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Abstract.
A non-governmental organization (NGO) can make a non-contractible investment to provide a public good. Only ownership can be specified ex ante, so ex post efficiency requires reaching an agreement with the government. Besley and Ghatak (2001) argue that the party with the larger valuation should be the owner. We show that when transaction costs have to be incurred before the bargaining stage can be reached, ownership by the *government* can be optimal even when the NGO has a larger valuation. Our finding also contrasts with the standard private-good setup where the investing party (i.e., the NGO) should always be the owner.

Keywords: transaction costs; public goods; property rights; bargaining; incomplete contracts

JEL Classification: D23; D86; C78; H41; L31

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1 Introduction

The property rights approach based on incomplete contracts, developed by Oliver Hart and his coauthors (Grossman and Hart, 1986; Hart and Moore, 1990; Hart, 1995), is widely regarded as a major advance in economic theory.[1] Originally, the property rights approach was concerned with optimal ownership arrangements in private-good contexts. Besley and Ghatak (2001) have applied the approach to discuss who should be the owner in public-good settings. In the present paper, we extend their framework in order to study the implications of transaction costs that may restrain ex post negotiations.

Specifically, consider two parties who both care about the benefits of a public good, say the government and a non-governmental organization (NGO).[2] At the outset, the parties can only specify an ownership structure. Subsequently, the NGO has to make a non-contractible investment. After the investment is sunk, provision of the public good becomes contractible, and the parties can bargain with each other. Ownership improves a party's bargaining position and hence influences the incentives to invest. In the private-good context studied by Hart and his coauthors, when only one party has to make an investment decision, then this party should always be the owner. In contrast, Besley and Ghatak (2001) argue that in a public-good context, the party who has the larger valuation of the public good should be the owner.

The property rights approach has been criticized because it assumes that ex post efficiency is always achieved by Coasean bargaining (Holmström and Roberts, 1998; Williamson, 2000). In the present paper, we thus introduce transaction costs in the most straightforward way possible, following an insightful paper by Anderlini and Felli (2006). They argue that in order to reach a bargaining stage, a party may first have to incur transaction costs.[3] We show that introducing such transaction costs into Besley and Ghatak's (2001) framework may overturn their main result as well as the standard finding of the property rights theory: ownership by the *government* can be optimal, even though the NGO has a larger valuation of the public good *and* the NGO is the only party that has to make an

[1] See Nobel Prize Committee (2016) for a detailed appreciation of Hart's contribution.

[2] As pointed out by Besley and Ghatak (2001), the two parties could also be different public entities (say, federal and local government).

[3] The transaction costs may be interpreted as the time spent preparing for the negotiations. For example, it may be necessary to conceive of a suitable language to describe the states of nature, information about the legal environment must be collected, etc. (see Anderlini and Felli, 2006, section 2).

investment decision.

The intuition behind our result is that the additional surplus that can be generated in the ex post negotiations has to be sufficiently large for the transaction costs to be covered. An ownership structure that yields a poor outcome in the absence of negotiations can hence become desirable, because it makes paying the transaction costs more attractive.

Related literature. Several authors have studied variants of Besley and Ghatak's (2001) public-good model. For instance, Francesconi and Muthoo (2011) consider impure public goods, Halonen-Akatwijuka (2012) investigates indispensability of agents, and Schmitz (2015) allows the ex post negotiations to break down with a small exogenous probability.[4] Yet, transaction costs as modelled by Anderlini and Felli (2006) have not been studied in this literature so far.[5]

2 Model

Consider two parties, G (government) and N (NGO). At some initial date $t = 0$, an ownership structure $o \in \{G, N\}$ is determined. At date $t = 1$, N makes an observable but non-contractible investment $I \geq 0$.[6] The public good which can be produced with the help of N's investment becomes contractible only after the investment is sunk. At date $t = 2$, N has to decide whether to pay the transaction cost $c \geq 0$.[7] A necessary condition for reaching an agreement to collaborate at date $t = 3$ is that N has paid the transactions cost c. If the parties agree to cooperate, they together provide the quantity $y(I)$ of the public good, where

[4] In Schmitz (2015), the optimal ownership structure looks more like the one in the standard property rights model (Hart, 1995). In particular, in his model it can never happen that ownership by the government is optimal when only the NGO invests and the NGO has a larger valuation of the public good.

