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Privatization, Investment and Ownership Efficiency

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Abstract

We provide a model that explains the following empirical observations: i) private ownership is more efficient than public ownership, ii) privatizations are associated with increases in efficiency and iii) the increase in efficiency predates the privatization. The two key mechanisms explaining the results are: (i) a government owner keeping control takes into account the negative effect on employment of investment and (ii) a privatizing government has a stronger incentive to invest than an acquiring firm: the government exploits the fact that investments increase the sales price not only due to the increase in the acquirer's profit, but also due to a reduced profit for the non-acquirer.

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JEL classification: D44, L13, L33, L4, P31

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1. Introduction

Which is more efficient: Private or public ownership? In their survey for *Journal of Economic Literature*, Megginson and Netter (2001, p. 380-381) summarize the cross-sectional and time series evidence on the relative efficiency of these ownership forms: "Research now supports the proposition that privately owned firms are more efficient and more profitable than otherwise-comparable state owned firms... We know that privatization 'works,' in the sense that divested firms almost always become more efficient, more profitable, and financially healthier, and increase their capital investment spending."

It is not clear how these results can be interpreted, however: Megginson and Netter (2001) hail a study by Dewenter and Malatesta (2001) as one of the most persuasive articles that examines the effects of privatization. Dewenter and Malatesta (2001) show that the profitability of the state-owned firms increases *before* privatization.[1] Controlling for the degree of remaining state ownership post-privatization, they find an inverse u-shape of profitability over a period running from ten years before the privatization to five years after the privatization, with a top of firm profitability just before the privatization.[2] The authors then draw the following conclusion: *If the government restructures firms and improves their performance before privatization, then the improvements cannot be attributed to the change in ownership.*

At first blush these empirical observations seem contradictory. In this paper we construct a simple model where the change in ownership is crucial for explaining these facts. The central mechanism is that the impending sale changes the incentives for the government: It receives an up-front sales proceed in substitution for a stream of future benefits from control (profits). The loss of control over the firm's future decisions will change the pre-privatization behavior in the government-owned firm: the government will have an incentive to increase the profitability pre-privatization, since the possibility of protecting

[1] Dewenter and Malatesta (2001) investigate the profitability of privatized enterprises using a sample of 63 privatized firms in the 1970, 1980s and 1990s.

[2] This result is found in multiple regression analysis when controling for GDP growth and government-retained ownership share at the end of the fiscal year. The results are presented in Table 5 in Dewenter and Malatesta (2001).

the employees' long-run interests is lost in the privatization process.

Strategic pre-privatization restructuring then leads to an increase in profitability before privatization in our model. The asset selling government has a stronger incentive to invest than an ownership-keeping government or a buyer of the privatized firm, since the seller exploits externalities on rival firms via the sales price of the sold state assets.

It should be noted that all agents in our model are fully informed and the strategic behavior by the government is not undertaken to manipulate information about the value of the firm. This implies that the long-run performance of the privatized firms is not worse than the performance of a comparable private firm, since these costs are taken into account by the acquiring firm when buying the privatized firm. This result is also consistent with the results on long-run stock market performance of privatized firms found in Dewenter and Malatesta (2001).

An implication of our model is that we may see substantial layoffs associated with pre-privatization restructuring. Note that this is not inconsistent with the government caring about employment in state-owned firms – the relative incentives to protect jobs are lower when you are about to sell. Empirically, we observe a number of instances with major restructuring including firings prior to privatization. For instance, Dewenter and Malatesta (2001, p 334) mention that prior to being sold, Japan National Railways were split into seven regional companies and employment was reduced by 200,000 people. Other examples are British Steel which prior to its privatization cut its employment by 40 % without losing sales, and British Airways which experienced a similar reduction in employment, while increasing the number of flights (Djankov and Pohl (1997)). Lopes-de-Silanes (1997) documents extensive pre-privatization (not always successful) restructuring in Mexico (1983-1992). In 89 of 221 privatized firms, there were labor cuts in the two years before privatization.

Let us briefly relate to the previous theoretical literature. So far, there is surprisingly little work that analyzes the time series patterns of efficiency surrounding privatization. There is a handful of papers analyzing this in settings motivated by a transition from a planned to a market economy: Bennet and Maw (2000), for instance, examine the case where a Cournot industry is privatized and Roland and Sekkat (2000) show how the intro-

duction of a managerial labor market can induce managers in state-owned enterprises to restructure in order to signal that they are good managers[3] while Roland (2000) discusses some earlier models of privatization in transition. Wang et al (2007) is somewhat related to the present work in that it examines the dual objective for the government of maximizing revenue and securing employment. Some previous work shows how privatization can trigger efficiency enhancing restructuring; see, for instance, Boycko et al (1996) or Bennedsen (2000). To the best of our knowledge, strategic investments by the government before privatization are not a feature of any previous work.[4]

Note that in our model, there are no distortions that would motivate state ownership.[5] Determining the extent to which maximization of private profit is socially desirable in set-ups where distortions are present is outside the scope of this paper. In Section 2, we present our model, Section 3 compares profits across different ownership structures and Section 4 analyzes sensitivity with respect to assumptions. The paper is concluded in Section 5.

2. The Model

We consider an oligopoly industry served by a set $\mathcal{I}$ of symmetric incumbent firms, where $\mathcal{I} = \{1, 2, .., n, ..., N\}$. There is also a state firm, denoted s, which might be privatized. In a stage 1, the state firm can make an investment k which increases the firm's product market profit, but decreases the product market profits of the rival firms in the ensuing product market interaction. We compare three scenarios:

Case 1: control over firm s is given to the private owner already at the beginning of stage 1.

[3] Debande and Friebel (2004) have another model that focuses on managers' incentives.

[4] In Norbäck and Persson (2006) an similar model set-up is used to study the difference between incumbent-financed and venture capital financed development.

