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Why Labor-Managed Firms May Not Be Socially Desirable

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ABSTRACT:- We employ a game-theoretic model to analyze five duopoly regimes: (1) state-owned and labor-managed firms, (2) labor-managed firms, (3) state-owned and capitalist firms, (4) capitalist firms, and (5) capitalist and labor-managed firms. We compare welfare outcomes across these regimes and find that labor-managed firms may not be socially desirable because of their adverse impact on economic welfare. This may help explain why labor-managed firms are relatively rare compared to capitalist firms.

Keywords: Capitalist firm; Cournot model; Economic welfare; Labor-managed firms; State-owned firm
JEL Classification Numbers: C72, D21, L32

I. INTRODUCTION

Labor-managed firms in the UK and Italy date back to the 19th century. After World War II, Yugoslavian enterprises were managed by employees within legal constraints. From the 1970s through the 1980s, labor-managed firms expanded significantly across Western Europe, with notable growth in Italy, France, and the UK. In the United States, the plywood industry in the Pacific Northwest featured prominent labor-managed firms as early as 1921, accounting for up to 25% of the sector's output during the 1950s. In China, economic reforms have enabled state-owned and collective enterprises to operate similarly to labor-managed firms, prioritizing income per worker over profit maximization. Although labor-managed firms exist in many countries, they remain relatively rare compared to capitalist enterprises.

The empirical analysis by Wigger (2022) explores why labor-managed firms remain rare in developed economies, despite their economic viability and social appeal. Wigger identifies three primary factors contributing to their limited prevalence. First, many entrepreneurs and workers are simply unaware of the existence and advantages of labor-managed models. Second, founders often favor conventional ownership structures that offer greater personal control and profit potential. Third, the collaborative governance inherent in labor-managed firms is frequently perceived as cumbersome, thereby discouraging their formation. Wigger further emphasizes that labor-managed firms are economically comparable and socially preferable to conventional firms, and that outdated critiques of their inefficiency have been convincingly refuted.

The pioneering theoretical model of a labor-managed firm was developed by Ward (1958). Since then, numerous researchers have examined the behavior of labor-managed firms from various perspectives (see, e.g., Vanek, 1977; Hill and Waterson, 1983 ; Stewart, 1992; Lambertini and Rossini, 1995; Lambertini, 1997; Neary and Ulph, 1997; Okamura et al., 1997; Ireland, 2003; Cellini and Lambertini, 2006; Ohnishi, 2011; Groot and van der Linde,

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2017; Hamada et al., 2017; Dow, 2018; Sakai, 2020; Ho et al, 2021; Kalashnykova et al., 2022).

The theoretical analysis by Ohnishi (2011) employs a simple numerical model to examine five duopoly regimes: state-owned and capitalist firms, capitalist firms, state-owned and labor-managed firms, labor-managed firms, and capitalist and labor-managed firms. The study demonstrates that the behavior of labor-managed firms leads to higher prices and reductions in consumer surplus, producer surplus, and overall economic welfare.

In this paper, we extend Ohnishi's (2011) numerical examples into a formal theoretical model. We examine the same five duopoly regimes: state-owned and labor-managed firms, labor-managed firms, state-owned and capitalist firms, capitalist firms, and capitalist and labor-managed firms. We compare the welfare outcomes across these regimes and assess the social desirability of labor-managed firms. Our outcomes are proven mathematically.

The rest of this paper is organized as follows. In Section 2, we explain the basic setting. Section 3 presents the results, and the conclusion is presented in Section 4.

II. BASIC SETTING

We study a Cournot duopoly with firm i and firm j. The price function is given by $P(Q) = a - Q$, where $a \in (0, \infty)$ denotes a constant and $Q = q_i + q_j$ is the total output. Firm i's cost function is given by $C(q) = q^2/2 + f$, where $f \in (0, \infty)$ is the fixed cost.