[5] Transaction costs in the spirit of Anderlini and Felli (2006) have recently also been studied by Müller and Schmitz (2016) in a property rights model with private goods and by Anderlini et al. (2016) in the context of pre-trial agreements.

[6] The model can be extended to the case in which both parties invest. Focusing on the case of one-sided investments only strengthens our main result, because in a standard property rights model (cf. Hart, 1995), N-ownership would always be optimal if only N invests.

[7] One can extend the model such that also G has to pay a transaction cost in order to reach the bargaining stage. Anderlini and Felli (2006) show that the implications of transaction costs are most interesting when there is a 'mismatch' between the distributions of the transaction costs and the parties' bargaining powers. Following Besley and Ghatak (2001) we will assume that both parties have the same bargaining power, hence we focus on the simplest case with asymmetric transaction costs.

$y(0) = 0$, $y'(I) > 0$, $y'(0) = \infty$, $\lim_{I\to\infty} y'(I) = 0$, and $y''(I) < 0$.

If c has not been paid or if c has been paid but the parties do not reach an agreement to cooperate, the quantity of the public good provided under ownership structure $o \in \{G, N\}$ is $\lambda_o y(I)$, where $0 < \lambda_G < \lambda_N < 1$. Thus, if cooperation fails such that the other party's human capital is missing, the owner can only produce a fraction of the quantity that would be feasible under cooperation; i.e., cooperation is always ex post efficient. Note that since N is the investing party, in the absence of collaboration the investment can be used more effectively when N is the owner.

The valuation of party $i \in \{G, N\}$ for the public good is given by $\theta_i > 0$. The parties' date-3 payoffs are summarized in Table 1, where T denotes a transfer payment from N to G.

	Payoff of party G	Payoff of party N
Collaboration	$\theta_G y(I) + T$	$\theta_N y(I) - T$
Default, $o = G$	$\theta_G \lambda_G y(I)$	$\theta_N \lambda_G y(I)$
Default, $o = N$	$\theta_G \lambda_N y(I)$	$\theta_N \lambda_N y(I)$

Table 1. The parties' date-3 payoffs.

To avoid uninteresting case distinctions, in the analysis we focus on $\theta_G > \tilde{\theta}_G$, where

$$\tilde{\theta}_G := \left[\frac{2(\lambda_N - \lambda_G)}{1 - \lambda_G} - 1\right]\theta_N. \tag{1}$$

Note that $\tilde{\theta}_G < \theta_N$; i.e., G's valuation can be smaller or larger than N's valuation.[8]

3 Analysis

3.1 Ex post division of surplus ($t = 3$)

Following Besley and Ghatak (2001), we assume that if negotiations are feasible at date $t = 3$, then the outcome is given by the regular Nash bargaining solution.[9] Hence, if N paid the transaction costs at date $t = 2$, the parties always collaborate at date $t = 3$ and agree on a transfer payment T such that each party receives its

[8] We focus on $\theta_G > \tilde{\theta}_G$ only to shorten the exposition. Note that in the example illustrated in Figure 1 below, we do not impose this parameter restriction.

