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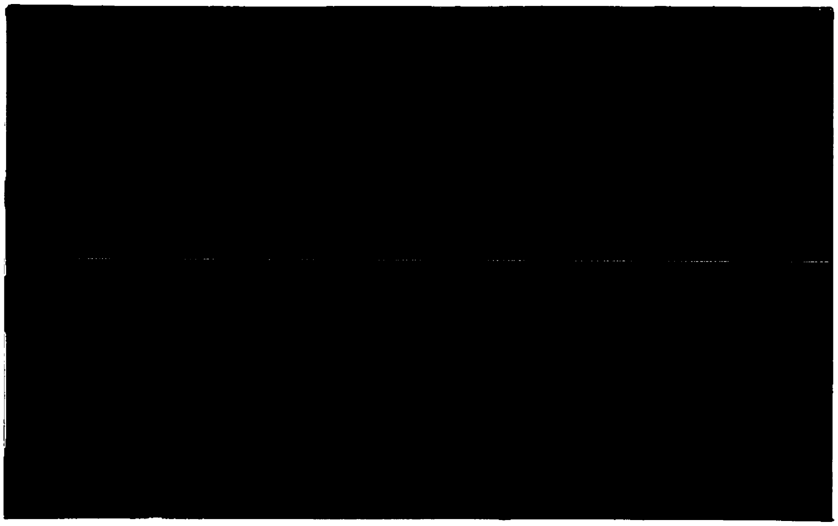

Political Coalition Breaking and Sustainability of Policy Reform

by

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Abstract

This paper examines the need and potential for coalition breaking in policy reform efforts related to agriculture and the environment. The objective is to consider traditional policy tools that can break existing political coalitions, given the powerful noncompetitive role of strong interest groups such as government bureaucracy and large trading organizations. Choice of the policy mix is modeled as a cooperative game. A modification of the Nash bargaining solution is used to endogenize coalition formation. This framework is then used to examine the potential for an external development agency to promote environmental interests in the policy formation process. The results explain how in some countries a small increase in strategic aid may achieve a major breakthrough in policy reform even if past activities have been unproductive and how, in other countries, a major increase in aid may be fruitless.

JEL classification codes: O19, C78

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Political Coalition Breaking and Sustainability of Policy Reform

1. Introduction

Many policies and institutions that have been in place in developing countries for many years have the effect of redistributing welfare in favor of powerful vested interests and constituencies including members of government bureaucracies. Policy reform efforts are directed at removing the social inefficiencies arising from these policies and institutions. Accordingly, most welfare improving policy reforms tend to adversely affect some interest groups. When powerful interest groups are adversely affected, even the best policy reforms from the public interest perspective will be blocked by interest group efforts to influence the political process. Moreover, even when welfare improving policies are successfully enacted, their beneficial effects are often partially or wholly mitigated by welfare redistributing policies enacted under ensuing pressure from the adversely affected interest groups. These realities imply that schemes to make welfare improving policies politically sustainable must consider existing coalitions, what measures are necessary to break existing coalitions, and what policies can cause new coalitions to arise. That is, useful policy reforms must be supported by new sustainable coalitions if they are to prosper.

One problem where these considerations are crucial is natural resource management in developing countries. Management policies call for political bargaining and negotiation both inside and outside of government (Honadle and Cooper; Gamman; Wilson and Morren). Many significant domestic policy problems related to agriculture and the environment have strong special interest groups including marketing organizations, producers, and government bureacrats. These interest groups are often sufficiently powerful to block environmental programs for biodiversity, forest and range management, water quality, and soil conservation. For example, environmental restrictions on land use are perceived as detrimental by agricultural producers and government officials concerned with economic growth. Resource management restrictions have the effect of transferring income and utility among producer, consumer and environmental groups. Can available policy instruments be used to compensate key interest groups and break the coalitions blocking environmental policies?

The objective of this paper is to examine conceptually the need and potential for coalition breaking in policy reform efforts related to agriculture and the environment. Several preliminary studies have been undertaken along these lines. However, these studies evaluate welfare assuming unrealistic lump sum transfers and assume competitive reactions of individual agents to alternative compensation schemes. The objective here is to consider compensation schemes that can break existing coalitions in the context of possibilities that are institutionally feasible and politically sustainable given the powerful noncompetitive role of interest groups. These problems are typified by collective action of groups representing, for example, government bureaucracy and trading institutions. A fundamental problem with the adoption of effective policies for environmental preservation in poor developing countries is that most parties, including high level government officials, see economic growth as a first priority and see environmental policies as counterproductive to that goal at least in the short run. For example, in the literature on sustainable agriculture in Africa, incentives to abuse lands in order to feed growing populations have tended to outweigh those of natural resource management (Falloux and Mukendi; Okigbo).

This paper models the choice of a policy mix as a cooperative game among the various parties. Nash bargaining has been a common technique for modeling government action. It has appeared both in the case where the government acts unilaterally but is subject to political pressure from interest groups (Beghin and Karp) and where it acts multilaterally with other countries, multinational firms, or centrally organized groups within its own border (Chan).

Bargaining among a fixed group of players is typically modeled using a (possibly asymmetric) Nash bargaining solution (NBS), where the chosen actions maximize the product of utility gains. The possibility that coalitions may form or that the number of players who participate is endogenous has been considered primarily in the context of games to divide a fixed surplus (Hart and Kurz 1983; Aumann and Myerson 1988), but most international development programs involve a joint decision, such as a mix of development projects and fiscal policy variables, the outcome of which has many of the features of a public good.

Bargaining games with more than two players and nontransferable utility have been analyzed by Thomson and Lensberg, among others (see Thomson and Lensberg 1989). Allowing the parties in such games to have explicit economic or political roles can be modeled by considering an asymmetric NBS given by:

$$\max_x \prod_i (u^i(x) - \bar{u}^i)^{\alpha_i}$$

where the u^i are utility functions, x is a vector of choice variables, and the α_i are weights in the interior of a multi-dimensional simplex. This is the unique solution that satisfies individual rationality, invariance with respect to affine transformations, and independence of irrelevant alternatives. Utility gains to one player may be weighted more highly than gains to another player and the chosen levels of the policy instruments will reflect more the preferences of the player with the higher weight. The source of the asymmetry in such models is usually unclear. Also, an explicit coalition formation mechanism has not typically been part of the Nash bargaining approach.

This paper develops an alternative model of policy choice. It explicitly considers the source of power in bargaining games and includes an explicit rule for coalition formation, determination of coalition size and membership and, potentially, for coalition breaking. The model can be contrasted with the asymmetric-political-power model which uses an asymmetric NBS with weights reflecting players' political strength (*e.g.*, Beghin and Karp). In that model, a single bureaucrat/decision-maker chooses a policy that affects the set of players, and asymmetric weights reflect players' ability to influence him. In our model, players jointly choose and carry out the solution. A player uses his influence to persuade not some outside decision-maker but the other players to agree to the actions favorable to him. These considerations are motivated by the fact that government bureaucrats in many countries are major players both in terms of enacting *ad hoc* policies and receiving associated rents or bribes. Similar considerations may apply in developed countries where rents are in the form of political support.

There has also been recent work to model multi-player bargaining as a noncooperative game in the Rubinstein-Stahl tradition (Rausser and Simon; Merlo and Wilson). Rausser and Simon present an alternating offer model in which, in each round, nature randomly selects a player who proposes a policy and a coalition. All members of the proposed coalition must accept the proposal; otherwise, an additional round is played. Their proposed solution is the limit of equilibrium outcomes in finite horizon games. They show that if there is at least one player who must be part of any admissible coalition, then there is typically a unique, deterministic solution that is independent of the chosen proposer. In contrast, our paper is a cooperative game and we concentrate on outcomes and feasible sets rather than the bargaining process.

2. A Solution Concept for Games with an Essential Player

Consider n players who must come to a multidimensional decision $x \in X$. Utilities are u^i, defined on X, $i = 1, \ldots, n$. Let C be the set of possible coalitions and let $X_c \subseteq X$, $c \in C$, be the set of feasible decisions when the coalition is c. An agent is either a member of the winning coalition or not.[1] If x_c is chosen by the winning coalition c, each member i receives utility $u^i(x_c)$. For a player who is not a member of the winning coalition c, $u^i(x_c)$ represents the highest utility he can achieve given the group choice x_c. In the absence of any agreement, utility is $\bar{u}^i$.

We assume that player 1 must be part of any coalition; she is called an *essential player*. Although the presence of an essential player restricts the generality of the proposed solution, this role is in fact characteristic of a large number of bargaining situations, such as between firms and labor unions (the owner of capital is the essential player) or between sovereign governments and their creditors (the government is the essential player). Indeed, the essential player role appears to be a neglected area of study. An essential player appears in Rausser and Simon as well as in several classic cooperative games (*e.g.*, Moulin 1988, p. 111.)

