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Establishing ownership in a lobbying contest with asymmetric information

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Abstract

We construct an incomplete information-lobbying contest involving a defender of economic interest and an exploiter. The parameters of each lobbyist are characterized such that the defenders' interests are secured without competition. The findings reveal that the ownership of vested interests can be established without third-party arbitration when the defender's preference parameter exceeds a certain threshold, provided that the exploiter's contest competitiveness remains below a fixed level.

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1. Introduction

The origin and determination of ownership are common concerns in economics, politics, biology, etc. Dong and Zhang (2016) extend previous research to a scenario that includes an incumbent's psychological endowment effect. They show that respect for property rights will be manifested among contestants without third-party arbitration, even in cases of asymmetric contestability. Smith and Parker (1976) examine how incomplete information among contestants influences the state of natural property rights. They introduce a contest game among animals competing for natural resources, assuming that they do not know their own winning probability. They indicate that in certain cases, evolution might select a state in which the agents avoid fighting opponents with weak contestability but fight those with strong contestability. However, in the context of uncertainty regarding migrants' valuation of resources, it remains vague whether the incumbent will secure possession. In reality, a firm with vested interests may not be able to observe its rival's valuation of owned rents in a lobbying competition. This study aims to offer a new perspective on this issue.

Following Dong and Zhang (2016), we introduce a sequential game with asymmetric information between lobbyists for economic resources. We apply Linster's (1993) solution concept to show that our game has a Stackelberg equilibrium outcome. We demonstrate that the incumbent's possession is protected from migrants' extraction of economic rents without third-party arbitration.

2. The model

2.1 The basic concepts and derivation of the Stackelberg equilibrium outcome

Consider a three-stage asymmetric information game involving two firms: a company colluding with authorities (the, defender) and an exploiter. We assume that the exploiter has two possible values for the defender's economic rent: high (V_h) and low (V_l), where $V_h > V_l > 0$. The exploiter's type set is denoted as $\boldsymbol{\Theta} = \{h, l\}$. We presume that the migrant values the rent at equal to or higher than the owner's valuation. Hence, we set the objective value of the rent for each party as $V \in [V_l, V_h)$. Moreover, the exploiter's type is private information; therefore, the defender plays against an exploiter of type h with probability $q \in [0, 1]$, and an exploiter of type l with probability $1-q$. The defender evaluates the rent as αV, where $\alpha > 1$ is the parameter that measures the defender's *endowment effect*.[1]

The decision-making process is as follows. First, without knowing the exploiter's actual type, the defender chooses an intensity of lobbying cost $c_D \geq 0$ to protect their interest. Then, each valuation type of exploiter chooses an intensity of lobbying cost $c_E^\tau \geq 0$ to acquire the rent. Finally, nature determines the winner of the game, who receives rent. The winning probability for both parties is given by the Tullock success function (Tullock 1980):

$$pr(Defender\ wins|V_\tau) = \frac{c_D}{c_D + kc_E^\tau}, \tau \in \boldsymbol{\Theta},$$
$$pr(Exploiter\ wins|V_\tau) = \frac{kc_E^\tau}{c_D + kc_E^\tau}, \tau \in \boldsymbol{\Theta},$$

where $k > 0$ is the exploiter's relative competitiveness. In contrast, both parties lose with

[1] The Bayesian situation where the defender observes $\tau \in \boldsymbol{\Theta}$ after the intensity of α is realized lies outside the scope of this study.

complementary probability; the loser seeks other commercial rents (e.g., colluding with an external firm), and the contest ends.

We assume that each lobbyist experiences a challenging competitive environment, and that seeking unoccupied rents generates an opportunity cost; thus, outside rents are not extremely attractive for either party. We denote the objective value of outside rents for each lobbyist as $\Delta \in (0, V_l)$.[2] Therefore, both parties maximize their payoffs:

$$\begin{aligned} u_D(c_D, c_E^h, c_E^l) &= q\left(\frac{c_D}{c_D + kc_E^h}\alpha V + \frac{kc_E^h}{c_D + kc_E^h}\Delta\right) + (1-q)\left(\frac{c_D}{c_D + kc_E^l}\alpha V + \frac{kc_E^l}{c_D + kc_E^l}\Delta\right) \\ &\quad - c_D, \\ u_E(c_D, c_E^\tau) &= \frac{kc_E^\tau}{c_D + kc_E^\tau}V_\tau + \frac{c_D}{c_D + kc_E^\tau}\Delta - c_E^\tau. \end{aligned}$$

We refer to this game as the *defender-exploiter game* (DEG). Our DEG model differs from that of Dong and Zhang (2016) in two ways. First, the exploiter type is common knowledge for both lobbyists. Second, they assume the existence of cases in which the loser cannot access outside rent, allowing Δ to take a negative value.

