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Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

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IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

1

Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

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We model a game involving a terrorist, the terrorist's benefactor, and a government protecting against terrorism. The terrorist generates terrorism effort using its own resources, funding from a benefactor, and crime. Crime can be lucrative for a terrorist but may deter benefactors, thus causing a strategic dilemma. The model accounts for resources, costs of effort, valuations of terrorism by the three players, and crime production characteristics. We determine how a variety of model parameters, the government, and the benefactor influence a terrorist's terrorism and crime efforts, and relative ideological orientation along a continuum from ideological to criminal. We determine which factors impact government protection, for example that it is inverse U shaped in terrorism effort. We determine the implications of letting the benefactor choose optimal funding and/or punishment for crime, for example eliminating punishment if both are chosen optimally. The model parameters are estimated for sixty-five terrorist groups using the global terrorism database and the fragile states index.

Achieving terrorism objectives requires resources which can be initially present, or can be provided by benefactors or by crime. Benefactors of terrorism may not be readily available, and crime may dilute a terrorist's ideological orientation. To understand this phenomenon, a game theoretic model is developed where a terrorist allocates or distributes its resources into terrorism and crime. The crime allocation generates profits that are directed into terrorism. Terrorists lacking benefactors commonly resort to crime for funding, which benefactors resent since they do not want a reputation for supporting profit-seeking crime syndicates, and seek to avoid the potential criticism from crime victims and the associated negative media attention. Thus, the benefactor funds the terrorist proportional to the terrorist's resources, and withholds funding and thus punishes the terrorist to the extent the terrorist engages in crime. A

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IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

2

government pursues terrorism protection effort to prevent the terrorist from reaching its objectives. The model accounts for resources, costs of effort, valuations of terrorism by the three players, and crime production characteristics.

This paper proceeds beyond earlier research in two specific ways to ensure modeling realism. First, we assume that the government chooses its protection and the benefactor chooses its funding mechanism first, and that the terrorist chooses its terrorism and crime efforts thereafter. Second, we enable the benefactor to behave strategically, choosing an optimal balance of funding of terrorism and/or punishment of crime. We estimate the model parameters for sixty-five terrorist groups, using the global terrorism database and the fragile states index.

The linkage between terrorism and crime has received some scholarly attention but is poorly understood.[1] Ehrenfeld (1990) argues that since both are illegal they may develop a symbiotic relationship. Lyman and Potter (1997, 307) suggest that "political agendas and profit motivation may be concurrent variables in many acts of terrorism." Sanderson (2004) argues that the line between terrorism and organized crime is increasingly unclear. Kenney (2008) shows how Osama bin Laden and Pablo Escobar developed their strategies. Hausken and Gupta (2016) follow a decision-analytic approach where a terrorist seeks optimal funding through benefactors and crime, which impact its orientation. Hausken and Gupta (2015a) consider a terrorist and a government in a simultaneous-moves terrorism and crime game, modeling a potential benefactor parametrically. The UN Security Council observed (Resolution 1373, September 28, 2001) "the close connection between international terrorism and transnational organized crime, illicit drugs, money-laundering, illegal arms trafficking, and illegal movement of nuclear, chemical, biological and other potentially deadly materials."

Terrorists need funding (Brock Blomberg et al. 2011; Siqueira and Sandler 2006). Ideological purity is more easily ensured with reliable benefactors. Benefactors are typically individual contributors from the terrorists' own communities, foreign state sponsors, or actors with interests aligned with the terrorist and/or opposed to the terrorist's targets. For example, Lashkar-e-Taiba is supported by the Pakistani

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[1] For research on linkages between terrorism and crime based on motivations, see Makarenko (2001), Napoleoni (2005), Shelley and Picarelli (2005), Dishman (2005), Eccarius-Kelly (2012), and Piazza (2012). For related research, see Azam (2006), Gates (2002), Humphreys et al. (2006), Kaplan (2013), McCormick (2003), Shapiro (2013), Weinstein (2005, 2007). See Hausken and Gupta (2015b) for a logistic regression model testing various hypotheses about terrorist organizations engaged in terrorism and crime. Hausken et al. (2015) conduct a laboratory experiment determining the impact of communication on how terrorist groups are composed. Participants are allocated roles of terrorist ideologues and criminal mercenaries, with and without a leader, and choose whether or not to participate in a terrorist attack.

IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

3

military and Hezbollah has Iranian state support (Constable 2011; Shahzad 2011; Jones and Catignani 2012), while al-Qaeda receives individual contributions (*zakat*) from Saudi Arabia and various Gulf states (Napoleoni 2005). For choice of targets see for example Drake (1998) and Berman and Laitin (2005).

With funding, groups can conduct terrorism and also provide public goods to their communities (Berman 2003; Gupta and Mundra 2005). For example, when Hamas carries out attacks, it signals commitment through its members' sacrifices (Ahmed 2005), which together with provision of public goods ensures Palestinian support. Since successful terrorist attacks are costly, ensuring funding becomes essential. Organizations lacking benefactors commonly turn to criminal activities, such as narcotics, human trafficking, money laundering, and counterfeiting. Terrorist organizations frequently provide salaries, respect, power, an organizational structure, and sometimes even meaning and ideological orientation to criminal mercenaries offering such services.

Correlating financing methods, Gupta (2008) locates terrorist groups on a continuum from ideological to criminal. For example, the Colombian group FARC (Revolutionary Armed Forces of Colombia) arose as a Marxist revolutionary group. But easy access to funds through crime, and a weakened government following civil war, turned it into a drug trafficking cartel (Betancourt 2011). Similarly, several splinter groups of the IRA in Northern Ireland, the longest-surviving terrorist organization in history, have turned to crime (English 2003), along with, for example, Abu Sayyaf of the Phillippines (Rogers 2003). Jordan et al. (2008) showed how the 2004 Madrid train bombing was funded by selling illegal drugs. Spencer and Croucher (2008) showed how some within the Basque Fatherland and Freedom (ETA) terrorist group resorted to crime. Wege (1991) showed how the Abu Nidal Organization resorted to crime. Resorting to crime can also be temporary, as when the Turkish Workers' Party's leader, Abdullah Ocalan, was arrested in 1997 (Roth and Sever 2007; Cronin 2011), with a subsequent return to terrorism (Eccarius-Kelly 2012).

