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## **Strategies and evaluating strategic choices of firms and consumers**

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**Abstract:** The purpose of this note is to introduce how to evaluate strategic choices of the firm using economic principles. The procedure is based on simple cost benefit considerations such as building on the economic principles of incentive compatibility constraints based in Game Theory.

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## 1. Introduction

The purpose of this note is to introduce how to evaluate strategic choices of the firm using economic principles. The procedure is based on simple cost benefit considerations such as building on the economic principles of incentive compatibility constraints based in Game Theory.

## 2. Strategies and Nash equilibrium

In Game theory consumers or firms (agents) are the object of interest, as they make choices relevant in economics. Their choices are made by them considering the profit or utility they get with regard to the choice. If a set of or a choice provides more profits than other choices then it is said to be dominant strategy of the agent.

### Strongly and weakly dominant strategies

A strategy  $x_i \in X_i$  of player  $i$  is called a *strongly dominant strategy* if for every other strategy  $x_i' \neq x_i$  and every strategy profile  $x_{-i} \in X_{-i}$  of the other players, it is the case that  $u_i(x_i, x_{-i}) > u_i(x_i', x_{-i})$ , which is it provide a higher pay-off than all other strategies given other players' strategies.

A strategy is called a *weakly dominant strategy* if it is the case that  $u_i(x_i, x_{-i}) \geq u_i(x_i', x_{-i})$ , which is it provide a higher or just as good a pay-off than other strategies given other players' strategies.

In game theory the most prominent solution concept is Nash Equilibrium (NE). A NE consists of the best reply an agent can make given the best reply of other players. The best reply of a player in a NE is a strongly or weakly dominant strategy, which means that for an agent would never choose a strategy that provide a lower payoff if a different strategy leads to a higher payoff, but always choose a strategy that provide a payoff at least as high as any other strategy that the firm has, assuming that the other agents adopt their own equilibrium strategies in the same way.

### Definition of Nash equilibrium or the optimal strategic choice

The profile of strategies  $x^* = (..., x^*, ...)$  is a Nash equilibrium if for every player  $i \in I$ , the strategy  $x_i^*$  is a best reply to the strategy profile  $x_{-i}^* = (..., x_j^*, ...)_{j \neq i}$  of the other players.

This sets the stage for how to evaluate strategic choices of firms and consumers.

## 3. The strategic choices of a monopolist

The last section showed us that the optimal strategic choice of a firm is the set of dominant strategies or the dominant strategy that provide the highest possible payoff given the best strategy or

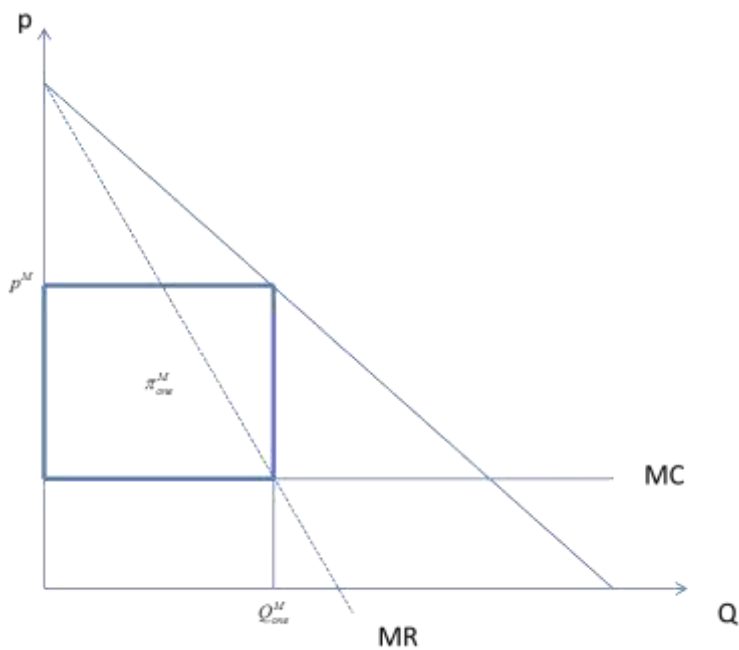
best reply of other firms. Thus, to evaluate two optimal strategies under different assumptions about firm behaviour or the market in which it operate in we have to compare the payoff of the firm in each case. The case with the highest possible pay-off is then the best strategy of the two.

To understand how this works in practice the following two cases of strategic choice of a monopolist. The strategic choices we will evaluate are the incentives the monopolist receives by the mutual exclusive strategies of setting one price versus setting many prices.

