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July 15, 2011

Abstract

In a scenario where terrorist organizations, based in an LDC, target a rich nation, we examine a joint, multi-pronged and dynamic counter-terror strategy and the role that developmental aid plays in its success. We show that aid-tying leads to a fruitful virtuous cycle whereby joint counter-terror operations help in the observability of aid delivery, and aid in its turn makes greater counter-terror possible. Further, the counter-terror operations must be the largest possible at the very beginning. We argue that it is not necessarily the case that a more hawkish donor is less pro-development, or that a more altruistic donor is softer on terror. Moreover, we identify channels through which international diplomacy aimed at reducing regional hostility can help in the war against terror.

Keywords: Developmental Aid, Terror, Aid-tying, Joint Counter-terror Operations, Diplomacy.
JEL Classifiers: D04, F50, O12

*Disclaimer: Names of nations, organizations and individuals that appear in this article are taken from numerous media resources, as are all the opinions and quotations used. We as authors are not in a position to judge the correctness of these reports.

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"Never, never, never believe any war will be smooth and easy." *Winston Churchill*

1 Introduction

The spectre of terrorism haunts countries all across the globe today.[1] So much so that the fight against terrorism constitutes an important element of the foreign policies of many countries, including, of course, the United States. President Obama made his commitment to counter-terror an explicit feature of his election campaign. Even earlier, the United States had been actively pursuing counter-terror objectives, with, for example, operation 'enduring freedom' being spread over several countries and continents, including Afghanistan, the Philippines, and the Trans-Sahara region.[2] The United Kingdom also has a similar focus, with battling terrorism ranking amongst Britain's top foreign policy priorities.[3] In fact, not just developed countries but also many less developed and emerging nations (e.g. India, Sri Lanka and Malaysia, among many others), have to bear the brunt of terrorism.

Interestingly, many target nations are increasingly coming around to the view that success in the war against terror requires a multi-pronged approach, involving not only counter-terror operations, but also developmental aid.[4] The focus of this paper is how aid helps or hurts this war on terror.[5] Both aid delivery and counter-terror operations involve serious moral hazard problems. One key issue therefore is the design of the aid counter-terror package and in particular to understand whether developmental aid should be *tied* to the performance on the counter-terror front. Also, given the usual fungibility issues concerning aid,[6] is it that the problem gets aggravated in the context of terror? In the context of counter-terror, the issue of aid diversion is yet to be addressed adequately in the literature[7] and in this paper we make a beginning in examining

[1]See, for example, Becker and Rubinstein (2005), Richman et al. (2008) and Abadie and Gardeazabal (2003, 2008), among others, for evidence on how terrorism can adversely affect economic and social conditions of target nations.

[2]In the context of South America, MSNBC reports that the Hezbollah has set up operations within the rural regions known as South Americas Tri-Border Area. Other known terrorist organizations in the region include the Revolutionary Armed Forces of Colombia (FARC) and the National Liberation Army (ELN), who facilitate the trafficking of narcotics and the laundering of money derived from that enterprise. Further, many Western intelligence agencies report that Al Qaeda members, including nuclear 'whiz-kid' Adnan el Shukrijumah, have been spotted throughout South America.

[3]According to the ex-British foreign secretary David Miliband. See the report by Azhar Massod and Agencies, Islamabad, 27 July, 2007.

[4]It is also important to note that one of the main contexts for foreign aid in this century is indeed the war on terror (see Table 1 in Temple (2010)).

[5]War in general and that against terror in particular of course has many other social, economic, political and military aspects that we abstract from in this paper (see the RAND Homeland Security Program document at `http://www.dtic.mil/cgi-bin/GetTRDoc?AD=ADA515296&Location=U2&doc=GetTRDoc.pdf`).

[6]It is now well accepted that besides outright corruption among officials and local development partners, there is an evident tendency in many developing country governments to channel aid to their own supporters. Aid diversion to supporters of current political leadership in many other spheres is now well studied as in Bates (1981), Acemoglu et al. (2004), Boone (1996), Adam and O'Connell (1999), Lahiri and Raimondos-Moller (2004) and Overland et al. (2005). See also Pande (2008) for a review on political corruption and foreign aid.

[7]If the country concerned is infested with terror organizations, the problem may seem to be far worse. See, for example, Syed Mohammad Ali, The Daily Times, 18 August 2006 where he argues that such aid may even be diverted

this important aspect of the war on terror.

Like aid, pre-emptive counter-terror operations[8] is problematic as well, especially when conducted by the recipient country alone. For one, the recipient country's military may be ill-equipped to deal with counter-terror, especially if its primary focus is on external security (and particularly so if there are regional hostilities). Besides, sympathy for terrorist organizations among the domestic population, especially if present among the bureaucracy and the military as well,[9] may make it hard for the recipient government to deliver on the promised level of counter-terror. These considerations create a role for joint counter-terror operations that is central in our model. The presence of military personnel from the donor country not only provides expertise to the recipient's army, but equally importantly, by making the counter-terror operations by the recipient easier to monitor, it helps ensure that the agreed upon counter-terror objectives are met. That such monitoring is of importance to the donors seems to be supported by the fact that the United States has been arguing for the 'embedding' of United States forces within the Pakistani operations for some time, but was only allowed to be so from September 2009 onwards (New York Times, on-line issue, December 10, 2010). As we now discuss however, deploying donor troops in a terror infested foreign land itself has other problems.

Unfortunately, counter-terror operations involving foreign donor personnel run the risk of fomenting discontent against the incumbent government in the LDC. This could be either because of some sympathy for the terrorist objectives among the recipient population, and/or a perception that counter-terror operations involve some loss of sovereignty, particularly if foreign troops get involved.[10] In the unfortunate event of there being some collateral damage, such perceptions may harden.[11] In the long run, such discontent could lead to political unrest, even possibly regime changes in the recipient country or make local recruitment easier for the terror organisations; hence the scheme backfires.[12] Such regime changes are disliked by not only the incumbent LDC government, but also the target nation as they may not only derail the war against terror, but, it is feared, may give rise to failed states. Developmental aid plays a key role in keeping such discontent under control.[13]

We then argue that the inter-linking of joint counter-terror operations and development aid can

to terrorists, citing the example of serial bomb blasts in Bangladesh which were allegedly funded by Islamist NGOs.

[8]See Das and Roy Chowdhury (2010) and Sandler and Sequiera (2006) on optimal policy mix between pre-emptive (or offensive) and defensive counter-terror strategies.

[9]A recent report by Matt Waldman of the London School of Economics argues that Pakistan's intelligence arm, the ISI, has a role in the training of the Afghan Taliban. Pakistan denies this allegation.

[10]Mesquita and Dickson (2007), for example, explore a similar idea when they suggest that counter-terror operations may lead to a polarization of the population (perhaps by changing the population's assessment of the government's motivations). Similar positions are also taken in the works of Figueiredo and Weingast (2001), Rosendorff and Sandler (2004) and Mesquito (2005).

[11]As reported in the Sunday Times on November 08, 2008, the Bush Administration's intervention in Somalia may have turned Somalia into a breeding ground for Islamic extremists and given al-Qaeda a foothold in the Horn of Africa.

[12]As democrat John Kerry had once said about the Kerry-Luger aid package to Pakistan, that "this is about the survivability of Pakistan as an independent state". See AFP, 12 June, 2009.

[13]As reported on June 3, 2009 on the BBC regarding Pakistan's recent crackdown against the Taliban, "a new report from the International Crisis Group has warned that unless relief, rehabilitation and reconstruction efforts are urgently improved, the army's offensive against the Taliban risks leaving extremists as the ultimate winners."

help reduce the various moral hazard and socio-political problems intrinsic to this scenario in a way that is novel in the literature on aid-tying. Since joint counter-terror operations lead to greater observability, the donor is reassured about the efficacy of the counter-terror input. Further, given that counter-terror is taking place and the design of the aid counter-terror package, there would be unrest in case aid is diverted. Thus in case of such unrest, the donor country can conclude that there is aid-diversion, and liquidate the project. Consequently, by improving the observability of counter-terror, joint operations serve to control aid-diversion itself. It is interesting to note that with such a mechanism, counter-terror helps implement aid even though aid diversion is not directly observable. Furthermore, the fact that aid does not get diverted increases the recipient government's socio-political ability to wage the war against terror in an effective manner. Thus, while (joint) counter-terror activities prove that aid is not misused, aid itself helps sustain counter-terror, as well as helping to prevent socio-political unrest. It is this circular relationship between aid and counter-terror, one augmenting the efficacy of the other to create a virtuous cycle, that is the key to understanding the logic of aid-tying in this context.

The benchmark model we use to address these aspects of the environment involves a less developed country that serves as a base for terrorist organizations targeting a prosperous nation (for reasons that are of little or no consequence to our analysis).[14] The target nation cares about both counter-terror operations and the welfare of the recipient population, and particularly of those living in the war zone. Hence, it provides development aid that is active over an interval of time, and in tandem, insists that the recipient delivers on a promised counter-terror schedule over this interval. The formal problem here is to design an aid-counter-terror package that is dynamically optimal from the point of view of the donor, and, furthermore, ensures that at each instant (a) aid is not diverted, and (b) there is no socio-political unrest in the recipient country.