Transformation from criminality to terrorism can also occur, but is rarer. Dawood Ibrahim, the head of the D-Company criminal gang in Mumbai, accomplished such a shift. After a band of fanatical Hindus destroyed the ancient mosque Babri Masjid in 1992, India experienced turmoil where Indian Muslims lost their lives. Pakistan's secret service, ISI, recruited Dawood Ibrahim (Hiro 2012, 184) to smuggle in explosives and plant bombs in the financial district of Mumbai (Zaidi 2003). As a crime boss, Dawood

IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

4

Ibrahim received limited attention from Indian law enforcement, but his transition to terrorism forced him to leave India and live in exile under Pakistani protection.

Although most terrorist groups start ideologically, only some maintain their ideology over time (for example Hamas, Lashkar-i-Taiba, Hezbollah, the IRA); some become criminal (for example FARC, Abu Sayaaf, the Islamic Movement of Uzbekistan), a few may transition from crime to terrorism (Dawood Ibrahim), and most die out (such as the Japanese Red Army, or Baader-Meinhof). Death of terrorist groups may occur for many reasons, for example government suppression. Examples are provided by Singer (2003) for Aum Shinrikyo in Japan (see also Kimura 2002), Aust and Bell (2009) for the Baader-Meinhof in Germany, Churchill and Wall (2001) for the Black Panthers in the United States, and Findley et al (1976) for the Symbionese Liberation Army in the United States. Another reason is the disruption of financing, for example through tightening of banking rules (Weintraub 2002; McCulloch and Pickering 2005; Masciandaro 2004; Bantekas 2003).

Terrorist groups seek to obtain public goods for a community (Berman 2003; Berman and Laitin 2008; Hoffman 1998), by means of violence, politics, and propaganda (Schmid and Jongman 1988; Schmid 2005, 8). In contrast, criminal groups aim to secure private goods for their members (Schelling 1971). However, both maximize objectives analyzed in this paper. Gupta (2008) identifies various actors within terrorist organizations. *Ideologues* produce, supply, and execute terrorist ideology. They are committed to the group's objectives and are willing to sacrifice their individual self-interest. In contrast, *criminal mercenaries* are weakly committed to the group and have a strong interest in personal gain. A terrorist organization's ideologues may be Marxist, religious, nationalistic, etc.[2] In this paper we account for the presence of ideologues and criminal mercenaries by assuming that a terrorist allocates its resources into terrorism (which means recruiting ideologues) and crime (which means recruiting criminal mercenaries). This division of labor enables ideologues and criminal mercenaries to exert efforts according to their competence and interest. A terrorist with a wealthy benefactor may deemphasize its need to recruit criminal mercenaries, and may preserve its ideological purity.

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[2] Rapoport (2005) suggests four terrorism cycles; anarchism (1880–1920), anti-colonialism (1920–1960), socialism/communism (1960–1990), and religious fundamentalism (1990 to present). See Simon (2011) for a possible fifth wave.

IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

5

In Section 1 we present the model. In Section 2 we solve the model. In Section 3 we show how we constructed indices and estimated the parameters. In Section 4 we use the model to predict and compare with empirical observations. In Section 5 we present our conclusions.

1. The Model

We distinguish between free choice variables chosen by the three players, parameters which are exogenously given, and dependent variables which depend on the free choice variables and the parameters. Only one free choice variable, crime effort x, is listed for the terrorist, since it implicitly determines the pure terrorism effort t dependent on the terrorist's resource constraint. One free choice variable, terrorism protection effort T, is listed for the government. For the benefactor, funding b and punishment d can either be parameters or free choice variables, as specified over the next sections. The variables and parameters are first defined succinctly in the following list, and thereafter interpreted more thoroughly as the model is developed. The measurement units are partially specified in the following list and exhaustively at the end of this section. A player's unit cost of effort is his cost of exerting one unit of effort (Varian 2010). This one unit may, for example, be one hour of labor at given competence and available technology.

<u>Free choice variables</u>

T   government's terrorism protection effort

x   terrorist's crime effort

<u>Dependent variables</u>

τ terrorist's own pure terrorism effort

t   terrorist's terrorism effort

y   crime production

u   terrorist's expected utility, $U.S.

U   government's expected utility, $U.S.

v   benefactor's expected utility, $U.S.

<u>Parameters or free choice variables</u>

b   benefactor's funding proportional to the terrorist's resources r, dimensionless

d   benefactor's punishment proportional to the terrorist's crime effort

Parameters

r   terrorist's resources, $U.S.

R   government's resources, $U.S.

a   terrorist's unit cost of terrorism effort

A   government's unit cost of terrorism protection effort

c   terrorist's unit cost of crime effort

k   crime production proportionality parameter, dimensionless

h   crime production efficiency, dimensionless

s   terrorist's valuation of terrorism objectives, $U.S.

S   government's valuation of terrorism objectives, $U.S.

w   benefactor's valuation parameter of terrorist's utility, dimensionless

The model captures the interaction in the form of actual behavior (not only symbolically) between a terrorist, its benefactor, and the government in a two-period game. In period 1 the government chooses its terrorism protection effort T and the benefactor announces its funding mechanism

$$Max\{0, rb-dx\} \tag{1}$$

where r is the terrorist's resources, x is the terrorist's crime effort, and funding b and punishment d are either parameters or variables determined by the benefactor in period 1 through optimization. The Max function in (1) equals 0 when rb<dx, and equals rb-dx when rb≥dx. That is, a benefactor searches for a resourceful and ideologically pure terrorist not corrupted by crime. In period 2, the terrorist observes the government's protection T and the benefactor's funding mechanism, and chooses crime effort x, which means also choosing terrorism effort t.

The terrorist's resources r can be transformed into two kinds of efforts. The first is pure terrorism effort τ at unit cost a aimed at terrorist goals. The second is crime effort x at unit cost c aimed at crime goals. The terrorist's resource constraint is

$$r = a\tau + cx \tag{2}$$

The crime production function, with the same denomination as the terrorist's resources, is

IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

7

$$y = kx^h \qquad (3)$$

where k≥0 is a proportionality parameter, a constant by which x^h is multiplied. A large constant k means that crime production is larger for any given x^h, and conversely if k is small. We further assume, as is common in production economics, h≥0 which is a crime production efficiency parameter. 0<h<1 means concave production, i.e. crime production increases decreasingly as the terrorist's crime effort x increases.[3] Concave production is associated with strong governance, strong governmental and police willingness to repress crime, and low societal tolerance for crime. h=1 means linear production, simply multiplying the terrorist's crime effort x with the constant k. Finally, h>1 means convex production, i.e. crime production increases increasingly as the terrorist's crime effort x increases.[4] Convex production is associated with weak governance, weak governmental and police willingness to repress crime, and high societal tolerance for crime.

