CSR as a bribe to a government

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PRELIMINARY. ANY COMMENTS APPRECIATED.

1 Introduction

The rationale behind partial privatization of public enterprises or social responsibility acts of private firms have been clarified from various angles, but mostly independently. As well as many other actions observed in economic scenes, the degree of privatization or CSR is chosen by stakeholders and thus must exert some pressure on the others behavior in oligopolistic situation. This observation brings us to endogenize the degree of partial privatization and CSR *à la* Matsumura (1998) in a mixed oligopoly setting, and thereby uncover the strategic interrelation of them.

Our main finding is a strategic substitution relationship between the privatization and CSR. From the main result, several corollaries, including but not limited to how the optimal degree of privatization changes and justification of bureaucratic inflexibility, follows.

1.1 Literature review

Privatization has attracted a lot of attention from researchers and policy makers. Seminal papers emphasized that the stated-own enterprise may harm social welfare under an oligopoly market even if the public firm takes welfare-maximizing behavior (De Fraja and Delbono 1989). This problem comes from the situation where public and private firms coexist in the market, which distort the public firm's behavior through strategic interaction. Matsumura (1998) challenged this issue and showed that "partial privatization" has a positive impact on welfare. The literature on the effect of partial privatization toward the market outcomes is still growing.

Most of previous studies in mixed oligopoly have a common assumption that private firms always maximize only purely its own profit. However, in reality, private firms may express, if not have, a different goal. One canonical example is sales orientation, whose

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rationality is demonstrated by Fershtman and Judd (1987), and another important one in this literature is so called corporate social responsibility(CSR, henceforth).From economics perspective, Bénabou and Tirole (2010) and Kitzmueller and Shimshack (2012) provide the overviews of CSR theoretically and empirically. The theoretical analysis based on the oligopoly theory responds to questions: Why do the firms engage in CSR activities ? What is the impact on firms' performance and welfare? The firms' owners have an incentive to undertake CSR by hiring a social conscious manager and delegating firm's decision , so as to attract more consumers who evaluate CSR activities (Manasaks et al (2014)) . Kopel and Brand (2012) explore CSR in a mixed oligopoly setting where a socially concerned firm and a profit maximizing firm are in the same market. The socially responsible firm is assumed to take into account not only its profit, but also consumer surplus. Matsumura and Ogawa (2014) investigate the endogenous timing game where both firms maximize the convex combination of its profit and social welfare. Lambertini, Palestini, and Tampieri (2016) show the strategic used of CSR in dynamic setting.

In common, firms undertaking CSR activities makes a commitment to embrace stakeholders such as consumers, environmental resorces, and social welfare. This idea is closely related to the literature on delegation game with strategic reward contracts.(Vickers, 1985; Fershtman and Judd, 1987; Sklivas 1987) They consider the situation where owners and managers are separated in the market. The profit-maximizing owners write the reward contracts for managers and delegate the decision for productions.

The closest paper to ours is Hino and Zennyo (2015), that endogenizes the degree of CSR in usual, meaning not mixed, oligopoly. To our knowledge, the link between partial privatization and endogenous corporate social responsibility has been little discussed.

2   Model

In a mixed duopoly, where a the demand is approximated linearly, the cost quadratically[3], the goods are perfect homogeneous and there exists no uncertainty, a version of the delegation games rolls. Precisely,

- 1st stage: A single public firm chooses its degree of partial privatization, $\theta_0 \in [0,1]$ to maximize social welfare (hereafter SW). And a single private firm chooses the degree of CSR, $1 - \theta_1 \in [0,1]$ to maximize its profit.

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[3]Another formulation of the cost function employed in the literature frequently is that of constant marginal cost with cost difference between the public and private. It turns out, however, that complicates the equation and derives zero production of the public in the equilibrium. Thus we choose a quadratic cost approximation.

- 2nd stage: The both firms play a duopolistic (simultaneous) Cournot game to maximize their objective functions, $(1 - \theta_i)SW + \theta_i\pi_i$ $(i = 0, 1)$.

The equilibrium concept is SPE, so backward solving follows.