[5] A caveat is in order here – there is a distortion due to oligopoly markups. Conceivably, government ownership could be used to strengthen competition. While such arguments are sometimes given by politicians, they fall outside typical motivations for public ownership given by economists. More generally, the higher profitability of a privatized firm may reflect that it ignores negative externalities or abuses a dominant position.

Investment in this case is made to maximize the private profit of the acquirer.

Case 2: the government keeps the ownership of firm s in all stages of the game and invests in stage 1.

Case 3: the government invests in stage 1, anticipating that it will privatize in stage 2.

In stage 2, the state firm is either privatized by means of a first-price perfect information auction, where the N_I incumbent firms are the potential buyers, or it remains in the hands of the state.

Finally, in stage 3, the incumbent firms compete in oligopoly interaction, setting an action x_i. We solve the game backwards.

2.1. Stage 3: Product-market equilibrium

Using backward induction, we start with the product market interaction, where firm $i \in \mathcal{I} + s$ chooses an action $x_i \in R^+$ to maximize its product market profit, $\Pi_i(x_i, \mathbf{x}_{-i}, k)$, which depends on its own and its rivals' market actions, x_i and $\mathbf{x}_{-i}$, as well as the total amount of investment k made by the potentially privatized firm, s. We may consider the action x_i as setting a quantity or a price. To highlight the strategic effect on the investment decision in period 1, we here assume that the decision x_i only affects the firm's profits and not its labor force.

We assume that there exists a unique Nash-Equilibrium in actions, $x^*(k)$, defined from the first-order condition (2.1):

$$\frac{\partial \Pi_i}{\partial x_i}(x_i^*, \mathbf{x}_{-i}^*; k) = 0, \tag{2.1}$$

where x_{-i}^* are the actions by firm i:s rivals.

Using ex-ante symmetry among incumbent firms, we only need to distinguish between three firm types, i.e. the acquiring privately owned firm (denoted A), the government-run firm (denoted G) and the non-acquiring firms (denoted N). The actions are then simply x_A, x_G and x_N, where x_N is one of the arguments in the vector x_N of symmetric actions taken by non-acquiring firms. We then define the reduced-form product market profits of

the acquirer, the government-run firm, and a non-acquirer as direct functions k. To keep track of who owns firm s (A or G) and its capital, we use k_j, $j = A, G$:

$$R_A(k_A) \equiv \Pi_A(x_A^*(k_A), \mathbf{x}_N^*(k_A), k_A), \quad R_G(k_G) \equiv \Pi_G(x_G^*(k_G), \mathbf{x}_N^*(k_G), k_G), \quad (2.2)$$

$$R_N(k_j) \equiv \Pi_N(\mathbf{x}_N^*(k_j), x_A^*(k_j)), j = A, G. \quad (2.3)$$

Note that in the case where the government owns firm s over all stages there will be no firm A; all private incumbents will in that case be symmetric N firms. We shall assume the reduced-form product market profit for a firm of type $h = \{A, G, N\}$, $R_h(k)$, to have the following characteristics:

Assumption 1: $\frac{dR_A}{dk} > 0$, $\frac{dR_G}{dk} > 0$, and $\frac{dR_N}{dk_j} < 0$, $j = A, G$.

Assumption 1 states that the reduced-form product market profit for the acquirer or the government is strictly increasing in investments, whereas such investments strictly decrease the rivals' profits.[6] To simplify comparisons of investment incentives, in addition, we want to ensure that R_A and R_G are symmetric such that for a given level of k, $R_A(\overline{k}_A) = R_G(\overline{k}_G)$. Since privatization, when an incumbent buys, will imply one less firm on the market, R_A would then be greater than R_G for a given level of investment in many parameterizations. This would be the result of increased concentration, which would obscure the comparison. Therefore, we make the following assumption:

Assumption 2: The number of firms in the industry is constant (equal to $N + 1$).

This assumption is made to make comparisons more transparent, but it is also realistic in that an increased concentration will increase the incentives for entry. The effects of relaxing this assumption are discussed in Section 4.2.

2.2. Stage 2: Privatization of state firm

We model the privatization as a perfect information auction where the N_I incumbent firms simultaneously post bids. Each incumbent firm announces a bid, b_i, where $\mathbf{b} =$

[6] Assumption 1 holds in the Linear-Quadratic Cournot model which is presented below, but it is also compatible with other oligopoly models such as that presented by Farrell and Shapiro (1996).

$(b_1, ..., b_i, ...b_{N_I}) \in R^{N_I}$ is the vector of these bids.[7] The equilibrium acquisition price is denoted by B.

We now turn to incumbent firms' valuations of firm s, defined in (2.4). The first term shows the profit for an incumbent firm when possessing the state firm and the second term shows the profit if it is obtained by a rival incumbent firm:

$$v = R_A(k) - R_N(k). \tag{2.4}$$

Note that since incumbent firms are symmetric ex-ante, their valuations are symmetric. It is then straightforward to derive the following lemma[8]:

Lemma 1. *In the privatization, the state firm is acquired by an incumbent firm, at a price, B, equal to a rival incumbent firm's valuation of the state firm, i.e. $B^* = v$.*

2.3. Stage 1: Investments

In subsection 2.3.1, we determine the optimal investment when the private owner invests absent any pre-privatization investment by the government. Section 2.3.2 determines the optimal investment for a government that owns the firm over all stages and Section 2.3.3 determines the optimal investment by the selling government. To focus on the product market effects, we assume that the government and the private owner face the same strictly convex investment function, $C(k)$, such that $C'(k) > 0$ and $C''(k) > 0$.

2.3.1. A private firm's optimal investment

The maximization problem facing a private firm that controls s already in period 1 can be written as follows:

$$\underset{\{k\}}{Max} : R_A(k) - C(k). \tag{2.5}$$

We assume $R_A(k) - C(k)$ to be strictly concave in k. The optimal choice by the acquiring firm is then defined by:

$$\frac{dR_A}{dk} = C'(k). \tag{2.6}$$

[7] The acquisition is solved for Nash equilibria in undominated pure strategies. There is a smallest amount, ε, chosen such that all inequalities are preserved if ε is added or subtracted.

