Notes on (Yong et al., 2020)

Optimal nonlinear pricing by a dominant firm under competition

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Abstract

(Yong et al., 2020) consider *a nonlinear pricing problem* faced by *a dominant firm* which competes with *a capacity-constrained minor firm* for *a downstream buyer* who may purchase the product from the firms *under complete information*.

Introduction

"Nonlinear pricing(NLP)[1] *is ubiquitous in intermediate-goods markets. The vast majority of antitrust cases involving NLP is abuse of dominance cases."*

The key feature of these dominance cases is *asymmetry*, i.e., a big firm(dominant) and its minor rival(s) which have limited capacity and utilize simple linear pricing(LP) strategy.

They consider a following problem faced by a dominant firm competing with a minor firm.

- Both firms can produce a *homogeneous* product at a *constant marginal cost*.
- The minor firm is *capacity constrained*.

[1] For more details, see (Wilson, 1993), and for why we use linear price assumption see (Kreps, 2013)(the possibility of resale).

- There is a representative downstream buyer who may purchase the product from *one or both firms*.(Not choosing only one firm)

A THREE-STAGE game:

1. The dominant firm offers a NLP schedule.
2. The minor firm responds a per-unit price(LP strategy).
3. The buyer chooses her purchases from both firms.

Remark (The optimal schedule of the dominant firm)**.** In the case of a monopoly firm without competition, a singleton quantity-payment offer is sufficient and optimal for the dominant firm. But this conjecture turns out to be not true in the case with competition.

Because of the competitive pressure from the minor firm, the dominant firm can strictly increase its profit by offering two bundles.

"By offering unchosen bundles, the dominant firm can ***provide the buyer with extra latent choices****, which in turn* ***constrain the minor firm's possible deviations*** *of undercutting the dominant firm."*

In contrast to the monopoly case, the dominant firm can be able to fully exclude the minor firm and reach social efficiency, but it is not optimal.(??[2])

Techniques

For we do not restrict the form of the dominant firm's schedule, it may be very difficult to find the solution.

The writers show that it can be transformed to a more tractable problem which the unit price of the minor firm can be viewed as *hidden information* of the buyer and the *hidden action* of the minor firm. And it is a mechanism design problem.

"This "mechanism design approach" of solving subgame-perfect equilibrium is of interest by its own. Generally speaking, for games where there is ***a single first mover whose action space is a function space*** *and* ***all the followers' action spaces are much simpler****, one can apply our*

[2]Why? The monopoly case is the best situation of the dominant firm, isn't it? Why is the fully exclusion not optimal?

mechanism design approach *to transform the problem of solving equilibrium outcomes into a more tractable mechanism design (constrained optimization) problem."*

The optimal NLP schedule

In stark contrast to a typical NLP tariff in the literature, their results exhibits *convexity*(rather than concavity[3]).

"When the capacity of the minor firm is relatively small, the optimal NLP, along with the aforementioned convexity, entails a minimum quantity requirement with a positive payment. As a result, despite the convexity, the optimal NLP tariff in our setting can meanwhile display quantity discounts, i.e., decreasing average prices with increasing volumes."(??)

1 Model

Agents:

- The dominant firm (firm 1)
- The minor firm (firm 2)
- The buyer/downstream firm

Production technology:

- Identical product
- Firm 1 can produce any quantity at a unit cost c
- Firm 2 has a capacity $k \in (0, \infty]$, and the same cost structure

Utility:

[3]The concave tariff can be implemented by a two-part tariff or incremental discounts.

If the buyer chooses to buy $Q \geq 0$ from firm 1 and $q \in [0, k]$ from firm 2, then she receives the utility of

$$u(Q+q)$$

Strategy:

- Firm 1 offers a nonlinear tariff $\tau(\cdot)$, $\tau(Q) \in \mathbb{R} \cup \{\infty\}$
- After observing $\tau(\cdot)$, firm 2 offers a unit price $p \geq c$ (up to k units)
- After observing $\tau(\cdot)$ and p, the buyer chooses the quantities she buys from the two firms

Equilibrium:

It is a *sequential-move game* with complete and perfect information, so we use the equilibrium concept of (pure strategy) *subgame-perfect equilibrium (SPE)*.

Remark (Model Settings)**.** In the standard settings, they usually assume symmetric contracting spaces and simultaneous moving order. For our key point is studying the dominant firm's behavior in an asymmetric environment. We assume the dominant firm have a more complex contracting space because of the minor firm have less pricing experiences. And these assumptions can be justified by the paper(Chao et al., 2019)(the timing of moves and the pricing choice sets can be endogenously chosen by both firms).

1.1 Equivalence

This is a reading note of the section Equivalence.

2 Section

3 Conclusion

References

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