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The Effect of Mixed Ownership on Competition

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Abstract: Partially state-owned firms are common in both developed and developing countries and contribute around 10% of the world's GDP. This has led to a rich literature exploring various aspects of competition between such "mixed"-ownership firms. This paper contributes to the existing literature by studying the effects of mixed ownership on the intensity of competition in oligopoly markets. Our findings indicate that state ownership exerts an anti-competitive influence, with a higher state ownership share resulting in less aggressive behavior by firms in the product market. This result implies that industries with a higher proportion of state ownership yield lower total surplus. Further, when considering factors such as taxes, soft budget constraints, and weak property rights, the anti-competitive effects of state ownership are accentuated.

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1. Introduction

Partial state ownership of competing firms is prevalent in many developing and transitional economies. It is not uncommon even in developed market economies. A study by the International Monetary Fund (IMF) used a comprehensive dataset with information on approximately 969,000 firms worldwide to find that about 15,000 among them were majority state-owned, and 4,000 were minority state-owned [1]. Moreover, their database mainly covered firms from OECD and emerging market economies, with a smaller sample from developing countries. However, state-owned enterprises (SOEs) play a crucial role in developing economies, often comprising a larger share of the corporate landscape than OECD countries. Indeed, a report indicated that SOEs account for over 20% of the world's largest companies [2]. This highlights that fully or partially state-owned enterprises are a significant part of the global economic landscape, contributing to various sectors and industries.

This prevalence of SOEs has led to an extensive body of literature looking at different aspects of competition among firms when some are partially state-owned. In this paper, we examine the interplay between such "mixed" ownership structures in oligopoly markets, which seem to have evolved along three distinct themes of inquiry [3]. The first theme, initiated by De Fraja and Delbono [4] (pp. 249-267), examines the relationship between public ownership and social welfare. Using a Cournot oligopoly model with a single public firm competing alongside private rivals, they showed that a mixed oligopoly might not always be socially beneficial, potentially leading to lower overall welfare compared to an oligopoly market where all firms are privately owned. Subsequent studies revisited this inquiry, many expanding this theme by exploring the impact of privatization and subsidization in mixed oligopolies. For example, White [5] (pp. 189–195) noted that using subsidies before and after privatization can maintain welfare levels. In contrast, Gil-Moltó et al. [6] found that privatization reduces the optimal R&D subsidy and increases aggregate R&D effort, improving social welfare only when the number of firms is sufficiently large. Another way this question has been reexamined is by introducing foreign ownership in private firms, as in Pal and White (1998) [7], who highlighted the potential for increased welfare with privatization when strategic trade policies are in place, mainly using domestic production subsidies. Matsumura [8] (pp. 275-287) and Fjell and Heywood (2004) [9] addressed the effect on welfare when the public firm is the Stackelberg leader.

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The second thematic strand revolves around the concept of partial privatization. Fershtman [10] (pp. 1–11) explored this theme within a Cournot duopoly framework, demonstrating that partial public ownership, up to a certain critical level, enables the public entity to attain higher profits than its private sector counterpart. Matsumura [11] (pp. 473–483) further expanded on this theme, highlighting that social welfare is maximized in a mixed duopoly when the public firm is partially privatized. Consequently, several subsequent studies, like that of Bennett and Maw [12], have identified partial privatization as the optimal policy choice. However, Matsumura and Kanda (2005) [13] introduce a crucial caveat. They demonstrate that Matsumura's [11] partial privatization argument loses validity when the free entry of private firms is permitted. Their findings suggest that "no privatization" is the optimal policy choice in such scenarios. Tomaru (2006) [14] and White [5] analyzed the effect of production subsidy under partial privatization. Both found that introducing partial privatization does not significantly alter the optimal subsidy, equilibrium output level, firm profits, or social welfare.

Indeed, the optimal proportion of state ownership in mixed ownership enterprises (MOEs) remains a topic of debate in academic circles. Proponents of increased state ownership highlight its advantages in mitigating costs and managing risks within a volatile market environment (such as Li & Yu) [15], its superior ability to access external financing (Liu et al.) [16] or fostering social welfare and harmony (Takeshi & Daisuke, 2019) [17]. However, a countervailing viewpoint advocating for reduced state ownership also exists among scholars of mixed ownership. A common argument in favor of reducing the proportion of state-owned shares is that it increases performance efficiency (Cosset et al., 2020) [18].

