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Resistance to Outside Investment: A rational model of surplus destruction

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Resistance to Outside Investment: A Rational Model of Surplus Destruction*

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Abstract

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1 Introduction

Over the last decade, local, provincial and national governments the world over have been increasingly relying on outside private investors to provide the impetus for growth in jobs and output (Balassa [1]; Corbo et al. [4]; Lal [7]; Khan and Reinhart [6]). Governments are actively pursuing private capital

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by providing incentives and otherwise creating conditions favorable for investment. Industry groups monitor the "investor-friendliness" of governments, and governments often compete with each other in wooing private capital (see a survey by Lim [8]). Concomitantly, there is a rising trend, especially in the third world, of local communities resisting non-local private capital (see Bardhan [2] in the context of India; Rodrik [12], Stiglitz [13]). Some of this resistance has gone beyond protests and demonstrations and taken the form of actual destruction of productive assets, disruption of production, or in some other way creating conditions that lower the productive capacity of the investor. As globalization spreads deeper into the developing world, one can expect such occurrences only to grow in frequency and intensity.

What is puzzling about these protests is that local communities seem to be resisting precisely what is necessary to lift them out of the poverty trap. The simplistic explanation that globalization always leaves local communities impoverished is inconsistent with the idea that the government can redistribute surplus from productive investment. Theoretically, as long as there is a positive surplus created from investment, the government can ensure that it is distributed in such a way that makes everyone better off: thus, destructive activities that ultimately reduce the available surplus seem counterproductive.

In this paper, we posit a rational explanation of why we observe destruction of productive assets (or more broadly, activities that adversely affect the investment climate) by purported beneficiaries of the investment even when the government is willing and able to redistribute the surplus from investment, and is in no way interested in the benefit of the external investor.

In our theory, different social groups (skilled vs. unskilled labor, industry vs. agriculture) value investment differently, and when the government offers conditions to the investor there is considerable uncertainty about the actual benefits to different groups. These valuations are realized at the interim stage (actual number of jobs created, multiplier effect, etc.) by the respective groups, but the government cannot directly elicit this information through the democratic process. In this situation, the group with low marginal valuation of surplus uses such destruction as a credible signal of its valuation, and the government implements an appropriate redistribution scheme taking into account this information.[1] In this way, the destruction of some investment can be read as a last-resort way for those who lose from the project (relative to others) to demand redistribution or compensation from the government.[2]

Notice that such destructive means need to be resorted to only in absence of other channels of upward flow of information, which is a hallmark of underdeveloped political institutions and in presence of more extreme uncertainty about the effect of investments on different social groups, which is the case when markets are underdeveloped and there are large positive or negative externalities. This probably explains why the phenomenon of destructive resistance to private investment is common the developing world and not the developed world. Even within the developing economies, the extent and intensity of resistance seems to be higher in communities that are more marginalized within the society. Our model presents comparative static results that are consistent with this observation: ceteris paribus, the less the government cares about a particular social group, the higher will be the extent of the resistance mounted by the group.

[1] Use of costly action to signal valuation in the context of redistribution is analyzed in Harstad [5]. In his paper, groups signal their valuation be delaying, thereby reducing the current value of the project.

[2] Models of costly political actions are not common in the positive political theory literature. Exceptions include Lohmann , [9], [10] and [11].

In our model, while the government values the welfare of different social groups asymmetrically, it does not care directly about the profits of the external investor. We do not intend this as an assertion about reality that there is never any covert nexus between the government and the external investor. On the contrary, our intention in making this assumption is to demonstrate that we may have resistance to investment even in absence of such a nexus. Violent protests may arise due to informational constraints in the society even with the most benign of governments. In turn, an implication of our model is that a more representative government (a "people's government") will not make the problem of resistance to investment vanish. We suggest that it is also necessary to address the rigidities and bottlenecks in the institutions of upward information flow in the society.

In addition, the fact that the government values the relationship with the investor only in terms of the possible gains to the groups internal to the society helps us endogenise the extent of "investor-friendliness" of the government. In particular, we analyze conditions under which the government should tax the investor and distribute profits within the society or offer a subsidy to lure the investor at the cost of the society. The tax or subsidy is used as an instrument to affect the scale of investment. If the investor's marginal benefit from the scale of the project is lower than that of marginal benefit to the society, the government should subsidize the investor to induce higher investment, and tax the investor and redistribute the proceeds otherwise. The possibility of asset destruction suppresses the scale of investment: and thus the government has to compensate the investor from loss due to destruction. Thus, while the popular left deems resistance to private investors as a response to the government "selling out", we argue that there is a reverse causality too: the possibility of asset destruction weakens the government in its negotiations with the investor and forces it to make concessions that would be unnecessary in absence of the possibility. This presents the government with a trade-off: while asset destruction provides information regarding valuations of groups that help in setting a better redistributive scheme within the society, it comes at a social cost of muted incentives for the external investor who needs to be compensated.

The paper is organized as follows. In Section 2, we introduce the basic model where the investor considers only one destination for the proposed investment. Section 3 analyses the problem, discusses the trade-offs and solves the equilibrium. Section 4 discusses the implication of resistance in our model and Section 5 concludes.

2 Analytical framework

2.1 Environment

2.1.1 Role of investment

Consider a development project that benefits the local economy and suppose that the government does not have the necessary resources (technical expertise, financial strength, human resources) for efficient implementation. The government, G, identifies an external investor, I, with such resources to implement the project.[3] G offers an investment tax $\tau \in R$ to the investor on the size of investment. A negative value of τ implies a subsidy to the investor. I decides the size of the project $x \geq 0$, after observing τ. For simplicity, we normalize I's private return from the project to be x. But investment

[3] In our basic framework, we assume that the government is the sole buyer of the investment. A geographically specific investment opportunity (e.g. mining) may be a relevant example here. Later we extend our model to incorporate possibilities in which two regions can compete to attract the investor.

is costly and the investment cost is given by $\frac{x^2}{2k}$, where $k > 0$ measures productivity of investment.[4] The productivity parameter k has many interpretations — it can reflect either the investor's ability or the extent to which an investment opportunity is attractive to the investor. The project creates economic externalities for the local community, which is for our purposes is the society. The society comprises of two groups A and B, who derive utility from the project. Groups may have different valuations of the project. Group i's total valuation of the project is given by $v^i x, i \in \{A, B\}$.

2.1.2 Informational constraints

We assume uncertainty about the economic externality that the project generates. The uncertainty affects the government's redistributive concern. This can be modeled by introducing uncertainty over the values of v^A, or v^B, or both. To keep the model simple, we only consider one-sided uncertainty. While v^A is assumed to be fixed, v^B can be either *high* or *low*. In low state, which occurs with probability p, v_B takes the value $\underline{v}$. In high state, which occurs with probability $1-p$, v_B equals $\overline{v}$. We assume that $p \in (0,1)$ and $\underline{v} < \overline{v}$. The distribution of v^B is commonly known, but v^B itself is realized after investment is made by the investor. The realized value of v^B is private information to group B.

2.1.3 Redistribution and signaling

In our framework, G decides on two different kinds of redistributive transfer. Through the investment tax, as described above, a redistribution of surplus takes place between the investor and the society. If there is a positive investment tax (when $\tau > 0$), G distributes the tax revenue among the citizens. Conversely, when offering a subsidy to I (when $\tau < 0$), G collects the subsidy from the society.

At the final stage, G decides on a redistributive transfer between groups. The timing of the redistributive transfer between groups is particularly important in our framework. If the transfer takes place after v^B is realized, group B has an incentive to signal its private information to affect the level of redistributive transfer. In particular, irrespective of the true valuation, B would like to pose as a low-valuation type to attract a higher transfer from the government. However, a high valuation type, by definition, values the surplus more than the low-valuation type. This creates an opportunity for the low valuation type to credibly signal its valuation by taking (publicly observable) action to destroy some surplus. Such destructive actions come in the form of protests, strikes or delaying the production process by other means. The government uses information inferred from such public action to implement an appropriate redistribution scheme. Such signaling, however, comes at a cost of surplus reduction which hurts all parties concerned. We assume that by taking an action of level $a \geq 0$, B effectively reduces the size of investment by ax. Notice that the action reduces the value of investment for the investor and for each of the two groups. Following an action of level a, group i's payoff from the project becomes $v^i x(1-a)$.

