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Location and ownership of public goods☆

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HIGHLIGHTS

- We introduce location choice for public goods in the property rights framework.
- Separation of location from ownership can be optimal.
- It can be optimal to locate the public good in the low-valuation region.

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ABSTRACT

We introduce location choice for the public good in the property rights framework. We find that it can be optimal to separate location from ownership.

1. Introduction

Besley and Ghatak (2001) apply the property rights theory (Grossman and Hart, 1986; Hart and Moore, 1990) to examine who should own public goods. They show that ownership should reside with the party that cares the most about the public good.[2] In this paper we introduce location choice for the public good.[3]

Suppose that a government and a non-governmental organization (NGO) cooperate in providing a public good, for example, a school. The school can be located in region 1 or region 2. NGO is closer to the interests of the recipients and has a higher valuation for the school than the government. NGO also prefers locating it in needy region 1 while the government prefers region 2 for political reasons.[4] Now both location and ownership affect incentives.

We show that it can be optimal to separate location from ownership in the sense that the public good is located in the NGO's preferred region 1 but is owned by the government. It can also be optimal to locate the public good in the low-valuation region 2 if the government is a key investor.

2. The model

There are two agents, 1 (NGO) and 2 (the government), producing a public good. Each agent makes a project-specific investment y_i. The benefit of the public good is $(y_1 + y_2)$. The public good can be located in region 1 or region 2. Agent i's utility is $\theta_i^j (y_1 + y_2)$ when the public good is located in region j.

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1 Tel.: +44 2078484486.

2 Impurity of the public good (Francesconi and Muthoo, 2011), indispensability of the agents (Halonen-Akatwijuka, 2012), repeated relationship (Halonen-Akatwijuka and Pafilis, 2013) or different bargaining powers (Schmitz, 2013) can change this result.

3 The current literature on public good location (e.g. Cremer et al., 1985; Chau and Huysentruyt, 2006) is based on the Hotelling model and does not consider ownership.

4 Evidence from developing countries suggests that the NGO location at the sub-national level depends not only on need but also on convenience factors (Brass, 2012) and pragmatic concerns (Fruttero and Gauri, 2005).

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Assumption 1. (i) $\left(\theta_1^1+\theta_2^1\right) > \left(\theta_1^2+\theta_2^2\right)$, (ii) $\theta_1^1 > \theta_1^2 > \theta_2^2 > \theta_2^1$.

According to Assumption 1(i), the location in region 1 is efficient for given investments. While according to Assumption 1(ii), agent 1 is the high-valuation agent and each agent gets higher utility from the public good located in his region.[5] Investment costs are given by $c(y_i)$ with $c(0)=0$, $c'(y_i)>0$, $c''(y_i)>0$ and the Inada endpoint conditions.

The location in region 1 and both agents investing y^*, given by $\left(\theta_1^1+\theta_2^1\right)=c'(y^*)$, are first best.

When agent i owns the public good, he can complete the project without agent j and generate benefit $\left(\lambda_j y_i+\mu y_j\right)$, where $0\le\lambda_j\le 1$ and $0\le\mu\le 1$. Parameter λ_j measures how much agent j's absence affects the value of agent i's investment, that is, how indispensable agent j is. Parameter μ measures how much of the non-owner's investment is sunk in the project.

The timing of the model is as follows.

1. The agents contract on the ownership and location of the public good.
2. The agents invest in project-specific capital.
3. The agents bargain over the completion of the project and produce the public good.

We assume that contracts are incomplete so that ex ante contracts can only be written on the ownership and location of the public good. We compare four structures 1–1, 1–2, 2–2 and 2–1 where the first digit refers to the owner and the second digit to the location.

3. Ownership, location and investments

Under ownership by agent i and location in region k, the Nash bargaining leads to the following payoffs for the agents.

$$u_i^{ik}=\theta_i^k\left(\lambda_j y_i+\mu y_j\right)+\frac{1}{2}\left(\theta_i^k+\theta_j^k\right)\left[\left(y_i+y_j\right)-\left(\lambda_j y_i+\mu y_j\right)\right]-c\left(y_i\right) \tag{1}$$

$$=\frac{1}{2}\left(\theta_i^k+\theta_j^k\right)\left(y_i+y_j\right)+\frac{1}{2}\left(\theta_i^k-\theta_j^k\right)\left(\lambda_j y_i+\mu y_j\right)-c\left(y_i\right) \tag{2}$$

$$u_j^{ik}=\frac{1}{2}\left(\theta_i^k+\theta_j^k\right)\left(y_i+y_j\right)+\frac{1}{2}\left(\theta_j^k-\theta_i^k\right)\left(\lambda_j y_i+\mu y_j\right)-c\left(y_j\right). \tag{3}$$

