The Interdependence between Ownership Status and Market Structure: The Case of Privatization

By CHAIM FERSHTMAN

Tel Aviv University

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One of the common justifications for privatization policy is the assertion that private firms are more efficient and thus potentially more profitable. The analysis of privatization policy, however, cannot be complete without specific attention to the market structure in which the firm operates and in particular to the interdependence between the ownership status and market structure. I examine a duopolistic market and demonstrate that a partly nationalized firm might realize higher profits than its private, profit-maximizing, competitor. The degree of nationalization also affects the interaction between an incumbent firm and a potential entrant. Using A. K. Dixit's framework, I consider the implications of privatization on the attractiveness of entry, the possibility of deterring entry, and the incumbent position as a natural monopoly. It is shown that it is possible that a firm is not a natural monopoly while being private but that alteration of its ownership status can transform it to a natural monopoly. Such an analysis establishes my main claim that ownership status may affect the market structure in which firms operate.

INTRODUCTION

Recently different governments have adopted the policy of transferring government-owned enterprises to private ownership. This policy is known in the economic jargon as 'privatization'. Bearing in mind that such a policy is not easily reversible, it is not surprising that privatization policy has become a major political issue, with dedicated supporters and opposition. Although the main economic justification for privatization is the efficiency argument, there is a need for detailed theoretical and empirical analyses regarding the behaviour of nationalized firms and the implications of privatization on the market equilibrium.1

An important aspect of privatization is the relationship between the ownership status and the decision-making process in the firm. However, when we wish to consider the effect of privatization on the firm's behaviour and performance, we cannot ignore the market structure in which the firm operates. The implications of privatization can be different in a monopolistic market from an oligopolistic market (see also Delbono and De Fraja, 1987). In this paper I wish to highlight some of the implications of privatization policy on the strategic interaction in oligopolistic markets, and the interdependence between the firms' ownership status and the market structure in which they operate. I believe that such an investigation is an essential stage in understanding the implications of privatization on market performance. The convention that nationalization reduces profits is examined and it is demonstrated that in a duopolistic market we should expect the opposite result. The equilibrium in the market can be such that a partly nationalized firm realizes higher profits than its private, profit-maximizing, competitor.

Even when a nationalized firm is the single firm in an industry and enjoys a complete monopolistic power, before enhancing any privatization policy one
should examine whether the reason that the nationalized firm has survived as a natural monopoly is its ownership status. It is demonstrated that the existence of a firm as a natural monopoly is not independent of its ownership structure. In addition, it is shown that the feasibility to deter entry depends also on the incumbent’s ownership structure. These are surprising results, since they indicate that firms’ ownership status can determine the market structure in which they operate.

The paper is organized as follows. Section I presents a simple Cournot-type duopolistic competition when one of the firms is partly nationalized while its competitor is private. In Section II we examine the role that nationalization can play in entry deterrence. Using Dixit (1980) and Eaton and Lipsey’s (1981) framework, we consider the implications of privatization on the attractiveness of entry, the possibility to deter entry, and the relationship between the incumbent degree of nationalization and its position as a natural monopoly. Production inefficiency and price competition in a differentiated-goods duopoly are briefly discussed in Section III.

I. A MODEL OF DUOPOLISTIC INDUSTRY WITH ONE PRIVATE FIRM AND ONE PARTLY NATIONALIZED FIRM

The traditional economic literature adopts the profit maximization hypothesis in the analysis of the behaviour of private firms. It is clear, however, that once the firm is nationalized, it might have objectives other than profit maximization (see for example Niskanen, 1975; Bos, Tillmann and Zimmermann, 1984; Delbono and De Fraja, 1987; and Rees, 1988).

Consider a duopolistic industry in which the first firm is partly nationalized while the second firm is privately owned. Let \( \theta_1 \) be the proportion of the government’s control of the first firm. The inverse demand function is assumed to be linear such that the market price is given by \( p = a - b(q_1 + q_2) \). We assume, for convenience, that both firms have identical linear cost functions \( C_i(q_i) = cq_i \) and that there is no cost inefficiency associated with nationalization.

Given the above assumptions, the \( i \)th firm’s profit function is given by

\[
\pi_i(q_1, q_2) = (a - b(q_1 + q_2) - c)q_i,
\]

which yields the profit maximization reaction function:

\( q_i(q_j) = (a - bq_j - c)/2b, \quad j \neq i \).