[9] See Muthoo (1999) for an excellent exposition of bargaining theory.

default payoff plus half of the renegotiation surplus (i.e., the additional surplus that is generated by collaboration). If N did not pay the transaction costs, such that negotiations cannot take place, each party receives its default payoff. Thus, at date $t = 3$ the parties' payoffs are

$$\pi_o^N(I) = \begin{cases} \overline{\pi}_o^N(I) := \left[\theta_N \lambda_o + \frac{1}{2}(\theta_N + \theta_G)(1-\lambda_o)\right] y(I) & \text{if } c \text{ was paid,} \\ \underline{\pi}_o^N(I) := \theta_N \lambda_o y(I) & \text{if } c \text{ was not paid,} \end{cases} \tag{2}$$

$$\pi_o^G(I) = \begin{cases} \overline{\pi}_o^G(I) := \left[\theta_G \lambda_o + \frac{1}{2}(\theta_N + \theta_G)(1-\lambda_o)\right] y(I) & \text{if } c \text{ was paid,} \\ \underline{\pi}_o^G(I) := \theta_G \lambda_o y(I) & \text{if } c \text{ was not paid.} \end{cases} \tag{3}$$

3.2 Payment of transaction costs ($t = 2$)

At date $t = 2$, N is willing to pay the transaction costs under ownership structure $o \in \{G, N\}$ whenever $\overline{\pi}_o^N(I) - c \geq \underline{\pi}_o^N(I)$, that is, whenever N's share of the renegotiation surplus covers the transaction costs. This requires N's investment at the prior stage to be sufficiently large,

$$I \geq y^{-1}\left(\frac{2c}{(\theta_N + \theta_G)(1-\lambda_o)}\right) =: \tilde{I}_o, \tag{4}$$

where y^{-1} denotes the inverse of y. Since y^{-1} is strictly increasing, $\tilde{I}_N \geq \tilde{I}_G$ holds. Intuitively, as each party's default payoff for a given investment I is larger under $o = N$ than under $o = G$, the renegotiation surplus is smaller under $o = N$. Therefore, the minimum investment necessary for the transaction costs to be covered by N's share of the renegotiation surplus is higher under $o = N$.

3.3 Investment incentives ($t = 1$)

The ex ante payoff of N when investing $I \geq 0$ reads

$$\Pi_o^N(I) = \begin{cases} \overline{\Pi}_o^N(I) := \overline{\pi}_o^N(I) - c - I & \text{if } I \geq \tilde{I}_o, \\ \underline{\Pi}_o^N(I) := \underline{\pi}_o^N(I) - I & \text{if } I < \tilde{I}_o, \end{cases} \tag{5}$$

where both $\overline{\Pi}_o^N(I)$ and $\underline{\Pi}_o^N(I)$ are strictly concave in I. The optimal investment level if N were always to pay the transaction costs under $o \in \{G, N\}$ is

$$\overline{I}_o = \arg\max_{I \geq 0} \overline{\Pi}_o^N(I) = g\left(\frac{1}{\theta_N \lambda_o + \frac{1}{2}(\theta_N + \theta_G)(1-\lambda_o)}\right), \tag{6}$$

where $g = y'^{-1}$ denotes the inverse of y'. The optimal investment level if N were never to pay the transaction costs under $o \in \{G, N\}$ is

$$\underline{I}_o = \arg\max_{I \geq 0} \underline{\Pi}_o^N(I) = g\left(\frac{1}{\theta_N \lambda_o}\right), \tag{7}$$

where $\underline{I}_o < \overline{I}_o$ since $g' < 0$. Note that $\overline{\Pi}_o^N(\overline{I}_o) \gtreqless \underline{\Pi}_o^N(\underline{I}_o)$ whenever $c \lesseqgtr \tilde{c}_o$, where

$$\tilde{c}_o := \left[\theta_N \lambda_o + \frac{1}{2}(\theta_N + \theta_G)(1 - \lambda_o)\right] y(\overline{I}_o) - \overline{I}_o - \left[\theta_N \lambda_o y(\underline{I}_o) - \underline{I}_o\right]. \tag{8}$$

It can be shown that $c \leq \tilde{c}_o$ implies $\overline{I}_o \geq \tilde{I}_o$, and $c > \tilde{c}_o$ implies $\underline{I}_o < \tilde{I}_o$. Hence, the following result holds.