The optimal investments are given by

$$\frac{1}{2}\left(\theta_i^k+\theta_j^k\right)+\frac{1}{2}\left(\theta_i^k-\theta_j^k\right)\lambda_j=c'\left(y_i^{ik}\right), \tag{4}$$

$$\frac{1}{2}\left(\theta_i^k+\theta_j^k\right)+\frac{1}{2}\left(\theta_j^k-\theta_i^k\right)\mu=c'\left(y_j^{ik}\right). \tag{5}$$

The first terms in (4) and (5) show the holdup problem. The second terms arise due to the nature of public goods. Even if the agents fail to reach an agreement, both agents can consume the public good. Therefore an investment increases the high-valuation agent's default payoff more than the low-valuation agent's default payoff. Therefore the second term is positive for agent 1 and negative for agent 2.

Eqs. (4) and (5) – and Besley and Ghatak (2001) – show that when the agents are relatively dispensable $\left(\lambda_j>\mu\right)$ ownership by the high-valuation agent is optimal. It enhances the positive bargaining position effect for agent 1 and limits the negative bargaining position effect for agent 2. However, as shown by Halonen-Akatwijuka (2012), when the agents are relatively indispensable $\left(\lambda_j<\mu\right)$ ownership by the low-valuation agent is optimal. Therefore for a given location of the public good

$$y_1^{1k}>y_1^{2k}\quad\text{for } k=1,2 \text{ if and only if } \mu<\lambda_2, \tag{6}$$

$$y_2^{1k}>y_2^{2k}\quad\text{for } k=1,2 \text{ if and only if } \mu<\lambda_1. \tag{7}$$

How does location affect the incentives? We start by examining agent 2's investment. Suppose $\mu<\lambda_1$. According to (7) 2–1 and 2–2 cannot maximize agent 2's incentives. From equation (5) agent 2's investment under 1–2 is greater than under 1–1 if and only if

$$\frac{1}{2}\left(\theta_1^2+\theta_2^2\right)+\frac{1}{2}\left(\theta_2^2-\theta_1^2\right)\mu>\frac{1}{2}\left(\theta_1^1+\theta_2^1\right)+\frac{1}{2}\left(\theta_2^1-\theta_1^1\right)\mu \tag{8}$$

which is equivalent to

$$\mu>\frac{\left(\theta_1^1-\theta_1^2\right)-\left(\theta_2^2-\theta_2^1\right)}{\left(\theta_1^1-\theta_1^2\right)+\left(\theta_2^2-\theta_2^1\right)}\equiv\hat{\theta}. \tag{9}$$

Note that $0<\hat{\theta}<1$. The location in region 2 lowers the benefit from a given investment (the first terms in (8)). However, the valuation difference becomes more moderate reducing the negative bargaining position effect (the second terms in (8)). When μ is high, the bargaining position effect is large and the location in region 2 maximizes 2's incentives.

Now suppose that $\mu>\lambda_1$. 2-ownership then maximizes 2's incentives. From equation (4), agent 2's investment under 2–2 is greater than under 2–1 if and only if

$$\frac{1}{2}\left(\theta_1^2+\theta_2^2\right)+\frac{1}{2}\left(\theta_2^2-\theta_1^2\right)\lambda_1>\frac{1}{2}\left(\theta_1^1+\theta_2^1\right)+\frac{1}{2}\left(\theta_2^1-\theta_1^1\right)\lambda_1 \tag{10}$$

which is equivalent to $\lambda_1>\hat{\theta}$. Proposition 1 sums up this analysis.

Proposition 1. *Agent 2's investment is maximized under*

(i) 1–1 *if and only if* $\mu<\min\left\{\lambda_1,\hat{\theta}\right\}$,
(ii) 1–2 *if and only if* $\hat{\theta}<\mu<\lambda_1$,
(iii) 2–2 *if and only if* $\hat{\theta}<\lambda_1<\mu$ *and*
(iv) 2–1 *if and only if* $\lambda_1<\min\left\{\mu,\hat{\theta}\right\}$.