Solving for the aid-counter-terror package, we show that the optimal counter-terror scheme should follow a pattern that involves what we call *continuous and maximal engagement*. Under such a scheme, counter-terror operations start as soon as the aid is delivered, and are uniform over time, at the maximal amount that still avoids socio-political unrest and ends before the economic impact of aid dies down.[15]

Note that such a scheme has echoes of the well known 'shock-and-awe' strategy, introduced initially by the strategic military analysts Ullman and Wade (1996). This doctrine argues that a war should start with the largest and most decisive attack and then carry on at a lower scale, since by then the enemy would be psychologically defeated. We provide a new rationale behind this doctrine that focusses on dynamic socio-economic considerations in a long drawn war, rather than any purely military-psychological ones. The key idea is that the incentive of the recipient government to default should be front-loaded and uniformly distributed across time, so that it is not too large at any one single point. With continuous and maximal engagement, at every instant

[14] As to the proximate cause of terrorism, the literature has looked at the effect of, among other factors, poverty, economic powerlessness, marginalization, and fundamentalism on the growth of terrorism (See for example, O'Kane, 2005).

[15] This feature is a general property of optimal contracts in a dynamic setting with moral hazard as also shown in Chowdhury et al. (2011) in the context of micro-finance.

the donor asks for the maximal feasible amount of counter-terror, thus ensuring that default incentives are not too large later on. Further, we show that the moral hazard problem has serious implications in the sense that compared to the case where development aid cannot be diverted, not only is the level of aid lower, but so is aggregate counter-terror. Our analysis also suggests that the result on continuous and maximal engagement is robust to all variations of the problem that we study.

We then use this basic framework to address some questions of interest. Suppose that there is a political change in the donor country, so that the donor becomes either more hawkish, or more altruistic.[16] For example, the donor can become more hawkish in response to a large scale terror attack on it, or more altruistic if under increased pressure from human rights lobbyists. Similarly, suppose that involving personnel becomes too costly for the donor, so that it has the option of using aid alone, or using a mix of aid and military equipment. How do such changes affect the optimal policy mix between aid and counter-terror? Also, in a situation where some neighbours are hostile to the recipient, can diplomacy by the donor play a role in its war on terror?

Popular wisdom suggests that an increase in hawkishness would be accompanied by an increase in counter-terror and a decrease in aid. Similarly, an increase in altruism would lead to an increase in aid and, perhaps, a decrease in counter-terror. The answers turn out to be much more nuanced. We find that while an increase in hawkishness always increases the magnitude of the war on terror, it may, in some cases be accompanied by an *increase* in developmental aid. This is possible only when the donor is not too altruistic, or when the reach of development programmes is severely restricted. Equally interestingly, while an increase in altruism always increases development aid, the magnitude of the war on terror may in fact *increase*, particularly when the donor is not too altruistic to begin with. As we suggest later in the paper, these findings have some resonance in reality, in particular in the United States anti-terror policies in the past decade.

The intuition for this non-monotonic response is not obvious and has to do with the various moral hazard problems and socio-political issues discussed earlier. Since this is key to many of the subsequent results as well, we discuss the linkages in some detail. While aid and donor personnel are strategically neutral in the unconstrained objective function of the donor, once the various constraints are factored in, this is no longer the case. The donor's unconstrained objective function depends on the effective contribution of the donor personnel times the aggregate counter-terror input deployed by the recipient. Given the moral hazard problem on aid diversion, incentive compatibility demands that the aggregate counter-terror input depends on the *net* aid output (i.e. gross aid output minus the recipient's payoff from aid diversion). Consequently, the donor's 'constrained' utility function depends on the product of two terms: the effective donor personnel and the net aid output. If the level of aid is relatively high, then the net marginal productivity of aid is negative, and hence aid and personnel are strategic substitutes. By a similar logic, aid and

[16]By hawkishness we simply mean that the donor's preferences are tilted more towards the size of counter-terror operations than towards the economic well-being of the war-torn population. Altruism is its mirror image. For example, the United States government can be expected to become more hawkish if the neo-conservatives gain ascendency. In the Indian context, a similar outcome can be expected if a BJP-led coalition comes into power. Other example can be readily provided.

personnel are strategic complements in case the level of aid is not that high.

Given the preceding discussion, let us now consider the effect of an increase in altruism. The first order effect is an increase in aid. In case the donor is already altruistic to begin with, the level of aid is large so that aid and personnel are strategic substitutes over this region. Consequently, an increase in aid implies that there is a commensurate decrease in personnel, and consequently in counter-terror output. If however the donor is not too altruistic to begin with, then while aid increases with an increase in altruism, it leads to an increase in counter-terror as well, since now aid and personnel become strategic complements. The non-monotonic relation between hawkishness and aid can be similarly explained. Further, one can use similar arguments to show that as the war moves into more and more remote areas, aid and personnel may, or may not increase.

We then examine some variations of the benchmark model that are motivated by various geo-political realities. Consider, for example, a scenario where the recipient government is itself sympathetic towards the terror organization. We find that the level of both aid and personnel deployed would be lower in this case. Interestingly though, the level of counter-terror input may be higher. Next, our brief examination of a scenario where the recipient country has a hostile relation with some neighbouring country shows that diplomatic initiatives by the donor aimed at managing hostility between the neighbours can reduce the incentives for aid-diversion. This, in turn, allows the donor to sustain a higher level of aid and consequently counter-terror, thus demonstrating a role for diplomacy in counter-terror. Finally, we examine a case where the donor has the option of supplying military equipment to the recipient. We show that an increase in the donor's altruism unambiguously leads to a decline in the supply of such equipment. However, the relation between military supply and donor's hawkishness turns out to be non-monotonic.

1.1 Related Literature

The present paper is in the spirit of a recent literature that examines the role of foreign aid in delegating counter-terror measures to a host country. Like in the present paper, Azam and Delacroix (2006), Azam and Thelen (2008, 2010), and Bandopadhyay, Sandler and Younas (2011), all examine a scenario where a target nation provides aid to host countries in a bid to fight terror. Interestingly, Azam and Delacroix (2006) demonstrates that there is a positive empirical relationship between the level of foreign aid received by a country and the number of terrorist attacks originating from it. Seen through the lens of the present paper, this fact is not inconsistent with a scenario where there is too much aid (beyond what is intertemporally incentive compatible), so that then aid gets diverted and the recipient country also backs out of the war on terror. While Azam and Thelen (2008) analyse the effect of two kinds of aid, one geared towards fighting terrorism, and the other an educational one, in Azam and Thelen (2010) the target country chooses between aid and military intervention. In the spirit of these papers, the present paper also addresses both aid and military intervention together, as well as in isolation, to suggest many meaningful policy comparisons. Finally, Bandopadhyay, Sandler and Younas (2011) allows for a scenario with two kinds of aid, both tied and untied, as well as defensive counter-terror measures by the target country. The authors also address the issue of social unrest and regime change.

While all these papers make significant contributions to our understanding of the linkage between aid and counter-terror, the present paper differs from the extant literature, as well as contributes to it, in several different dimensions. First, this paper takes the issue of aid-diversion, an ever-present reality in the LDCs where terror organizations are often based, very seriously. One of the central contributions of this paper is to show that aid and counter-terror work in unison to create a virtuous cycle, each enhancing the efficacy of the other, an argument that is critically dependent on the possibility of aid-diversion. Second, we use a dynamic model, that allows us to make the point that the optimal counter-terror policy may look very much like one of shock-and-awe, though it is derived from purely dynamic incentive considerations. In contrast, the literature mostly adopts a static-multistage approach. Third, while in the literature counter-terror is mostly delegated to the host country, we analyse a situation where counter-terror operations are jointly undertaken, arguing that such joint counter-terror operations are key to solving some of the agency and socio-political problems intrinsic to this setup. Finally, in terms of results, our framework allows us to address some issues hitherto not analysed in the literature, e.g. the effects of increased hawkishness in the target nation, international diplomacy and other aspects of the such wars.

There is also some interesting existing work on counter-terror operations, in particular deterrence and pre-emption. Sandler et al. (1983) and Sandler and Scott (1987) both examine hostage situations with a focus on logistical aspects, as well as the risk attitudes of the various parties involved. Das and Lahiri (2006) examine the equilibrium level of security-deterrence in a non-cooperative game between one terrorist organization and *one* target country. This framework has been extended to allow for multiple countries as well as pre-emptive strategies by Sandler and Siqueira (2006) and Das and Roy Chowdhury (2008) respectively.[17] There is also an earlier theoretical literature dealing with hostage scenarios and subsequent negotiations between terrorists and governments.

There is an important body of literature on tied aid, see, e.g. Koeberle (2003), Koeberle et al. (2005), Kanbur (2006), Collier (2007) and Riddell (2007), as well as the authoritative survey by Temple (2010). Our paper builds on two different ideas in this literature. First, in our framework aid-tying is conceptually rooted in the 'fungibility' of aid, an issue that is also recognized in this literature (see, among others, Pack and Pack (1993), Feyzioglu et al. (1998), Mishra and Newhouse (2007) and van de Walle and Mu (2007)). Second, our model involves significant, though tacit, 'cooperation' between the donor and the recipient in various dimensions, and is thus reminiscent of the 'partnership' models in the foreign aid literature (see, among others, World Bank (2004) and Bourguignon and Leipziger (2006)). Our paper also contributes to this broader literature on aid-tying by identifying a new channel through which such aid-tying might help, namely the fact that it helps resolve the moral hazard problems associated with aid, and also by identifying the circular relationship between aid and counter-terror, each in turn enhancing the efficacy of the other.

[17] See Sandler and Enders (2004) on a survey of how economic analysis can be applied for better policy making with respect to transnational terrorism. For a political science approach to these and other related issues, see the two volumes edited by O'Kane (2005).

