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# On the output and welfare effects of a non-profit firm in a mixed duopoly: A generalization

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## ABSTRACT

We study the output and welfare impacts of a non-profit firm in a mixed duopoly. In particular, we show that technical efficiency at the margin is crucial to determine whether the social responsibility of the non-profit firm increases or reduces welfare, assuming general demand and cost functions. This implies the paradoxical result that more social responsibility may reduce welfare. In addition, we introduce the concept of technical advantage in production and apply it to the study of a mixed duopoly considering convex-quadratic cost functions. Interestingly, a firm may have a technical advantage in production and at the same time be technically less efficient than its rival at the margin. We show that the paradox eventually occurs as the non-profit firm exhibits more social responsibility if firms have quadratic cost functions. This can happen even if the non-profit firm has a substantial technical advantage over its rival.

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## 1. Introduction

There is a recent economic literature that analyzes the interaction between private for-profit firms (FPF) and private non-profit organizations (NPO) in mixed oligopoly markets. Part of this literature tries to explain how firms decide to be more profit or consumer oriented. Some examples of this type of work are Goering (2007), Königstein and Muller (2001), Kopel and Brand (2012) and Kopel et al. (2014). Another part of the literature is devoted to studying the effects of the NPO's concern for consumers on output or welfare. This part of the literature includes the work of Goering (2008), Lien (2002) and Nakamura (2013).

A closely related literature addresses the role of corporate social responsibility in regard to several important issues. For example, Wang et al. (2012) as well as Chang et al. (2014) develop duopoly models to study strategic international trade policy with firms that exhibit concern for consumers. Similarly, Manasakis et al. (2013) and Liu et al. (2015) model the effects of certification, while Manasakis et al. (2014) study corporate governance in imperfectly competitive markets where firms' social responsibility is related to environmental efforts.

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A standard assumption in the literature is that FPFs maximize profits while NPOs maximize a weighted sum of own profits and consumer surplus (CS).<sup>1</sup> The particular weight that an NPO places on CS represents the degree of social responsibility (or concern for consumers) of this firm. This weight is usually constrained not to exceed the weight that the firm places on own profits. Hence, the extreme cases occur when (a) the weight of CS approaches zero and, consequently, the NPO behaves almost like an FPF and (b) when the NPO places equal weight on profits and CS.

An interesting and paradoxical result in Goering (2008) is that welfare may decrease as the NPO exhibits a higher degree of social responsibility. More precisely, Goering (2008) shows that technical efficiency in production is crucial to determine whether a higher degree of social responsibility of the NPO increases or reduces welfare. If the NPO is technically more efficient than the FPF, then a higher degree of social concern increases welfare. However, if the opposite occurs, then a higher degree of social concern may reduce welfare.

The intuition behind this result is simple. The output of the NPO increases as it cares more for consumers, while the output of the FPF decreases in response to the behavior of the NPO. However, total output increases (Lien, 2002). This has two effects on welfare. On the one hand, the expansion of output itself increases welfare. On the other hand, part of the additional output of the NPO replaces the output of the FPF. If the NPO is technically less (or more) efficient than the FPF, output replacement reduces (or increases, respectively) welfare.

Although the results of Goering (2008) and Lien (2002) are very intuitive, their analysis is limited to linear demand and constant marginal costs. Moreover, most of the articles in the related literature assume that demand is linear and marginal costs are constant (Goering, 2007; Königstein and Müller, 2001; Kopel and Brand, 2012; Kopel et al., 2014; Lambertini and Tampieri, 2015; Nakamura, 2013). Therefore, it is interesting to show – as we do in this article – that the results of Lien (2002) on output and Goering (2008) on welfare can be extended to more general demand and cost functions.

In this article, we show that technical efficiency at the margin is crucial to determine whether the social responsibility of the NPO increases or reduces welfare in the context of relatively general demand and cost functions. In addition, we introduce the concept of technical advantage in production and apply it to the study of a mixed duopoly with convex cost functions. We say that a firm has a technical advantage over its rival if it can produce the same output that its rival produces at lower marginal and total costs than the rival. Interestingly, a firm may have a technical advantage over the other but be technically less efficient at the margin. Finally, we show that the paradoxical result that more social responsibility reduces welfare eventually occurs as the NPO cares more for consumers if firms have quadratic cost functions. This can happen even if the non-profit firm has a substantial technical advantage over its rival.

## 2. Model

As in most of the related literature, assume that there are two firms in a mixed market (Chang et al., 2014; Goering, 2007; Kopel and Brand, 2012; Lien, 2002; Nakamura, 2013, 2014; Wang and Wang, 2009; Wang et al., 2012). One of the firms is an NPO and the other an FPF. Firms sell their output  $q_N \geq 0$  and  $q_F \geq 0$ , respectively, at the market clearing price  $p(Q)$ , where  $Q = q_N + q_F$ . Suppose that the cost function of firm  $i (=N \text{ or } F)$  is  $c_i(q_i)$ . This framework is essentially the same that Goering (2008) and Lien (2002) use to obtain the results that we are discussing. However, they consider linear demand and cost functions.

Instead of specifying the form of demand and cost functions, we will assume that each of them is twice differentiable and satisfies a couple of relatively standard properties. On the one hand, the inverse of the demand function has a negative slope and is not very concave or convex. That is,

$$p' < 0 \tag{A1}$$

and

$$|p''| < -p' \cdot \min\left\{\frac{1}{q_F}, \frac{1}{q_N}\right\} \tag{A2}$$

On the other hand, the cost function of firm  $i (=N \text{ or } F)$  increases with output and is either linear or convex. That is,

$$c'_i > 0 \tag{A3}$$

and

$$c''_i \geq 0 \tag{A4}$$

It should be clear that these conditions are satisfied by many demand and cost functions that are used in economic analysis.

<sup>1</sup> There is an older literature that studies mixed oligopolies in which private and public firms interact (Cremer et al., 1991; De Fraja and Delbono, De Fraja and Delbono, 1989; Harris and Wiens, 1980; Matsumura, 1998). In this literature, public firms are assumed to maximize welfare.

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