Firm i's profit is given by

$$\pi_i = P(Q)q_i - C(q_i) = (a - Q)q_i - \frac{q_i^2}{2} - f \tag{1}$$

Economic welfare is given by

$$W = \int_0^Q (a - t)dt - C(q_i) - C(q_j) = \frac{a^2 - (a - Q)^2 - 4f - q_i^2 - q_j^2}{2} \tag{2}$$

Furthermore, if firm i is a labor-managed firm, then its objective function is given by

$$\omega_i = \frac{P(Q)q_i - C(q_i)}{l(q_i)} = \frac{(a - Q)q_i - \frac{q_i^2}{2} - f}{q_i^2} \tag{3}$$

where l denotes the labor input function. We assume $l(q_i) = q_i^2$. Since the inverse demand function is defined only for non-negative outputs, any equilibrium output is necessarily non-negative.

III. RESULTS

We solve for the Nash equilibria of the following five one-shot duopoly games: (1) state-owned and labor-managed firms (SL), (2) labor-managed firms (LL), (3) state-owned and capitalist firms (SC), (4) capitalist firms (CC), and (5) capitalist and labor-managed firms (CL). Throughout the remainder of this paper, superscripts indicate the respective market regimes. All equilibrium values are assumed to be nonnegative real numbers. The analysis proceeds sequentially, beginning with regime (1).

(1) State-owned and labor-managed firms (SL)

We consider a mixed duopoly game with a state-owned firm (firm S) and a labor-managed firm (firm L). Both firms simultaneously and independently choose outputs. Each firm's reaction function is given by

$$R_S(q_L) = \frac{a - q_L}{2}$$

$$R_{\mathrm{L}}(q_{\mathrm{S}}) = \frac{2f}{a - q_{\mathrm{S}}}$$

where the subscripts S and L denote firm S and firm L, respectively.

We present the Cournot equilibrium values of $q_{\mathrm{S}}^{\mathrm{SL}}$, $q_{\mathrm{L}}^{\mathrm{SL}}$, Q^{SL}, P^{SL}, $\omega_{\mathrm{L}}^{\mathrm{SL}}$, and W^{SL}.

$$q_{\mathrm{S}}^{\mathrm{SL}} = \frac{3a - \sqrt{a^2 + 16f}}{4} \qquad q_{\mathrm{L}}^{\mathrm{SL}} = \frac{-a + \sqrt{a^2 + 16f}}{2}$$

$$Q^{\mathrm{SL}} = \frac{a + \sqrt{a^2 + 16f}}{4} \qquad P^{\mathrm{SL}} = \frac{3a - \sqrt{a^2 + 16f}}{4}$$

$$\omega_{\mathrm{L}}^{\mathrm{SL}} = \frac{\left(a^2 + 8f + a\sqrt{a^2 + 16f}\right)\left(3a\sqrt{a^2 + 16f} - 3a^2 - 20f\right)}{128f^2}$$

$$W^{\mathrm{SL}} = \frac{5a\sqrt{a^2 + 16f} - 3a^2 - 40f}{8}$$

(2) Labor-managed firms (LL)

We consider a duopoly game with two labor-managed firms (firm L1 and firm L2). Two firms' reaction functions are given by

$$R_{\mathrm{L1}}(q_{\mathrm{L2}}) = \frac{2f}{a - q_{\mathrm{L2}}}$$

$$R_{\mathrm{L2}}(q_{\mathrm{L1}}) = \frac{2f}{a - q_{\mathrm{L1}}}$$

where the subscripts L1 and L2 denote firm L1 and firm L2, respectively.

The Cournot equilibrium values can be obtained as follows:

$$q_{\mathrm{L1}}^{\mathrm{LL}} = \frac{a - \sqrt{a^2 - 8f}}{2} \qquad q_{\mathrm{L2}}^{\mathrm{LL}} = \frac{a - \sqrt{a^2 - 8f}}{2}$$

$$Q^{\mathrm{LL}} = a - \sqrt{a^2 - 8f} \qquad P^{\mathrm{LL}} = \sqrt{a^2 - 8f}$$