[8] The correct acquisition price is $v - \varepsilon$ but, to simplify the presentation, we use v.

Denote this optimal choice k_A^*, which is illustrated in point A in the upper diagram in Figure 2.1.

2.3.2. A government-owned firm's optimal investment

Following Boycko, Shleifer and Vishny (1996), we assume that the decisions in the state firm are made by a politician, referred to as the industry minister, who cares both about profits (sales proceeds) and employment. Dewenter and Malatesta (2001), as well as many other studies, document that government firms are more labor intensive than private firms. Indeed, Megginson and Netter (2001, p. 356) note that "All governments fear that privatization will cause former SOEs [state owned enterprises] to shed workers, and the key question in virtually every case is whether the divested firm's sales will increase enough after privatization to offset the dramatically higher levels of per-worker productivity". Therefore, we assume that the politician cares about employment $L(k)$, which is negatively affected by the level of capital investments k, i.e. $L'(k) < 0$ and $L''(k) > 0$. Then, the maximization problem can be written as follows[9]:

$$\underset{\{k\}}{Max} : R_G(k) - C(k) + L(k). \tag{2.7}$$

We assume $R_G(k) - C(k) + L(k)$ to be strictly concave in k. The optimal choice by the government-owned firm is then defined by:

$$\frac{dR_G}{dk} + L' = C'(k). \tag{2.8}$$

The optimal investment when the government keeps the firm is indicated as k_G^* in the upper diagram in Figure 2.1. Comparing expressions (2.6) and (2.8), we see that the

[9]The term $L(k)$ can be seen as a measure of monetary contributions to the politician. As discussed, we introduce this term to capture (realistic) caring of politicians about employment in state firms. All else equal, a political owner would value the firm higher and one may wonder why politicians ever sell. Ideology or a higher opportunity cost of taxation may be motivations: Bortolotti et al (2003) provide evidence of many privatization decisions being subject to fiscal imbalances and political preferences. Such issues are largely orthogonical to our focus and we simply take it as given that the government may want to sell.

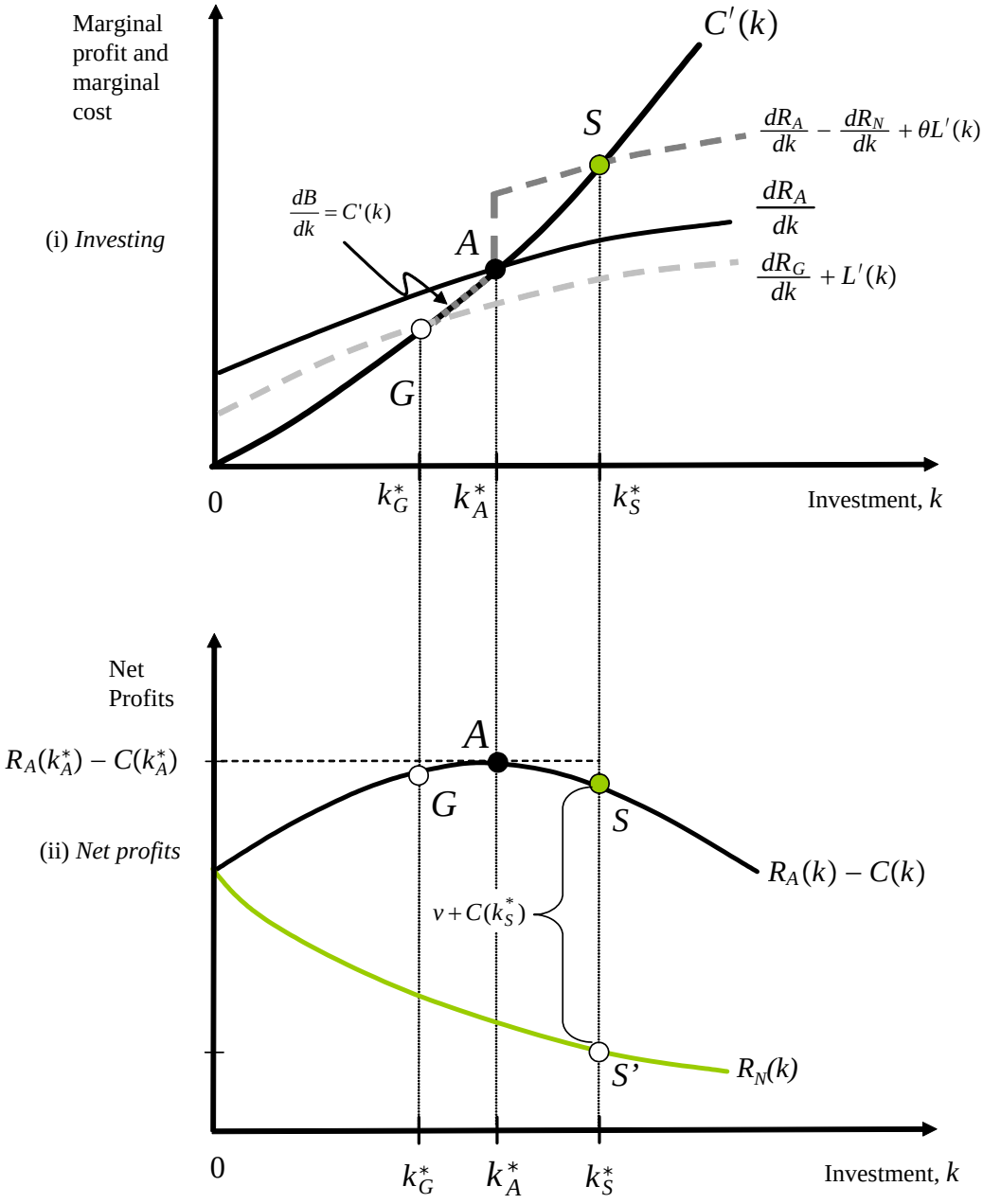

Figure 2.1: Comparing investment incentives.

government-owned firm has weaker incentives to invest than the acquiring firm, since the government-owned firm does not only take into account the increase in profits for the firm $\frac{dR_G}{dk}$, but also the negative effect on labor, captured by the term $L'(k)$, which is negative by assumption. Thus, we have derived the following result:

Proposition 1. *The optimal investment by a government-owned firm is lower than the optimal investment by the acquiring firm, i.e.* $k_G^* < k_A^*$.

