An Oligopoly Model with Donative Most-Favored-Nation Pricing

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Abstract- **This paper studies a two-stage oligopoly model with donative most-favored-nation pricing. First, each profit-maximizing firm simultaneously and independently decides whether to offer a donative most-favored-nation policy as a strategic instrument. Second, each firm simultaneously and independently chooses its actual price. We find that the introduction of donative most-favored-nation pricing into the analysis of oligopoly competition is profitable for all firms.**

Keywords- Oligopoly Model; Donative Most-Favored-Nation Pricing; Collusive Equilibrium

I. INTRODUCTION

Cooper [1] examines the role of the retroactive most-favored-customer policy as a practice facilitating coordination in a two-period model of a price-setting duopoly. A firm that offers retroactive most-favored-customer pricing guarantees its first period customers a rebate of the price difference if it sells to its second period customers at a lower price. Salop [2] argues that the retroactive most-favored-customer policy helps sellers cooperate because it raises the cost of price cutting. Tirole [3] asserts that the most-favored-customer policy is not a good strategy for entry deterrence purposes because it commits to a less aggressive behavior that induces its rival to produce more. Neilson and Winter [4] examine Cooper's two-period duopoly model and show that the unilateral most-favored-customer equilibrium price lies strictly between the Bertrand price and the Stackelberg leader price. Neilson and Winter [5] also examine Cooper's model and show that unless one firm's demand is more responsive to changes of its competitor's price than to its own price changes, there is no equilibrium in which both firms adopt most-favored-customer policies. In addition, Ohnishi [6] introduces the donative most-favored-nation policy by using a one-production-period two-stage duopoly model. This policy is that a firm agrees to donate to nations or to charities for social services if it lowers its price in the future.

We study a two-stage oligopoly model in which profit-maximizing firms are allowed to offer donative most-favored-nation policies.[1] The following situation is considered. In Stage 1, each firm simultaneously and independently decides whether to offer a donative most-favored-nation policy. In Stage 2, each firm simultaneously and independently chooses its actual price. At the end of Stage 2, the market opens and each firm sells at its actual price. We demonstrate that the introduction of donative most-favored-nation pricing into the analysis of oligopoly competition is profitable for all firms.

This paper proceeds as follows: Section II describes the framework of the model; Section III presents the results of our analysis; and Section IV concludes the paper.

II. THE FRAMEWORK

In this market, there are n profit-maximizing firms $(i=1,2,...,n)$. There is no possibility of entry or exit. The oligopolists produce imperfect substitutable goods in an effort to serve a single market. Firm i sets price $p^i > 0$ and produces output $q^i(p^1, p^2,..., p^n)$ at constant marginal cost $c^i > 0$. As a result, firm i's profit is $\pi^i(p^1, p^2,..., p^n) = (p^i - c^i)q^i(p^1, p^2,..., p^n)$.

Let us assume that there is a unique Bertrand equilibrium. In addition, we assume the following assumptions.

Assumption 1 (Differentiability): $q^i(p^1, p^2,..., p^n)$ is twice continuously differentiable with $\partial q^i / \partial p^i \equiv q^i_i < 0$, and $\partial q^i / \partial p^j \equiv q^i_j > 0 \quad (i, j = 1,2,...,n; i \neq j)$.

Assumption 2 (Strategic complementarity): $\pi^i_{ij} > 0$.

Assumption 3 (Stability): $\pi^i_{ii} + \pi^i_{ij} < 0$.

Assumption 1 states that demand is downward-sloping and that the goods are substitutes. Assumption 2 states that a price increase by firm i makes a price increase more attractive to firm j. Assumption 3 means that firm i's own effects of price on demand exceed firm j's cross effects.

This market will be modeled by means of the following two stage game.

Stage 1: Each firm simultaneously and independently decides whether to offer a donative most-favored-nation policy. If firm i offers the policy, then it chooses a price $\bar{p}^i \in [0,\infty)$ and a number $z^i \in [0,\infty)$, and advertises that if it sells goods to its customers at a lower price p^i than $\bar{p}^i$, then it will donate the amount of z^i times the difference $(\bar{p}^i - p^i)$ to nations or to charities for social services.

