State-owned enterprises as indirect instruments of entry regulation

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Abstract

In the context of mixed markets, Matsumura and Kanda (2005) show that social welfare in free entry equilibrium is maximized when there exists a public firm in the market. *En passant*, these authors state that this outcome is connected to the entry-deterring influence of a public firm. In this way, they counter-act the excess entry problem of Mankiw and Whinston (1986). We explain this result arguing that the state-owned firm can be an indirect instrument to regulate entry. In fact, under free entry equilibrium welfare may be greater with the presence of a public firm than with a social planner.

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1 Introduction

The role that state owned enterprises can play as an instrument of indirect regulation has been considered in various papers. For instance, Harris and Wiens (1980), Cremer, Marchand and Thisse (1989) and De Fraja and Delbono (1989). More recently, Garvie and Ware (1996) studied "the regulatory role of a public firm in an environment of private but correlated information about industry costs". The idea that the public firms can be an instrument of indirect regulation in mixed markets is associated with various factors. First, the presence of these firms can discipline the behavior of private firms with market power, since generally public enterprises are supposed to pursue the objective of welfare maximization. Second, they can be an alternative to regulation where informational costs of regulation are very high. Even when there is an option for direct regulation, public firms can be an instrument for obtaining information by the regulatory authorities, particularly in cases where collecting direct information about costs and demand is very difficult.

Lately there has been a wave of privatization and liberalization motivated on the one hand by advances in technology (the case of telecommunications comes immediately to mind), and on the other by the concern about the efficiency of public firms. Technological changes have challenged, in some sectors, the natural monopoly argument that led to public ownership and entry deterrence. At the same time, it is accepted that cost minimization presents serious incentive problems associated with the organization and management of public firms. Recent empirical literature on this subject draws attention to the necessity of taking the context in which firms are privatized into account. See, for instance, Kikeri and Nellis (2004), D'Souza *et al.* (2005) or Megginson and Sutter (2006).

Regardless of the above arguments in favor of privatization, there have been alternative solutions such as the replacement of state-owned monopolies by *mixed markets*, that is, market structures where public and private firms coexist. This happened in sectors like education and health but also, in some countries, in telecommunications, banking, transports, media and energy, for example. Mixed markets exist in several countries of western Europe and Japan and are especially important in transition economies.

In the context of mixed markets, Matsumura and Kanda (2005) show that social welfare in free entry equilibrium is maximized when there exists a public firm in the market. This is achieved by comparing the welfare when one firm is solely concerned in welfare maximization to the welfare obtained

when one firm is only partially public. *En passant*, these authors state that this outcome is connected to the entry-deterring influence of a public firm. In this way, they counter-act the excess entry problem of Mankiw and Whinston (1986).

This paper is concerned with the role played by a public firm in a mixed market where entry is an issue. First, we recall that in the case where all firms are private, the free entry equilibrium will lead, in some circumstances, to a sub-optimal level of welfare. This was proved by Mankiw and Whinston (1986) in the presence of business-stealing effect and with a homogeneous product. These authors show that the number of entrants in a free entry equilibrium is higher than the number of entrants allowed by a social planner seeking welfare maximization. The free entry equilibrium is not optimal from the point of view of the welfare in the circumstances described by Mankiw and Whinston (1986) and entry regulation can increase welfare. In the literature, indirect ways for improving welfare may be found when there is excess or insufficient entry. Cabral (2004) defines excess and insufficient entry, respectively, according to the positive effect of entry taxes and subsidies on welfare, in order to study this issue in the context of simultaneous entry in a market without firms. This is a different issue from the one we analyze here, in that we assume the previous existence of an incumbent firm in the market. We use sequential entry in the context set up by Mankiw and Whinston (1986).

Here we ask the following question: *can the existence of a public incumbent firm avoid the problem of excess entry and increase the level of welfare?* If so, the presence of a public firm can be an indirect instrument of entry regulation and an alternative to a social planner.

We answer this question in a model where we admit Cournot competition (the business-stealing effect is present) and a homogeneous product. We use the functional forms of De Fraja and Delbono (1989) which satisfy the assumptions of Mankiw and Whinston (1986). This guarantees that the number of entrants allowed by a social planner will be smaller and the level of welfare higher than that at the free entry equilibrium, for all values of the parameters characterizing the model. We then assume that the incumbent firm is public, welfare maximizing, and calculate the number of entrants in a free entry equilibrium under those assumptions. For this number of entrants we calculate the welfare level and compare it to that obtained by a social planner that can decide the optimal number of entrants when all firms are private. We prove that for an open subset of parameter space (parameters describe fixed and variable costs), welfare is higher when the public firm is present. Thus, we can answer, in the affirmative, the question above: we

prove that the presence of a public enterprise can be an alternative to direct regulation to avoid the excess entry problem. This is one of the factors that explain why some governments maintain mixed oligopolies in some sectors.

