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## ACQUISITIONS IN THE ELECTRICITY SECTOR: ACTIVE VS. PASSIVE OWNERS



Department of Economics

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# Acquisitions in the Electricity Sector: Active vs. Passive Owners\*

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## Abstract

The starting point of this paper is a mixed oligopoly market consisting of  $n$  privately owned profit maximizing firms and 1 state-owned welfare maximizing firm. Motivated by the trend of mergers and acquisitions in the liberalized electricity markets, and by the debate about public or private ownership, the paper looks at two cases. In Case 1, the state-owned company acquires an ownership share in one of the private companies. In Case 2, the state-owned company is partially privatized. The paper focuses on differences in generated quantities and social surplus, depending on whether the investors behind the acquisitions are behaving as active or passive owners. One result shows that in the case of partial privatization, passive ownership provides the highest total industry generation, while active ownership induces maximum social surplus.

## 1 Introduction

The deregulation of the electricity markets has triggered a series of mergers and acquisitions of ownership shares among the companies preparing for the future energy market. However, as opposed to the situation in the UK, where the liberalization of the electricity market went hand in hand with privatization of the companies, public ownership is still dominating in many countries, even after the liberalization. Currently, we observe a trend where the publicly owned

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companies are active making acquisitions ownership shares in competing companies both domestically and abroad. One example is the Norwegian electricity market, which is dominated by public ownership through one large state-owned company, Statkraft, and many smaller companies owned by municipalities. At the same time, Statkraft, already controlling more than 30% of the generation capacity in Norway, is the most acquisitive company.<sup>1</sup> The same tendency can be seen in Sweden, where state-owned Vattenfall, is continuously increasing its already dominating position through a number of acquisitions both in Sweden and internationally.

The development towards fewer and larger companies is expected to continue. Simultaneously there is an ongoing debate about privatization of publicly owned companies. In Norway, some of the large state-owned companies in other industries, e.g. petroleum and telecommunications, have been partially privatized during the last few years. Even if no final decision has been made about Statkraft in this respect, there is reason to believe that a partial privatization of this company can happen in the near future.

This development raises some interesting questions concerning the effect on e.g. generated quantities and social surplus of mergers and acquisitions in the electricity markets. Mergers between competing companies will clearly make the markets less competitive and thus most likely induce reduced generation, higher prices and lower social surplus. The effect of partial ownership, however, can be a bit more puzzled. Will an acquisition of an ownership share in a rival provide the investor with the possibility to affect the behavior of this company? And what is the motive behind such an acquisition? One interesting approach to these questions is to separate between active and passive ownership. In Norway, Statkraft's strategy is: "*...to take a part in the restructuring of the electricity sector in order to utilize the company's competence, and to realize economies of scale within electricity generation and wholesale*".<sup>2</sup> An important aspect is whether Statkraft, through its ownership, will directly influence the strategic decisions of the companies in which the acquisitions are made. If this is the case, Statkraft should be considered as an active owner. On the other hand, the ownership can be passive in the sense that the investing company only takes part of the profit generated by the company it owns a part of without involving directly in the operation of the company. These two ownership strategies will in this paper be shown to have different effects on the market equilibrium.

I will not go into the debate on whether the companies should be publicly or

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<sup>1</sup>According to the Norwegian Ministry of Petroleum and Energy, more than 100 mergers and acquisitions of ownership shares at a total value of 70 billion NOK were carried out by different companies in the Norwegian electricity market during 1999 and 2000.

<sup>2</sup><http://www.Statkraft.no>

privately owned, but rather consider two alternative developments in the electricity market. First, assuming that the current trend continues in the sense that the degree of public ownership increases due to the public companies making acquisitions of ownership shares in their privately owned competitors. Thereafter, I will look at a development towards partial privatization of the publicly owned companies. In each of these alternative developments the difference between active and passive ownership, and the effects on the market equilibrium, will be analyzed.

The paper is organized as follows. In section 2, the difference between active and passive ownership is further emphasized and related to the economic literature. Section 3 introduces an analytic equilibrium model based on the literature of mixed oligopolies.<sup>3</sup> The model is used to analyze the differences between active and passive ownership on variables like generated quantity and social welfare in an oligopolistic market with Cournot competition. Three cases are considered. The starting point (case 0) is a market with 1 publicly owned company and  $n$  privately owned companies. In case 1, the publicly owned company acquires an ownership share in one of the privately owned companies, and in case 2 the publicly owned company is partially privatized. The results are presented in section 4. Finally, Section 5 summarizes and concludes.