Stage 2: Each firm simultaneously and independently chooses its actual price p^i. At the end of this stage, the market opens and each firm sells at its actual price p^i. If $p^i < \bar{p}^i$, then firm i denotes the amount $(\bar{p}^i - p^i)z^i$ to nations or to charities for social services.

Firm i's profit changes as follows:

[1] The analysis of [7] considers a model of Bertrand competition where labor-managed firms are allowed to offer donative most-favored-nation policies as a strategic commitment. For excellent surveys of labor-managed firms, see [8]-[11].

$$\hat{\pi}^i(\overline{p}^i, z^i, p^1, p^2, ..., p^n) = \begin{cases} \pi^i(p^1, p^2, ..., p^n) & \text{for} \quad p^i \geq \overline{p}^i \\ \pi^i(p^1, p^2, ..., p^n) - (\overline{p}^i - p^i) z^i & \\ & \text{for} \quad p^i \leq \overline{p}^i \end{cases} \quad (1)$$

We derive firm i's best reaction function from (1). If firm i does not offer a donative most-favored-nation policy, then its reaction function is defined by

$$R^i(p^{-i}) = \arg\max_{\{p^i>0\}} \pi^i(p^1, p^2, ..., p^n), \quad (2)$$

where $p^{-i} = (p^1, p^2, ..., p^{i-1}, p^{i+1}, ..., p^n)$. On the other hand, if firm i offers a donative most-favored-nation policy and donates $(\overline{p}^i - p^i)z^i$, then its reaction function is defined by

$$\overline{R}^i(p^{-i}) = \arg\max_{\{p^i>0\}} [\pi^i(p^1, p^2, ..., p^n) - (\overline{p}^i - p^i) z^i]. \quad (3)$$

Therefore, if firm i offers a donative most-favored-nation policy, then its best response is as follows:

$$\hat{R}^i(p^{-i}) = \begin{cases} R^i(p^{-i}) & \text{for} \quad p^i > \overline{p}^i, \\ \overline{p}^i & \text{for} \quad p^i = \overline{p}^i, \\ \overline{R}^i(p^{-i}) & \text{for} \quad p^i < \overline{p}^i. \end{cases} \quad (4)$$

Note that the adoption of donative most-favored-nation policy by firm i creates kinks in the best response at the level of $\overline{p}^i$. In this paper, we use subgame perfection as the equilibrium concept.

III. RESULTS

We begin by presenting the following lemmas.

Lemma 1: If firm i offers a donative most-favored-nation policy and an equilibrium is achieved, then at equilibrium $\overline{p}^i = p^i$.

Proof. We first consider the possibility that $\overline{p}^i < p^i$ at equilibrium. Firm i's marginal cost is c^i. It is impossible for firm i to change its output in equilibrium because such a strategy is not credible. That is, if $\overline{p}^i < p^i$, donative most-favored-nation pricing does not function as a strategic commitment.

Second, we consider the possibility that $\overline{p}^i > p^i$ at equilibrium. From (1), if $\overline{p}^i > p^i$, firm i must donate $(\overline{p}^i - p^i)z^i$ to nations or charities for social services. That is, firm i can increase its profit by reducing $\overline{p}^i$, and the equilibrium point does not change in $\overline{p}^i \geq p^i$. Hence, $\overline{p}^i > p^i$ does not result in an equilibrium. Q.E.D.

Lemma 2: Suppose oligopoly competition with no donative most-favored-nation policies. Then each firm's Stackelberg leader price exceeds its Bertrand price.

Proof. We suppose that firm i is the Stackelberg leader. Then firm i maximizes its profit $\pi^i(p^i, R^j(p^i))$ with respect to p^i, and hence its Stackelberg leader price satisfies the first-order condition:

$$\pi_i^i + \pi_j^i R_i^j = 0. \quad (5)$$

Our model is the case of strategic complements in which goods are substitutes, so that π_j^i and R_i^j are both positive. To satisfy (5), π_i^i must be negative. Q.E.D.