2.1 2nd stage

Given both θs, the both simultaneously choose positive or zero amounts of quantity.

$$\max_{q_i} (1 - \theta_i)SW + \theta_i\pi_i \tag{1}$$

where

$$\pi_0 = (a - q_0 - q_1)q_0 - \frac{q_0^2}{2}, \quad \pi_1 = (a - q_0 - q_1)q_1 - \frac{q_1^2}{2}$$

$$SW = \pi_0 + \pi_1 + \frac{(q_0 + q_1)^2}{2}.$$

Second order conditions are satisfied. Reaction functions and equilibrium quantities are

$$q_0(q_1) = \frac{a - q_1}{\theta_0 + 2}, \quad q_1(q_0) = \frac{a - q_0}{\theta_1 + 2}, \tag{2}$$

$$q_0^*(\theta_0, \theta_1) = \frac{a(1 + \theta_1)}{\theta_0\theta_1 + 2\theta_0 + 2\theta_1 + 3}, \quad q_1^*(\theta_0, \theta_1) = \frac{a(1 + \theta_0)}{\theta_0\theta_1 + 2\theta_0 + 2\theta_1 + 3}. \tag{3}$$

As (2) shows, each player can interfere only in own reaction function through θ_i. From the different angle, both players can shift their reaction function and reach more desirable outcome (SW for the public and own profit for the private) by adjusting and committing θ_i, i.e. employing more or less privatization or CSR. In the example of Figure 1, the public increases θ_0 and shift its reaction function to the left for better SW, so it explains the necessity of partial privatization. For the private firm case, in turn, it increases $1 - \theta_1$, showing the one reason of CSR activity. If this adjustment happens one after another and repeatedly, e.g. the public does first, the private next then in the second round the public first again and so on, then the process, which embodies the substitutability of privatization and CSR, converges to the equilibrium as shown below.
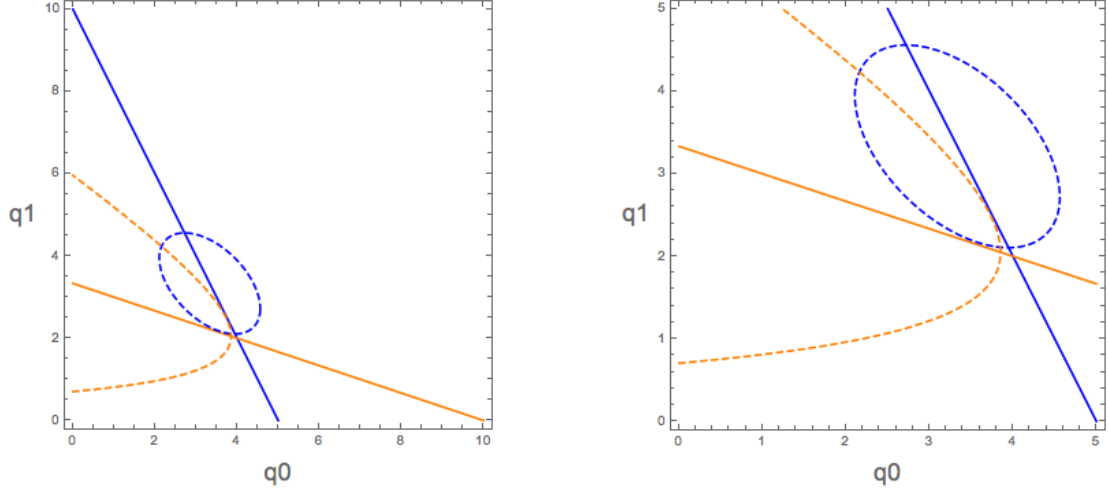
Figure 1: Reaction functions of q_i and Iso-SW and Iso-profit curves (dashed) (Example values: $\theta_0 = 0$, $\theta_1 = 1$, $a = 10$).

2.2 1st stage: Simultaneous

Anticipating the result of the second stage game, the both firms simultaneously choose θ_i to maximize SW or its profit. For the public,

$$\max_{\theta_0} \; SW(\theta_0, \; \theta_1) \tag{4}$$

where

$$SW(\theta_0, \; \theta_1) = \frac{a^2(\theta_0 + 1)(\theta_1 + 1)(\theta_0 + \theta_1 + 3)}{(\theta_0(\theta_1 + 2) + 2\theta_1 + 3)^2} \tag{5}$$

and for the private,

$$\max_{\theta_1} \; \pi_1(\theta_0, \; \theta_1) \tag{6}$$

where

$$\pi_1(\theta_0, \theta_1) = \frac{a^2(2\theta_1 + 1)(1 + \theta_0)^2}{2(\theta_0(\theta_1 + 2) + 2\theta_1 + 3)^2}. \tag{7}$$

