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Limit Pricing under Complete Information: A Theoretical Analysis of Mobile network Operators

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Abstract:
Limit pricing is a very interesting issue in industrial organization. This is a case where firms with market power, when faced with a threat of market entry, charge a very low price that is lower than their marginal cost for their products or services in order to prevent the entry of new potential competitors or prevent their smaller competitors from expanding their business. This they do to protect their market dominance. After successfully deterring entry, the incumbent firms then revert to charging higher prices. Previous theoretical studies show that this strategy is viable in the presence of information asymmetry. Competition Authorities and other regulatory agencies treat limit pricing as anti-competitive and illegal. This research paper theoretically analyses limit pricing among telecommunications companies by way of linear demand equations within an oligopoly framework involving one dominant incumbent and fringe firms under complete information. The analysis proves that dominant firms can use their market power to engage in limit pricing in the absence of information asymmetry concerning the true operating costs among the incumbents. This finding is of great help to Competition Authorities and other policy makers in ensuring that dominant firms do not abuse their market power. This ensures fair competition among all the market players irrespective of their market share.

Keywords: Limit Pricing, Complete Information, Dominant firms, Fringe firms, Entry deterrence.

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I. INTRODUCTION

It is widely accepted that when an established firm faces a threat of entry from a potential competitor, it will discourage the entry by charging a price below its short run profit maximizing level to affect the potential entrant's perception of the profitability of entering the market (Bain, 1949). Given that the incumbents are aware that their profits will reduce with new entry, they will not sit idly as their markets are threatened. Faced with potential entry, the incumbent has a host of entry deterrence mechanisms available including excess capacity, increased advertising, Research and Development investment and limit pricing (Smiley, 1988; Sigh et al, 1998).

A limit pricing strategy is one in which the incumbent firm uses low prices to signal it has low costs to a potential entrant (Bain, 1949). If the signal is effective, the potential entrant will believe that it will make a loss when it enters the market. Therefore, the best option for the potential entrant is to stay out. In this case, the incumbent firm successfully deters entry through limit pricing. Milgrom and Roberts (1982) show that this strategy works only under asymmetric information. This is a situation where the potential entrant or the existing competitor does not know the true operating costs of the incumbent. Many authors within the context of multiple incumbents have also supported this strategy of limit pricing. To mention but a few, Bagwell and Ramey (1991) and Schultz (1999) show that incumbents' first period prices may be used as a signal of their unknown costs under a rational set of expectations. However, there is no previous theoretical study, which has analysed limit pricing within the context of market dominance in the absence of information asymmetry. Theoretically, the study shows that the price of the dominant incumbent can affect market entry by the potential competitors and market expansion by the fringe (smaller) competitor. This study contributes to the existing body of theoretical literature on limit pricing by showing that even in the absence of information asymmetry, it is possible for a dominant incumbent firm to engage in limit pricing.

II. LITERATURE REVIEW

Limit pricing theory explains how price manipulation by an existing firm in before-entry periods can alter the entry decision of other potential competitors by influencing their perception of after-entry profitability. Bain (1949) explained two scenarios under which current prices can deter entry. To begin with, a low current price may make the potential entrants to believe that present and future market conditions are not favourable to actual market entry. Next, a low current price can signal to potential entrants on some information concerning the incumbent's reaction to market entry. The initial generation of theoretical models focused majorly on this second scenario and laid much emphasis on models that were not static in nature, a criteria which is relevant to the ongoing analysis concerning relationships of competing firms. This literature examined a number of equilibrium limit price-paths. However, the theoretical frameworks had a shortcoming as revealed by Friedman (1979): the models assume that the potential entrants will react in a certain manner rather than deriving the appropriate reaction function under rational decision-making. This results into unrealistic equilibrium solutions. A potential entrant that models the future well will find that it will not make sense for operating firms not to change their before-entry price when faced with sudden entry. Given this, with standard assumptions, before-entry pricing will not influence the entry decision of potential competitors and therefore limit pricing will not happen. Milgrom and Roberts (1982) provided solution to this limitation by transforming the problem as one of information asymmetry. They model a case

of one operating firm facing one potential entrant, with all the two firms being ignorant of each other's operating costs. The operating firm is either a high-cost firm or a low-cost firm. If the entrant firm makes profits in case the operating firm is high- cost and losses in the event that the operating firm is a low-cost, then operating firm may try to signal to the entrant that it is a low-cost type consequently deterring its entry. This is an important analysis; however, it assumes that there is no uncertainty in the environment other than costs. However, in a real-life situation we normally experience a situation in which we have at least one operating firm with private information on cost within a given market involve more than one. A case in point is in oligopolistic markets where privately informed operating firms may use their price or output levels to signal to potential entrants that market entry is not profitable. These oligopolistic firms may also use advertising to signal to consumers that the quality of their products and services is high. Harrington (1987) shows that equilibrium solutions obtained in markets with one operating firm are synonymous with the solutions obtained after analyzing markets with more than one operating firm. He analyses a quantity competition game of limit pricing under which two operating firms with similar hidden operating costs first choose their output levels leading to a market price that influences the market entry decision of a potential competitor. Harrington shows that an equilibrium solution under which output can be distorted exists and that the potential market entrants only observe the aggregate market price and not the individual outputs of the involved operating firms.