Let $w^i, i = A, B$ denote group i's surplus before the between-groups transfer takes place. We can write $w^A = v^A x(1-a) + s\tau x$ and $w^B = v^B x(1-a) + (1-s)\,\tau x$, where s is the proportion at which the tax/subsidy revenue is split between two groups. In the analytical section, we will argue the choice of s will not be a strategic consideration for G. We therefore assume that s is fixed for simplicity. Let $t \in \mathbb{R}$ denote the redistributive transfer from A to B. Therefore, post-transfer surplus of groups A

[4] Our results hold for any strictly increasing and convex cost function. The assumption of quadratic cost function is taken for simplicity and tractability of our results.

and B are given by

$$\begin{aligned} w^A - t &= v^A x(1-a) + s\tau x - t, \text{ and} & (1)\\ w^B + t &= v^B x(1-a) + (1-s)\,\tau x + t. & (2) \end{aligned}$$

The following condition is assumed throughout our analysis.

Assumption 1 $v^A + \underline{v} > 0$.

Assumption 1 guarantees that the project is large enough to ensure positive surplus for the groups in every state. By making this assumption, we move away from the 'adverse selection' problem of choosing bad projects, and focus only on the informational problem related to the redistribution of surplus.

2.2 Payoffs

A group's payoff is given by its post-transfer surplus (1), (2). In our framework, group A is not considered as a strategic player, and does not take any action to influence its payoff. Group B chooses the level of action to signal its valuation of the project.

The investor's payoff is given by[5]

$$x\,(1-a) - \frac{x^2}{2k} - \tau x. \tag{3}$$

In our framework, we do not model the government as a rent-seeker. Instead, it plays the role of a planner with two concerns - *a)* inducing private investment that is necessary for development, and *b)* redistribution of surplus among different groups within society. Its motivation for redistribution implicitly stems from a concern over unequal distribution of surplus. To capture the redistribution motivation, we therefore introduce a measure of inequality. The cost of inequality to G is given by

$$\left[\lambda\left(w^A - t\right) - (1-\lambda)\left(w^B + t\right)\right]^2.$$

In the above expression, λ measures G's bias towards group B when measuring the difference in post-transfer surplus.[6] For $\lambda = 1/2$, this measure of inequality is simply the square difference between two groups' post-transfer wealth. As λ increases (decreases) from $1/2$, high post-transfer wealth of A (relative to B) is considered to be costly to G, thus creating a bias toward group B's wealth in determining the level of inequality. The exact opposite effect works as λ decreases from $1/2$.

For a given level of inequality, G prefers high total surplus of the society. Therefore, its payoff function can be given as

$$\begin{aligned} & \left[\left(w^A - t\right) + \left(w^B + t\right)\right] - \left[\lambda\left(w^A - t\right) - (1-\lambda)\left(w^B + t\right)\right]^2 & (4)\\ = & \left[w^A + w^B\right] - \left[\lambda\left(w^A - t\right) - (1-\lambda)\left(w^B + t\right)\right]^2. \end{aligned}$$

The first component in (4), $w^A + w^B$, measures the total surplus (independent of transfer) of the society, and the second component reflects the cost of inequality

[5] In the basic framework, we assume that the investment tax/subsidy is contingent on the total size of the project. The government does not provide any insurance to the investor against the losses due to costly action.

[6] The bias toward one of the groups may result from several factors such as lobbying power, number of swing voters etc. We are particularly interested in analyzing the distortionary effect of this bias on private investment.

There is an alternative expression for the objective function that is equivalent in terms of the optimal choice of the government and of the other parties. If the government has Cobb-Douglas preferences over the group utilities, i.e. if the objective function is $\left(w^A - t\right)^{1-\lambda} \left(w^B + t\right)^{\lambda}$, then we are really solving the same optimization problem for the government. Thus, the government in our model is a weighted social welfare maximizer. While the Cobb-Douglas objective function is perhaps easier to interpret, it has the problem that the expression is undefined for "negative" values of the utilities. Since w^A and w^B are themselves endogenous, there is no easy way of avoiding this problem. We therefore work with the ineuality weighted objective function.

2.3 Sequence of events

The sequence of events in the basic model is described below:

1. Policy stage: G decides the investment tax/subsidy τ.
2. Investment stage: I decides the size of investment x.
3. Signaling stage: v^B is realized but only B can observe v^B. B takes an action $a \geq 0$ to signal its valuation v^B to G.
4. Redistribution stage: G decides a transfer $t \in \mathbb{R}$ from A to B.

To identify the impact of signaling, we discuss an alternative sequence of events in Section 3. In particular, we assume G determines the transfer before v^B is realized, and commits not to renegotiate the amount. Therefore, B finds no incentive to signal through costly action after v^B is realized. The scenario effectively has three stages of actions - policy stage, investment stage and redistribution stage. Finally, after the redistribution stage, nature determines v^B and payoffs are realized.

3 Equilibrium analysis

We proceed to solve the model by considering three different informational regimes. First, in section 3.2, we consider the "full information" benchmark case where the valuation of group B is known to the government. In this case, the government can optimally allocate the surplus created by the investment at no cost, and moreover, there is no distortionary effect on investment. Next, in section 3.3, we proceed to the "costly signaling" regime, in which the group with private information can signal its valuation through action that is costly to the society. Note that in a separating equilibrium signaling fully reveals information. Therthefore, G can still redistribute the surplus optimally, but the level of investment gets affected due to costly destructive action. A comparison between "full information" and "costly signaling" regimes measures the distortionary effect of the signaling channel on investment. In section 3.4, we consider the "no signaling" regime in which G decides on the redistributive transfer before the valuation is privately observed, and commits not to renegotiate later. In this case, there is no incentive for group B to signal its valuation, and the since the transfer is decided only on basis of the expected valuation, it is ex-post sub-opimal. However, there is no distortionary effect on investment. Compating the "no signaling" regime with the "full information" benchmark we can measure the effect of the informational constraint on the government in absence of signaling. Further, the comparison between the "costly signaling" and the "no-signaling" regimes reflects the trade-off faced by the government between allocative efficiency and its twin costs - direct destruction of surplus and indirect distortion of incentives of the investor.

We will begin with describing players' strategies and the equilibrium concept for our analysis.

3.1 Strategies, belief and equilibrium concept

The strategy of the investor I is the size of investment $x(\tau) \in \mathbb{R}$, given an investment tax τ. The marginal valuation of the project to Group B, i.e. $v^B \in \{\underline{v}, \overline{v}\}$ is private information only to B. B's strategy is $a\left(\tau, x, v^B\right) \in \mathbb{R}_+$, the level of action taken by B after observing an investment tax τ, the size of the project x and the marginal valuation of the project v^B. G chooses two different taxes. First, it decides on an investment tax that will be imposed on the investor. Finally, after observing the action taken by B, G decides on a redistributive transfer between A and B. Therefore, G's strategy is given by a tuple (τ, t) such that $\tau \in \mathbb{R}$ is the investment tax and $t(\tau, x, a)$ is the redistributive transfer from A to B, given an investment tax τ, size of investment x and action level a. Let $\mu(\tau, x, a) \in [0, 1]$ denote G's belief that group B has low valuation for the project, after observing a feasible choice tuple (τ, x, a) in which τ is the tax rate chosen by G, x is the size of investment and a is the action made by group B. We will look for the set of *Perfect Bayesian Equilibrium* (PBE) that involves a strategy profile and a belief system such that the strategy profile is sequentially rational and beliefs are derived by Bayes' rule when possible. The set of signaling equilibria is large because of broad flexibility permitted by PBE in specifying out-of-equilibrium beliefs. To get more tractability of our results, we restrict our attention only to the separating equilibria satisfying the *Intuitive Criterion* (Cho and Kreps [3]).