We now examine agent 1's incentives. Suppose $\mu<\lambda_2$. According to (6) 2–1 and 2–2 cannot maximize agent 1's investment. From equation (4), agent 1's investment is greater under 1–1 than under 1–2 if and only if

$$\frac{1}{2}\left(\theta_1^1+\theta_2^1\right)+\frac{1}{2}\left(\theta_1^1-\theta_2^1\right)\lambda_2>\frac{1}{2}\left(\theta_1^2+\theta_2^2\right)+\frac{1}{2}\left(\theta_1^2-\theta_2^2\right)\lambda_2. \tag{11}$$

Eq. (11) holds for all parameter values. The location in region 1 increases the benefit from a given investment (the first terms in (11)) and furthermore increases the valuation difference reinforcing the positive bargaining position effect for agent 1 (the second terms in (11)).

Then suppose $\mu>\lambda_2$. Now agent 1's incentives are maximized under 2-ownership. Agent 1's investment is greater under 2–1 than

[5] In Section 4 we consider the case where the host is the high-valuation agent.

under 2–2 if and only if

$$\frac{1}{2}\left(\theta_1^1+\theta_2^1\right)+\frac{1}{2}\left(\theta_1^1-\theta_2^1\right)\mu > \frac{1}{2}\left(\theta_1^2+\theta_2^2\right)+\frac{1}{2}\left(\theta_1^2-\theta_2^2\right)\mu. \quad (12)$$

Eq. (12) holds unambiguously.

Proposition 2 summarizes these results.

Proposition 2. *Agent* 1*'s investment is maximized under*

(i) 1–1 *if and only if* $\lambda_2 > \mu$,
(ii) 2–1 *if and only if* $\lambda_2 < \mu$.

From Propositions 1 and 2 we can find parameter values for which the same structure maximizes both agents' incentives.

Proposition 3. (i) 2–1 *is optimal if* $\mu > \max\{\lambda_1, \lambda_2\}$ *and* $\lambda_1 < \hat{\theta}$.
(ii) 1–1 *is optimal if* $\mu < \min\{\lambda_1, \lambda_2\}$ *and* $\mu < \hat{\theta}$.

Proposition 3(i) shows that both agents' incentives can be maximized by separating location from ownership. This is the case when both agents are relatively indispensable and therefore ownership by agent 2 is optimal. However, the location in region 2 never maximizes agent 1's incentives and does not maximize agent 2's incentives either if the bargaining position effect is small ($\lambda_1 < \hat{\theta}$).

Proposition 3(ii) shows that when both agents are relatively dispensable and the bargaining position effect is small, agent 1 should both own and host the public good.

Can it ever be optimal to locate the public good in the low-valuation region? Since such location reduces agent 1's incentives, it can only be optimal if agent 2 is a key investor (so that he has a relatively more important investment).

Proposition 4. *The location in region* 2 *is optimal only if agent* 2 *is a key investor and* $\min\{\mu, \lambda_1\} > \hat{\theta}$.

Proposition 4 combines Proposition 1(ii) and (iii) and shows that if the negative bargaining position effect is large enough, it is optimally reduced by a more moderate valuation difference in region 2. Note that Proposition 4 gives a necessary condition. Maximizing agent 2's investment is not sufficient since a given investment is less valuable in region 2. If additionally $\widetilde{\theta} \equiv \left(\theta_1^1+\theta_2^1\right)-\left(\theta_2^2+\theta_1^2\right)$ is small enough, then the location in region 2 is optimal. Note that $\hat{\theta}$ is increasing in $\widetilde{\theta}$. Therefore small enough $\widetilde{\theta}$ is consistent with $\min\{\mu, \lambda_1\} > \hat{\theta}$.[6]

4. High-valuation host

In Section 3 we assumed that 1 remains the high-valuation agent even when the public good is located in region 2. We now assume that the host is the high-valuation agent.

Assumption 1′. (i) $\left(\theta_1^1+\theta_2^1\right) > \left(\theta_1^2+\theta_2^2\right)$,
(ii) $\theta_1^1 > \theta_2^2 > \theta_1^2 > \theta_2^1$,
(iii) $\theta_2^2\left(|\mu-\lambda_1|+1\right) < \left(\theta_1^1+\theta_2^1\right)+\theta_1^2\left(|\mu-\lambda_1|-1\right)$.