SOC is satisfied. The reaction functions and solutions are,

$$\theta_0^*(\theta_1) = \frac{\theta_1}{\theta_1^2 + 2\theta_1 + 2}, \quad \theta_1^*(\theta_0) = \frac{1 + \theta_0}{2 + \theta_0} \tag{8}$$

$$\theta_0^N = \frac{6(A + B - 4)}{A^2 + 4A + B^2 + 4B + 60}, \quad \theta_1^N = \frac{A + B - 4}{6} \tag{9}$$

where

$$A = \sqrt[3]{80 - 30\sqrt{6}}, \quad B = \sqrt[3]{80 + 30\sqrt{6}}$$

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3 Proposition and Corollaries

3.1 Proposition

In the above result, the equation (8) states our main finding.

Proposition 1 : θ_0 and θ_1 are in the relationship of strategic complement. On the flip side of the same coin, the degrees of partial privatization and CSR are of strategic substitution.

Proof: Differentiating each $\theta_i^*(\theta_j)$ with its argument shows positive relation, i.e.,

$$\frac{\partial \theta_0^*}{\partial \theta_1} = \frac{2 - \theta_1{}^2}{\left(\theta_1{}^2 + 2\theta_1 + 2\right)^2} > 0 \ (\theta_1 \in [0, 1]), \quad \frac{\partial \theta_1^*}{\partial \theta_0} = \frac{1}{(\theta_0 + 2)^2} > 0.$$
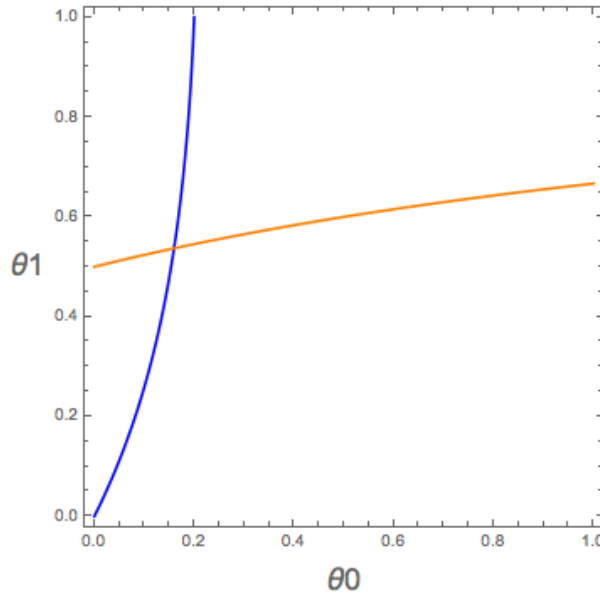

Figure 2: Reaction functions of θ_i

The mechanism behind this proposition or convergence dynamics can be ocular using Figure.1. Figure 3 animates the convergence to the equilibrium from the situation depicted in Figure 1, or equivalently the point (0,1) in θ_0-θ_1 coordinates in Figure 2. From the upper-left to upper-right in Figure 3, the public firm adjusts its reaction function to increase welfare, by increasing partial privatization from (0, 1) to ($\theta_0^*(1)$=1/5, 1). In response to that, the private firm in turn decreases θ_1, i.e. increases CSR from (1/5, 1) to (1/5, $\theta_1^*(1/5)$=6/11). This is exhibited in the middle row. Then in the bottom row, again in response to the increased CSR, the public firm decreases partial privatization

from (1/5, 6/11) to (θ_0^*(6/11)=33/205, 6/11). And again in response to the decreased partial privatization, the private increases CSR, and so on to the equilibrium.

While the figure 3 gives us a graphical intuition of Proposition 1, it can be translated into natural language. From the perspective of the public firm, if the private inclines to CSR, the public has a less anxiety for a crowding out effect and resulting cost inefficiency. Therefore the necessity of privatization becomes lower. From the view point of the private firm, if the public decreases the degree of partial privatization, signaling the intention of conquering more demand, then the residual demand for the private would shrink. To resist the scenario, the private tries to steal back the demand through more intensive CSR. The substitutional relationship between partial privatization and CSR consists of these two incentives.

