

Price Discrimination.

Economies of Scale and Profits

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Abstract

We show that a price-discriminating monopolist facing two markets under economies of scale may sell in both markets even if one market is inherently unprofitable in the sense that price is always below average cost. The basic intuition is that higher profits in the profitable market due to economies of scale may exceed the losses incurred in the unprofitable market. I also use this intuition to explain the phenomenon of seemingly unprofitable dumping or international price discrimination.

I. Introduction

There has long been a debate in economics about whether third-degree price discrimination by a firm with monopoly power is socially beneficial or not. In fact, the debate goes all the way back to Pigou (1920) and Robinson (1933). There are two main reasons why third-degree price discrimination affects welfare - (1) the fact that different groups of buyers are charged different prices leads to a misallocation of output and (2) the total output under price discrimination may differ from total output under uniform pricing.

Schmalensee (1981), Varian (1985) and Schwartz (1990) show that welfare falls if total output is same or lower under price discrimination than under uniform pricing. That is, in order for price discrimination to yield a higher welfare, a necessary but insufficient condition is that total output be higher under price discrimination. In this connection, Hausman and Mackie-Mason (1988) argue that price discrimination is most beneficial when there are economies of scale. On the other hand, Layson (1994) shows that it is possible for economies of scale to decrease the welfare gains from price discrimination rather than increase them.

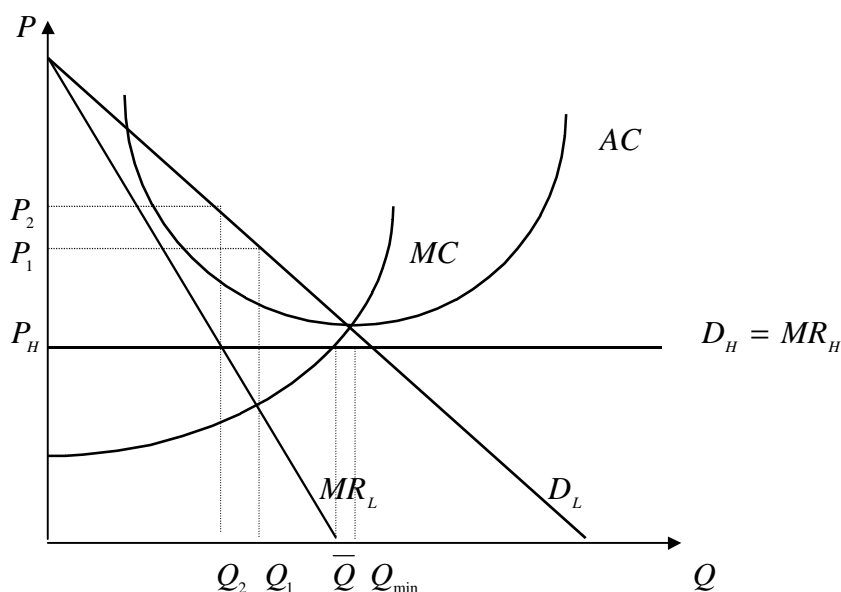
In this paper, I first show that it is possible for economies of scale to induce a price-discriminating monopolist to sell in an unprofitable market where the average cost exceeds always the price. Then I show that this may lower rather than raise welfare.

II. The Basic Model

I develop and make use of an extremely simple model which is illustrated in Figure 1 below. A single monopolist of a homogeneous good is assumed to face two groups of buyers with differing elasticities of demand. The demand curve D_H represents a group of buyers with a high elasticity of demand (hereinafter "H") while the demand curve

D_L represents another group with a low elasticity of demand (“hereinafter “L”). For simplicity and without any loss of generality, we assume D_H to be perfectly elastic at a price of P_H . In addition, the monopolist faces rising marginal costs and average costs which initially fall and subsequently rise.