Lemma 1 *At stage $t = 1$, N's optimal investment under ownership structure $o \in \{G, N\}$ is given by*

$$I_o^* = \begin{cases} \overline{I}_o & \text{if} \quad c \leq \tilde{c}_o, \\ \underline{I}_o & \text{if} \quad c > \tilde{c}_o. \end{cases} \tag{9}$$

Proof: See Appendix A.

Observe that (7) implies $\underline{I}_G < \underline{I}_N$. Thus, if N does not pay the transaction costs under either ownership structure, N-ownership provides higher investment incentives than G-ownership. From (6) we obtain $\overline{I}_G \gtreqless \overline{I}_N$ whenever $\theta_N \lambda_G + \frac{1}{2}(\theta_N + \theta_G)(1 - \lambda_G) \gtreqless \theta_N \lambda_N + \frac{1}{2}(\theta_N + \theta_G)(1 - \lambda_N)$, i.e. whenever $\theta_G \gtreqless \theta_N$ holds. Hence, if N pays the transaction costs under either ownership structure, then ownership by the high-valuation party induces larger investment incentives than ownership by the low-valuation party. Finally, from (6) and (7) it follows that $\overline{I}_G > \underline{I}_N$, since by assumption $\theta_G > \tilde{\theta}_G$. Thus, if N pays the transaction costs under G-ownership but not under N-ownership, then G-ownership provides larger investment incentives. Therefore, the following result holds.

Lemma 2 *The investment levels can be ranked as follows:*

(i) If $\theta_G \leq \theta_N$, then $\underline{I}_G < \underline{I}_N < \overline{I}_G \leq \overline{I}_N$.

(ii) If $\theta_N < \theta_G$, then $\underline{I}_G < \underline{I}_N < \overline{I}_N < \overline{I}_G$.

3.4 Optimal ownership structure ($t = 0$)

We can now analyze which ownership structure maximizes the total surplus. Define

$$\overline{S}(I) := (\theta_N + \theta_G) y(I) - c - I \tag{10}$$

and

$$\underline{S}_o(I) := (\theta_N + \theta_G) \lambda_o y(I) - I, \tag{11}$$

where both $\overline{S}(I)$ and $\underline{S}_o(I)$ are strictly concave functions of I. Total surplus under ownership structure $o \in \{G, N\}$ is given by

$$S_o = \begin{cases} \overline{S}(\overline{I}_o) & \text{if } c \leq \tilde{c}_o, \\ \underline{S}_o(\underline{I}_o) & \text{if } c > \tilde{c}_o. \end{cases} \tag{12}$$

First, suppose that transaction costs are so small that cooperation takes place irrespective of the ownership structure, $c < \min\{\tilde{c}_G, \tilde{c}_N\}$. In this case, $S_o = \overline{S}(\overline{I}_o)$ for $o \in \{G, N\}$. Note that $g' < 0$ and (6) imply that there is always underinvestment with regard to the benchmark $\overline{I}^S = \arg\max_{I \geq 0} \overline{S}(I) = g(\frac{1}{\theta_N + \theta_G})$. Strict concavity of $\overline{S}(I)$ then implies that $\overline{S}(\overline{I}_G) \gtreqless \overline{S}(\overline{I}_N)$ whenever $\overline{I}_G \gtreqless \overline{I}_N$. Thus, by Lemma 2, it is optimal that the party with the higher valuation is the owner.

Second, suppose that transaction costs are so large that cooperation does not take place under either ownership structure, $c > \max\{\tilde{c}_G, \tilde{c}_N\}$. Hence, $S_o = \underline{S}_o(\underline{I}_o)$ for $o \in \{G, N\}$. With $\underline{I}_o^S = \arg\max_{I \geq 0} \underline{S}(I) = g(\frac{1}{(\theta_N + \theta_G)\lambda_o})$ and $g' < 0$, (7) implies that $\underline{I}_o < \underline{I}_o^S$ for $o = \{G, N\}$. Thus, $\underline{S}_G(\underline{I}_G) < \underline{S}_N(\underline{I}_G) < \underline{S}_N(\underline{I}_N)$, where the first inequality holds since $\lambda_G < \lambda_N$ and the second inequality follows from $\underline{I}_G < \underline{I}_N < \underline{I}_N^S$. Hence, N-ownership is optimal, because N-ownership not only induces stronger investment incentives than G-ownership, but also leads to a smaller loss due to foregone cooperation.

