow the entry of foreign competition, which can reduce the retail price. At first glance, then, allowing foreign competition, possibly even subsidizing it, could be desirable. For z low enough ($z < p(q)$), the foreign competition has the effect of forcing a decrease in p , bringing it closer to the marginal cost. On the other hand, the distortion in the provision of services is exacerbated, since the retailers' profit margins shrink. As a result of these conflicting effects, welfare in the second-best world can rise or fall when foreign competitors enter the market.

An Example

We assume that a representative consumer's utility is given by

$$U = y + u(x,s), \quad (20)$$

where y represents all other goods, $u(x,s)$ is concave and increasing in x and s , and $\partial^2 u / \partial x \partial s > 0$ (x and s are complementary goods).

The typical consumer maximizes his or her utility subject to the budget constraint $y + (p + tl)Q < e$, where e is that consumer's income and l is the distance to the closest retailer. The consumer's surplus is $U - e = u + y - e = u(Q,s) - (p + tl)Q$.²⁵ The choice of $u(Q,s) = aQ(\mu \ln(s) + 1 - \ln(Q))$ leads to the demand function used in the example, equation (10).

Here, the first-best solution (from equations (18)) is determined by:

$$p = c \quad (18a')$$

$$s = \frac{2a^2\mu}{t} e^{-c/a} [1 - e^{-t/(an)}]^{1/(1-\mu)} \quad (18b')$$

$$n = \frac{t}{av}, \text{ where } v \text{ is the positive solution of } e^v = 1 + \frac{v}{1-\mu}. \quad (18c')$$

²⁵This approach is analogous to Salop (1979) and Mathewson and Winter (1986). Welfare is defined as the sum of consumers' utilities minus all costs (production, service, and transportation). This measure is equivalent to the sum of the consumers' surplus and the manufacturer's and retailers' profits.

In the absence of foreign competition, the vertical restraint equilibrium has a price above the first-best price equal to c [equation (18a')]. The effect of foreign competition is to force a decrease of price if the foreign price is low enough, moving price closer to c . If, however, the foreign price is between p^* and z_1 , a decrease in z leads to an increase in p .

Thus, in the vertically restrained equilibrium, an increase in tariffs may either increase or decrease welfare for a given group or the nation as a whole. Table 1 shows the ratios of the welfare, service, and price in the vertical restraint equilibrium to the corresponding first-best values for various values of z and μ , the elasticity of sales with respect to service. These results are independent of the number of retailers, which are the same in both the first-best and vertical restraint equilibrium. In the absence of foreign competition, the level of service in the vertical restraint equilibrium is below the first-best level. Increased foreign competition further reduces the level, until service and welfare go to 0 as z approaches c .

Figures 3 and 4 illustrate how, in the vertically restrained equilibrium, welfare varies with z and how the results depend on the sensitivity of demand to services, μ .²⁶ Figure 3 shows how welfare for each of the groups and total welfare varies with z , for $\mu = 0.8$.²⁷ At high levels of z , retailers are not constrained so welfare and profits are independent of z . When z falls to $z_1 = 2.24$, z becomes binding and the various welfare and profit measures (except

²⁶In all the diagrams, $a = 1$, $c = 1$, and $t = 1$.

²⁷For clarity, Figure 3 multiplies the manufacturer's and the retailers' profits by three.

π^m) are nondifferentiable at that point. As z falls further, welfare, consumer surplus, and manufacturer profits rise as the retail price falls more than service. Finally, as z falls further, all the welfare measures drop as service goes to zero.

Retailers are worse off in the presence of foreign competition than in its absence. When faced with foreign competition, however, retailers' profits may rise as z falls. In our example, when as z falls from $z_1 = 2.24$ to $c+a = 2.01$, retailers' profits rise by 11%. In this range, the decrease in the wholesale price offsets the decrease in the retail price.

This example shows that welfare and consumer surplus are maximized in the constrained region. At $z \geq z_1 = 2.24$, $W = .704$ and $CS = .586$. However, W reaches its maximum of .821 (17% higher than at $z \geq 2.24$) at $z = 1.83$ and CS reaches its maximum of .727 (24% higher) at $z = 1.79$. Given an initial z below that which maximizes welfare, increasing tariffs is desirable:

Theorem 2: In markets with vertical restraints, an increase in tariffs may increase welfare.