The social welfare function, which is a sum of producer and consumer surplus, is a function of \( q_1 \) and \( q_2 \) and is given by

\[
W(q_1, q_2) = (1/2)[a + (a - b(q_1 + q_2))](q_1 + q_2) - c(q_1 + q_2).
\]

Given \( q_i \), the social welfare function is maximized at

\( q_i(q_j) = (a - bq_j - c)/b, \quad j \neq i \),

which is the reaction function of a social-welfare-maximizing firm.

A complete analysis of the behaviour of a partly nationalized firm must consider the conflict situation between the directors representing private owners’ interest and the directors representing the government’s interest. If decisions are made by voting using the majority rule, the firms behave either as profit-maximizing or as welfare-maximizing. In this paper we assume that
the conflict between the two interest groups is resolved by a compromise. In particular, we let the partly nationalized firm's choice of output be a compromise between $q$ and $\tilde{q}$ such that its reaction function is

\[ \psi_1(\theta_t, q_2) = \theta_t \tilde{q}_t(q_2) + (1 - \theta_t)q_t(q_2) = (a - b q_2 - c)(1 + \theta_t)/2b. \]

**Proposition 1.** In a duopolistic market with one partly nationalized firm and one private firm,

(a) the equilibrium price declines as $\theta_t$ increases;
(b) when $0 < \theta_t < 0.6$, i.e. when the government owns less than 60 per cent of firm 1, the equilibrium profits of the partly nationalized firm are above the regular Cournot equilibrium profits;
(c) the profits of the partly nationalized firm are maximized at $\theta_t = 1/3$;
(d) in the above duopolistic market, as long as $0 < \theta_t < 1$, the partly nationalized firm has higher profits than its private competitor. Moreover, the private firm's profits are below the regular Cournot profits.

**Proof.** Solving the two reaction functions (1) and (4) yields the following equilibrium:

\[ q_t^* = (1 + \theta_t)(a - c)/(3 - \theta_t)b, \]
\[ q_2^* = (1 - \theta_t)(a - c)/(3 - \theta_t)b, \]

and the equilibrium price is

\[ p^* = ((1 - \theta_t)a + 2c)/(3 - \theta_t). \]

(a) Differentiating (6) with respect to $\theta_t$ yields

\[ \frac{\partial p^*}{\partial \theta_t} = \frac{(1 - \theta_t)a + 2c - a(3 - \theta_t)(3 - \theta_t)}{(3 - \theta_t)^2 < 0}. \]

(b) The Cournot equilibrium profit is $\pi_t = (a - c)^2/9b$. Using (5a) and (6) yields that, in our model, the first firm's profit is

\[ \pi_t = (a - c)^2(1 - \theta_t^2)/(3 - \theta_t)^2b. \]

Comparing $\pi_t$ with $\pi_t^*$ indicates that, for $\theta_t < 0.6$, $\pi_t^* > \pi_t$.

(c) Maximizing (8) with respect to $\theta_t$ yields that $\arg \max_{\theta_t} \pi_t^* = 1/3$.

(d) Using (5b) and (6) yields

\[ \pi_2^* = (1 - \theta_t)^2(a - c)^2/(3 - \theta_t)^2. \]

Comparing $\pi_1^*$ and $\pi_2^*$, it is evident that

\[ \pi_2^* - \pi_1^* = 2(a - c)^2(\theta_t(\theta_t - 1))/b(3 - \theta_t)^2, \]

which implies that for $\theta_t = 0$ and $\theta_t = 1$, $\pi_2^* = \pi_1^*$, but for every $0 < \theta_t < 1$, $\pi_2^* < \pi_1^*$. Using (10), one can also conclude that $\pi_2^* < \pi_2^*$. Q.E.D.

Proposition 1 implies that in a duopolistic market the partly nationalized firm, regardless of its degree of nationalization, earns higher profits than its private competitor. Since we assume that both firms are identical with respect to their cost functions, it is clear that the difference in profits is due to the strategic interaction between the two firms rather than to any production efficiency or inefficiency associated with the privatization process.
The analysis in this section is carried out under restrictive assumptions of linear demand and cost functions and a simplified description of the decision-making process in a partly nationalized firm. However, it is important to note that, as long as the reaction functions are downward-sloping (strategic substitutes) and the objective function of the partly nationalized firm has some element of social welfare maximization, results similar to ours can be obtained.

The partial nationalization serves as a credible commitment to increase output beyond the profit-maximizing level. Thus, as the degree of nationalization increases, the firm's reaction function shifts rightward. Standard analysis indicates that such a shift results in higher profits for the partly nationalized firm. Clearly, the level of nationalization that maximizes profits is the one that pushes the reaction function far enough so that the Stackelberg point becomes the new Nash equilibrium.