## 2 Active vs. passive ownership

If a company makes an acquisition in another company and the ownership is passive, this ownership part does not give the investing company any direct influence on the strategic decisions of the company in which the acquisition is made. Assuming a Cournot oligopoly, the only way it can influence the quantity decision of the other company is through its own quantity decision. The company will therefore take into account the way its own generation decision affects the profit of the company it owns a share in. The optimization problem is then to select the quantity that maximizes the sum of profits from its own generation and from the ownership share in the other company. Active ownership, on the other hand, will be characterized by the companies involved making a coordinated generation decision. More specifically this will mean that the objective functions of both the companies involved will change. If the ownership is passive, only the objective function of the firm making the acquisition will change. Amundsen and Bergman (2002) mention this difference between active and passive owners, and refer to Bresnahan and Salop (1986), Reynolds and

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<sup>3</sup>A mixed oligopoly market is characterized by having both privately and publicly owned firms competing in the same market.

Snapp (1986) and Flath (1991) for a more comprehensive discussion of the effect of passive ownership arrangements among companies.

Looking at Reynolds and Snapp, they are considering an industry where the companies can have "partial equity interest" in each other. This must be considered as passive ownership as they are referred to as "interests not conveying control". The authors use a simple Cournot model with profit maximizing firms that are identical in every aspect. A firm that makes an acquisition of an ownership share in another firm will not influence directly on the output decision of the firm it buys a share of. However, it will include the profit it earns from this other firm in its own objective function. Thus, the acquisition will influence on its output decision indirectly, i.e. the ownership is passive. The main conclusion from the paper is that in a market where entry is difficult, partial ownership arrangements could result in less output and higher prices than otherwise, even if the ownership shares are relatively small.

### 3 The model

The market for electricity generation is analyzed as a mixed oligopoly. De Fraja and Delbono (1990) defines mixed oligopoly as "*... a market where a homogenous or differentiated good is supplied by a "small" number of firms and the objective function of at least one of them differs from that of the other firms*". Merrill and Schneider (1969) emphasizes the establishment of a mixed oligopoly, e.g. through the state buying one private firm operating in a specific industry, as a possible alternative in regulating imperfect competition in an industry. Their conclusion is: "*...that the existence of a government firm in an oligopolistic industry can result in improved market performance, i.e. lower prices and increased output*". The idea is that the authorities can affect the running of an industry from the inside through a public firm which interacts with private firms.

Within the relatively scarce literature on mixed oligopolies, the majority of the contributions model markets in which privately and publicly owned companies generate a homogenous good and compete on equal basis using only market instruments. Their objective functions differ in the sense that the private firms are profit maximizers paying no attention to social goals, while the public firm is pursuing a welfare economic goal, typically through a function of consumer and producer surpluses.<sup>4</sup>

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<sup>4</sup>One exception to this modelling approach to public objectives is the article by Merrill and Schneider. They let the public company maximize total industry output, subject to the conditions that it does not inflict losses on the private firms, and that the price is not set so low that demand exceeds total industry capacity.

Modelling a publicly owned company as a welfare maximizer is not obviously a correct approach. Some years ago, assuming such motives for a publicly owned company was maybe more realistic, and it was often used as the main argument for public ownership. However, in the transition from regulated to deregulated markets, many publicly owned companies have been assumed to change their focus towards acting like profit maximizers. On the other hand, in many countries with less liberalized electricity markets, publicly owned companies may still be focusing on welfare maximization. For the specific case of the Norwegian electricity market, we see some examples of municipally owned companies selling electricity at prices below the market price to the inhabitants of the municipality owning the company. This is an example of "local welfare maximization", and it shows that welfare maximization can be the objective of companies even within a liberalized market. So, realizing the potential lack of realism in assuming the state-owned company in the model to be a welfare maximizer, I still choose to follow the literature in this area and model the state company as focusing on optimizing social surplus.

The model has similarities to both De Fraja and Delbono (1989) and to Delbono and Scarpa (1992). It is a partial equilibrium static model that looks at the strategic interaction among firms within a particular industry. De Fraja and Delbono do, however, not consider the possibility that the firms can acquire ownership shares in their competitors. Instead they consider alternative strategies employed by the public firm and their effects on some key variables as welfare and total generation.<sup>5</sup> Delbono and Scarpa, on the other hand, are looking at *mergers* between public and private companies. More specifically, they consider different market structures looking for conditions for such mergers to be Pareto optimal in the sense that it increases both the profit for the private owner and the social welfare, which is the objective of the public owner.<sup>6</sup>

I start by specifying the model for the Base case that describes the market structure prior to any acquisitions of ownership shares. Thereafter, the model is described for two cases. In case 1, the public firm makes an acquisition of an ownership share in one of the private companies. Case 2 describes the situation where the public firm is partially privatized. In these cases the focus will be on emphasizing the differences related to whether the investor is acting as an active

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<sup>5</sup>More specifically, De Fraja and Delbono look at four different strategies of the public firm. Two extreme strategies where the public firm is either a profit maximizer or has the possibility to nationalize the whole sector, and two strategies where it is a welfare maximizer with and without Stackelberg leadership.

