Changing threat perceptions and the efficient provisioning of international security

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Abstract

This paper proposes a mechanism for structuring international institutions to efficiently provision global security against the threat of a rogue nation. The effects of security effort by an alliance member are assumed to be non-rival and non-excludable for other members. Specifically, this effort has both positive and negative effects, as security measures prevent attacks by the rogue nation, but also involves loss of commercial and diplomatic benefits. Further, the alliance members are assumed to have heterogeneous tastes regarding the desired security level. The allies act strategically vis-a-vis one another with regard to security provision, and the alliance a whole acts strategically with respect to the rogue nation, which strategizes in turn. Importantly, this paper investigates how the evolution of public opinion, in the respective countries facing the rogue nation's threat, impacts the proposed mechanism.

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1 Introduction

1.1 Overview and main results

This paper tackles the issue of designing an institutional structure for a military alliance facing the common threat of a rogue nation. The goal is to design an alliance structure which would ensure an efficient level of joint security for the members of the alliance as a whole, in the situation where the alliance members have heterogeneous tastes regarding the desired security level. The threat faced by the alliance is endogenized in my model: there is a rogue nation which acts strategically vis-à-vis the alliance, hence making the threat level variable in response to action by the alliance. Interestingly, strategic behavior by the rogue nation makes it possible to analyze how evolving tastes for security among the member nations of the alliance would impact the provision of international security.

In this paper, the security effort by an alliance member is assumed to be non-rival and non-excludable, so the benefits of the effort jointly accrue to every other member. This effort has both positive and negative effects, as security measures prevent attacks by the rogue nation, but also involves loss of commercial,

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political, and diplomatic benefits. Thus, it is assumed that security effort may not only have positive externalities, but also have negative externalities beyond a point. Note that the type of negative externality considered in this paper does not arise either due to the fact that action by one of the allies deflects the threat to another ally, nor is it due to the fact that the allied actions bring about a stronger adversarial response (though the latter possibility is present in my model). This distinction is important, as it separates my paper from other models studying the role of negative externalities in the context of defense alliances.[1] Specifically, alliance models of defense dealing with negative externalities may be divided into two categories:

(i). Models of defense alliances against enemy nations in which the negative externality arises because greater arming by an ally leads to a more severe reaction by the adversary, leading to a negative externality for other allies.[2]

(ii). Models of alliances against terrorism, where more effort by an ally deflects terrorists to target another ally, thereby leading to negative externality of effort.[3]

However, my model considers another scenario that has become the issue of much national and international debate, particularly after the Second Gulf War which does not fit either of the above contexts. I deal with the negative externality accruing to allies (like France and Germany, for example) due to unilateral actions by another ally (the US, a NATO ally) against an adversary (Saddam Hussein-era Iraq). We may call this a "third kind" of negative externality in an alliance situation, quite distinct from those I describe in points (i) and (ii) above. It seems fairly clear that it would not be proper to characterize this third kind of negative externality as being the same as negative externalities in points (i) and (ii). This third kind of negative externality has received much attention in the media and public sphere over the last decade, but to the best of my knowledge, not been addressed sufficiently in the economics literature.[4] As this situation is at least contextually very different from the phenomena analyzed and studied earlier in the alliance literature (even when the literature had considered the possibility of negative externalities, as I mentioned earlier), in my opinion it deserves separate study. Thus, the results obtained in this paper give valuable insights into the problems that might be faced in designing an institution in the context of an important real-world

[1] See Sandler and Hartley (1995) for a survey of models in that category.

[2] Notable example of such a model may be found in Bruce (1990) and Ihori (2000). Sandler and Hartley (2001) also mention this issue (see page 888).

[3] Numerous contributions in this area exist in the literature. For the interested reader wishing to acquaint oneself in this genre, notable and recent papers include those by Sandler (2005) and Sandler and Siqueira (2006). In the words of Sandler (2005), "defensive actions deflect attacks to softer targets, thereby giving rise to external benefits to protected foreign residents, and external costs to venues abroad".

[4] Critics might respond that the Second Gulf War did not involve unilateral action by the US, and it was a multilateral action. However, there is enough opinion to the contrary in public discourse. Many experts see the US action as predominantly unilateral, where token participation of some minor nations was secured through political channels for the purpose of legitimacy. Further, British participation along with the US, might have occurred as a result of the traditional closeness of Anglo-US foreign policy during the major part of the twentieth century (and, as some observers might allege, the lack of a truly independent British policy). In my model below, British participation can easily be technically incorporated by assuming the same preference parameter for security for both nations (which would lead to multiple equilibria, some of which would be consistent with the observed Anglo-US participation). I steer clear of this assumption to keep my model clean, since doing so would not qualitatively affect my main results.

phenomenon. While at a theoretical level the analysis is an application of Coasean bargaining, the paper details the institutional environment that would be needed for such bargaining to succeed.[5] In sum, the contribution of this paper is threefold:

(a). An institutional mechanism is suggested to move the joint effort level of the alliance from a unilateral (inefficient) to an efficient (multilateral) level.

(b). The evolution of the security-related desires of the alliance members (dependent on the changes in public opinion in these respective nations) is seen to be important in achieving an efficient level of joint security effort. This evolution of security-related desires is brought about in my model through the endogenization of the security threat.

(c). The paper demonstrates the impact of "fair-weather friends" within the alliance, i.e. allies that increase support for joint security effort when the threat becomes less dangerous, but withdraw support in more dangerous circumstances.

1.2 Related literature

The contribution of this paper to the alliance literature should be seen in the current context in which the tastes of traditional allies on security issues have diverged to a considerable extent.[6] In fact, there seems to be disagreement among allies on certain issues (like the US, France, and Germany in the context of the Second Gulf War) whether after a certain level security effort is intrinsically 'good' or 'bad', in sharp contrast to the Cold War era. The institutional structure suggested by the paper takes into consideration these changes in world affairs. In the process we add to the literature on the economics of alliances beginning with Olson and Zeckhauser's seminal contributions (1966 and 1967), which studied the NATO defense alliance against the USSR, and analyzed the dominant role of the United States in it. Later contributions by Murdoch and Sandler (1982) and McGuire (1990) studied the evolving structure of NATO, with countries other than the US taking on a greater share of the defense burden than before, and the various explanations of this occurrence (like the "joint product" model, and public-private benefits of defense, among others).[7]

In addition to the above contributions, mention must be made of some the important contributions in the defense alliance literature on institutional mechanisms. Weber and Wiesmeth's (1991) analysis of a supra-national institutional structure for NATO, that leads to quasi-egalitarian cost-sharing among the members,

[5] While considerable application of bargaining theory has occurred in the broader literature on conflict and wars, and in conflicts involving environmental issues, to the best of my knowledge the specific literature on defense alliances have not had much application of bargaining theory to study intra-alliance interactions (though there have been studies of bargaining with terrorists, perhaps in hostage situations, or offering them safe havens under the of the "paid-riding" option). This literature has, however, seen research involving the cost-sharing of defense burdens.

[6] For a detailed survey see Hartley and Sandler (1995) and Sandler and Hartley (1995). Additionally, see related literature on the role of alliances in combating terrorism, which include contributions by Lee (1988), Lee and Sandler (1989), and Sandler, Tschirhart, and Cauley (1983).

[7] For alternative collective-goods models of military alliances, see Conybeare, Murdoch, and Sandler (1994).

is of special interest in this regard. The solution proposed by the authors is supportable as a strong Nash, depending on the requirement of a planning agency with supranational influence and power to enforce their mechanism (the authors do not comment on the necessary structure of such an agency, in their contribution). In a more recent paper, Arce and Sandler (2001a) consider the use of correlated strategies among allies to send costless signals, which allow the participants to avoid bad outcomes and improve their expected payoffs over Nash equilibria. In Arce and Sandler (2001b), the authors use cooperative game theory to model alliances with noncontiguous members. This approach leads to a distribution of alliance costs that does not coincide with the exploitation hypothesis - rather it depends on a nation's spatial and strategic location within the alliance. Specifically, this current paper builds on Gupta (2010), which proposes a similar mechanism for efficiently provisioning global security by an alliance. However, in that paper, the threat against the alliance is assumed to be exogenous. Endogenizing the threat actually has considerable implications for the institutional mechanism - particularly the role of evolving public opinion on its effectiveness. The importance of this institutional mechanism may also be understood in a broader context, when we realize that if institutional mechanisms promoting commitment on part of the members are absent, promises within the alliance might often be broken. In the presence of such a mechanism, however, the optimistic message is that it is possible for allies with divergent views regarding security to reach a compromise, and effectively provision an efficient level of joint security.

2 The Model

2.1 Environment

The Allies

There is a finite number of countries (governments) $i = 1, 2, ..., I$ forming an alliance, to fight against a level of global threat $t \in [0, \infty)$.