Third, suppose that N pays the transaction costs under one ownership structure but not under the other ownership structure; i.e., $\tilde{c}_{\hat{o}} < c \leq \tilde{c}_o$ for $o, \hat{o} \in \{G, N\}$ with $o \neq \hat{o}$. According to Lemma 2, N's investment is larger under ownership structure o than under under ownership structure $\hat{o}$. Whether this larger investment also translates into higher surplus, however, depends on the transaction costs, which N pays under o-ownership but not under $\hat{o}$-ownership. Specifically, $\overline{S}(\overline{I}_o) > \underline{S}_{\hat{o}}(\underline{I}_{\hat{o}})$ whenever $c < c_{o,\hat{o}}^S$, where

$$c_{o,\hat{o}}^S := (\theta_N + \theta_G)y(\overline{I}_o) - \overline{I}_o - [(\theta_N + \theta_G)\lambda_{\hat{o}} y(\underline{I}_{\hat{o}}) - \underline{I}_{\hat{o}}]. \tag{13}$$

The following proposition summarizes the three cases.[10]

Proposition 1 *(i) If $c < \min\{\tilde{c}_G, \tilde{c}_N\}$, then N-ownership is optimal when $\theta_G < \theta_N$ and G-ownership is optimal when $\theta_G > \theta_N$.*

(ii) If $c > \max\{\tilde{c}_G, \tilde{c}_N\}$, then N-ownership is optimal.

(iii) If $\tilde{c}_{\hat{o}} < c < \tilde{c}_o$ for $o, \hat{o} \in \{G, N\}$ and $o \neq \hat{o}$, then $\hat{o}$-ownership is optimal when $c > c_{o,\hat{o}}^S$ and o-ownership is optimal when $c < c_{o,\hat{o}}^S$.

The proposition is illustrated in Figure 1.[11]

[10] For brevity, we neglect knife-edge cases where both ownership structures result in identical surplus.

[11] In the figure, $y(I) = \sqrt{I}$, $\lambda_N = .8$, $\lambda_G = .4$, and $\theta_N = 1$. The figure depicts how the optimal ownership structure depends on the government's valuation θ_G and the transaction costs c.

Part (i) corresponds to the result that Besley and Ghatak (2001) obtained in the absence of transaction costs ($c = 0$). If c is sufficiently small, then ownership should go to the party that has the larger valuation of the public good.

Part (ii) shows that if the transaction costs are prohibitively large, such that negotiations never take place, then ownership by the investing party (i.e., N-ownership) is optimal, just as in the standard property rights model with private goods (Hart, 1995).

Part (iii) allows for the main novel finding of the present paper. G-ownership can be optimal even when $\theta_G < \theta_N$, despite the fact that only N invests. The reason is that ceteris paribus under G-ownership the default payoffs are smaller and thus more can be gained in the ex post negotiations. Hence, paying the transaction costs is more attractive under $o = G$. Indeed, the following result shows that if θ_G is only slightly smaller than θ_N, there are always levels of c such that G-ownership is optimal.

Corollary 1 *There exists* $\varepsilon > 0$ *such that for* $\theta_G \in (\theta_N - \varepsilon, \theta_N + \varepsilon)$ *we have* $\tilde{c}_N < \min\{\tilde{c}_G, c^S_{G,N}\}$. *If* $\tilde{c}_N < c < \min\{\tilde{c}_G, c^S_{G,N}\}$, *then* G*-ownership is optimal.*

Proof: See Appendix B.