Consider a coalition between players 1 and 2. If they reach an agreement, then the standard axioms (symmetry with respect to individuals, individual rationality, invariance with respect to affine transformations of utility, and independence of irrelevant alternatives) are invoked to imply that it must be the symmetric NBS given by

$$\max_{x \in X_{12}} \; [u^1(x) - \bar{u}^1]\,[u^2(x) - \bar{u}^2].$$

Only outcomes in which all components of the product are positive will be considered. Let x^*_{12} be the solution to the above problem if one exists. More generally, define x^*_{ij} as the solution to a symmetric two-player Nash bargaining game between players i and j with threat point $(\bar{u}^i, \bar{u}^j)$.

Conditional on a two-player coalition forming, player 1 is able to produce the coalition that provides her with the highest utility. Define utility from the two-player bargaining game as:

$$u^{1*}_{(2)} = \max_j \; [u^1(x^*_{1j})]$$

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[1]This is known as a simple game. A coalition is "an agreement among two or more persons to coordinate their actions" (Ordeshook, p. 302).

if $u^1(x^*_{1j}) > \overline{u}^1$ for at least one j. If no NBS exists for any {1,j}-games, define $u^{1*}_{(2)} = \overline{u}^1$.

Next, consider possible three-player coalitions. If a three-player coalition forms, we set up a symmetric three-player game but use as the threat point the utilities from the two-player game that would otherwise have been played.[2] Suppose the best two-player coalition for player 1 is {1,2}. We then make the outcome x^*_{12} the threat point for a three-player game. The solution for a coalition between players 1, 2, and 3 is defined as:

$$\max_{x \in X_{123}} \; [u^1(x) - u^1(x^*_{12})]\,[u^2(x) - u^2(x^*_{12})]\,[u^3(x) - u^3(x^*_{12})] \tag{1}$$

if a solution exists. On the other hand, if the best two-player coalition for player 1 is {1,3} then x^*_{13} is designated as the threat point for the three-player game and the proposed solution is:

$$\max_{x \in X_{123}} \; [u^1(x) - u^1(x^*_{13})]\,[u^2(x) - u^2(x^*_{13})]\,[u^3(x) - u^3(x^*_{13})]. \tag{2}$$

Let $u^{1*}_{(3)} = \max_k[u^1(x^*_{1jk})\,|j]$ be player 1's utility in a three-player bargaining game when {1,j} is the best two-player coalition for player 1. We call {1,j} the *shadow coalition.* The solution requires $u^1(x^*_{123}) > u^1(x^*_{1j})$, $u^2(x^*_{123}) > u^2(x^*_{1j})$, and $u^3(x^*_{123}) > u^3(x^*_{1j})$. If a solution to this set of inequalities does not exist, define $u^{1*}_{(3)} = u^{1*}_{(2)}$.

If a four-player coalition forms, the proposed solution is the symmetric multiple player NBS where the threat point is the best agreement player 1 can obtain in all smaller games. The extension to coalitions of arbitrary size m is then straightforward. In words, the proposed solution is the NBS of a symmetric bargaining game where the threat point is the vector of utilities in the best shadow coalition agreement that player 1 can achieve. The final (winning) coalition is of size m such that $u^{1*}_{(m)} \geq u^{1*}_{(j)}$ for all $j < m$.

The advantage of this recursive solution is that it models coalition formation with an

[2]Although the model is different, the motivation is similar to Grossman and Hart (1986), in which players' control of decision variables affects their disagreement point in a bargaining game.

intuitive and easily calculated solution. The model does not, however, provide a complete noncooperative game of the coalition formation process. Since asymmetric Nash bargaining has been particularly prominent in the interest group literature, we contrast our solution to the NBS where the Nash product is taken over the set of agents in a coalition chosen by the essential player.[3] There are at least two desirable properties of the proposed solution that are not shared by this NBS. These are described in Results 1 and 2. Proofs are in the Appendix.

Result 1: Let n = 3. Suppose the shadow coalition is {1,2}. Then a necessary condition for player 3 to be in the winning coalition is $X_{12} \not\supset X_{123}$. This statement is not true for the NBS.

In most models of cooperative public good provision with a variable number of players, including a (possibly asymmetric) Nash bargaining game, a player is helped by adding to the game players with similar preferences even if the feasible set shrinks. In our proposed solution, a similarity of preferences between players 1 and 3, for example, is not sufficient for player 3 to be added to the coalition {1,2} if {1,2} is the best two-player coalition for player 1. Player 3 must bring added opportunities. If players 1 and 3 are governments of developing countries, this result ensures that they gain nothing from bargaining together with an outside development agency unless this joint-bargaining brings expanded opportunities to the negotiating table.

In most games, we are interested in how the solution changes as exogenous variables change. Of particular interest are cases where the solution is not continuous but may change abruptly even when exogenous variables are changing smoothly. This corresponds to a frequently observed feature of political activity and economic development where prevailing policies change abruptly or political logjams are broken by seemingly minor changes in the policy environment

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[3]In most games, the winning coalition will consist of all n players (See our examples in the following Sections). Thus, our statements about the NBS are also true if there is no "choice" of coalition by the essential player.

(some examples are in Alesina 1989; Just 1993; Drazen and Grilli 1993). The proposed solution allows such discontinuous changes in the solution.

Let y be a parameter of the decision set, written $X_c(y)$; in the example below, y is player 3's income and therefore the maximum bribe he can offer the other players. We assume that utilities are differentiable and that $X_c(y)$ is smooth in y for all c. Under the proposed solution, equilibrium utilities will often be discontinuous in y. We state this as Result 2:

Result 2: Suppose there exist y, y′ such that $u^1(x^*_{12}(y)) > u^1(x^*_{1j}(y))$, $j \neq 2$, and $u^1(x^*_{13}(y')) > u^1(x^*_{1j}(y'))$, $j \neq 3$, where $x^*_{ij}(y)$ is the solution when the coalition is $\{i,j\}$ and the decision set is $X_c(y)$. Call this Condition A. If a three or more player coalition is winning, then equilibrium utilities will be discontinuous in y. Under the NBS, equilibrium utilities will almost always be continuous and differentiable in y.

Condition A states that there exists some value of y such that player 1's utility is highest in the two-player game with player 2, and some other value of y such that player 1's utility is highest in the two-player game with player 3. In other words, as y changes, the shadow coalition changes. A change in the shadow coalition changes threat points in subsequent levels of the game, changing the equilibrium outcome discontinuously.

A more restrictive version of Condition A when n = 3 is that $du^1(x^*_{12}(y))/dy > du^1(x^*_{13}(y))/dy$ for all y, and that there exist at least one value of y for which player 1 prefers to bargain with each of the other players if he were restricted to a two-player game. This form states that changes in y are more valuable to player 1 in some games than others. By Result 2, the solution will then be discontinuous in y.

3. A Simple Example of Interest Groups in a Developing Country

To demonstrate the solution concept developed in Section 2, consider a simple model of interest groups in a developing country where environmental concerns are externally important but internally of little interest to government. Major interest groups are government bureaucracy, trading institutions, and environmental groups. Suppose interests of other groups such as producer and consumer groups are taken into account in a reduced form sense insofar as they matter to government bureaucrats.

The utility of the government bureaucracy is represented by $u^g = r + \lambda\pi$ where r is government revenue and π represents private interests of producers and consumers. The private interests of producers and consumers may be regarded as the net private balance of trade for a competitive economy with net (restricted) profit function $\pi(p)$ reflecting private economic welfare where p is the price of the aggregate good produced and exported. Alternatively, π may be regarded as a reduced-form net benefit function for domestic producers and consumers, taking into account problems of hunger that result from tight environmental restrictions and low producer prices when sufficient food production is not induced. In either case, reasonable assumptions include $\pi_p = q > 0$, $\pi_{pp} = q_p > 0$ where q is aggregate supply of the exported good. Government revenue is derived from export taxes with $r = tq$ where t is the ad valorem export tax. Let $z(q)$ be the quantity of an environmental good such as biodiversity, rain forest, or range quality "used up" by production, with $z_q > 0$.

In many countries, major exports are traded by exporting institutions such as marketing boards. In such cases, the officials of the exporting institutions are pseudo-bureaucrats who typically benefit from the margins charged. Alternatively, private exporting institutions may act as middlemen who profit by the trading margin. In either case, the interests of the exporting institution are represented by the utility function $u^x = mq$ which is the profit earned from a per unit margin of m on the exported quantity q. Using a small country assumption, suppose world price is $\bar{p}$ so that domestic price after marketing margins and export taxes is $p = \bar{p} - m - t$.

Environmental interests are represented by the utility function $u^e = y + v(q) - b$ where y is wealth/income of the environmental group and b is a payment made to the developing country government (possibly to bureaucrats) to induce environmental preservation, sometimes labeled a bribe. A reasonable assumption is $y - b \geq 0$. Disutility from environmental destruction is $v(q) \equiv v(z(q))$ with $v_q < 0$. With the addition of the bribe payment, the utility of government becomes $u^g = tq + \lambda\pi + b$. The environmental group may be either an external interest such as a development agency of a developed government or a local in-country group. The external group can intervene by supplementing the income of the environmental group or the "bribe" payment to government as an additional incentive to protect global aspects of the environment. The objective of external intervention would be to discourage environmentally damaging production activity by raising export taxes.