We introduce a few notations for convenience of exposition. We shall sometimes refer to groups' surplus by $w^A = w^A(a)$ and $w^B = w^B(v, a)$ with v and a denoting the realized valuation of B and the level of signaling action respectively. There are other arguments in the expression for w^A and w^B, but we are suppressing them now.

$$\begin{aligned} w^A(a) &= [v^A(1-a) + s\tau]x \\ \text{and } w^B(v, a) &= [v(1-a) + (1-s)\tau]x. \end{aligned}$$

Similarly, the total surplus can be expressed as a function of group B's marginal valuation v and level of action a, in the following way:

$$S(v, a) = \left[w^A(a) + w^B(v, a)\right] = [(v^A + v)(1-a) + \tau]x \tag{5}$$

Finally, G's payoff depends on B's marginal valuation, v, the action, a, and the redistributive transfer, t. We therefore often express it as $W(v, a, t)$.

$$W(v, a, t) = \left[w^A(a) + w^B(v, a)\right] - \left[\lambda\left(w^A(a) - t\right) - (1-\lambda)\left(w^B(v, a) + t\right)\right]^2.$$

3.2 The benchmark case: full information

As the benchmark, we consider a situation in which the government can gain information about groups' valuation at no cost. It is important to note that the realized value of v^B will still be unknown at the policy stage and the investment stage, but will only be known at the redistribution stage. The total surplus available to the government for redistribution within groups is then $S\left(v^B, 0\right) = (v^A + v^B + \tau)x$, given the investment tax τ and the size of investment x. At the redistribution stage, G chooses $t \in R$ to maximize $W\left(v^B,0,t\right)$, which is equivalent of minimizing $\left[\lambda\left(w^A(0)-t\right)-(1-\lambda)\left(w^B\left(v^B,0\right)+t\right)\right]^2$. The optimal group transfer is given by

$$t^o=\lambda w^A(0)-(1-\lambda)\,w^B\left(v^B,0\right).$$

Essentially, the weighted inequality is set to zero at this transfer and the post transfer payoff to G is

$$S\left(v^B,0\right)=\left(v^A+v^B+\tau\right)x.$$

It is easy to check that the payoffs of groups A and B are given by $(1-\lambda)\,S\left(v^B,0\right)$ and $\lambda S\left(v^B,0\right)$ respectively. Since groups are not taking any action that is costly to the investor, I's choice of investment will be independent of the choice of optimal transfer t^o. I chooses x to maximize $x-\frac{x^2}{2k}-\tau x$. The optimal size of investment is given by

$$x^o=\arg\max_x\left(x-\frac{x^2}{2k}-\tau x\right)=k\,(1-\tau).$$

Next consider G's expected payoff at the policy stage. Since the marginal valuation of the project to B is not known, the expected payoff will be given by

$$E\left[w^A(0)+w^B\left(v^B,0\right)\right]=\left(v^A+Ev^B+\tau\right)x^o.$$

$$\text{where } Ev^B\equiv(1-p)\,\overline{v}+p\underline{v}.$$

Ev^B denotes B's expected marginal valuation for the project. The optimal choice of investment tax is a solution of the following optimization problem

$$\tau^o=\arg\max_\tau(v^A+Ev^B+\tau)k\,(1-\tau)=\frac{1-v^A-Ev^B}{2}.$$

The following Proposition outlines the equilibrium actions and payoffs in absence of the informational problem.

Proposition 1 *Consider a situation in which groups' marginal valuations are public information. The following action profile* (t^o,x^o,τ^o) *constitutes the unique equilibrium:*

$$\begin{aligned} t^o &= \lambda w^A(0)-(1-\lambda)\,w^B\left(v^B,0\right), \\ x^o &= k\,(1-\tau^o), \\ \tau^o &= \frac{1-v^A-Ev^B}{2}. \end{aligned}$$

Further, the players' expected payoffs are given by

$$\begin{aligned} G &: EW=\frac{k}{4}\left(1+v^A+Ev^B\right)^2, \\ I &: E\pi=\frac{k}{8}\left(1+v^A+Ev^B\right)^2, \\ \text{Group } A &: \frac{\lambda k}{4}\left(1+v^A+Ev^B\right)^2, \\ \text{Group } B &: \frac{(1-\lambda)\,k}{4}\left(1+v^A+Ev^B\right)^2. \end{aligned}$$

The proposition collects all the results we have discussed so far. The following corollary suggests when the government will tax ($\tau > 0$) or subsidize ($\tau < 0$) the investor when there is free access to information about group valuations. This will serve as the benchmark for the rest of the paper.

Corollary 1 *Consider a situation in which groups' marginal valuations of the project are public information. G will tax investment if and only if*

$$v^A + Ev^B < 1.$$

After completion of the project , the society's expected total marginal valuation of the investment is $v^A + Ev^B$, and the investor's marginal valuation is 1. The above corollary states that G will tax ($\tau > 0$) investment if and only if the society's expected total marginal valuation of the project is less than the investor's marginal return from it. The result can be interpreted as follows. An increased tax raises the society's marginal return from each unit of investment, but also depresses the size of investment by reducing the investor's marginal return. The government basically sets the tax at a level where the society's post tax total expected marginal benefit, i.e. $\left(v^A + Ev^B + \tau\right)$ is equal to the investor's, i.e. $1 - \tau$. The apparent simplicity of the result depends on two assumptions: quadratic costs and fixed marginal valuations[7].

Notice that the tax rate is decided *as if* it results from an underlying bargaining scenario. If G has a relatively high stake after completion of the project (i.e., when $v^A + Ev^B > 1$), it takes a soft position in dealing with the investor and offers subsidy. On the other hand, if I has a relatively high stake after completion (i.e., when $v^A + Ev^B < 1$), the converse effect holds. This line of interpretation turns out to be useful throughout our analysis. Comparing relative stakes of two parties after completion of the project in different scenarios, it is easy to interpret how and why G becomes more or less aggressive in dealing with the investor.

3.3 The "standard" case: Private information and signaling

In this section, we analyze the problem when B's valuation of the project is private information and B can signal by taking a costly public action. We solve the game by backward induction.

First consider the redistribution stage. Assume that the investment tax τ, the size of investment x and the level of action a are known. In any separating equilibrium, group B's true valuation will be revealed with certainty. We therefore, look at the optimal between-group transfer when G knows the realized value of v^B.

For any belief $\mu \in [0, 1]$ over types, the optimal transfer is

$$t(\mu, a) \in \arg\max_{t'} E_\mu W(a, t') \text{ where } E_\mu W(a, t') = \mu W(\underline{v}, a, t') + (1 - \mu) W(\overline{v}, a, t') \qquad (6)$$

The following lemma shows that the equilibrium transfer for any belief falls in a bounded set.

[7] In general, if the social valuation of investment is $V_G(x)$ and that of the investor is $V_I(x)$, and if $V_I(x)$ is concave, the government essentially chooses x^{opt} such that

$$\frac{MV_G(x^{opt}) + MV_I(x^{opt})}{-MV_I'(x^{opt})} = x^{opt}$$

and sets τ^* as $MV_I(x^{opt}) = \tau^*$.

Lemma 1 *For all* $a \in [0,1]$, *all values of* $\overline{v} > \underline{v}$ *and all beliefs* μ, $t(\mu, a) \in [\underline{t}(a), \overline{t}(a)]$, *where* $\overline{t}(a)$ *and* $\underline{t}(a)$ *are given by equations*

$$\overline{t}(a) = \lambda w^A(a) - (1-\lambda) w^B(\overline{v}, a), \quad (7)$$

$$\underline{t}(a) = \lambda w^A(a) - (1-\lambda) w^B(\underline{v}, a) \quad (8)$$

Proof. In appendix. ■

Next, consider the signaling stage. Assume that the investment tax τ and the size of investment x (> 0) are known. We examine the separating equilibria of the signaling game. In a separating equilibrium, the two types take actions $\overline{a}$ and $\underline{a}$ respectively, with $\overline{a} \neq \underline{a}$, and beliefs satisfy $\mu(\overline{a}) = 0$ and $\mu(\underline{a}) = 1$.

The following lemma shows that B will take a costly action only if it has low valuation for the project. The key to this is showing that B can always signal its high valuation by not taking any action in a separating equilibrium.

Lemma 2 *Suppose* $x > 0$ *and Assumption 1 holds. In any separating equilibrium, we must have* $\overline{a} = 0$.

Proof. In appendix. ■

The next lemma characterizes the level of action B takes if it has low valuation of the project.

Lemma 3 *Suppose* $x > 0$ *and Assumption 1 holds. Then, the set of separating equilibrium actions is given by* $\underline{a} \in [a_L, \min\{a_H, 1\}]$ *and* $\overline{a} = 0$, *where*

$$a_L = \frac{(1-\lambda)(\overline{v} - \underline{v})}{((v^A + \overline{v}) - (1-\lambda)(v^A + \underline{v}))}, \text{ and } a_H = \frac{(1-\lambda)(\overline{v} - \underline{v})}{\lambda(v^A + \underline{v})}.$$

Proof. In appendix. ■

Lemma 3 shows that there are infinitely many levels of action that can be supported in a separating equilibrium. For the purpose of tractability, we restrict our attention to the equilibria that satisfy the intuitive criterion. The following lemma shows that there is a unique separating equilibrium that survives the restriction.