The third theme of research, pioneered by Anderson et al. [19], introduces product differentiation in the competition within mixed ownership firms. While Anderson considered a monopolistic competition model, later studies used a differentiated product oligopoly model. Studies by Fujiwara [20], Saha [21] (pp.25-43), and Barcena-Ruiz and Garzon [22] (pp. 27-42) are a few that exemplify this trend. However, since we have considered a homogeneous good model for our research, we will not delve into a detailed discussion on the differentiated product mixed oligopoly literature for this paper.

The issues addressed by our paper are similar to the first two thematic strands of the mixed oligopoly literature that we just mentioned. However, we emphasize the competition policy aspect of mixed markets, which is not that common in the literature on mixed oligopolies. While Escrihuela-Villar and Gutiérrez-Hita [23] (pp. 259-274) examined the competition policy and welfare aspects of mixed oligopoly, they focused on how the timing of policy measures affects the degree of competition and welfare, which differs from our approach.

The main contribution of this paper is that we add to this intriguing debate around the optimal proportion of state ownership in oligopoly by studying it from the point of view of the competition policy aspects of privatization. We have considered a general demand function, unlike most of the existing literature that uses a linear demand function. In addition, we have examined the effects of soft budget constraints and weak property rights on the intensity of competition between the two mixed-ownership firms. While prevalent in developing countries and transition economies, these two features are usually not discussed in the existing literature on mixed oligopoly.

Using a Cournot duopoly model with homogeneous goods, we find that the two competing firms behave less aggressively when the state holds shares in both firms. While there may be several reasons for such behavior, we focus on an "ownership concentration" effect: being partially state-owned, a firm will care to a certain degree about its competitors, who are also partially state-owned. Further, our analysis reveals that though there is a trade-off between the state's collusive interests and the other owners' competitive incentives, the private owners *may* eventually gain from their association with the state. To our knowledge, this is a new insight. Further, the higher the proportion of state-owned shares in each firm, the lower the welfare. The results continue to hold when we expand our analysis by introducing various features of the business environment, such as taxes, soft budget constraints, and weak property rights. This emphasizes the robustness of our results. In

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contrast, Escrihuela-Villar and Gutiérrez-Hita found that the presence of a public firm improves welfare unless it is highly inefficient relative to the private firms.

An essential aspect of our argument is that the intensity of competition is only weakly related to concentration measures, such as the number of firms or the Herfindahl index, because of the implicit collusion existing in the industry. Tacit collusion can largely influence total industry output, irrespective of the number of firms or their cost efficiency. A similar result has been noted by Earle and Estrin [24], who found that labor productivity as sales per employee is positively influenced by private ownership, while the impact of competition measured as market concentration on labor productivity is much weaker. This result suggests that privatization directly affects efficiency (sales per employee) via factors that have little to do with competition.

Another interesting implication of the competitive effect of privatization is a possible solution to a dilemma voiced by Carlin et al. [25]. They note that while privatization is a domain that can be a target of government action, the degree of competition in the market is a much more sensitive issue. Against this background, our result that privatization can substitute competition policy (but not the other way around) has an evident and valuable policy implication.

The remainder of the paper is organized as follows. Section 2 presents the basic model where two firms with partial state ownership compete in Cournot Nash fashion. In Section 3, we introduce the effect of taxes on the equilibrium policy responses of each firm. Section 4 extends the analysis to consider the effect of soft budget constraints. Similarly, section 5 examines the effect of weak property rights. Section 6 offers some concluding remarks.

2. A Basic Model of Duopoly with State Ownership

We consider a symmetric Cournot duopoly model in which the state owns a fraction σ_i of firm i's capital stock, where $0 \le \sigma_i \le 1, i = 1,2$. The objective of each firm is a weighted average of the objectives of the two categories of owners. The private owners of each firm care only about that firm's profit. However, the state's interest includes, besides that firm's profit, also a part of the rival firm's profit. This is because the state is also the part owner of the rival firm.

Let $\pi^i(x_i, x_j)$ denote the profits of firm i, with x_i being its output, while x_j denotes the output of its rival firm j, where $i = 1,2,\ j = 1,2,\ i \neq j$.