As Figure 2 shows, if z lies between w_1 and w_2 (where w_1 and w_2 are the bounds on welfare corresponding to the bounds z_1 and z_2 on π^m), decreased foreign competition (higher z) decreases welfare compared to the unconstrained equilibrium. If, however, z lies between z_1 and w_1 , a tariff high enough to prevent all imports would raise welfare.

Welfare is maximized when foreign goods are allowed to enter the domestic market and retail price equals an optimal z^* . If the foreign supply is infinitely elastic, the optimal tariff (or subsidy) equals $z^* - z$, where z is the price of foreign goods in the absence of governmental intervention.

Figure 4 shows the values of z that maximize various welfare measures as a function of μ , the elasticity of sales with respect to service. The z^* that maximizes total welfare is an increasing function of μ . When sales are more sensitive to service, sales decrease more when the retailers' profit margin decreases, and the service effect on welfare becomes more important than the price effect. Therefore, when μ approaches 1, cheap imports lower welfare below its maximum level. In contrast, when μ is low, the service effect is less important, and welfare is maximized at lower values of z .

Figure 4 also demonstrates the conflict between the various groups. While retailers never gain from foreign competition and prefer high tariffs, consumers and the manufacturer may gain from imports. As $\mu \rightarrow 1$, both consumers and the manufacturer want the same level of tariffs (so that $z = 2$ in the diagram). As $\mu \rightarrow 0$, the interests of the manufacturer and the consumers diverge. Consumers want a very low tariff since the service effect is negligible. A very low foreign price would force the manufacturer to reduce its wholesale price and hence its profit margin. In Figure 3, where $\mu = 0.8$, π^m reaches a peak at a higher z than does CS.

5. Conclusions

As import prices fall, retailers reduce service, so that domestic welfare may rise or fall. While retailers are always hurt by foreign competition, the manufacturer and consumers may gain. Thus, various interest groups disagree on the optimal tariff or subsidy.

These results stem from a market distortion caused by imperfect vertical restraints. These types of imperfect restraints are common (Lafferty, Lande, and Kirkwood (1984)). Were complete vertical intergration possible, there

would still be monopoly distortions, but the gains in terms of service would be eliminated, since the manufacturer would have complete control of services at all times. Here, foreign competition may help or hurt consumers, but unambiguously harms the manufacturer.

It remains to be shown how the story changes in the case of a gray market. This problem is more complex because the manufacturer competes with itself, whereas, in our analysis, the foreign competitors are separate entities. The same service effects hold, however, so that tariffs are sometimes desirable.

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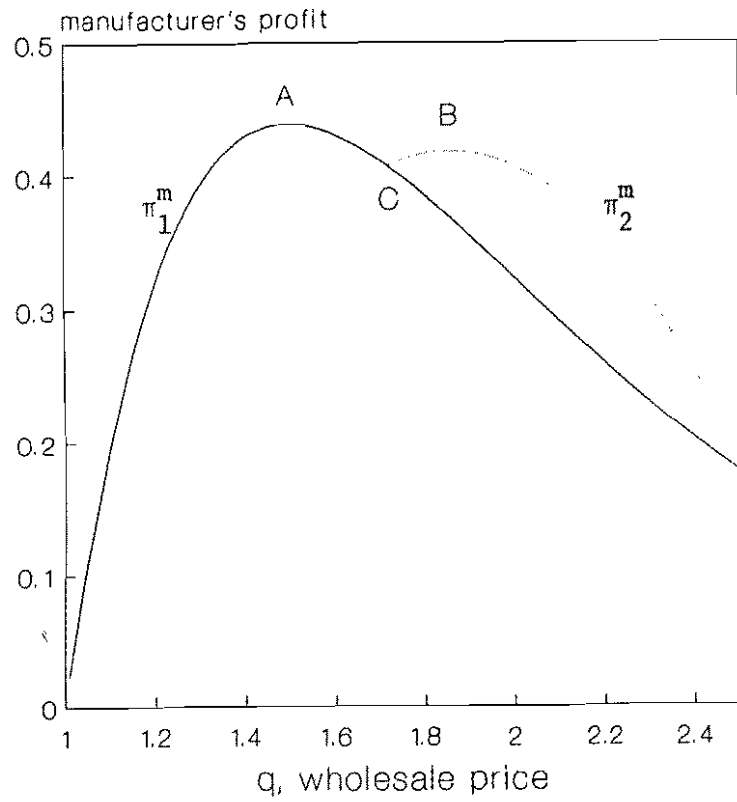
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Table 1
 Ratio of Vertical Restraint Equilibrium to First Best
 Price (p), Welfare (W), and Service (s)