The terrorist's aggregate terrorism effort t, hereafter referred to as the terrorist's terrorism effort t, depends on three inputs. The first is its own pure terrorism effort τ in (2). The second is its crime production y in (3), where crime effort is exerted generating output that can be applied to reach terrorism objectives. The third is the benefactor's funding mechanism in (1), which is provided only if the terrorist's crime production is not too large. Applying (1), (2), and (3), the terrorist's terrorism effort is

$$t = \tau + \frac{y}{a} + \frac{Max\{0, rb-dx\}}{a} = \frac{r - cx + kx^h + Max\{0, rb-dx\}}{a} \qquad (4)$$

where r-cx are the initial resources allocated to terrorism, kx^h are the resources produced by crime effort, and Max{0,rb-dx} are the resources provided by the benefactor.

The terrorist and government fight over terrorism objectives valued as s by the terrorist and S by the government. For instance, the 9/11 attacks were directed towards symbolic values represented by the World

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[3] Concave production is defined mathematically with positive first derivative $\partial y / \partial x = khx^{h-1} > 0$ and negative second derivative $\partial^2 y / \partial x^2 = kh(h-1)x^{h-1} < 0$.

[4] Convex production is defined mathematically with positive first derivative $\partial y / \partial x > 0$ and positive second derivative $\partial^2 y / \partial x^2 > 0$.

IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

8

Trade Center, economic value in terms of the value of the buildings with contents and businesses, and human value of 2,996 deaths plus injuries. For a recent account of how such different values can be measured with a common scaling, see Hausken's (2016) cost-benefit analysis, applying different weights to the various values from a terrorist's perspective.

The players' success obtaining their objectives is determined by the contest success function (Skaperdas 1996). The terrorist's probability of success is t/(t+T) multiplied by the valuation s of terrorism objectives, and we subtract the initial resources r, to yield the terrorist's expected utility u. The government's probability of loss is t/(t+T) multiplied by the valuation S of terrorism objectives S, subtracting the cost expenditure AT where A is the unit cost of protection effort T, to yield the government's expected utility U. The cost expenditure AT equals the government's resource R, i.e. R=AT.

The benefactor's expected utility v equals the terrorist's expected utility weighted with a valuation parameter w, i.e. wu, minus its cost of funding expressed as $Max\{0, rb - dx\}$ in (1). The three players' expected utilities are

$$u = \frac{ts}{t+T} - r, \quad U = -\frac{tS}{t+T} - AT, \quad v = wu - Max\{0, rb - dx\} \tag{5}$$

The terrorist has one free strategic choice variable x chosen in period 2 after the benefactor has announced its funding mechanism in period 1. This follows from (2) where r, a, and c are parameters. Thus, when the terrorist's crime effort x is determined, the terrorist's pure terrorism effort τ follows automatically from (2). We could equally well have chosen τ as the terrorist's one free strategic choice variable, and then x would follow automatically from (2). We cannot let both x and τ be free strategic choice variables for the terrorist since that would produce an overdetermined system that violates (2). Naturally, within its resource constraint in (2), the terrorist wants to maximize its terrorism effort t which consists of the three factors in (4), i.e. the terrorist's pure terrorism effort τ, the crime production divided by the unit cost, y/a, and the benefactor's funding divided by the unit cost, $Max\{0, rb - dx\}/a$. We thus assume that the terrorist uses its fixed resource r optimally to maximize its terrorism effort t regardless of the government's protection effort T. This is often realistic for terrorists, who may not have the capacity to assess their terrorism capabilities against the government's terrorism protection capa-

IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

9

bilities. Consequently, the terrorist uses its only available free choice variable, its crime effort x, to maximize its terrorism effort t, and receives the expected utility u in (5). The government also has one free strategic choice variable, which is its terrorism protection effort T. The government indeed has the capacity to adapt its terrorism protection capabilities to the terrorist's capabilities, and thus the government's terrorism protection effort T depends on the terrorist's terrorism effort t. The government furthermore weighs its loss –tS/(t+T) from its effort T against its cost expenditure AT. We assume that the government chooses protection T in period 1, but mathematically it is irrelevant when the government chooses T since whereas protection T depends on terrorism effort t, t does not depend on T.

The terms in the players' expected utilities u, U, and v are measurable in whatever unit one prefers. One common unit is monetary value, for example in $U.S. This unit applies directly for the resources r and R and valuations s and S. The benefactor's valuation parameter w is dimensionless since it is multiplied by u in (5) resulting in a figure in $U.S. The efforts T, x, τ, and t have units common for effort, usually expressed by quality and/or quantity. Examples include a player's technology (for example measured in $U.S.), competence (experience, education, etc), and the number of hours invested. The unit costs a, A, c, and d have measurement units so that the corresponding resources, aτ, AT, cx, and dx are expressed in $U.S.

2. Solving the Model

This section determines the players' strategic choice variables, i.e. crime effort x for the terrorist (which implies terrorism effort t), terrorism protection effort T by the government, and funding b and/or punishment d by the benefactor when the benefactor is a player. Section 2.1. considers only two players, the terrorist and government, while funding b and punishment d by the benefactor are parameters. We thereafter consider three players, including the benefactor. Sections 2.2., 2.3., and 2.4. permit the benefactor respectively to choose both funding b and punishment d strategically, choose only b but not d (i.e., d is a parameter), and choose only d but not b (i.e., b is a parameter).