Then, the objective function of firm i (i = 1, 2) is as follows:

$F^i(x_1, x_2) = (1 - \sigma_i)\pi^i + \sigma_i(\pi^i + \sigma_j\pi^j)$, which can be simplified as

$$F^i(x_1, x_2) = \pi^i + \sigma_i\sigma_j\pi^j;\ i = 1,2, j = 1,2, i \neq j; \qquad (1)$$

As a weighted average of two profit functions, $F^i(.)$ has the usual properties associated with a regular, well-behaved profit function. Consequently, we assume that the objective function $F^i(.)$ has the following properties:

$$F^i_i > 0;\ F^i_{ii} < 0,\ i = 1,2; \quad (2)$$

In other words, as the output of firm i (x_i) increases, $F^i(.)$ also increases, but it does so at a decreasing rate. The first-order conditions for maximizing the two objective functions in (1) are as follows.

$$\begin{cases} F^i_i(x_i, x_j) \equiv \pi^i_i + \sigma_i\sigma_j\pi^j_i = 0 \\ F^j_j(x_i, x_j) \equiv \pi^j_j + \sigma_i\sigma_j\pi^i_j = 0 \end{cases} \quad (3)$$

We use comparative static analysis to explore the effect of a change in the state's share in firm i on the equilibrium output. To do that, we totally differentiate the two first-order conditions in (3), yielding the following equations.

$$\begin{cases} F^i_{ii}\,dx_i + F^i_{ij}\,dx_j + F^i_{i\sigma_i}d\sigma_i = 0 \\ F^j_{ji}\,dx_i + F^j_{jj}\,dx_j + F^j_{j\sigma_i}d\sigma_i = 0 \end{cases} \quad (4)$$

Next, we divide equations (4) through by $d\sigma_i$. In that case, we can solve the system with respect to $\frac{dx_i}{d\sigma_i}$ and $\frac{dx_j}{d\sigma_i}$. The solution of this system requires using the Cramer rule. Let us denote the relevant determinants by Δ_i, Δ_j and Δ. The detailed expressions of these determinants are the following.

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$$\Delta = \begin{vmatrix} F_{ii}^i & F_{ij}^i \\ F_{ji}^j & F_{jj}^j \end{vmatrix} = F_{ii}^i F_{jj}^j - F_{ij}^i F_{ji}^j$$

$$\Delta_i = \begin{vmatrix} -F_{i\sigma_i}^i & F_{ij}^i \\ -F_{j\sigma_i}^j & F_{jj}^j \end{vmatrix} = \sigma_j(-\pi_i^j F_{jj}^j + \pi_j^i F_{ij}^i)$$

$$\Delta_j = \begin{vmatrix} F_{ii}^i & -F_{i\sigma_i}^i \\ F_{ji}^j & -F_{j\sigma_i}^j \end{vmatrix} = \sigma_j(-\pi_j^i F_{ii}^i + \pi_i^j F_{ji}^j)$$

A quick investigation into the signs of $\frac{dx_i}{d\sigma_i}$ and $\frac{dx_j}{d\sigma_i}$ based on the signs of these determinants yields our first major result.

Lemma 1. *In a symmetric Cournot mixed duopoly market, as the state-owned share of a firm increases, the firm becomes less aggressive in that its equilibrium output decreases.*

Proof. In a Cournot competition, a less aggressive behavior by firm i corresponds to a lower equilibrium quantity produced. To assess the effect of state ownership on competition we have to find the sign of the following derivative:

$$\frac{dx_i^*}{d\sigma_i} = \frac{\Delta_i}{\Delta} = \frac{\sigma_j}{\Delta}(-\pi_i^j F_{jj}^j + \pi_j^i F_{ij}^i) \quad (5)$$

The two derivatives and π_i^j are equal if the firms are symmetric. In a Cournot game, the derivative π_j^i being negative reflects that an increase in firm j's output diminishes firm i's profit. In addition, the following equality holds: $F_{ij}^i = F_{ji}^j$ when symmetry is assumed. Both these derivatives are negative when the goods produced by the two firms are strategic substitutes, which is a natural assumption in a Cournot game. The condition $\Delta > 0$ implies that $|F_{jj}^j| > |F_{ji}^j|$. Along with these observations and considering that $F_{jj}^j < 0$, we can see that the derivative in equation (5) is negative, which proves the Lemma. □

Recall that Lemma 1 has been proved for firms that differ only in ownership structure but are otherwise symmetric. This result implies that a firm with a higher proportion of capital owned by the state produces a lower quantity than the rival firm. Equivalently, such a firm holds a lower market share in the industry. When testing this hypothesis, one must adjust the size variables to make the firms comparable. A possible way to do that is, for instance, to adjust each firm's market share by the number of workers.

Next, we examine the best response of a mixed ownership firm when the state-owned share of its rival firm goes up. The finding is our second major result.