2.3.3. A selling government's optimal investment

When privatizing, the government is assumed to set investment levels such that the sales price of the privatized firm is maximized. A question that arises is how a selling government views the effect of investment on employment. Here, we allow for the possibility of government caring about employment in this firm also when losing control with a weight $\theta \in [0,1]$. If $\theta = 1$, the government cares as much about workers after privatization as if it controlled the firm itself. If $\theta = 0$, it does not take into account the effects on employment at all when losing future control. Indeed, it can be argued for a government about to cede control that it makes little sense to underinvest today. We support this claim in Section 4.1.1. In this section, we therefore allow any $\theta \in [0,1]$, but we focus on the case where $\theta = 0$ in the subsequent analysis. Using Lemma 1 and (2.4), the problem is then defined as:

$$\begin{aligned} \underset{\{k\}}{Max}: \;& B(k) - C(k) + \theta L(k) \\ s.t \;:\; & B(k) = R_A(k) - R_N(k). \end{aligned} \tag{2.9}$$

The first-order condition is:

$$\frac{dR_A}{dk} - \frac{dR_N}{dk} + \theta L' = C'(k), \tag{2.10}$$

where we assume that $R_A(k) - R_N(k) + \theta L(k) - C(k)$ is strictly concave in k. The optimal k for a selling government is indicated as k_S^* in the upper diagram in Figure 2.1. Comparing expressions (2.6) and (2.10), we see that the selling government has stronger incentives to invest than the keeping government, $k_S^* > k_G^*$. The selling government also invests more

than the acquiring firm as long as $\theta L'(k) < \frac{dR_N}{dk}$. The selling government achieves a higher acquisition price by not only taking into account the increase in profits for the acquirer $\frac{dR_A}{dk}$, but also by exploiting the negative externalities on non-acquirers, captured by $\frac{dR_N}{dk}$, which are negative from Assumption 1. Thereby, we have derived the following result:

Proposition 2. *(i) The optimal level of investment by the selling government exceeds the optimal level of investment by the keeping government, $k_S^* > k_G^*$. (ii) If $\theta L'(k) < \frac{dR_N}{dk}$, the optimal level of investment by the selling government exceeds the optimal level of investment by the acquiring firm, i.e. $k_S^* > k_A^*$.*

As we shall see in Section 4, the case where $\theta = 0$ has a great deal to support it, in which case $k_S^* > k_A^*$ always holds. In the following, we assume that $\theta = 0$.[10]

3. Profits.

In Section 3.1, we compare the total long-run profits for the three different ownership regimes: private in all stages, government in all stages, and a selling government. Total profits are then defined as product market profits $R_h(k)$ minus investment costs $C(k)$ for the different ownership regimes (the acquisition price is thus excluded in profits or total profits). In Section 3.2, we compare pre- and post-privatization profits for these three cases. Product market profits do not include any investment costs and are as defined in Section 2.1.

3.1. Total and product market profits

It immediately follows from the set-up that the private owner will generate the highest total profits, since it invests in order to maximize total profits. In Proposition 1 and Proposition 2, we show that the selling government overinvests relative to the optimal level and the

[10] This is done to simplify the exposition. The propositions that follow typically hold also when $\theta > 0$. For instance: All that is required for Proposition 3 to hold is that the effects of investment on employment ($\theta L'(k)$) and non-acquirers ($\frac{dR_N}{dk}$) are not perfectly equal.

keeping government underinvests as compared to the profit maximizing level. We can directly state the following proposition:

Proposition 3. *Total profits are higher for the privately owned firm (case 1),* $R_A(k_A^*) - C(k_A^*)$*, than for the government-owned firm (case 2),* $R_G(k_G^*) - C(k_G^*)$*, or for the privatized firm (case 3),* $R_A(k_S^*) - C(k_S^*)$*. (ii) Total profits can be higher or lower for the government-owned firm (case 2) as compared to the privatized firm (case 3).*

We illustrate the proposition in the lower part of Figure 2.1. This, in turn, implies that the privatized firm has the highest product market profits (and the highest investment costs) and the government firm has the lowest product market profits (and the lowest investment costs). Then, we can state the following proposition:

Proposition 4. *The product market profits for the privatized firm (case 3),* $R_A(k_S^*)$*, are higher than the product market profits for the privately owned firm (case 1),* $R_A(k_A^*)$ *which, in turn, are higher than the product market profits for the government-owned firm (case 2),* $R_G(k_G^*)$*.*

3.2. Pre- and post-privatization profits, and deductions

Typically, investments have an impact on firms' profit over several periods. Empirical examinations of privatization usually build on accounting data where the way in which investment costs are deducted will affect the results. To incorporate this aspect, we extend the model to have two periods of product market interaction: one period before the possible privatization (referred to as the pre-privatization period), and one period after the possible privatization (referred to as the post-privatization period). Different jurisdictions will have different accounting practices for how costs are deducted and how takeovers are treated. A simple way of modeling deductions, that is still able to handle several cases, is to assume that a share α of the investment costs is deducted in the first product market interaction period and the remaining share $1-\alpha$ is deducted in the second product market interaction period.