2.1. Benefactor Makes No Strategic Decision; Funding and Punishment Are Parameters

We first consider only two players. The government chooses its terrorism protection effort T in period 1. The benefactor's funding mechanism $Max\{0, rb - dx\}$ in (1) is also known in period 1, depending on the three parameters funding b, punishment d, and terrorist resources r, and the terrorist's crime

IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

10

effort x to be chosen in period 2. The terrorist chooses crime effort x strategically in period 2, which causes terrorism effort t to be determined from (2), (3), and (4). Appendix A solves the model for the terrorist when funding b and punishment d are parameters, which implies the terrorist's crime effort

$$
x = \begin{cases}
\dfrac{r}{c} \ \ if \ \ rb > d\left(\dfrac{hk}{c+d}\right)^{\frac{1}{1-h}} (benefactor) \ and \ \left(\dfrac{hk}{c+d}\right)^{\frac{1}{1-h}} \geq \dfrac{r}{c} \ (pure \ criminal) \\[3ex]
\left(\dfrac{hk}{c+d}\right)^{\frac{1}{1-h}} \ if \ \ rb > d\left(\dfrac{hk}{c+d}\right)^{\frac{1}{1-h}} (benefactor) \ and \ \left(\dfrac{hk}{c+d}\right)^{\frac{1}{1-h}} < \dfrac{r}{c} \ (terrorist \ and \ criminal) \\[3ex]
\dfrac{r}{c} \ \ if \ \ rb < d\left(\dfrac{hk}{c+d}\right)^{\frac{1}{1-h}} (no \ benefactor) \ and \ \left(\dfrac{hk}{c+d}\right)^{\frac{1}{1-h}} \geq \dfrac{r}{c} \ (pure \ criminal) \\[3ex]
\left(\dfrac{hk}{c}\right)^{\frac{1}{1-h}} if \ \ rb < d\left(\dfrac{hk}{c+d}\right)^{\frac{1}{1-h}} (no \ benefactor) \ and \ \left(\dfrac{hk}{c+d}\right)^{\frac{1}{1-h}} < \dfrac{r}{c} \ (terrorist \ and \ criminal)
\end{cases}
$$

$$(6)$$

Equation (6) has four rows. Row 1 describes the uncommon event that the terrorist allocates its entire resources r/c to crime effort x despite enjoying benefactor support. Satisfying the two inequalities in row 1 implies that rb>dr/c is also satisfied, which implies b>d/c, which means that the benefactor has unusually large tolerance for crime, i.e. high funding b and low punishment d. Row 2 is the common event of a benefactor funding a terrorist balancing terrorism against crime. In row 3 the terrorist has no benefactor and allocates its entire resources r/c to crime effort. Satisfying the two inequalities in row 3 implies that rb<dr/c is also satisfied, which implies b<d/c, i.e. low funding b and high punishment d. That is, since potential benefactors have low tolerance for crime, the terrorist is unable to recruit a benefactor. In row 4 the terrorist has no benefactor but is able to stand on its own feet balancing terrorism against crime.

Property 1. If x<rMin{b/d,1/c} (row 2 in (6)), $\partial x/\partial c < 0$, $\partial x/\partial d < 0$, $\partial x/\partial k > 0$, and $\partial x/\partial h > 0$ if $Ln[hk/(c+d)] > (h-1)/h$.

Proof. Follows from (6).

IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

11

Property 1 states that the terrorist's crime effort x decreases when the unit cost c and punishment d increase, increases when the crime production proportionality parameter k increases, and increases when the crime production efficiency h increases assuming that k and h are large compared with c and d. That is, conditions unfavorable for crime, such as high cost of committing crime (for example due to efficient policing and high probability of incarceration) and high punishment by benefactors (through withholding funding), inhibit crime. In contrast, conditions favorable for crime, such as ease of producing crime efficiently, encourage crime.

Inserting (6) into (4) gives

$$
t = \begin{cases}
\dfrac{k(r/c)^h + rb - dr/c}{a} & if \ \ rb > d\left(\dfrac{hk}{c+d}\right)^{\frac{1}{1-h}} \ and \ \left(\dfrac{hk}{c+d}\right)^{\frac{1}{1-h}} \geq \dfrac{r}{c} \\[3em]
\dfrac{r(b+1) + k(1-h)\left(\dfrac{hk}{c+d}\right)^{\frac{h}{1-h}}}{a} & if \ rb > d\left(\dfrac{hk}{c+d}\right)^{\frac{1}{1-h}} \ and \ \left(\dfrac{hk}{c+d}\right)^{\frac{1}{1-h}} < \dfrac{r}{c} \\[3em]
\dfrac{k(r/c)^h}{a} & if \ \ rb < d\left(\dfrac{hk}{c+d}\right)^{\frac{1}{1-h}} \ and \ \left(\dfrac{hk}{c+d}\right)^{\frac{1}{1-h}} \geq \dfrac{r}{c} \\[3em]
\dfrac{r + k(1-h)\left(\dfrac{hk}{c}\right)^{\frac{h}{1-h}}}{a} & if \ rb < d\left(\dfrac{hk}{c+d}\right)^{\frac{1}{1-h}} \ and \ \left(\dfrac{hk}{c+d}\right)^{\frac{1}{1-h}} < \dfrac{r}{c}
\end{cases} \tag{7}
$$

Property 2. If x<rMin{b/d,1/c} (row 2 in (7)), $\partial t/\partial a < 0$, $\partial t/\partial b > 0$, $\partial t/\partial r > 0$, $\partial t/\partial c < 0$, $\partial t/\partial d < 0$, $\partial t/\partial k > 0$, and $\partial t/\partial h > 0$ if $Ln[hk/(c+d)] > 0$ and h<1.

Proof. Follows from (7).

Property 2 states that the terrorist's terrorism effort t decreases when the unit costs a and c of terrorism effort t and crime effort x, and punishment d, increase; increases when the resources r, funding b, and crime production proportionality parameter k increase; and increases when the crime production efficiency h increases assuming that k and h are large compared with c and d. That is, conditions unfavorable for terrorism, such as high cost of both terrorism effort and crime effort (for example due to

IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

12

efficient policing and high probability of incarceration) and high punishment by benefactors (through withholding funding), inhibit terrorism effort. In contrast, conditions favorable for terrorism effort, such as ample resources, encourage terrorism effort. Appendix B solves the model for the government when funding b and punishment d are parameters, which implies the government's terrorism protection effort

$$
T = \begin{cases} \left(\sqrt{\dfrac{S}{A}} - \sqrt{t} \right) \sqrt{t} & if \ \ t < \dfrac{S}{A} \\ 0 \ \ if \ t \geq \dfrac{S}{A} \end{cases}
$$

(8)

where t is given by (7).

Property 3. When t<S/A, $\partial T / \partial A < 0$, $\partial T / \partial S > 0$, and $\partial^2 T / \partial t^2 < 0$. T_{max}=S/4A when t=S/4A.

Proof. Follows from (8).