Note that, even though the public firm is already in the market, suggesting that it is a Stackelberg leader, we assume simultaneous actions in production. This guarantees that the results depend solely on the firm's objective rather than be influenced by the timing of decision making.

In the next section we describe the model and show that the assumptions of Mankiw and Whinston (1986) are satisfied. Section 3 is devoted to the calculations and comparison of welfare level. In the last section, we present our conclusions.

2 The model

We consider a market with one incumbent firm and the existence of potential entrants in the market. The entrants are private firms. All firms produce a homogeneous product and compete in quantities. We use the subscript 0 to indicate the incumbent firm. We assume a linear inverse demand function $p = 1 - (q_0 + \sum_{i=1}^{n} q_i)$ and a cost function of the form

$$c(q_i) = f + \frac{k}{2} q_i^2, \quad i = 1, \ldots, n.$$

The marginal cost is increasing so that, in the case of an incumbent public firm, this firm does not supply the entire market. The profit function is, as usual, $\pi_i = pq_i - c(q_i)$; $i = 0, \ldots, n$ and the welfare is given by the sum of consumers' and producers' surplus as follows

$$W = \int_0^{q_0 + \sum_{i=1}^{n} q_i} (1 - t)dt - \sum_{i=1}^{n} c(q_i) - c(q_0).$$

The firms act simultaneously. We consider two cases:[4]

Case 1: all firms (incumbent and entrants) are private, that is, they maximize their profit. There exists a social planner so that the number of entrants is equal to the number of firms that maximize welfare.

[4]The study of the welfare in such a market when there exist a public firm and n private firms according to different objectives pursued by the public firm was done by De Fraja and Delbono (1989).

Case 2: the incumbent firm is public having welfare maximization as its objective and the entrant firms are private, maximizing profit. There are no other agents so that the number of entrants corresponds to the free entry equilibrium.

Mankiw and Whinston (1986) consider the following assumptions that support the free-entry equilibrium with excess entry:

Assumption 1	$Nq_N > \hat{N}q_{\hat{N}}$ for all $N > \hat{N}$ and $\lim_{N\to\infty} Nq_N = M < \infty$
Assumption 2	$q_N < q_{\hat{N}}$ for all $N > \hat{N}$
Assumption 3	$P(Nq_N) - c'(q_N) \geq 0$ for all N.

These are satisfied in our setting as the quantities and price at equilibrium are given by, in each case

Case 1:

$$q_0 = \frac{1}{2+k+n}; \quad q = \frac{1}{2+k+n}; \quad p = \frac{1+k}{2+k+n}$$

Case 2:

$$q_0 = \frac{k+1}{(1+k)^2+kn}; \quad q = \frac{k}{(1+k)^2+kn}; \quad p = \frac{(1+k)k}{(1+k)^2+kn}$$

This guarantees that Proposition 1 in Mankiw and Whinston (1986) is also valid here. This proposition states that the number of entrants if all firms are private is higher, and therefore welfare is lower, than under the rule of a social planner. The social planner decides on the optimal number of firms that should enter the market for the welfare to be maximal.

We want to compare the level of welfare in two cases: when there is an incumbent public firm and entry is free and when the number of entrants is fixed by the social planner in the circumstances above. We assume the incumbent firm is efficient when pursuing the maximization of welfare.

It is worthwhile stating clearly the differences between the question we pursue and that which is addressed by De Fraja and Delbono (1989): while these authors establish the best strategy, in terms of welfare, for a public firm in a market with a fixed number, n, of private firms, we are concerned with the issue of entry, in particular *excess entry* producing a lower welfare than

expected. We handle this by making the number n of private firms endogenous. Hence, in our results, the number of private firms in the market needs not be the same under the two cases under consideration.

3 Number of entrants and the level of welfare

The number of entrants is calculated in two different ways, depending on whether we admit the existence of a social planner or whether we leave it to the free market to decide. In the case of a social planner, the number of entrants maximizes welfare. In the case of free entry, the number of entrants is such that the profit of each private entrant firm is zero. To calculate the welfare in each of the cases we use q_0 and q from case 1 and case 2 above. The welfare when all firms are private is given by[5]

$$W_{SP} = \frac{3 + k + (4 + k)n + n^2}{2(2 + k + n)^2} - (n + 1)f \tag{1}$$

and the profit of a potentially entrant (private) firm, when there is a public welfare-maximizing incumbent firm in the market, is

$$\pi_{IP} = \frac{k^2}{((1 + k)^2 + nk)^2}(1 + \frac{k}{2}) - f.$$

The number of entrants in the presence of a social planner, n_{SP}, is then found by differentiating (1) with respect to n and solving