These lemmas state characterizations of donative most-favored-nation policies as a strategic commitment.

We consider the following proposition.

Proposition 1: Suppose that at least one firm offers a donative most-favored-nation policy. Then all firms earn higher profits than in the Bertrand game with no donative most-favored- nation policies.

Proof. We suppose that firm i offers the donative most-favored-nation policy. From (2), (3) and (4), we see that prices cannot be below the Bertrand prices because the donative most-favored-nation policy limits only price reductions. We can rewrite (3) as

$$\overline{R}^i(p^{-1}) = \arg\max_{\{p^i>0\}} [(p^i - c^i)(q^i(p^1, p^2, ..., p^n) + z^i) - (\overline{p}^i - c^i) z^i],$$

where the second term is irrelevant as far as marginal choices are concerned, and everything is as if firm i faced demand $q^i(p^1, p^2, ..., p^n) + z^i$. Let z^i be a variable which can take values of zero and above. Therefore, firm i's price rises according to the value of z^i. Let $\overline{p}^i$ be also a variable which can take values of zero and above. From Lemmas 1 and 2, firm i's profit is higher than in the Bertrand equilibrium with no donative most-favored-nation policies. If firm i chooses a price higher than the Bertrand price, then the other firms' demand increases. Even if the other firms choose the Bertrand prices, they can earn more than in the Bertrand game with no donative most-favored-nation policies. The optimal strategies must yield at least these profits. Q.E.D.

Proposition 1 indicates that all firms earn greater profits if only one firm offers the donative most-favored-customer policy. We explain the intuition behind Proposition 1. We assume that only firm i offers the policy. Firm i can improve its profit by raising p^i slightly above the Bertrand price. From (1), we see that prices cannot be below the Bertrand prices because the donative most-favored-nation policy limits only price reductions. Since the model is the case of strategic complements in which goods are substitutes, each firm has an incentive to raise its price. That is, firm i does not want to choose the Bertrand price. The adoption of the policy is the key to achieving higher prices. If $\overline{p}^i > p^i$, firm i must donate $(\overline{p}^i - p^i)z^i$ to nations or charities for social services. The donative most-favored-nation policy prevents firm i from setting p^i below $\overline{p}^i$, and that commitment enables firm j to increase p^j. If firm i chooses a price higher than the Bertrand price, then the other firms' demand increases. Even if the other firms choose the Bertrand prices, they can earn more than in the Bertrand game with no most-favored-nation policies.

The main result of this paper is stated in the following proposition.

Proposition 2: There exists an equilibrium in which at least one firm offers a donative most-favored-nation policy.

Proof. In Stage 1, each firm non-cooperatively decides whether to offer a donative most-favored-nation policy. In Stage 2, each firm non-cooperatively chooses its actual price p^i. At the end of Stage 2, the market opens and each firm sells at p^i. Each firm's profit is decided. Our equilibrium concept is subgame perfection, and all information in the model is common knowledge. Therefore, we can consider the profit matrix in Fig. 1 (see [12]). Here, y^i denotes an adoption of the donative most-favored-nation policy and x^i no adoption. From Proposition 1, we see that $A^i < B^i, C^i, D^i, ..., \Omega^i$. Q.E.D.

Propositions 1 and 2 indicate that the introduction of donative most-favored-nation pricing into the analysis of oligopoly competition is profitable for all firms. The firms select their actions independently, but each firm considers how the other firms will respond to its choice before making decisions. If firm i offers a donative most-favored-nation policy, then each firm knows that $\overline{p}^i$ affects actual prices. That is, the offer of the policy leads to higher non-cooperative prices. Since the higher prices yield increased profits, at least one firm offers the policy.