Property 3 and (8) state that the government's terrorism protection T is inverse U shaped in the terrorist's terrorism effort t. With no terrorism effort, t=0, no government protection is needed: T=0. As terrorism effort t increases above zero, it has limited impact and thus limited government protection is sufficient. In this situation the government is superior, weighs benefits against costs, and finds no need to protect substantially against the limited threat. Government protection reaches a maximum T_{max}=S/4A when t=S/4A and thereafter decreases to zero when t=S/A. Increased terrorism effort beyond t=S/4A is what no government wants to face. It means that when the government weighs the benefits of terrorism protection against the costs, the terrorist threat is so overwhelming that the costs are not justified by the benefits. One example is when ISIL ejected government forces from key cities in western Iraq in 2014. If the government forces had stayed, they would have been killed, so they decided to cut their losses and abandon their protection efforts. In this situation the government is inferior and the terrorist is superior. Intuitively, the government's protection T decreases when its unit cost A of protection increases, and increases when its valuation S increases.

The players' expected utilities follow from inserting (7) and (8) into (5) and distinguishing between the eight cases flowing from four if-conditions for terrorism effort t and two if-conditions for government protection T, i.e.

IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

13

$$
u = \begin{cases} s\sqrt{t}\sqrt{\dfrac{A}{S}} - r & if \;\; t < \dfrac{S}{A} \\[2mm] s - r & if \; t \geq \dfrac{S}{A} \end{cases}, \quad U = \begin{cases} \left(\sqrt{t} - 2\sqrt{S/A}\right)A\sqrt{t} & if \;\; t < \dfrac{S}{A} \\[2mm] -S & if \; t \geq \dfrac{S}{A} \end{cases},
$$

$$
v = \begin{cases} w\left(s\sqrt{t}\sqrt{\dfrac{A}{S}} - r\right) - Max\{0, rb - dx\} & if \;\; t < \dfrac{S}{A} \\[3mm] w(s - r) - Max\{0, rb - dx\} & if \; t \geq \dfrac{S}{A} \end{cases}
$$

(9)

where t and x are given by (7) and (6).

Property 4. When t<S/A, $\partial u/\partial t > 0$, $\partial u/\partial s > 0$, $\partial u/\partial A > 0$, $\partial u/\partial S < 0$, $\partial U/\partial t < 0$, $\partial^2 U/\partial t^2 > 0$, $\partial U/\partial A < 0$, $\partial^2 U/\partial A^2 > 0$, $\partial U/\partial S < 0$, $\partial^2 U/\partial S^2 > 0$, $\partial v/\partial u > 0$, $\partial v/\partial w > 0$.

Proof. Follows from (9).

Property 4 and (9) state that the terrorist's expected utility increases when its terrorism effort t, valuation s, and the government's unit cost A increase, and decreases when the government's valuation S increases. That is, the terrorist seeks to attack targets it sees as valuable, and earns lower expected utility when these targets are also valuable to the government, which then protects them more thoroughly. If the government's protection cost increases, for example if its targets are dispersed geographically, or cutting-edge defense technology against sophisticated terrorist attacks becomes more costly, the terrorist's expected utility increases. The government's expected utility U decreases concavely when its unit cost A, valuation S, and terrorism effort t increase. That is, higher terrorism effort against more valuable targets, and increased costs of protecting these targets, cause lower expected utility U for the government. The benefactor's expected utility increases when the terrorist's expected utility u and its valuation w increase. This follows since the benefactor's expected utility is proportional to the terrorist's expected utility, with proportionality parameter w.

Since the benefactor's funding b and punishment d are parameters in this section 2.1, the benefactor's funding mechanism $Max\{0, rb - dx\}$ depends on three parameters, funding b, punishment d, and the terrorist's resources r, and the terrorist crime effort x specified in (6). This automatically gives the benefactor's expected utility v in (9). This expected utility v also follows if the benefactor has fixed

IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

14

intrinsic preferences for the parameters funding b and punishment d, and simply implements the funding mechanism in (1) without optimizing, i.e. without choosing funding b and punishment d strategically. We now proceed to analyze the situation with three players when the benefactor chooses funding b and/or punishment d strategically.

2.2. Benefactor Chooses Funding and Punishment Strategically

We assume that the benefactor chooses the optimal values of funding b and punishment d as free strategic choice variables to maximize its expected utility v. This is realistic for benefactors with the least constraints, which can maximize expected utility v relatively freely. The benefactor's two choices occur in period 1, knowing that the terrorist takes funding b and punishment d as given in period 2 when choosing the optimal crime effort x and terrorism effort t. Appendix C solves the model for the benefactor when funding b and punishment d are free choice variables.

Property 5. When both benefactor funding b and benefactor punishment d are free choice variables, then the benefactor optimally chooses

$$b = \frac{1}{r}\left(\frac{As^2w^2}{4aS} - (1-h)k\left(\frac{hk}{c}\right)^{\frac{h}{1-h}} \right) - 1, \quad d = 0 \tag{10}$$

Proof. Appendix C.

Property 5 states that the benefactor chooses not to punish, reasoning that punishment would be dysfunctional and cause lower expected utilities for both benefactor and terrorist. In order for funding b to be positive in (10), the transfer of rb in equation (1) when punishment d=0, i.e. the product of funding b and the terrorist's resources r, from the benefactor to the terrorist has to cause a larger gain in expected utility u for the terrorist, and thus for the benefactor, than the cost expenditure rb. This is possible in equation (10) when $As^2w^2/4aS$ is large. Expressed verbally, transfer of rb from the benefactor to the terrorist occurs when the benefactor's valuation w of the terrorist's expected utility is large, the terrorist's valuation s is large, the government's unit cost A of protection is low, the terrorist's unit cost a of terrorism effort is low, and the government's valuation S is low. Summing up, this subsection has shown that conditions are possible where the benefactor prefers to transfer an optimal amount rb of funds to the terrorist, and not to punish the terrorist.

IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

15

2.3. Benefactor Chooses Funding Strategically while Punishment Is a Parameter

In some instances the benefactor may not have the luxury of choosing both funding b and punishment d strategically. For example, the benefactor may be an organization strongly committed to some terrorist ideology, and may not tolerate any form of criminal behavior by the terrorists they fund. The board of directors of such a benefactor may risk-aversely impose a quite large punishment d exogenously, to prevent any mistakes by donors associated with the benefactor, with no option to choose punishment d strategically. This means that the term -dx in (1), i.e. punishment multiplied by the terrorist's crime effort x, may be quite large and gets subtracted from the benefactor's funding rb of the terrorist in (1). If dx exceeds rb, no funding occurs. In period 1 the benefactor thus takes punishment d as given, knowing that the terrorist chooses crime effort x in period 2 to furnish the term dx, and chooses funding b optimally.