Consider first the noncooperative Nash equilibrium which corresponds to the case where no coalitions form. In this case, trading institutions maximize utility by choosing the margin m to satisfy first order condition

$$u_m^x = q - mq_p = 0 \tag{3}$$

which yields $m = q/q_p > 0$.

The government bureaucracy maximizes utility by choosing the export tax rate to satisfy

$$u_t^g = q - tq_p - \lambda q = 0$$

which yields $t = (1 - \lambda)q/q_p$ and thus price level $p = p_0 \equiv \bar{p} - (2 - \lambda)q/q_p$. If the government values its revenues more highly than private profits at the margin, this tax rate is positive. This is typical of developing countries which tend to tax exports as compared to developed countries which tend to subsidize exports.

Now consider the impact of cooperation between x and g. The symmetric NBS satisfies

$$\max_{m,t} \Delta_0^g \Delta_0^x \tag{4}$$

where, in general, $\Delta_0^i = u^i - \bar{u}_0^i$ and $\bar{u}_0^i$ is the utility of group i in the noncooperative case, i = g, x, e. First-order conditions are

$$-(tq_p + \lambda q)\Delta_0^x + (q - mq_p)\Delta_0^g = 0 \tag{5}$$

$$(q - tq_p - \lambda q)\Delta_0^x - mq_p\Delta_0^g = 0 \tag{6}$$

which have solution $t + m = (1 - \lambda)q/q_p$ so that price becomes $p = p_{gx} \equiv \bar{p} - (1 - \lambda)q/q_p$. Substituting into the latter condition further reveals $\Delta_0^x = \Delta_0^g$. This result demonstrates that the coalition will reduce the export tax plus marketing margin so that domestic price rises, which induces more production. This results in greater welfare for private producers and consumers whose benefits are represented in π.

In this case as well as the no collusion case, the environmental group has no influence and thus maximizes its utility by setting b = 0. Without environmental policies, cooperation between g and x results in heavier environmental degradation than no cooperation. Thus, breaking this coalition would be important for environmental interests even if no further bargains between the environmental group and government occur.

4. Export Taxes and Environmental Policy

To analyze the role of environmental groups, consider the outcome when the government deals with, and only with, the environmental group. An agreement satisfies

$$\max_{t,b} \Delta_0^g \Delta_0^e. \tag{7}$$

In this case, the exporting institution is assumed to choose m noncooperatively as in (3) with solution $m = q/q_p$. Two possible outcomes occur depending on whether the income constraint of the environmental group, $y - b \geq 0$, is binding. If the constraint is not binding, then first order conditions are

$$(q - tq_p - \lambda q)\Delta_0^e - v_q q_p \Delta_0^g = 0 \tag{8}$$

$$\Delta_0^e - \Delta_0^g = 0 \tag{9}$$

which have solution $t = (1 - \lambda)(q/q_p) - v_q$ and $p = p_{ge} \equiv \bar{p} - (2 - \lambda)q/q_p + v_q$. If the constraint is binding, then only the condition in (8) applies along with $y = b$ which yields

$$t = \frac{(v - \bar{u}_0^e)(1 - \lambda)q/q_p - v_q(\lambda\pi + y - \bar{u}_0^g)}{v + v_q q - \bar{u}_0^e} \tag{10}$$

where the latter equality follows from $p = \bar{p} - m - t$ and $m = q/q_p$.

The outcome for the nonbinding-constraint case is the simultaneous solution to the system of equations (3), (8), and (9). Price is lower and t + m is higher in the government-environmental coalition (denoted $t_{ge} + m_{ge}$) than in the non-cooperative solution (denoted $t_0 + m_0$) in which case t + m is larger than in the government-trader coalition (denoted $t_{gx} + m_{gx}$). Thus, price and production among the three cases have the inverse ordering, $p_{ge} < p_0 < p_{gx}$ and $q_{ge} <$

$q_0 < q_{gx}$. This relationship also holds in the income constrained case.

In the case where all three groups are involved in negotiations, the agreement must satisfy

$$\max_{t,m,b} \Delta^g \Delta^x \Delta^e \tag{11}$$

where $\Delta^i = u^i - \bar{u}^i$. Disagreement utilities depend on the shadow coalition and are given by

$$\bar{u}^i = \begin{cases} \bar{u}^i_{gx} \text{ if } \bar{u}^g_{gx} > \bar{u}^g_{ge} \\ \bar{u}^i_{ge} \text{ if } \bar{u}^g_{gx} < \bar{u}^g_{ge}, \end{cases} \qquad i = g, x, e,$$

where $\bar{u}^i_{gx}$ and $\bar{u}^i_{ge}$ represent the optimal utility level of group i under the {g, x} and {g, e} coalitions, respectively.

For this problem, one can verify that the three-player coalition will always form. That is, starting from starting from any two-player outcome, there exists a policy triplet {m, t, b} that makes all parties better off.[4] To see this, note by total differentiation of utilities, a solution to the three-player game exists if dt, dm, and db satisfy

$$du^g = (q - tq_p - \lambda q)\ dt - (tq_p + \lambda q)\ dm + db > 0 \tag{12}$$

$$du^x = -mq_p\ dt + (q - mq_p)\ dm > 0 \tag{13}$$

$$du^e = -v_q q_p(dt + dm) - db > 0. \tag{14}$$

Starting from {g, x}, (6) implies $q - tq_p - \lambda q > 0$ and (5) implies $q - mq_p > 0$, and (5) and (6) together imply $(tq_p + \lambda q)/(q - tq_p - \lambda q) = (q - mq_p)/(mq_p)$. Thus, (13) implies $(q - tq_p - \lambda q)$ dt -

[4]There exist other, reasonable economic models in which three-way cooperation is not valuable; in other words, a two-player coalition is winning.

$(tq_p + \lambda q)$ dm < 0 which together with (12) implies db > 0. This in turn implies dt + dm > 0 in (14). Any dt > 0, dm > 0, and db > 0 suffices provided that $-v_q q_p(dt + dm) > db > -(q - tq_p - \lambda q)\, dt + (tq_p - \lambda q)\, dm > 0$, which is clearly possible.

Similarly, starting from {g, e}, if income is not constraining, (3) implies that dt < 0 from (13) and (8)-(9) imply $q - tq_p - \lambda q = v_q q_p < 0$ so that adding (12) and (14) yields -qdm > 0 and dm < 0. Thus, from (12) and (14), any dt < 0, dm < 0, and db < 0 suffices provided $-v_q q_p(dt + dm) > db > -v_q q_p(dt + dm) + q\, dm$ which is clearly possible. Alternatively, if income is constraining in {g, e}, then $v - \bar{u}_0^e > 0$ and $tq + \lambda\pi + y - \bar{u}_0^g > 0$ which implies that $q - tq_p - \lambda q < 0$ so the same proof follows.

These results show that the three-player coalition will improve the environment over the two-player case if {g,x} is the shadow coalition (dt + dm > 0 cause p and q to fall). This is accomplished by the environmental group paying a positive bribe as compensation. On the other hand, the three-player coalition leads to more environmental degradation compared to the two-player case if {g,e} is the shadow coalition (dt, dm < 0 cause p and q to rise). The environmental group is compensated by reducing the amount of the bribe (db < 0).

Given that a three-player coalition will always result, relevant questions are, what do the agreements look like and how are they affected by the shadow coalition?

5. Cooperation and the Egalitarian Solution

An interesting question is how behavior with full cooperation, the three-player outcome, differs from the outcome that maximizes the sum of benefits over all groups, also known as the Egalitarian solution. (Note that the sum of compensating and equivalent variations for this problem are unambiguously equal to $\Delta^g + \Delta^x + \Delta^e$.) To examine this relationship, consider first order conditions for the three-player solution in (11) when the income constraint is not binding,

$$(q - tq_p - \lambda q)\ \Delta^x\ \Delta^e - mq_p\ \Delta^g\ \Delta^e - v_q q_p\ \Delta^g\ \Delta^x = 0 \tag{15}$$

$$-(tq_p + \lambda q)\ \Delta^x\ \Delta^e + (q - mq_p)\ \Delta^g\ \Delta^e - v_q q_p\ \Delta^g\ \Delta^x = 0 \tag{16}$$

$$\Delta^x\ \Delta^e - \Delta^g\ \Delta^x = 0. \tag{17}$$

From (17) $\Delta^e = \Delta^g$ which from (15) and (16) implies $t + m = (1 - \lambda)(q/q_p) - v_q$ and $p = p_{gxe} \equiv \bar{p} - (1 - \lambda)q/q_p + v_q$. Clearly, $p_{ge} < p_{gxe} < p_{gx}$ and thus $q_{ge} < q_{gxe} < q_{gx}$. Furthermore, if government assigns a weight $\lambda = 1$ to the private interests of producers and consumers, then this outcome is equivalent to classical social welfare maximization where the marginal social benefit of production, $\bar{p}$, is equal to marginal private cost, p, plus the marginal "external" cost, $-v_q$. If $\lambda < 1$, then production is below the social optimum consistent with exploitation of private producers and consumers. In either case, bargaining plays the role of determining t, m, and b to divide the social welfare pie among the three players where pricing and production are fixed (at the social optimum if $\lambda = 1$). Thus, if income is not constraining, then bargaining and bribery by external agencies has no effect on prices, production, and environmental degradation even though it may influence income distribution.