The remainder of the paper is structured as follows. In section 2 we formally describe the benchmark model and provide a full characterization of the optimal aid-counter-terror scheme. In section 3 we study the impact of donor preferences, in particular donor altruism and hawkishness, on the optimal scheme. Section 4 is devoted to some variations of the benchmark model. The paper concludes in section 5.

2 The War Against Terror: A Framework

The model comprises two strategic actors, a donor country (henceforth donor) and a recipient country (henceforth recipient). The donor is a *hard-liner* in that apart from supplying development aid, it also sends military personnel to actively supplement the anti-terror war waged jointly with the recipient.[18]

The amount of aid shall be denoted by k, where $0 \leq k \leq 1$. An investment of k in development yields an instantaneous return of ak at every instant $t \in [0,1]$, so that a denotes the productivity of the project (we shall later re-interpret a as a measure of the *reach* of the aid program). At any instant t, the remaining aggregate yield from this development project is $ak(1-t)$, yielding a utility of $ak(1-t)$ to the recipient and $\beta ak(1-t)$ to the donor, where $\beta \geq 0$ is the *altruism* parameter of the donor.

Delivery of aid however involves a potential moral hazard problem in that the recipient nation can divert this aid to other activities that do not meet the donor's objective. This aid diversion generates a utility of $b(k(1-t))$ for the recipient government, and an unacceptably large dis-utility for the donor.[19] We assume that $b(\cdot)$ satisfies the following smoothness and increasing returns conditions:

Assumption 1. *$b(\cdot)$ is twice differentiable, increasing and strictly convex over the interval $[0,1]$, with $b(0) = b'(0) = 0$, and $b(1) > a$.*

The donor ties the aid to the recipient's performance on counter-terror measures. The effective counter-terror at any instant t depends on two elements, the cost $C(t)$ incurred by the recipient on counter-terror, as well as P, the personnel deployed by the donor, yielding a counter-terror output of $f(P)C(t)$, but at a cost of $\zeta(P)$ to the donor. Counter-terror output should be thought of as number and size of successful attacks on terror organisations and their training camps in the LDC. For any donor, deploying personnel who face the threat of death and serious injury is costly, not just in terms of money, but more importantly in terms of the potential cost to valuable lives (and possibly the consequent dwindling of public support). This is captured by $\zeta(P)$. The function $f(P)$ captures two aspects of personnel deployment. First, such personnel can guide, as well as provide advice and expertise to the recipient country, thus making counter-terror more effective. Second, the deployment of personnel increases the observability of counter-terror activity by the recipient,

[18] We later consider a scenario where the donor supplies military equipment, but no personnel.

[19] Also, the fact that a recipient may not follow the donor's suggestions may itself be unacceptable to the donor authorities, either ideologically, or politically.

something very useful for the donor in a situation where recipients may have incentives to shirk.[20] This counter-terror output $f(P)C(t)$ at t reduces terror attacks by an equal amount $f(P)C(t)$ at that instance and so yields an instantaneous utility of $\alpha f(P)C(t)$ to the donor where $\alpha > 0$ is a parameter that measures the donor's utility impact of counter terror operations on actual reduction of terror aimed at the donor. The parameter α (> 0) can be then viewed as a preference parameter that captures how *hawkish* the donor country is on counter-terror. For instance, α is likely to increase in response to either a terror strike, or to information gathered by the donor's intelligence agencies that such a strike is imminent.

We maintain that $f(P)$ and $\zeta(P)$ satisfy:

Assumption 2. *Both $f(P)$ and $\zeta(P)$ are twice differentiable. (i) $f(P)$ is increasing and strictly concave $\forall P > 0$, with $f(0) > 0$, $f(P) \leq 1$ and $f'(0) = \infty$. (ii) $\zeta(P)$ is increasing and strictly convex $\forall P > 0$, and $\zeta(0) = \zeta'(0) = 0$.*

These assumptions are mostly standard. Also, the assumptions that $f(0) > 0$ and that $f(P) \leq 1$ together capture the notion that the involvement of donor personnel, while extremely important, is neither indispensable, nor a panacea in the war against terror.

In the long-run counter-terror activities may, however, lead to severe unrest, even possibly a regime change, and such unrest is deeply disliked by both the donor and the recipient authorities. It is avoided if and only if the developmental aid is large enough compared to the aggregate counter-terror. Thus in the rest of the paper we shall impose the requirement that the war against terror is *unrest-proof* in equilibrium, so that for each t we have,[21]

$$f(P)C(t) \leq ak. \tag{1}$$

To fix ideas, when $f(P)C(t) \leq ak$ for some instant t, this would mean, for our purposes, that the counter terror offensives at instant t do not generate too much sympathy and support for the terrorist organization. Hence, while the continuation of aid and counter-terror cannot be directly conditioned on unrest (or lack of it), whenever $f(P)C(t) = ak$, the absence of unrest at t still signals that aid is not being diverted.

An aid scheme is thus the tuple $\mathcal{S} = \langle k, C(t), P \rangle$, specifying the size of the development fund, the counter-terror cost schedule and the personnel deployed. Such schemes share the spirit of tied-aid programmes in that if the effective counter-terror at any instant falls below the contracted amount $f(P)C(t)$, the donor liquidates the aid project, as well as withdrawing the personnel support to counter-terror activities. This yields a continuation payoff of zero for the recipient.

[20] The New York Times on-line issue on December 10, 2010 suggests that the Pakistani Army approves the deployment of United States special operation elements to support Pakistani military operations. The first deployment occurred in September 2009. Previously, the Pakistani military leadership opposed such embedding in fear of opposition from the population. These developments thus appear to represent a sea change in the Pakistani establishment's thinking on the war.

[21] While this requirement may look somewhat ad hoc, there are no qualitative implications if the unrest-proof condition is instead framed as $f(P)C(t) \leq \tau ak$, for any $\tau > 0$. Clearly a larger τ reflects a society less prone to such unrest. Moreover, our results will hold qualitatively if we modelled the unrest as a smooth function of k and $C(t)$.

Let $C(\mathcal{S})$ be the total counter-terror cost of the recipient, $D(\mathcal{S})$ be the amount of total development output, and $B(\mathcal{S})$ be the total aid diversion activity under the scheme $\mathcal{S}$. Then the payoff of the donor from $\mathcal{S}$ is

$$U_D(\mathcal{S}) = \begin{cases} -\infty, \text{if either } B(\mathcal{S}) > 0, \text{ or there is unrest,} \\ \alpha f(P)C(\mathcal{S}) + \beta D(\mathcal{S}) - k - \zeta(P), \text{otherwise.} \end{cases} \tag{2}$$

The function $U_D(\mathcal{S})$ incorporates the following: (a) any scheme $\mathcal{S}$ that leads to aid diversion or a possible unrest in the long run is not acceptable to the donor, (b) a unit reduction in actual terror attacks engineered by a unit rise in counter terror output registers in a rise in the donor's utility by the factor α, (c) a unit rise in developmental output increase the donor's utility by the factor β and (d) the donor has to bear the economic costs of supplying aid and personnel.

The payoff of the recipient from $\mathcal{S}$ is

$$U_R(\mathcal{S}) = \begin{cases} -\infty, \text{if there is unrest,} \\ D(\mathcal{S}) - C(\mathcal{S}) + B(\mathcal{S}), \text{otherwise.} \end{cases} \tag{3}$$

The function $U_R(\mathcal{S})$ incorporates the following: (a) any scheme $\mathcal{S}$ that leads to a possible unrest in the long run is not acceptable to the recipient, (b) a unit rise in developmental output or diverted usage of aid increase the recipient's utility by 1 and (c) the donor bears the cost of its own military input of size C.

A scheme $\mathcal{S}$ satisfies *Individual Rationality* for the recipient if it yields an aggregate payoff that exceeds its reservation value (which we assume is 0 for each t). Granted that, a scheme is Individually Rational if $U_R(\mathcal{S}) \geq 0$.[22]

2.1 Optimal Scheme

Our task here is to solve for an optimal scheme that maximizes the donor's utility, and is both feasible and unrest-proof. We introduce the following notations: let $\tilde{k}$ solve $ak - b(k) = 0$ for $k > 0$ and let k^* solve $a = b'(k)$. Thus, $\tilde{k}$ is the highest amount of aid above which the utility of the recipient government from diverting aid exceeds the utility it obtains if the aid actually reaches its target. On the other hand, the gap between ak and $b(k)$ is maximized when aid equals k^*. As we shall see in what follows, k^* will play a crucial role in the ensuing analysis.

Let $0 \leq \tilde{t} \leq 1$ be the last instant when counter-terror is positive. In the simple set up studied here, we abstract away from the purely military and technological issues of counter-terror, and focus entirely upon the economic incentives of the parties involved and the social and political constraints that they face. The donor's problem is therefore to choose a scheme $\mathcal{S} = \langle k, C(t), P \rangle$ in order to maximize $U_D(\mathcal{S})$ so that it is incentive compatible, as well as unrest-proof. Thus at each

[22] As we shall see below, nothing changes even if individual rationality is imposed dynamically at every instant.

$t \in [0,1]$ such a scheme must respect the following:

$$\begin{aligned} & (i) \quad f(P)C(t) \leq ak, \forall t \in [0,1], \\ & (ii) \quad ak(1-t) - \int_t^{\tilde{t}} C(t)dt \geq b(k(1-t)), \forall t \in [0,\tilde{t}], \\ \text{and,} \quad & (iii) \quad ak(1-t) \geq b(k(1-t)), \ \forall t > \tilde{t}. \end{aligned}$$

Constraint (i) guarantees that the scheme is *unrest-proof*. Constraints (ii) and (iii) together imply that the project is *feasible*, i.e. *incentive compatible* at each t when the project is alive. Observe that given $b(0) = 0$, any feasible scheme is also individually rational at each instant.