Figure 1
Monopolist’s Optimum under
Sales to 1 Market and Sales to 2 Markets



As we can see in Figure 1, if the monopolist sells only to H, it would sell Q_1 at a price of P_1 . If the monopolist sells to both H and L, its marginal revenues are MR_L up to Q_2 and MR_H from Q_2 onward. The monopolist produces up to where its marginal cost equals its marginal revenue in both markets. The monopolist produces \bar{Q} , of which it sells Q_2 at a price of P_2 in the L market and the rest at P_H in the H market.

The monopolist’s minimum efficient size is Q_{min} . As Figure 1 shows, I assume average cost to exceed P_H , including at \bar{Q} . The monopolist thus incurs losses on all units it sells in Market H. Despite such inherent unprofitability of selling in Market H,

the monopolist can still sell in both Market H and Market L rather than only in Market L. We now explain this paradox.

Denoting inverse demand as $P(Q)$ and average costs as $\bar{C}(Q)$, the monopolist's profits when it sells only in one market (Market L), p_1 , are

$$p_1 = P_1 Q_1 - \bar{C}(Q_1) Q_1 = [P(Q_1) - \bar{C}(Q_1)] Q_1 \quad (1)$$

It is instructive to re-express (1) as

$$p_1 = [P(Q_1) - \bar{C}(Q_1)] Q_2 + [P(Q_1) - \bar{C}(Q_1)] (Q_1 - Q_2) \quad (1)'$$

The monopolist's profits when it sells in two markets (Market H and Market L) are

$$p_2 = P_2 Q_2 + P_H (\bar{Q} - Q_2) - \bar{C}(\bar{Q}) \bar{Q} = P(Q_2) Q_2 + P_H (\bar{Q} - Q_2) - \bar{C}(\bar{Q}) \bar{Q} \quad (2)$$

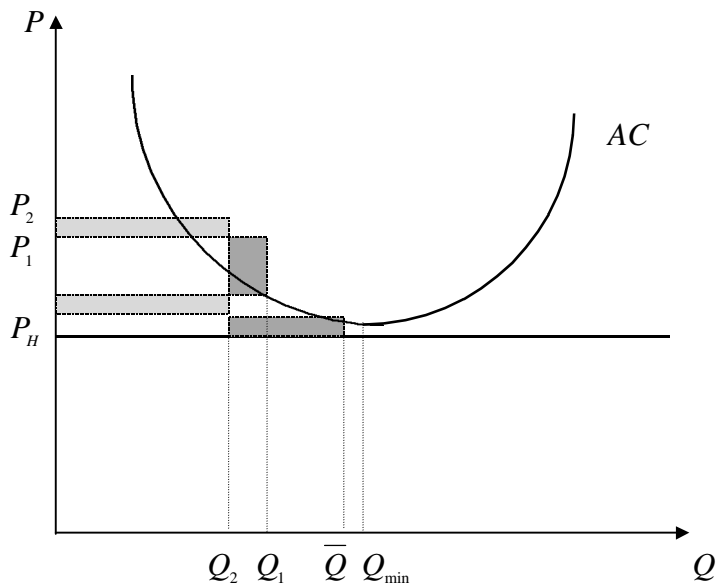
It is useful to re-express (2) as

$$p_2 = [P(Q_2) - \bar{C}(\bar{Q})] Q_2 + [P_H - \bar{C}(\bar{Q})] (\bar{Q} - Q_2) \quad (2)'$$

Relative to selling to only L, the monopolist's benefits or additional profits when it sells to both L and H are:

$$B = [P(Q_2) - P(Q_1)] Q_2 + [\bar{C}(Q_1) - \bar{C}(\bar{Q})] Q_2 \quad (3)$$

Figure 2
Monopolist's Gains and Losses
due to Selling in Both Markets



The upper light rectangle in Figure 2, or the first term on the righthand side of (3), measures the additional profits due to the reduction in sales to L and hence higher price received for each unit sold to L. The lower light rectangle, or the second term on the RHS of (3), shows the additional profits due to realization of greater economies of scale. Intuitively, since average costs are declining at Q_1 and selling in both markets results in a larger output ($\bar{Q} > Q_1$), selling in both markets reduces the average cost of producing all units, including those sold to L. Selling to H thus boosts profits in the L market for two reasons - higher price and lower average cost.