Lemma 4 *Suppose* $x > 0$ *and Assumption 1 holds. The only separating equilibrium that survives the Cho-Kreps intuitive criterion is* $\underline{a} = a^e = \frac{(1-\lambda)(\overline{v} - \underline{v})}{((v^A + \overline{v}) - (1-\lambda)(v^A + \underline{v}))}$ *and* $\overline{a} = 0$.

Proof. In appendix ■

Given the unique equilibrium of the signaling game, we are now in a position to solve for the optimal size of investment and the investment tax at the preceding stages.

To solve for the optimal size of investment, assume that the tax rate τ is given. I chooses x to maximize its expected return from investment. For a given investment tax τ, the optimal choice of investment size is given by

$$\begin{aligned} x^e &= \arg\max_x (1-p)x + p(1-a^e)x - \frac{x^2}{2k} - \tau x \\ &= \arg\max_x (1 - \tau - pa^e)x - \frac{x^2}{2k} \\ &= k(1 - \tau - pa^e). \end{aligned} \quad (9)$$

Finally, at the policy stage, G decides the optimal investment tax that maximizes its expected payoff. From the redistribution stage, we see that if v^B is truthfully revealed, G chooses the between-groups transfer in a way that makes cost of inequality to zero. Therefore, G's expected payoff at the policy stage is

$$\begin{aligned} EW &= (1-p)\, W\left(\overline{v}, 0, t\left(\overline{v}, 0\right)\right) + pW\left(\underline{v}, a^e, t\left(\underline{v}, a^e\right)\right) \\ &= \left(v^A + Ev^B + \tau - pa^e\left(v^A + \underline{v}\right)\right) x^e \\ &= k\left(v^A + Ev^B + \tau - pa^e\left(v^A + \underline{v}\right)\right)\left(1 - \tau - pa^e\right). \end{aligned}$$

From the first order condition, we see that the optimal investment tax is given by

$$\tau^e = \frac{pa^e\left(v^A + \underline{v} - 1\right) - \left(v^A + Ev^B - 1\right)}{2}. \tag{10}$$

The following proposition summarizes above results and provides a complete characterization of the unique PBE satisfying the intuitive criterion.

Proposition 2 *Assume that group B's valuations of the project is private information and it can signal through costly public action. The following action profile* (t^e, a^e, x^e, τ^e) *with belief* $\mu(\underline{v})$ *constitute the unique separating PBE satisfying the intuitive criterion:*

$$t^e = \begin{cases} \lambda w^A(a^e) - (1-\lambda)\, w^B(\underline{v}, a^e) & \text{if } a = a^e \\ \lambda w^A(0) - (1-\lambda)\, w^B(\overline{v}, 0) & \text{otherwise} \end{cases},$$

$$a^e = \frac{(1-\lambda)\left(\overline{v} - \underline{v}\right)}{\left(\left(v^A + \overline{v}\right) - (1-\lambda)\left(v^A + \underline{v}\right)\right)},$$

$$x^e = k\left(1 - \tau^e - pa^e\right),$$

$$\tau^e = \frac{pa^e\left(v^A + \underline{v} - 1\right) - \left(v^A + Ev^B - 1\right)}{2},$$

$$\mu(\underline{v}) = \begin{cases} 1 & \text{if } a = a^e \\ 0 & \text{otherwise} \end{cases}.$$

Further, the players' expected payoffs are given by

$$\begin{aligned} G: EW &= \frac{k}{4}\left[\left(v^A + Ev^B + 1\right) - pa^e\left(v^A + \underline{v} + 1\right)\right]^2, \\ I: E\pi &= \frac{k}{8}\left[\left(v^A + Ev^B + 1\right) - pa^e\left(v^A + \underline{v} + 1\right)\right]^2, \\ \textit{Group } A &: \frac{(1-\lambda)\, k}{4}\left[\left(v^A + Ev^B + 1\right) - pa^e\left(v^A + \underline{v} + 1\right)\right]^2, \\ \textit{Group } B &: \frac{\lambda k}{4}\left[\left(v^A + Ev^B + 1\right) - pa^e\left(v^A + \underline{v} + 1\right)\right]^2. \end{aligned}$$

From the above proposition, we see that G will tax investment ($\tau^e > 0$) if and only if

$$\left(v^A + Ev^B - 1\right) < pa^e\left(v^A + \underline{v} - 1\right). \tag{11}$$

As before, we can interpret this condition by comparing society's expected marginal valuation with the investor's marginal return (net of investment cost) from the project. After investment is made, society's expected marginal valuation is given by $v^A + Ev^B - pa^e\left(v^A + \underline{v}\right)$, in which the first two terms are the expected marginal valuation of the project to two groups and the third term is the expected marginal loss due to destructive action. Similarly, the investor's expected marginal valuation is given by $(1 - pa^e)$. If G has a relatively high stake after completion (i.e., when $v^A + Ev^B - pa^e\left(v^A + \underline{v}\right) > 1 - pa^e$), it takes a soft position in dealing with the investor and offers subsidy. In the converse scenario, G will tax investment.

It is easy to see that the condition for taxation holds only if the right hand side is negative. Therefore, G offers subsidy whenever $v^A + \underline{v} > 1$. This is because its stake in both states ($v^B = \underline{v}$ *or* $\overline{v}$) is comparatively high, and therefore offers subsidy to provide an incentive to the investor to increase size of investment. On the other hand, when $v^A + \underline{v} < 1$, G offers subsidy if the probability of bad state p is high or if the extent of costly destruction a^e is high. Since the extent of destruction is itself endogenous, we next look into how the parameters of the model affect the extent of resistance.observed in equilibrium.

3.3.1 Destruction of output

Certain conclusions are obvious from the set-up. We do not observe resistance to all investment, it occurs only when an affected group considers the valuation of investment to be low, and uses destructive means to demand more compensation. Second, since a^e is independent of the scale of investment, the total destruction $a^e x$ is strictly increasing in the scale of investment. Thus, large projects face large resistance. Also, since high subsidies are associated with large scale projects (yielding high social return), one can see that more destruction of total output will be seen to occur when the volume of subsidies is high, seemingly explaining the high correlation between increased resistance and highly subsidized projects of governments.

The following proposition tells us how the share of output destroyed, a^e, depends on the nature of investment project and the political structure of the society.[8]

Proposition 3 *As λ, which is G's bias in favor of the affected group increases from* 0 *to* 1, *the optimal action a^e by the group decreases monotonically from* 1 *to* 0. *Ceteris paribus, a^e is strictly decreasing in v^A and $\underline{v}$. If $\overline{v} > v^A$, then a^e is strictly decreasing in $\overline{v}$, while if $\overline{v} < v^A$, then a^e is strictly increasing in $\overline{v}$.*

Notice that the equilibrium action is determined by the level at which the high type is indifferent between taking the action and not doing so. The comparative static effect of $\lambda, \underline{v}$ and v^A can simply be seen from the fact that the gain in transfer for a certain level of action (for either type) is decreasing in each of these parameters, while the high type's cost of misrepresentation is left unaffected.

The first part of proposition 3 shows that the more politically marginalised the affected group is, the more destructive action it undertakes. On the other hand, if G is favorably biased toward the affected group, it expects a high transfer in each state. This creates an incentive not to destroy too much of surplus, since such destruction eventually hurts the total amount of post-transfer wealth. The optimal action a^e decreases in v^A and $\underline{v}$ because an increase in these parameters increases the marginal valuation of output in each state, creating an incentive to destroy less. The intuition for the effect of $\overline{v}$ is a little more subtle. Notice that a^e is determined by equating the gain in transfer from action and the high type's cost of taking action. While an increase in $\overline{v}$ leads to a larger transfer, it also increases the cost of misrepresentation to the high type. The comparative static can go either way depending on whether $\overline{v}$ is greater or less than v^A.

[8] The proof follows from the first order differentiation of a^e, defined in Lemma 4, with respect to various parameters. The algebra is straightforward, we therefore skip the proof of this proposition.