6. The Importance of the Shadow Coalition in Poor Countries

A more interesting case in the context of developing countries is where the income constraint of environmental groups is binding. In this case, the bargaining solution for the three-player case satisfies (15), (16), and y = b. While this case is more difficult to treat analytically, a simple example can serve to illustrate important principles. Suppose $\lambda = 0$, $\pi = p^2/2$, $v = -q$, and $\bar{p} =$

3. This choice normalizes parameters so that price and production as well as the utility of both government and the exporter are 1 in the no collusion case. It also sets the marginal environmental damage equal to 1, which is one-third of the world value of production, so that utility of the environmental group is y - 1.

An understanding of the three-player outcome requires determining the appropriate threat point from the two-player game. Table 1 shows values of t, m, and p that occur in the (best) two-player game. Using the results of sections 3 and 4, the two-player results can be determined as a function of income of the environmental group as in Table 1. The interesting result in Table 1 is that when income is below some level y_0, {g,x} will be the shadow coalition, since the environmental group does not have sufficient economic resources to "break" it. It could not pay the government a sufficient amount to induce cooperation with the environmental group instead of the exporter. At intermediate income levels ($y_0 < y < y_1$), the environmental group could offer a sufficient bribe to break the government-exporter coalition, thus {g,e} is the appropriate shadow coalition. At higher income levels ($y > y_1$), {g,e} is still the shadow coalition, but the income constraint is not biding.

Note that $\bar{p}/2 = p(y_0) > (\bar{p} - 1)/3 = p(y_1)$ so the price/production/environmental-damage response to income of the environmental group is continuous and non-increasing in environmental group income. Similarly, government utility is continuous and non-decreasing. The utility of the exporter is non-increasing and the utility of the environmental group is strictly increasing, but both have a distinct point of discontinuity at the income level y_0 where the government-exporter coalition is broken.

The implications of these two-player outcomes are important because they form the threat points for the three-player negotiations. That is, as the $\bar{u}^i$ in (11) change, the outcome of the three-player negotiation changes. For the case where income is constraining, this also makes price, production, and environmental damage a function of the income of the environmental group. To demonstrate this dependence, Table 2 lists outcomes for the shadow two-player coalition and the winning three-player coalition, for $\bar{p} = 3$ and four values of y, representing the endpoints of income ranges that correspond to each shadow coalition regime.

These results demonstrate that a distinct discontinuity with respect to income occurs in the three-player solution for all variables except government utility. Most notably, at the income level $y_0 = .0039$ where the shadow coalition switches from {g,x} to {g,e}, the export tax increases by about 80 percent which induces environmentally damaging production to decline by about 50 percent. At this point, the exporter's utility also drops by about 43 percent and the environmental group's utility improves dramatically.

7. Impacts of External Intervention

We now turn to the implications of the above results for international development agencies or, in general, for external sovereign governments that wish to influence a more desirable environmental outcome in developing countries. Two interpretations are possible: the environmental group of this paper may represent the external agency directly or, more interestingly, the external agency can consider grants in aid that relax the income constraint of the environmental group or, equivalently, compensate developing country government for taking steps to improve the environment.

The result of most interest in Table 2 is the response of production or environmental damage to the income level of the environmental group. If an international development agency adopts a policy of supplementing the income level of the environmental group, then this response function may describe the response of transboundary environmental damage to strategic international aid. The result in Table 2 is that environmental damage declines continuously at a small rate in response to y up to an income level y_0. At the income level where the shadow coalition changes, a large and discrete decline occurs. This result is in sharp contrast to traditional competitive analyses where continuous responses are suggested throughout.

Above y_1, environmental damage is not reduced by an increase in y. Instead, the environmental group keeps the additional income, and may even extract a payment from the government ($b < 0$). The environmental group is able to do this because its high income gives it a good bargaining position, and allows it to convince the government to strike a hard bargain with traders that reduces the marketing margin. The government's utility is then improved by increasing the output tax. Environmental damage is unchanged.

From the standpoint of an international development agency seeking environmental improvement, this is an undesirable development, since the grant in aid is essentially used to line the pockets of the environmental group rather than employed in productive investments. One possibility suggested by the last section of Table 2 is the imposition of a condition whereby the environmental group cannot accept a (reverse) bribe. While enforcement and credibility of such a condition requires additional considerations, the results in the last section of Table 2 show that increasing y now leads to lower environmental damage, though at a decreasing rate.

8. Concluding Comments

The interesting opportunities suggested by this paper are where intervention by an external agency can cause an existing (shadow) coalition to be broken and replaced with another. In particular, the case of interest is where an environmental group is not a member of an existing (shadow) coalition but can be with external incentives or intervention.

In many countries, complementary relationships have arisen between government and prominent private firms historically. This paper shows how this behavior explains some observed marginal production below cost. Such agreements raise the government's utility above a noncooperative outcome, but often contribute to poor environmental conditions. Environmental groups or development agencies have an interest in improving environmental conditions and can do so by offering a lump sum payment in return for a specific policy reform.

This paper considers the possibility that environmental groups can supplant industry in the reigning coalition or in the shadow coalition that determines the bargaining outcome of the reigning coalition. Which outcome prevails depends on the financial resources of the environmental group, the utility it gets from environmental protection, and the contribution of industry to the economy. If external development agencies join forces with internal environmental interests or represent these interests at the bargaining table, then financial resources are more likely to be sufficient.

The results of this paper suggest that the potential for environmental improvements by strategic use of international aid is a complex issue. Marginal analysis may be of little value in identifying the most productive opportunities. In some countries, the marginal payoff of previous activities may continue in future endeavors. In other countries, a small increase in activities may achieve a major payoff even though past activities have been unproductive. In still other countries, unproductive activities can be expected to remain unproductive even with a major increase in effort.

The key in each case is to examine the characteristics of major interactions among government, the private sector, and environmental concerns. Assessment of the marginal improvement that can be purchased with a given increment in strategic aid may be much less important than determining how much strategic aid can cause a coalition or even a shadow coalition to break. Expanding strategic aid beyond these levels may be futile unless credible additional conditions can be imposed. The results here demonstrate that increasing external incentives may have limited marginal success in the context of a given coalition but may achieve distinct breakthroughs when the reigning coalition is altered.

At any point in time, a development agency faces a portfolio of development opportunities involving many countries. The problem is one of choosing the portfolio with the greatest payoff. Clearly, the success or performance of development activities depends on identifying potential breakthroughs and administering levels of incentives precisely to attain those breakthroughs.

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Table 1. Price, production, and utility in the two-player coalition case.

Variable	Income Level[a]		
	$y < y_0$	$y_0 < y < y_1$	$y > y_1$
Coalition	{g, x}	{g, e} with y = b	{g, e} with y > b
t	$\bar{p}/4$	$\bar{p} - 2p(y)$	$(\bar{p} + 2)/3$
m	$\bar{p}/4$	$p(y)$	$(\bar{p} - 1)/3$
p = q	$\bar{p}/2$	$p(y)$	$(\bar{p} - 1)/3$
u^g	$\bar{p}^2/8$	$\bar{p}p(y) - 2p^2(y) + y$	$(2\bar{p}^2 + \bar{p} + 1)/18$
u^x	$\bar{p}^2/8$	$p^2(y)$	$(\bar{p}^2 - 2\bar{p} + 1)/9$
u^e	$y - \bar{p}/2$	$-p(y)$	$y - (5\bar{p} - 1)/18$

[a] Note that $p(y) = .3(\bar{p} - y) - .3(\bar{p}^2 + 18y + 180y + 81y^2)^{-.5}$, $y_1 = (5 - \bar{p})/18$, and y_0 is defined by $\bar{p}^2/8 = \bar{p}p(y) - 2p^2(y) + y$. Also note that $y_1 > y_0$ is assured by $\bar{p} < 4.8284$; otherwise, the {g,x} coalition is the shadow coalition for all income levels.

Table 2. Price, production, and utility and the shadow coalition.