The utility of government i is given by:

$$\begin{aligned} U^i(m^i, e; t) &= \text{Utility of private good + Positive benefits of joint effort + Negative benefits of joint effort} \\ &= m^i + S^i(e; t) - N^i(e) \\ &= m^i + \lambda^i(t)S(e) - \varpi^i N(e) \\ &= m^i + \lambda^i(t)e - \varpi^i e^2 \end{aligned}$$

Here m^i is a private good (money) consumed by i, $e = \sum_{i=1}^{I} e^i$ is the amount of joint effort expended by the alliance against the rogue nation, e^i is i's (non-negative) contribution to the joint effort.[8] Effort is

[8]The linear technology for summing effort is widely used in the conflict literature. There are other kind of technologies that

assumed to be proactive (offensive rather than defensive), non-rival, and non-excludable - its results jointly accrue to every member. Note that this effort might include military action, trade embargoes, and other kinds of punitive action. Let $\lambda^i(t) \in (0, \infty)$ be different for each nation (I explain below what λ is), or $\lambda^i(.) \neq \lambda^j(.), \forall i, j$. For the present I assume that λ is increasing in the level of threat t, hence $\lambda^i_t > 0$ (this assumption will be modified in later sections, to explore certain other plausible situations that might occur). The value of $\lambda(.)$ is greatest for country I for any t, so $\lambda^I(.) > \lambda^i(.), \forall i \neq I$. The other $(I-1)$ alliance members are ranked according to the value of their λs, such that for all t, $\lambda^{I-1}(.) > \lambda^{I-2}(.) > .... > \lambda^1(.)$. λ^i may be thought of as an index of public support for security effort in a nation. The marginal benefit of effort for i is $[\lambda^i(t) - 2e]$, which implies $\frac{\partial^2 U^i}{\partial e \partial t} > 0$. Thus, the marginal benefit is more for higher $\lambda^i(t)$. Briefly, the governments' utility is dependent on the amount of private good consumed and the security effort expended by the alliance. However, such effort does not only have the positive effect of increasing security $S(e) = e$ by eliminating the threat,[9] but also has a negative effect $N(e)$ on utility in case the effort put in by the alliance infringes on commercial benefits, diplomatic and trade contacts, political ties, etc. Both these elements are captured in the government's utility function by the term $S^i(e;t) - N^i(e) = [\lambda^i(t)e - \varpi^i e^2]$, where $S^i(e;t) = \lambda^i(t)S(.) = \lambda^i(t)e$ and $N^i(e) = \varpi^i N(e) = \varpi^i e^2$, where ϖ^i is a positive index of nation i's share of disutility of joint effort. In what follows, I assume $\varpi^i = 1$ for all nations, for the sake of simplicity. Thus, $N^i(e) = e^2$.[10] The reader might wonder why joint, rather than just individual activity activity has negative consequences for a nation. It is likely that joint effort would have disutility for an individual alliance member, though the effort might be made by another alliance member. Joint action (in the nature of direct military action or trade embargoes, etc.) may affect regional stability and political conditions, which might affect commercial ties and other relations with the rogue nation. In a real life context, the commercial ties of France and Germany with Saddam Hussein's Iraq certainly got affected by the Second Gulf War. In sum, for a given level of t, an increase in joint effort e leads to greater utility by providing security, but also has a disutility that is captured by the part e^2. Thus, we have single-peaked utility function for these nations, with different "ideal points" of security for each of them.

Cost structure of the alliance members: The budget constraint of each ally is $m^i + C(e^i) \leq M^i$;where $\infty > M^i > 0$ is the initial endowment of the private good of i and $C(e^i) = ce^i, c > 0$, is the cost of security

have been used in various contexts like the "weakest-link" and "best-shot" technologies. I leave the analysis of the effects of such technologies, in the current context, to subsequent research.

[9] I assume there is a simple linear technology converting effort to a level of security (by destroying the threat). The process how effort eliminates the threat is not modeled.

[10] The results of my model will not change qualitatively even if $\varpi^I < \varpi^{I-1} < ... < \varpi^i < ... < \varpi^1$. This particular scenario seems quite plausible as nation I (being the one most opposed to the rogue nation, would be expected to have the least commercial and diplomatic benefits from it, compared to nations that were less intrinsically inimical to it. Thus the latter would suffer relatively more negative effects in case of conflict. For example the commercial benefits of France and Germany in case of Saddam Hussein-era Iraq were more than the US. Given this, the qualitative results of my model would not change if I assume instead $\varpi^i = 1$,for all i, with the added benefit of algebraic simplicity in the latter case.

level e^i.

The Rogue Nation

There is a rogue nation L which makes the decision to make effort $t \in [0, \infty)$, which gives the level of threat against the alliance of countries seen above.[11]

The utility of the rogue nation is given by:

$$\begin{aligned} U^L(m^L, t; e) &= \text{Utility of private good} + \text{Positive benefits of threat effort} + \text{Negative benefits of threat effort} \\ &= m^L + \alpha(e)t - t^2 \end{aligned}$$

where $m^L \in [0, \infty)$ is a private good (money) consumed by L, and $0 < \alpha(e) < \infty$ is a preference index of the rogue government, and is a measure of the support it has for it activities from within its constituency. Let $\alpha_e < 0$.

The rogue government has a positive benefit from undertaking effort, as well as disutility from that effort. The positive benefit would come from causing harm to what they consider enemy nations. Note that this benefit is weighted by the term $\alpha(e)$.This is because a rogue state may suffer plausible consequences from the security effort of the allies, which would decrease the "value" of its positive benefit (various effects of trade embargoes, boycotts and restrictions, and even direct military action b the allies. This is reflected by the fact that $\alpha_e < 0$, which leads to the utility of the rogue's effort being less, for more e. The last term t^2 captures the disutility of committing "bad acts" faced by the rogue nation, as it suffers more and more isolation from its supporters in the rest of the world (as it raises its threat effort) - I assume that this last effect occurs due to the behavior of countries which are outside supporters of the rogue nation (who, however, are not rogues themselves), and not belonging to the alliance fighting it.[12] The marginal utility of the rogue's effort (activity) decreases with an increase in the given level of e, i.e. $\frac{\partial^2 U^L}{\partial t \partial e} < 0$.

Cost structure of the rogue nation: The budget constraint of the rogue country is given by: $m^L + C(t) \leq M^L$;where $\infty > M^L > 0$ is the initial endowment of the private good of L and $C(t) = vt, v > 0$, is the cost of threat activity level t.

2.2 The benchmark game

I consider that all countries play a simultaneous move game of complete information with respect to its alliance members and with the rogue enemy nation. The rogue nation also moves simultaneously with

[11] I could also have modeled a linear technology that would have mapped effort by the rogue nation one-to-one onto a level of threat. However, I choose to interchangeably use the concepts of effort by the rogue nation and the level of threat presented by it. This shortcut does not affect the results of my model.

[12] Nations like Saddam-Hussein era Iraq, North Korea, and Iran have had their supporters in the global community. However, this support would likely suffer as these countries raise their threat efforts, as it becomes harder and harder for these "outside" nations to support an undeniable rogue nation.

respect to the actions taken by the alliance members, and has complete information. In the overall game there are $(I+1)$ players, with the alliance members choosing effort e^i, and the rogue nation choosing threat level (effort) t^L. To repeat, all countries, including the alliance members, and the rogue nation, act simultaneously with respect to each other.

Payoffs: The payoff for an alliance member is V^i and that of the rogue nation isV^L, such that $V^i(.) = M^i + \sum_{i=1}^{I} e^i[\lambda^i(t) - \sum_{i=1}^{I} e^i] - ce^i$, for $i = 1, 2, .., I$, and $V^L(.) = M^L + \alpha(e)t - (t)^2 - vt$, for L. Note that $e = \sum_{i=1}^{I} e^i$. The reader will notice that these payoffs incorporate the cost side of the nations' decisions (using their budget constraint equations).

Equilibrium

We can solve for the Nash equilibrium of the overall game by solving for the Nash equilibrium level of effort of each country in a game within its alliance, taking the effort level of the enemy as given. This will give us the joint effort level of the alliance, as well as the choice of threat by the rogue nation, as a reaction function of the other. Using these reaction functions, we can arrive at the equilibrium level of threat and security effort.

As a first step, note that ally i's effort in the game between the governments in the alliance, given the rogue's threat level, is given by:[13]

$$\begin{aligned} e^i &= \frac{1}{2}[\lambda^i(t) - c - 2\sum_j e^j], \text{ for } \lambda^i > c + 2\sum e^j, j \neq i \\ \text{and} \quad 0, \text{otherwise (since } e^i &\geq 0) \end{aligned}$$

Examination of the above FOC reveals that it must be that $e^i = 0$ for $i \neq I$. This can be seen by plugging in the value of a positive e^I in the above equation and realizing that this would fetch a negative value of e^i (which violates the condition $e^i \geq 0$), for all values of t. But for $e^i = 0$ for $i \neq I$, $e^I = \frac{1}{2}[\lambda^I(t) - c]$. Thus, in the Nash equilibrium of the intra-bloc game for the alliance, effort is provided solely by country I (all other allies provide zero effort levels) and is given by:

$$e^N = e^I = \frac{1}{2}[\lambda^I(t) - c]$$

See Appendix 1 for a formal derivation of the equilibrium of the intra-alliance game, and the uniqueness of the equilibrium.

Now, in order to get the equilibrium of the overall game (involving the alliance and the rogue nation), we solve for the FOC of the rogue nation. The equilibrium level of threat is given by:

[13] I assume that at times of crises the time available for responses is so small that effort provision must practically be simultaneous.

$$t^L = \frac{1}{2}[\alpha(e) - v]$$

Now, we must solve for the equilibrium of the game between the alliance as a whole and the rogue nation: this effectively reduces to a game between the two countries I and L, given the equilibrium of the intra-alliance game above (note that all players, including the rogue nation, move simultaneously). The players I and L have effort choices e^I and t^L, and payoff functions V^I and V^L. Here $V^I(.) = M^I + e^I[\lambda^I(t^L) - e^I] - ce^I$ and $V^L(.) = M^L + t^L[\alpha(e^I) - t^L] - vt^L$ and $e^I = e^N$ and $t^L = t^N$. So, the Nash equilibrium effort outcome for this overall game is described by the pair (e^N, t^N) given by the simultaneous solution of the equations:

$$e^N = \frac{1}{2}[\lambda^I(t^L) - c]$$

and

$$t^N = \frac{1}{2}[\alpha(e^I) - v]$$

for $t^N = t^L$ and $e = e^N = e^I$. Let us call e^N the unilateral effort level for the alliance. I compile the above results in Proposition 1 below.