We shall focus on schemes $\mathcal{S} = \langle k, C(t), P \rangle$ that involve counter-terror schedules with *Continuous and Maximal Engagement* (henceforth CME): $f(P)C(t) = ak$ for all $t \leq t'$ for some $t' > 0$, and $f(P)C(t) = 0$ otherwise.

As we shall argue in Proposition 1 below, such schemes are central to the analysis since they 'dominate' other schemes (in a sense made formal later), so that any feasible scheme can be replaced by another feasible CME scheme with the same level of aid and aggregate counter-terror. This result is analytically extremely useful since, along with the unrest proof constraint, it straight away provides a closed form solution for the counter-terror function $C(t)$.

As mentioned earlier, the logic of maximal engagement does not follow from any military one of shock-and-awe, but purely from dynamic incentive considerations. Further, such maximal engagement is not obvious though because while the project is at its most valuable phase initially, being worth ak at $t = 0$, the payoff from deviation is also at its highest at $t = 0$. As we demonstrate however, the net incentive to deviate decreases with time, so that a scheme that is incentive compatible initially, will continue to do so at all subsequent instants of time.

Proposition 1. *Given any feasible scheme $\mathcal{S} = \langle k, C(t), P \rangle$, there is another feasible scheme $\mathcal{S}' = \langle k, C'(t), P \rangle$ such that (a) the associated counter-terror scheme involves continuous and maximal engagement (CME) and (b) it yields the same level of aid, as well as aggregate counter-terror input.*

Proof. Since $\mathcal{S} = \langle k, C(t), P \rangle$ is feasible, it is IC at $t = 0$ so that

$$ak - \int_0^1 C(t)dt \geq b(k).$$

Let $t(k)$ solve $\frac{akt}{f(P)} = \int_0^1 C(t)dt$. We construct a counter-terror scheme $C'(t)$ such that $C'(t) = \frac{ak}{f(P)}, \forall t \leq t(k)$ and zero otherwise.[23] Note that by construction this scheme is CME, and involves the same level of aggregate counter-terror. Clearly, since $\int_0^1 C'(t)dt = \int_0^1 C(t)dt$, and $C(t)$ is IC at $t = 0$, the scheme $\mathcal{S}' = \langle k, C'(t), P \rangle$ is IC at $t = 0$.

Next consider the IC constraint at some t, $1 \geq t > 0$, $t \leq t(k)$. The new scheme is IC at such t provided

$$ak(1-t) - \frac{ak}{f(P)} \max\{0, t(k) - t\} \geq b(k(1-t)).$$

[23]Notice that $t(k) \leq 1$, since $C'(t)$ has been constructed from $C(t)$ by shifting terror-input from later to strictly earlier instants.

Note that this holds at $t \geq t(k)$, when the above simplifies to $ak(1-t) \geq b(k(1-t))$ (this follows since from IC at $t = 0$, $ak > b(k)$). Next consider $t < t(k)$. In this case, while the LHS is either increasing, or decreases linearly in t, the RHS is decreasing and convex in t. □

Given Proposition 1, we shall henceforth restrict attention to CME schemes. This is reasonable since if we allow for any discount factor less than 1, the donor always strictly prefers a CME scheme over another one that yields the same level of counter-terror. We then optimize over the set of CME schemes. Proposition 2 below provides a complete and closed form characterization of the optimal scheme, thereby providing some critical insights regarding the linkages between counter-terror, aid and donor personnel.

Let (P_H, k_H) solve

$$\alpha f'(P)[ak - b(k)] - \zeta'(P) = 0, \tag{4}$$

and

$$\alpha f(P)(a - b'(k)) + \beta a - 1 = 0. \tag{5}$$

Proposition 2. *The optimal policy involves a counter-terror scheme that prescribes continuous and maximal engagement, and a personnel-aid vector of* (P_H, k_H)*. Moreover:*

1. *If the donor is not too altruistic, or the productivity of aid is small (i.e.* $1 - \beta a > 0$*), then aid is small in the sense that* $k_H < k^*$*; otherwise, aid is large with* $k_H > k^*$*. However, aid is never too large in the sense that* $k_H < \tilde{k}$*.*

2. *The counter-terror scheme involves*
   $C(t) = \begin{cases} \frac{ak_H}{f(p_H)} & \text{if } t \in [0, \tilde{t}_H], \\ 0 & \text{thereafter,} \end{cases}$
   where
   $$0 < \tilde{t}_H = \frac{f(P_H)[ak_H - b(k_H)]}{ak_H} < 1.$$

Proof. The donor's problem is as follows:

$$Max_{\{k,P,\tilde{t}\}} \alpha f(P) \int_0^{\tilde{t}} C(t)dt + \beta ak - k - \zeta(P),$$

subject to the no-unrest and incentive compatibility constraints (i), (ii) and (iii) discussed earlier. Given that an optimal scheme is CME, we proceed as follows. We set equality in (i), and replace in (ii) which then becomes

$$ak(1-t) - (\tilde{t} - t)\frac{ak}{f(P)} \geq b(k(1-t)).$$

At $t = 0$, this becomes $ak - \tilde{t}\frac{ak}{f(P)} \geq b(k)$. From Proposition 1 if the scheme is IC at $t = 0$, then it is IC at each $t \in [0, 1]$. Hence, the problem of the donor simplifies to

$$max_{\{k,P,\tilde{t}\}} \alpha \tilde{t} ak + \beta ak - k - \zeta(P),$$

subject to:

$$\tilde{t}\frac{ak}{f(P)} \leq ak - b(k).$$

Observe that for any fixed value of k, the maximand is increasing in $\tilde{t}$. Thus, for every value of k, the constraint must hold with equality, so that the donor's problem then simplifies to

$$max_{\{k,P\}} Z(P,k) = \alpha f(P)[ak - b(k)] - (1 - \beta a)k - \zeta(P). \tag{6}$$

We call $Z(P,k)$ the constrained objective function of the donor in that it incorporates the various constraints that the donor operates under. Given our assumptions, one can use Weirstrass's theorem to show that a solution exists. Further, it is straightforward to argue that any solution must be interior.[24] Consequently, the solution (P_H, k_H) is characterized by the first order conditions (4) and (5).

It is then easy to see that $k_H < \tilde{k}$. If not, then the LHS of (4) becomes non-positive while by Assumption 2, the RHS is strictly positive. Next suppose $1 - \beta a > 0$. Then from (5) it follows that $a > b'(k)$, since under Assumption 2, $f(P) > 0$. Thus it must be that $k_H < k^*$. For $1 - \beta a < 0$, a similar argument establishes that $k_H > k^*$.

The solution to P_H follows subsequently along with $C(t)$, where

$$\tilde{t}_H = \frac{f(P_H)[ak_H - b(k_H)]}{ak_H}.$$

Given $f(P) \leq 1$ it follows immediately that $\tilde{t}_H < 1$. □

As demonstrated in the proof of Proposition 2, the donor's constrained maximization problem simplifies to

$$max_{\{k,P\}} Z(P,k) = \alpha f(P)[ak - b(k)] - (1 - \beta a)k - \zeta(P),$$

where $Z(P,k)$ now incorporates the various constraints that the donor operates under. Note that the donor's constrained utility function, $Z(P,k)$, turns out to depend on $f(P)$, i.e. the contribution of donor personnel, times the *net* aid utility of the donor (i.e. the gross aid output ak minus the recipient's payoff from aid diversion $b(k)$). We shall find that many of the results will depend on whether P and k are *strategic substitutes* (respectively *complements*) for the donor, i.e. on whether $Z_{Pk} = \alpha f'(P)[a - b'(k)] < 0$ (respectively $Z_{Pk} > 0$).[25] The following corollary will be helpful in having a clearer understanding of many of the results that follow as it pins down this observation precisely in the parameter space of the model.

Corollary 1. *Aid and personnel are strategic substitutes if* $1 - \beta a < 0$ *and strategic complements if* $1 - \beta a > 0$.

[24] This follows from the Inada condition that $f'(0) = \infty$.

[25] Note that we use the term strategic substitute/complement to capture the effects personnel has on the net marginal productivity of aid. We are aware however that these terms have very different usages in standard strategic environments, in particular in the industrial organization literature, where they are used to denote how players' best responses react to an increase or decrease in other players' strategic variables.

To see this, observe that if the level of aid is relatively high, then the *net* marginal productivity of aid is negative (i.e. $a - b'(k) < 0$), and hence aid and personnel are strategic substitutes. By a similar logic, aid and personnel are strategic complements in case the level of aid is not that high. Further, let $1 - \beta a < 0$. Then it must be that $k_H > k^*$, since otherwise an increase in aid increases $Z(P, k)$. Consequently, $a < b'(k_H)$. Hence, given that $f'(P) > 0$, P and k are strategic substitutes. By analogous arguments, whenever $1 - \beta a > 0$, P and k are strategic complements.

2.2 Disciplined Recipient

In this sub-section we argue that the possibility of aid diversion has negative implications, not only for the level of aid itself, but also on the magnitude of counter-terror output. To this end we consider a *disciplined recipient* nation that has no intention to divert aid, so that $b(k) = 0$ for any k. Of course, it still remains true that waging this war is costly and uncontrolled aggression still runs the risk of local unrest.