Variable	Shadow Two-Player Coalition				
	{g, x}		{g, e} with y = b		{g, e} with y > b
Two-Player Outcome					
y	.0000	.0039	.0039	.1111	>.1111
t	.7500	.7500	1.4121	1.6667	1.6667
m	.7500	.7500	.7939	.6667	.6667
p = q	1.5000	1.5000	.7939	.6667	.6667
u^g	1.1250	1.1250	1.1250	1.2222	1.2222
u^x	1.1250	1.1250	.6303	.4444	.4444
u^e	-1.5000	-1.4961	-.7939	-.6667	y - .7777
b	.0000	.0000	.0039	.1111	.1111
Three-Player Outcome					
y	.0000	.0039	.0039	.1111	>.1111
t	.7500	.7519	1.3555	1.5185	1.5185
m	.7500	.7519	.6445	.4815	.4815
p = q	1.5000	1.4961	1.0000	1.0000	1.0000
u^g	1.1250	1.1288	1.1392	1.2593	1.2593
u^x	1.1250	1.1250	.6445	.4815	.4815
u^e	-1.5000	-1.4961	-.7798	-.6296	y -.7407
b	.0000	.0039	-.2164	-.2593	-.2593
Three-Player Outcome Constrained by $b \geq 0$					
y	.0000	.0039	.0039	.1111	>.1111
t	.7500	.7519	1.4121	1.6508	1.6318
m	.7500	.7519	.7901	.5714	.6083
p = q	1.5000	1.4961	.7978	.7778	.7600
u^g	1.1250	1.1288	1.1266	1.2840	1.2401
u^x	1.1250	1.1250	.6303	.4444	.4623
u^e	-1.5000	-1.4961	-.7939	-.6667	y -.7600

Political Coalition Breaking and Sustainability of Policy Reform

by

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Political Coalition Breaking and Sustainability of Policy Reform

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Abstract

This paper examines the need and potential for coalition breaking in policy reform efforts related to agriculture and the environment. The objective is to consider traditional policy tools that can break existing political coalitions, given the powerful noncompetitive role of strong interest groups such as government bureaucracy and large trading organizations. Choice of the policy mix is modeled as a cooperative game. A modification of the Nash bargaining solution is used to endogenize coalition formation. This framework is then used to examine the potential for an external development agency to promote environmental interests in the policy formation process. The results explain how in some countries a small increase in strategic aid may achieve a major breakthrough in policy reform even if past activities have been unproductive and how, in other countries, a major increase in aid may be fruitless.

JEL classification codes: O19, C78

Keywords: Coalition formation, interest groups, nongovernmental organizations, environmental policy

Political Coalition Breaking and Sustainability of Policy Reform

1. Introduction

Many policies and institutions that have been in place in developing countries for many years have the effect of redistributing welfare in favor of powerful vested interests and constituencies including members of government bureaucracies. Policy reform efforts are directed at removing the social inefficiencies arising from these policies and institutions. Accordingly, most welfare improving policy reforms tend to adversely affect some interest groups. When powerful interest groups are adversely affected, even the best policy reforms from the public interest perspective will be blocked by interest group efforts to influence the political process. Moreover, even when welfare improving policies are successfully enacted, their beneficial effects are often partially or wholly mitigated by welfare redistributing policies enacted under ensuing pressure from the adversely affected interest groups. These realities imply that schemes to make welfare improving policies politically sustainable must consider existing coalitions, what measures are necessary to break existing coalitions, and what policies can cause new coalitions to arise. That is, useful policy reforms must be supported by new sustainable coalitions if they are to prosper.

One problem where these considerations are crucial is natural resource management in developing countries. Management policies call for political bargaining and negotiation both inside and outside of government (Honadle and Cooper; Gamman; Wilson and Morren). Many significant domestic policy problems related to agriculture and the environment have strong special interest groups including marketing organizations, producers, and government bureacrats. These interest groups are often sufficiently powerful to block environmental programs for biodiversity, forest and range management, water quality, and soil conservation. For example, environmental restrictions on land use are perceived as detrimental by agricultural producers and government officials concerned with economic growth. Resource management restrictions have the effect of transferring income and utility among producer, consumer and environmental groups. Can available policy instruments be used to compensate key interest groups and break the coalitions blocking environmental policies?

The objective of this paper is to examine conceptually the need and potential for coalition breaking in policy reform efforts related to agriculture and the environment. Several preliminary studies have been undertaken along these lines. However, these studies evaluate welfare assuming unrealistic lump sum transfers and assume competitive reactions of individual agents to alternative compensation schemes. The objective here is to consider compensation schemes that can break existing coalitions in the context of possibilities that are institutionally feasible and politically sustainable given the powerful noncompetitive role of interest groups. These problems are typified by collective action of groups representing, for example, government bureaucracy and trading institutions. A fundamental problem with the adoption of effective policies for environmental preservation in poor developing countries is that most parties, including high level government officials, see economic growth as a first priority and see environmental policies as counterproductive to that goal at least in the short run. For example, in the literature on sustainable agriculture in Africa, incentives to abuse lands in order to feed growing populations have tended to outweigh those of natural resource management (Falloux and Mukendi; Okigbo).

This paper models the choice of a policy mix as a cooperative game among the various parties. Nash bargaining has been a common technique for modeling government action. It has appeared both in the case where the government acts unilaterally but is subject to political pressure from interest groups (Beghin and Karp) and where it acts multilaterally with other countries, multinational firms, or centrally organized groups within its own border (Chan).

Bargaining among a fixed group of players is typically modeled using a (possibly asymmetric) Nash bargaining solution (NBS), where the chosen actions maximize the product of utility gains. The possibility that coalitions may form or that the number of players who participate is endogenous has been considered primarily in the context of games to divide a fixed surplus (Hart and Kurz 1983; Aumann and Myerson 1988), but most international development programs involve a joint decision, such as a mix of development projects and fiscal policy variables, the outcome of which has many of the features of a public good.

Bargaining games with more than two players and nontransferable utility have been analyzed by Thomson and Lensberg, among others (see Thomson and Lensberg 1989). Allowing the parties in such games to have explicit economic or political roles can be modeled by considering an asymmetric NBS given by:

$$\max_{x} \prod_{i} (u^{i}(x) - \bar{u}^{i})^{\alpha_i}$$

where the u^i are utility functions, x is a vector of choice variables, and the α_i are weights in the interior of a multi-dimensional simplex. This is the unique solution that satisfies individual rationality, invariance with respect to affine transformations, and independence of irrelevant alternatives. Utility gains to one player may be weighted more highly than gains to another player and the chosen levels of the policy instruments will reflect more the preferences of the player with the higher weight. The source of the asymmetry in such models is usually unclear. Also, an explicit coalition formation mechanism has not typically been part of the Nash bargaining approach.

This paper develops an alternative model of policy choice. It explicitly considers the source of power in bargaining games and includes an explicit rule for coalition formation, determination of coalition size and membership and, potentially, for coalition breaking. The model can be contrasted with the asymmetric-political-power model which uses an asymmetric NBS with weights reflecting players' political strength (*e.g.*, Beghin and Karp). In that model, a single bureaucrat/decision-maker chooses a policy that affects the set of players, and asymmetric weights reflect players' ability to influence him. In our model, players jointly choose and carry out the solution. A player uses his influence to persuade not some outside decision-maker but the other players to agree to the actions favorable to him. These considerations are motivated by the fact that government bureaucrats in many countries are major players both in terms of enacting *ad hoc* policies and receiving associated rents or bribes. Similar considerations may apply in developed countries where rents are in the form of political support.

There has also been recent work to model multi-player bargaining as a noncooperative game in the Rubinstein-Stahl tradition (Rausser and Simon; Merlo and Wilson). Rausser and Simon present an alternating offer model in which, in each round, nature randomly selects a player who proposes a policy and a coalition. All members of the proposed coalition must accept the proposal; otherwise, an additional round is played. Their proposed solution is the limit of equilibrium outcomes in finite horizon games. They show that if there is at least one player who must be part of any admissible coalition, then there is typically a unique, deterministic solution that is independent of the chosen proposer. In contrast, our paper is a cooperative game and we concentrate on outcomes and feasible sets rather than the bargaining process.

2. A Solution Concept for Games with an Essential Player

Consider n players who must come to a multidimensional decision $x \in X$. Utilities are u^i, defined on X, $i = 1, ..., n$. Let C be the set of possible coalitions and let $X_c \subseteq X$, $c \in C$, be the set of feasible decisions when the coalition is c. An agent is either a member of the winning coalition or not.[1] If x_c is chosen by the winning coalition c, each member i receives utility $u^i(x_c)$. For a player who is not a member of the winning coalition c, $u^i(x_c)$ represents the highest utility he can achieve given the group choice x_c. In the absence of any agreement, utility is $\bar{u}^i$.

We assume that player 1 must be part of any coalition; she is called an *essential player*. Although the presence of an essential player restricts the generality of the proposed solution, this role is in fact characteristic of a large number of bargaining situations, such as between firms and labor unions (the owner of capital is the essential player) or between sovereign governments and their creditors (the government is the essential player). Indeed, the essential player role appears to be a neglected area of study. An essential player appears in Rausser and Simon as well as in several classic cooperative games (*e.g.*, Moulin 1988, p. 111.)

Consider a coalition between players 1 and 2. If they reach an agreement, then the standard axioms (symmetry with respect to individuals, individual rationality, invariance with respect to affine transformations of utility, and independence of irrelevant alternatives) are invoked to imply that it must be the symmetric NBS given by

$$\max_{x \in X_{12}} [u^1(x) - \bar{u}^1]\,[u^2(x) - \bar{u}^2].$$

Only outcomes in which all components of the product are positive will be considered. Let x^*_{12} be the solution to the above problem if one exists. More generally, define x^*_{ij} as the solution to a symmetric two-player Nash bargaining game between players i and j with threat point $(\bar{u}^i, \bar{u}^j)$.

Conditional on a two-player coalition forming, player 1 is able to produce the coalition that provides her with the highest utility. Define utility from the two-player bargaining game as:

$$u^{1*}_{(2)} = \max_j \, [u^1(x^*_{1j})]$$

[1]This is known as a simple game. A coalition is "an agreement among two or more persons to coordinate their actions" (Ordeshook, p. 302).

if $u^1(x^*_{1j}) > \bar{u}^1$ for at least one j. If no NBS exists for any {1,j}-games, define $u^{1*}_{(2)} = \bar{u}^1$.