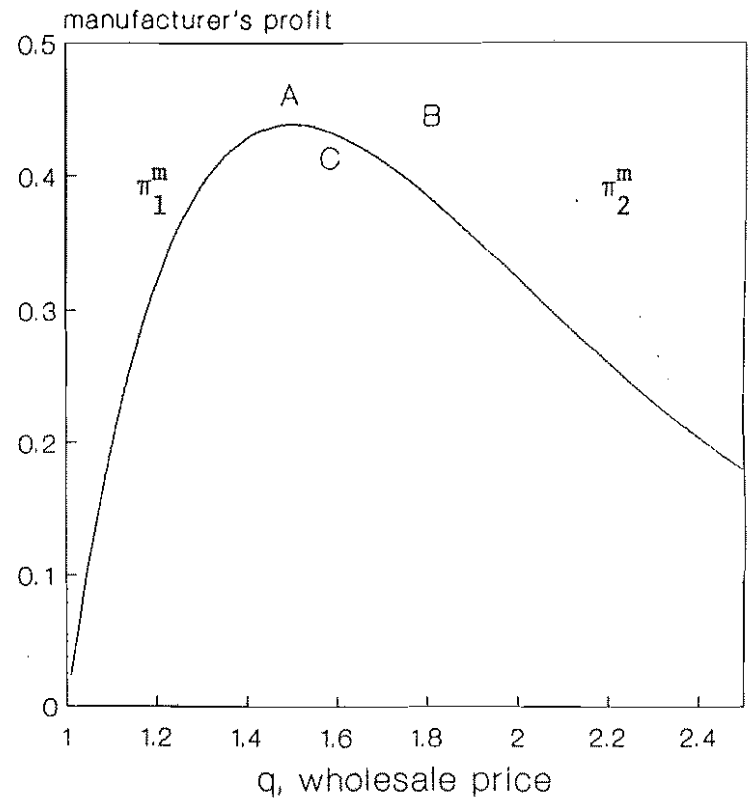
z	$\mu = .2$			$\mu = .5$			$\mu = .8$		
	p	W	s	p	W	s	p	W	s
∞	2.80	.343	.105	2.50	.199	.050	2.20	.017	.003
z_1	3.31	.185	.021	2.66	.135	.025	2.20	.015	.002
Second-Best Welfare Maximum	1.44	.559	.028	1.67	.264	.029	1.85	.020	.002
c	1.	.0	.0	1.	.0	.0	1.	.0	.0

Figure 1a



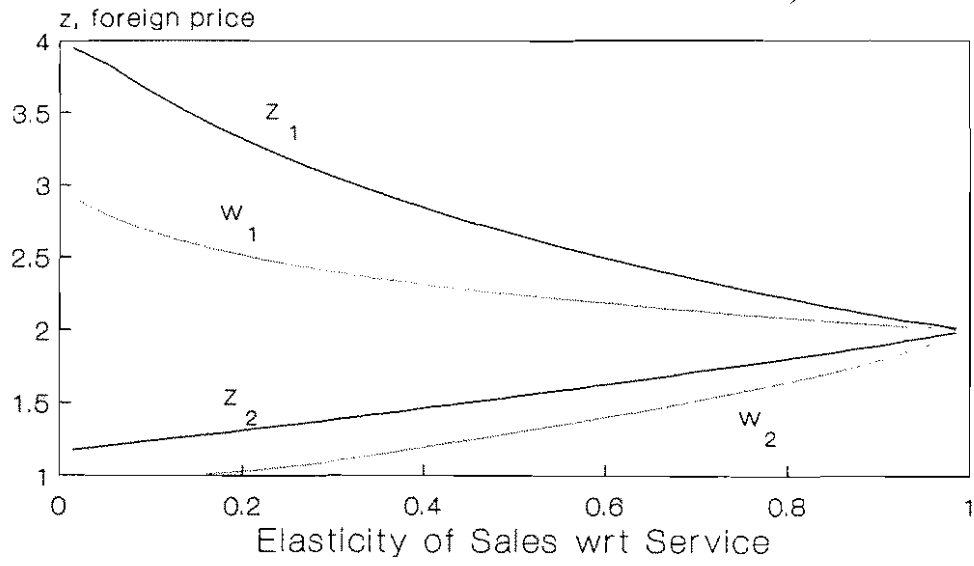
Constrained and Unconstrained
Manufacturer's Profit Curves