Lemma 2 *In a symmetric Cournot duopoly, as the state-owned share owned of the rival firm increases, a partially state-owned firm acts less aggressively in the sense that its equilibrium output decreases.*

***Proof*:** Following the lines of the previous proof, one can see that the derivative $\frac{dx_j^*}{d\sigma_i}$ is negative.

$$\frac{dx_j^*}{d\sigma_i} = \frac{\Delta_j}{\Delta} = \frac{\sigma_j}{\Delta}(-\pi_j^i F_{ii}^i + \pi_i^j F_{ji}^j) \quad \square$$

This is an interesting and somewhat surprising result since from Lemma 1 we know that a firm's equilibrium quantity decreases if its state-owned share goes up. In general, in Cournot competition, since the quantities are strategic substitutes, we would expect that the rival firms output goes up. However, Lemma 2 proves that it is not the case.

Combining Lemma 1 and Lemma 2 yields our first proposition.

Proposition 1 *An industry where the firms are partially state-owned is less competitive than a fully privatized industry.*

Proof: This result immediately follows from the two Lemmas that were proved before. From the two Lemmas, an increase in the state-owned share of any firm makes both firms behave less aggressively, reducing their equibrium output. Consequently the industry output decreases, making the industry less competitive. □

The result stated by Proposition 1 may appear trivial. However, it has an interesting implication: partial ownership by the state facilitates collusion, reduces total output, and moves the joint output of each firm closer to the monopoly output level. This may also lead to an increase in the private owners' profits in the industry. On the other hand, since the state owns part of the firm, the profit

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share of the private owners are less than in private duopoly. On balance, under certain situations, when the former effect outweighs the latter, partial state ownership raises the private owners' profits in the industry.

Further, in the Cournot model, the firms produce less than the socially competitive output. As such, increased state ownership, by reducing the equilibrium output of each firm, will lead to the industry output becoming even lower, thus reducing the social welfare.

3. The Effect of Taxes

In this section, we extend our basic symmetric mixed-duopoly model to consider the effect of taxes. Since taxes add to the state exchequer, higher tax revenue will directly benefit the state. However, let us examine how taxes affect the equilibrium responses of each firm. When we add taxes to our model, the state's objective is the sum of firm i's profit, the state's tax revenue from both firms, and the state's share in Firm j's profit. With this assumption, the firm i's objective function is, again, a weighted average of the objectives of the two types of owners. Let τ be the tax rate. Then the objectives of the two types of owners of firm *i* are given by:

$$F^i(x_1, x_2) = (1-\sigma_i)\pi^i + \sigma_i\{\pi^i + \tau(\pi^i + \pi^j) + \sigma_j\pi^j\}$$

$$F^i(x_1, x_2) = (1+\sigma_i\tau)\pi^i + \sigma_i(\tau+\sigma_i)\pi^j \quad (6)$$

The following equation represents the first-order conditions for maximizing the objective function (6).

$$F^i_i(x_1^*, x_2^*) = (1+\sigma_i\tau)\pi^i_i + \sigma_i(\tau+\sigma_j)\pi^j_i = 0 \quad (7)$$

The determinants Δ, Δ_i, and Δ_j have the same general formulae as in the previous section. One must calculate the following derivatives to evaluate their signs for the new objective function.

$$F^i_{i\sigma_i} = \tau\pi^i_i + (\tau+\sigma_j)\pi^i_j \quad (8)$$
$$F^j_{j\sigma_i} = \sigma_j\pi^i_j$$

With these formulae, the determinant Δ_i is given by:

$$\Delta_i = -\{\tau\pi^i_i + (\tau+\sigma_j)\pi^i_j\}F^j_{jj} + \sigma_j\pi^i_j F^i_{ij} \quad (9)$$

At the equilibrium point, where equations (7) must hold, the marginal profit $\pi^i_i(x_i^*, x_j^*)$ is related to π^i_j as follows:

$$\pi^i_i = -\frac{\sigma_i(\tau+\sigma_j)\pi^j_i}{(1+\sigma_i\tau)}$$

which can be introduced in expression (9). After re-arranging the terms and assuming symmetry ($\pi^i_j = \pi^j_i$), one obtains the following new expression for Δ_i.

$$\Delta_i = -\pi^i_j\left(\frac{\tau+\sigma_j}{1+\tau\sigma_i}\right)F^j_{jj} - \sigma_j F^i_{ij}$$

It can be seen that $\frac{\tau+\sigma_j}{1+\tau\sigma_i}$ is always greater than σ_j. Therefore, under the assumptions explained in the proof of Lemma 1, the sign of Δ_i is negative. The relation $\frac{dx_i^*}{d\sigma_i} < 0$ remains, thus, true when taxes are introduced in our model. Repeating the calculations for the derivative $\frac{dx_j^*}{d\sigma_i}$, one can find that its sign is ambiguous. Nevertheless, the sign of the change in the total industry output when σ_i varies is unambiguously negative, which confirms the result asserted by Proposition 1.