Proposition 1 *The inter-alliance effort choice game leads to a unilateral outcome, with the nation having the highest public support for security provision making all of the joint effort for the alliance. Thus in Nash equilibrium, nation I, with $\lambda^I(.) > \lambda^i(.) \forall i \neq I$, provisions joint effort level for the alliance $e^N = \frac{1}{2}[\lambda^I(t^L) - c]$, and the rogue nation makes threat level $t^N = \frac{1}{2}[\alpha(e^I) - v]$.*

Remark 1 *The slope of the reaction function of the alliance is $\frac{\partial e^N}{\partial t^N} > 0$, and that of the rogue nation is $\frac{\partial t^N}{\partial e^N} < 0$.*

Proposition 1 is unremarkable in itself, and as such is an extreme artifact that allows us to concentrate in developing the more substantial parts of the paper, in the following sections. The case of "extreme unilateralism" seen in the proposition arises due to fact that for every ally: (a). The effort technology is linear; (b). There are no income effects because of the quasi-linear utility functions; (c). The cost functions are linear; (d). The wealth endowment of country I does not impose a binding constraint on its effort level, below its private optimal; and (e). The taste of effort of country I is distinctly more than all other allies (if another country shared the same taste, multiple equilibria would be possible). If Proposition 1 was the main result of the paper, there would not be much insight gained from it, particularly in a real-world context. Further, more general environments, in themselves, have already been studied in the economics of alliances literature and do not remain topics of new research (see Sandler and Hartley (2001) for a comprehensive survey of such studies). However, since the main purpose of the paper is to build an institution to gain efficiency, in the face of unilateralism, I would argue that the strong special-case artifact of strong unilateralism is therefore a desirable benchmark. Further, the insights gained in this environment (seen in Propositions 2 and 3 which follow in subsequent sections) will remain relevant in more general contexts. More general contexts might include:

(i). Non-linear effort technology, income effects in the utility function, binding wealth constraints, non-linear costs, same taste parameters for security effort: Any, or a combination of these factors, might lead to extreme unilateralism not occurring. However, I will later argue (in Section 5) that the insights of the main results of this paper (Propositions 2 and 3) will be mostly valid in a more general setting.

(ii). Presence of uncertainty: In this paper I assume complete information. Countries with a working intelligence apparatus would know with a level of certainty the "public support" for security in free nations, and the proclivity for creating disruption (in the case of the rogue nation) in most circumstances. For example, there is no reason France and Germany would not know the US public's support for war, to the extent the US government would (hence there might be little scope for the US to "masquerade"). This might be a little harder in case of the rogue nation, particularly if the leadership in that nation is "unstable". For the purposes of this paper I rely on the strength of the intelligence gathering apparatus in identifying this information, which might be true in many real-world situations. However, I recognize that the main results of this paper may need to be modified in a highly uncertain environment - an issue which should be explored in subsequent research. On the side of the alliance members, regime change might be an issue - the preferences of the Bush and Obama administrations in the US regarding security were not the same. So players acting in a situation of pending regime change might have incomplete information at the time they have to act. This issue is also left for future research.

2.3 Efficiency

I now solve for the efficient level of joint effort of the alliance:

$$\begin{aligned} Maximize_{\{\sum m^i, e\}} \sum_{i=1}^{I} V^i(.) &= \sum_i m^i + \sum_i e[\lambda^i(t) - e], \\ s.t. \sum_i m^i + ce &= \sum_i M^i; \sum m^i \in [0,\infty); e \in [0,\infty) \end{aligned}$$

or

$$Maximize_{\{e\}} \sum M^i + e[\sum \lambda^i(t) - Ie] - ce; e \in [0,\infty)$$

Solution to the FOC of the above problem gives us the efficient solution:

$$e^E = \frac{1}{2I}[\sum_{i=1}^{I} \lambda^i(t) - c]$$

If the alliance provisions the efficient level of effort e^E and not the unilateral level e^N, the rogue country L will make effort

(A)

$$t^E = \frac{1}{2}[\alpha(e^E) - v]$$

We notice that this level of effort is different than that seen in the last section, since it is a best-response to the efficient effort level by the alliance, and not the unilateral level e^N. Let us call this t^E. To reiterate, this is the "best response" threat level from the rogue nation to "efficient" joint effort by the alliance.

Thus, putting $t = t^E$ in the equation for e^E we get:

(B)

$$e^E = \frac{1}{2I}[\sum_{i=1}^{I} \lambda^i(t^E) - c]$$

The equilibrium at the inter-bloc level is given by the pair (e^E, t^E) got by simultaneous solution of equations (A) and (B). The efficient level of effort for the alliance may be more or less than the unilateral level, as seen in lemma 2 below. The efficient effort level is unique, and not dependent on who provides the effort. It may be provided by any combination of nations (and I suggest a scheme on who will provide it, in the section below).

Lemma 1 *The efficient level of joint effort* e^E *is lesser (greater) than the unilateral outcome* e^N *for* $\lambda^I(t^N) \gtreqless \frac{\sum_{i=1}^{I} \lambda^i(t^E)}{I} + \frac{c(I-1)}{I}$.

Proof. $e^E \lesseqgtr e^N$ for $\frac{1}{2I}[\sum_i \lambda^i(t^E) - c] \lesseqgtr \frac{1}{2}[\lambda^I(t^N) - c]$.
Rearranging the terms of the latter inequality, we arrive at the above result. ■

We notice that the index λ shifts for a change in effort level, since the level of threat is sensitive to the effort level of the alliances. Thus, whether the efficient effort level is more or less than the unilateral level depends not just on the values of the λs in the unilateral outcome, but the values of the λs that would occur if the alliance were to shift to the efficient level of security from the unilateral level. In other words, the efficiency level is dependent on the magnitudes of shift of these indices, for a change in the level of threat that would occur from a shift in the security level. Note that the efficient level can be higher than the unilateral level, even though the λs might all have fallen, because the former is a function of the sum of the λs, and hence this situation is possible (especially if the unilateral level was low to begin with).

Assumption: I assume that nation I still has the highest λ, if the alliance moves from the unilateral to the efficient effort level.

The next result relates the level of threat observed in our model, to the level of security that is provisioned by the alliance. It seems fairly intuitive that if the level of effort at the efficient outcome is less than the unilateral outcome for the alliance, then the equilibrium amount of threat in the former situation will be more compared to the latter. The opposite should hold for the situation where the level of efficient security effort is more than the unilateral level. Conversely, if the level of threat is higher for the alliance making the unilateral effort level, compared to the level of threat if they play the efficient outcome, then it must be true that the effort in the unilateral outcome is lower than that in the efficient outcome. These results are proved below.

Lemma 2 *If security effort at the unilateral outcome is greater (lesser) than that at the efficient outcome, then the threat level is lesser (greater) at those respective outcomes, and vice versa, i.e.* $e^N \gtrless e^E \Longleftrightarrow t^N \lessgtr t^E$.

Proof. See Appendix 2. ■

We note that since $t^E > t^N$ implies $e^E < e^N$, it must be true for $t^E > t^N$ that the condition $\lambda^I(t^N) > \frac{\sum_{i=1}^{I}\lambda^i(t^E)}{I} + \frac{c(I-1)}{I}$ must hold (using the above result and Lemma 1). In other words, if ex-post efficiency requires a drop in security levels, then the average of the public opinion indices (even after the increase in the threat level), must be still lesser than the public opinion index in country I under the unilateral outcome.

3 The institutional structure

I will now outline an institutional structure for the alliance which will lead to the provision of an efficient level of joint security.[14] This institutional structure is set forth through the game described below, which I will henceforth call the "institutional game". For the sake of brevity, I describe the game for the case where $e^E < e^N$ - a game with an absolutely similar structure is applicable for the case $e^E > e^N$, with minor changes in some of the technical conditions seen below (for the sake of completeness, I actually work out the conditions applicable to the $e^E > e^N$ case in Section 3.1).

Let the set of all the I members of the alliance be called S. The transfers will be paid by a set of payers $P \subset S$ to a set of recipients $R \subset S$. In what follows, I will outline a game of complete information in which all the members belonging to the sets P and R participate, along with a neutral player (think of the neutral player as an independent entity within a supranational agency, like the Office of Security within the NATO - perhaps more appropriately an independent career-based bureaucracy). There will be certain rules of interaction among the players. From these rules it is possible to identify an institutional structure for the alliance that would lead to the efficient outcome. I call the game described below the 'institutional

[14] My findings are consistent with Cornes and Sandler (2000) who show that when redistributions are made from non-contributors to contributors (which also happens in my model), such transfers can lead to a new Nash equilibrium, that Pareto-dominates the one without redistributions.

game'. All players in this game are rational and have complete information. This game exists only if P is non-empty. It is assumed that the ex-post efficiency condition outlined in the paper holds. The "institutional game" is as follows:

There are four stages in this game. In the first stage, the neutral player makes a proposal to the other players. The proposal is a collection of elements $[P, R, (T^i)_{i=1}^I, (e^i)_{i=1}^I]$, where P is a set of payers, R is a set of recipients, $(T^i)_{i=1}^I$ is a vector of transfers paid by payers and received by recipients, and $(e^i)_{i=1}^I$ is a particular effort vector. For what follows, let the effort vector proposed by the neutral player be $(e^i)_{i=1}^I = (0, 0, ..0, e^E)$. P and R are such that $P \cup R = S$, and $P \cap R$ is an empty set.

In the second stage, the players in the set P, player I, and players $i \in R$ with $\phi^i > 0$ simultaneously vote either *Agree* or *Not Agree* to the proposal. The parameter ϕ^i (where $\phi^i = \lambda^i(t^E) - \frac{e^N}{e^E}\lambda^i(t^N)$) depends on the evolution of "public support" for security effort in nation i, and is described in detail in Section 3.1 below. As mentioned, for the payers the proposal contains a total amount that they need to pay and a rule to divide the payment among them. For I, the proposal commits to pay an amount of transfer τ to him, dependent on it making the efficient effort level. For the proposal to be adopted, it must be adopted *unanimously* by all players in the set P and player I. Otherwise the proposal fails, and no transfers are made. Once a player votes for the proposal, it is committed to adhering to it. It is not possible (by membership rules of the alliance) for any member of P to make a private transfer to any other player, other than through the neutral player. If the proposal succeeds, the neutral player takes the amounts given in vector $(T^i)_{i=1}^I$ and holds them. If it does not, no payments are made, that is $(T^i)_{i=1}^I = (0^i)_{i=1}^I$.