<sup>6</sup>The market structures considered by Delbono and Scarpa are: a market with one private and one public firm, a market with 1 public and n private firms, and a market where the public firm merges with a foreign private firm.

or a passive owner. In the case of partial privatization, it will also make a difference whether the investor is one of the rival firms, or if it is an external investor in the sense that it is not a competitor to the firm in which the acquisition is made. In both cases the model will be solved for both active and passive ownership, producing a set of Nash-Cournot equilibrium expressions for generation and prices for each case. These expressions, together with the result from the Base case, will be compared to focus on the importance of the type of ownership for the resulting industry output and the welfare level. It should be noted that describing the behavior of electricity producers within a Cournot modelling framework rather than in e.g. a Bertrand model is not obvious. Amundsen and Bergman (2002) refers to Borenstein and Bushnell (1999) for a discussion of this theme.<sup>7</sup> Flath (1991) argues that whether one consider a market to be a Bertrand- or a Cournot oligopoly will affect whether it is rational for firms to acquire a passive ownership share in a competing firm.

Calculation of the Nash-Cournot equilibria for all the different cases is straight forward and will not be presented in detail. I will now go through the specification of the model for each of the cases, before presenting the equilibrium solutions and analyzing the results in section 4.

### 3.1 Case 0: the Base case

The market in this case consists of  $n$  privately owned firms and 1 publicly owned firm, i.e. a total of  $n + 1$  firms in the industry. We can think of this as the situation in the Norwegian electricity market prior to any mergers or acquisitions of ownership shares.<sup>8</sup> The industry structure and the objectives of the firms in the Base case are identical to the "Nash-regime" in De Fraja and Delbono (1989). Firm 0 is the public firm while the privately owned firms are numbered  $1, \dots, n$ . All agents have perfect information and the technology is assumed to be identical across the firms. The private firms will therefore make symmetric quantity decisions. The output level of each private firm is denoted  $x_i$ ,  $i = 1, 2, \dots, n$ . However, since I am only considering identical generation levels for the private firms, the subscript can be removed, i.e.  $x_i = x$ ,  $i = 1, 2, \dots, n$ . The output level of the public firm is represented by  $z$ .

The inverse demand function is assumed to be linear and decreasing:

$$P(Q) = a - Q,$$

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<sup>7</sup>See also De Fraja and Delbono (1990) for a short discussion of why the Cournot framework is usually used within this literature.

<sup>8</sup>The companies owned by municipalities are then thought of as profit maximizers.

with  $a > 0$ .  $P$  is the market price and  $Q = nx + z$  is total industry output. The technology employed by every firm in this industry is given by the following cost function:

$$C(q) = q^2,$$

where  $q$  refers to each firm's individual output, i.e.  $q = x$  or  $z$ . The cost function is twice continuously differentiable with non-negative marginal costs and no capacity constraint. It is also assumed that there are no fixed costs. This assumption about technology is in line with most of the mixed oligopoly literature.<sup>9</sup>

The only difference between the firms lies in their objective functions. The Nash-Cournot assumption implies that the privately owned producers consider the quantity generated by the publicly owned company (represented by  $\bar{z}$ ) as given when choosing their profit maximizing quantity. The objective function of the profit maximizing firms has the following form:

$$\pi(x, \bar{z}) = P(Q)x - C(x).$$

The social surplus maximizing public firm considers the quantity chosen by the profit maximizing firms (represented by  $\bar{x}$ ) as given, and maximizes this welfare function:

$$W = W(\bar{x}, z) = \int_0^Q (a - t) dt - nC(\bar{x}) - C(z).$$

The Nash-Cournot equilibrium solution for the Base case is presented in Table 1.

Table 1: Nash-Cournot equilibrium for the Base case	
Variable	Case 0
Private firms' generation	$2\frac{a}{2n+9}$
Public firm's generation	$3\frac{a}{2n+9}$
Total production	$a\frac{2n+3}{2n+9}$
Welfare	$\frac{1}{2}a^2\frac{4n^2+28n+27}{(2n+9)^2}$

<sup>9</sup>De Fraja and Delbono (1990) refer to Beato and Mas-Colell (1984) as a work considering different shapes of the cost function. They also state that the assumption about technology is an important one and suggest that it therefore should be given more consideration in future research.