Proposition 2. *Taxes have an anti-competitive effect in a symmetric Cournot mixed duopoly with partial state ownership in each firm.*

Proof: The sign of the derivative, $\frac{dx_i^*}{d\tau}$ can be evaluated by totally differentiating the first-order conditions (7) and applying the Cramer rule. The result is the following expression for the derivative $\frac{dx_i^*}{d\tau}$.

$$\frac{dx_i^*}{d\tau} = \frac{\Delta_{i\tau}}{\Delta} = -\frac{\sigma_i}{\Delta}(\pi^i_i + \pi^j_i)(F^j_{jj} + F^i_{ij}) = -\frac{\sigma_i\pi^j_i}{\Delta}\frac{1-\sigma_i\sigma_j}{1+\sigma_i\tau}(F^j_{jj} + F^i_{ij}) < 0. \square$$

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Thus, in summary when taxes are introduced in our model, we find that:

(a) Proposition 1 still holds, that is, firms become less aggressive with increased state share.

(b) Higher taxes lower the equilibrium output of each firm, thus having an anti-competitive effect.

The following section explores how soft budget constraints affect the competitive behavior of the firms.

4. Soft Budget Constraints

State ownership in a firm may have anti-competitive consequences in an industry through channels related to the state's institutional characteristics. In this section, we investigate one such institutional characteristic: the soft budget constraints faced by firms with state participation.

The experience of some developing and transition economies shows that those firms with significant state ownership run huge overdue debts to the state budget arising from unpaid taxes. These firms are more likely to be granted debt forgiveness when the level of the debt becomes too high. Debt forgiveness is granted for reasons like trade union pressure, industrial policy, or in preparation for a future privatization of the firm. Kornai (2014) [26] provides several examples of state-owned enterprises like the Budapest Transport Company (BKV), which was rescued multiple times by the state in Hungary. Recent examples of soft budget constraints among firms are available in China [27], and the Punjab National Bank failure in India, dubbed one of the biggest scams in Indian banking history [28].

The soft budget constraint will be modeled here as a perceived probability that a firm will be granted tax forgiveness. Although the tax rate is the same for all the firms and profit levels, the probability of future tax forgiveness differs for the two firms in a duopoly model. Thus, the expected tax rate is firm-specific and depends on the state's share in a firm: the higher the state's share, the lower the expected tax rate.

Suppose the tax rate that firm i expects is denoted by $\tau(\sigma_i)$, which is a decreasing function of the state's share, σ_i, in firm i's capital structure. The firm i's objective function (6) can be modified as follows to incorporate the soft budget constraint assumption.

$$F^i(x_i, x_j) = (1-\sigma_i)\pi^i + \sigma_i(\pi^i + \tau_i\pi^i + \tau_j\pi^j + \sigma_j\pi^j);$$

where $\tau_i = \tau(\sigma_i), \tau_j = \tau(\sigma_j), \tau'(\sigma) < 0$

By re-grouping the terms, the expression of the objective function can be written as

$$F^i(x_i, x_j) = (1-\sigma_i\tau_i)\pi^i + \sigma_i(\tau_j + \sigma_j)\pi^i \qquad (10)$$

As before, the solution (x_i^*, x_j^*) that maximizes the objective function (10) is given by the following two simultaneous equations.

$$\left.\begin{aligned} F_i^i(x_i, x_j) &\equiv (1-\sigma_i\tau_i)\pi_i^i + \sigma_i(\tau_j + \sigma_j)\pi_i^j = 0 \\ F_j^j(x_i, x_j) &\equiv (1-\sigma_j\tau_j)\pi_j^j + \sigma_j(\tau_i + \sigma_i)\pi_j^i = 0 \end{aligned}\right\} \qquad (11)$$