We now derive the subgame perfect equilibria of the DEG $(c_D^*, c_E^{h*}, c_E^{l*})$. From the first-order condition with respect to c_E^τ, we obtain the exploiter's best reply function with type τ:

$$c_E^{\tau*} = \max\left\{0, \frac{-c_D + \sqrt{k(V_\tau - \Delta)c_D}}{k}\right\}. \tag{1}$$

Inspecting the terms in (1), we verify that each type of exploiter incurs a positive cost when $c_D < k(V_\tau - \Delta)$. By dividing both sides of this inequality by k, we obtain $c_D/k < (V_\tau - \Delta)$. The interpretation of this condition is as follows: if the defender's lobbying cost adjusted for the exploiter's competitiveness (i.e., c_D/k) is less than the premium value of the owned rent that an exploiter could acquire (i.e., $V_\tau - \Delta$), then the exploiter has an incentive to capture the defender's interests.

Thus far, the analysis has been confined to the subgame perfect equilibrium strategy. $c_D^* < k(V_l - \Delta)$ seems inconsistent with the defenders' incentive to protect their rent. Given that the exploiter selects its strategy as the follower of the defender, if the defender's cost exceeds the product of the l-type exploiter's compatibility and the premium rent they could acquire (i.e., $c_D^* \geq k(V_l - \Delta)$), then the l-type exploiter maximizes its payoff without competing. This model specification is partially identical to Linster's (1993) setting.[3] Therefore, following Linster's (1993) argument regarding the derivation of the Stackelberg equilibrium outcome, we can replace (1) with

$$c_E^{\tau*} = \left\{ \begin{array}{ccc} 0 & : & \tau = l \\ \max\left\{0, \frac{-c_D + \sqrt{k(V_h - \Delta)c_D}}{k}\right\} & : & \tau = h. \end{array} \right. \tag{2}$$

If the defender's defensive cost is greater than $k(V_l - \Delta)$, then they will win the contest against the l-type exploiter with a probability of one. Hence, their expected payoff becomes

$$u_D(c_D, c_E^{h*}, c_E^{l*}) = q\left(\frac{c_D}{c_D + kc_E^h}\alpha V + \frac{kc_E^h}{c_D + kc_E^h}\Delta\right) + (1-q)\alpha V - c_D. \tag{3}$$

[2] Assuming a participation constraint for each type of exploiter, we set Δ to be less than V_l instead of less than V.

[3] When $k = 1$ and $\Delta = 0$, this condition coincides completely with Linster's (1993) original framework. We are grateful to the anonymous referee for highlighting this.

Setting $c_E^{\tau *}$ equal to c_E^{h*} and substituting it into the right-hand side (RHS) of (3), we have

$$\begin{aligned} u_D(c_D, c_E^{h*}, c_E^{l*}) &= q\frac{\alpha V c_D + \Delta \max\{0, -c_D + \sqrt{k(V_h - \Delta)c_D}\}}{c_D + \max\{0, -c_D + \sqrt{k(V_h - \Delta)c_D}\}} + (1-q)\alpha V - c_D \\ s.t.\quad & c_D \geq k(V_l - \Delta). \end{aligned}$$

To conduct the analysis, we classify the possible values of c_D into two cases.[4] First, if the defender chooses $c_D < k(V_h - \Delta)$, their objective becomes the following:

$$u_D(c_D, c_E^{h*}, c_E^{l*}) = \frac{q\Delta(\alpha V - \Delta)\sqrt{c_D}}{\sqrt{k(V_h - \Delta)}} + \alpha V(1-q) + q\Delta - c_D.$$

From the first-order condition with respect to c_D, we obtain

$$c_D^* = \frac{q^2(\alpha V - \Delta)^2}{4k(V_h - \Delta)}. \tag{4}$$

Substituting the RHS of (4) into (2), c_E^{h*} becomes

$$c_E^{h*} = \frac{2(V_h - \Delta)k - q(\alpha V - \Delta)}{4k^2(V_h - \Delta)} q(\alpha V - \Delta). \tag{5}$$

Combining $c_D^* \in (k(V_l - \Delta), k(V_h - \Delta))$ with (4) and rearranging the terms with respect to α, we obtain $\alpha \in (\underline{\alpha_l}, \underline{\alpha_h})$, where

$$\underline{\alpha_l} = \frac{\Delta}{V} + 2\frac{\sqrt{(V_l - \Delta)(V_h - \Delta)}}{qV}k \tag{6}$$

and

$$\underline{\alpha_h} = \frac{\Delta}{V} + 2\frac{V_h - \Delta}{qV}k. \tag{7}$$

Based on the above, it can be said that if $\alpha \in (\underline{\alpha_l}, \underline{\alpha_h})$ then there exists an equilibrium outcome such that the defender incurs a non-negative cost, whereas only the h-type exploiter competes against them.