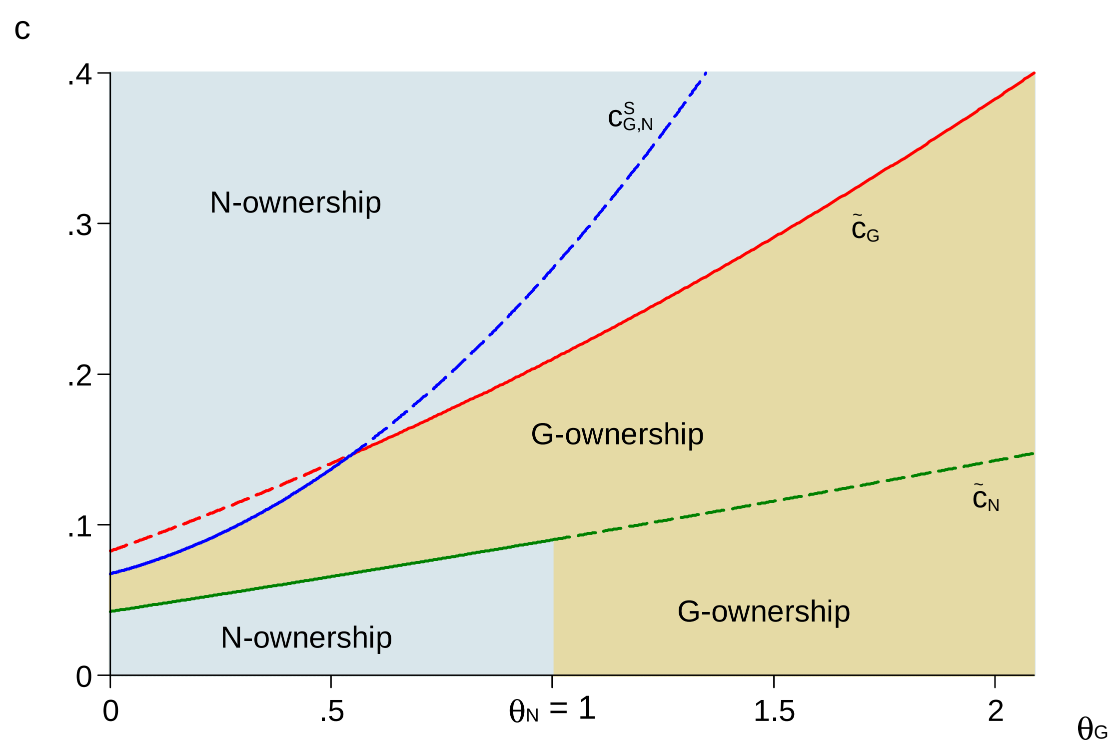

Figure 1. The optimal ownership structure.

4 Conclusion

We have explored the optimal ownership structure in a public-good setting in the spirit of Besley and Ghatak (2001). In the presence of transaction costs (as modelled by Anderlini and Felli, 2006), it may be optimal that the *government* is the owner, even when the NGO is the only party that has to make an investment decision *and* the NGO is the party that has a larger valuation of the public good.

Appendix A

Proof of Lemma 1. Comparing (4) with (6) reveals that $\tilde{I}_o \leq \overline{I}_o$ whenever $c \leq \bar{c}_o$, where

$$\bar{c}_o := \frac{1}{2}(\theta_N + \theta_G)(1 - \lambda_o)y(\overline{I}_o). \tag{14}$$

From (8) and (14) it follows that

$$\tilde{c}_o < \bar{c}_o \Leftrightarrow \frac{y(\overline{I}_o) - y(\underline{I}_o)}{\overline{I}_o - \underline{I}_o} < \frac{1}{\theta_N \lambda_o}, \tag{15}$$

where the latter inequality holds because $y'(\underline{I}_o) = \frac{1}{\theta_N \lambda_o}$ and $y'' < 0$.