### 3.2 Case 1 model

In case 1, the state increases its involvement in the industry. It is assumed to do this through an acquisition of ownership shares in one of the private firms. This is similar to what we actually see in the Norwegian electricity market at the moment, as Statkraft is acquiring ownership shares in municipally owned companies. As a simplification, it is assumed that the public company only acquires ownership shares in *one* of its rivals. Throughout the article, I will refer to the firm in which the acquisition is done, as the firm with mixed ownership. The industry now consists of firms with three different ownership structures, and therefore also three different quantity decisions in equilibrium. This changes the model somewhat.

The inverse demand function is like specified above, but with  $Q = (n - 1)x + y + z$  as total industry output, where  $y$  refers to the output of the firm with mixed ownership.

I assume that the public firm's acquisition of an ownership share does not influence the technology available to the firms. Thus, the cost function is the same as in the Base case.<sup>10</sup> The firms differ, however, in their objective functions. Like before, the pure private firms maximize profit, while the pure public firm maximizes social surplus. The form of the objective function of the firm with mixed ownership will be dependent on whether the state acts as an active or a passive owner.

Letting  $\bar{y}$  represent the quantity chosen by the firm with mixed ownership (which the other firms consider as given), the privately owned firms maximize the following objective function:

$$\pi(x, \bar{y}, \bar{z}) = P(Q)x - C(x).$$

The pure state-owned firm maximizes:

$$W = W(\bar{x}, \bar{y}, z) = \int_0^Q (a - t) dt - (n - 1)C(\bar{x}) - C(\bar{y}) - C(z).$$

The difference between whether the state in this case is acting like an active or as a passive owner will be reflected in the objective function of the firm in which the acquisition is made. The public firm's acquisition of ownership shares will necessarily have to involve some kind of payment. In my analysis I will, however, concentrate on the allocation effects and leave questions on payment and compensation aside.

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<sup>10</sup>Note that we now have the cost function  $C(q) = q^2$ , with  $q = x, y$  or  $z$ .

### 3.2.1 Active ownership

When the state behaves as an active owner, it will use its ownership share to influence the objective function of the firm in which the acquisition is made. The motive of the state is to make the firm include social welfare in its quantity decision. The firm with mixed ownership will therefore be assumed to maximize a weighted average of social surplus and profit. The weight is decided by the distribution of ownership shares between the public and private owner. It may seem controversial to model the objective function of a company with different types of owners like this. However, we may think of the ownership shares of the public and private owners as reflecting their relative bargaining power in the company's board. It can of course happen that one of the owner groups is so large that it, through a majority decision, may force through a strategy of e.g. pure profit maximization. Still, I choose to use this modelling approach, which is also used in Delbono and Scarpa (1992).<sup>11</sup> The parameter  $\alpha$  specifies the private ownership part of the firm and decides the weight to be placed on profit maximization in the objective function. The objective function of the firm with mixed ownership, represented by  $\Pi$ , is then specified as:

$$\begin{aligned} \Pi(\bar{x}, y, \bar{z}) &= \alpha [P(Q)y - C(y)] \\ &+ (1 - \alpha) \left[ \int_0^Q (a - t) dt - (n - 1) C(\bar{x}) - C(y) - C(\bar{z}) \right] \end{aligned}$$

We would also expect the objective function of the company making the acquisition to change. This does, however, not happen in this case. The public firm maximizes welfare, which is a function of total industry output. Thus, the objective function of the active owner in this case is already including the effect that its own quantity decision has on the quantity decision made by the firm it owns a part of. The Nash-Cournot equilibrium for this case is presented in Table 2.

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<sup>11</sup>Modelling a merger between a public and a private firm, Delbono and Scarpa assumes that the agreement between the two participants in the merger must specify the weight of each partners interest in the new firms objective function.

Table 2: Nash-Cournot equilibrium for case 1 with active ownership	
Variable	Case 1 (active owner)
Private firms' gen.	$2a \frac{2+\alpha}{4n+2n\alpha+7\alpha+20}$
Mixed firm's gen.	$6 \frac{a}{4n+2n\alpha+7\alpha+20}$
Public firm's gen.	$3a \frac{2+\alpha}{4n+2n\alpha+7\alpha+20}$
Total generation	$a \frac{4n+2n\alpha+8+\alpha}{4n+2n\alpha+7\alpha+20}$
Welfare	$\frac{1}{2} a^2 \frac{16n^2+16n^2\alpha+104n\alpha+128n+4n^2\alpha^2+20n\alpha^2+3\alpha^2+96\alpha+144}{(4n+2n\alpha+7\alpha+20)^2}$

### 3.2.2 Passive ownership

In this case, looking at the public firm as a passive owner will not change the situation from the Base case. As a passive owner the public firm should just change it's own objective function to consider the effect of the quantity decision made by the firm it owns a part of. This is, as explained above, already included in the objective function of the publicly owned company. The Nash-Cournot equilibrium for case 1 with passive ownership is thus presented in Table 1.