Second, when $c_D \geq k(V_h - \Delta)$, the defender can rationally maximize their payoff without engaging in any competition with any type of exploiter by choosing $c_D^* = k(V_h - \Delta)$. The condition $c_D \geq k(V_h - \Delta)$ is equivalent to $\alpha \geq \underline{\alpha_h}$, and the corresponding equilibrium outcome in this case is $(c_D^*, c_E^{h*}, c_E^{l*}) = (k(V_h - \Delta), 0, 0)$. The following proposition provides a summary of these observations.

Proposition 1. *The Stackelberg equilibrium outcome of the DEG is*

$$(c_D^*, c_E^{h*}, c_E^{l*}) = \begin{cases} \left(\frac{q^2(\alpha V - \Delta)^2}{4k(V_h - \Delta)}, \frac{2(V_h - \Delta)k - q(\alpha V - \Delta)}{4k^2(V_h - \Delta)} q(\alpha V - \Delta), 0\right) & : \quad \alpha \in (\underline{\alpha_l}, \underline{\alpha_h}) \\ (k(V_h - \Delta), 0, 0) & : \quad \alpha \geq \underline{\alpha_h}. \end{cases}$$

2.2 Parameter region for establishing ownership

We now characterize the pair of parameters (k, α) that secures the incumbent's ownership without third-party arbitration. From Proposition 1, it follows that whenever $\alpha \geq \underline{\alpha_h}$,

[4] We are grateful to the anonymous referee for highlighting that two subgame perfect equilibrium outcomes exist depending on the intensity of the defender's strategy.

each type of exploiter would not reasonably incur an excessive cost. Recalling that $\alpha \geq 1$ and rearranging this inequality, the intensity of α at which the h-type exploiter chooses zero cost becomes $\alpha \geq \max\{1, \underline{\alpha_h}\}$.

We can reasonably assume that the defender's lobbying costs do not exceed the rent value. When $\alpha \geq \underline{\alpha_h}$, this condition can be expressed as $k(V_h - \Delta) \leq V$, which is equivalent to $k < V/(V_h - \Delta)$. The shaded area in Figure 1 visualizes the region of (k, α) that simultaneously satisfies $\alpha \geq \underline{\alpha_h}$ and $k < V/(V_h - \Delta)$.[5] In this region, neither type of exploiter competes with the defender, who rationally defends its rent. We denote this *ownership region* by R.[6] As $V/(V_h - \Delta) > q(V - \Delta)/2(V_h - \Delta) \geq 0$, we can conclude that the area of R is strictly positive. Therefore, the following proposition follows.

Proposition 2. *There exist combinations of contest parameters (k, α) under which the incumbent firm's ownership is secured even when there is asymmetric information among lobbyists.*