Property 6. When benefactor funding b is a free choice variable, and benefactor punishment d is a parameter, then the benefactor optimally chooses

$$b = \frac{1}{r}\left(\frac{As^2 w^2}{4aS} - (1-h)k\left(\frac{hk}{c+d} \right)^{\frac{h}{1-h}} \right) - 1, \quad d \text{ is a parameter} \tag{11}$$

where $\dfrac{\partial b}{\partial d} = \dfrac{\partial b}{\partial c} = \dfrac{1}{r}\left(\dfrac{hk}{c+d} \right)^{\frac{1}{1-h}} > 0,$ $\partial b/\partial h < 0$ when hk>c+d, $\partial b/\partial k < 0$, $\partial b/\partial a < 0$,

$\partial b/\partial r < 0$ when b>0, $\partial b/\partial A > 0$, $\partial b/\partial S < 0$, $\partial b/\partial w > 0$.

Proof. Follows from Appendix C and differentiating funding b in (11) with respect to the various parameters.

Funding b in (11) equals funding b in (10) with the exception that punishment d is added in the second denominator. Positive punishment d>0 thus causes the second term within the parentheses in (11) to be smaller, and thus funding b becomes larger, i.e. $\partial b/\partial d > 0$. This result is noteworthy and perhaps surprising. It means that with fixed positive punishment d>0, the benefactor has already implemented a mechanism punishing terrorists potentially engaging in crime, which enables the

IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

16

benefactor to fund the terrorist more, expressed with larger b, than with no punishment expressed with d=0. More technically, Property 6 states that when punishment d is a parameter, the benefactor's optimal choice of funding b proportional to the terrorist's resources r increases when punishment d, unit cost c of crime effort, government's unit cost A of terrorism protection, and its valuation w increase, decreases when the crime production efficiency h increases assuming that hk>c+d, and decreases when the crime production proportionality parameter k, the terrorist's unit cost a of terrorism effort, the terrorist's resources r, and the government's valuation S increase. Thus conditions favoring crime, which provides the terrorist with alternative revenues, and conditions favoring government protection, induce the benefactor to fund less.

2.4. Benefactor Chooses Punishment Strategically while Funding Is a Parameter

Our last possibility is that the benefactor is constrained differently, i.e. to choose the optimal value of punishment d when funding b is a parameter. This is realistic when the benefactor has a fixed budget which cannot be exceeded. Many benefactors may have income streams and expenses which are relatively steady, or may have a board of directors allocating funds in various directions simplified by allocating a certain budget to terrorism. Given this fixed budget rb, i.e. funding b multiplied by the terrorist's resources in (1), the benefactor may prefer to retain the possibility of choosing strategically how to punish terrorists who resort to crime. This may also be directed by the board of directors which may prefer the punishment d not to be imposed arbitrarily, but optimally. This punishment amounts to dx in (1), i.e. the punishment d multiplied with the terrorist's crime effort x. If dx exceeds rb, no funding occurs according to (1). The benefactor thus informs the terrorist in period 1 that funding rb will be provided, but that the terrorist will be punished with dx when engaging in crime against the benefactor's wishes. The dynamic is that the terrorist chooses x optimally in period 2 knowing punishment d from period 1. Thus we may well enable the benefactor to choose d optimally in period 1 to take into account how the terrorist can be expected to react in period 2, as determined by backward induction.

Property 7. When benefactor punishment d is a free choice variable, and benefactor funding b is a parameter, then benefactor punishment d has an optimal intermediate value determined by

IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

17

$$b = \frac{1}{r}\left(\frac{As^2w^2}{4aS} - (1-h)k\left(\frac{hk}{c+d} \right)^{\frac{h}{1-h}} \right) - 1, \quad b \; is \; a \; parameter \tag{12}$$

Proof. Appendix C.

Equation (12) is the same as (11) except that funding b is now a parameter, and punishment d has to be determined numerically, except for special cases such as h=1/2 when punishment d in (12) follows from solving a third order equation. It can be shown numerically that the benefactor's expected utility v has a maximum for an intermediate value of punishment d. The intuition is that the terrorist's crime effort x is large when punishment d=0, i.e. the terrorist takes advantage of the absent punishment d. As punishment d increases above zero, dx increases from zero increasing the benefactor's expected utility v. Conversely, when punishment d equals infinity, d=∞, arbitrarily small crime effort x eliminates funding, which decreases the terrorist's expected utility u and the benefactor's wu. As punishment d decreases from infinity, the terrorist can exert limited crime effort x and still receive some funding rb-dx according to (1).

3. Constructing Indices and Estimating the Parameters

Table 1 lists sixty-five terrorist groups that either are or have been especially active, or are included for completeness (such as the ten al-Qaeda groups), or are included to ensure geographical diversity. The START database (http://www.start.umd.edu/gtd/) is the most credible source of publicly available information on these groups. It provides information on target types, attack types, and financial support.

The relative values of the variables, parameters, and indices, and the logic through which they are constructed matter more than the absolute values. The qualitative nature of the results is central. As future data becomes available, sets of numbers can be replaced with new sets of numbers. We now proceed to estimate and determine the six terrorist parameters r, a, c, k, h, and s, three government parameters R, A, and S, and three benefactor parameters b, d, and w. Some of these appear in Table 2. Since the relative values are what matter, some parameters, such as the unit costs of efforts a, c, and A for some of the players, are set to the benchmark values of 1.

IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

18

First, we created a *target type index*, see column 3 in Table 1. Twenty-two target types are listed in the START database: abortion related (2, Ar), airports & aircraft (2, Ai), business (1, Bu), educational institution (1, Ed), food or water supply (1, FW), government (diplomatic) (2, GD), government (general) (2, GG), journalists & media (1, J), maritime (2, Ma), military (4, M), NGO (1, N), other (1, O), police (3, P), private citizens & property (1, Pr), religious figures/institutions (1, Rf), telecommunication (2, Te), terrorist/non-state militia (3, TN), tourists (1, To), transportation (2, T), unknown (1, Un), utilities (gas, electricity, oil) (2, Ut), violent political parties (2, V). The weights given in parentheses are assigned according to how "hard" each target is assessed to be. The highest weight 4 is assigned to the military, which has the highest skills and most lethal weapons. The second-highest weight 3 is assigned to the police and terrorist/non-state militia, which have less lethal weapons. The second lowest weight 2 is assigned to various government agencies and other targets, i.e. Ar, Ai, GD, GG, Ma, Te, T, Ut, and V, which are usually either equipped with political tools and limited weaponry, or are hardened in some limited way. The lowest weight 1 is assigned to targets within the civilian and business domain, i.e. Bu, Ed, FW, J, N, O, Pr, Rf, To, and Un, which are usually not hard. The target type index is created by multiplying the number of times a target type is attacked with its corresponding weight, and summing. As a simple example, al-Ittihaad al-Islami (row 6 in Table 1) has attacked business, government (general), religious figures/institutions, and transportation once; and NGO and private citizens & property twice. This gives the target type index $1×1+2×1+1×1+2×1+1×2+1×2=10$ in Table 1. The calculation has been made in Excel based on the model and assumptions in this paper, information in the START database, and the Fragile States Index. Table 1 also ranks the three most prevalent target types. In case of equal prevalence, alphabetical ranking is applied. Hence the ranking is N, Pr, and Bu for al-Ittihaad al-Islami. If a terrorist group only chooses two target types, only these two target types are ranked. If a terrorist group only chooses one target type, only this one target type is listed.

Second, we created an *attack type index*, see column 4 in Table 1. Nine terrorist attack types are specified in the START database: armed assault (4, AA), assassination (4, As), bombing/explosion (3, B), facility/infrastructure attack (2, F), hijacking (2, Hi), hostage taking (barricade incident) (2, Hb), hostage taking (kidnapping) (2, Hk), unarmed assault (1, Ua), unknown (1, Un). The weights given in parentheses are assigned according to the risk incurred by the operatives. The highest weight 4 is assigned to armed assault and assassination, which are most risky. The second highest weight 3 is assigned to bombing/explosion. The second lowest weight 2 is assigned to facility/infrastructure attack, hijacking, hostage taking (barricade incident), and hostage taking (kidnapping). The lowest weight 1 is

IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

19

assigned to unarmed assault and unknown, which are assumed to be least risky. The attack type index is created by multiplying the number of times an attack type is used with its corresponding weight, and summing. As a simple example, al-Ittihaad al-Islami (row 6 in Table 1) has perpetrated armed assault once, assassination twice, and bombing/explosion also twice. This gives the attack type index 1×4+2×4+2×3=18 in Table 1. Table 1 also ranks the three most prevalent attack types. In case of equal prevalence, alphabetical ranking is applied. Hence the ranking is As,B,AA for al-Ittihaad al-Islami. If a terrorist group only chooses two attack types, only these two attack types are ranked. If a terrorist group only chooses one attack type, only this one attack type is listed.

Third, we created a *funding index*. Some qualitative data for funding is available on http://www.start.umd.edu/baad/database, not quantified (for example in $US) but indicating which sources are involved. Some such sources are listed in column 5 in Table 1. We let our funding index range from 9 to 18. Our first observation is whether a terrorist has a benefactor. For the fourteen terrorists with no benefactor we assign the average funding index 9. In contrast, forty-one of the terrorists not only have a benefactor, but enjoy support from at least two of the following three sources: a country, a diaspora, or voluntary donations from a community. These are assigned the maximum funding index 18. The remaining ten terrorists are assigned the funding index 15 (six terrorists) and 12 (four terrorists) based on a qualitative assessment of their strength of financial support.

These three indices – target type index, attack type index, and funding index –are used to estimate each terrorist group's resources r. Individually, each index may not capture the resources, but jointly they may be more representative. The target type index ranges from 2 to 8,815, rescaled to range from 18×2/8,815 to 18. The attack type index ranges from 2 to 15,084, rescaled to range from 18×2/15,084 to 18. Summing these three indices gives resources r between 0 and 54 for each terrorist.

Terrorists with a high attack type index can be expected to be experienced in terrorism, with high competence and skills, efficient organization and operation, enjoying a low unit cost a of generating pure terrorism effort τ. We assume that the fifteen terrorists with attack type index above 1,000 have a low benchmark unit cost, a=1, of generating pure terrorism effort τ. In contrast, we assume that the fifteen terrorists with attack type index below 50 are less experienced causing unit cost at around 2. A simple equation accomplishing these characteristics is the logistic function

$$a = 1 + \frac{2}{1+Exp[0.01(attack\ type\ index-200)]},$$ (13)

IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

20

causing a =1.06, a =1.6, a =1.98, a =2.05, for attack type indices 500, 200, 50, 2, respectively.

The START database lists the four crime types extortion (E), robberies (R), drugs (D), cocaine (Co). The fourteen terrorists with no benefactor are involved in at least one of these. Since these fourteen terrorists cannot survive without crime, we can expect them to be experienced in it. We thus assume a benchmark unit cost c=1 of crime effort for these fourteen terrorists. For terrorists with a benefactor, crime effort is usually more expensive. First, they may be less experienced in crime, which is not their primary objective. For them, crime is only a means to an end, i.e. terrorism. Second, terrorist organizations with a benefactor need to camouflage their possible criminal behavior not only from the benefactor, but usually also for the rest of their organization which may believe that they are ideologically pure, not impacted by crime, and possibly not knowing how funds are provided. We assume twice as high unit cost, c=2, for the forty-one terrorists enjoying the maximum funding index 18. Interpolating linearly, we assume c=1.67 for the six terrorists with funding index 15, and c=1.33 for the four terrorists with funding index 12. Thus the equation is c=1+(funding index-9)/9.

The crime production function $y=kx^{h}$ in (3) requires h and k to be determined. We assume concave crime production, h=0.5, which means that crime production increases decreasingly as the terrorist's crime effort x increases, see section 1. Since r is scaled from 0 to 54 in $r=a\tau+cx$ in (2), similar resource allocation of r to terrorism $a\tau$ and crime cx would mean that each of $a\tau$ and crime cx is scaled from 0 to 27. Since the unit effort costs a and c of terrorism and crime range from around 1 to 2, pure terrorism effort τ and crime effort x range from 0 to 27. Thus $y/a=kx^{0.5}/a$ in (4) ranges from 0 to $\frac{k\sqrt{27}}{a} \approx 5\frac{2k}{a}$. If y/a in (4) should also range from 0 to 27 in (4), k should be at least 5, and might be 10 due to division by a which ranges from 1 to 2. As a compromise we set k=7.5. This ensures that the two crucial terms τ and y/a which determine the terrorist's terrorism effort t in (4) are or can be similarly sized, ranging from 0 to around 27. The relative sizes are what matter, preventing some terms for example in (4) completely dominating other terms.