In the third stage, the alliance members $i \in R \backslash I$ with $\phi^i < 0$ play a simultaneous-move non-cooperative game of effort choice for adoption of the proposal.[15] For non-adoption of the proposal, there is the status quo effort choice game with all players in S. If the proposal was adopted in the second stage, there is an effort choice game where transfer amounts are committed by the neutral player to recipients according to a scheme outlined in the proposal (which is discussed in detail later). In brief, the neutral player commits to pay players $i \in R$ a transfer sum z^i from the transfer amounts handed over to it by the payers, if the effort chosen by them is zero. If, however, they make positive effort then they do not receive this transfer. For the proposal being adopted and the set ($R \backslash I$ and $\phi^i < 0$) being empty, there is no third stage, the fourth stage described below follows the second. In this paper I assume the more general case, so the set ($R \backslash I$ and $\phi^i < 0$) is assumed to be non-empty.

The fourth stage is the payments stage (for the game with transfers). Payments are made to all recipients

[15] Note that in my scheme these countries would be the recipients of transfers, but are not included among the players having votes in the second stage. This is because they are not compensated enough to give them their status-quo utility and would break any deal that moves to efficiency from status quo, if they could. These nations are the ultimate beneficiaries of free-riding and lose their exaggerated benefits in the proposed scheme.

upon observation of effort or money given back to payers, in full or in part (dependent on the effort choices of the players in set R).

Lastly, it is assumed that the neutral player does not retain any money itself (thus, the amount paid by the payers equals the amount received by the recipients) and conforms to all the rules of the game described above.[16]

3.1 Payers

The first step now is to find out in our model which of the alliance partners would be willing to pay to move from an allocation with effort vector with joint effort provision at e^N, to one at which the joint effort is e^E, and how much. For a country to be willing to pay a positive amount z^i for this movement, it has to be true that its utility from e^E must be greater than from e^N, even after it pays z^i. For the unilateral outcome, no country pays anything. In our current environment, the change in the threat level in response to the alliance's action, becomes important. The individual rationality condition for i being willing to pay $z^i > 0$ to achieve the efficient effort outcome over the unilateral outcome is $[V^i(m^E, e^E; t^E) \mid z^i > 0] \geq [V^i(M^i, e^N; t^N) \mid z^i = 0]$. The notation is as seen in earlier sections, and the superscripts for the security effort, threat levels and the private goods are self explanatory. We now find out that for a certain country willing to pay for the change, what is the maximum amount that it is willing to pay.

Lemma 3 *If the utility of a country rises for a change in the effort level, the maximum amount it might be willing to pay for the change, given that it makes no effort contribution in the efficient allocation, is* $e^E\lambda^i(t^E) - e^N\lambda^i(t^N) + (e^N)^2 - (e^E)^2$.

Proof. See Appendix 3. ■

Remark 2 *Note that* $z^i > 0 \Longrightarrow \lambda^i(t^E) - \frac{e^N}{e^E}\lambda^i(t^N) + \frac{(e^N)^2}{e^E} - e^E > 0$*, as we have assumed that effort levels are non-negative.*

We will now group the countries according to their willingness to contribute to a fund for transfers that need to be given to move to the efficient outcome.

Case (I). $e^E > e^N$: We will group the countries according to their willingness to contribute for a change in outcome. In order to do this, we categorize the nations according to their shift in λ between the unilateral outcome and the efficient outcome.

For nation i we have

$$z^i = \lambda^i(t^E) - \frac{e^N}{e^E}\lambda^i(t^N) + \kappa, \text{ where } \kappa = \frac{(e^N)^2}{e^E} - e^E$$

[16] I ignore any transaction costs that might arise in the implementation of this mechanism. The simple reason for that is that such costs will have to be absorbed by the payees (and reimbursed to the recipients) as part of the transfer payments. This would affect the size of the payments, but have no other effect on the mechanism I describe. Of course, presence of insurmountable transaction costs would derail the whole exercise and make it pointless.

Since $t^E < t^N$ for $e^E > e^N$ (vide Lemma 2), and $\lambda^i(t^E) < \lambda^i(t^N)$ since $\lambda_t > 0$, it follows that $z^i > 0$ iff $\lambda^i(t^E) > \frac{e^N}{e^E}\lambda^i(t^N) - \kappa$ (note that $\kappa = \frac{(e^N+e^E)(e^N-e^E)}{e^E}$is negative, and that $\frac{e^N}{e^E} < 1$). So, the willingness to contribute to the fund depend on the change in $\lambda(.)$ and the values of e^E and e^N.

From our results, we observe the crucial importance of how the public support index evolves between the unilateral and efficient states (rather than a fixed level) in determining the contribution to the transfers' fund. In fact, given that $\frac{e^N}{e^E} < 1$, the public support $\lambda^i(t^E)$ in the institutionally-obtained efficient outcome should be sufficiently close to the support $\lambda^i(t^N)$ in the unilateral outcome, for a nation to be willing to contribute a positive amount to the transfers' fund, in the case where the efficient level of security is higher than the unilateral level. This is not surprising, when one realizes that greater security would reduce threat levels, hence reducing the public's appetite for security (even though, on one hand, greater security related benefits accrue to the nation). Hence a positive contribution towards enhanced security levels can be supported only if the appetite for security remains high enough, even with a reduction in the threat level. In order to make our task simpler, we can construct $\delta^i = \lambda^i(t^E) - \frac{e^N}{e^E}\lambda^i(t^N)$ and rank countries according to the value of their δs, such that $\delta^1 < \delta^2 < ... < \delta^j < \delta^{j+1} < ... < \delta^{I-1}$. We note that this ranking of a country in this case is different from its ranking according to the value of $\lambda(.)$. The value of the δs obviously depend on the change in $\lambda(.)$ and the values of e^E and e^N, and only countries with high enough δs would contribute for a movement to the efficient security level.[17]

Remark 3 *It follows that if there are j nations in the alliance with $\delta^i = \delta^1, ..., \delta^j$ such that $\delta^i > \kappa$, they would be willing to pay a positive amount for the movement to the efficient outcome.*

Case (II). $e^E < e^N$:

For nation i let

$$z^i = \lambda^i(t^E) - \frac{e^N}{e^E}\lambda^i(t^N) + \kappa, \text{where } \kappa = \frac{(e^N)^2}{e^E} - e^E$$

Since $t^E > t^N$ for $e^E < e^N$, we have $\lambda^i(t^N) < \lambda^i(t^E)$. Also, in this case $\kappa = \frac{(e^N+e^E)(e^N-e^E)}{e^E}$is positive, and that $\frac{e^N}{e^E} > 1$.Now, in order to understand the situations where nations would be willing to pay for a move to the efficient security level, let us write $\kappa - \frac{e^N}{e^E}\lambda^i(t^N) = \mu$.

Situation 1: For $\mu > 0$, $z^i = \lambda^i(t^E) + \mu > 0$ automatically. In this case, $\lambda^i(t^N) < e^N - \frac{(e^E)^2}{e^N}$ (solving for $\mu > 0$). This could happen for a low enough $\lambda^i(t^N)$, or a low enough $\frac{e^N}{e^E}$ (i.e. the efficient and unilateral effort levels are close), or both.

[17] This easily seen. Consider a country having a shift in λ from 9 to 1, and another having a higher initial value of λ, 11, which shifts to 10. The ranking of the λs for the countries is preserved, but the change for the first country is higher. However, in an alternate scenario, if the first country has a shift from 5 to 1, and the second a shift from 11 to 6, then the change for the second country is higher.

Situation 2: For $\mu < 0$ (which entails a high enough $\lambda^i(t^N)$, i.e. $\lambda^i(t^N) > e^N - \frac{(e^E)^2}{e^N}$), for z^i to be positive we need either a high enough $\lambda^i(t^E)$ (i.e. $\lambda^i(t^E) > \mu$), or a low enough $\frac{e^N}{e^E}$ (i.e. the efficient and unilateral effort levels are close),[18] or both.

From the above discussion, it is clear that for z^i to be positive, $\lambda^i(t^E) - \frac{e^N}{e^E}\lambda^i(t^N)$ must be positive (as the term κ, seen above, is always positive). To make our task simpler, let us construct $\phi^i = \lambda^i(t^E) - \frac{e^N}{e^E}\lambda^i(t^N)$, and rank countries according to the value of their ϕs, such that $\phi^1 < \phi^2 < ... < \phi^J < \phi^{J+1} < ... < \phi^{I-1}$. Of these, let J nations have $\phi^i > 0$. Loosely speaking, for a large enough difference between the unilateral and efficient security levels, these would typically be nations whose levels of the public support index in the efficient regime are sufficiently greater than the public support levels in the unilateral regime. In other words, lesser security (due to the movement to e^E) raises the threat, making the public in these nations sufficiently raise their appetite for security. In reality one would expect the public support for security in these nations low to begin with, causing them to advocate for a reduction in the security level. The reduced security would raise threat levels, but would cause a decline in the negative effects of security efforts (as seen earlier), and also enhance the public's appetite for security. So, for the governments of these nations, the movement to the efficient level would cause an increase in utility levels.

This result is actually quite interesting. One would have thought that less rise in public support in the payer countries would be desirable, as it would provide the incentive for them to contribute to a cut in effort. However, the result observed here seems counter-intuitive in that respect. The explanation is that there is another avenue for the mechanism to work: if the desires of the payers under the efficient regime move (upward) towards what the desire of nation I is in the unilateral case - then the efficient effort level will be closer to the unilateral effort level. Thus, the level of transfers needed to support the scheme will be lower, and hence more likely to be achieved.