Figure 1b



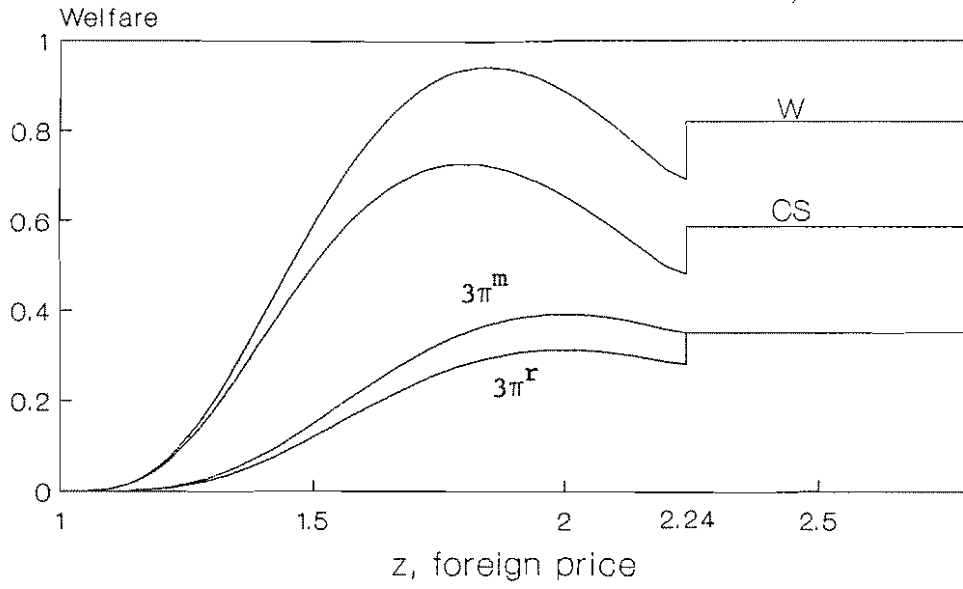
Constrained and Unconstrained
Manufacturer's Profit Curves

Figure 2



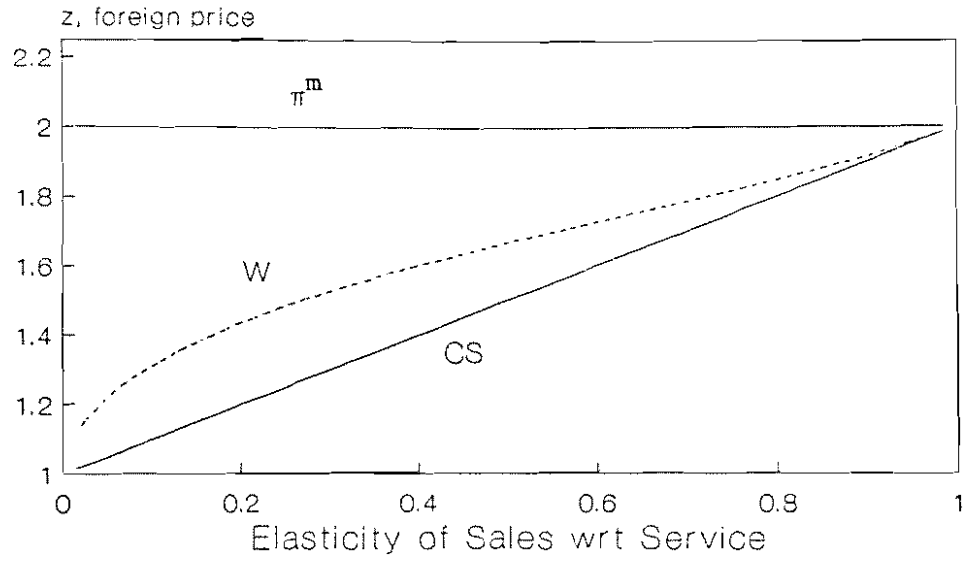
Bounds on Manufacturer's Profits
and on Welfare

Figure 3



Welfare Measures as a Function of z

Figure 4



The z that Maximizes various
Welfare Measures