The objective function for a private owner is then:

$$\underset{\{k\}}{Max} : R_A^1(k) - \alpha C(k) + R_A^2(k) - (1-\alpha)C(k), \tag{3.1}$$

where $R_A^1(k)$ is the pre-privatization period product market profit and $R_A^2(k)$ is the post-privatization period product market profit. The optimal investment by a private firm is then defined by:

$$\frac{dR_A^1}{dk} + \frac{dR_A^2}{dk} = C'(k). \tag{3.2}$$

The objective function for the government-owned firm is:

$$\underset{\{k\}}{Max} : [R_G^1(k) + L^1(k)] - \alpha C(k) + [R_G^2(k) + L^2(k)] - (1-\alpha)C(k), \tag{3.3}$$

with the associated first-order condition:

$$\frac{dR_G^1}{dk} + \frac{dR_G^2}{dk} + \frac{dL^1}{dk} + \frac{dL^2}{dk} = C'(k). \tag{3.4}$$

The objective function for the selling government owner is (remember that, for simplicity, $\theta = 0$):

$$\underset{\{k\}}{Max} : \ [R_S^1(k) + L^1(k)] - \alpha C(k) + B(k) \tag{3.5}$$

$$s.t \ : \ B(k) = [R_A^2(k) - R_N^2(k)] - (1-\alpha)C(k), \tag{3.6}$$

with the optimal investment defined by:

$$\frac{dR_S^1}{dk} + \frac{dL^1(k)}{dk} + (\frac{dR_A^2}{dk} - \frac{dR_{NA}^2}{dk}) = C'(k). \tag{3.7}$$

To abstract for effects caused by change in demand between periods, we assume

Assumption 3 (i) the profit opportunities are the same in the pre-privatization product market interaction and the post-privatization product market interaction, i.e. $R_j^1(k_j) = R_j^2(k_j)$ and $R_{-j}^1(k_j) = R_{-j}^2(k_j)$ for $j = A, G$ and (ii) the labor well-being opportunities are the same in the two periods, i.e. $L^1(k_j) = L^2(k_j)$.

It follows that the difference in the maximization problem between the private owner and the selling government looks equivalent to the above and it follows from (3.2) and (3.4) that the private owner invests more. Using the same reasoning as in the proof of Proposition 3, Assumption 2, and that the investment cost share α is equal for the private and government owner, we establish that pre-privatization and post-privatization profits are higher for the privately owned firm than for the government-owned firm.

Consider the privatized firm's behavior which is now more involved as seen in (3.7). It has an incentive to underinvest since it takes into account the negative effect on labor pre-privatization, but it also has an incentive to overinvest due to the strategic effect on the sales price of the state firm. Without further assumptions, we cannot determine which is the dominating effect.

However, we can show that our model is consistent with the findings in Dewenter and Malatesta (2001). First note that due to (3.7) and (3.4), it follows that $k_S^* > k_G^*$. Then, if α is sufficiently low, the pre-privatization profit for the privatized firm is higher than the pre-privatization profit for the government-owned firm. Second, if α is sufficiently low, it also follows that the pre-privatization profit for the privatized firm is higher than the post-privatization profit for the privatized firm.

Thus, we have derived the following result:

Proposition 5. *Profits in both periods are higher for the privately owned firm than for a firm that is owned by the government in one or both periods. Furthermore, there exist equilibria where: (1) the profit for the privatized firm in the period before privatization is higher than the profit for a state-owned firm that is not sold and (2) the pre-privatization profit for the privatized firm is higher than the post-privatization profit for the privatized firm.*

Proposition 5 is thus consistent with a main finding in Dewenter and Malatesta (2001): the pre-privatization profit for the privatized firm can be higher than the post-privatization profit for the privatized firm. It could also be noted that all agents are fully informed and the strategic government behavior is not undertaken to manipulate information about the value of the firm. This implies that the long-run performance of the privatized firm is

not worse than the performance of a comparable private firm, since these costs are taken into account by the acquiring firm when buying the privatized firm. This result is also consistent with the results on long-run stock market performance of privatized firms found in Dewenter and Malatesta (2001).[11]

4. Analysis of assumptions

4.1. Favoring employees and lost future control

We saw above that even if the government cares as much about labor when intending to sell ($\theta = 1$) as in a firm it intends to keep, there is a stronger incentive to invest in case it intends to sell. If the effects of investments on employment are sufficiently weak, relative to the effects on non-acquirers' profits, a selling government will invest more than a private firm. The propositions are starker when the politician does not at all take into account the effects of employment after privatization ($\theta = 0$). Several arguments are possible for supporting this as a plausible case.[12] Here, we explore one mechanism in some detail: If the politicians were to underinvest in order to favor employees in the future, the acquiring firm would sequentially invest to compensate for this.

[11] Moreover, Proposition 5 can also help us understand another main empirical finding in Dewenter and Malatesta (2001): Post-privatization profitability is negatively related to the government's remaining ownership share in a cross-section analysis. Such a partially privatized firm will maximize a combination of profit and labor well-being, and will therefore be less profitable than a private firm. At the same time, pre-privatization profits can be higher than post-privatization profits, due to strategic over-restructuring behavior by the selling politician.

[12] One motivation is that it is easier for employees to evaluate if the politicians really made the decision to favor them when the firm is in government hands. This, in turn, implies that the benefits of favoring employees in the future will decrease. It could also be argued, as is done by Boycko, Shleifer and Vishny (1996), that it is more costly to subsidize a private firm than a government firm. Subsidies to private firms are more visible and, in addition, subject to tighter legal restraints in many jurisdictions.

4.1.1. Political under-investment and sequential investment by the acquirer

Consider the set-up from Section 2.3 and assume that the private owner has an option to invest sequentially in case the state firm is privatized. The acquiring firm's optimal choice of investment then depends on the level of investment made by the selling government in the pre-privatization stage. Use k_A and k_S to denote the investments of the acquirer and the selling government. The maximization problem facing the acquiring firm can then be written as follows:

$$\underset{\{k_A\}}{Max} : R_A(k_A) - C(k_A \mid k_S). \tag{4.1}$$

$C(k_A \mid k_S)$ denotes the cost of investing k_A, given the choice of the selling government, k_S. The associated marginal cost of investing k_A is:

$$C'(k_A \mid k_S) = \begin{cases} 0 : k_A \leq k_S \\ C'(k_A) : k_A > k_S \end{cases}, \tag{4.2}$$

that is, investments acquired from the selling government, k_S, can be used without any costs, whereas any additional investments are subject to the marginal cost, $C'(k_A)$, which is illustrated in Figure 4.1.