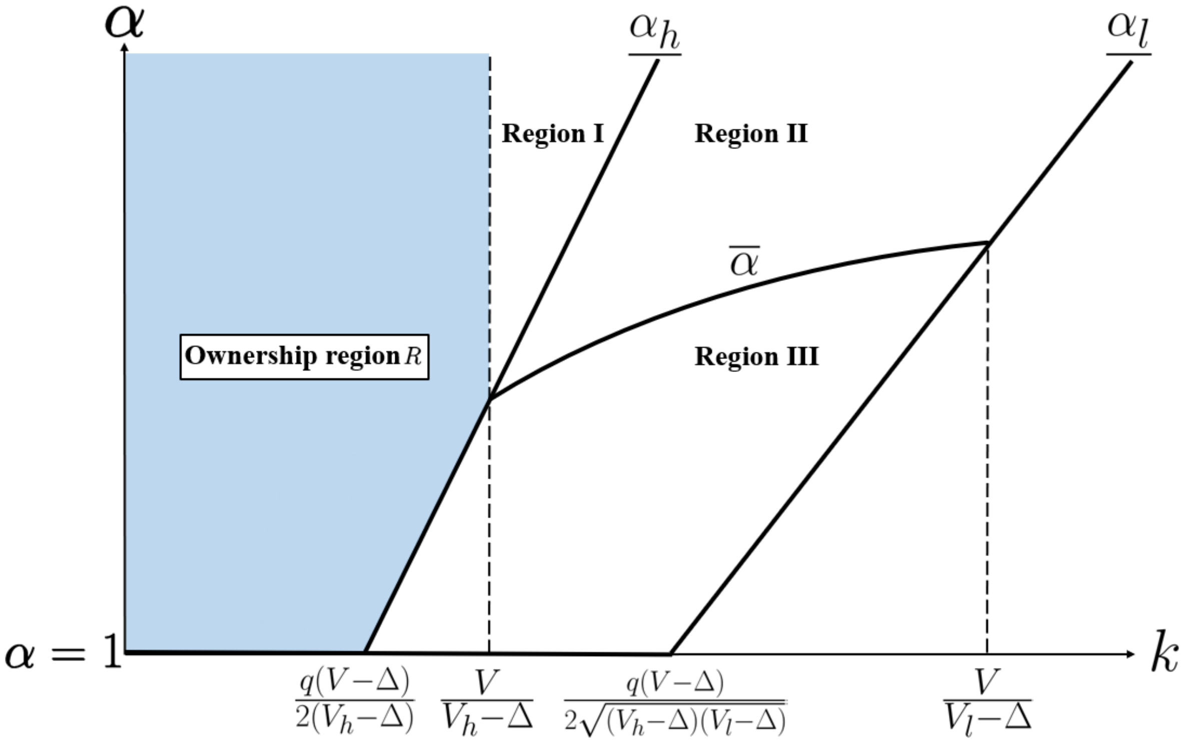

Figure 1: Illustration of the ownership region

In the case where $\alpha \in (\underline{\alpha_l}, \underline{\alpha_h})$, this condition turns out to be $q^2(\alpha V - \Delta)^2/[4k(V_h - \Delta)] \leq V$. Recalling that $\alpha \geq 1$, and rearranging this inequality, the intensity of α at which the defender incurs lobbying cost becomes $\alpha \leq \max\{1, \overline{\alpha}\}$, where

$$\overline{\alpha} = \frac{\Delta}{V} + 2\frac{\sqrt{V(V_h - \Delta)k}}{qV}. \tag{8}$$

Any α located below the curve $\overline{\alpha}$ in Figure 1 satisfies this inequality. Conversely, in the region above this curve, the defender gives up possession of the economic rent.

[5]The Appendix provides the detailed derivation of the intersections of each curve in Figure 1.

[6]We apply this term to distinguish it from the *natural property area* in Dong and Zhang (2016).

Aside from region R, three additional regions enclosed by the curves in Figure 1 can be identified. Their interpretations are as follows. Although neither type of exploiter competes with the defender, the defender does not protect its interests in the parameter space where $k > V/(V_h - \Delta)$ and $\alpha \geq \underline{\alpha_h}$, which corresponds to Region I. In the area enclosed by the line segments $\underline{\alpha_l}$, $\underline{\alpha_h}$ and the upper side of the $\overline{\alpha}$ (i.e., Region II), only the h-type exploiter acquires the defender's interests, whereas the defender relinquishes them. Conversely, in the region bounded by $\underline{\alpha_l}$, $\underline{\alpha_h}$, and the lower side of $\overline{\alpha}$ (i.e., Region III), only the h-type exploiter attempts to capture the economic rent, while the defender actively resists this appropriation. Regions I and II seem to arise if the defender pays less attention to protecting its interest, thereby motivating the h-type exploiter to attempt to capture the owned resource. It is easy to confirm that no (k, α) pair exists in the region below the line segment $\underline{\alpha_l}$, provided that Proposition 1 holds.

3. Concluding remarks

We extended Dong and Zhang's (2016) model to an asymmetric information situation. Our study confirmed that ownership might be established without third-party intervening in the contest if the defender's endowment effect exceeds a specific threshold (i.e., $\underline{\alpha_h}$) and the exploiter's competitiveness is lower than a certain level (i.e., $V/(V_h - \Delta)$).

We noted that if $V_h < V + \Delta$, it follows that $V/(V_h - \Delta) > 1$. Considering Figure 1, this implies that the ownership region includes points (k, α) such that $k > 1$. In other words, the exploiter respects ownership despite a competing advantage over the defender. This result is partially consistent with Loncarich's (2015) conjecture that if information is incomplete and one contestant has a fighting advantage over the other, contests are resolved before they escalate. More importantly, both parties secure ownership when, without knowing the actual type of exploiter, the defender can guess that the high-type migrant's valuation slightly differs from the objective benchmark. These findings clarify the persistence of vested interests in certain industries and political authorities.

This study could be extended in two directions. First, future researchers could examine the evolutionary stability of the preference parameter α (Bester and Güth 1998). Second, a DEG can be constructed using a more general probability distribution for the exploiter type (Brookins *et al.* 2025).

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Appendix. Derivations of the intersections of each curve in Figure 1

$\underline{\alpha_h}$ is equal to one at $k = q(V - \Delta)/2(V_h - \Delta)$, and $\underline{\alpha_l}$ is equal to one at $k = q(V - \Delta)/2\sqrt{(V_h - \Delta)(V_l - \Delta)}$. Furthermore, from (7) and (8), $\overline{\alpha}$ is equal to $\underline{\alpha_h}$ at $k = V/(V_h - \Delta)$. Analogously, from (6) and (8) $\overline{\alpha}$ is equal to $\underline{\alpha_l}$ at $k = V/(V_l - \Delta)$.