If the monopolist sets one price it uses the uniform pricing condition of setting its marginal revenue equal to its marginal costs, whereas many prices imply that the monopolist uses its knowledge about consumers to set prices equal to each consumer's reservation price which is the price equal to the consumer's maximum willingness to pay.

Under uniform pricing the monopolist's objective is to maximize the area  $\pi^M$  in the below figure (Figure 1).

Figure 1. Uniform pricing and resulting profit of a monopolist



The optimal price choice is the monopoly price  $p^M$ , as it provides the highest possible pay-off to the monopolist. Thus, it is the price that dominant all other uniform price choices and given that the monopolist is the only player on the market, it is also the NE of the game. The profit of the monopolist is the incentives the firm receives when choosing the uniform pricing strategy and we need to calculate this to assess whether the uniform monopoly price is dominant to a strategy where the monopolist is charging many prices.

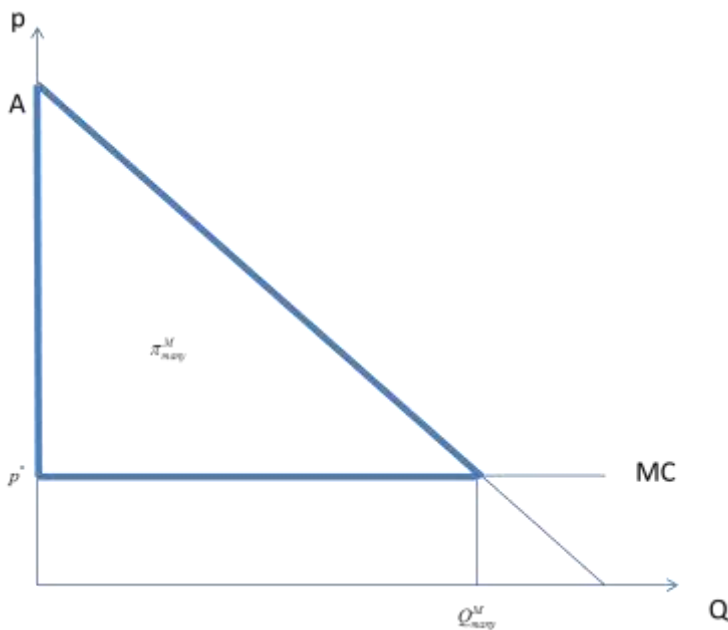
The monopolist profit when setting a uniform price is,

$$\pi_{one}^M = (p^M - MC)Q^M \quad (1.1)$$

A strategy of charging many prices of a monopolist for the same product require that the monopolist is able to identify the maximum amount each consumer or consumer group is willing to pay for the product. If the monopolist is able to do so, it is able to price discriminate among its customers. Assuming that it is able to identify all its customers' willingness to pay, the first degree price discrimination is the optimal solution for it. This implies setting all the prices in the interval  $p = [p^*, A]$  as this provides the highest possible pay-off to the monopolist in Figure 2. This set of prices is a dominant strategy to any other possible subset of prices consisting of more than one price and given that the monopolist is the only player on the market, it is also the NE of the game. The profits to the monopolist is the area  $\pi_{many}^M$  which is,

$$\pi_{many}^M = \frac{1}{2}(A - MC)Q_{many}^M \quad (1.2)$$

Figure 2. Setting many prices and resulting profit of a monopolist.



#### 4. Evaluating the strategic choices of the monopolist

Comparing the profit of the monopolist in the two cases it is easy to see that,

$$\pi_{one}^M < \pi_{many}^M \quad (1.3)$$

Thus, whenever possible the monopolist will prefer to set many prices to setting a uniform price.

An analysis of strategy can have many levels. So far the analysis have been from the point of view of the firm, but we could also take other considerations into account for example evaluate the strategies from a society perspective by considering the strategies in the light of the impact on social welfare or consider what effect competition authority scrutiny would have on the strategic choices of the monopolist. We will do this in turn below.

#### Society perspective (neoclassical approach)

Assessing the impact of the pricing choices of the monopolist, we have to make assumptions about the calculation of social welfare like what do we include in the measure. To make things simple we will consider social welfare and the effects of the two pricing strategies as the sum of consumer surplus (CS) and producer surplus (PS) compared to the optimal social welfare level, which is that under perfect competition.