Relative to selling only to L, the monopolist's costs or losses when it sells to both L and H are:

$$C = [P(Q_1) - \bar{C}(Q_1)](Q_1 - Q_2) + [\bar{C}(\bar{Q}) - P_H](\bar{Q} - Q_2) \quad (4)$$

The upper dark rectangle in Figure 2, or the first term on the RHS of (4), simply reflects the reduction in profits due to the reduction in the amount sold in the L market when the monopolist sells in both markets. The lower dark rectangle, or the second term on the RHS of (4), stems from our assumption that the monopolist's average costs always exceed P_H and represents the direct losses due to selling in an unprofitable market.

Since $p_2 > p_1$ under our assumptions, the following must be true:

$$B - C = [P(Q_2) - P(Q_1)]Q_2 + [\bar{C}(Q_1) - \bar{C}(\bar{Q})]Q_2 - [P(Q_1) - \bar{C}(Q_1)](Q_1 - Q_2) - [\bar{C}(\bar{Q}) - P_H](\bar{Q} - Q_2) > 0 \quad (5)$$

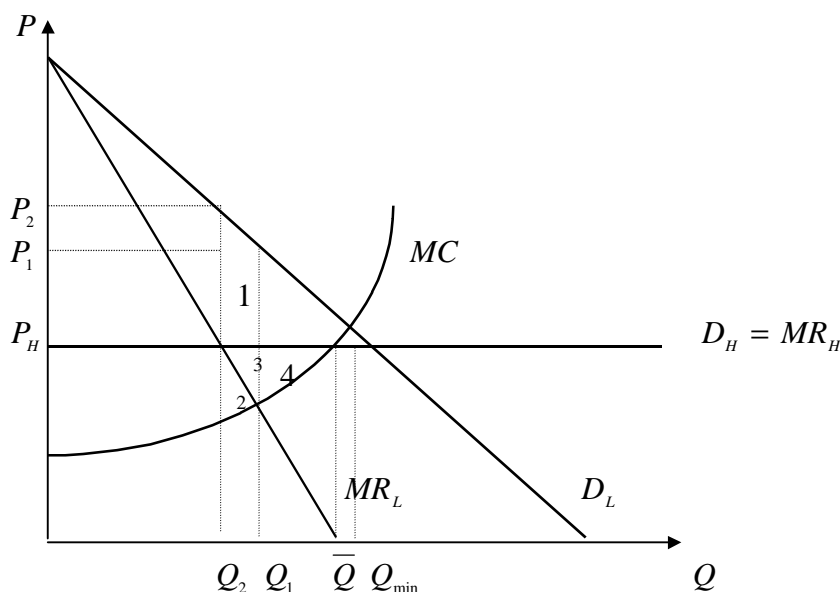
It is intuitively helpful to re-arrange (5) as follows:

$$[P(Q_2) - P(Q_1)]Q_2 + [\bar{C}(Q_1) - \bar{C}(\bar{Q})]Q_2 - [P(Q_1) - \bar{C}(Q_1)](Q_1 - Q_2) > [\bar{C}(\bar{Q}) - P_H](\bar{Q} - Q_2) \quad (5)'$$

The lefthand side of (5)' reflects the monopolist's net gain in the L market due to selling in both markets. Since the first two terms represent the increase in L profits and the third term indicates profits foregone by selling in both markets rather than selling in only the L market, subtracting the latter from the former gives us the net increase in profits from L. The righthand side of (5)' is the loss incurred in the H market. Hence (5)' gives us an intuitively appealing reason for why a price-discriminating monopolist might sell at a loss in an unprofitable market - "unprofitable" sales will be profitable after all if indirect benefits in the profitable market outweigh the direct costs incurred in the unprofitable market.