## 3.3 Case 2 model

The situation is now turned around as it is assumed that the public firm is partially privatized. In this case it makes a difference whether the partial privatization of the public company is being done through an external acquisition of shares, or if it is one of the competitors that makes an acquisition of an ownership share of the public company.

### 3.3.1 Active ownership

Assuming first that the acquisition of ownership shares in the public firm is done by a private external investor, i.e. an investor that is not a rival firm, only the objective function of the firm in which the acquisition is done will change. The privately owned companies will have the same objective function as in the Base case. For the partially privatized public firm, however, the private investor will influence the firm to put more emphasis on profit maximization. Note that in this section,  $z$  is representing the output of the now partially privatized public firm. This firm maximizes a weighted average of profit and producers' and consumers' surpluses:

$$W(\bar{x}, z) = \alpha [P(Q)z - C(z)] + (1 - \alpha) \left[ \int_0^Q (a - t) dt - nC(\bar{x}) - C(z) \right]$$

The equilibrium solution is presented in Table 3.

Table 3: Nash-Cournot equilibrium for case 2 with an active external owner	
Variable	Case 2 (active external owner)
Private firms' generation	$a \frac{2+\alpha}{2n+9+\alpha n+3\alpha}$
Partly privatized firm's gen.	$3 \frac{a}{2n+9+\alpha n+3\alpha}$
Total generation	$a \frac{2n+\alpha n+3}{2n+9+\alpha n+3\alpha}$
Welfare	$\frac{1}{2} a^2 \frac{4n^2+28n+4\alpha n^2+22\alpha n+27+18\alpha+\alpha^2 n^2+4\alpha^2 n}{(2n+9+\alpha n+3\alpha)^2}$

Assume now that a private internal investor, i.e. one of the privately owned rival firms, acquires a share equal to  $\alpha$  of the public firm, and that this investor is an active owner. Letting  $y$  represent the output of the firm making the investment, the set of objective functions for the different firms then become like follows.

The  $(n - 1)$  privately owned firms with no acquisitions in other firms maximize profit as before:

$$\pi(x, \bar{y}, \bar{z}) = P(Q)x - C(x).$$

The privately owned firm with an active ownership share in the public firm maximizes profit, and takes into account the profit it earns from its ownership share in the public firm. When making its own quantity decision, the investing firm considers the quantity chosen by the partially privatized firm and the other privately owned firms as given (represented by  $\bar{z}$  and  $\bar{x}$ , respectively) and chooses the quantity that maximizes its total profit. Assuming that the share of profit that goes to the investor is given by the ownership share  $\alpha$ , the objective function becomes.

$$\Pi(\bar{x}, y, \bar{z}) = P(Q)y - C(y) + \alpha [P(Q)\bar{z} - C(\bar{z})].$$

The public firm wants to be a welfare maximizer, but has to include profit maximization in its objectives because of the private investors' active ownership share. Thus, the objective function of the partially privatized company will be a weighted combination of welfare and profit maximization:

$$W(\bar{x}, \bar{y}, z) = \alpha [P(Q)z - C(z)] \\ + (1 - \alpha) \left[ \int_0^Q (a - t) dt - (n - 1)C(x) - C(y) - C(z) \right].$$

The Nash-Cournot equilibrium is specified in Table 4.

Table 4: Nash-Cournot equilibrium for case 2 with and active internal owner	
Variable	Case 2 (active internal owner)
Private firm's generation	$(\alpha + 2) \frac{a}{\alpha n + 2n + 2\alpha + 9}$
Investing firm's generation	$2 \frac{a}{\alpha n + 2n + 2\alpha + 9}$
Partly privatized firm's gen.	$3 \frac{a}{\alpha n + 2n + 2\alpha + 9}$
Total generation	$a \frac{\alpha n + 2n - \alpha + 3}{\alpha n + 2n + 2\alpha + 9}$
Welfare	$\frac{1}{2} a^2 \frac{\alpha^2 n^2 + 4\alpha n^2 + 2\alpha^2 n + 18\alpha n + 4n^2 + 28n - 3\alpha^2 + 8\alpha + 27}{(\alpha n + 2n + 2\alpha + 9)^2}$

### 3.3.2 Passive ownership

An external investor exercising passive ownership in a welfare maximizing firm is not a realistic case. I will therefore concentrate on the case where a privately owned rival is making the investment and acts as a passive owner. The objective function of the firm making the investment will then change compared to the Base case, as it takes into account the profit it gets from the ownership share in the public company. The objective function for this firm will thus be identical to the specification above where it was an active owner. The  $(n - 1)$  private firms will maximize profit, while the public firm will still only focus on social surplus, like in the Base case. The Nash-Cournot equilibrium for case 2 with a passive internal investor is presented in Table 5.