Remark 4 *It follows that these J nations (with $\phi^i = \phi^{I-J}, ..., \phi^{I-1} > 0$) may be willing to pay a positive amount for the movement to the efficient outcome.*

However, as we will see in the next section, I will not be able to include all these nations that are potentially willing to pay for a movement to the efficient outcome among my set of "payer nations" in the institutional scheme designed by me for achieving the efficient level of joint security by the alliance of nations facing the rogue nation's threat.

[18] This is seen as follows: for $e^E \longrightarrow e^N$, $\frac{e^N}{e^E} \longrightarrow 1$, reducing $z^i = \lambda^i(t^E) - \lambda^i(t^N) + e^N - e^E$ which is positive in this particular case.

3.2 Recipients

In this section, I will analyze who will need to be paid for the alliance to move to the efficient level of security. In what follows, I assume that country I, which had the largest public support index among the countries in the alliance in the unilateral case still has the largest public support index under the efficient regime. In other words, the λ ranking of country I is preserved, even if the alliance moves from the unilateral to the efficient security level. The reader will recall that I have the neutral player propose that the alliance shift to the efficient level with the member nations provisioning the effort profile $(e^i)_{i=1}^{I} = (0, 0, ..0, e^E)$ - in what follows, I will term this outcome as the "institutional regime". In other words, in both the unilateral, as well as the efficient scenarios, country I is the only nation undertaking security effort. In what follows, I will analyze which countries need to be paid (and how much), to realize this proposed effort profile.

For country I, a movement to the efficient level will not entail a loss in utility, if it is given a transfer τ, seen below. As the unilateral effort level was chosen by country I in the benchmark model, even when the efficient effort was available, this transfer level should be positive.

$\tau^I = V^I(m^N, e^N; t^N) - V^I(m^E, e^E; t^E)$

$= \{M^I + e^N[\lambda^I(t^N) - e^N] - ce^N\} - \{M^I + e^E[\lambda^I(t^E) - e^E] - ce^E\}$

$= e^N\lambda^I(t^N) - e^E\lambda^I(t^E) - (e^N - e^E)[(e^N + e^E) + c]$

Let us now move on to the other nations that are adversely affected by a movement from the unilateral to the efficient level of joint effort. The main purpose of this exercise is to determine which countries have to be given a transfer (which I would like to be the minimally required amount, rather than one which would be Pareto improving for all member nations of the alliance) to maintain the effort profile $(e^i)_{i=1}^{I} = (0, 0, ..0, e^E)$.

1. Case (I): $e^E > e^N$

First, note that the level of effort provision for each country under a scenario where joint effort from other allies is at the given level e^E and threat level is t^E, is $\widehat{e^i} = \frac{1}{2}[\lambda^i(t^E) - 2e^E - c]$. This is the level of effort that a country would make, if it had to fight the rogue nation with joint effort fixed at e^E from the side of all its other allies. Now, for $e^E > e^N$, no country would want to deviate from zero effort. This is easily seen, as $\widehat{e^i} < e^E$ (since $\widehat{e^i} < e^N$, as $t^E < t^N$). Hence, if no other country other than I was supplying effort in the unilateral (Nash) outcome,in the efficient outcome no one else would have an incentive to make effort. This means that for effort e^E by I, the best response of other countries would be to make no effort. This means that to achieve a profile $(e^i)_{i=1}^{I} = (0, 0, ..0, e^E)$ with $e^E > e^N$, no other country other than I needs to be compensated by the payer nations (discussed in the last section).

2. Case (II): $e^E < e^N$

Now, let $e^{i*} = \frac{1}{2}[\lambda^i(t^E) - c]$ be the private effort level of a nation, i.e. the effort level it would provision if it had to fight a threat level t^E alone, without the help of any allies. For joint effort $e^E < e^N$ (supplied by I), countries having private provision e^{i*} levels greater than e^E would have an incentive to deviate from zero effort (and make up the difference between e^E and e^{i*}, gaining utility in the process),[19] and hence make it difficult to sustain the effort profile $(e^i)_{i=1}^I = (0, 0, ..0, e^E)$. It is easily verified that these are countries for which $\lambda^i(t^E) > \frac{\sum_{i=1}^I \lambda^i(t^E)}{I} + \frac{c(I-1)}{I}$. However, this can be prevented by having a transfer scheme in which they would be compensated up to their utility level for their private provision level (conditional on making no effort). This level of transfer is given by $\tau^i = V^i(m^{i\prime}, e^{i*} - e^E, 0 \mid e^{i*}) - V^i(m^E, 0, \tau^i \mid e^E)$

$= e^{i*}[\lambda^i(t^E) - e^{i*}] - c(e^{i*} - e^E) - e^E[\lambda^i(t^E) - e^E]$

$= (e^{i*} - e^E)[\lambda^i(t^E) - (e^{i*} + e^E + c)]$[20]

The set of countries for which these transfers are needed contains not only nations which suffer a loss in utility due to a movement from the unilateral to the efficient effort level, but may also contain some countries which gain from the movement. The reason they get compensated is because their private provision level under the "institutional regime" is more than the efficient level. Hence they must to compensated to maintain zero effort levels, if the effort profile $(0, 0, ..0, e^E)$ has to be maintained. Note that set of recipients may include nations having $\phi^i > 0$, in addition to those with $\phi^i < 0$.

3.3 The subgame perfect equilibrium of the institutional game

In this section I will outline one of the main results of this paper: Proposition 2 below describes the subgame perfect equilibrium of the institutional game described earlier. This proposition is relevant for the case $e^E < e^N$, and a similar result can easily be derived for the case $e^E > e^N$, which I leave to the interested reader, for the sake of brevity.

In what follows, S is the set of all nations in the alliance, the set P consists of a set of payers among the nations in the alliance: This set contains nations with $\phi^i > 0$ (see Section 3.1 above) and $\lambda^i(t^E) > \frac{\sum_{i=1}^I \lambda^i(t^E)}{I} + \frac{c(I-1)}{I}$. The set R consists of all other nations in the alliance (for the sake of simplicity I make the minor assumption that there are no nations with the same utilities under the unilateral and the institutional outcome with efficient effort level). I have also assumed that if a country gets the same payoff from making zero effort and a positive effort, then it makes no effort. As mentioned earlier, other than these players, there is a "neutral" player in the "institutional game" who acts as a proposer and facilitator. I assume that the ex-post efficiency condition $\sum\limits_{i \in P} z^i \geqslant \sum_{i \in R} \tau^i + \tau^I$ holds.

[19]Note that for $e^I = e^E$ and $e^j = 0$, for $j \neq i, I$, $e^i = \frac{1}{2}[\lambda^i(t^E) - c - 2e^E] = \frac{1}{2}[\lambda^i(t^E) - c] - e^E = e^{i*} - e^E$, where e^{i*} is the private provision level of i.

[20]Notice that this compensation amount is one which puts a recipient country at its utility level for the joint effort provision of the alliance being at its ex post private provision level, but it having to bear the cost of provision only for the amount of this effort which is above the efficient level. A bit of algebra shows this transfer amount to be positive, substituting for e^{i*}, e^E, and using the fact that $\lambda^i(t^E) > \frac{\sum_{i=1}^I \lambda^i(t^E)}{I} + \frac{c(I-1)}{I}$ as $e^{i*} > e^E$

Proposition 2 *The profile* ($\{Agree,\ e^i = 0$ *for* $NP\}_{i\in P}$, $\{Agree,\ e^i = 0$ *for* $NP\}_{i\in R\backslash I \text{ and } \phi^i>0}$,$\{Agree,$ $e^I = e^N$ *for* $NP\}_I$, $\{e^i = 0$ *for* P *&* $NP\}_{i\in R\backslash I \text{ and } \phi^i<0}$)*, where P stands for the proposal's adoption and NP for non-adoption, is a subgame perfect equilibrium of the institutional game, for the elements proposal by the neutral player being such that:*
(i). z^i *for all* $i \in P$ *such that* $0 \leq z^i \leqslant e^E\lambda^i(t^E) - e^N\lambda^i(t^N) + (e^N)^2 - (e^E)^2$*, and* $\sum_{i\in P} z^i = \sum_{i\in R}\tau^i + \tau^I$.
(ii). The neutral player proposing to compensate player I an amount $\tau^I = e^N\lambda^I(t^N) - e^E\lambda^I(t^E) - (e^N - e^E)[(e^N + e^E) + c]$ *for* $e^I = e^E$*, and 0 otherwise.*
(iii). Proposing to compensate players $i \in R\backslash I$ *an amount* $\tau^i = (e^{i*} - e^E)[\lambda^i(t^E) - (e^{i*} + e^E + c)]$*, for choosing* $e^i = 0$ *in the effort choice subgame with transfers, and 0 otherwise.*
(iv). The proposal requiring unanimity support of nation I, nations $i \in P$*, and nations* $i \in R\backslash I$ *and* $\phi^i > 0$ *who are the only nations invited to vote on the proposal.*
This subgame perfect outcome of the institutional game has all invited voters agreeing to pass the neutral player's proposal in the second round and all alliance members $i \in S$ *making effort choices in the third round such that the effort outcome is* $(e^i)_{i=1}^I = (0, 0, ..., e^E)$*. Hence, the joint effort of the alliance is at the institutionally-obtained efficient level.*

Proof. See Appendix 4. ■

This proposition gives an important result, which suggests a particular institutional structure for the alliance that would help it reach its efficient effort level. For such an institutional structure, unilateral action by a single nation would be tempered towards the efficient outcome by multilateral participation by other alliance members. Note that in the above mechanism, nation I is getting "cheated" a little bit, compared to the other recipients, because they are getting compensated up to the utility of their "private effort" levels under the institutional regime, while nation I is getting compensated only up to the utility of its private effort level in the unilateral case. However, it can do nothing about it, because if it does not agree to the proposal, the status quo remains, hence as the unilateral provider in the benchmark case, it can do no better.[21]

More to the point, Proposition 2 lays out one of the most important contributions of this paper, i.e. how the evolution of public opinion in the member nations in the alliance might influence the movement to efficiency. Endogenizing the threat level allows us to perform this particular analysis. We notice the crucial importance of how the public support index evolves in the payer states, between the unilateral and efficient states, in determining the contribution to the transfers' fund.