Let us now discuss the welfare implications of our main result that the monopolist may sell in both a profitable market and an unprofitable market when there are economies of scale. That is, does welfare, or the sum of consumer surplus and producer surplus, rise or fall when the monopolist sells in two markets rather than one?

Figure 3
Welfare under
Sales to 1 Market and Sales to 2 Markets



In Figure 3, the sum of regions 3 and 4 represent the increase in the monopolist's producer surplus due to selling in both markets rather than in only one market. The

sum of regions 1, 2 and 3 represent the loss of consumer surplus suffered by buyers in the profitable market. If the latter exceeds the former, then welfare would fall when the monopolist serves both markets. In the more general case where D_H is not perfectly elastic so that buyers in the unprofitable market enjoy a consumer surplus, we would have to compare the sum of this surplus and the increase in producer surplus with the reduction of consumer surplus in the profitable market. It is entirely possible that the former exceeds the latter, all the more so since output falls in the market where the buyers value the product more highly than in the other market.

III. An Application to Dumping

Dumping, or charging a lower price abroad than at home for a given product, is usually thought of as an international form of standard monopolistic price discrimination. A profit-maximizing monopolist which faces a higher elasticity of demand abroad than at home and can discriminate between the two markets will charge a lower price abroad than at home. However, this view of dumping cannot, in the absence of more, account for the following paradox - firms often appear to dump their products below costs.

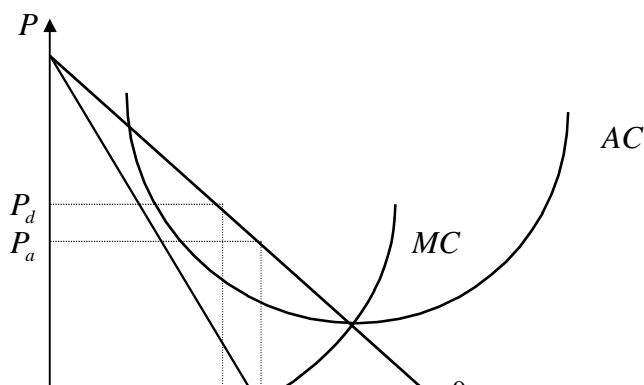
Recent literature suggests either demand correlation or demand uncertainty as possible explanations for the paradox. In a recent paper, Anam, Chiang and Shrestha (1996) show that when domestic and foreign demand are correlated, a covariance-based strategy can lead to dumping below costs. On the other hand, Ethier (1982), Davies and McGuinness (1982), Hillman and Katz (1986) and Blair and Chang (1984) show that when firms set output or price before demand is realized and the realized demand is lower than expected, firms may end up dumping below costs.

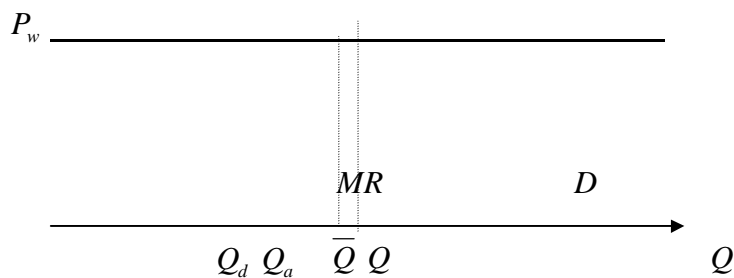
In this section, I provide an alternative explanation for seemingly unprofitable and hence irrational dumping by combining the dumping-as-price-discrimination theory

with the economies of scale-as-a-cause-of-trade theory. Krugman (1987, 1979) has formally shown that economies of large-scale production can be an independent source of international trade since trade expands the market and thus allows for greater exploitation of economies of scale. The main conclusion I obtain from combining the two theories is that if a monopolist dumps below costs when there are economies of scale, higher profits at home can more than offset losses incurred abroad.