3.2   1st stage: Sequential

The proposition 1 and Figure 2 includes a number of corollaries as stated henceforth. Before stepping into them, however, solving a sequential version of the first stage game and defining the solution is helpful in understanding by comparison each. When the public is a leader and the private a follower[4], only the action of the public changes. Namely, given $\theta_1^*(\theta_0)$ in (8), the public maximizes SW through the degree of privatization.

$$\max_{\theta_0} \ SW(\theta_0) \tag{10}$$

where

$$SW(\theta_0) = \frac{a^2(\theta_0 + 1)(2\theta_0 + 3)\left(\theta_0{}^2 + 6\theta_0 + 7\right)}{(\theta_0 + 2)^2(3\theta_0 + 4)^2} \tag{11}$$

SOC is satisfied. We call the equilibrium pair of θs of this version as (θ_0^L, θ_1^F). Similarly, (θ_0^F, θ_1^L) is also defined where the public is a follower and the private a leader.

3.3   Corollaries

For descriptive simplicity, we exhibit Figure 4, which includes all result so far, instead of giving an explicit analytical solution. Several corollaries immediately follows from the diagram.

Corollary 1 : Every corner except (0,0) in $\theta_0 - \theta_1$ coordinates has neither intersect with reaction functions of θ_0 nor θ_1.

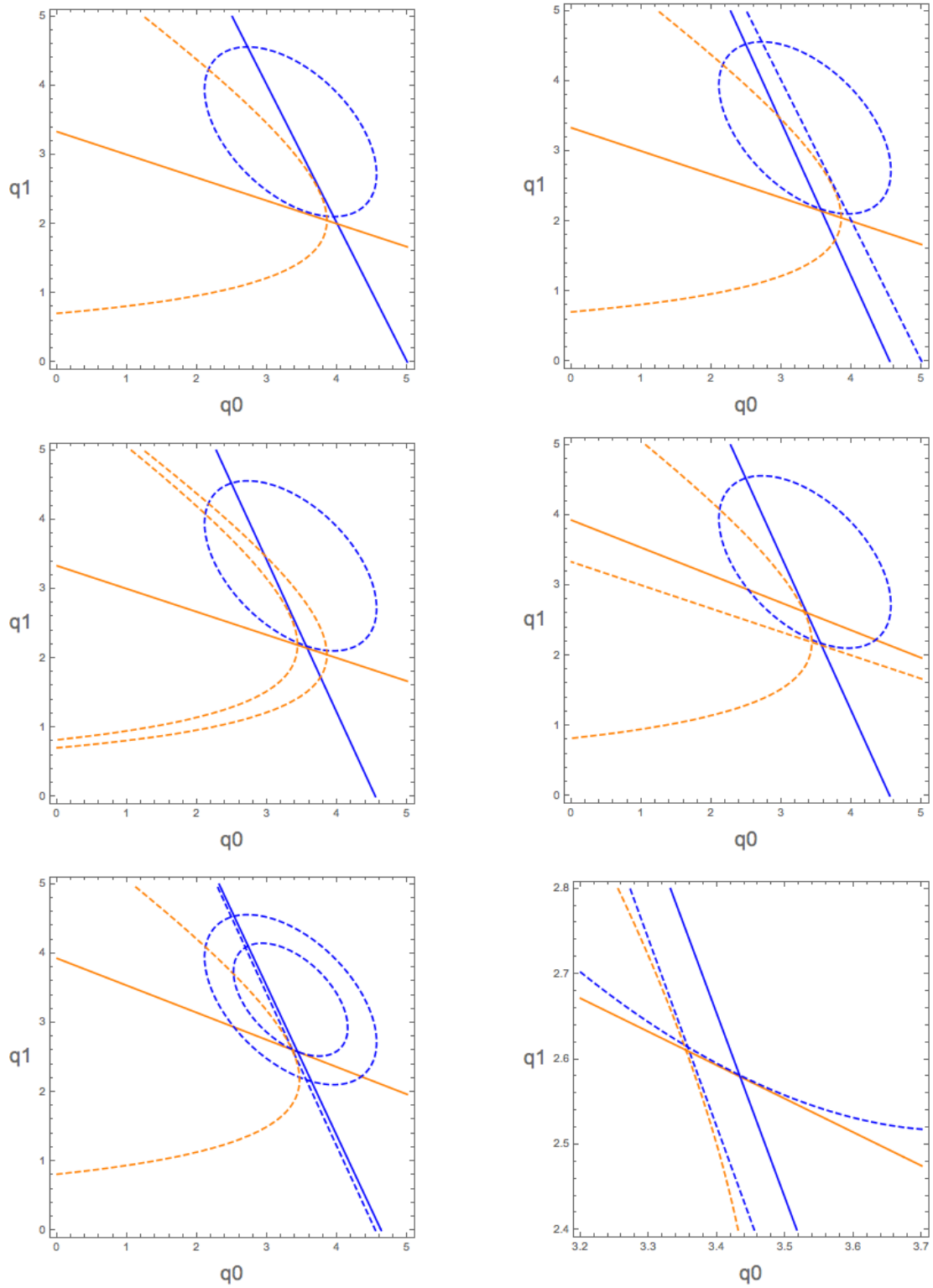[4]They moves simultaneously in the quantity setting stage anyway.