3.4 The alternative regime: No signaling

In the previous section, the government uses information about valuations to implement the optimal redistribution scheme, but such information comes at a public cost. Additionally, the possibility of such a cost being imposed on the investor leads to a distortion in the government's deal with the investor. To balance the extent of the benefit of optimal redistribution against these two costs, we need to compare the government's payoff in the previous section with another benchmark - an alternative regime where there is no signaling (and therefore no cost), and the government has to implement a redistribution scheme without the precise knowledge of the group valuations.

Previously, we have assumed however that the government cannot commit to not use the information about valuations once it is made available. In this section, we assume that the government commits not to use such information even if it is made available. Such commitment takes away the incentive for signaling activity by social groups. In reality, an announced ban on signaling will have the same effect. While we develop the equilibrium predictions for this no-signaling benchmark in this section, in the next section, we show that the government may sometimes be better off by committing not to use information.

The game is the same was it as in section 3.3, except that we force the value of a to be 0. Equivalently, there is no signaling stage. In the redistribution stage, the government uses the transfer that maximizes the expected welfare. Therefore, the tax offered to the investor is given by

$$t^{ns} = \arg\max_{t \in R} pW(\underline{v}, 0, t) + (1-p)W(\overline{v}, 0, t)$$

Define the loss from inequalty when the tax is t, there is no political action, i.e. $a = 0$ and the valuation of group B is $v^B \in \{\underline{v}, \overline{v}\}$ as

$$L(v^B, t) = (\lambda w^A(0) - (1-\lambda)w^B(v^B, 0) - t)^2$$

Now, we can write

$$\begin{aligned} t^{ns} &= \arg\min_{t \in R}(1-p)L(\underline{v}, t) + pL(\overline{v}, t) \\ &= \lambda w^A(0) - (1-\lambda)Ew^B(v^B, 0) \end{aligned}$$

where $Ew^B(v^B, 0) = pw^B(\underline{v}, 0) + (1-p)w^B(\overline{v}, 0)$. This solution depends specifically on the quadratic form we have chosen for the loss function.

After some algebra, the loss $L(v^B, t^{ns})$ for each of the pair of values of v^B can be calculated as

$$\begin{aligned} L(\overline{v}, t^{ns}, x) &= [p(1-\lambda)(\overline{v} - \underline{v})x]^2 \\ L(\underline{v}, t^{ns}, x) &= [(1-p)(1-\lambda)(\overline{v} - \underline{v})x]^2 \end{aligned}$$

The size of the investment is the same as before,

$$x^{ns}(\tau) = k(1-\tau)$$

Finally, the optimal investment tax solves

$$\begin{aligned} \tau^{ns} &\in \arg\max_{\tau} \begin{array}{l} p\{w^A(0,\tau) + w^B(\underline{v}, 0) - L(\underline{v}, t^{ns}, x^{ns})\} \\ +(1-p)\{w^A(0,\tau) + w^B(\overline{v}, 0) - L(\overline{v}, t^{ns}, x^{ns})\} \end{array} \\ &= \arg\max_{t}(v^A + Ev^B)x^{ns}(\tau) + \tau x^{ns}(\tau) - [pL(\underline{v}, t^{ns}, x^{ns}) + (1-p)L(\overline{v}, t^{ns}, x^{ns})] \end{aligned}$$

After some algebra, we get

$$\tau^{ns} = \frac{1 - (v^A + Ev^B) + 2\eta kp(1-p)(1-\lambda)^2(\overline{v} - \underline{v})^2}{2 + 2\eta kp(1-p)(1-\lambda)^2(\overline{v} - \underline{v})^2}$$

We collect the above results in proposition 4.

Proposition 4 *Assume that group B's valuations of the project is private information, but it cannot convey the information to the government. The following action profile* $(t^{ns}, x^{ns}, \tau^{ns})$ *constitutes the unique SPNE of the game:*

$$t^{ns} = \lambda w^A(0) - (1-\lambda)\left[pw^B(\underline{v}, 0) + (1-p)w^B(\overline{v}, 0)\right],$$
$$x^{ns} = k(1 - \tau^e)$$
$$\tau^{ns} = \frac{1 - (v^A + Ev^B) + 2kF}{2 + 2kF}$$

Further, the players' expected payoffs are given by

$$W^{ns} = \frac{k}{4}\frac{(1 + v^A + Ev^B)^2}{1 + kF}$$

where $F = p(1-p)(1-\lambda)^2(\overline{v} - \underline{v})^2$.

Proof. In appendix ■

The following corollary establishes that the government will tax investment if and only if the total expected marginal return to the society is greater than a threshold strictly greater than the marginal return to the investor.

Corollary 2 *Assume that group B's valuations of the project is private information, but it cannot convey the information to the government. Then, the government will tax the investor if and only if*

$$v^A + Ev^B < 1 + 2kF$$

where $F = p(1-p)(1-\lambda)^2(\overline{v} - \underline{v})^2 > 0$.

In other words, when $v^A + Ev^B \in (1, 1 + 2kF)$, the government taxes the investor under no-signaling while it would have subsidized the investor under private information. In this sense, the government acts "too aggressively" compared to what it would do under full information.

4 Role of Resistance

In this section we examine the role of destructive resistance. First we look at the economic value of destructive resistance as a signaling channel: in particular, when is it beneficial. Then we demonstrate how resistance affects investor-friendliness of the government

4.1 Economic value of resistance

As discussed before, while signaling allows the government to implement the optimal redistribution scheme, it involves lost surplus and also distorts the government's deal with the investor. We compare the government's payoff under signaling with that under no-signaling to see when destructive resistance as a signaling channel is overall beneficial to the society. Another way to ask the same question is this: suppose the government could choose to enforce a ban on signaling/resistance activities: when would it actually do so? Our main result is the signaling equilibrium is preferred over the no-signaling regime if and only if the affected group is sufficiently marginalized and the probability of the bad state is sufficiently low.

Proposition 5 *Fix $\{\underline{v}, \overline{v}\}$ and let p and λ vary as parameters. Now compare the government's welfare in the no-signaling regime with that in the regime where the government allows signaling. There exists some cut-off $\lambda^* \in (0, 1)$ such that for $\lambda > \lambda^*$, the government achieves a higher payoff in the no-signaling regime than under signaling for every value of p. If on the other hand $\lambda < \lambda^*$, then there is a unique cut-off $p^*(\lambda)$ such that the government prefers no-signaling to signaling if and only if $p > p^*(\lambda)$.*

Proof. In appendix. ■

4.2 Resistance and Investor-friendliness

We have already seen (proposition 2) that the possibility of resistance endogenously generates investor friendliness. We take as benchmark τ^0, the government's offer to the investor if there were no informational problem. In the following proposition we examine when resistance makes the government too aggressive or too soft in its negotiations with the investor.

Proposition 6 *Compare the case when valuations are public information with the case when group B's valuation of the project is private information and it can signal through costly public action. The government will be less aggressive (i.e., $\tau^e < \tau^o$) in choosing the tax rate in the second case if and only if $v^A + \underline{v} < 1$. Moreover, the difference between the tax offers in the two regimes $|\tau^e - \tau^o|$ is increasing in p, the probability of the bad state and a^e, the share of output destroyed.*

Proof. We can rewrite τ^e in (10) as a function τ^o as follows:

$$\tau^e = \tau^o + \frac{1}{2} p a^e \left(v^A + \underline{v} - 1 \right). \tag{12}$$

Therefore, $\tau^e < \tau^0$ if and only if $v^A + \underline{v} < 1$. For the second part, note that $|\tau^e - \tau^o| = \frac{1}{2} p a^e \left(|v^A + \underline{v} - 1| \right)$. ■

■

According to the proposition, the possibility of destructive signalling introduces a "distortion" over the full information benchmark τ^0. This distortion is the second term in (12). Increasing the tax rate has two effects: raising revenue per unit of investment the one hand and depressing total investment on the other. If $v^A + \underline{v} > 1$, the society's marginal loss from resistance is relatively high, society values output increase that much less. As a consequence, output loss due to increased tax rate costs a little less in the margin, and the government raises tax above τ^0. On the other hand, if the society values output relatively less in the bad state, i.e. $v^A + \underline{v} < 1$, then the government is softer, i.e. more investor friendly, than it would be under full information. The second part of the proposition says that higher the resistance, the stronger is the distortion.