From (5a) and (5b), note that \( q_y/(q_y + q_f) \) is an increasing function of \( \theta_1 \). Thus, partial nationalization increases the market share of the nationalized firm. If firms have unequal production cost such that the nationalized firm is a priori less efficient, nationalization may promote inefficiency if it increases the share of the output produced by the inefficient firm. Clearly, the overall contribution to welfare of nationalization consists of the direct effect of greater output and the loss arising from production inefficiency. Using the linear case discussed previously and analyzing the unequal cost case yields the following.

**Proposition 2.** Nationalization of an inefficient firm in duopolistic markets may result in lower social welfare.

**Proof.** The proof is straightforward and similar to the proof of Proposition 1. After calculating the equilibrium quantities, we can use equation (2) to calculate the social welfare with and without nationalization. Assuming enough cost inequality will finish the proof. Q.E.D.

II. **Nationalization and Entry Deterrence**

In the previous section it was demonstrated that the firms' ownership structures affect the market equilibrium. Since the first step in analysing the entry deterrence problem is to analyse the post-entry game, a potential entrant, in its entry decision, should take into account the ownership status of the incumbent firms, thus establishing the interdependence between the ownership status and the market structure in which firms operate.

The main issue in such an analysis is whether the ownership structure of the incumbent firm is some form of an entry barrier. Consider, for example, a firm that has the opportunity of entering into two different markets. In both these markets there is a single incumbent firm and identical demand functions. Further, assume that the potential entrant and the two incumbents have identical cost functions. The only difference between the two markets, however, is that in the first market the incumbent is private while in the second it is partly (or totally) nationalized. In analysing the relative attractiveness of the two markets, one should discuss all the differences between private and nationalized firms and their effects on entry deterrence. For example, the partly nationalized firm might enjoy the support and backing of government agencies.
This support can be very helpful in particular when government's contracts provide an important share of the market demand, or when the advantage of having the government's financial backing plays an important role in the market competition. On the other hand, assuming that nationalized firms are less efficient, and if cost advantage plays an important role in the market competition, the potential entrant might prefer to compete against a nationalized firm rather than against a private firm.

In Section 1 we demonstrated that, when a profit-maximizing firm faces a partly nationalized competitor, its profits are below the regular Cournot equilibrium profits (see Proposition 1). Thus, a profit-maximizing potential entrant prefers to enter a market in which its competitor, i.e. the incumbent firm, is private.

The analysis in this section is based on Dixit (1980) and Eaton and Lipsey (1981). In these models it was assumed that firms' cost function is given by

\[ TC_i(q_i, k_i) = \begin{cases} f_i + w_i q_i + r_i k_i, & q_i < k_i, \\ f_i + (w_i + r_i) q_i, & \text{otherwise}, \end{cases} \tag{11} \]

where \( q_i \) is the quantity produced by firm \( i \), \( k_i \) is the \( i \)th firm's capacity, \( f_i \) is the fixed cost, \( w_i \) is the variable cost per unit, and \( r_i \) is the cost of having one unit of capacity. Capacity costs are assumed to be sunk, such that when \( q_i < k_i \) the firm still has to pay \( r_i k_i \).

The problem is modelled as a two-stage game. In the first stage the incumbent firm, denoted henceforth as firm 1, chooses a capacity level \( k_1 \). In the second stage the second firm has to decide whether or not to enter. If entry occurs there is a Cournot-type competition, the equilibrium of which both firms can calculate.

The interaction between the two firms is better illustrated by a reaction function analysis (see Figure 1). Firm 1, by making strategic decisions with

![Figure 1](image-url)
respect to $k_1$, can alter its second-period reaction function and hence the equilibrium of the duopolistic game. Consider first the case in which firm 1, the incumbent, is completely private. Let $\psi_1$ be the ‘full cost reaction function’ of the first firm, i.e. the reaction function when the marginal costs are $w_1 + r_1$, and let $\hat{\psi}_1$ be its ‘variable cost reaction function’, i.e. its reaction function when the marginal cost is only $w_1$. Since the choice of $k_1$ is made in period 1, the reaction function of firm 1 in period 2 depends on its choice of capacity $k_1$, and, as is illustrated in Figure 1, the incumbent’s reaction function in the second period is identical to $\hat{\psi}_1$ until $q_1$ reaches the full capacity level of $k_1$; then the reaction function goes down to $\psi_1$. Since the potential entrant has not yet any capacity, its reaction function in the second period is its full cost reaction function denoted in the figure as $\psi_2$. The above description indicates that, if the two firms are in the market, the Nash equilibrium is on $\psi_2$ between $T = (T_1, T_2)$ and $V = (V_1, V_2)$, depending on the choice of $k_1$. When $k_1 \leq T_1$, the equilibrium in the second stage is at $T$. When $k_1 \geq V_1$ the equilibrium is at $V$, and when $T_1 < k_1 < V$, the equilibrium point is on $\psi_2$ between $T$ and $V$.