Figure 3: the substitutability of partial privatization and CSR.

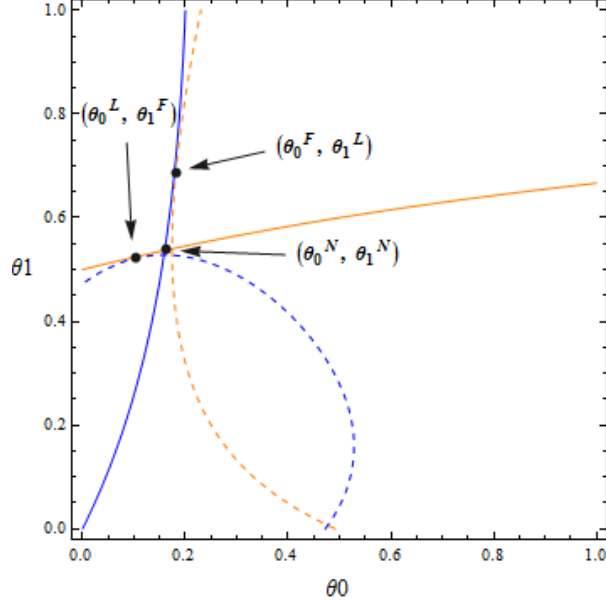Figure 4: Reaction functions of θ_i, and Iso-SW and Iso-profit curves(dashed)

Corollary 2 : $(0, \theta_1^*(0)) < (\theta_0^L, \theta_1^F) < (\theta_0^N, \theta_1^N) < (\theta_0^F, \theta_1^L) < (\theta_0^*(1), 1)$.

Corollary 3 : $SW(\theta_0^L, \theta_1^F) > SW(\theta_0^N, \theta_1^N) > SW(\theta_0^F, \theta_1^L) > SW(\theta_0^*(1), 1)$.

Corollary 4 : $\pi_1(\theta_0^F, \theta_1^L) > \pi_1(\theta_0^N, \theta_1^N) > \pi_1(\theta_0^L, \theta_1^F) > \pi_1(0, \theta_1^*(0))$.

The first corollary reconfirms the result already shown in the literature of delegation or mixed oligopoly, that both public and private firms have an incentive to pretend own objective function to attain an intrinsic objective. The second comes from the proposition 1 and an orthogonal property of a reaction function and an iso-objective curves[5]. The last inequality shows that the optimal degree of partial privatization decreases when both private and public can pretend and commit to different objectives than the intrinsic. One more point is that the firm who can commit relatively strongly to its extrinsic objective inclines more to the intrinsic one. The corollary 3 and 4, especially the second inequalities each, is immediate from the corollary 2. The last inequalities shows that either SW or π_1 increases if the competitor become able to delegate. The welfare increases because the private come to take care with it strongly enough to dominate the inflated cost inefficiency. While, the profit increases because of the strong strategic substitution effect within quantities[6].

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[5]For the second inequality as an example, the proposition 1 (and precisely that the first best SW is at (0,0)) guarantees $(\theta_1^*(\theta_0))' > 0$, so that it touches the iso-SW curves at the left of the (θ_0^N, θ_1^N).

[6]Along the reaction function of $\theta_1^*(\theta_0)$, q_1 is increasing in θ_1

From corollaries 3 and 4, the following corollary holds, which predicts a result in an endogenous timing game in the 1st stage.

Corollary 5 : If the timing of choosing θ_i is endogenized, then both firms wish to be a leader, but it ends up a simultaneous equilibrium.

The intersection of the reaction functions is the equilibrium outcome point. As each contour curves shows, if each player is eligible to be a leader, then they happily accept the role, and adjust own θ, i.e. orienting SW more if public and vice versa, to make the equilibrium more desirable for them respectively. Therefore as a policy implication, it may be justified to specify the degree of partial privatization in the time of foundation and impose stiff regulation not to be affected by market situation.