Comparative statics allow us to identify the properties of the Cournot equilibrium when σ_i, the state ownership parameter varies. To do that, we differentiate, as before, the first order conditions (11) with respect to x_i, x_j, and σ_i. We assume that $\tau(.)$ has the same functional form for the two firms, but σ_i and σ_j vary independently. The "Cramer" determinants Δ, Δ_i, and Δ_j involve the following derivatives:

$$F_{i\sigma_i}^i = (\tau_i + \sigma_i\tau_i')\pi_i^i + (\tau_j + \sigma_j)\pi_j^i \qquad (12)$$

$$F_{j\sigma_i}^j = (\sigma_j\pi_j^i) \qquad (13)$$

Proposition 3. *In the presence of a soft budget constraint, on a symmetric Cournot duopoly, if firm i has a state capital share σ_i that is higher than Firm j's, then firm i behaves less aggressively.*

Proof: The sign of the derivative $\frac{dx_i^*}{d\sigma_i}$ is the same as the sign of the determinant Δ_i, which has the same general formula as before:

$$\Delta_i = -F_{i\sigma_i}^i F_{jj}^j + F_{j\sigma_i}^j F_{ij}^i$$

Introducing (12) and (13) in this latter expression and plugging the expression for π_i^i from the first equation in (11), the following expression can be obtained.

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$$\Delta_i = \pi_j^i \left\{ -\left(\tau_j + \sigma_j\right) \frac{1-\sigma_i^2 \tau_i'}{1+\sigma_i \tau_i} F_{jj}^j + \sigma_j F_{ij}^i \right\} \quad (14)$$

The first term within the parenthesis is always positive because $\tau_i' < 0$ and $F_{jj}^j < 0$, while the second term is negative. A sufficient condition for the sign of the expression inside the parenthesis to be positive, implying $\Delta_i < 0$, is the following:

$$\left(\tau_j + \sigma_j\right) \frac{1-\sigma_i^2 \tau_i'}{1+\sigma_i \tau_i} > \sigma_j \quad (15)$$

By straightforward manipulation, it can be shown that this latter inequality holds, at least for the case $\sigma_i > \sigma_j$. This is, therefore, a sufficient condition for Δ_i and $\frac{dx_i^*}{d\sigma_i}$ to be negative and the proposition is thus proved. □

The result in Proposition 3 partially confirms the one stated by Lemma 1. In other words, one can notice that the proof of Proposition 3 is restricted to the case when firm i has a higher share of state ownership than the rival firm. It turns out that this restriction is not necessary when looking at the total industry output, which is stated in our following proposition.

Proposition 4. *An industry where the firms are partially state-owned is less competitive than a fully privatized industry even in the presence of soft budget constraints*

Proof: Along the same lines of reasoning as before, one needs to evaluate the sign of the expression:

$$\Delta_i + \Delta_j = (-F_{jj}^j + F_{ji}^j)(F_{i\sigma_i}^i + F_{j\sigma_i}^j) \quad (16)$$

The expression within the first parenthesis is positive. Using the derivatives calculated for Proposition 3, one can quickly check that both terms in the second parenthesis are negative. Thus, the sign of the sum of the two determinants is negative, which implies $\frac{d(x_i^* + x_j^*)}{d\sigma_i} < 0$. □

In the next section, we address the final extension of our basic model, by examining how weakly enforced property rights affect the nature of competition between the firms.

5. Weakly Enforced Property Rights

The weakness of the institution of property rights may take various forms and have numerous and diverse consequences. One of those implications is, for instance, additional costs incurred by the proprietor in defending his/her property against expropriation. In transition economies, particularly in Russia, private safety provision was the rule rather than the exception.

Another aspect of weak property rights is the uncertainty concerning the future status of the property. In Russia, privatization was largely perceived as unfair. Important assets have been appropriated by the elite, the *novye russkii* (new Russians), who happened to be influential at the time of the big-bang privatization [29]. In Romania, many former owners did not restitute their properties, particularly in real estate. Current owners perceive a danger that their property rights be challenged by those whose properties have been expropriated by the communist regime. Romania has an ongoing political debate about whether actual proprietors or tenants should be given the right to use the assets. Uncertainty changes the behavior of economic agents, particularly concerning long-term investments.

A notable category of stakeholders in the assets of an enterprise is formed by its employees. When property rights are weakly defined or enforced, like when the state has a considerable share in a firm, the managers and the other employees would appropriate part of the cash flow through various channels. High salaries to the top management, excessive spending on business trips, and generous fringe benefits are part of the rich set of instruments used for misappropriation by the insiders. A more subtle practice is the conclusion of highly disadvantageous procurement or delivery contracts between the (partially) state-owned and small firms run by the insiders or their friends. In Romania, these satellite firms, *firma-capousha* (parasite firms), have been making huge profits at the expense of the heavily indebted state-owned firms [30].