Given (6) and the fact that $b(k) = 0$, the constrained maximization problem simplifies to

$$Max_{\{P,k\}} V(P, k) = \alpha f(P)ak + \beta ak - k - \zeta(P).$$

Let (P^d, k^d) be the solution to this problem. The following proposition compares the outcome in this case with our benchmark model.

Proposition 3. *Suppose that the recipient has no incentive to divert the developmental aid. Then $P^d > P_H$ and $k^d > k_H$. Moreover, $k^d = 1$ if $1 - \beta a < 0$.*

Proof. Note that

$$V_P = \alpha ak f'(P) - \zeta'(P),$$

and

$$V_k = \alpha a f(P) - (1 - \beta a).$$

First observe that if $1 - \beta a < 0$, then $V_k > 0$ for all values of P, so that $k^d = 1 > k_H$. So suppose $1 - \beta a > 0$. Recall from Proposition 2 that in the benchmark model, we have

$$\alpha a f(P_H) - \alpha a f(P_H) b'(k_H) = (1 - \beta a).$$

Hence, it must follow that $\alpha a f(P_H) - (1 - \beta a) > 0$. Hence $k^d > k_H$.

We then argue that $P^d > P_H$. Suppose not. Then

$$\zeta'(P_H) \geq \zeta'(P^d) = \alpha f'(P^d)ak \geq \alpha f'(P_H)ak_H > \alpha f'(P_H)(ak_H - b(k_H)),$$

which is a contradiction. □

Consequently, in the absence of aid diversion, the level of aid is high, which is intuitive. Furthermore, in this case aid and personnel are necessarily strategic complements, so that the level of personnel is also larger compared to the baseline model with moral hazard. We also show that when $1 - \beta a < 0$, then the maximal amount of aid is supplied. This in turn allows the donor to employ the maximal possible personnel subject to there being no risk of unrest. Thus if the recipient nation has little corruption in aid delivery, both aid and personnel are high, as is the size of the war. It is also straightforward to show that the duration of the war is longer.

3 Hawks, Altruists and Geography

Given that the war on terror is a long drawn process, there can be several factors that impact the donor's objectives and priorities over time. Either because of national political changes, or perhaps because of pressures from world bodies, the donor can become more altruistic. National politics can also drive the donor to become more hawkish, as can a terror attack on the donor country. It is therefore of some interest to examine the implications of such changes on the war on terror. Does an increase in hawkishness necessarily imply that development funding will be affected? Does the donor becoming more altruistic mean that the war on terror is diluted? Finally, what effect does geography have on counter-terror and aid? In particular, what happens as the war on terror moves to more inaccessible terrains?

We employ standard comparative statics techniques, examining the impact of α, β and a on equilibrium values of P and k, in order to address these issues. Totally differentiating the first order conditions for an interior solution yield the following:

$$Z_{PP}\mathbf{d}P + Z_{Pk}\mathbf{d}k = -f'(P)[ak - b(k)]\mathbf{d}\alpha + 0\mathbf{d}\beta - \alpha f'(P)k\mathbf{d}a,$$

$$Z_{Pk}\mathbf{d}P + Z_{kk}\mathbf{d}k = -f(P)[a - b'(k)]\mathbf{d}\alpha - a\mathbf{d}\beta - [\alpha f(P) + \beta]\mathbf{d}a.$$

The second order conditions for optimality implies that $Z_{PP}, Z_{kk} < 0$ along with

$$D = Z_{PP}Z_{kk} - Z_{Pk}^2 > 0.$$

For any variable $x \in \{P_H, k_H\}$ and any parameter $y \in \{\alpha, \beta, a\}$, we have $\frac{\mathbf{d}x}{\mathbf{d}y} = \frac{D_{x,y}}{D}$.[26]

3.1 Are More Hawkish Donors Less Pro-development?

The Bush administration's stance, post 9/11, was believed to be rather hawkish. The Bush Doctrine, perhaps drawing on neo-conservative ideas, held that the United States is entangled in a global war between the Western nations championing liberal values, and extremist forces seeking to destroy them. Consequently, so the argument went, this was a war of ideology where the United States must take responsibility and show leadership by actively engaging the extremist

[26] In what follows, the following expressions will prove useful:

$$D_{P,\alpha} = -Z_{kk}f'(P)[ak - b(k)] + Z_{Pk}f(P)[a - b'(k)],$$

$$D_{k,\alpha} = -Z_{PP}f(P)[a - b'(k)] + f'(P)Z_{Pk}[ak - b(k)],$$

$$D_{P,\beta} = aZ_{Pk},$$

$$D_{k,\beta} = -aZ_{PP},$$

$$D_{P,a} = -Z_{kk}\alpha f'(P)k + Z_{Pk}[\alpha f(P) + \beta],$$

$$D_{k,a} = -Z_{PP}[\alpha f(P) + \beta] + Z_{Pk}\alpha f'(P)k.$$

forces.[27] Interestingly, as noted by Lynch (2008), it was also commonly understood that the 'neo-conservatives' did not advocate increased aid to tackle terror. As he writes, the neo-conservatives believed strongly that "prosperity cannot be used as the solution ... and foreign aid is therefore broadly irrelevant in the war against terror." Somewhat paradoxically therefore, it was the Bush administration that was also instrumental in lifting many of the economic sanctions on Pakistan post 9/11 and increasing economic aid to levels never seen before.[28]

To reconcile some of these issues and provide possible theoretical foundations for some of the United States policies following 9/11, we then examine the effect of an increase in hawkishness, i.e. in α. We show that development aid may in fact increase with an increase in hawkishness. Interestingly, this is possible only when the donor is not too altruistic, or when the reach of such programmes is severely restricted. Note that while the first of these conditions seem to be in line with Lynch (2008), the second one is not too implausible either, given that the war was often taking place in remote geographical areas where aid has limited reach.

Proposition 4. *Suppose the donor becomes more hawkish, i.e. α increases. Then,*

1. *There is an unambiguous increase in personnel P_H.*
2. *Developmental aid k_H increases if the donor is not too altruistic, i.e. $1 - \beta a > 0$, and decreases if the donor is very altruistic, i.e. $1 - \beta a < 0$.*
3. *Both the aggregate counter-terror input and output increase unambiguously.*

Proof of Proposition 4. The proof requires the use of Proposition 2 in the same way it was used to prove Proposition 3. It then follows that when $1 - \beta a > 0$, $Z_{Pk} > 0$ so that $D_{P,\alpha} > 0$ and $D_{k,\alpha} > 0$. On the other hand, when $1 - \beta a < 0$, $Z_{Pk} < 0$ so that $D_{P,\alpha} > 0$ and $D_{k,\alpha} < 0$. This proves parts 1 and 2 of the proposition. So consider aggregate counter terror input $I = [ak_H - b(k_H)]$. We have just shown that when $1 - \beta a > 0$, $k_H < k^*$ and k_H rises in α. Thus $\frac{\mathbf{d}I}{\mathbf{d}\alpha} > 0$. However, when $1 - \beta a < 0$, $k_H > k^*$ and k_H decreases in α. Thus $\frac{\mathbf{d}I}{\mathbf{d}\alpha} > 0$ as well. Hence we have shown that $\frac{\mathbf{d}I}{\mathbf{d}\alpha} > 0$ unambiguously. Since we have already shown that P_H increases unambiguously in α, it follows immediately that $\frac{\mathbf{d}A}{\mathbf{d}\alpha} > 0$ unambiguously as well. □

The intuition of the above result hinges on the strategic substitutability/complementarity between developmental aid and donor personnel (see Corollary 1). With an increase in α, there is an increase in personnel from the donor country. With aid and personnel being strategic substitutes when the donor is very altruistic to begin with, there is a commensurate decrease in aid. The opposite implication holds when the donor is not too altruistic to begin with.

An interesting possibility, at least theoretically, arises out of Proposition 4. In that proposition we have shown that if hawkishness increases after a major terror strike, this may lead to an increase in aid in some cases. This suggests the possibility that the recipient nation may have some

[27] The then Vice President Dick Cheney, the Secretary of Defence Donald Rumsfeld and a number of influential Department of Defence policy makers (such as Paul Wolfowitz and Richard Perle), for example, argue that direct and unilateral United States military action was highly justified. For more on this, see Monten (2005).

[28] See Reuters, March 20, 2009: `http://www.reuters.com/article/latestCrisis/idUSN20525639`.

incentive to suppress prior knowledge of possible terror attacks against the donor, knowing that such attacks would increase the quantum of aid. Analysing this possibility in any greater depth is beyond the scope of the present paper though.

3.2 Are More Altruistic Donors Softer on Terror?

When President Obama came into power, there was perhaps an expectation that this would usher in an era of greater altruism. But does an increase in altruism necessarily go hand in hand with a softer line on terror? That however does not seem to be the case with the Obama administration, with there being no scaling back of the offensive against the Taliban. Similarly, in the context of the counter-terror offensive in Colombia, there was, in fact, an increased militarization of the United States' intervention in Colombia during Obama's first year in office. Thus is it the case that greater altruism need not preclude a more aggressive stance on the war against terror? To address this issue, we consider a scenario where the donor becomes more altruistic, i.e. β increases. We have the following proposition.