Bagwell and Ramey (1991) acknowledge the importance of the analysis by Harrington (1987) on the issue of signaling to the potential market entrants via aggregate market price that entry is not profitable. In their analysis, the entrant observes the incumbents' individual prices and an equilibrium solution exists whereby the operating firms may be able deter market entry without distorting their prices from their full information levels. They define unprejudiced beliefs as the smallest number of deviations required to create a specific out-of-equilibrium price mix. They then show that the equilibrium under full information is the only separating equilibrium that satisfies the unprejudiced beliefs (UPB) refinement. Their results are interesting and imply that there may exist a big disparity between equilibrium solutions within markets with one operating firm and markets with at least one operating firm. Martin (1995) analyses limit pricing in an oligopoly setting within the two categories of strategic substitutes and strategic complements. He outlines the scenarios under which it is a sequential equilibrium for firms to sacrifice part of their profits to reduce the chances of market entry, if there is information asymmetry between operating firms and potential market entrants. The study shows that limit pricing as a strategy is more viable when strategic substitutes are involved between the operating firms and potential entrants than when strategic complements are involved. Shultz (1999) examines limit pricing when operating firms have conflicting interests. The analysis considers entry into a market with two operating firms where one firm prefers entry and the other firm does not want any further market entry. With the exception of the potential entrant, all the two operating firms are aware of the level of market demand. The firm that prefers entry would like to signal to the potential entrant that the market demand is high while the firm that does not want any further market entry would like to signal to the potential entrant that the market demand is low. Within the separating equilibrium, the analysis shows that operating firms select Nash-equilibrium strategies under full information in each demand state. The equilibrium strategies only exist if entry is relatively not important for an operating firm in relation to the cost of deviating to the other equilibrium strategies. It is difficult to satisfy this condition in growing markets and only a pooling equilibrium may exist in this case under which one

operating firm distorts price upwards with the other operating firm distorting the price downwards. Sorenson (2004) studies limit pricing in the presence of information asymmetry: Reassuring solutions to most asked questions. The analysis gives a formal review of the limit-pricing model by Milgrom and Roberts (1982).The author addresses the three questions that normally arise when the students are go through the model: What happens if we have at least two periods? What happens when there is still presence of information asymmetry even after market entry has already taken place? What happens if the operating firm does not know the beliefs of the entrant? The author proves that, although there are a few interesting behavioural implications, none of these modifications significantly alters the conclusions of the model by Milgrom and Roberts (1982). From this theoretical literature review, it is clear that information asymmetry or the presence of incomplete information on costs sustains the equilibrium solutions within the respective limit pricing models. Even though most of the markets do not have the presence of information asymmetry on cost, there has been less focus on analyzing limit pricing within the context of complete information. This paper addresses this theoretical knowledge gap by analyzing limit pricing within the telecommunication industry involving one dominant firm and a group of small (fringe) firms in the absence of information asymmetry or under complete information.

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III. MODEL SET UP AND ASSUMPTIONS

The Study considers a mobile network operator market having one dominant mobile network operator and a group of small (fringe) mobile network operators. This is a static model with no explicit consideration of time. The study uses linear demand equations in deriving the equilibrium solution to the limit-pricing model.

Let the market demand be,

$$P = g - h(N + n)$$

Where P is the service price, N is the number of subscribers belonging to the dominant firm, n represents the number of mobile subscribers under the fringe firms and the constants g, h are positive numbers.

The dominant firm's cost of providing service to its N mobile subscribers is given by the following function:

$C(N) = cN$

And the cost of the fringe firms is given by:

$C(n) = k + cn$

Where n is the number of mobile subscribers for the fringe firms and $k > 0$ is the sunk cost of entry by the potential entrant or the sunk cost of expansion for the fringe (small) competitors.

Proposition 1: The number of subscribers under the dominant mobile network operator and the fringe mobile network operators are inversely related

PROOF:

We derive the number of subscribers and the price for the dominant mobile network operator if it was the only incumbent in the market.

In this case, $n = 0$. The demand function for the dominant mobile network operator will be:

$P = g - hN$

Equating $Marginal\ Revenue = Marginal\ Cost$ results into,

$$g - 2bN = c \Longrightarrow N^m = \frac{g - c}{2h} \qquad (1)$$

$$P^m = g - h\left(\frac{g - c}{2h}\right) = g - \frac{g - c}{2} = \frac{g + c}{2} = P^m \qquad (2)$$

The residual demand equation for the fringe firms becomes:

$$P = (g - hN) - hn \quad (3)$$

Where $(g - hN)$ is treated as a constant.

Equating the Marginal Revenue and the Marginal cost for the fringe (small) mobile network operators results into the following equations:

$$(g - hN) - 2hn = c \quad (4)$$

$$n = \frac{g - hN - c}{2h} \quad (5)$$

Equation (5) is the fringe firms' reaction function.