We assume $R_A(k_A) - C(k_A \mid k_S)$ to be strictly concave in k_A. The optimal choice by the acquiring firm if the selling government were not to invest at all (i.e. $k_S = 0$), k_A^*, is then defined from the unconstrained optimum condition (2.6).

For a given investment choice by the selling government, k_S, the optimum investment for the acquiring incumbent firm, k_A^{opt}, becomes:

$$k_A^{opt} = \begin{cases} k_S : k_A^* \leq k_S \\ k_A^* : k_A^* > k_S \end{cases}. \tag{4.3}$$

This optimal choice is illustrated in Figure 4.1. When $k_A^* \leq k_S$, the acquiring firm refrains from investing in development and only uses the (cost-less) investment from the selling government, $k_A^{opt} = k_S$. Given that $k_A^* > k_S$, the optimal investment $k_A^{opt} = k_A^*$ is given by (2.6).

Proposition 6. *Political underinvestments to favor employees in the future do not lead*

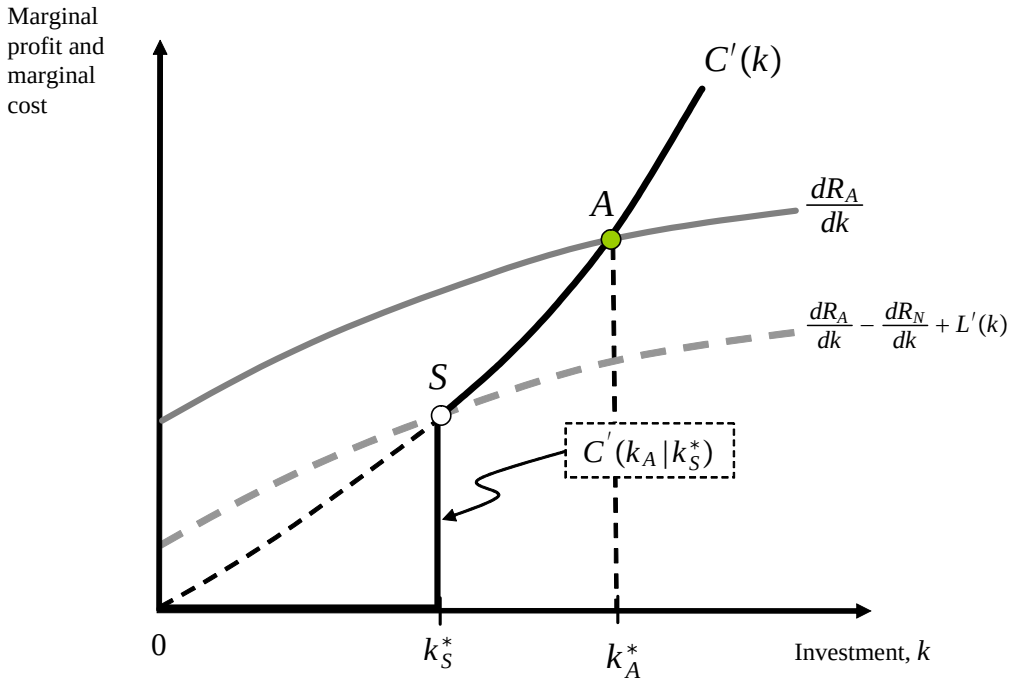

Figure 4.1: Sequential investment

to higher employment since the acquiring firm sequentially invests up to its unconstrained optimal investment levels.

4.2. How robust is the strategic oligopolistic over-investment effect?

One of the main findings of this paper is that, in equilibrium, the selling government has a stronger incentive to restructure the state assets than the acquiring firm, since it internalizes the negative effect of restructuring on the non-acquiring firms' profit through the sales price. Would these incentives remain sufficiently strong also when relaxing some of the assumptions made in the main analysis? In the following, we explore the sensitivity of results to allowing for alternative selling mechanisms, allowing the non-acquiring firms to invest, allowing privatization leading to a more concentrated product market, and allowing firm asymmetries.

4.2.1. Alternative selling mechanisms

It has been assumed that the selling government uses a first-price sealed bid auction. We would argue that this auction set-up captures essential features of the bidding competition used in practice. However, privatization can also take place using other methods, for instance by giving away shares or vouchers to the public (this was particularly common in the large scale privatization during Eastern Europe's transition from planned to market economies; see Roland (2000)). In many conceivable set-ups, the mechanisms identified here would nevertheless be present. For instance, a government freely distributing shares and wishing to maximize the value of this gift should invest strategically as described in Section 2.3.3. Naturally, the exact operation of the mechanism will depend on the details of such an alternative model.[13]

4.2.2. Optimal investment by the non-acquirer

Another concern is if the results are robust to allowing investments by the non-acquirers. We explore this in a linear Cournot model which is described in the Appendix. As before, we compare a situation where a private firm invests to maximize profit to the case where a selling government invests. For simplicity, product market interaction is a duopoly between firm N and firm A (where the amount of capital owned by A can depend on ownership history).