$$\omega_{\mathrm{L1}}^{\mathrm{LL}} = \frac{\left(a^2 - 4f + a\sqrt{a^2 - 8f}\right)\left(3a\sqrt{a^2 - 8f} - 3a^2 + 16f\right)}{32f^2}$$

$$\omega_{\mathrm{L2}}^{\mathrm{LL}} = \frac{\left(a^2 - 4f + a\sqrt{a^2 - 8f}\right)\left(3a\sqrt{a^2 - 8f} - 3a^2 + 16f\right)}{32f^2}$$

$$W^{\mathrm{LL}} = \frac{a\sqrt{a^2 - 8f} - a^2 + 8f}{2}$$

(3) State-owned and capitalist firms (SC)

We consider a mixed duopoly game with a state-owned firm (firm S) and a capitalist firm (firm C). Each firm's reaction function is given by

$$R_{\mathrm{S}}(q_{\mathrm{C}}) = \frac{a - q_{\mathrm{C}}}{2}$$

$$R_C(q_S) = \frac{a - q_S}{3}$$

where the subscript C denotes firm C.

We present the Cournot equilibrium values:

$$q_S^{SC} = \frac{2}{5}a \qquad q_C^{SC} = \frac{1}{5}a$$

$$Q^{SC} = \frac{3}{5}a \qquad P^{SC} = \frac{2}{5}a$$

$$\pi_S^{SC} = \frac{2a^2 - 25f}{25} \qquad \pi_C^{SC} = \frac{3a^2 - 50f}{50}$$

$$W^{SC} = \frac{8a^2 - 50f}{25}$$

Notice that $q_C^{SC} < q_S^{SC}$ and $\pi_C^{SC} < \pi_S^{SC}$.

(4) Capitalist firms (CC)

We consider a game with two capitalist firms (firm C1 and firm C2). Two firms' reaction functions are given by

$$R_{C1}(q_{C2}) = \frac{a - q_{C2}}{3}$$

$$R_{C2}(q_{C1}) = \frac{a - q_{C1}}{3}$$

where the subscripts C1 and C2 denote firm C1 and firm C2, respectively.

The Cournot equilibrium values can be obtained as follows:

$$q_{C1}^{CC} = \frac{1}{4}a \qquad q_{C2}^{CC} = \frac{1}{4}a \qquad Q^{CC} = \frac{1}{2}a \qquad P^{CC} = \frac{1}{2}a$$

$$\pi_{C1}^{CC} = \frac{3a^2 - 32f}{32} \qquad \pi_{C2}^{CC} = \frac{3a^2 - 32f}{32} \qquad W^{CC} = \frac{5a^2 - 32f}{16}$$

Notice that $Q^{CC} < Q^{SC}$ and $P^{SC} < P^{CC}$.

(5) Capitalist and labor-managed firms (CL)

We consider a duopoly game with a capitalist firm (firm C) and a labor-managed firm (firm L). Each firm's reaction function is given by

$$R_C(q_L) = \frac{a - q_L}{3}$$

$$R_L(q_C) = \frac{2f}{a - q_C}$$

The Cournot equilibrium values can be calculated as follows:

$$q_C^{CL} = \frac{2a - \sqrt{a^2 + 6f}}{3} \qquad q_L^{CL} = \sqrt{a^2 + 6f} - a$$

$$Q^{CL} = \frac{2\sqrt{a^2 + 6f} - a}{3} \qquad P^{CL} = \frac{4a - 2\sqrt{a^2 + 6f}}{3}$$

$$\pi_C^{CL} = \frac{5a^2 - 4a\sqrt{a^2+6f}}{6}$$

$$\omega_L^{CL} = \frac{\left(a^2+3f+a\sqrt{a^2+6f}\right)\left(6a\sqrt{a^2+6f}-5a^2-10f\right)}{36f^2}$$

$$W^{CL} = \frac{19a\sqrt{a^2+6f}-17a^2-60f}{9}$$

Now, we compare the equilibrium outcomes of the five market regimes. The main result of this study is described by the following proposition.

Proposition 1: In the equilibrium outcomes of the five duopoly games, $W^{LL} < W^{CL} < W^{SL} < W^{CC} < W^{SC}$.