Table 5: Nash-Cournot equilibrium for case 2 with a passive internal owner	
Variable	Case 2 (passive internal owner)
Private firm's generation	$2 \frac{a}{2n + 9 - \alpha}$
Investing firm's generation	$(2 - \alpha) \frac{a}{2n + 9 - \alpha}$
Partly privatized firm's gen.	$3 \frac{a}{2n + 9 - \alpha}$
Total generation	$a \frac{2n + 3 - \alpha}{2n + 9 - \alpha}$
Welfare	$\frac{1}{2} a^2 \frac{4n^2 + 28n - 4n\alpha + 27 - 10\alpha - \alpha^2}{(2n + 9 - \alpha)^2}$

## 4 Results

The main results from the analysis will now be highlighted. The focus is on total generation and welfare under the different ownership arrangements.

### 4.1 Case 1

For the case where the public firm is increasing its influence in the industry through an acquisition of an ownership share in one of its privately owned rivals, passive ownership will not change anything compared to the situation before the acquisition. Thus, the Base case also represents the result of passive ownership in case 1. Hence, the results from the Base case, actually also describes the Nash-Cournot equilibrium of Case 1 with passive ownership. However, if the state acts as an active owner, we will get a different equilibrium solution. Let  $Q$  represent total industry output, and the subscripts  $A$  and  $P$  refer to Case 1 with active and passive ownership, respectively. Then, comparing the expressions for total industry output I find that if the state acts as an active owner, total generation in case 1 will always be larger than if the ownership is passive:

$$Q_A > Q_P, \forall \alpha \in [0, 1].$$

Thus, any public acquisition of ownership shares in one of the private firms will increase total generation as long as the state acts like an active owner, as compared to passive ownership. However, a closer look at the expressions shows that the difference between total generation in the two cases decreases as the number of firms in the industry increases.<sup>12</sup>

Does an increase in total generation also mean that the social welfare level always will increase from more active public involvement in the industry? Letting  $W$  represent the welfare I get:

$$\begin{aligned} \text{For } n \leq 5 : & \quad W_A > W_P \quad \forall \alpha \in [0, 1], \text{ but} \\ \text{for } n \geq 6 : & \quad W_A < W_P \text{ for an interval of low } \alpha\text{-values.} \end{aligned}$$

If the level of competition in the industry is low (5 or less firms in this specific model setting), a positive active public ownership share in one of the private firms will always increase welfare, as compared to if the ownership is passive. For higher levels of competition there will exist an interval of low active

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<sup>12</sup>Relating this result to De Fraja and Delbono, they show that total quantity is at its maximum when the whole industry is nationalized. This can be seen as the extreme of my case 1 where the public sector buys all the private firms operating in this particular industry.

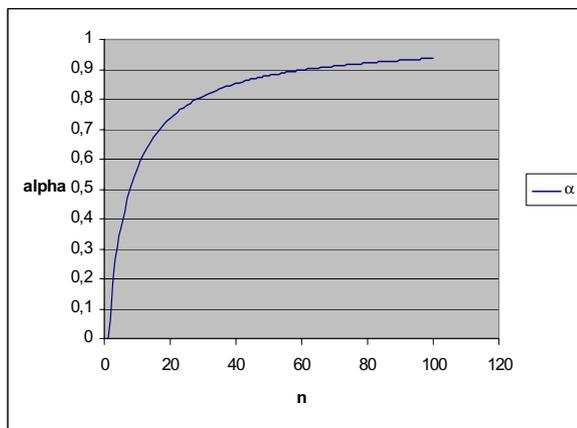


Figure 1: *Private ownership share of the mixed firm inducing maximum welfare as a function of the degree of competition in the market.*

private ownership shares that reduces welfare.<sup>13</sup> The numbers should not be taken literally, as they are a result of the model specification. Rather, they should be seen as an indication of the direction that the results take if the competition in the market is increased or reduced.

A closer look at the equilibrium solution shows that the size of the public firm's acquisition that maximizes welfare will depend critically on the number of firms active in the market. Maximizing the welfare expression for the active owner in case 1 with respect to  $\alpha$  yields:

$$\alpha = 4 \frac{n - 1}{4n + 23}.$$

The relationship between  $\alpha$  and  $n$  is illustrated in Figure 1.

The analysis of the welfare effects of an active public investor then shows that the higher the competition, the more weight should the mixed company put on profit maximizing, i.e. the lower should the public ownership share be.