It can be shown that the acquirer's optimal investment, denoted $\widetilde{k}_A^*$, and the subsequent investment by the non-acquirer, denoted $\widetilde{k}_N^*|_A$, are (μ, b and Λ are constants):

$$\widetilde{k}_A^* = 4\frac{\Lambda\left(3b\mu-2\right)\left(3b\mu-4\right)}{160b\mu-216b^2\mu^2+81b^3\mu^3-32} \tag{4.4}$$

$$\widetilde{k}_N^*|_A = 4\frac{\Lambda\left(9b^2\mu^2-20b\mu+8\right)}{160b\mu-216b^2\mu^2+81b^3\mu^3-32}. \tag{4.5}$$

We can derive the government's optimal investment, $\widetilde{k}_S^*$, and the non-acquirer's optimal

[13] Biais and Perotti (2002) examine how privatizations by distributing (underpriced or free) shares can arise due to a right-wing government that wants to make the median voter choose less redistribution. The value of the shares is central also in that application.

investment $\widetilde{k}_N^*|_S$:

$$\widetilde{k}_S^* = 2\frac{\Lambda\left(27b^2\mu^2 - 44b\mu + 16\right)}{(3b\mu - 2)\left(9b\mu - 4\right)(3b\mu - 4)} \tag{4.6}$$

$$\widetilde{k}_N^*|_S = 4\frac{\Lambda\left(9b^2\mu^2 - 20b\mu + 8\right)}{(3b\mu - 4)\left(9b\mu - 4\right)(3b\mu - 2)}. \tag{4.7}$$

From (6.11) and (4.6), it is straightforward to derive the following Lemma, as detailed in the Appendix.

Lemma 2. *In a Cournot model (linear demand, homogenous products and quadratic investment costs), a selling government invests more than a private firm and the non-acquirer invests less when the government sells,* $\widetilde{k}_S^* > \widetilde{k}_A^*$ *and* $\widetilde{k}_N^*|_S < \widetilde{k}_N^*|_A$.

Thus, the selling government's overinvestment is a feature of the model also when we allow the non-acquirer to invest.

4.2.3. Privatization leading to a more concentrated product market

Let us now relax Assumption A2 and let privatization lead to more concentrated market structures than if the government had kept the ownership. The main difference from above is that the effects on the government keeping the firm and the acquirer of an increase in investments now differ, i.e. $\frac{dR_G}{dk} \neq \frac{dR_A}{dk}$, whereas under assumption A2, $\frac{dR_G}{dk} = \frac{dR_A}{dk}$. In many oligopoly models, including the Linear Cournot model presented above, $\frac{dR_A}{dk} > \frac{dR_G}{dk}$ holds, i.e. a larger acquirer (as compared to the government keeping the firm) would have more to gain from increased investment. Under this assumption, the selling government will then have an additional investment incentive due to the market concentration effect.

4.2.4. Asymmetric firms: Oligopoly and monopoly

Private firms' valuations of the state assets may differ substantially. For example, the acquirer may have firm-specific assets that match the assets for sale particularly well. In that case, the acquirer may have a stronger incentive to restructure than the government. The reason is that the acquisition price equals the valuation of the state assets for the firm with the second highest valuation. This firm's valuation might then not be so sensitive to

restructuring, while the acquirer's profit is. However, also note that the opposite might be true. It then follows that the government's incentive to restructure relative to that of the acquirer increases even further.

It should be noted that if the non-acquirers are substantially smaller than the former state-owned firm, the government's incentives to restructure are more closely aligned to the investment incentives of the acquirer. The privatized firm will then essentially become a monopolist and the sales price is close to the monopoly profit. Consequently, our central mechanism has the potential of being quantitatively important in the oligopoly case, but not in the monopoly case or in the case of a dominant firm with a competitive fringe.

5. Concluding remarks

While many people might mainly associate privatization with the Thatcher era and the 1990s transition in formerly central planned economies, privatization remains important: in 2007, the global proceeds from privatization were $144 billion (Privatization Barometer (2007)). Current cases that have received attention are, for instance, Alitalia, the proposed Swedish privatization of six major state-owned enterprises (including the maker of Absolut Vodka) and a proposed privatization of California State Lotteries. Substantial parts of the industry are state owned in Europe, which means that privatizations are very much live issues. We have shown how a simple model based on two assumptions that appear to fit many privatization cases (the sales price is dependent on the market value of assets and government firms care about employment) can generate the time series pattern of efficiency around privatization documented by Dewenter and Malatesta (2001).

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6. Appendix – a Cournot model

In this Appendix, we solve the game described in Section 4.2.2. We model oligopoly interaction in the last stage as a Cournot duopoly (firms A and N) with homogeneous goods. We compare investments under two scenarios: i) the government owns a firm it intends to sell and ii) the firm of interest is owned by a private firm. We compare investments in scenario i) with investments in scenario ii). The timing and assumptions are as described in Section 2.

6.1. Product market competition.

Let the inverse demand in the product market be given by (6.1):

$$P = a - b\left(q_A + q_N\right), \tag{6.1}$$

where q_A and q_N are the quantities produced, $a > 0$ is a demand parameter, and b may be interpreted as the (inverse) size of the market. The product market profit for firm A, $\Pi_A(q_A, q_N, k_A, k_N)$, can be written:

$$\Pi_A = (P - c_A)q_A, \tag{6.2}$$

where we assume the firm's marginal cost, c_A, to be decreasing in its own capital ownership:

$$c_A = c - k_A. \tag{6.3}$$

Given the capital, firms' maximization problems are:

$$\max_{q_A}(P - c - k_A)q_A$$
$$\max_{q_N}(P - c - k_N)q_N$$

with associated first-order conditions:

$$\begin{aligned} P - c - k_A + \frac{\partial P}{\partial q_A}q_A &= 0, \\ P - c - k_N + \frac{\partial P}{\partial q_N}q_N &= 0. \end{aligned}$$

Making use of (6.1) in the first-order conditions leads to the following Nash-quantities:

$$q_A^*(k_A, k_N) = \frac{\Lambda + 2k_A - k_N}{3b}, \tag{6.4}$$

where $\Lambda = a - c > 0$.

The reduced-form product market profits defined in (2.2), $R_A(k_A, k_N)$, take the form:

$$R_A(k_A, k_N) = b\left(\frac{\Lambda + 2k_A - k_N}{3b}\right)^2. \tag{6.5}$$

6.2. Investments

In period 1, firms have the opportunity to invest in capital. We assume a quadratic cost of investments in capital for agent $j = A, S, N$:

$$C(k_j) = \frac{\mu k_j^2}{2}. \tag{6.6}$$

For simplicity, we assume that all firms share the same investment technology in terms of the cost-parameter, μ.