Next, consider possible three-player coalitions. If a three-player coalition forms, we set up a symmetric three-player game but use as the threat point the utilities from the two-player game that would otherwise have been played.[2] Suppose the best two-player coalition for player 1 is {1,2}. We then make the outcome x^*_{12} the threat point for a three-player game. The solution for a coalition between players 1, 2, and 3 is defined as:

$$\max_{x \in X_{123}} [u^1(x) - u^1(x^*_{12})]\,[u^2(x) - u^2(x^*_{12})]\,[u^3(x) - u^3(x^*_{12})] \tag{1}$$

if a solution exists. On the other hand, if the best two-player coalition for player 1 is {1,3} then x^*_{13} is designated as the threat point for the three-player game and the proposed solution is:

$$\max_{x \in X_{123}} [u^1(x) - u^1(x^*_{13})]\,[u^2(x) - u^2(x^*_{13})]\,[u^3(x) - u^3(x^*_{13})]. \tag{2}$$

Let $u^{1*}_{(3)} = \max_k[u^1(x^*_{1jk})\,|j]$ be player 1's utility in a three-player bargaining game when {1,j} is the best two-player coalition for player 1. We call {1,j} the *shadow coalition.* The solution requires $u^1(x^*_{123}) > u^1(x^*_{1j})$, $u^2(x^*_{123}) > u^2(x^*_{1j})$, and $u^3(x^*_{123}) > u^3(x^*_{1j})$. If a solution to this set of inequalities does not exist, define $u^{1*}_{(3)} = u^{1*}_{(2)}$.

If a four-player coalition forms, the proposed solution is the symmetric multiple player NBS where the threat point is the best agreement player 1 can obtain in all smaller games. The extension to coalitions of arbitrary size m is then straightforward. In words, the proposed solution is the NBS of a symmetric bargaining game where the threat point is the vector of utilities in the best shadow coalition agreement that player 1 can achieve. The final (winning) coalition is of size m such that $u^{1*}_{(m)} \geq u^{1*}_{(j)}$ for all $j < m$.

The advantage of this recursive solution is that it models coalition formation with an

[2]Although the model is different, the motivation is similar to Grossman and Hart (1986), in which players' control of decision variables affects their disagreement point in a bargaining game.

intuitive and easily calculated solution. The model does not, however, provide a complete noncooperative game of the coalition formation process. Since asymmetric Nash bargaining has been particularly prominent in the interest group literature, we contrast our solution to the NBS where the Nash product is taken over the set of agents in a coalition chosen by the essential player.[3] There are at least two desirable properties of the proposed solution that are not shared by this NBS. These are described in Results 1 and 2. Proofs are in the Appendix.

Result 1: Let n = 3. Suppose the shadow coalition is {1,2}. Then a necessary condition for player 3 to be in the winning coalition is $X_{12} \not\supseteq X_{123}$. This statement is not true for the NBS.

In most models of cooperative public good provision with a variable number of players, including a (possibly asymmetric) Nash bargaining game, a player is helped by adding to the game players with similar preferences even if the feasible set shrinks. In our proposed solution, a similarity of preferences between players 1 and 3, for example, is not sufficient for player 3 to be added to the coalition {1,2} if {1,2} is the best two-player coalition for player 1. Player 3 must bring added opportunities. If players 1 and 3 are governments of developing countries, this result ensures that they gain nothing from bargaining together with an outside development agency unless this joint-bargaining brings expanded opportunities to the negotiating table.

In most games, we are interested in how the solution changes as exogenous variables change. Of particular interest are cases where the solution is not continuous but may change abruptly even when exogenous variables are changing smoothly. This corresponds to a frequently observed feature of political activity and economic development where prevailing policies change abruptly or political logjams are broken by seemingly minor changes in the policy environment

[3]In most games, the winning coalition will consist of all n players (See our examples in the following Sections). Thus, our statements about the NBS are also true if there is no "choice" of coalition by the essential player.

(some examples are in Alesina 1989; Just 1993; Drazen and Grilli 1993). The proposed solution allows such discontinuous changes in the solution.

Let y be a parameter of the decision set, written $X_c(y)$; in the example below, y is player 3's income and therefore the maximum bribe he can offer the other players. We assume that utilities are differentiable and that $X_c(y)$ is smooth in y for all c. Under the proposed solution, equilibrium utilities will often be discontinuous in y. We state this as Result 2:

Result 2: Suppose there exist y, y′ such that $u^1(x^*_{12}(y)) > u^1(x^*_{1j}(y))$, $j \neq 2$, and $u^1(x^*_{13}(y')) > u^1(x^*_{1j}(y'))$, $j \neq 3$, where $x^*_{ij}(y)$ is the solution when the coalition is {i,j} and the decision set is $X_c(y)$. Call this Condition A. If a three or more player coalition is winning, then equilibrium utilities will be discontinuous in y. Under the NBS, equilibrium utilities will almost always be continuous and differentiable in y.

Condition A states that there exists some value of y such that player 1's utility is highest in the two-player game with player 2, and some other value of y such that player 1's utility is highest in the two-player game with player 3. In other words, as y changes, the shadow coalition changes. A change in the shadow coalition changes threat points in subsequent levels of the game, changing the equilibrium outcome discontinuously.

A more restrictive version of Condition A when n = 3 is that $du^1(x^*_{12}(y))/dy > du^1(x^*_{13}(y))/dy$ for all y, and that there exist at least one value of y for which player 1 prefers to bargain with each of the other players if he were restricted to a two-player game. This form states that changes in y are more valuable to player 1 in some games than others. By Result 2, the solution will then be discontinuous in y.

3. A Simple Example of Interest Groups in a Developing Country

To demonstrate the solution concept developed in Section 2, consider a simple model of interest groups in a developing country where environmental concerns are externally important but internally of little interest to government. Major interest groups are government bureaucracy, trading institutions, and environmental groups. Suppose interests of other groups such as producer and consumer groups are taken into account in a reduced form sense insofar as they matter to government bureaucrats.

The utility of the government bureaucracy is represented by $u^g = r + \lambda\pi$ where r is government revenue and π represents private interests of producers and consumers. The private interests of producers and consumers may be regarded as the net private balance of trade for a competitive economy with net (restricted) profit function $\pi(p)$ reflecting private economic welfare where p is the price of the aggregate good produced and exported. Alternatively, π may be regarded as a reduced-form net benefit function for domestic producers and consumers, taking into account problems of hunger that result from tight environmental restrictions and low producer prices when sufficient food production is not induced. In either case, reasonable assumptions include $\pi_p = q > 0$, $\pi_{pp} = q_p > 0$ where q is aggregate supply of the exported good. Government revenue is derived from export taxes with $r = tq$ where t is the ad valorem export tax. Let z(q) be the quantity of an environmental good such as biodiversity, rain forest, or range quality "used up" by production, with $z_q > 0$.

In many countries, major exports are traded by exporting institutions such as marketing boards. In such cases, the officials of the exporting institutions are pseudo-bureaucrats who typically benefit from the margins charged. Alternatively, private exporting institutions may act as middlemen who profit by the trading margin. In either case, the interests of the exporting institution are represented by the utility function $u^x = mq$ which is the profit earned from a per unit margin of m on the exported quantity q. Using a small country assumption, suppose world price is $\bar{p}$ so that domestic price after marketing margins and export taxes is $p = \bar{p} - m - t$.

Environmental interests are represented by the utility function $u^e = y + v(q) - b$ where y is wealth/income of the environmental group and b is a payment made to the developing country government (possibly to bureaucrats) to induce environmental preservation, sometimes labeled a bribe. A reasonable assumption is $y - b \geq 0$. Disutility from environmental destruction is $v(q) \equiv v(z(q))$ with $v_q < 0$. With the addition of the bribe payment, the utility of government becomes $u^g = tq + \lambda\pi + b$. The environmental group may be either an external interest such as a development agency of a developed government or a local in-country group. The external group can intervene by supplementing the income of the environmental group or the "bribe" payment to government as an additional incentive to protect global aspects of the environment. The objective of external intervention would be to discourage environmentally damaging production activity by raising export taxes.

Consider first the noncooperative Nash equilibrium which corresponds to the case where no coalitions form. In this case, trading institutions maximize utility by choosing the margin m to satisfy first order condition

$$u_m^x = q - mq_p = 0 \tag{3}$$

which yields $m = q/q_p > 0$.

The government bureaucracy maximizes utility by choosing the export tax rate to satisfy

$$u_t^g = q - tq_p - \lambda q = 0$$

which yields $t = (1 - \lambda)q/q_p$ and thus price level $p = p_0 \equiv \bar{p} - (2 - \lambda)q/q_p$. If the government values its revenues more highly than private profits at the margin, this tax rate is positive. This is typical of developing countries which tend to tax exports as compared to developed countries which tend to subsidize exports.