Let $M_1$ be the incumbent monopolistic output. Assuming that the entrant incurs some fixed cost of entry, the profit of the second firm reaches zero at some point along its reaction function $\psi_2$. Let $B_1$ be the point on the $q_1$-axis vertically below the point at which $\psi_2$ reaches zero. Thus, if for some reason $q_1 > B_1$, the optimal response of the potential entrant is to stay out of the market.

Given the above structure, there are several possible outcomes of the entry game:

(a) If $B_1 \leq M_1$, firm 1 is a natural monopoly. The firm does not have to deviate from its behaviour as a monopolist in order to deter entry. Thus, in this case the first firm produces the monopolistic output, $k_1 = M_1$, and there is no entry.

(b) If $B_1 > V_1$, entry cannot be prevented. The worst that can happen to firm 2 is that $k_1 \geq V_1$ and the equilibrium of the second stage of the game is at $V$. But since the profits at this point are positive, entry is attractive.

(c) If $M_1 < B_1 \leq V_1$, entry can be blocked by setting $k_1 = B_1$. However, in this case entry deterrence may not be the best strategy for firm 1, since its profit as an artificial monopoly may be below its profits in the duopolistic market.

In order to discuss the implications of ownership status on the strategic interaction between the incumbent and the potential entrant, let us consider now the case in which the potential entrant is private while the incumbent is partly nationalized.

**Proposition 3.** The ownership status of the incumbent firm affects its incentives and ability to deter entry. In particular, (a) it is possible that a firm is not a natural monopoly while being private but that alteration of its ownership structure so that it becomes partly nationalized can transform the firm to a natural monopoly; (b) when $B_1 > V_1$, entry cannot be deterred by a private firm, but it is possible that when the incumbent firm becomes partly nationalized entry deterrence becomes feasible.

**Proof:** The proof is based on the reaction function analysis presented in Figure 1. An increase in $\theta_1$ alters the firm’s objective function and induces a
rightward shift of its reaction function. Thus, for a given $\theta_i > 0$, the 'full cost reaction function' is $\psi_1(\theta_i)$ while the 'variable cost reaction function' is $\hat{\psi}_1(\theta_i)$. It is clear now from Dixit's analysis that the equilibrium in the post-entry game lies on $\psi_2$ between $T(\theta_i)$ and $V(\theta_i)$. We denote as $M_1(\theta_i)$ the monopolistic output of a partly nationalized firm. Our previous analysis yields that $M_1'(\theta_i) > 0$. As was defined above, natural monopoly occurs when $B_1 < M_1(\theta_i)$. Thus, when $M_1 < B_1 < M_1(\theta_i)$, as is depicted in Figure 1, a private firm is not a natural monopoly while a partly nationalized firm, with $\theta_i$ large enough so that $B_1 < M_1(\theta_i)$, is a natural monopoly.

$V_i < B_1 < V_1(\theta_i)$ implies that a private firm cannot deter entry since $V_i < B_1$, but that, if $\theta_i$ is large enough and $B_1 < V_1(\theta_i)$, the partly nationalized firm has the power to prevent entry. Since $V_1'(\theta_i) > 0$, the reverse situation is not plausible. Q.E.D.

Proposition 3 implies that the firms' ownership status affects the market structure in which the firms operate. For example, an industry remains monopolistic while being partly nationalized and then once it is privatized a new firm might find it attractive to enter the industry transforming it to a duopoly. Clearly, in such cases the possible change in market structure affects the price that the government can get for its share of the firm as private buyers realize that future profits might decline as a result of the anticipated competition in the market.

In analysing the effect of privatization, the main focus in the literature has been the efficiency gain as it is widely believed that private firms operate more efficiently. Even if we accept this view, the total evaluation of privatization policy should consider also its implication on market structure. In particular, it follows from Proposition 3 that it is possible to have welfare gain from privatization if such a policy leads to a more competitive market structure. This competition might be more beneficial to the economy than having a firm that maximizes a combination of profits and welfare.