The import of the proposition is that if the society's valuation of the bad state is not very high, resistance forces the government to be "too investor friendly" . While the common rhetoric suggests that such resistance arises in response to the government being too investor-friendly, the point of the paper is to show that a reverse causality exists Notice that higher resistance may happen due to increased marginalisation (decrease in λ) of the affected group. Thus, the political structure of the society as encapsulated by λ may have a significant impact on the deal offered to a foreign investor and consequently, the scale of investment.

What if the government could ban signaling? Simple algebra shows us that $\tau^{ns} > \tau^0$. Both under the benchmark case and no-sinaling case, there is no output loss due to resistance, but in the latter case, the surplus is suboptimally distributed across groups. Thus, the marginal value of increased output is lower in the latter case than the benchmark. Therefore, the government sets a higher tax than the benchmark case when signaling is banned.

When signaling is banned, the government is more aggressive compared to the full information benchmark. Then we can say from proposition 6 that the government is more aggressive under no-signaling compared to the signaling regime whenever $v^A + \underline{v} < 1$. When $v^A + \underline{v} > 1, i$ i.e. output destruction is relatively costly, the comparison between τ^{ns} and τ^e remains ambigous: in the signaling case, increase in output is devalued by destructive resistance, and in the no-signaling case, value of increased output is reduced by suboptimal redistribution. If the former effect is larger (smaller) than the latter, the government is more (less) aggressive under the signaling regime than under the no-signaling regime.

5 Conclusion

In our paper, we constructed a framework of interaction between the government, affected groups and the investor to analyze the extent of destructive action and investor-friendliness of governments. We show that destructive action may have informational value especially in a less-developed society where the bottom-up channels of information may not work very well. The government may indeed want not to ban or enforce strictures on such destructive actions. According to our framework, rather than legally protect the investor from asset destruction, the government should rather financially compensate the investor through appropriate subsidies. We also take the position that the government's "investor-friendliness" should be determined by a comparison of the marginal valuation of the investment by the investor and that by the society. We recognize however that in dealing with an investor, governments may face severe external constraints in the form of competing governments. Not only does this competition mean that the investor benefits at the cost of both societies, it may often lead to economic inefficiencies as the investor might want to locate in a less action-prone destination rather than a more productive destination. It is a challenge for governments in less developed economies to solve this problem by coordinating with each other. A possible solution would be for the more productive society to get the investment and arrange some side-payments with the other society. We look into such alternative solutions in our further research.

6 Appendix

Proof of Lemma 1. The proof proceeds by examining three possible cases.

Case 0: $x = 0$ (or $a = 1$ and $\tau = 0$) : Here, $S(v, a) = 0$ for $v \in \{\underline{v}, \overline{v}\}$, or $w^B(v, a) = w^A = 0$. Then $t(\mu, a) = 0$ for all $\mu \in [0, 1]$. For any other t, $E_\mu W(a, t) \leq -B$.

Case 1: $S(\overline{v}, a) = 0$, $S(\underline{v}, a) < 0$: Here, $w^B(\overline{v}, a) + w^A = 0$. For $t = -w^B(\overline{v}, a) = w^A$, $W(\overline{v}, a, t) = 0$. For all other values of t, $W(\overline{v}, a, t) \leq -B$. Also, for all values of $t, W(\underline{v}, a, t) \leq -B$. It is easy to show that there is some $\mu_1(B) \in (0, 1)$ for all B, but increasing in B such that

$$t(\mu, a) = \begin{cases} w^A = t(\overline{v}, a) \text{ for } \mu \leq \mu_1(B) \\ \mu t(\underline{v}, a) + (1 - \mu)t(\overline{v}, a) \text{ for } \mu > \mu_1(B) \end{cases}$$

Case 2: $S(\underline{v}, a) = 0$, $S(\overline{v}, a) > 0$. In this case, $w^B(\underline{v}, a) + w^A = 0$. For $t = -w^B(\underline{v}, a) = w^A$, $W(\underline{v}, a, t) = 0$. For all other values of t, $W(\underline{v}, a, t) \leq -B$. On the other hand, for $t \in [w^B(\underline{v}, a), w^B(\overline{v}, a)]$, $W(\overline{v}, a, t) \geq 0$, and for $t \notin [w^B(\underline{v}, a), w^B(\overline{v}, a)]$, $W(\overline{v}, a, t) \leq B$. Notice that $w^B(\underline{v}, a) = -w^A$

Again, it is possible to show that there is a cutoff $\mu_2(B) \in (0, 1)$ for all B, and decreasing in B and a function $h(\mu) \in (0, 1)$ that is increasing in μ such that

$$t(\mu, a) = \begin{cases} w^A = t(\overline{v}, a) \text{ for } \mu \geq \mu_2(B) \\ h(\mu)t(\underline{v}, a) + (1 - h(\mu))t(\overline{v}, a) \text{ for } \mu < \mu_2(B) \end{cases}$$

There are two subcases: (i) $w^A < w^B(\overline{v}, a)$ and $(ii) w^A > w^B(\overline{v}, a)$. Notice that case (ii) arises only if $w^B(\underline{v}, a) < 0$.

In case (i), for $t = w^A$, $w^B(\overline{v}, a) - t = w^B(\overline{v}, a) - w^A > 0$, and thus $W(\overline{v}, a, t) = 0$. In this case, the $E_\mu W(a, t(\mu, a)) \geq 0$ for all $\mu \in [0, 1]$.

In case (ii), for $t = w^A$, $w^B(\overline{v}, a) - t = w^B(\overline{v}, a) - w^A < 0$, and thus $W(\overline{v}, a, t) \leq B$. In this case, the expected welfare may well be negative for high values of μ.

Case 3: $S(\underline{v}, a) > 0$. This implies that $S(v, a) > 0$ for $v \in \{\underline{v}, \overline{v}\}$. Note also that since $-w^B(\overline{v}, a) < -w^B(\underline{v}, a)$, we have $[-w^B(\underline{v}, a), w^A] \subset [-w^B(\overline{v}, a), w^A]$. Thus, the range of t for which $W(\overline{v}, a, t) \geq 0$, is a subset of the range for which $W(\underline{v}, a, t) \geq 0$. In this case, we will have $t(\mu, a)$ such that $W(v, a, t(\mu, a)) > 0$ for $v \in \{\underline{v}, \overline{v}\}$. By inequality **??**, $t(\overline{v}, a) < t(\underline{v}, a)$. There are again, however, two different cases: $(i) t(\overline{v}, a) < -w^B(\underline{v}, a)$ and $(ii) t(\overline{v}, a) \geq -w^B(\underline{v}, a)$.

In case (i), it is possible to show that there exists a function $g(\mu) \in [0, 1]$ that is weakly increasing in μ (and involving a discontinuity) such that

$$t(\mu, a) = g(\mu)t(\underline{v}, a) + (1 - g(\mu))t(\overline{v}, a)$$

In case (ii), from equations **??** and 6, $t(\mu, a)$ must satisfy

$$\mu W(\underline{v}, a, t) \left\{ \frac{\lambda}{w^B(\underline{v}, a) + t} - \frac{1 - \lambda}{w^A - t} \right\} + (1 - \mu) W(\overline{v}, a, t) \left\{ \frac{\lambda}{w^B(\overline{v}, a) + t} - \frac{1 - \lambda}{w^A - t} \right\} = 0$$

Concavity of $W(v, a, t)$ implies that there exists a strictly increasing function $f(\mu) \in [0, 1]$ such that

$$t(\mu, a) = f(\mu)t(\underline{v}, a) + (1 - f(\mu))t(\overline{v}, a)$$

Notice that in either subcase, since there exists some t for which $W(v, a, t) > 0$, we must have $E_\mu W(a, t(\mu, a)) > 0$ for all $\mu \in [0, 1]$. ∎

Proof of Lemma 2. First consider $\overline{v}+v^A>0$, and suppose $\overline{a}>0$. The utility of the high type is $\lambda[(\overline{v}+v^A)(1-\overline{a})+\tau]x$. By deviating to $a=0$, the transfer is $t(\mu(0),0)\geq t(\overline{v},0)$, by Lemma 1. The resulting payoff from deviation is

$$\overline{v}x+t(\mu(0),0)+s\tau x\geq\overline{v}x+t(\overline{v},0)+s\tau x=\lambda[(\overline{v}+v^A)+\tau]x>\lambda[(\overline{v}+v^A)(1-\overline{a})+\tau]x$$