This latter aspect of slack property rights will be analyzed in the following variant of our mixed ownership duopoly model. Only for this section, the objective function of the firms will include one additional term reflecting insiders' incentives. We define the parameter ς as representing the weight

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of the insiders' interest in the objective function of a firm. Insiders' revenue is reflected in higher unit production costs $c_i(x_i)$. For various reasons, the insiders value not only their direct revenues, but also the firm's profit. (For instance, the insiders may be, at the same time, shareholders.) Thus, the insiders' objective function is profit plus cost, which amounts to the firm's total revenue. It is also assumed that ς is the same for the two firms. For making our point, whether ς depends on the state's share, σ_i, is irrelevant. Misappropriation, which is more likely in state-owned firms, may also occur in private firms due to the economy-wide weakness of the property rights institutions. The adjusted objective function is as follows.

$F^i(x_i, x_j) = (1 - \sigma_i - \varsigma)\pi^i + \sigma_i(\pi^i + \sigma_j\pi^j) + \varsigma\{\pi^i + c_i(x_i)\}$; (17)

$F^i(x_i, x_j) = \pi^i + \sigma_i\sigma_j\pi^j + \varsigma c_i(x_i)$, where $c_i' > 0$ (18)

The first-order conditions for maximizing this objective function are as follows.

$F_i^i = \pi_i^i + \sigma_i\sigma_j\pi_i^j + \varsigma c_i' = 0$ (19)

It is interesting to see how the firm's behavior in the market is influenced by ς, the insider-control parameter, which is captured in Proposition 5.

Proposition 5. *Weak monitoring of a firm (robust control by insiders) is pro-competitive.*

Proof: See Appendix A. □

The intuition behind this striking result is that the insiders can manipulate the costs such that a higher share of these costs can go to the insiders as revenue. Therefore, they have an incentive to lower the "true" costs, which reflect the actual production efficiency, while the price-cost markup is diminished by raising the apparent cost. Therefore, the industry appears more competitive if judged by the markup criterion. As the proof of Proposition 5 suggests, the equilibrium output is also increased by stronger insider control.

The weakness of property rights concerning state ownership is somewhat different. The most crucial aspect here is that the state is a dispersed owner. Therefore, it is unable to pursue strict efficiency criteria in economic activity. The state has, instead, a comparative advantage in raising taxes. Here is the feature that the following model will attempt to capture. In managing a firm as a shareholder, the state values the tax revenue from that firm more than profit because it knows that taxes can more safely be appropriated than profit.

The model employed to investigate the effect of slack property rights on competition is like Equation (6), adjusted to include a property rights parameter, ψ. The parameter is the weight put by the state on profit, while $1 - \psi$ remains for the tax revenue.

$$F^i(x_1, x_2) = (1 - \sigma_i)\pi^i + \sigma_i\{\psi\pi^i + \tau(1 - \psi)(\pi^i + \pi^j) + \sigma_j\pi^j\}$$

Rearranging by collecting terms with π^i, and π^j, we get:

$$F^i(x_i, x_j) = [1 - \sigma_i(1 - \psi)(1 - \tau)]\pi^i + \sigma_i[(1 - \psi)\tau + \sigma_j]\pi^j \quad (20)$$

Analyzing the properties of the equilibrium quantities associated with the objective function (20) by the same method as before, it is easy to re-establish the result given by Proposition 1. In other words, a symmetric duopoly will behave more collusively when state ownership is present, even when the state's property rights are weakly enforced.

Next, we examine the direct effect of weak property rights involved by state ownership on competition. Our findings are summarized in the following proposition.

Proposition 6. *Weak property rights associated with state ownership are anti-competitive.*

Proof: See Appendix A. □

From the proof (available in the Appendix), we find that $\frac{dx_i^*}{d\psi} > 0$, that is, a worsening of property rights (if $\psi \downarrow$) will lead to a reduction in the output of each firm, making it anti-competitive. Intuitively, with weak property rights, the state values tax revenue more than profits (relative to the situation when the property rights are well-enforced and clearly defined). From Proposition 2, an increase in taxes reduces equilibrium output. With weak property rights, the incentive to expropriate more tax revenues leads to higher taxes and, thus, less output.