For the case where the efficient level is lower than the unilateral level, for a large enough difference between the unilateral and efficient security levels, the payer nations would typically need to have levels of the public support in the institutional (efficient) outcome which are sufficiently greater than the levels in the unilateral case. In other words, lesser security (due to the movement to the efficient security level) raises the

[21] This presents us with an interesting question: can a representative government actually reduce the level of security provision, in face of greater public support (or more strongly put - demand) for action? Note that alongside this support for greater action, there is now visible "multilateral" support for the government I's actions on the world stage, perhaps lower military losses, and easing of actions which also partly have a negative connotation, in our context. Further, notice that technically the utility level of the country does not fall from the situation of "unilateral action". Thus, given high (in fact, increasing) support for its war at home, and all the factors mentioned here, the government might not do that badly politically, even if it reduces security effort. From a certain viewpoint, some security reductions (up to a reasonable point) might in fact suit the government.

threat, which in turn should sufficiently raise the publics' appetite for security. As mentioned before, the enhancement of the public's appetite for security would cause an increase in utility levels of the governments of these nations under the institutional regime. In fact, the rise in support causes desires of the payers under the institutional regime to move up towards the desire of nation I under the unilateral regime. Thus, the efficiency level will be closer to the unilateral effort level and transfers needed to support the scheme will be lower. Hence, it will more likely be achieved. Also note that since money and effort are perfectly substitutable as payments in my model, a real-world scenario might actually involve the payer nations contributing to "boots on the ground", operating under the "command and control" of nation I. That would truly lead to a multilateral, as well as efficient combating of the threat, in every sense.

The relevant results obtained in Sections 3.1 and 3.2 for the case $e^E > e^N$ may be easily incorporated into Proposition 2, to extend it for that case. One main difference would be that only nation I would be needed to be paid off, in that situation. For the payers, we see (somewhat akin to the case $e^E < e^N$) that the level of public support under the institutional regime should be sufficiently close to the public support in that nation under the unilateral regime, for it to be willing to contribute a positive amount to the transfers' fund (see the applicable results of Section 3.1). This occurs because greater security would reduce threat levels, hence reducing the public's appetite for security (even though, on one hand, greater security related benefits accrue to the nation). Hence a positive contribution towards enhanced security levels can be supported only if the appetite for security remains high enough, even with a reduction in the threat level.

In sum, the conclusion is that when a movement to a "lower" (efficient) level is sought, the public desire for security in the payer nations (in the institutionally-obtained outcome) should climb up towards the desire for security in nation I. On the other hand, when a movement to a "higher" (efficient) level is sought, the public desire for security in the payer nations (in the institutional outcome) should not become too "pacifist" compared to the desire for security in nation I. Intuitively speaking, in both cases the support for the movement towards efficiency (through payments) arises from the desires of the payers either "getting close" or "remaining close" to the desire of nation I.[22]

4 Declining public support

In the previous section I have assumed that λ is increasing in the level of threat t, hence $\lambda_t^i > 0$. However, there are some real world occurrences where for some nations the reverse is true, i.e. an increase in the threat level actually weakens public support for their contributions security efforts of the alliance. This may

[22] The reader might note that Proposition 2 gives the individuality rationality constraints of the payees, but does not mention any specific payment-sharing rule for determining actual transfer payments by individual payees. I would like to add that many such payment sharing rules are possible, within the limits of the individual rationality constraints.

particularly be true if: (i). these countries are initially low targets for the threats, but then become targets - making the public feel a that a lower profile in security activities would again make them low priority targets.[23] (ii). The other situation where this would occur is where the public in a target country initially have a strong appetite for joint security effort, but as the conflict progresses, attacks cause them to lose the appetite for fighting (and more disengagement is advocated, perhaps to deflect attacks towards other countries).[24] In order to model this phenomenon, I now assume that for the countries belonging to set P in the earlier section, $\lambda_t^i < 0$ (so public support begins at a certain level, but as threat levels increase, they go down). For all other nations λ_t^i is still positive. It seems natural to investigate what would happen to the mechanism proposed in Section 3, if the countries that would actually have to pay for a movement from the unilateral to the efficient outcome remain only "fair-weather friends", and in some sense distance themselves from nation I if the threat situation becomes more dangerous.

1. Case (I): $e^E > e^N$

Since $t^E < t^N$ for $e^E > e^N$ (vide Lemma 2), for the nations in set P, $\lambda^i(t^E) > \lambda^i(t^N)$. This means that in this case $e^E = \frac{1}{2I}[\sum_{i=1}^I \lambda^i(t^E) - c]$ will be higher than the efficient effort level when all nations had $\lambda_t^i > 0$. Thus the transfer τ^I needed to make nation I supply the higher efficient level of effort will be higher:

$$
\begin{aligned}
\frac{\partial \tau^I}{\partial e^E} &= -\lambda^I(t^E) - e^E \frac{\partial \lambda^I(t^E)}{\partial t^E}\frac{\partial t^E}{\partial e^E} + 2e^E + c \\
&= -\lambda^I(t^E) - e^E \frac{\partial \lambda^I(t^E)}{\partial t^E}\frac{\partial t^E}{\partial e^E} + \frac{\sum_{i=1}^I \lambda^i(t^E)}{I} + \frac{c(I-1)}{I} > 0
\end{aligned}
$$

(substituting for e^E and using the facts that $\lambda^I(t^E) < \lambda^I(t^N) < \frac{\sum_{i=1}^I \lambda^i(t^E)}{I} + \frac{c(I-1)}{I}$, $\frac{\partial \lambda^I(t^E)}{\partial t^E} > 0$, and $\frac{\partial t^E}{\partial e^E} < 0$)

Recall that there are no other recipients of transfers (except for I) in the case where $e^E > e^N$.

Now, for nation $i \in P$ we have

$$z^i = \lambda^i(t^E) - \frac{e^N}{e^E}\lambda^i(t^N) + \kappa, \text{where } \kappa = \frac{(e^N)^2}{e^E} - e^E$$

Since for $e^E > e^N$ we now have $\lambda^i(t^E) > \lambda^i(t^N)$, rather than $\lambda^i(t^E) < \lambda^i(t^N)$ as before, it follows that the value of z^i is higher in this case (or the maximum amount country i is willing to pay for a movement to the efficient level has gone up compared to the case where public support goes down with a decrease in threat).

[23] The experience in Spain after the Madrid train bombings of 2004, with resultant decline in public support for the war in Iraq (which was low enough to start with), is a case to the point.

[24] Intuitively one might expect the first situation to occur in an environment where the preferences of the allies were such that $e^E < e^N$, and the second situation to occur in the opposite case.

So even though a higher transfer amount has to be supported by the payer countries, given that reduction of the threat actually increases the public support for the conflict, it might be easier to support the (higher) efficient amount of joint effort in this case.

Case (II). $e^E < e^N$:

Since $t^E > t^N$ for $e^E < e^N$, for the nations in set P, $\lambda^i(t^E) < \lambda^i(t^N)$. This means that in this case $e^E = \frac{1}{2I}[\sum_{i=1}^{I} \lambda^i(t^E) - c]$ will be lower than the efficient effort level when all nations had $\lambda_t^i > 0$. We see below the transfer τ^I needed to make nation I supply a lower efficient level of effort might be higher or lower:

$$\begin{aligned}\frac{\partial \tau^I}{\partial e^E} &= -\lambda^I(t^E) - e^E \frac{\partial \lambda^I(t^E)}{\partial t^E}\frac{\partial t^E}{\partial e^E} + 2e^E + c \\ &= -\lambda^I(t^E) - e^E \frac{\partial \lambda^I(t^E)}{\partial t^E}\frac{\partial t^E}{\partial e^E} + \frac{\sum_{i=1}^{I} \lambda^i(t^E)}{I} + \frac{c(I-1)}{I} \lesseqgtr 0\end{aligned}$$

Thus, from the above equation we have :

$$\frac{\partial \tau^I}{\partial e^E} < 0 \text{ if } \left| e^E \frac{\partial \lambda^I(t^E)}{\partial t^E}\frac{\partial t^E}{\partial e^E}\right| < \frac{\sum_{i=1}^{I} \lambda^i(t^E)}{I} + \frac{c(I-1)}{I} - \lambda^I(t^E)$$

$$\text{and } \frac{\partial \tau^I}{\partial e^E} > 0 \text{ if } \left| e^E \frac{\partial \lambda^I(t^E)}{\partial t^E}\frac{\partial t^E}{\partial e^E}\right| > \frac{\sum_{i=1}^{I} \lambda^i(t^E)}{I} + \frac{c(I-1)}{I} - \lambda^I(t^E)$$

(substituting for e^E and using the facts that $\lambda^I(t^E) > \lambda^I(t^N) > \frac{\sum_{i=1}^{I} \lambda^i(t^E)}{I} + \frac{c(I-1)}{I}$, $\frac{\partial \lambda^I(t^E)}{\partial t^E} > 0$, and $\frac{\partial t^E}{\partial e^E} < 0$)