Now, consider $\overline{v}+v^A<0$, and suppose $\overline{a}<1$. Note that at $a=1$, $W(v,a,t)$ is independent of v for all t. Thus, $t(\mu,1)=\lambda(1-s)\tau x-(1-\lambda)s\tau x=(\lambda-s)\tau x$ for all $\mu\in[0,1]$. By deviating to $a=1$, the resulting payoff is $t(\mu(1),1)+s\tau x=\lambda\tau x>\lambda[(\overline{v}+v^A)(1-\overline{a})+\tau]x$. Note that Assumption 1 ensures that $\overline{v}+v^A>0$ since $\overline{v}>\underline{v}$. Therefore under Assumption 1, it follows that $\overline{a}=0$. ■

Proof of Lemma 3. By Lemma 2, in any separating equilibrium, we must have $\overline{a}=0$. A necessary condition that the optimal level of actions $(\underline{a},0)$ would have to satisfy is that neither type would gain by misrepresenting its own type. Let $w^B\,(a,t|v)$ denote group B's payoff given its true marginal valuation v, a redistributive transfer t, and an action a. The no-lying constraint for the high type is

$$w^B(0,t(\overline{v},0)|\overline{v})\geq w^B(\underline{a},t(\underline{v},\underline{a})|\overline{v}) \tag{13}$$

And the no-lying constraint for the low type is

$$w^B(\underline{a},t(\underline{v},\underline{a})|\underline{v})\geq w^B(0,t(\overline{v},0)|\underline{v}) \tag{14}$$

By rearranging terms, we see that inequalities (13) can be summarised as (14),

$$\overline{v}\underline{a}x\geq\Delta t\,(a)\geq\underline{v}\underline{a}x,\ \text{where}\ \Delta t\,(a)=t(\underline{v},\underline{a})-t(\overline{v},0)$$

The gain in transfer $\Delta t\,(\underline{a})$ from representing oneself as of having low valuation by taking an action of level $\underline{a}$ is given by

$$\Delta t\,(a)=x\left[(1-\lambda)\,(\overline{v}-\underline{v})+\underline{a}\left((1-\lambda)\,\underline{v}-\lambda v^A\right)\right].$$

After rearranging terms, we see that in any separating equilibrium,

$$\frac{(1-\lambda)\,(\overline{v}-\underline{v})}{((v^A+\overline{v})-(1-\lambda)\,(v^A+\underline{v}))}\leq\underline{a}\leq\frac{(1-\lambda)\,(\overline{v}-\underline{v})}{\lambda(v^A+\underline{v})}. \tag{15}$$

where the upper bound comes from condition 13 and the lower bound from condition 14. Condition 15 is only necessary for there to be a separating equilibrium. We now show that any $\underline{a}\in[a_L,a_H]$ will be an equilibrium, given beliefs

$$\mu(a)=\begin{cases}0\text{ if }a\in[0,\underline{a})\cup(\underline{a},1]\\ 1\text{ if }a=\underline{a}\end{cases}$$

For the high type, the utility from taking any action a rather than 0 is

$$w^B(a,t(\mu,a)|\overline{v})=\begin{cases}\lambda((\overline{v}+v^A)(1-a)+\tau)x\text{ if }a\in[0,\underline{a})\cup(\underline{a},1]\\ w^B(\underline{a},t(\underline{v},\underline{a})|\overline{v})\text{ if }a\in\underline{a}\end{cases}$$

$w^B(0,t(\overline{v},0)|\overline{v})=\lambda((\overline{v}+v^A)+\tau)x>\lambda((\overline{v}+v^A)(1-a)+\tau)x$ since $\overline{v}+v^A>0$ and $w^B(0,t(\overline{v},0)|\overline{v})\geq w^B(\underline{a},t(\underline{v},\underline{a})|\overline{v})$ by the no-lying constraint 13. Thus, the high type has no profitable deviation. For the low type, the utility from taking any other action a rather than $\underline{a}$ is $w^B(a,t(\overline{v},a)|\underline{v})$, which is weakly lower than $w^B(a,t(\mu,a)|\underline{v})$ by the no-lying constraint of the low type, i.e. inequality 14.

When does a separating equilibrium exist? It does, only if $[a_L, \min\{a_H, 1\}]$ is a non-empty interval. By inspection, it is easy to see that if $\overline{v} + v^A > 0$, $a_L \in (0,1)$. Also, after a little algebra, we see that

$$a_H - a_L = \frac{(1-\lambda)\left(\overline{v} - \underline{v}\right)^2}{[(v^A + \overline{v}) - (1-\lambda)\left(v^A + \underline{v}\right)]\lambda(v^A + \underline{v})}, \tag{16}$$

and thus $a_H > a_L$ if and only if $(v^A + \underline{v}) \geq 0$, which holds true given Assumption 1. ■

Proof of Lemma 4. Consider any separating equilibrium with $\underline{a} > a_L$, and $\overline{a} = 0$. That there exists such an $\underline{a}$ is guaranteed by that fact that since $\overline{v} - \underline{v} > 0$, we will never have 0 in the right hand side of equation 16. Consider the action $a' = \frac{1}{2}(\underline{a} + a_L)$. For any belief $\mu \in [0,1]$,

$$\begin{aligned} w^B(a', t(\mu, a')|\overline{v}) &= vx(1-a') + t(\mu, a') + s\tau x \leq vx(1-a') + t(\overline{v}, a') + s\tau x \\ &= \lambda((\overline{v} + v^A)(1-a') + \tau)x < \lambda((\overline{v} + v^A) + \tau)x = w^B(0, t(\overline{v}, 0)|\overline{v}). \end{aligned}$$

Therefore, for all possible beliefs μ arising from action a', the high type would get a lower utility from playing a' that it does in equilibrium. Thus, a' is equilibrium dominated for the high type, and hence we must have $\mu(a') = 1$. If $\mu(a') = 1$, then the payoff of the high type from playing action a' is

$$w^B(a', t(\underline{v}, a')|\underline{v}) = \lambda((\underline{v} + v^A)(1-a') + \tau)x > \lambda((\underline{v} + v^A)(1-\underline{a}) + \tau)x = w^B(\underline{a}, t(\underline{v}, a')|\underline{v}).$$

Therefore, the low type has a deviation yielding a higher payoff than the equilibrium payoff. Thus, the separating equilibrium with $\underline{a} > a_L$, and $\overline{a} = 0$ does not survive the intuitive criterion. ■

Proof of proposition 5

Fix $\overline{v}, \underline{v}$ and λ, and consider W^e and $\not{W}^{ns}$ as functions of p. Now, it is easy to see that

$$\frac{\not{W}^{ns}(p)}{W^e(p)} = \left[\frac{N(p)}{S(p)}\right]^2$$

where

$$N(p) = \frac{v_A + Ev_B + 1}{\sqrt{1 + kF(p)}}, \; F(p) = p(1-p)(1-\lambda)^2(\overline{v} - \underline{v})^2 \tag{17}$$

$$S(p) = (v_A + Ev_B + 1) - pa^e(v_A + \underline{v} + 1), \; a^e = \frac{\lambda(\overline{v} - \underline{v})}{(v_A + \overline{v}) - \lambda(v_A + \underline{v})} \tag{18}$$

Since $(v_A + Ev_B + 1) - pa^e(v_A + \underline{v} + 1) > 0$, we can say that $\not{W}^{ns}(p) \lesseqgtr W^e(p)$ if and only if $N(p) \lesseqgtr S(p)$.