Now consider the impact of cooperation between x and g. The symmetric NBS satisfies

$$\max_{m,t} \Delta_0^g \Delta_0^x \tag{4}$$

where, in general, $\Delta_0^i = u^i - \bar{u}_0^i$ and $\bar{u}_0^i$ is the utility of group i in the noncooperative case, i = g, x, e. First-order conditions are

$$-(tq_p + \lambda q)\Delta_0^x + (q - mq_p)\Delta_0^g = 0 \tag{5}$$

$$(q - tq_p - \lambda q)\Delta_0^x - mq_p\Delta_0^g = 0 \tag{6}$$

which have solution $t + m = (1 - \lambda)q/q_p$ so that price becomes $p = p_{gx} \equiv \bar{p} - (1 - \lambda)q/q_p$. Substituting into the latter condition further reveals $\Delta_0^x = \Delta_0^g$. This result demonstrates that the coalition will reduce the export tax plus marketing margin so that domestic price rises, which induces more production. This results in greater welfare for private producers and consumers whose benefits are represented in π.

In this case as well as the no collusion case, the environmental group has no influence and thus maximizes its utility by setting b = 0. Without environmental policies, cooperation between g and x results in heavier environmental degradation than no cooperation. Thus, breaking this coalition would be important for environmental interests even if no further bargains between the environmental group and government occur.

4. Export Taxes and Environmental Policy

To analyze the role of environmental groups, consider the outcome when the government deals with, and only with, the environmental group. An agreement satisfies

$$\max_{t,b} \Delta_0^g \Delta_0^e. \tag{7}$$

In this case, the exporting institution is assumed to choose m noncooperatively as in (3) with solution $m = q/q_p$. Two possible outcomes occur depending on whether the income constraint of the environmental group, $y - b \geq 0$, is binding. If the constraint is not binding, then first order conditions are

$$(q - tq_p - \lambda q)\Delta_0^e - v_q q_p \Delta_0^g = 0 \tag{8}$$

$$\Delta_0^e - \Delta_0^g = 0 \tag{9}$$

which have solution $t = (1 - \lambda)(q/q_p) - v_q$ and $p = p_{ge} \equiv \bar{p} - (2 - \lambda)q/q_p + v_q$. If the constraint is binding, then only the condition in (8) applies along with $y = b$ which yields

$$t = \frac{(v - \bar{u}_0^e)(1 - \lambda)q/q_p - v_q(\lambda\pi + y - \bar{u}_0^g)}{v + v_q q - \bar{u}_0^e} \tag{10}$$

where the latter equality follows from $p = \bar{p} - m - t$ and $m = q/q_p$.

The outcome for the nonbinding-constraint case is the simultaneous solution to the system of equations (3), (8), and (9). Price is lower and t + m is higher in the government-environmental coalition (denoted $t_{ge} + m_{ge}$) than in the non-cooperative solution (denoted $t_0 + m_0$) in which case t + m is larger than in the government-trader coalition (denoted $t_{gx} + m_{gx}$). Thus, price and production among the three cases have the inverse ordering, $p_{ge} < p_0 < p_{gx}$ and $q_{ge} <$

$q_0 < q_{gx}$. This relationship also holds in the income constrained case.

In the case where all three groups are involved in negotiations, the agreement must satisfy

$$\max_{t,m,b} \Delta^g \Delta^x \Delta^e \tag{11}$$

where $\Delta^i = u^i - \bar{u}^i$. Disagreement utilities depend on the shadow coalition and are given by

$$\bar{u}^i = \begin{cases} \bar{u}^i_{gx} \text{ if } \bar{u}^g_{gx} > \bar{u}^g_{ge} \\ \bar{u}^i_{ge} \text{ if } \bar{u}^g_{gx} < \bar{u}^g_{ge}, \end{cases} \qquad i = g, x, e,$$

where $\bar{u}^i_{gx}$ and $\bar{u}^i_{ge}$ represent the optimal utility level of group i under the {g, x} and {g, e} coalitions, respectively.

For this problem, one can verify that the three-player coalition will always form. That is, starting from starting from any two-player outcome, there exists a policy triplet {m, t, b} that makes all parties better off.[4] To see this, note by total differentiation of utilities, a solution to the three-player game exists if dt, dm, and db satisfy

$$du^g = (q - tq_p - \lambda q)\, dt - (tq_p + \lambda q)\, dm + db > 0 \tag{12}$$

$$du^x = -mq_p\, dt + (q - mq_p)\, dm > 0 \tag{13}$$

$$du^e = -v_q q_p(dt + dm) - db > 0. \tag{14}$$

Starting from {g, x}, (6) implies $q - tq_p - \lambda q > 0$ and (5) implies $q - mq_p > 0$, and (5) and (6) together imply $(tq_p + \lambda q)/(q - tq_p - \lambda q) = (q - mq_p)/(mq_p)$. Thus, (13) implies $(q - tq_p - \lambda q)$ dt -

[4]There exist other, reasonable economic models in which three-way cooperation is not valuable; in other words, a two-player coalition is winning.

$(tq_p + \lambda q)\ dm < 0$ which together with (12) implies $db > 0$. This in turn implies $dt + dm > 0$ in (14). Any $dt > 0$, $dm > 0$, and $db > 0$ suffices provided that $-v_q q_p(dt + dm) > db > -(q - tq_p - \lambda q)\ dt + (tq_p - \lambda q)\ dm > 0$, which is clearly possible.

Similarly, starting from {g, e}, if income is not constraining, (3) implies that $dt < 0$ from (13) and (8)-(9) imply $q - tq_p - \lambda q = v_q q_p < 0$ so that adding (12) and (14) yields $-qdm > 0$ and $dm < 0$. Thus, from (12) and (14), any $dt < 0$, $dm < 0$, and $db < 0$ suffices provided $-v_q q_p(dt + dm) > db > -v_q q_p(dt + dm) + q\ dm$ which is clearly possible. Alternatively, if income is constraining in {g, e}, then $v - \bar{u}_0^e > 0$ and $tq + \lambda\pi + y - \bar{u}_0^g > 0$ which implies that $q - tq_p - \lambda q < 0$ so the same proof follows.

These results show that the three-player coalition will improve the environment over the two-player case if {g,x} is the shadow coalition ($dt + dm > 0$ cause p and q to fall). This is accomplished by the environmental group paying a positive bribe as compensation. On the other hand, the three-player coalition leads to more environmental degradation compared to the two-player case if {g,e} is the shadow coalition ($dt, dm < 0$ cause p and q to rise). The environmental group is compensated by reducing the amount of the bribe ($db < 0$).

Given that a three-player coalition will always result, relevant questions are, what do the agreements look like and how are they affected by the shadow coalition?

5. Cooperation and the Egalitarian Solution

An interesting question is how behavior with full cooperation, the three-player outcome, differs from the outcome that maximizes the sum of benefits over all groups, also known as the Egalitarian solution. (Note that the sum of compensating and equivalent variations for this problem are unambiguously equal to $\Delta^g + \Delta^x + \Delta^e$.) To examine this relationship, consider first order conditions for the three-player solution in (11) when the income constraint is not binding,

$$(q - tq_p - \lambda q)\ \Delta^x\ \Delta^e - mq_p\ \Delta^g\ \Delta^e - v_q q_p\ \Delta^g\ \Delta^x = 0 \tag{15}$$

$$-(tq_p + \lambda q)\ \Delta^x\ \Delta^e + (q - mq_p)\ \Delta^g\ \Delta^e - v_q q_p\ \Delta^g\ \Delta^x = 0 \tag{16}$$

$$\Delta^x\ \Delta^e - \Delta^g\ \Delta^x = 0. \tag{17}$$

From (17) $\Delta^e = \Delta^g$ which from (15) and (16) implies $t + m = (1 - \lambda)(q/q_p) - v_q$ and $p = p_{gxe} \equiv \bar{p} - (1 - \lambda)q/q_p + v_q$. Clearly, $p_{ge} < p_{gxe} < p_{gx}$ and thus $q_{ge} < q_{gxe} < q_{gx}$. Furthermore, if government assigns a weight $\lambda = 1$ to the private interests of producers and consumers, then this outcome is equivalent to classical social welfare maximization where the marginal social benefit of production, $\bar{p}$, is equal to marginal private cost, p, plus the marginal "external" cost, $-v_q$. If $\lambda < 1$, then production is below the social optimum consistent with exploitation of private producers and consumers. In either case, bargaining plays the role of determining t, m, and b to divide the social welfare pie among the three players where pricing and production are fixed (at the social optimum if $\lambda = 1$). Thus, if income is not constraining, then bargaining and bribery by external agencies has no effect on prices, production, and environmental degradation even though it may influence income distribution.

6. The Importance of the Shadow Coalition in Poor Countries

A more interesting case in the context of developing countries is where the income constraint of environmental groups is binding. In this case, the bargaining solution for the three-player case satisfies (15), (16), and y = b. While this case is more difficult to treat analytically, a simple example can serve to illustrate important principles. Suppose $\lambda = 0$, $\pi = p^2/2$, $v = -q$, and $\bar{p} =$

3. This choice normalizes parameters so that price and production as well as the utility of both government and the exporter are 1 in the no collusion case. It also sets the marginal environmental damage equal to 1, which is one-third of the world value of production, so that utility of the environmental group is y - 1.