Suppose $\mu > \max\{\lambda_1, \lambda_2\}$ as in Proposition 3(i). Then ownership by the low-valuation (non-hosting) agent is optimal. From equations (4) and (5), both agents have higher investments under 2–1 than under 1–2 if and only if

$$\frac{1}{2}\left(\theta_1^1+\theta_2^1\right)+\frac{1}{2}\left(\theta_1^1-\theta_2^1\right)\mu > \frac{1}{2}\left(\theta_1^2+\theta_2^2\right)+\frac{1}{2}\left(\theta_1^2-\theta_2^2\right)\lambda_2 \quad \text{and} \quad (13)$$

$$\frac{1}{2}\left(\theta_1^1+\theta_2^1\right)+\frac{1}{2}\left(\theta_2^1-\theta_1^1\right)\lambda_1 > \frac{1}{2}\left(\theta_1^2+\theta_2^2\right)+\frac{1}{2}\left(\theta_2^2-\theta_1^2\right)\mu. \quad (14)$$

(13) holds unambiguously. We can rewrite (14) as

$$\lambda_1 < \hat{\theta}-\frac{\left(\theta_2^2-\theta_1^2\right)(\mu-\lambda_1)}{\left(\theta_1^1-\theta_1^2\right)+\left(\theta_2^2-\theta_2^1\right)}. \quad (15)$$

Although this is a stronger condition for optimality of 2–1 than in Proposition 3(i), the result is qualitatively similar.[7]

Then suppose $\mu < \min\{\lambda_1, \lambda_2\}$ as in Proposition 3(ii). Ownership by the high-valuation (hosting) agent is optimal. The incentives are higher under 1–1 than under 2–2 if and only if

$$\frac{1}{2}\left(\theta_1^1+\theta_2^1\right)+\frac{1}{2}\left(\theta_1^1-\theta_2^1\right)\lambda_2 > \frac{1}{2}\left(\theta_1^2+\theta_2^2\right)+\frac{1}{2}\left(\theta_1^2-\theta_2^2\right)\mu \text{ and} \quad (16)$$

$$\frac{1}{2}\left(\theta_1^1+\theta_2^1\right)+\frac{1}{2}\left(\theta_2^1-\theta_1^1\right)\mu > \frac{1}{2}\left(\theta_1^2+\theta_2^2\right)+\frac{1}{2}\left(\theta_2^2-\theta_1^2\right)\lambda_1. \quad (17)$$

(16) holds unambiguously. We can rewrite (17) as

$$\mu < \hat{\theta}-\frac{\left(\theta_2^2-\theta_1^2\right)(\lambda_1-\mu)}{\left(\theta_1^1-\theta_1^2\right)+\left(\theta_2^2-\theta_2^1\right)}. \quad (18)$$

Therefore also Proposition 3(ii) is qualitatively robust.

Finally, suppose agent 2 is a key investor as in Proposition 4. According to (15) and (18) the location in region 2 maximizes 2's incentives if

$$\min\{\mu, \lambda_1\} > \hat{\theta}-\frac{\left(\theta_2^2-\theta_1^2\right)|\mu-\lambda_1|}{\left(\theta_1^1-\theta_1^2\right)+\left(\theta_2^2-\theta_2^1\right)}. \quad (19)$$

This is a weaker – but qualitatively similar – condition as in Proposition 4.

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6 Suppose $\theta_1^1 = 5, \theta_1^2 = 3, \theta_2^2 = 2, \theta_2^1 = 1, c(y_2) = \frac{1}{2}(y_2)^2$ and only agent 2 has an investment. Then $y_2^{11} = (3-2\mu), y_2^{12} = \frac{1}{2}(5-\mu), y_2^{22} = \frac{1}{2}(5-\lambda_1)$ and $y_2^{21} = (3-2\lambda_1)$. As per Proposition 1, 2's investment is maximized by location in region 2 if and only if $\min\{\mu, \lambda_1\} > \frac{1}{3}$. Joint surplus equals $S^{11} = 6(3-2\mu)-\frac{1}{2}(3-2\mu)^2$, $S^{12} = \frac{5}{2}(5-\mu)-\frac{1}{8}(5-\mu)^2$, $S^{22} = \frac{5}{2}(5-\lambda_1)-\frac{1}{8}(5-\lambda_1)^2$ and $S^{21} = 6(3-2\lambda_1)-\frac{1}{2}(3-2\lambda_1)^2$. Therefore the location in region 2 maximizes joint surplus if and only if $\min\{\mu, \lambda_1\} > 0.684$.

7 Assumption 1′(iii) guarantees that the right-hand-side of (15) is positive.