Proposition 5. *Suppose the donor becomes more altruistic, i.e. β increases. Then,*

1. *Development aid k_H increases unambiguously;*
2. *Personnel P_H increases if the donor is not too altruistic, i.e. $1 - \beta a > 0$, and decreases if the donor is very altruistic, i.e. $1 - \beta a < 0$.*
3. *Both the aggregate counter-terror input and output first increases monotonically when $1 - \beta a > 0$, and decreases monotonically when $1 - \beta a < 0$.*

Proof. First suppose $1 - \beta a > 0$. In this case, $Z_{Pk} > 0$ and equilibrium implies $a - b'(k) > 0$ and $ak - b(k) > 0$. Hence $D_{P,\beta} > 0$ and $D_{k,\beta} > 0$. Next suppose $1 - \beta a < 0$. Then $Z_{Pk} < 0$ and equilibrium implies $a - b'(k) < 0$ and $ak - b(k) > 0$. Hence, $D_{P,\beta} < 0$ and $D_{k,\beta} > 0$. This proves parts 1 and 2 of the proposition.

From the reduced maximand, it follows that aggregate equilibrium counter terror input equals $I = [ak_H - b(k_H)]$ and output equals $A = f(P_H)I$.

Suppose $1 - \beta a > 0$. From Proposition 2 it follows that $k_H < k^*$. Since we have shown that an increase in β in this case increases k_H and P_H, given our assumptions on the function $b(\cdot)$ it then follows that $\frac{\mathbf{d}I}{\mathbf{d}\beta} > 0$ and $\frac{\mathbf{d}A}{\mathbf{d}\beta} > 0$.

Now suppose $1 - \beta a < 0$. From Proposition 2 it follows that $k_H > k^*$ while we have just shown that in this range an increase in β increases k_H but decreases P_H, it now follows that $\frac{\mathbf{d}I}{\mathbf{d}\beta} < 0$ and $\frac{\mathbf{d}A}{\mathbf{d}\beta} < 0$. □

In such a situation, we find that there is necessarily an increase in development aid. However, there is a non-monotonic relation between the size of the war on terror and the degree of donor altruism. In particular, and somewhat surprisingly, in case the donor is not too hawkish to begin with (a case one may argue holds for Obama's first months in office), the donor in fact comes down more heavily on terror (i.e. deploys more troops) with an increase in altruism. As discussed in the introduction, the intuition hinges on the strategic substitutability between aid and personnel.

3.3 Geography and Reach of Aid

We then examine the effect of geography on the war on terror. Problems encountered by the United States in Afghanistan and Pakistan suggest that counter-terror operations may often take place in remote and difficult areas, or may involve transit through such areas. One simple way to capture this aspect in our model would be to re-interpret the parameter 'a' as a measure of the *reach* of the aid-program. Under this interpretation, greater reach then implies that the investment is capable of reaching areas where it is likely to do the most good in the context of terror, i.e. areas where the terror problem is the most severe, including possibly remote geographic locations. While increasing the reach in this sense may reduce the aggregate output from investment, we assume that for both the donor, as well as the recipient, the enhanced targeting that this entails outweighs any fall in purely economic returns. To fix ideas, we assume therefore that when the war moves into more remote areas, it results in a *decrease* in a.

When the war needs to be fought in an area that is more accessible, so that a is higher, this directly eases the unrest-proof constraint, allowing for more room to enforce counter terror. On top of that, the donor's utility from development increases as well, since $\beta > 0$. How is this increased counter-terror managed between aid and personnel?

Proposition 6. *Suppose the reach of the development aid increases, that is, a increases. Then,*

1. *As long as* $1 - \beta a > 0$*, both aid* k_H *and personnel* P_H *rise monotonically in a; consequently, both aggregate counter terror input and output rise.*

2. *When* $1 - \beta a < 0$*, the impacts of a rise in a on both aid and personnel are in general ambiguous. However, if the donor is minimally hawkish (so that* α *is positive but close to* 0*) then aid* k_H *rises monotonically in a, while personnel* P_H *falls monotonically in a; as a consequence, both aggregate counter terror input and output fall.*

Proof. It is easy to check that when $1 - \beta a > 0$, we have $D_{k,a} > 0$ and $D_{P,a} > 0$. Also, we know that in this case $k_H < k^*$. Hence it must be that $\frac{\mathbf{d}I}{\mathbf{d}a} > 0$ and $\frac{\mathbf{d}A}{\mathbf{d}a} > 0$. So suppose $1 - \beta a < 0$. In this case $Z_{Pk} < 0$ and so in general the signs of $D_{k,a}$ and $D_{P,a}$ are ambiguous. However, in the limit when $\alpha \to 0$, we have $D_{k,a} \to -Z_{PP}\beta > 0$ and $D_{P,a} = Z_{Pk}\beta < 0$. Hence by continuity, it follows that for α small enough, a rise in a increases k_H and decreases P_H. Since also we know that $k_H > k^*$, it must be that when α is small enough then $\frac{\mathbf{d}I}{\mathbf{d}a} < 0$ and $\frac{\mathbf{d}A}{\mathbf{d}a} < 0$. □

Proposition 6 thus suggests that as the war moves into more and more remote areas (so that there is a gradual decrease in reach), aid and personnel may, or may not fall. Suppose that the war is being fought in a remote area, so that a is already low to begin with and consequently $1 - \beta a > 0$. Then, as the existing war moves into even more inaccessible terrains, it is accompanied by lower amounts of aid and personnel, and as a consequence the size of the war decreases. On the other hand, if the donor is very altruistic (so that $1 - \beta a < 0$), but not too hawkish, then the donor may respond to the war moving into more inaccessible areas by reducing developmental aid, but increasing military personnel.

4 Variations

In this section we examine some extensions of our baseline model that yield some interesting new results that may be relevant for policy analysis, as well as provide robustness checks for the preceding analysis.

4.1 A Recipient who Supports Terrorists

In a situation where the recipient government sympathizes with terror organizations,[29] the development aid may, in fact, be diverted to the terror organization itself. How does this possibility affect the optimal policy mix? We argue that, somewhat paradoxically, in such a situation there may be an increase in counter-terror operations undertaken by the recipient country. This has the important implication that *it is not necessarily the case that recipients who show more direct involvement in the war are less sympathetic to terrorists*.

To address these issues, we introduce two important modifications to our benchmark model. First, we now interpret $b(k)$ as the utility that the recipient government obtains when it channels development aid directly towards terrorist organizations. Second, we need to incorporate the fact that now aggregate counter-terror is disliked by the recipient government (over and above any costs incurred by it in the process of the war). Hence, the utility of the recipient under a given scheme $\mathcal{S}$ changes to

$$U_R(\mathcal{S}) = \begin{cases} -\infty, \text{if there is unrest,} \\ D(\mathcal{S}) - f(P)C(\mathcal{S}) - C(\mathcal{S}) + B(\mathcal{S}), \text{otherwise.} \end{cases} \tag{7}$$

It is straightforward to see that even in this case Proposition 1 holds so that we can restrict our analysis to schemes that are CME. Let $(\hat{P}_H, \hat{k}_H, \hat{t}_H)$ denote the solution to this problem. We find that the level of both aid, as well as personnel deployed would be lower in this case, as would be the duration of the operations. Interestingly however, aggregate counter terror input and output falls only when either the donor is not very altruistic, or the reach of the aid programme is severely restricted, for example when the war is fought in remote areas. Otherwise, while total counter-terror input may in fact rise, total counter-terror output may rise or fall. The following proposition addresses these points.

Proposition 7. *Suppose the recipient is sympathetic to the terrorists. Then,*

1. *The optimal scheme involves supplying less development aid, as well as less military personnel. Also, counter-terror activities stop sooner. Thus* $\hat{P}_H < P_H$, $\hat{k}_H < k_H$ *and* $\hat{t}_H < \tilde{t}_H$.

2. *Moreover, (i) if* $1 - \beta a > 0$ *then both aggregate counter terror input and output is lower, and (ii) if* $1 - \beta a < 0$, *then aggregate counter terror input is higher (while output is ambiguous) compared to the case where the recipient is not sympathetic to the terror organization.*

[29] See for example the United States State Department documents at `http://www.state.gov/s/ct/rls/crt/2008/122438.htm` for a list of nations believed to be falling under this category.

Proof. For the scheme $\mathcal{S} = \langle k, C(t), P \rangle$ to be incentive compatible and unrest-proof at each $t \in [0,1]$ we now require

$$(i) f(P)C(t) \leq ak, \forall t \in [0,1],$$

$$(ii)' ak(1-t) - \int_t^{\hat{t}} f(P)C(t)\mathbf{d}t - \int_t^{\hat{t}} C(t)\mathbf{d}t \geq b(k(1-t)), \forall t \in [0,\hat{t}],$$

and

$$(iii) ak(1-t) \geq b(k(1-t)) \forall t > \hat{t}.$$

As before, we set equality in (i) so that $C(t) = \frac{ak}{f(P)}$ and substitute this in $(ii)'$ to obtain

$$ak(1-t) - (\hat{t}-t)ak - (\hat{t}-t)\frac{ak}{f(P)} \geq b(k(-t)).$$

At $t = 0$, this reduces to

$$ak - \hat{t}ak\left(1 + \frac{ak}{f(P)}\right) \geq b(k).$$

It then follows that $ak \geq b(k)$ so that $ak(1-t) \geq b(k(1-t))$. Thus we can ignore (iii) as before. Hence the hard-line donor's problem is now

$$Max_{\{k,P,\hat{t}\}} \alpha\hat{t}ak + \beta ak - k - \zeta(P),$$

subject to:

$$\hat{t} \leq \left(\frac{ak - b(k)}{ak}\right)\left(\frac{f(P)}{1+f(P)}\right).$$

Setting equality into the above constraints, the problem reduces to

$$Max_{\{k,P\}} F(k,P) = \alpha[ak - b(k)]\left(\frac{f(P)}{1+f(P)}\right) + \beta ak - k - \zeta(P).$$

As our assumptions on $f(\cdot)$ guarantees an interior solution, consider the first order conditions:

$$F_P : \alpha\left(\frac{f'(P)}{(1+f(P))^2}\right)[ak - b(k)] = \zeta'(P),$$

and

$$F_k : \alpha\left(\frac{f(P)}{1+f(P)}\right)[a - b'(k)] = 1\beta a.$$

Since $P_H > 0$ and $f(P_H) > 0$ it follows that at (P_H, k_H), the LHS of the above two conditions become less than the corresponding RHS. Hence if $\hat{P}_H$ and $\hat{k}_H$ be the solution of the above maximization problem, then it must be that $\hat{P}_H < P_H$ and $\hat{k}_H < k_H$.