I make use of the extremely simple model of dumping developed by Caves and Jones (1985) and illustrated in Figure 4 below. A single domestic monopolist of a homogeneous tradeable good is assumed to face a given world price, P_w . I assume that the domestic market is, for various reasons, closed to imports while the domestic monopolist is able to export; thus, trade means exports. Also, for simplicity, I ignore transportation costs.

Figure 4
Monopolist' Optimum under Autarky and Trade

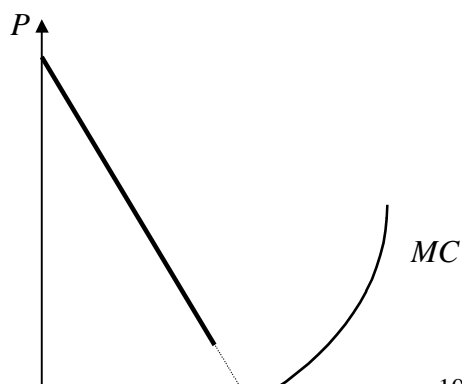


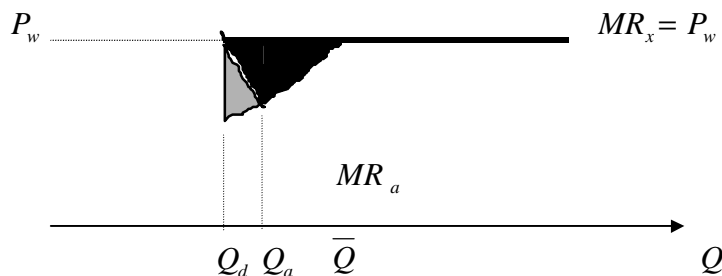


As we can see in Figure 4, at the monopolist's trade optimum, its marginal cost equals its marginal revenue in both the domestic and foreign markets. In the foreign market, marginal revenue is simply P_w . The monopolist produces \bar{Q} , of which Q_d is sold in the home market at a price of P_d and the rest is sold abroad at P_w . At its autarky optimum, the monopolist would produce and sell Q_a at P_a .

The monopolist's minimum efficient size is \underline{Q} . As we can see in Figure 4, I assume average cost to exceed the world price everywhere, including at \underline{Q} . The monopolist incurs losses on all units it sells abroad. In a very real sense, the monopolist has a comparative disadvantage since it would go out of business if the domestic market were opened up to imports. Despite the inherent unprofitability of exporting implied by such a disadvantage, the monopolist still exports since doing so as well as selling at home is more profitable than selling at home alone under our assumptions.

Figure 5
Monopolist's Gains and Losses
due to Trade





Up to Q_d , marginal revenues under autarky, MR_a , and marginal revenues under trade(exports), MR_x , are equal because those units are sold at home in either case. Beyond Q_d , marginal revenues are higher under trade than under autarky. Therefore, the relevant marginal revenue function facing the monopolist is the solid kinked line in Figure 5. The dark quasi-triangle there indicates the increase in profits due to exporting while the light quasi-triangle indicates the loss in profits due to exporting. Since the former exceeds the latter, exporting is profitable. But how can exporting be profitable when our assumption about the relationship between the monopolist's average costs and the world price appears to rule out profitable exports? Let us now resolve this paradox.

Resolving the paradox requires use of the main insight we derived in the previous section - selling in an unprofitable market may be profitable after all when there are economies of scale due to higher profits in a profitable market. Here we assume the unprofitable market to be the foreign market and the profitable market to be the domestic market. That is, we simply extend our analysis to an international setting.