Corollary 6 : Along with reaction function of θ_i, $\dfrac{dq_i}{d\theta_i}$ may be positive, zero, or negative.

On the reaction functions, θs are interrelated, so,

$$\frac{dq_i}{d\theta_i} = \frac{\partial q_i}{\partial \theta_i} + \frac{\partial q_i}{\partial q_j} \cdot \frac{\partial q_j}{\partial \theta_j} \cdot \frac{\partial \theta_j^*(\theta_i)}{\partial \theta_i}.$$

The first term of the right hand side is negative, but the first factor of the second term is negative, the second factor is negative and the third is positive from the proposition 1. Therefore, the sign of whole effects depends on specification. As an example, we put the numerical result of this time's formulation[7]. As shown, consumer surplus is decreasing along with both reaction function, implying partial privatization may be redundant when it comes to maximize consumer surplus instead of welfare.

4   Conclusion

We apply the delegation game formulated by Fershtman and Judd (1987) to endogenize the partial privatization and CSR in mixed oligopoly. Main result is the strategic substitution relationship between the two. From the main proposition, several corollaries comes. We do not check the robustness of our result, but believe the proposition and corollaries are fairly robust to general setting. Instead, the number of results not written explicitly, such as comparison of profits at $(\theta_0(1), 1)$ and (θ_0^N, θ_1^N) or decreasing consumer surplus, have the possibility of formulation dependent. To check the generality of those result will enrich the

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[7]The intersection of q_0 and q_1 in the above of Figure 5 is the equilibrium when the private duopoly play the game.
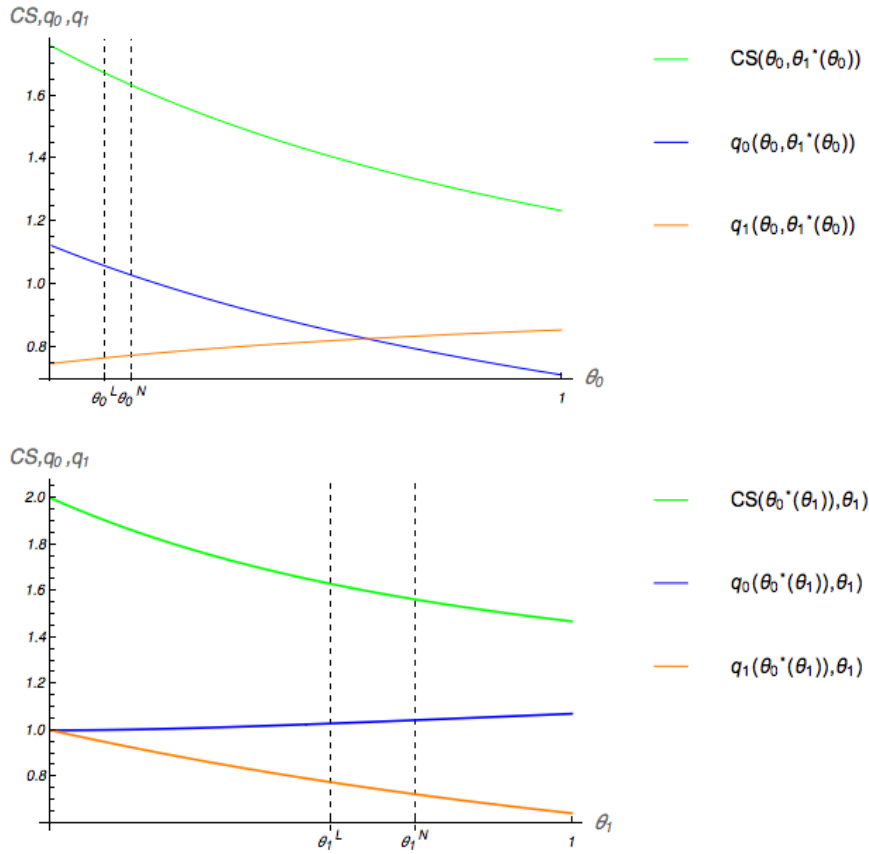
Figure 5: consumer surplus and quantities along with $\theta_0^*(\theta_1)$ (above) and $\theta_1^*(\theta_0)$ (below).

understanding the formulation. Duopoly to oligopoly and quantity to price competition are also natural extensions. Moreover, the 1st stage game can be generalized to a convex combination version of an intrinsic objective. If the relation between the intrinsic degree of the convex combination and the extrinsic is one-to-one, then an empirical assessment using the inverse relation can be possible.

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