We then move to compare $\tilde{t}_H$ with $\hat{t}_H$. Recall, that

$$\tilde{t}_H = \frac{ak_H - b(k_H)}{ak_H} f(P_H),$$

while

$$\hat{t}_H = \frac{a\hat{k}_H - b(\hat{k}_H)}{a\hat{k}_H}\left(\frac{f(\hat{P}_H)}{1+f(\hat{P}_H)}\right).$$

Let $G(k) = \frac{ak-b(k)}{ak}$ and $J(P) = \frac{f(P)}{1+f(P)}$. Then,

$$J'(P) = \frac{f'(P)}{(1+f(P))^2} > 0.$$

Hence, since $f(P) > \frac{f(P)}{1+f(P)}$ and $P_H > \hat{P}_H$, it follows that

$$f(P_H) > \frac{f(\hat{P}_H)}{1+f(\hat{P}_H)}.$$

Also,

$$G'(k) = -\frac{1}{ak^2}[b(k) - kb'(k)].$$

Since $k_H > \hat{k}_H$, it follows that if $G'(k) > 0$ then $G(k_H) > G(\hat{k}_H)$. But $G'(k) > 0$ if and only if $b(k) - kb'(k) < 0$. Since $0 < \hat{k}_H < k_H$, it is sufficient for us to show that for all $k > 0$ we have $b(k) - kb'(k) < 0$, which we now show. Notice that as $k \to 0$, $L(k) = b(k) - kb'(k) = 0$. Now, $L'(k) = b'(k) - b'(k) - kb''(k) = -kb''(k) < 0$. Thus we have proved that $G'(k) > 0$ for all $k > 0$. This completes the proof of the proposition. □

When a recipient government sympathizes with terror organizations, the war on terror is difficult not because it requires greater involvement, but to the contrary because more involvement backfires! Hence the donor has to manage with less personnel and less aid (as otherwise such aid gets diverted to further support the terrorists). Nevertheless, it is interesting that the actual involvement of the recipient in the war may be higher than in the case where the nation was not supporting terrorists. For example consider the case when aid and personnel are strategic substitutes, so that $1 - \beta a < 0$, and suppose now the governance of the recipient changes so that the new rulers are terror sympathizers. While aid and personnel would be immediately cut, a cut in aid reduces the returns from diversion much more than the returns from development. Hence, the donor can now ask the recipient to increase its own involvement.

4.2 Regional Hostility

Many of the nations where terror organizations operate have neighbouring countries that are either hostile to them, or perceived to be so. A simple way to capture aspects of such hostility is to let $b(k)$ represent the benefits from diverting aid and using it against the hostile neighbour. An increase in such hostility, either real or perceived,[30] can then be modelled as shifting the $b(k)$ function upwards to say $\hat{b}(k)$. In that case, the maximum amount of incentive compatible aid $\tilde{k}$

[30] Such beliefs, for example, can be justified in the case of Pakistan when there is an increase in the military capability of India, or a surge in the build up of troops along the international border of the two nations.

decreases unambiguously. If we also assume that this shift upwards is regular in the sense that for each $k \in (0,1]$, we have $b'(k) < \hat{b}'(k)$, then there is a decrease in both aid and personnel. Moreover, the time length of the war is also necessarily reduced.

The preceding discussion therefore suggests that regional hostility is not in the interest of the donor, thus creating a role for international diplomacy in managing regional hostility to boost the war against terror. While a complete model of diplomacy is both beyond the scope of this paper and not our focus, in what follows we suggest a simple extension of our benchmark model.

Suppose the donor country can spend an amount d on diplomatic efforts aimed at reducing regional hostility. If it does so, then regional hostility is reduced so that the gain from aid diversion is $\Delta(d)b(k)$, where $\Delta'(d) < 0$. Using familiar arguments from Propositions 1 and 2, the constrained objective function now becomes

$$Z(P,k,d) = \alpha[ak - \Delta(d)b(k)] - (1-\beta a)k - \zeta(P) - d.$$

It is easy to see that personnel and aid are both strategic complements with diplomatic effort d. This suggests, at least for the case when aid and personnel are strategic complements (i.e., $1-\beta a > 0$), that periods of diplomatic activity are likely to see large counter-terror activities and aid as well.[31]

4.3 Fighting the War only with Aid

In the previous sections, we have concentrated on the case where the donor involves its own personnel in the war against terror. Given that doing so may be politically and ideologically unacceptable, an alternative may be to use just aid (along with possibly military equipment) in a bid to induce counter-terror.

We begin by considering the case of pure aid. The Indian Prime Minister, Manmohan Singh, has for example recently announced a major 1 billion USD financial aid for the Sheikh Hasina government in Bangladesh, aimed at ensuring continuing cooperation from Bangladesh in dealing with terrorism and insurgency targeted at India. Interestingly however, and in line with the moral hazard problem embedded in our benchmark model, Bangladesh's top priority is water management that involves conflicts of interest with India. Consequently, any diversion of aid funds to this end may adversely affect Indian interests.[32]

We then examine such a donor's problem when it is politically infeasible for the donor to send personnel to war, formalized by setting $\zeta(P) = +\infty$. A priori it would seem that aid and personnel are alternative ways of helping the recipient country fight the war against terrorists, so that a country that is unable to contribute personnel, should be contributing a relatively greater amount of development aid. We show that this is not true. In fact, in this case we find that the level of aid is unambiguously lower.

Under this scenario, the effective counter-terror output at t from input $C(t)$ is $f(0)C(t)$. Clearly, one can mimic the proof of Proposition 1 to argue that the optimal scheme must involve a CME in

[31] When $1-\beta a < 0$, this may not necessarily be true though diplomacy will still help, and the details of how aid and personnel change in response to increased diplomacy can be easily worked out.

[32] See for example, Times of India, January 12, 2010.

this case as well. Further, mimicking the proof of Proposition 2, the optimal problem reduces to maximizing

$$\alpha f(0)(ak - b(k)) + \beta ak - k - \zeta(0).$$

Let $\underline{k}$ solve $\alpha f(0)[a - b'(k)] = 1 - \beta a$.

Proposition 8 below shows that independent of parameter values, the optimal scheme will involve less aid when compared to the benchmark case.

Proposition 8. *Suppose the donor is unable to send military personnel, but can provide developmental aid in a bid to induce counter-terror. Then, the optimal level of developmental aid involves $\underline{k}$, with $\underline{k} < k_H$.*

Proof. Let k_0 be the solution. The unconstrained FOC of this maximization problem yields

$$\alpha f(0)[a - b'(k)] = 1 - \beta a.$$

This gives the solution $k_0 = \underline{k}$. IC at each t implies that $k_O < \tilde{k}$.

In contrast, the solution (P_H, k_H) involves

$$\alpha f(P_H)[a - b'(k_H)] = 1 - \beta a,$$

where $P_H > 0$. Hence, it follows that

$$\frac{f(P_H)[a - b'(k_H)]}{f(0)[a - b'(k)]} = 1.$$

Since $f(P_H) > f(0)$ it follows that $a - b'(k_H) < a - b'(k_0)$ independent of the sign of $1 - \beta a$. Thus, $b'(k) < b'(k_H)$ so that $k < k_H$. □

The comparative statics results are straightforward and hence we omit the derivations. They suggest that the volume of aid increases in case the donor becomes more altruistic (i.e. β increases), or the reach a of the aid increases. However, interestingly, an increase in hawkishness (i.e. a rise in α) increases the supply of aid if the donor is not too altruistic, i.e. $1 - \beta a > 0$. Otherwise, it decreases the supply of aid.

4.4 Aid and Military Equipment

In the financial year 2006, the United States Congress had authorized the United States Department of Defence to use 200 million USD of its Operation and Maintenance funds to equip foreign military forces with advanced technologies for counter-terrorism operations. Twenty-one countries where terrorist organizations were presumed to be flourishing received such funding in addition to what was already being provided through other military assistance programs. Since then, the Pentagon has budgeted more than 1 billion USD to equip foreign military forces through a program known in Congress as "Section 1206."[33]

[33]Countries that received Section 1206 funding in the fiscal year 2009 include Bahrain, Bangladesh, Ethiopia, Kenya, Lebanon, Pakistan, Philippines and Yemen, among many others. Read more on this at `http://www.foxnews.com/politics/2010/01/04/war-terror-pentagon-looks-tap-foreign-aid-aq-fight/`. Further, during the latest round of U.S.-Pakistani strategic dialogue, the Secretary of State Hillary Clinton announced that the administration will ask the Congress for $2 billion for Pakistan to purchase U.S.-made arms, ammunition and accessories from 2012 to 2016 (Associated Press release on November 22, 2010).