Denoting inverse demand as $P(Q)$ and average costs as $\bar{C}(Q)$, the monopolist's maximum autarky profits, \bar{p}_a , are

$$\bar{p}_a = P_a Q_a - \bar{C}(Q_a) Q_a = [P(Q_a) - \bar{C}(Q_a)] Q_a \quad (6)$$

It is instructive to re-express (6) as

$$\bar{p}_a = [P(Q_a) - \bar{C}(Q_a)] Q_d + [P(Q_a) - \bar{C}(Q_a)] (Q_a - Q_d) \quad (6)'$$

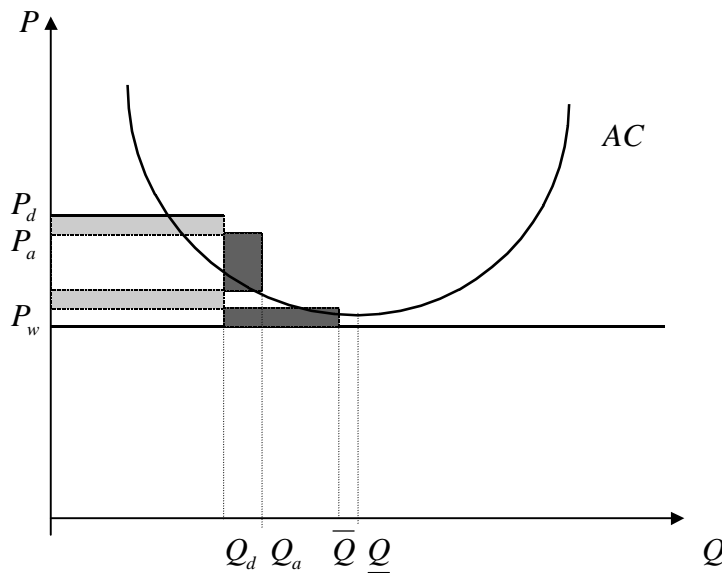
The monopolist's maximum profits under trade (exports) \bar{p}_x are

$$\bar{p}_x = P_d Q_d + P_w (\bar{Q} - Q_d) - \bar{C}(\bar{Q}) \bar{Q} = P(Q_d) Q_d + P_w (\bar{Q} - Q_d) - \bar{C}(\bar{Q}) \bar{Q} \quad (7)$$

It is useful to re-express (7) as

$$\bar{p}_x = [P(Q_d) - \bar{C}(\bar{Q})] Q_d + [P_w - \bar{C}(\bar{Q})] (\bar{Q} - Q_d) \quad (7)'$$

Figure 6
Monopolist's Gains and Losses
due to Trade: Another View



Relative to autarky, the monopolist's makes the following gains or additional profits under trade(exports):

$$GX = [P(Q_d) - P(Q_a)] Q_d + [\bar{C}(Q_a) - \bar{C}(\bar{Q})] Q_d \quad (8)$$

The upper light rectangle in Figure 6, or the first term on the righthand side of (8), measures the additional profits due to the reduction in domestic sales and hence higher price received for each unit sold at home. The lower light rectangle, or the second term on the RHS of (8), shows the additional profits due to realization of greater economies of scale. Intuitively, since average costs are declining at the autarky output and dumping results in a larger output ($\bar{Q} > Q_a$), dumping reduces the average cost of

producing all units, including those sold at home. Selling abroad thus boosts profits in the domestic market for two reasons - higher price and lower average cost.

Relative to autarky, the monopolist incurs the following loss under trade:

$$LX = [P(Q_a) - \bar{C}(Q_a)](Q_a - Q_d) + [\bar{C}(\bar{Q}) - P_w](\bar{Q} - Q_d) \quad (9)$$

The upper dark rectangle in Figure 6, or the first term on the RHS of (9), simply reflects the reduction in profits due to the reduction in the amount sold domestically under trade relative to autarky and the loss of profits earned on those units. The lower dark rectangle, or the second term on the RHS of (9), stems from our assumption that the monopolist is at a comparative disadvantage internationally; even its minimum average cost exceeds the world price. This loss involves a loss on an amount which would have been produced under autarky ($Q_a - Q_d$) as well as on the additional output due to trade ($\bar{Q} - Q_a$).