Proof: First, we prove that $W^{LL} < W^{CL}$.

$$W^{CL} - W^{LL} = \frac{19a\sqrt{a^2+6f}-17a^2-60f}{9} - \frac{a\sqrt{a^2-8f}-a^2+8f}{2} = \frac{38a\sqrt{a^2+6f}-25a^2-192f-9a\sqrt{a^2-8f}}{18}$$

We now prove that $38a\sqrt{a^2+6f} - 25a^2 - 192f - 9a\sqrt{a^2-8f} > 0$. We transpose "$-25a^2 - 192f - 9a\sqrt{a^2-8f}$" to the right-hand side:

$$38a\sqrt{a^2+6f} > 25a^2+192f+9a\sqrt{a^2-8f}$$

Furthermore, we square both sides of this inequality:

$$\left(38a\sqrt{a^2+6f}\right)^2 > \left(25a^2+192f+9a\sqrt{a^2-8f}\right)^2$$

$$123a^3 + 2936af > 75a^2\sqrt{a^2-8f} + 726f\sqrt{a^2-8f}$$

This inequality follows from $123a^2\sqrt{a^2} > 75a^2\sqrt{a^2-8f}$ and $2936f\sqrt{a^2} > 726f\sqrt{a^2-8f}$.

Second, we prove that $W^{CL} < W^{SL}$.

$$W^{SL} - W^{CL} = \frac{5a\sqrt{a^2+16f}-3a^2-40f}{8} - \frac{19a\sqrt{a^2+6f}-17a^2-60f}{9}$$
$$= \frac{109a^2+120f+45a\sqrt{a^2+16f}-152a\sqrt{a^2+6f}}{72}$$

Furthermore,

$$\frac{109a^2+120f+45a\sqrt{a^2+16f}-152a\sqrt{a^2+6f}}{72}$$
$$> \frac{109a^2+120f+45a\sqrt{a^2+16f-2\sqrt{16a^2f}}-152a\sqrt{a^2+6f-2\sqrt{6a^2f}}}{72}$$
$$\frac{109a^2+120f+45a\sqrt{a^2+16f}-152a\sqrt{a^2+6f}}{72} > \frac{a^2+60f+76a\sqrt{6f}-90a\sqrt{f}}{36} > 0$$

Third, we prove that $W^{SL} < W^{CC}$.

$$W^{CC} - W^{SL} = \frac{5a^2 - 32f}{16} - \left(\frac{5a\sqrt{a^2 + 16f} - 3a^2 - 40f}{8} \right) = \frac{11a^2 + 48f - 10a\sqrt{a^2 + 16f}}{16}$$

Furthermore,

$$\frac{11a^2 + 48f - 10a\sqrt{a^2 + 16f}}{16} > \frac{11a^2 + 48f - 10a\sqrt{a^2 + 16f - 2\sqrt{16a^2 f}}}{16}$$

$$\frac{11a^2 + 48f - 10a\sqrt{a^2 + 16f}}{16} > \frac{a^2 + 48f + 40a\sqrt{f}}{16} > 0$$

Finally, we prove that $W^{CC} < W^{SC}$.

$$W^{SC} - W^{CC} = \frac{8a^2 - 50f}{25} - \left(\frac{5a^2 - 32f}{16} \right) = \frac{3}{400} a^2 > 0. \text{ Q.E.D.}$$

This proposition suggests that the behavior of labor-managed firms is detrimental to economic welfare. Accordingly, labor-managed firms may not be socially desirable due to their adverse impact on overall welfare outcomes.

IV. CONCLUSION

We have examined five duopoly regimes: state-owned and capitalist firms, capitalist firms, state-owned and labor-managed firms, labor-managed firms, and capitalist and labor-managed firms. We have compared the equilibrium outcomes across these market regimes and have demonstrated that the behavior of labor-managed firms tends to reduce economic welfare. Our findings suggest that labor-managed firms may not be socially desirable, which could help explain their relative scarcity compared to capitalist firms.

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