We can notice that the number of mobile subscribers for the dominant firm and the fringe firms are inversely related. The more the mobile subscribers for the dominant firm, the less the mobile subscribers for the fringe firms. That is:

$Higher\ N \Longrightarrow Lower\ n$■

Proposition 2: The number of subscribers needed by the dominant mobile network operator to deter entry or the expansion of the fringe mobile network operators is inversely related to the cost of entry or expansion of the fringe mobile network operators.

PROOF:

We compute the limit pricing equilibrium of the dominant mobile network operator in order to satisfy this proposition.

To prevent expansion or to deter the entry of the fringe mobile network operators, the dominant mobile network operator must reduce its price down to the level where the fringe mobile network operators' profits are equal to zero.

Let π^f represent the profit of the fringe mobile network operators.

$$\pi^f = (P - c)n - k \quad (6)$$

Substituting in for the value of, we get:

$$\pi^f = \{g - h(N + n) - c\}n - k \quad (7)$$

Substituting in the value of n from equation (5) into equation (7) we get:

$$\pi^f = \left\{g - hN - h\left(\frac{g - hN - c}{2h}\right) - c\right\}\left(\frac{g - hN - c}{2h}\right) - k \quad (8)$$

Simplifying and collecting the like terms gives:

$$\pi^f = \frac{(g - hN - c)^2}{4h} - k \quad (9)$$

Equating π^f to zero and solving for N we get:

$$N^L = \frac{g - c}{h} - \frac{\sqrt{4hk}}{h} \quad (10)$$

Where superscript L represents the limit value. Further simplification results to:

$$N^L = \frac{g - c}{h} - 2\sqrt{\frac{k}{h}} \quad (11)$$

We can note that, $\frac{g-c}{h}$ is the competitive level of the number of subscribers served

when the price is equated to the marginal cost. Let us represent it by W.
Therefore, equation (11) becomes,

$$N^L = W - 2\sqrt{\frac{k}{h}} \qquad (12)$$

We can note that N^L is decreasing in k■
Proposition 3: There always exists a limit pricing equilibrium for the dominant mobile network operator with market power.
PROOF:

The limit price, P^L relating to N^L is given by the following equation:

$$P^L = g - h\left(W - 2\sqrt{\frac{k}{h}}\right) \qquad (13)$$

$$P^L = g - h\left(\frac{g-c}{h} - \sqrt{\frac{k}{h}}\right) \qquad (14)$$

$$P^L = c + 2\sqrt{hk} \qquad (15)$$

The market power as specified by the learner Index, L^{lim} is given by:

$$L^{lim} = \frac{P^L - c}{P^L} = \frac{c + 2\sqrt{hk} - c}{c + 2\sqrt{hk}} = \frac{2\sqrt{hk}}{c + 2\sqrt{hk}} = 1 - \frac{c}{c + 2\sqrt{hk}} \qquad (16)$$

It can be noted that the market power of the dominant firm is increasing in k.
When $k = 0$, the dominant firm has no market power■

CONCLUSION
This theoretical analysis has shown that market power sustains the limit pricing equilibrium among dominant mobile network operators in the absence of information asymmetry or in the case of complete information on operating cost in the market. Many of the mobile network operator markets all over the world are characterized by the presence of one dominant mobile network operator competing against many fringe (small) mobile network operators. As shown in the theoretical analysis of this paper, the dominant mobile network operators can abuse their market power by lowering their service prices to a level lower enough to prevent the expansion or drive out of business their smaller competitors in the mobile network operator market. This limit price by the dominant mobile network operators can also deter further market entry of new potential mobile network operator competitors. This eliminates fair competition in the market, minimizes the space for research and innovation among mobile network operators and limits the scope of choice for the mobile network subscribers.

These findings are consistent with the results of the previous studies only on the existence of a limit pricing equilibrium. The findings of the analysis in this research paper are however inconsistent with the findings of the previous scholars on the sustenance of the limit pricing equilibrium. The presence of information asymmetry or incomplete information sustains the limit pricing equilibrium according to previous theoretical scholars (Milgrom and Roberts, 1982; Flavio Toxvaed, 2017 and Eray and Gabo, 2018). The theoretical analysis in this study verifies that market power sustains the limit pricing equilibrium in the absence of information asymmetry or under complete information.

POLICY IMPLICATIONS

The findings of this study are of great importance to the Competition Authorities all over the world. These Authorities play a key role in ensuring fair competition among firms in their respective markets of operation. Competition Authorities have been mainly relying on the presence of information asymmetry when developing and updating their policies on limit pricing and when dealing with complaints on limit pricing among firms. The findings of this study magnify the scope for consideration by the Competition Authorities on limit pricing by incorporating markets under complete information. These Authorities can now update their policies on limit pricing based on market power of the competing firms in the absence of information asymmetry or in the presence of incomplete information.

AREAS FOR FURTHER RESEARCH

Since most dominant mobile network operators have at least one tariff, this analysis can be extended to include a dominant price discriminating mobile network operator, a fringe (small) mobile network operator and a potential entrant in a sequential price competition game. This can result into more interesting equilibrium solutions on limit pricing. Interesting results can still emerge when this theoretical analysis extends to a dynamic context under time variation.

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