A similar result is emphasized in De Fraja and Delbono (1989), as they find that if the competition in an industry is high enough, it will be better in a welfare economic sense for a public firm to behave like a profit maximizer than

<sup>13</sup>Note that I am using only integer numbers when I refer to the number of firms even though the exact calculations give real numbers. It is not possible though to have e.g. 5,32 firms in the industry.

to maximize social surplus. The reason for this counterintuitive result is that, given the assumptions about identical firms and increasing marginal costs, cost efficient generation implies that total generation is distributed equally among the firms.<sup>14</sup> If the number of firms competing in the industry is large, total output is close to the competitive one. The small increase in consumer surplus resulting from the welfare maximizing public firm increasing its generation until the price equals its marginal cost will then be offset by the higher cost inefficiency due to increased inequality in firms generation and lower private profits. This is also the explanation adopted by De Fraja and Delbono. However, they do not emphasize this further.

The result has its explanation in the specific setting of the Nash game, in which quantity decisions are made simultaneously, and the assumption about increasing marginal cost. For the sake of simplicity, forget about the public firms' acquisition of ownership shares for a moment. Given the specific characterizations of the objective functions in the Base case above, welfare is actually maximized. However, the welfare can be increased if the objective function of the public company changes. Remember that there is perfect information among the companies in this industry. If the public company put some weight on profit in its objective function, it will reduce its generation compared to what it would do as a pure welfare maximizer. The private firms will then increase their generation. In total, produced quantity will decrease, and the difference in produced quantities between the private companies and the public company will be reduced. The result is increased cost efficiency, as the assumption about increasing marginal costs imply that the generation should be distributed as equally as possible among the active firms. It is then possible that the increased cost efficiency more than offsets the negative effect on consumers' surplus from the reduction in quantity.<sup>15</sup> If this is the case, the increased social surplus will

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<sup>14</sup>The assumption about increasing marginal costs, and no fixed costs, is obviously critical for this welfare result. Assuming another cost structure will change this. As an example we can think of a technology implying constant marginal costs and a fixed cost component. In such a case, assuming no capacity constraints, maximum welfare will be reached by having one welfare maximizing firm producing the whole market quantity.

<sup>15</sup>The intuition described above is similar to a Stackelberg game where the public firm can act as a Stackelberg leader. As a Stackelberg leader, the public firm will be able to "move" some of its production to the private firms as the private firms observe the actual quantity decision made by the public firm before they make their own decision. In this situation, there will be no possible welfare gains from changing the objective function of the public firm. De Fraja and Delbono (1989) show that if the public firm is a Stackelberg leader, pricing at marginal cost is not optimal. The reason being that the leader position of the public firm makes it possible for it to reduce the difference in quantity decisions between itself and the private companies, i.e. increase cost efficiency. It does this by reducing its own production from the level that makes price equal to marginal cost. The private companies observe this and respond by increasing

only benefit the producers, as the consumers will be worse off, paying a higher price for a reduced quantity.

More specifically, what is happening in case 1 above is that the firms, recognizing the new set of objective functions, will act in the following way to the public firm's acquisition of ownership shares in one of the private firms: the private firms decrease their generation, the new mixed firm increases its generation compared to when it was a pure profit maximizing firm, and the pure public firm decreases its generation. The overall result is, as stated above, increased industry output. The effect on welfare will then be positive if the increase in consumers' surpluses exceeds the decrease in producers' surpluses of the private firms and the pure public firm. The higher the competition in the industry, the more weight should be put on profit maximization in the mixed firm. The intuition should then be clear, the higher the competition, the closer is the industry output to the competitive one. The room for increase in consumer surplus is then small while the decrease in producer surplus will affect many firms. It is then less likely that the increase in consumer's surpluses will dominate the decrease in producer's surpluses. It is worth noting that the increase in welfare will benefit the consumers on expense of the producers in case 1.<sup>16</sup>

## 4.2 Case 2

First, comparison of the Nash-Cournot equilibrium expressions from case 2 with the Base case shows that total generation will decrease after partial privatization of the publicly owned firm, irrespective of whether the investor is active or passive. However, as in case 1, the change in welfare from the Base case is indeterminate. Again, the level of competition is the key variable in this respect. If the number of firms is high, the welfare level can increase, as compared to the Base case, even if total generation is reduced. Inspection of the equilibrium expressions shows that the higher the competition, the higher is the critical value of private ownership share,  $\alpha$ , inducing maximum welfare.

The difference between active and passive ownership becomes more clear in this partial privatization case than in case 1 above. I focus again on total industry output and the resulting welfare level to see if there are any differences between the three different privatization strategies.

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their production.

<sup>16</sup>It should also be mentioned that the first-best optimum in this model is to have the whole industry nationalized. If the state acquired all shares in all the companies, they would produce the total quantity that equates price and marginal cost and divide the production equally among the active firms. An other special case is the situation where marginal production costs are constant. Then, given no capacity constraints, the first best solution would be for the public firm to supply the whole market demand to a price equal to marginal cost.