In the case of perfect competition the social welfare is using the drawing in Figure 2,

$$\begin{aligned} W^* &= CS^* + PS^* \\ \Downarrow \\ CS^* &= \frac{1}{2}(A - MC)Q_{many}^M \\ PS^* &= 0 \\ \Downarrow \\ W^* &= \frac{1}{2}(A - MC)Q_{many}^M + 0 \end{aligned} \quad (1.4)$$

Evaluating if the strategies of the monopolist is preferable from the point of view of society imply evaluating the following,

$$W^M - W^* = 0 \Rightarrow \begin{cases} > \\ > \\ > \end{cases} \left\{ \begin{array}{l} > \\ W^M = W^* \\ < \end{array} \right\} \Rightarrow \begin{cases} \text{strategy is preferable from social perspective} \\ \text{strategy is preferable from social perspective} \\ \text{strategy is not preferable from social perspective} \end{cases} \quad (1.5)$$

Thus what we have to do to evaluate if a uniform pricing strategy is preferable from a society perspective is to evaluate,

$$\begin{aligned}
& > \\
CS_{one}^M + PS_{one}^M - CS^* - PS^* &= 0 \\
& < \\
\Downarrow \\
CS_{one}^M &= \frac{1}{2}(A - p_{one}^M)Q_{one}^M \\
PS_{one}^M &= (p_{one}^M - MC)Q_{one}^M \\
\Downarrow \\
\frac{1}{2}(A - p_{one}^M)Q_{one}^M + (p_{one}^M - MC)Q_{one}^M - \frac{1}{2}(A - MC)Q_{many}^M - 0 &= DW_{one}^M < 0
\end{aligned} \tag{1.6}$$

Due to the dead-weight characterising uniform pricing of monopolies, then from a society perspective uniform pricing is not preferable.

In the case of many prices the evaluation entails the same. Thus,

$$\begin{aligned}
& > \\
CS_{many}^M + PS_{many}^M - CS^* - PS^* &= 0 \\
& < \\
\Downarrow \\
CS_{many}^M &= 0 \\
PS_{many}^M &= \frac{1}{2}(A - MC)Q_{many}^M \\
\Downarrow \\
0 + \frac{1}{2}(A - MC)Q_{many}^M - \frac{1}{2}(A - MC)Q_{many}^M - 0 &= 0
\end{aligned} \tag{1.7}$$

Thus, from a society perspective many prices are preferable.

### Competition authority perspective

Competition authorities (CAs) also consider the impact of concentrations has on social welfare, but they distinguish themselves from other analytical approaches by only considering the impact on consumer surplus.

The impact of the pricing strategies of the monopolist is from the perspective of CAs,

$$\begin{aligned}
& \left\{ \begin{array}{l} CS_{one}^M > 0 \\ CS_{many}^M = 0 \end{array} \right. \\
\Downarrow \\
(\text{uniform price})_{CA} &> (\text{many prices})_{CA}
\end{aligned} \tag{1.8}$$

Thus, a uniform price is preferable to many prices as many prices do not leave any CS to consumers, whereas uniform pricing does.

## 5. Bringing it all together

The existing practice of CAs towards price discrimination shows, that CAs realize that price discrimination does improve social welfare as long as the pricing is not loyalty inducing or provide too excessive incentives to customers to repeat their purchases from the price discriminating firm. Since this is a matter of taste more than anything else, it is reasonable to assume that in some cases CAs will find price discriminatory behaviour of firms for anti-competitive and apply fines and penalties to firms that engage in such practice.

If this is the case the CAs introduces disincentives towards firms using many prices. Thus, the appropriate incentive constraint to consider for a monopolist is,

$$\begin{array}{c} > \\ \pi_{one}^M = (1 - \beta)\pi_{many}^M - \beta\Phi \\ < \end{array} \quad (1.9)$$

Where  $\beta$  is the probability of being found anti-competitive ( $0 \leq \beta \leq 1$ ) and  $\Phi$  is the fine or penalty the firm will get in that case. The left hand side is the profits from a uniform price strategy and the right hand side the expected profits from using price discrimination or many price strategy.

The overall impact on social welfare now depend on to what degree the CAs actively pursue firms charging many prices as well as the size of the fine applied. The choices can be seen as CAs' policy variables and as how an activity from an authority can intervene into the functioning of a market.

## 6. Conclusion

Strategic choices of firms and consumers in a more complex setting are naturally a lot more than the above have shown. Nevertheless the idea of this paper is not to involve the reader in a complex decision making framework but to exemplify how the strategic interaction of firms, competition policy and standard welfare economic considerations work together.



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