Since $\bar{p}_x > \bar{p}_a$ under our assumptions, the following must be true:

$$GX - LX = [P(Q_d) - P(Q_a)]Q_d + [\bar{C}(Q_a) - \bar{C}(\bar{Q})]Q_d - [P(Q_a) - \bar{C}(Q_a)](Q_a - Q_d) - [\bar{C}(\bar{Q}) - P_w](\bar{Q} - Q_d) > 0 \quad (10)$$

It is intuitively helpful to re-arrange (10) as follows:

$$[P(Q_d) - P(Q_a)]Q_d + [\bar{C}(Q_a) - \bar{C}(\bar{Q})]Q_d - [P(Q_a) - \bar{C}(Q_a)](Q_a - Q_d) > [\bar{C}(\bar{Q}) - P_w](\bar{Q} - Q_d) \quad (10)'$$

The lefthand side of (10)' reflects the monopolist's net gain in the domestic market due to exporting rather than remaining in autarky. Since the first two terms represent the increase in domestic profits under trade and the third term indicates domestic profits foregone by switching from autarky to trade, subtracting the latter from the former gives us the net increase in domestic profits or, net gain in the domestic market associated with dumping. The righthand side of (10)' is the external loss due to dumping. This loss is the net loss since there are, by definition, no exports under

autarky. Hence (10)' gives us an intuitively appealing reason for why a monopolist with comparative disadvantage might dump at a loss abroad - "unprofitable" exports will be profitable if indirect gains at home outweigh the direct losses incurred abroad.

IV. Concluding Remarks

This paper points out that when economies of scale are present a price-discriminating monopolist may sell in a market which is unprofitable in the sense that the price always falls below average costs. The main insight here is that selling in both the profitable and unprofitable markets enables the monopolist to enjoy the benefits of greater scale economies - lower unit costs - without suffering from the consequences of the Law of Demand - lower price due to greater output - because all the additional output is sold in the unprofitable market. Quite interestingly, welfare may decrease rather than increase when the monopolist serves both markets instead of only the profitable market. Intuitively, although the monopolist will serve both markets if doing so is profitable, the loss of consumer surplus suffered by the buyers with less elastic demand may more than offset the sum of the gain in the monopolist's profits and the consumer surplus enjoyed by the buyers with more elastic demand.

We then extend our analysis to the phenomenon of dumping or international price discrimination. Under our assumptions, dumping involves a loss in the foreign market as well as a net gain in the domestic market for the monopolist. If the net gain outweighs the loss, it pays the monopolist to dump even though dumping is unprofitable per se. The domestic net gain, in turn, is ultimately due to economies of scale. The higher domestic price resulting from lower domestic sales under trade does not, in and of itself, bring about higher profits - otherwise, the monopolist could not have been maximizing its autarky profits to begin with. What does unambiguously raise domestic profits is the larger total production under trade relative to autarky. This

lowers average costs without adversely affecting the domestic price since all the additional output is sold abroad. That is, in the context of the domestic market, dumping abroad enables the monopolist to enjoy the benefits of greater scale economies - that is, lower average costs - without suffering the consequences of the law of demand.

This paper suggests that firms with market power in a protected market may dump primarily as a means of making higher profits at home rather than penetrating foreign markets. This stands on its head the widely held view that dumping is an international form of predatory pricing. As was shown, dumping at a loss may be inconsistent with profit maximization by a monopolist, even in the short run. Furthermore, seemingly unprofitable dumping could persist as long as domestic gains are large enough to compensate for the external losses. Finally, stylized evidence suggests that dumping often involves firms with market power in relatively closed home markets dumping below costs in more open foreign markets. Thus, our central result appears to have at least some empirical relevance.

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