We see in one of the cases above that a lower transfer might be required to get to the lower efficient effort level in the case where a combination of factors occur: the increase in threat due to falling effort is not that high; and there is sufficient gain in public support in I (which has an increasing λ) due to the increase in the threat level (thus perversely compensating the government in I for the increase in threat). There is also saving on costs (as effort provision falls), hence requiring less compensation in form of transfers. In the other, more intuitive case, a higher transfer is needed to compensate nation I , for it to move to a lower (efficient) level of effort. As seen below, a similar result does not obtain for other recipients since they are compensated for their private provision levels under the institutional regime (which increases for a lower efficiency level) - this is not the case for I, which is compensated up to its private provision level in the unilateral outcome. Recall that there are other recipients of transfers (other than I) in the case where $e^E < e^N$. For these other recipients of transfers, a reduction in the efficient effort level will also impact the transfer levels. In fact, the transfer τ^i needed to make nation i make no effort on its own will be unambiguously higher (for a lower efficient level of joint effort):

$$\begin{aligned}\frac{\partial \tau^i}{\partial e^E} &= (e^{i*} - e^E)\left[\frac{\partial \lambda^i(t^E)}{\partial t^E}\frac{\partial t^E}{\partial e^E} - 1\right] - [\lambda^i(t^E) - (e^{i*} + e^E + c)] \\ &= (e^{i*} - e^E)\left[\frac{\partial \lambda^i(t^E)}{\partial t^E}\frac{\partial t^E}{\partial e^E} - 1\right] - \frac{1}{2}\left[\lambda^i(t^E) - \left(\frac{\sum_{i=1}^I \lambda^i(t^E)}{I} + \frac{c(I-1)}{I}\right)\right] < 0\end{aligned}$$

(substituting for e^{i*}, e^E, and using the facts that $\lambda^i(t^E) > \frac{\sum_{i=1}^I \lambda^i(t^E)}{I} + \frac{c(I-1)}{I}$ as $e^{i*} > e^E$, $\frac{\partial \lambda^i(t^E)}{\partial t^E} > 0$, and $\frac{\partial t^E}{\partial e^E} < 0$)

Now, for nation $i \in P$ we have

$$z^i = \lambda^i(t^E) - \frac{e^N}{e^E}\lambda^i(t^N) + \kappa, \text{where } \kappa = \frac{(e^N)^2}{e^E} - e^E$$

Since for $e^E < e^N$ we now have $\lambda^i(t^E) < \lambda^i(t^N)$, rather than $\lambda^i(t^E) > \lambda^i(t^N)$; it follows that the value of z^i is lower in this case (or the maximum amount country i is willing to pay for a movement to the efficient level has gone down compared to the case where public support increase with an increase in threat). The escalation of the threat decreases the public support for the conflict. The above analysis mostly suggests it might be harder to support the (lower) efficient amount of joint effort in this case, when public opinions in the allied countries diverge (not in small part also because, under this scenario, the difference between the unilateral and efficient effort is likely to be much greater). One way to interpret these results is to say that they give us the conditions under which an alliance will unravel. I compile the above results in Proposition 3 below.

Proposition 3 *If $\lambda'(t) < 0$ $\forall i \in P$ and $\lambda'(t) > 0$ $\forall i \in R$, then:*
(i). For $e^E > e^N$, the transfer τ^I needed to make nation I supply the efficient level of effort and the maximum transfer z^i a payer nation is willing to pay, will be higher compared to the case where $\lambda'(t) > 0$ for all alliance members.
(ii). For $e^E < e^N$, the transfer τ^I needed to make nation I supply the efficient level of effort may be either higher or lower (depending on whether $\left|e^E \frac{\partial \lambda^I(t^E)}{\partial t^E}\frac{\partial t^E}{\partial e^E}\right| \gtrless \frac{\sum_{i=1}^I \lambda^i(t^E)}{I} + \frac{c(I-1)}{I} - \lambda^I(t^E)$ respectively), the transfer amount needed to support zero effort levels by other recipient nations will be higher, and the maximum transfer z^i a payer nation is willing to pay will be lower, compared to the case where $\lambda'(t) > 0$ for all alliance members.

Proposition 3 characterizes the scenario where the public opinion supporting the conflict actually drops in a subset of member nations of the alliance, when the level of threat increases. The results seen in the proposition have implications for achieving ex post efficiency constraint, hence on workability of the institutional scheme suggested in this paper:

(i). It turns out that the transfer needed to shift to the efficient level of security, when the efficient level is higher than the unilateral level, is more than in the earlier scenario (when the public support in all nations increase for a higher threat). However, as the maximum amount the payer countries are willing to pay for a movement to the efficient level goes up compared to before (given that reduction of the threat actually increases the public support for the conflict) it might be easier to support the (higher) efficient amount of joint effort in this case. This case demonstrates that the payers fulfill their role as "fair-weather friends" in a situation where the threat becomes less dangerous.

(ii). On the other hand, if the efficient security level is less than the unilateral level, the maximum amount payer countries are willing to pay for a movement to the efficient level has goes down compared to before, as the escalation of the threat decreases the public support for the conflict. This suggests that it might be harder to support the (lower) efficient amount of joint effort in this case. While the decrease in decrease in desire for security effort provides an incentive to pay (by the payers) for reduction in such effort (by the unilateral provider), there is also a countervailing incentive to not pay in any way for any such effort at all (when the λ value falls too low). When the latter effect dominates, it will be difficult to support the transfer mechanism, especially if the transfer amount required by the unilateral provider increases at the same time.

(iii). Surprisingly, in the case efficient security level is less than the unilateral level, a scenario is possible where a lower transfer might be required to get the unilateral provider to the lower efficient effort level. For that to happen, a combination of factors must occur - the efficient level of security is high enough, the gain in public support due to the increase in the threat level is sufficiently high in the effort-providing nation, and the increase in threat level not that high. Thus, the perverse effect of decreasing security, leading to a greater threat, simultaneously drives up public support in the provider country and saves on cost, hence requiring less compensation in form of transfers (as this increasing public support increases the utility of government of the country supplying the security effort to a sufficient level, to compensate for the actual loss in security itself). In this situation, it might possibly be easier to support the transfer mechanism, even with a decrease in the amount payer countries are willing to pay.

Both cases (ii) and (iii) demonstrate the payers fulfilling their role as "fair-weather friends", who distance themselves in a situation where the threat becomes more dangerous. Interestingly, the outcome where the efficient level is higher than the unilateral level seems easier to support through the institutional mechanism in the presence of "fair-weather friends". The opposite is true for the outcome where the efficient level is lower than the unilateral level, when "fair-weather friends" are present.

5 Discussion

There are some broader implications of the results seen in this paper. First, the institutional structure suggested in Proposition 2 , for the realization of the efficient level of global security, is quite “inclusive". This structure gives all nations in the alliance, except for those that enjoy hugely positive free-riding benefits, a chance to participate in the decision of whether or not to accept the neutral player's proposal. Not only that, since all voting nations have de facto “veto rights", all these nations have a strong say in the decision-making process. From a democratic perspective, this certainly seems desirable. The reader might wonder whether the unanimity rule is at all needed to secure the efficient outcome, or whether it is an irrelevant artifact, adding to the complexity of the institutional mechanism? A result by Maggi and Morelli (2006), when invoked in our context, provides us with an answer. The authors show that unanimity is the best an organization can do if there is no enforcement of voting outcomes, but if there is enforcement, majority rule of some kind could be better. In my framework, enforcement of transfer payments occurs through the handing over of the payment to the neutral player by the payers after the voting process. Other than this, there can be no obvious enforcement mechanism that can force a sovereign nation to pay up against its wishes, if it ends up on the losing side of a majority vote. In fact, in this kind of situation, the most plausible minimalist assumption is that a “yes" voting nation pays and a “no" voting nation does not. Seen in this light, the bite of the unanimity rule in the institutional mechanism suggested in this paper becomes clear, if the mechanism has to ensure that all the designated payers pay up their dues.[25] If, however, we want to impose the stronger rule that majority decisions prevail even on the no voters, then for all purposes the rationale of a “no" vote goes away, making the comparison of its desirability vis-a-vis the unanimity rule rather irrelevant.[26]

A second point of contention arises with regard to the rather strong power of the neutral agent to restrict voting to a subset of member nations of the alliance. However, this restriction should be seen in the proper context. The restricted countries are ultimate free-riders who actually gain a security level under status quo beyond a point they would privately (alone) provision, and that too without any contribution towards the joint effort level. After the movement to the efficient level, they still continue to provide zero effort levels. However, their security is guaranteed by the proposed mechanism up to their private level. Thus, they have no incentive to break off from the alliance, even after their voting rights are restricted. What the mechanism

[25] The reader can easily think of a situation where a designated payer nation having the option of not paying if it votes "no", would do so, as best response to the “yes" votes of a majority of voting nations (who would then be bound to pay up, if the minimalist assumption of paying according to one's vote, holds). This would create a free-rider problem on the payers' end.

[26] On reflection, multiple equilibria might be possible in this scenario. One where everyone votes “yes" either because each believes that his vote is decisive or it is irrelevant to vote “no" against the majority (and yet pay up). The other would be where everyone would believe that the majority would vote no and it would be (weakly) irrelevant to vote “yes". So, even here there is some rationale to preserve the unanimity rule, if only to prevent the possibility of the latter bad outcome occurring sometimes.

does is curb their role as "deal-breakers". In sum, these excluded nations are actually recipients of payments, and do not make any effort in equilibrium, their exclusion does not seem unfair. Further, as these nations get compensated so that they gain utility levels which they would have by "going-it-alone", we need not fear an exodus of these nations from the alliance.

Third, given the restrictions of the benchmark model in this paper (linear effort technology, linear costs, no income effects, and non-binding wealth constraints), would the conclusions of my paper be valid in a more general context? The relaxation of these constraints will not give us the strong unilateral outcome seen in the benchmark model, with only one effort provider. However, even though there will be more nations making effort, the joint effort level will likely not be at the efficient level, and given the features of our model, can be either more or less than efficient for different parameter values. The question is: will the mechanism outlined in Proposition 2 work in the more general case where there are multiple effort providers at "status quo", as well? Intuitively, I believe the answer is yes, where *all providers at status quo are compensated fully up to their status-quo utility levels*. Further, *the payers might have to make compensation through effort, and not just monetary transfers*. Demonstration of these assertions are part of my ongoing research.