$$\frac{\partial W_{SP}}{\partial n} = 0 \tag{2}$$

for n. Equation (2) has one real and two complex roots. The expression for the real root depends on the parameter range. We are going to assume, from now on, that $f \geq 0.007$ (for $0 \leq f < 0.007$ the real root has a more complicated expression) so that the real root is given by

$$n_{SP} = \frac{r^{1/3}}{6f} + \frac{k}{r^{1/3}} - 2 - k, \tag{3}$$

with

$$r = (108 + 108k + 6\sqrt{-\frac{6k^3 - 324f - 648fk - 324fk^2}{f}})f^2.$$

[5]We use the subscript *SP* to indicate quantities in the case where there is a *Social Planner* and the subscript *IP* to indicate the existence of an *Incumbent Public* firm.

Now we find the number of entrants in the presence of an incumbent public firm and free entry, n_{IP}. This is given by the positive zero of the equation

$$\pi_{IP} = 0 \tag{4}$$

when solved for n. The positive zero of equation (4) is

$$n_{IP} = -\frac{(k+1)^2}{k} + \frac{\sqrt{2f(2+k)}}{2f}. \tag{5}$$

Replacing n by n_{SP} in W_{SP} we obtain the level of welfare when the number of entrants is established by the social planner. We call this level of welfare $maxW_{SP}$. The level of welfare when there is an incumbent public firm and entry is free is calculated replacing n by n_{IP} in the expression for the welfare, which is

$$W_{IP} = \frac{(1+k)^3 + nk(nk+2+4k+k^2)}{2((1+k)^2+nk)^2} - (n+1)f.$$

We call this level of welfare $maxW_{IP}$. We have

$$\begin{aligned} maxW_{IP} &= \frac{2f(1+k+2k^2+k^3) - 2\sqrt{2f(2+k)}(k+1) + k(k+2)}{2k(k+2)} \\ maxW_{SP} &= \frac{3+k+(4+k)(\frac{r^{1/3}}{6f} + \frac{k}{r^{1/3}} - 2 - k) + (\frac{r^{1/3}}{6f} + \frac{k}{r^{1/3}} - 2 - k)^2}{(\frac{r^{1/3}}{6f} + \frac{k}{r^{1/3}})^2} \\ &\quad -(\frac{r^{1/3}}{6f} + \frac{k}{r^{1/3}} - 1 - k)f. \end{aligned}$$

The welfare levels $maxW_{SP}$ and $maxW_{IP}$ depend on the values of the parameters f and k. The purpose of this paper is to show that there is an open range of parameter values, in the (f, k)-plane, for which we have $maxW_{IP} > maxW_{SP}$. That is, the welfare is higher when allowing for free entry, but maintaining a public incumbent firm in the market, than when the entry is conditioned by a social planner.

Since the expressions for either $maxW_{SP}$ and $maxW_{IP}$ are very complicated we cannot solve directly $maxW_{IP} > maxW_{SP}$. Instead we note the following: despite the fact that they are complicated, both $maxW_{SP}$ and $maxW_{IP}$ are continuous functions of the parameters f and k. Hence, the sign of $maxW_{IP} - maxW_{SP}$ will be constant on either side of the curve of solutions to $maxW_{IP} - maxW_{SP} = 0$. The analytical solution of this equation is too complicated to allow for any interpretation. Instead, we plot the zero level

curve of the function $[maxW_{IP} - maxW_{SP}](f, k)$ and evaluate the sign of the difference at a representative point. [6] The zero level curve is plotted in figure 1 together with the line $n_{IP} = 0$, below which there are no entrants, i.e., the public firm will remain a monopolist in the market. In this case of a public monopolist welfare is obviously higher than when there is a mixed oligopoly. It is worthwhile noticing that, as the fixed cost increases, this is the expected outcome thus solving the excess entry problem in the most drastic way. Comparing the values obtained for n_{SP} and n_{IP} in (3) and (5), respectively, we observe that $n_{IP} < n_{SP}$ for the parameter values we are considering, thus showing that there is no excess entry when a public incumbent firm is present in the market. In figure 1, we consider that the fixed cost varies between half a percent and ten percent of the maximum allowed price. The values of k, associated with the variable cost, we consider are between zero and one. In the open set below the full line, the level of welfare is higher under free entry with an incumbent public firm than under the rule of a social planner. This difference in welfare can be non-negligible. Using Clenshaw-Curtis quadrature, we have calculated the average welfare gain (that is, the average value of $maxW_{IP}/maxW_{SP}$) for $0.001 < k < 0.1$ and $0.05 < f < 0.1$. The result shows that the welfare gain associated to the presence of a public firm is important. In fact, the average gain is approximately 6.6, showing an increase of 560%. If we expand the parameter region to include higher values (up to 0.75) of the variable cost k, the average welfare gain remains above 100%. For values of k close to 1, the average welfare gain drops to 78%.