Given the preceding discussion, we now analyse the case where the donor uses a combination of aid and military equipment (either by direct supply or through financial funding), in a bid to fight terror. The analysis suggests interestingly that the comparative statics results for this case are somewhat different from the case where the donor could commit personnel.

We let M denote the size of military equipment. For simplicity, assume that the donor has excess supply of military equipment so that supplying such equipment is costless for the donor. Military support of this sort to a poor recipient naturally reduces the recipient's costs for waging the war. If C is the total counter-terror input and M is the size of equipment, then, setting $f(0) = 1$ in the benchmark model, the terror output is C, while cost of the war for the recipient is now $Max\{C - M, 0\}$. However, there is an important difference between personnel and equipment. Unlike deployed personnel, now military equipment and development aid can both be diverted. Let the returns to the recipient if military equipment amounting to M and aid amounting to k is diverted be $h(M)b(k)$, with $h(0) = 1$, $h'(M) > 0$ and $h''(M) > 0$.

In the following proposition we show that while the donor's level of altruism is negatively related to the amount of equipment sent, an increase in hawkishness does not necessarily imply more military equipment for the recipient.

Proposition 9. *Consider a situation where the donor can costlessly supply military equipment, but supplying personnel is infeasible. Then,*

1. *A more altruistic donor supplies less military equipment;*
2. *For low levels of hawkishness, so that $1 - \alpha\beta > 0$, as the donor gets more hawkish it supplies less military equipment. Otherwise, as hawkishness increases, so does the supply of military equipment.*

Proof. The problem faced by the donor is then as follows:

$$Max_{\{k,\tilde{t},M\}} \alpha \int_0^{\tilde{t}} C(t)dt + \beta \int_0^1 D(t)dt - k$$

subject to:

$$(i) C(t) \leq ak, \forall t \in [0,1],$$

$$(ii) ak(1-t) - Max\left\{\left(\int_t^{\tilde{t}} C(t)dt - M\right), 0\right\} \geq h(M)b(k(1-t)), \forall t \in [0,\tilde{t}],$$

and

$$(iii) ak(1-t) \geq h(M)b(k(1-t)) \forall t > \tilde{t}.$$

We first impose CME so that from constraint (i) it follows that $C(t) = ak$ for all $0 \leq t \leq \tilde{t}$ and $C(t) = 0$ otherwise. Then constraint (ii) becomes

$$ak(1-t) - Max\left\{\left((\tilde{t}-t)ak - M\right), 0\right\} \geq h(M)b(k(1-t)).$$

Hence, for each $0 \leq t \leq \tilde{t}$, it must be that

$$ak(1-t) \geq h(M)b(k(1-t)).$$

For any $t > \tilde{t}$, the above inequality continues to hold. Thus we can ignore constraint (iii). Also, it is then necessary and sufficient to simply satisfy (ii) at $t = 0$. Hence the problem of the donor

$$Max_{\{k,M,\tilde{t}\}} \alpha \tilde{t} ak + \beta ak - k$$

subject to:

$$\tilde{t} ak \leq ak + M - h(M)b(k).$$

Thus in the optimum it must be that

$$\tilde{t}(k, M) = 1 - \frac{h(M)b(k) - M}{ak}.$$

Replacing this in the maximand reduces the problem to

$$Max_{\{k,M\}} \alpha[ak + M - h(M)b(k)] + \beta ak - k.$$

The optimal solution for k and M is completely characterised by the following two first order conditions (these are sufficient as well under our assumptions on $b(\cdot)$ and $h(\cdot)$):

$$b'(k) = \frac{a(\alpha + \beta) - 1}{\alpha h(M)},$$

and

$$h'(M)b(k) = 1.$$

We now proceed with the impact of changes in α and β on the above solution. Total differentiation of the above two equations yield the following:

$$\alpha h(M)b''(k)\mathbf{d}k + \alpha b'(k)h'(M)\mathbf{d}M = (a - h(M)b'(k))\mathbf{d}\alpha + a\mathbf{d}\beta,$$

and

$$h'(M)b'(k)\mathbf{d}k + b(k)h''(M)\mathbf{d}M = 0\mathbf{d}\alpha + 0\mathbf{d}\beta.$$

Hence,

$$D = \begin{vmatrix} \alpha h(M)b''(k) & \alpha b'(k)h'(M) \\ h'(M)b'(k) & b(k)h''(M) \end{vmatrix} > 0.$$

Next

$$D_{M,\alpha} = \begin{vmatrix} \alpha h(M)b''(k) & a - h(M)b'(k) \\ h'(M)b'(k) & 0 \end{vmatrix}, D_{M,\beta} = \begin{vmatrix} \alpha h(M)b''(k) & a \\ h'(M)b'(k) & 0 \end{vmatrix}.$$

It is straightforward to check that $D_{M,\beta} < 0$. This proves part 1 of the proposition. To prove part 2, we have

$$D_{M,\alpha} = -\left(\frac{1 - \alpha\beta}{\alpha}\right)\frac{b'(k)}{b(k)}.$$

The rest of the proof is now straightforward. □

Note that in contrast to the baseline model where an increase in altruism can either increase or reduce personnel, in this case altruism necessarily leads to a decrease in military equipment. The intuition follows from the fact that in this case development aid and military equipment are strategic substitutes. Also, the monotonic relationship between personnel and hawkishness is overturned when we consider equipment. The non-monotonic relation between equipment and the degree of hawkishness comes from the following observation. Consider a donor who is not too hawkish. With an increase in hawkishness, it wants the recipient to step up on counter-terror. But since it is not too hawkish, it reduces military supply and over-compensates it by aid. The trend gets reversed after a point when the donor becomes very hawkish.

4.5 When Donors do not care about Development

A donor may not care about development at all, so that $\beta = 0$. Clearly then aid and personnel are strategic complements, since $1 - \beta a = 1 > 0$. While the analysis so far includes this as a special case, it may be useful to collect together all the results in one place.

In this scenario the amount of aid supplied will be small, this being the case even if the recipient is disciplined and has no incentives to divert developmental aid (cf. Propositions 2 and 3). Next, we find that if such a donor gets more hawkish (or if the reach of programme, i.e. a, increases), then both personnel and aid would increase, as would aggregate counter terror input and output (see Propositions 4 and 6). Suppose now that the recipient is sympathetic to terror organisations. Proposition 7 then implies that aggregate counter terror input from the recipient and output from the joint operations would be low. Further in this case periods of regional diplomacy will be accompanied by large counter terror activities and high flows of development aid to the recipient. It is straightforward to derive similar implications for the other variations studied in the paper, e.g. when the war is fought with aid alone, or with aid and military equipment, etc.

5 Conclusion

Given the complexity of the problem of terrorism, no one study can do justice to the myriad of issues involved. In this paper we therefore focus on two policy tools, namely pre-emptive operations and development aid, and provide a theoretical foundation as to how these two can work in tandem to solve the twin problems of terror and under-development. In particular, we provide a simple rationale for aid-tying in this context, showing that such aid-tying leads to a virtuous cycle whereby joint counter-terror helps the observability of aid, and aid in its turn makes greater counter-terror possible.

The framework also allows us to develop several non-obvious results with interesting policy implications pertaining to the issue of terrorism (a problem that unfortunately shows little signs of abetting in the coming years). We confirm that aid helps in the war against terror, but too much aid on the other hand faces the risk of diversion. Second, the counter-terror operations must be the largest possible at the very beginning. While this has echoes of 'shock-and-awe', it is driven by dynamic incentive considerations, rather than purely military ones. Third, we find that political

changes in the donor country, or pressures from international agencies on the donor government, can have unanticipated consequences. Sending military personnel is helpful (if politically feasible), but it is not necessarily the case that a more hawkish donor is less pro-development. Neither is it necessary that a more altruistic donor is softer on terror. Fourth, it is often the case that such wars move into more remote areas over time. Our analysis suggests that when this happens, aid and personnel deployed need not necessarily fall.

We then study the case where the donor has political constraints that do not allow its government to send personnel. In the case where aid can be supplemented by military equipment (which itself can be misused), we show that while a more altruistic donor supplies less military equipment, the supply of military equipment is ambiguous with respect to an increase in hawkishness. Next allowing for the possibility that the recipient government supports the terrorists, we find that it is not necessarily the case that recipients who show more direct involvement in the war against terror are less sympathetic to terrorists. Finally, we argue that in the presence of neighbours hostile to the recipient country, periods of diplomatic initiatives by the donor country (aimed at reducing such hostilities) are likely to coincide with periods of large aid, as well as counter-terror activities.

Finally, we indicate some avenues for further research that we plan to follow in the future. Note that the unrest-proof condition did encapsulate the possibility, albeit in a reduced form, that counter-terror itself could generate some support for the terrorist organization. That this linkage is important is suggested, among other things, by the fact that terrorist organisations often target government funded aid delivery to the LDC population, presumably in a bid to radicalise the population. It would therefore be of interest to endogenise this aspect, explicitly modelling the choices and constraints facing the domestic population, a task that we leave for future work. Finally, geo-political realities suggest that one allows for multiple donors. Our analysis then indicates that coordination among them may be crucial, so as to ensure that there is neither any unrest, nor aid diversion. Further, what if there are conflicts of interest between the various donors in terms of both aid and counter-terror? Global politics then becomes very important. Again we leave these ideas for future work.

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