The above analysis was carried out under the assumption that the potential entrant is private while the incumbent is partly nationalized. Clearly, we can carry out a similar analysis when we let the incumbent be private while the potential entrant is partly nationalized. Such an analysis will no doubt indicate that the possibility of entry deterrence, and the existence of natural monopoly, may depend on the ownership structure of the potential entrant.

III. Some Remarks on Cost Inefficiency and Price Competition

In the previous two sections we assumed that the degree of nationalization affects only the firm's objective function. We have modelled the firm as a rational decision-maker that is doing its best to achieve its goals. This point of view translates itself to the assumption that both the private and the partly nationalized firms have identical cost functions. However, casual observation and empirical works indicate that nationalized firms are technically inefficient. (For more details see Bos, 1988; Bos and Peters, 1989; Perelman and Pestieau, 1988; and Rees, 1988.) But an increase in profits after privatization does not necessarily imply that the firm produces inefficiently while being nationalized. Clearly, as was stated previously, changing the ownership structure of the firm affects its objective function. Nationalized firms can produce efficiently and
yet observe lower profits simply because they are not profit-maximizers. Even if we accept the view that nationalized firms produce inefficiently, one needs a specific model that incorporates management's effort as one of the inputs needed for production, and such a model can be used in analysing the relationship between managerial effort and the incentives facing the management. For use of agency theory to explain public firms' inefficiency, see Rees (1988).

Letting production cost depend on the degree of nationalization, and bearing in mind our results for the equal-costs case, we can use continuity arguments to conclude that it is possible that in a duopolistic market a partly nationalized firm is inefficient in production but still realizes higher profits than its private, cost-efficient, profit-maximizing rival.

The underlying assumption in our analysis so far has been that the product is homogeneous and that firms compete through quantities. Such assumptions imply that the firms' reaction functions are downward-sloping. It is already recognized in the literature that, once we change the strategic variable and consider price competition, the results might be reversed. (See, for example, Brander and Spencer, 1985; Bulow, Geanakoplos and Klemperer, 1985; Eaton and Grossman, 1986; Bonanno and Vickers, 1988; Fershtman and Judd, 1987; Fudenberg and Tirole, 1984; Shapiro, 1989; and Vickers, 1985.)

Consider a differentiated-goods duopoly in which firms compete through prices. Let the first firm be partly nationalized. Standard analysis indicates the following.

**Proposition 4.** In a differentiated-goods duopolistic market the equilibrium prices decline as \( \theta \) increases. For every \( \theta > 0 \), the profit of the partly nationalized firm is below the regular Bertrand equilibrium profits.

Comparing Propositions 1 and 4 indicates that the effect of privatization on the firms' performance in an oligopolistic market depends on the nature of the competition in the market as well as on the degree of privatization. When price is the strategic variable, nationalization leads to lower profits while in quantity competition an increase in the degree of nationalization may lead to higher profits.

**IV. Concluding Remarks**

The analysis of markets in the traditional microeconomic theory has been based on the assumption that firms are profit-maximizers and that the production cost function is independent of the firm's ownership structure. When we discuss the implications of nationalization of firms we have to re-examine these two basic assumptions and to replace them with a model that describes the relationship between the firm's behaviour and performance and its degree of nationalization. In this paper we concentrate only on one aspect of this relationship, namely, the relationship between the degree of nationalization and its performance in oligopolistic markets. We have shown that privatization can lead to lower profits if the firm operates in a duopolistic market. This result holds even if nationalization is associated with some degree of production inefficiency. There is, however, one important remark that should be emphasized. In this paper we do not discuss the decision-making process in firms
that are partly nationalized. We simply assume that partly nationalized firms put some emphasis on social welfare so that they are not profit-maximizers, and that there is some production inefficiency that is associated with nationalization. Thus there is certainly a need for further investigation of these two aspects of nationalization: (1) a model that specifies the decision-making process in a nationalized firm and in particular the bargaining between the representatives of the different owners; (2) a model that describes the relationship between the degree of nationalization, the managerial incentives, and their effect on the firm’s production efficiency.

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NOTES
2. For a detailed discussion on the objective function of a partly nationalized firm, see Bos and Peters (1989). I would like to thank Dieter Bos for pointing out that maximizing an objective function that consists of profits and social welfare is not equivalent to our above assumption regarding the firm’s output choice. However, the implication of maximizing $U_f(\pi, W)$ is that the firm chooses an output that is a combination of $\hat{q}$ and $\hat{q}$.

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