From figure 1, we see that for high values of the fixed cost f the existence of a public incumbent firm is welfare enhancing. A high fixed cost lowers welfare directly while an increase in variable cost k tends to lower production. However, with a public incumbent in the market the total output level is kept high enough to allow for the maintenance of a low price level. In this way, entrance of some private firms is deterred and the welfare is increased. When the fixed cost is not so high, the influence of a public firm diminishes. In the extreme case of a high variable cost and a low fixed cost, the excess output of the public firm decreases welfare and a social planner is more desirable.

[6] We note that, due to the continuity of the functions involved, the results are robust, ensuring that the qualitative information, on the sign of $[maxW_{IP} - maxW_{SP}](f, k)$, provided by figure 1 does not depend on numerical performance.

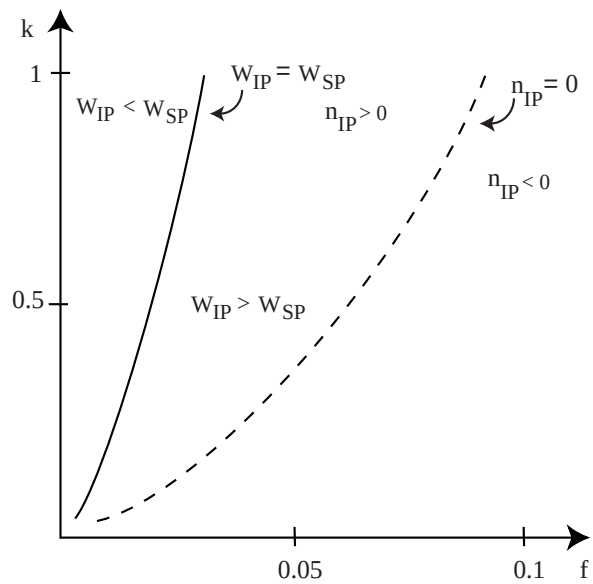

Figure 1: The full line represents the set of points where $maxW_{IP} - maxW_{SP} = 0$ and the dashed line represents the set of points where $n_{IP} = 0$. The region below (to the right of) the full line is that where the welfare with a public incumbent firm and free entry is higher than that obtained by a social planner and private firms. Below the dashed line the public firm remains a monopolist in the market.

4 Conclusions

We compare the levels of welfare attained in two instances: *i)* when there is free entry and the incumbent firm is state-owned, and *ii)* when the incumbent firm is private and entry is regulated by a social planner. All entrant firms are private. We show that for a wide range of values of both fixed and variable costs, the level of welfare obtained when there is an incumbent public firm is significantly higher than that obtained when entry is regulated by a social planner. As fixed and variable costs increase this result is more probable since it occurs for a larger set of parameters.

An intuitive explanation for the positive association between greater fixed costs and the possibility of the public firm effect consists in the fact that with higher fixed costs there are fewer entrants and the public firm can expand its output. The fact that the public firm can play an indirect regulatory role provides a partial explanation for the persistance of mixed oligopolies in certain countries and industries, regardless of the widespread idea that public firms are less efficient than private ones. Furthermore, our results explain

the statement by Matsumura and Kanda (2005) that, under free entry, the state should own all the shares of a public company in order to maximize welfare.

We are aware of the issue of the inefficiency of state-owned firms. Theoretically the inefficiency of state owned firms has been explained by the agency argument, as stated in Okten and Arin (2006): "Vickers and Yarrow (1988) argue that managers of SOEs may lack high-powered incentives or proper monitoring. Shleifer and Vishny (1994) stress that political interference in the firm results in excessive employment, poor choices of product and location, lack of investments and ill-defined incentives for managers." In a survey of empirical studies on privatization (the authors also make a short survey of privatization's theory), Megginson and Netter (2001) conclude that "research now supports the proposition that privately owned firms are more efficient and more profitable than otherwise-comparable state-owned firms". However, in this model we would need to introduce great efficiency differentials so that the public firm's effect is cancelled, since the welfare gains are very high. The need to consider the magnitude of the improvement from privatization is also present in Bradburd (1995), as pointed out by Willner (1996).

We stress that we want to focus solely on the indirect regulatory role of the public firm, *ceteris paribus*, which is why we do not address the problem of the advantages and disadvantages of public versus private firms. [7] If we were to introduce differences between the efficiency of public and private firms, the result might be different. The study of this issue takes us into a 3-dimensional parameter space. Obtaining concluding results in such a setting provides a challenge for future work.

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[7] We note, for those familiar with De Fraja and Delbono's results, that there is no contradiction between this result and theirs: in fact the level of welfare reached in our model in the case of a public firm corresponds to a smaller number of private firms in the market than in the case of a social planner, a situation not admitted in De Fraja and Delbono's setting.

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