First, notice that $N(0) = S(0) = v_A + \overline{v} + 1$. Also, $N(1) = (v_A + \underline{v} + 1) > S(1) = (1 - a^e)(v_A + \underline{v} + 1)$ since $a^e \in (0,1)$. Next, note that

$$\frac{dS(p)}{dp} = (\underline{v} - \overline{v}) - a^e(v_A + \underline{v} + 1) < 0 \tag{19}$$

According to (24), $S(p)$ is a downward sloping straight line. On the other hand,

$$\begin{aligned} \frac{dN(p)}{dp} &= \frac{1}{1 + kF(p)}\left\{(\underline{v} - \overline{v})\sqrt{1 + kF(p)} - (v_A + Ev_B + 1)\frac{k(1-\lambda)^2(\overline{v} - \underline{v})^2}{2\sqrt{1 + kF(p)}}(1 - 2p)\right\} \\ &= \frac{(\underline{v} - \overline{v})}{\sqrt{1 + kF(p)}} - (v_A + Ev_B + 1)\frac{k(1-\lambda)^2(\overline{v} - \underline{v})^2}{(1 + kF(p))^{\frac{3}{2}}}\left(\frac{1}{2} - p\right) \end{aligned} \tag{20}$$

Notice that

$$\frac{dN(p)}{dp}|_{p=0} = (\underline{v} - \overline{v}) - \frac{1}{2}k(v_A + \overline{v} + 1)(1-\lambda)^2(\overline{v} - \underline{v})^2 \tag{21}$$

Claim 3 *For any $p^* \in (0,1)$ for which $N(p) = S(p)$, we must have $\frac{dN(p)}{dp} > \frac{dS(p)}{dp}$.*

Proof. Suppose not, and there is some $p^* \in (0,1)$ satisfying $N(p) = S(p)$, and $\frac{dN(p)}{dp} \leq \frac{dS(p)}{dp}$.

Therefore, from (24) and (25), for p^*, we must have

$$\begin{aligned}
\frac{(\underline{v}-\overline{v})}{\sqrt{1+kF(p)}} - (v_A + Ev_B + 1)\frac{k(1-\lambda)^2(\overline{v}-\underline{v})^2}{(1+kF(p))^{\frac{3}{2}}}(\frac{1}{2}-p) &\leq (\underline{v}-\overline{v}) - a^e(v_A + \underline{v} + 1), \text{ or} \\
(v_A + Ev_B + 1)\frac{k(1-\lambda)^2(\overline{v}-\underline{v})^2}{(1+kF(p))^{\frac{3}{2}}}(\frac{1}{2}-p) - a^e(v_A + \underline{v} + 1) &\geq \frac{(\underline{v}-\overline{v})}{\sqrt{1+kF(p)}} - (\underline{v}-\overline{v})
\end{aligned}$$

Since $p^* > 0$, $\sqrt{1+kF(p)} > 1$, and since $(\underline{v}-\overline{v}) < 0$, the right hand side is strictly positive. Therefore, we must have

$$(v_A + Ev_B + 1)\frac{k(1-\lambda)^2(\overline{v}-\underline{v})^2}{(1+kF(p))^{\frac{3}{2}}}\left(\frac{1}{2}-p\right) > a^e(v_A + \underline{v} + 1) \tag{22}$$

From (22) and (23), since $N(p) = S(p)$ at p^*, we have

$$\begin{aligned}
\frac{v_A + Ev_B + 1}{\sqrt{1+kF(p)}} &= (v_A + Ev_B + 1) - pa^e(v_A + \underline{v} + 1) \\
v_A + Ev_B + 1 &= \frac{pa^e(v_A + \underline{v} + 1)}{\left[1 - \frac{1}{\sqrt{1+kF(p)}}\right]}
\end{aligned} \tag{23}$$

Using (28), condition (27) reads

$$a^e(v_A + \underline{v} + 1)\frac{k(1-\lambda)^2(\overline{v}-\underline{v})^2\left(\frac{1}{2}-p\right)p}{\left[1 - \frac{1}{\sqrt{1+kF(p)}}\right](1+kF(p))^{\frac{3}{2}}} > a^e(v_A + \underline{v} + 1)$$

which is true if and only if

$$\begin{aligned}
\left[1 - \frac{1}{\sqrt{1+kF(p)}}\right](1+kF(p))^{\frac{3}{2}} &< k(1-\lambda)^2(\overline{v}-\underline{v})^2\left(\frac{1}{2}-p\right)p, \text{ or} \\
(1+kF(p))^{\frac{3}{2}} - (1+kF(p)) &< k(1-\lambda)^2(\overline{v}-\underline{v})^2\left(\frac{1}{2}-p\right)p, \text{ or} \\
\left[1 + k(1-\lambda)^2(\overline{v}-\underline{v})^2(1-p)p\right]^{3/2} &< k(1-\lambda)^2(\overline{v}-\underline{v})^2\left(\frac{1}{2}-p\right)p + 1 + k(1-\lambda)^2(\overline{v}-\underline{v})^2(1-p)p \\
&= 1 + k(1-\lambda)^2(\overline{v}-\underline{v})^2 p\left(\frac{3}{2}-2p\right)
\end{aligned} \tag{24}$$

Now, from the Taylor series expansion of the left hand side,

$$\begin{aligned}
\left[1 + k(1-\lambda)^2(\overline{v}-\underline{v})^2(1-p)p\right]^{3/2} &> 1 + \frac{3}{2}k(1-\lambda)^2(\overline{v}-\underline{v})^2(1-p)p \\
&= 1 + k(1-\lambda)^2(\overline{v}-\underline{v})^2 p\left(\frac{3}{2}-\frac{3}{2}p\right) \\
&> 1 + k(1-\lambda)^2(\overline{v}-\underline{v})^2 p\left(\frac{3}{2}-2p\right)
\end{aligned} \tag{25}$$

since $p^* > 0$. Inequality (30) is a contradiction to inequality (29). Since inequality (29) is false, condition (27) is not satisfied. ■

Therefore, whenever $N(p^*) = S(p^*)$ other than $p^* = 0$, $N(p)$ should cut $S(p)$ from below. This implies that there is at most one solution to $N(p) = S(p)$ for $p \in (0,1]$. To see that, suppose there were more than one solutions to $N(p) = S(p)$. By claim 1, in case of each solution, $N(p)$ should cut $S(p)$ from below. But since both $N(p)$ and $S(p)$ are continuous, by the intermediate value theorem, between any two such distinct solutions, there must be some p' such that $N(p') = S(p')$ where $N(p)$ cuts $S(p)$ from above. This is a contradiction to claim 1. From claim 1, it follows that there is at most one solution to $N(p) = S(p)$ for $p \in (0,1]$. Also, if there exists such a solution p^*, for $p < p^*$, $N(p) < S(p)$ and for $p > p^*$, $N(p) > S(p)$. Since $N(0) = S(0)$, there is an interior solution p^* to if the equation $N(p) = S(p)$ if and only if there is some $\epsilon > 0$ such that $N(p) < S(p)$ for the interval $(0, \epsilon)$. Such an ϵ exists if and only if $\frac{dN(p)}{dp} < \frac{dS(p)}{dp}$ at $p = 0$. Comparing (24) and (26), the condition is

$$a^e(v_A + \underline{v} + 1) < \frac{1}{2}k(v_A + \overline{v} + 1)(1-\lambda)^2(\overline{v} - \underline{v})^2 \tag{26}$$

Condition (31) can be broken down further as

$$\begin{aligned} \frac{\lambda(\overline{v} - \underline{v})}{(v_A + \overline{v}) - \lambda(v_A + \underline{v})} &< \frac{(v_A + \overline{v} + 1)}{(v_A + \underline{v} + 1)}\frac{1}{2}k(\overline{v} - \underline{v})^2(1-\lambda)^2, \text{ or} \\ \left(\frac{1}{\sqrt{\lambda}} - \sqrt{\lambda}\right)^2 [(v_A + \overline{v}) - \lambda(v_A + \underline{v})] &> \frac{(v_A + \underline{v} + 1)}{(v_A + \overline{v} + 1)}\frac{2}{k(\overline{v} - \underline{v})} \end{aligned} \tag{27}$$

Since $\lambda \in (0,1)$, $\left(\frac{1}{\sqrt{\lambda}} - \sqrt{\lambda}\right)$ is decreasing in λ, and so is $[(v_A + \overline{v}) - \lambda((v_A + \underline{v})]$, since $v_A + \underline{v} > 0$. The left hand side of (32) is thus continuous and strictly decreasing in λ : it goes from infinity to zero as λ goes from 0 to 1. The right hand side has a finite, positive value. Therefore, there is some $\lambda^* \in (0,1)$ such that for $\lambda \geq \lambda^*$, condition (32) is not satisfied, and $N(p) > S(p)$ for all $p \in (0,1]$; and for $\lambda < \lambda^*$, there is some cut-off $p^* \in (0,1)$ such that $S(p)$ dominates $N(p)$ for $p < p^*$ and $N(p)$ dominates $S(p)$ for $p > p^*$.

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