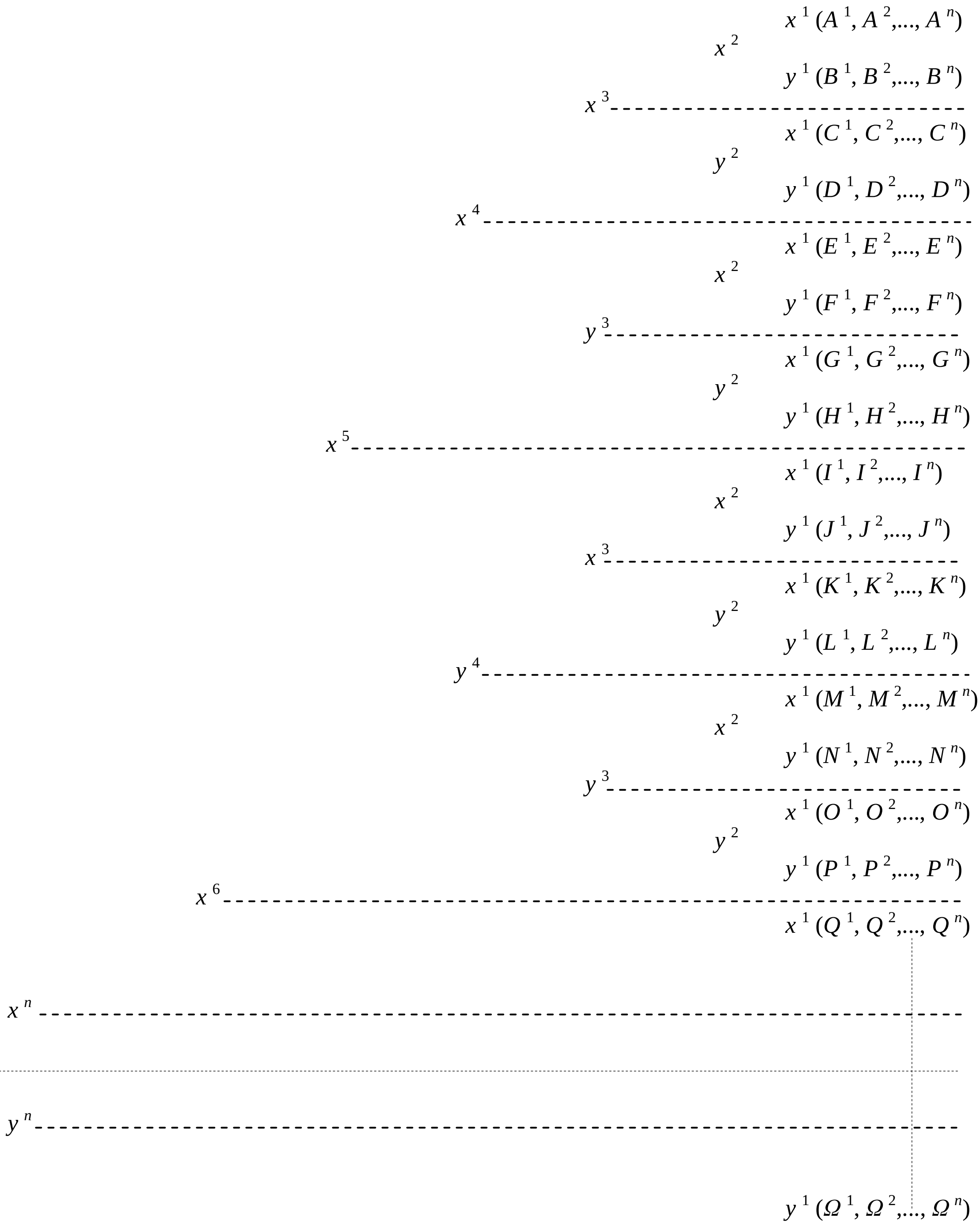

Fig. 1 An *n*-player game with two action sets (x^i and y^i)

IV. CONCLUSION

We have considered a two-stage oligopoly model in which profit-maximizing firms are allowed to adopt donative most-favored-nation policies as a strategic instrument. We have demonstrated that there is an equilibrium in which at least one firm offers a donative most-favored-nation policy and at equilibrium all firms earn higher profits than in the Bertrand game with no donative most-favored-nation policies. As a result, we see that the donative most-favored- nation policy is more effective in stable industries with high entry barriers.

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