6. Conclusion and Discussion

In this paper, we have examined the effects of an increased share of state ownership on the intensity of competition using a Cournot duopoly model with non-linear demand, where both firms

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are partially state-owned. In such a situation, our findings indicate that state ownership facilitates tacit collusion by making firms behave less aggressively. The equilibrium output is lower for each firm with increased state ownership. Conversely, privatization increases competition. Our result remains robust when taxes, soft budget constraints, and slack property rights are introduced in the basic model. In addition, increasing taxes and the worsening of property rights also facilitate tacit collusion by reducing the equilibrium output of each firm in our model.

In contrast to most articles in the existing literature, we have not limited our investigation to linear demand. However, we have made other restrictive assumptions in our model. The firms in the industry have been considered symmetric, a simplifying assumption often present in much of the existing literature. Relaxing this assumption and examining how asymmetry affects the results of our analysis will be a straightforward extension of our model. Further, introducing product differentiation in our model, like Saha (2019), will allow us to examine the effect of increased state-share on the equilibrium quality level of the firms. This will be another interesting avenue for future research.

Another fruitful extension will be empirically testing some of our model's results for developing countries or transition economies. If so, the following caveats should be kept in mind when testing these hypotheses. First, our theoretical model purposely disregarded some omitted variables to focus on state ownership, like the anti-trust policies and other government policies like tariffs, subsidies, access to resources and funding, political influence, and degree of product differentiation. Some of these omitted variables are considered important in the literature on mixed ownership. For example, Liu et al. [16] found that State-owned enterprises have a superior ability to obtain resources like external financing.

As pointed out earlier, symmetry can be handled by controlling size. A large state enterprise may have a higher market share than a small private one, which apparently contradicts the result in Proposition 1. Nevertheless, if we control the size, for example, by calculating market share per employee or another measure of size, we can test Proposition 1, and our results can be verified empirically.

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Appendix A

Proof of Proposition 5

Proof: A comparative statics exercise implies differentiating the first-order conditions $F_i^i = 0$, then evaluating the sign of the derivative $\frac{dx_i^*}{d\varsigma}$. If the conditions for the existence of an equilibrium still hold, the sign of the determinant $\Delta_{i\varsigma}$ determines the sign of the derivative mentioned above.

$$Sign\left(\frac{dx_i^*}{d\varsigma}\right) = Sign(\Delta_{i\varsigma}) = Sign\left(-F_{i\varsigma}^i\left(F_{jj}^j - F_{ij}^i\right)\right) \qquad \text{(A1)}$$

Examining this last expression, where it was assumed that $F_{i\varsigma}^i = F_{j\varsigma}^j$ one could notice that the sign that we are seeking to evaluate is the same as the sign of the derivative:

$$F_{i\varsigma}^i = c_i' > 0. \text{ (A2)}$$

This proves Proposition 5. □

Proof of Proposition 6

Proof: To prove this proposition, we differentiate the first-order conditions associated with equation (20) with respect to the two strategic variables (x_i and x_j) and ψ. Applying the Cramer rule again, the sign of the derivative $\frac{dx_i^*}{d\psi}$ is given by the sign of the following determinant:

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$$\Delta_{i\psi} = -F^i_{i\psi}F^j_{jj} + F^j_{j\psi}F^i_{ij} = F^i_{i\psi}(-F^j_{jj} + F^i_{ij}), \text{ (A3)}$$

where symmetry has implied the equality $F^i_{i\psi} = F^j_{j\psi}$. Under the usual assumptions, the term within the parenthesis in the expression of $\Delta_{i\psi}$ in (A3) is positive, so the sign of this determinant is the same as the sign of $F^i_{i\psi}$.

$$F^i_{i\psi} = \sigma_i(1-\tau)\pi^i_i - \sigma_i\tau\pi^j_i \text{ (A4)}$$

The derivative π^i_i in this expression can be replaced with its equilibrium value, which can be calculated from the first-order conditions associated with the maximization problem (20):

$$\pi^i_i = -\frac{\sigma_i\{(1-\psi)\tau + \sigma_j\}}{1-\sigma_i(1-\psi)(1-\tau)}$$

Plugging this value into (A4) and re-arranging the terms, the following expression can be found, which is clearly positive:

$$F^i_{i\psi} = -\pi^i_j\sigma_i\frac{\tau + \sigma_i\sigma_j(1-\tau)}{1-\sigma_i(1-\psi)(1-\tau)} > 0$$

With this, it has been proved that $\frac{dx^*_i}{d\psi} > 0$. Now, recall that a lower ψ is equivalent to weaker property rights enforcement. Thus, the sign of the derivative being positive suggests that under weaker property rights, a lower quantity is produced by each of the two firms (by symmetry), that is, lower competition in the industry. □

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