An understanding of the three-player outcome requires determining the appropriate threat point from the two-player game. Table 1 shows values of t, m, and p that occur in the (best) two-player game. Using the results of sections 3 and 4, the two-player results can be determined as a function of income of the environmental group as in Table 1. The interesting result in Table 1 is that when income is below some level y_0, {g,x} will be the shadow coalition, since the environmental group does not have sufficient economic resources to "break" it. It could not pay the government a sufficient amount to induce cooperation with the environmental group instead of the exporter. At intermediate income levels ($y_0 < y < y_1$), the environmental group could offer a sufficient bribe to break the government-exporter coalition, thus {g,e} is the appropriate shadow coalition. At higher income levels ($y > y_1$), {g,e} is still the shadow coalition, but the income constraint is not biding.

Note that $\overline{p}/2 = p(y_0) > (\overline{p} - 1)/3 = p(y_1)$ so the price/production/environmental-damage response to income of the environmental group is continuous and non-increasing in environmental group income. Similarly, government utility is continuous and non-decreasing. The utility of the exporter is non-increasing and the utility of the environmental group is strictly increasing, but both have a distinct point of discontinuity at the income level y_0 where the government-exporter coalition is broken.

The implications of these two-player outcomes are important because they form the threat points for the three-player negotiations. That is, as the $\overline{u}^i$ in (11) change, the outcome of the three-player negotiation changes. For the case where income is constraining, this also makes price, production, and environmental damage a function of the income of the environmental group. To demonstrate this dependence, Table 2 lists outcomes for the shadow two-player coalition and the winning three-player coalition, for $\bar{p} = 3$ and four values of y, representing the endpoints of income ranges that correspond to each shadow coalition regime.

These results demonstrate that a distinct discontinuity with respect to income occurs in the three-player solution for all variables except government utility. Most notably, at the income level $y_0 = .0039$ where the shadow coalition switches from {g,x} to {g,e}, the export tax increases by about 80 percent which induces environmentally damaging production to decline by about 50 percent. At this point, the exporter's utility also drops by about 43 percent and the environmental group's utility improves dramatically.

7. Impacts of External Intervention

We now turn to the implications of the above results for international development agencies or, in general, for external sovereign governments that wish to influence a more desirable environmental outcome in developing countries. Two interpretations are possible: the environmental group of this paper may represent the external agency directly or, more interestingly, the external agency can consider grants in aid that relax the income constraint of the environmental group or, equivalently, compensate developing country government for taking steps to improve the environment.

The result of most interest in Table 2 is the response of production or environmental damage to the income level of the environmental group. If an international development agency adopts a policy of supplementing the income level of the environmental group, then this response function may describe the response of transboundary environmental damage to strategic international aid. The result in Table 2 is that environmental damage declines continuously at a small rate in response to y up to an income level y_0. At the income level where the shadow coalition changes, a large and discrete decline occurs. This result is in sharp contrast to traditional competitive analyses where continuous responses are suggested throughout.

Above y_1, environmental damage is not reduced by an increase in y. Instead, the environmental group keeps the additional income, and may even extract a payment from the government ($b < 0$). The environmental group is able to do this because its high income gives it a good bargaining position, and allows it to convince the government to strike a hard bargain with traders that reduces the marketing margin. The government's utility is then improved by increasing the output tax. Environmental damage is unchanged.

From the standpoint of an international development agency seeking environmental improvement, this is an undesirable development, since the grant in aid is essentially used to line the pockets of the environmental group rather than employed in productive investments. One possibility suggested by the last section of Table 2 is the imposition of a condition whereby the environmental group cannot accept a (reverse) bribe. While enforcement and credibility of such a condition requires additional considerations, the results in the last section of Table 2 show that increasing y now leads to lower environmental damage, though at a decreasing rate.

8. Concluding Comments

The interesting opportunities suggested by this paper are where intervention by an external agency can cause an existing (shadow) coalition to be broken and replaced with another. In particular, the case of interest is where an environmental group is not a member of an existing (shadow) coalition but can be with external incentives or intervention.

In many countries, complementary relationships have arisen between government and prominent private firms historically. This paper shows how this behavior explains some observed marginal production below cost. Such agreements raise the government's utility above a noncooperative outcome, but often contribute to poor environmental conditions. Environmental groups or development agencies have an interest in improving environmental conditions and can do so by offering a lump sum payment in return for a specific policy reform.

This paper considers the possibility that environmental groups can supplant industry in the reigning coalition or in the shadow coalition that determines the bargaining outcome of the reigning coalition. Which outcome prevails depends on the financial resources of the environmental group, the utility it gets from environmental protection, and the contribution of industry to the economy. If external development agencies join forces with internal environmental interests or represent these interests at the bargaining table, then financial resources are more likely to be sufficient.

The results of this paper suggest that the potential for environmental improvements by strategic use of international aid is a complex issue. Marginal analysis may be of little value in identifying the most productive opportunities. In some countries, the marginal payoff of previous activities may continue in future endeavors. In other countries, a small increase in activities may achieve a major payoff even though past activities have been unproductive. In still other countries, unproductive activities can be expected to remain unproductive even with a major increase in effort.

The key in each case is to examine the characteristics of major interactions among government, the private sector, and environmental concerns. Assessment of the marginal improvement that can be purchased with a given increment in strategic aid may be much less important than determining how much strategic aid can cause a coalition or even a shadow coalition to break. Expanding strategic aid beyond these levels may be futile unless credible additional conditions can be imposed. The results here demonstrate that increasing external incentives may have limited marginal success in the context of a given coalition but may achieve distinct breakthroughs when the reigning coalition is altered.

At any point in time, a development agency faces a portfolio of development opportunities involving many countries. The problem is one of choosing the portfolio with the greatest payoff. Clearly, the success or performance of development activities depends on identifying potential breakthroughs and administering levels of incentives precisely to attain those breakthroughs.

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Table 1. Price, production, and utility in the two-player coalition case.

Variable	Income Level[a]		
	$y < y_0$	$y_0 < y < y_1$	$y > y_1$
Coalition	{g, x}	{g, e} with y = b	{g, e} with y > b
t	$\bar{p}/4$	$\bar{p} - 2p(y)$	$(\bar{p} + 2)/3$
m	$\bar{p}/4$	$p(y)$	$(\bar{p} - 1)/3$
p = q	$\bar{p}/2$	$p(y)$	$(\bar{p} - 1)/3$
u^g	$\bar{p}^2/8$	$\bar{p}p(y) - 2p^2(y) + y$	$(2\bar{p}^2 + \bar{p} + 1)/18$
u^x	$\bar{p}^2/8$	$p^2(y)$	$(\bar{p}^2 - 2\bar{p} + 1)/9$
u^e	$y - \bar{p}/2$	$-p(y)$	$y - (5\bar{p} - 1)/18$

[a] Note that $p(y) = .3(\bar{p} - y) - .3(\bar{p}^2 + 18y + 180y + 81y^2)^{.5}$, $y_1 = (5 - \bar{p})/18$, and y_0 is defined by $\bar{p}^2/8 = \bar{p}p(y) - 2p^2(y) + y$. Also note that $y_1 > y_0$ is assured by $\bar{p} < 4.8284$; otherwise, the {g,x} coalition is the shadow coalition for all income levels.

Table 2. Price, production, and utility and the shadow coalition.

Variable	Shadow Two-Player Coalition				
	{g, x}		{g, e} with y = b		{g, e} with y > b
Two-Player Outcome					
y	.0000	.0039	.0039	.1111	>.1111
t	.7500	.7500	1.4121	1.6667	1.6667
m	.7500	.7500	.7939	.6667	.6667
p = q	1.5000	1.5000	.7939	.6667	.6667
u^g	1.1250	1.1250	1.1250	1.2222	1.2222
u^x	1.1250	1.1250	.6303	.4444	.4444
u^e	-1.5000	-1.4961	-.7939	-.6667	y - .7777
b	.0000	.0000	.0039	.1111	.1111
Three-Player Outcome					
y	.0000	.0039	.0039	.1111	>.1111
t	.7500	.7519	1.3555	1.5185	1.5185
m	.7500	.7519	.6445	.4815	.4815
p = q	1.5000	1.4961	1.0000	1.0000	1.0000
u^g	1.1250	1.1288	1.1392	1.2593	1.2593
u^x	1.1250	1.1250	.6445	.4815	.4815
u^e	-1.5000	-1.4961	-.7798	-.6296	y -.7407
b	.0000	.0039	-.2164	-.2593	-.2593
Three-Player Outcome Constrained by b ≥ 0					
y	.0000	.0039	.0039	.1111	>.1111
t	.7500	.7519	1.4121	1.6508	1.6318
m	.7500	.7519	.7901	.5714	.6083
p = q	1.5000	1.4961	.7978	.7778	.7600
u^g	1.1250	1.1288	1.1266	1.2840	1.2401
u^x	1.1250	1.1250	.6303	.4444	.4623
u^e	-1.5000	-1.4961	-.7939	-.6667	y -.7600