6.2.1. Investment by Firm *A*

Consider the case where firm A sets k_A to maximize profits first and firm N is then allowed to invest, which is a standard Stackelberg case. The total profit for firms A and N can be written:

$$\pi_A(k_A, k_N) \equiv R_A(k_A, k_N) - C(k_A), \tag{6.7}$$
$$\pi_N(k_A, k_N) \equiv R_N(k_A, k_N) - C(k_N). \tag{6.8}$$

Firm N's first-order condition is

$$\frac{d\pi_N}{dk_N} = \frac{\partial R_N}{\partial k_N} - C'(k_N) = 0.$$

It is straightforward to derive firm N's reaction function which can be written as

$$k_N(k_A) = \frac{\Lambda - k_A}{\frac{9}{4}\mu b - 2}. \tag{6.9}$$

Firm A will choose its investment internalizing the non-acquirer's behavior through the reaction function (6.9). The first-order condition for firm A is:

$$\frac{d\pi_A}{dk_A} = \frac{\partial R_A}{\partial k_A} + \frac{\partial R_A}{\partial k_N}\frac{dk_N}{dk_A} - C'(k_A) = 0. \tag{6.10}$$

Using the investment cost function (6.6), the reaction function (6.9) and the reduced-profit product market profit (6.5), it can be shown that the acquirer's optimal investment, denoted $\widetilde{k}_A^*$, and the subsequent investment by the non-acquirer, denoted $\widetilde{k}_N^*|_A$, are:

$$\widetilde{k}_A^* = 4\frac{\Lambda\left(3b\mu - 2\right)\left(3b\mu - 4\right)}{160b\mu - 216b^2\mu^2 + 81b^3\mu^3 - 32} \tag{6.11}$$

$$\widetilde{k}_N^*|_A = 4\frac{\Lambda\left(9b^2\mu^2 - 20b\mu + 8\right)}{160b\mu - 216b^2\mu^2 + 81b^3\mu^3 - 32}, \tag{6.12}$$

where $160b\mu - 216b^2\mu^2 + 81b^3\mu^3 - 32 > 0$ holds from the second-order condition $\frac{d^2\pi_A}{dk_A^2} < 0$. Assume that $9b^2\mu^2 - 20b\mu + 8 > 0$, such that there are positive investments by the non-acquirer.

6.2.2. Optimal investment by a selling government

Now consider the case where the government intends to sell the firm of interest. The maximization problem is as in 2.9, but set θ to zero for simplicity.

$$\begin{aligned} \underset{\{k\}}{Max}: \;& B(k) - C(k) \\ s.t \;:\; & B(k) = R_A(k) - R_N(k). \end{aligned} \tag{6.13}$$

The first-order condition is:

$$\frac{dB}{dk_S} = \frac{dR_A}{dk_S} - \frac{dR_N}{dk_S} = C'(k_S). \tag{6.14}$$

The maximization problem of firm N is again

$$\pi_N(k_S, k_N) \equiv R_N(k_S, k_N) - C(k_N),$$

with the first-order condition

$$k_N(k_S) = \frac{\Lambda - k_S}{\frac{9}{4}\mu b - 2}. \tag{6.15}$$

The total profit for firm A can be written:

$$\pi_A(k_A, k_N) \equiv R_A(k_A, k_N) - C(k_A). \tag{6.16}$$

Making use of the reduced-profit functions $R_A(k_S, k_N)$ from (6.5), the investment cost function (6.6) and the non-acquirer's reaction function (6.9), we can derive the selling government's optimal investment $\widetilde{k}_S^*$, as well as the non-acquirer's optimal investments $\widetilde{k}_N^*|_S$:

$$\widetilde{k}_S^* = 2\frac{\Lambda\left(27b^2\mu^2 - 44b\mu + 16\right)}{(3b\mu - 2)\left(9b\mu - 4\right)(3b\mu - 4)} \tag{6.17}$$

$$\widetilde{k}_N^*|_S = 4\frac{\Lambda\left(9b^2\mu^2 - 20b\mu + 8\right)}{(3b\mu - 4)\left(9b\mu - 4\right)(3b\mu - 2)}. \tag{6.18}$$

6.2.3. Comparing investments

Let us now compare the government's optimal restructuring $\widetilde{k}_S^*$ to the private firms' optimal investment $\widetilde{k}_A^*$.

$$\widetilde{k}_S^* - \widetilde{k}_A^* = 2b\mu\frac{\Lambda\left(9b^2\mu^2 - 20b\mu + 8\right)}{(3b\mu-2)(3b\mu-4)(9b\mu-4)(160b\mu-216b^2\mu^2+81b^3\mu^3-32)} > 0, \tag{6.19}$$

where $(3b\mu - 2)\left(3b\mu - 4\right)\left(9b\mu - 4\right) > 0$ by the second-order condition for the government's maximization problem, $\frac{d^2\pi_S}{dk_S^2} = -\frac{(3b\mu-2)(3b\mu-4)(9b\mu-4)}{(9b\mu-8)b} < 0$, where $160b\mu - 216b^2\mu^2 + 81b^3\mu^3 - 32 > 0$ by the second-order condition for the private owners' maximization problem (6.10), $\frac{d^2\pi_A}{dk_A^2} = -\frac{160b\mu-216b^2\mu^2+81b^3\mu^3-32}{(9b\mu-8)^2b}$, and where $9b^2\mu^2 - 20b\mu + 8 > 0$ is required for $\widetilde{k}_N^*|_A > 0$ in (6.12). Investments are strategic substitutes and it follows that $\widetilde{k}_N^*|_S - \widetilde{k}_N^*|_A = \frac{\Lambda-\widetilde{k}_S^*}{\frac{9}{4}\mu b-2} - \frac{\Lambda-\widetilde{k}_A^*}{\frac{9}{4}\mu b-2} = \frac{\widetilde{k}_A^*-\widetilde{k}_S^*}{\frac{9}{4}\mu b-2} < 0$.