Price Discrimination and Economic Efficiency

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Can price discrimination be a superior alternative to regulation? In markets where firms do not earn a rate of return at least equal to the opportunity cost of capital, they have several choices. One is when revenues fail to cover even fixed costs, in which case they should exit the market. A second is to look to government subsidies to help them cover the difference between total revenues and total costs. The only problem with such a subsidy is that it tends to foster moral hazard, i.e., firms lose the incentive to pursue technical efficiency when they know that a subsidy will be forthcoming and average costs rise as long as the subsidy is unbounded. A third option is to look to regulation to enable them to set prices in a way that will enable them to match costs and revenues equal to the opportunity cost of capital. Here too there is a problem with moral hazard. Such regulated firms may over-invest in capital to cover variations in demand unmatched by a corresponding degree of flexibility in prices, a phenomenon dubbed the Averch-Johnson effect by two economists who observed this practice in regulated utilities in the 1950's and 1960's.

The fourth option is to use price discrimination. While price discrimination has been exercised by regulated firms under the presumption that they have market power, there is no compelling evidence that these two conditions are linked. To illustrate their separability, market power requires that a firm can reduce output and raise prices above what they would be in a more competitive industry. In the numerical example below, we show that price discrimination can increase a firm's weighted average price across two differentiated markets, but that output does not change. How much price should deviate from marginal cost depends on the underlying own-price elasticities of demand in the respective markets. Our numerical example illustrates the principle of Ramsey pricing, i.e., that where price discrimination is used, there will be a higher price in those markets with a lower own-price elasticity of demand, and a corresponding lower price in those markets with a higher own-price elasticity of demand in comparison to the standard profit-maximizing solution. As our numerical example also shows, while prices will differ across markets, total output does not change from the undifferentiated solution, in which case the firm cannot be said to be exercising market power.

One additional point is who exercises the "power" to engage in the price discrimination. Our example is based on no government regulation, and is driven by the simple fact that in the absence of some form of price discrimination, the firm would be unprofitable. A commonsense answer is that consumers themselves may maket market segmentation possible by virtue of their differential own-price elasticities of demand rather than the fact that a price discriminating firm is forcing them to adopt choices they otherwise would not exercise. How, then are markets segmented beyond the identification of differential own-price elasticities of demand? Geography, income, the size of segmented markets, and the number of firms competing in such markets each play a role. What also is significant is that the number of firms will vary according to their own level of technical efficiency, i.e., some firms manage their costs better than others, even in the face of universally accessible information sets on production and management choices. However, even in the presence of a significant number of firms, price discrimination may still be possible even if all firms have the same cost functions. This does not depend on collusion among competing firms, but again, on differences in the own-price elasticity of demand in individual markets.

Much has been said about the role of sunk costs serving as a significant barrier to entry in some industries, e.g., airline landing slots and equipment. While sunk costs can be significant (and they show up in our numerical example as the intercept term of the firm's cost function), they are probably less significant than they may appear. For example, new startup firms can lease rather than purchase equipment, and this provides much greater flexibility in the level of fixed costs. Secondly, if, in the case of airlines, there is a shift toward the use of auctions, and more to the point, options, on the leasing of airport terminal landing slots, this also may be less of a barrier than first meets the eye. As to separability, our example depends on a firm not being able to separate costs across segmented markets, in which case the problem is how to allocate total costs in the most efficient manner, for which price discrimination may be the most effective solution.

Finally, while price discrimination may be necessary and sufficient to achieve economic efficiency, firms do not have an unlimited ability to differentiate prices across sub-markets. One reason why this will be so is that once price discrimination is introduced, it may actually increase competition by virtue of making profitable the entry of low-fixed-high-marginal cost firms. This was clearly the case before AT&T was restructured in that excess returns from long-distance service that had been used to subsidize universal local service made profitable the entry of new firms such as MCI that could bypass the large fixed costs of a land-based transmission system.

With these considerations in mind, let us now consider the following numerical illustration:

TC =	450.00	+22.00 Q	(the firm's total cost function)
Q =	36.75	-0.45 P	(the firm's functional demand)

1. If there is only one firm in the market, determine the profit-maximizing level of output, the corresponding market price, and the level of total revenue:

a. Inverse demand function:

0.45 P =	36.75	-1 Q
P =	81.67	-2.22 Q

b. Total revenue function:

$$TR = PxQ = 81.67\ Q \quad -2.22\ Q^2$$

c. Marginal revenue function:

MR = δTR/dQ =	**81.67**	**-4.44**	**Q**

d. Marginal cost function:

MC = δTC/dQ =	**22.00**

e. Profit-maximizing level of output:

(MR = MC) =	**81.67**	**-4.44**	**Q =**		**22.00**
Q_{opt} =	**13.425**	**Pe =**	**$51.83**		

The point own Price point elasticity of demand is: **-1.7374**

f. Market equilibrium:

TR =	**$695.86**
TC =	**$745.35**
Profit =	**-$49.49**
Rate of Return on Sales	**-7.11%**
Opportunity cost of capital =	**10.00%**

g. Suppose the market now can be segmented into the following two units:

Qa =	**12.86**	**-0.2375**	**Pa**
Qb =	**23.89**	**-0.2125**	**Pb**

h. Derive the new market equilibrium conditions, beginning with the inverse demand functions:

Pa =	**54.16**	**-4.21**	**Qa**		
Pb =	**112.41**	**-4.71**	**Qb**		
TRa =	**54.16 Q**			**-4.21**	**Qa^2**
TRb =	**112.41 Q**			**-4.71**	**Qb^2**
MRa =	**54.16**	**-8.42**	**Qa**		
MRb =	**112.41**	**-9.41**	**Qb**		
(MRa=MC)=	**54.16**	**-8.42**	**Qa =**	**22.00**	
(MRb=MC)=	**112.41**	**-9.41**	**Qa =**	**22.00**	
Q_{opt}(a)=	**3.82**	28.45%	Market (a) share		
Q_{opt}(b)=	**9.61**	71.55%	Market (b) share		
Q(a)+Q(b)=	**13.425**	100.00%	Total Market quantity		

(*n.b* ., the same as the undifferentiated level)

i. Price discriminating prices and total revenues will be:

Pa =	**$38.08**	Own Price point elasticity value is:	-2.3682	(compare this Ramsey solution
Pb =	**$67.21**	Own Price point elasticity value is:	-1.4867	with the original)

The weighted average price thus is:

($38.08)x 0.28	**+**	**($67.21)x 0.72**	**=**	**$58.92**

j.

TRa =	**$145.41**	
TRb =	**$645.60**	
TR(a+b)=	**$791.01**	
TC =	**$745.35**	
Profit =	**$45.66**	
RR Sales =	**5.77%**	(= Economic Rate of Return)
OCC =	**10.00%**	(= Opportunity Cost of Capital)
ARR =	**15.77%**	(= Accounting Rate of Return)

In this example, price discrimination with just two markets enables an otherwise unprofitable firm to achieve a sustainable price and output configuration. However, the resulting economic profit arising from the higher priced market is likely to attract new entrants. In the limit, lowering the price differentials across markets may bring the firm to normal profitabilty (i.e., zero economic profitability), but it still does not eliminate the potential for new entrants into the higher priced segment. Technology thus counts and may force otherwise profitable firms to account for the limits to price discriminating strategies, i.e., there is no guarantee that market segmentation can result in a sustainable configuration for an individual firm.

Figure 1

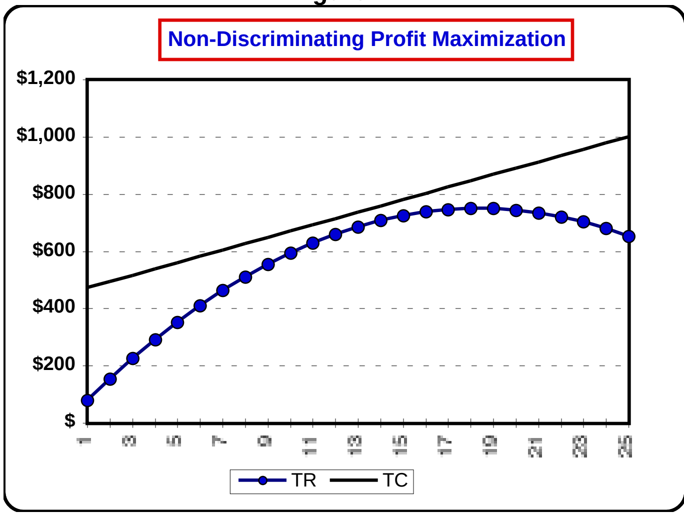

Figure 2

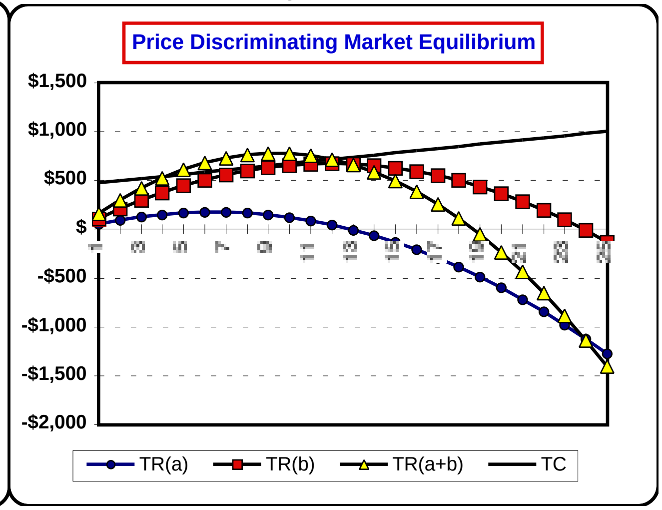

Figure 1 shows that for positive marginal costs, there is no sustainable output configuration for the firm in a non-segmented market. Figure 2 displays the total revenue functions of the two segmented markets, along with an augmented total revenue function that combines them both to indicate the range of profitable output configurations. As noted above, whether in the end a firm can perpetuate its pattern of price discrimination depends on the response not just of other firms already in the market, but also on the extent to which the relatively higher price in one market attracts new entrants. As long as entry barriers are not significant, the price discriminating firm can be constrained purely by market forces alone to produce a pricing and market segmentation pattern consistent with normal profits, i.e., no economic profits, a result consistent with the standard competitive model.