Lastly, I believe that the reader might be interested in learning what the mechanism suggested in Proposition 2 might look like, at the practical level. The whole exercise of this paper would come to naught if the idea of a neutral directorate is not implementable in real life. Fortunately, Gupta (2010) provides a detailed description of the organizational structure that a neutral directorate should possess, in very pragmatic terms (see pages 190-192 of that paper). The paper not only suggests how the neutral directorate might be structured in a real-world situation, but it also discusses some of the problems that it might face in its operations. I believe that the characteristics of the neutral directorate outlined by Gupta (2010) warrants close consideration - as it contains proposals that are both tangible and implementable. To summarize the suggestions, they include:

1. A proposal to set up a directorate within the international institution comprising of career officers belonging to an "international civil service" whose membership should be determined by technical qualifications and clearance of a suitable examination process. This directorate would serve as the neutral agent mentioned in the current paper.

2. An outline of checks and balances (both top-down and bottom-up) among the ranks of these career officers which might be required to ensure their neutrality.

6 Conclusion

In this paper I have proposed an institutional structure for efficient provision of global security by an alliance of nations, against the threat of a rogue nation, which reacts strategically against the alliance. Thus, the rogue nation and the alliance interact, and the efforts of both are endogenously determined. Initially, a single member of the alliance makes a unilateral security effort, which may not be efficient. However, there exists an institutional structure that would facilitate the alliance's movement from a unilateral to an efficient level of global security. It is seen that evolving public support for security effort in various nations would impact the achievement of such an institutional structure.

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Appendices

Appendix 1: The solution and uniqueness of the intra-alliance game

By assumption $\lambda^I > \lambda^i, \forall i \neq I$.

It follows from the solution to the FOC for country $i \neq I$ that for $\sum_{j\neq i} e^j = \frac{1}{2}[\lambda^I(t) - c], e^i = 0$ is its best response.

But for $e^i = 0, e^I = \frac{1}{2}[\lambda^I(t) - c]$ is the best response for I (from its FOC & the above assumption).

So the (Nash) equilibrium of the intra-alliance game is: $(e^1, e^2, ..., e^I) = (0, 0, ..., \frac{1}{2}[\lambda^I(t) - c])$.

Thus, $e^N = e^I = \frac{1}{2}[\lambda^I(t) - c]$, as $e^i = 0$, for $i \neq I$.

This equilibrium is unique since for any other profile of effort by the players, at least one player has a profitable deviation:

Consider $e^i = \theta^i \geq 0$ for $i \neq I$, with $\theta^i > 0$ for at least one i.

I's best response in this case is: $e^I = \frac{1}{2}[\lambda^I(t) - c - 2\sum_{j\neq I} e^j] > 0$ or 0.

But for such a response by I, i's best response is: $e^i = \frac{1}{2}[\lambda^i(t) - c - 2\sum_{j\neq i,I} e^j - 2e^I] = \frac{1}{2}[\lambda^i(t) - c - 2\sum_{j\neq i,I} e^j - \{\lambda^I(t) - c - 2\sum_{j\neq I} e^j\}]$

$= \frac{1}{2}[\lambda^i(t) - \lambda^I(t) + 2\theta^i]$, (putting $e^i = \theta^i > 0$)

$= \theta^i + \frac{1}{2}[\lambda^i(t) - \lambda^I(t)] < \theta^i$, since $\lambda^i(t) < \lambda^I(t)$.

Hence θ^i is not i's best response.

Now, consider $e^I < \frac{1}{2}[\lambda^I(t) - c]$. We have seen that for $e^i = 0$ for $i \neq I$, this is not I's best response. The only way it might be a best response is if $e^i > 0$ for some $i \neq I$. But we have already seen than any outcome with $e^i > 0$ for some $i \neq I$ cannot be a Nash equilibrium since $e^i > 0$ is not i's best response. Hence the equilibrium is unique.

Appendix 2: Proof of Lemma 2

Proof. If $e^N \gtreqless e^E$, *then* $\alpha(e^N) \lesseqgtr \alpha(e^E)$ *(since* $\alpha_e < 0$*)*

Thus, it follows from the solutions for t^N *and* t^E *that* $t^N \lesseqgtr t^E$.

Now, for $t^N > t^E$, *let* $e^N > e^E$.

If $e^N > e^E$, *then* $\alpha(e^N) < \alpha(e^E)$, *since* $\alpha_e < 0$.

But this violates the original premise that $t^N > t^E$ *(as per the solutions for* t^N *and* t^E, this would follow from $\alpha(e^N) < \alpha(e^E)$).

Thus, it must be true that $e^N < e^E$.

So, for $t^N > t^E$,*it must be that* $e^N < e^E$. *Similarly, for* $t^N < t^E$,*it must be that* $e^N > e^E$.

Appendix 3: Proof of Lemma 3

Proof. From the individual rationality condition, a country i might be willing to pay a positive amount, i.e. $z^i > 0$,*only when* $[V^i(m^E, e^E; t^E) \mid z^i > 0] \geq [V^i(M^i, e^N; t^N) \mid z^i = 0]$

Or, $[V^i(m^E, e^E; t^E) \mid z^i > 0] - [V^i(M^i, e^N; t^N) \mid z^i = 0] \geq 0$

We note that the utility of $i \neq I$ *for the unilateral outcome is* $M^i + e^N[\lambda^i(t^N) - e^N]$,
And its utility in the efficient outcome is $M^i + e^E[\lambda^i(t^E) - e^E] - z^i$
So, $[V^i(m^E, e^E; t^E) \mid z^i > 0] - [V^i(M^i, e^N; t^N) \mid z^i = 0] \geq 0$
$\Longrightarrow \{M^i + e^E[\lambda^i(t^E) - e^E] - z^i\} - \{M^i + e^N[\lambda^i(t^N) - e^N]\} \geq 0$
$\Longrightarrow z^i \leq e^E\lambda^i(t^E) - e^N\lambda^i(t^N) + (e^N)^2 - (e^E)^2$
Thus, the maximum amount i would be willing to pay for the change is $e^E\lambda^i(t^E) - e^N\lambda^i(t^N) + (e^N)^2 - (e^E)^2$

Appendix 4: Proof of Proposition 2

Proof. Part A: The effort choice for $i \in R\backslash I$ in the third stage of the institutional game is zero
Note that for countries $i \in R\backslash I$ the best response function in the status quo game is: $e^i = \frac{1}{2}[\lambda^i(t^N) - c - 2\sum_j e^j]$, for $\lambda^i > c + 2\sum e^j, j \neq i$ and 0 otherwise.
In the institutional game with transfers, given $\tau^i = (e^{i*} - e^E)[\lambda^i(t^E) - (e^{i*} + e^E + c)]$ for $e^i = 0$ and 0 otherwise, the best response effort level is zero, for e^E by I and no effort by others.
This is because from the best response function $e^i = \frac{1}{2}[\lambda^i(t^E) - c - 2\sum_j e^j]$, for $\lambda^i > c + 2\sum e^j, j \neq i$ and 0 otherwise, its best response to e^E by I and no effort by others, is to make effort $e^{i*} - e^E$. The payoff from making this effort is $V^i(m^{i\prime}, e^{i*} - e^E, 0 \mid e^{i*})$ if $e^I = e^E$. But payoff from making no effort is $V^i(m^E, 0, \tau^i \mid e^E)$. Since by construction $V^i(m^E, 0, \tau^i \mid e^E) = V^i(m^{i\prime}, e^{i*} - e^E, 0 \mid e^{i*})$, i's effort level zero is payoff equivalent to making effort.[27] Note that if a country gets the same payoff from making zero effort and a positive effort, then it makes no effort (by assumption).
Further, for $e^i = \theta \neq 0$, $\tau^i = 0$ and $e^I = e^E - \theta$, for no effort by the other players. Using the best response functions, it is easy to check that these strategies are indeed best responses to each other.
Hence, i's payoff from deviation is $M^i + e^E[\lambda^i(t^E) - e^E] - c\theta < M^i + e^E[\lambda^i(t^E) - e^E] + \tau^i$.
Thus, $e^i = 0$ maximizes (weakly) i's payoff, given $e^I = e^E - \theta$ and $e^j = 0$, $j \neq i, I$.
Part B: In the second stage of the institutional game, voters unanimously "agree" to the neutral player's first stage proposal
By construction $V^i(m^E, 0, \tau^i \mid e^E) + \tau^i = V^i(m^{i\prime}, e^{i*} - e^E, \tau^i = 0 \mid e^{i*})$ for $i \in R\backslash I$ and $\phi^i > 0$.
By construction $V^I(m^E, e^i = e^E; t^E) + \tau^I = V^I(m^N, e^N; t^N) - V^I(m^E, e^E; t^E)$ for I.
As $0 \leq z^i \leqslant e^E\lambda^i(t^E) - e^N\lambda^i(t^N) + (e^N)^2 - (e^E)^2$ for all $i \in P$, $V^i(m^E, e^i = 0, \tau^i \mid e^E) \geq V^i(M^i, e^i = 0, \tau^i = 0 \mid e^N)$ for these players.
Hence agreeing to the neutral players proposal at least (weakly) dominates not agreeing for all voters. Thus the proposal is unanimously adopted.

[27] In this proof $V^i(m^i, e^i, \tau^i(e^i) \mid e)$ denotes i's utility from its consumption of the private good m^i, the amount of effort e^i that it puts in, and the transfer $\tau^i(e^i)$ it gets (dependent on its effort), given the joint effort level e. Note that an effort level e^i is weakly preferred by i to an alternate level $e^{i\prime}$, if $V^i(m^i, e^i, \tau^i(e^i) \mid e) \geqslant V^i(m^{i\prime}e^{i\prime}, \tau^{i\prime}(e^{i\prime}) \mid e')$ for given effort levels of all $j \neq i$.