Using subscripts AE, AI and PI for the cases with an active external investor, active internal investor and passive internal investor, respectively, I find for total generation:

$$Q_{PI} > Q_{AE} > Q_{AI},$$

and for the welfare levels:

$$W_{AE} > W_{AI} > W_{PI}.$$

When the investor is passive and internal, total generation in the industry is higher than in the case where the investor is active and external. If we look closer to the individual quantities produced in the case of passive ownership, we will see that the firm making the acquisition reduces its quantity, while the other privately owned firms respond, as expected, by increasing their generation. However, this increase is less than the reduction made by the investing firm. The reason behind the increased total generation is the quantity decision made by the now partially privatized public firm. Because the ownership is passive, the objective function of this firm does not change. Since the partially privatized firm knows the objective functions of the other firms, it will increase its own generation since the generation from the other firms decreases. The total effect will then be that total industry output increases, as compared to when the investor is active and external.

When the ownership is active and the investment is done by an internal firm, the difference from the active external case is that the firm making the investment now takes into account the effect of its own quantity decision on the profit it earns from its ownership part in the former public company. The total effect is that total generation falls as compared to the case of an active external investor.

The effect on the welfare level is also somewhat counterintuitive in the sense that the case with highest total output is the case providing the lowest welfare level. The explanation follows the line of argumentation given in case 1 above, i.e. it is the distribution of the generated quantities between the firms that is the key factor. In the case of passive ownership, this distribution is the most ineffective because the partially privatized firm generates too much relative to the other firms.

Thus, partial privatization of the public company through external active investors provides a higher welfare level than if a company already operating in the industry is allowed to acquire a part of the public company. If the privatization is done in the latter way, active ownership is better than passive ownership from a welfare point of view. However, privatization through a passive internal owner provides the highest industry output.

Relating these results to Reynolds and Snapp (1986) who just look at profit maximizing companies, we can see some of the same results as the passive ownership makes the investing firm generate less and the other firms (except the public one) generate more. So, if the investment was done in another profit maximizing firm and there was no firm maximizing social surplus, I would get the same result for passive ownership as Reynolds and Snapp.

## 5 Summary and concluding remarks

In this paper I have used a simple analytic equilibrium model to describe a so called mixed oligopoly market in which a public firm is operating together with private firms. The firms were assumed to be identical, except in their objective functions. The purpose of the paper has been to look at the difference between active and passive ownership connected to acquisitions of partial ownership shares in companies operating in a mixed oligopoly industry like the electricity market. The focus has been on the effects on economic efficiency from changes in the degree of public ownership in the industry, dependent on whether the investor making an acquisition is acting like an active or a passive owner. This was done by looking at three different cases. In the Base case, the market consisted of 1 public firm and  $n$  private firms. In case 1, the public firm was assumed to acquire an ownership share in one of the private firms. The motivation for looking at such a case was the current development in the electricity markets, where the publicly owned companies, like Statkraft in Norway, make acquisitions of ownership shares in their privately owned competitors. In case 2, the public firm was partially privatized. This case was motivated by the current political debate about privatizing large state-owned companies. I looked at two different privatization alternatives: a) partial privatization where one of the competing privately owned companies acquired an ownership share in the publicly owned company, and b) partial privatization where an external private investor made an acquisition. Active and passive ownership were considered in both cases. After specifying the model for each case, the equilibrium expressions for generated quantities and the resulting welfare level were calculated, assuming that the firms were playing a Nash-Cournot game. The main conclusions from these results are:

- Acquisitions made by the state-owned company increased total generation, given that the ownership is active. Passive ownership had no effect on total generation compared to the situation before the acquisition, i.e. the Base case.

- From a welfare point of view, the analysis showed that increased generation not necessarily induces higher welfare. In the case of active ownership, the optimal size of the acquisition made by the state, i.e. the ownership share that induces maximum welfare, is reduced as the competition in the industry increases. Thus, the higher the competition, the more careful should the state-owned company be in making acquisitions of ownership shares in its rivals, given that it acts as an active owner and wants to maximize welfare.
- In the case of partial privatization of the state-owned company, the analysis showed that maximum total generation was attained in the case of passive ownership when the investor was one of the rival firms, i.e. an internal investor.
- Welfare was, however, maximized as the private internal investor exercised active ownership.

One should of course be careful to make clear policy recommendations from such a simple model used in this paper. However, the analysis has shown that the distinction between active and passive ownership can have important effects on the market equilibrium in a market where companies make acquisitions of partial ownership shares in their competitors. Further, it seems like in the case of a welfare maximizing public firm, the level of competition in the market will be of significant importance when it comes to the welfare effects of a public firm's acquisition of ownership shares in a profit maximizing company.

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