Comparing (4) with (7) shows that $\tilde{I}_o \geq \underline{I}_o$ whenever $c \geq \underline{c}_o$, where

$$\underline{c}_o := \frac{1}{2}(\theta_N + \theta_G)(1 - \lambda_o)y(\underline{I}_o). \tag{16}$$

From (8) and (16) it follows that

$$\tilde{c}_o > \underline{c}_o \Leftrightarrow \frac{y(\overline{I}_o) - y(\underline{I}_o)}{\overline{I}_o - \underline{I}_o} > \frac{1}{\theta_N \lambda_o + \frac{1}{2}(\theta_N + \theta_G)(1 - \lambda_o)}, \tag{17}$$

where the latter inequality holds since $y'(\overline{I}_o) = \frac{1}{\theta_N \lambda_o + \frac{1}{2}(\theta_N + \theta_G)(1 - \lambda_o)}$ and $y'' < 0$.

Thus, $\underline{c}_o < \tilde{c}_o < \bar{c}_o$. In consequence, if $c \leq \tilde{c}_o$, then investing $I = \overline{I}_o$ at date $t = 1$ leads to N paying c at date $t = 2$, such that investing $I = \overline{I}_o$ maximizes $\Pi_o^N(I)$. Likewise, if $c > \tilde{c}_o$, then investing $I = \underline{I}_o$ at date $t = 1$ leads to N not paying c at date $t = 2$, such that investing $I = \underline{I}_o$ maximizes $\Pi_o^N(I)$. □

Appendix B

Proof of Corollary 1. For $\theta_G = \theta_N$ we have $\tilde{c}_o|_{\theta_G = \theta_N} = H(\lambda_o)$, where

$$H(\lambda) := \theta_N y\left(g\left(\frac{1}{\theta_N}\right)\right) - g\left(\frac{1}{\theta_N}\right) - \left[\theta_N \lambda y\left(g\left(\frac{1}{\theta_N \lambda}\right)\right) - g\left(\frac{1}{\theta_N \lambda}\right)\right]. \tag{18}$$

As

$$\frac{dH(\lambda)}{d\lambda} = -\theta_N y \left(g \left(\frac{1}{\theta_N \lambda} \right) \right) < 0, \tag{19}$$

we have $\tilde{c}_G|_{\theta_G=\theta_N} > \tilde{c}_N|_{\theta_G=\theta_N}$. Hence, by continuity of $\tilde{c}_G$ and $\tilde{c}_N$ in θ_G, for θ_G sufficiently close to θ_N we have $\tilde{c}_G > \tilde{c}_N$. Moreover, comparison of (8) and (13) reveals that $c^S_{G,N}|_{\theta_G=\theta_N} > \tilde{c}_N|_{\theta_G=\theta_N}$ whenever

$$F(\lambda_N) := y \left(g \left(\frac{1}{\theta_N} \right) \right) - \lambda_N y \left(g \left(\frac{1}{\theta_N \lambda_N} \right) \right) > 0. \tag{20}$$

Condition (20) is indeed satisfied for all $\lambda_N \in (0,1)$, because $F(1) = 0$ and

$$F'(\lambda_N) = - \left[y \left(g \left(\frac{1}{\theta_N \lambda_N} \right) \right) - \frac{1}{\theta_N^2 \lambda_N^2} g' \left(\frac{1}{\theta_N \lambda_N} \right) \right] < 0. \tag{21}$$

Thus, by continuity of $\tilde{c}_G$, $\tilde{c}_N$, and $c^S_{G,N}$ in θ_G, there exists $\varepsilon > 0$ such that $\tilde{c}_N < \min\{\tilde{c}_G, c^S_{G,N}\}$ for $\theta_G \in (\theta_N - \varepsilon, \theta_N + \varepsilon)$. As a consequence, there exist transaction costs $c \in (\tilde{c}_N, \min\{\tilde{c}_G, c^S_{G,N}\})$ such that according to Proposition 1(iii) the surplus is strictly larger under G-ownership than under N-ownership. □

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