The last term in (4), $Max\{0,rb-dx\}$, requires the benefactor's funding parameter b and the benefactor's punishment parameter d to be determined. The most plausible benchmark is b=d=1 which gives benefactor support r-x if the terrorist has a benefactor, and no benefactor support if the terrorist has no benefactor, which occurs when r<x. For a terrorist with a benefactor, (4) thus expresses the

IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

21

terrorism effort $t=(r-cx+7.5x^{0.5}+r-x)/a$, which means that the benefactor doubles the terrorist's resources from r to 2r (summing the first term and fourth term in this expression for t), and punishes the terrorist proportional to the crime effort x (subtracting x in the fifth term). If adequate empirical support can be furnished, it is quite possible to assume that the benefactor funds more (b>1) or less (b<1) than proportionally (b=1), or that the benefactor punishes crime effort more (d>1) or less (d<1) than proportionally (d=1).

The government parameters are R, A, and S. Economic indicators such as GDP may not adequately express a government's unit costs and resources allocated to terrorism and crime. Instead we use the 2016 Fragile States Index (http://fsi.fundforpeace.org/rankings-2016) based on twelve indicators creating a scale from 0 to 120.[5] Higher scores mean greater fragility. The right column in Table 1 shows the FSI for the country or countries where each terrorist group is based and operates. These countries are listed in column 6. If several countries are involved, an average FSI is estimated. For example, al-Qaeda in the Indian Subcontinent operates in both Bangladesh (FSI=90.7) and Pakistan (FSI=101.7), which gives an average of 96.2. Alternatively, the Irish Republican Army is based in Ireland (headquarter in Dublin) (FSI=22.5) and operates in the United Kingdom (FSI=32.4), which gives an average of 27.45.

Since more fragile states usually have less government resources, we assume that the government's resources R are inversely proportional to the Fragile States Index, which in Table 1 ranges from 22.6 (Sweden) to 111.5 (Yemen). Since the terrorist's resources r (above) range from 0 to 54, we choose to furnish the government with up to twice as much resources, i.e. a range from 0 to 108. This is accomplished by defining R=108×22.6/FSI, which gives R=108 for Sweden (row 16 in Table 2) and R=21.9 for Yemen (rows 11 and 14 in Table 2).

As for b=d=1 above, also for the government's unit cost A of terrorism protection we assume a benchmark unit cost around 1 for the most non-fragile and stable governments, and around 2 for the most fragile and least stable governments. The former can be expected to have developed the most efficient procedures for addressing terrorism, and to have driven down the unit cost of effort. We assume the simple equation A=1+FSI/120, which gives A=1.19 for Sweden (row 16 in Table 2) and A=1.93 for Yemen (rows 11 and 14 in Table 2). We set S=170 to get reasonably sized numbers. The terrorist's

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[5] Demographic pressures, refugees and internally displaced persons, group grievance, human flight and brain drain, uneven economic development, poverty and economic decline, state legitimacy, public services, human rights and rule of law, security apparatus, factionalized elites, external intervention.

IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

22

valuation s does not impact the strategic choice variables, but does impact the terrorist's and benefactor's expected utilities in (9). A plausible benchmark is s=S=170. The benefactor's valuation w of the terrorist's utility does not impact the strategic choice variables, but does impact the benefactor's expected utility in (9). A plausible benchmark is w=1.

4. Model Prediction of the Three Players' Behaviors and Comparison with the Actual Behavior of the Sixty-five Terrorist Organizations

Having estimated the parameters, we now use the model to predict the three players' behaviors. The four rightmost columns 9, 10, 11, and 12 in Table 2 show the three players' four efforts Max{0,rb-dx} for the benefactor, x and t for the terrorist, and T for the government, determined by inserting the parameter values into equation (1) for the benefactor, equations (6) and (7) for the terrorist, and equation (8) for the government. We now compare these predictions against reality, i.e. how the four rightmost columns 9, 10, 11, and 12 in Table 2 match against the actual behavior of the sixty-five terrorist organizations. Fifty-one of the sixty-five terrorists have a benefactor, expressed as Y in column 3 in Table 2, and fourteen have no benefactor expressed as N in that column. For the fifty-one terrorists with a benefactor, the parameter values imply that row 2 in equations (6) and (7) determine crime effort x and terrorism effort t. For the fourteen terrorists with no benefactor, the parameter values imply that row 3 in equations (6) and (7) determine crime effort x and terrorism effort t. Row 1 shows the Abu Nidal Organization, which operates internationally with good benefactor support, rb-dx=17.0. Hence the crime effort is low, x=1.6, and terrorism effort is high, t=27.4. The FSI is reasonably high, 72.5, as is government protection, T=26.5. In row 2, in contrast, the Abu Sayyaf Group has no benefactor and scores high on crime, x=12.3, and also high on terrorism effort, t=26.3. The FSI is high, 84.7, and the government protection is reasonably high, T=24.9. In row 6 al-Ittihaad al-Islami operates in Ethiopia and Somalia with high FSI=105.6 causing lower government protection, T=22.5. The group enjoys good benefactors enabling low crime, x=1.6, and reasonably high terrorism effort, t=20.1. In row 37, ISIL enjoys good benefactor support enabling low crime, x=1.6, and extremely high terrorism effort, t=89.7. The high FSI=104.7 has caused extremely low government protection, T=0.5. In row 58, FARC with no benefactor resorts to high crime, x=30.5, and also high terrorism effort, t=41.4. Colombia has reasonably high FSI=80.2, and government protection is reasonably high, T=23.6. In row 59, Shining Path, also with no benefactor,

IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

23

has similar characteristics, i.e. high crime, x=45.0, high terrorism effort, t=50.3, reasonably high FSI=72 in Peru, and reasonably high government protection, T=22.8.

5. Conclusion

To determine strategic assessments, a game theoretic model was developed in which a terrorist allocates its resources into terrorism and crime. The allocation to crime generates a crime profit which is also allocated to terrorism. The terrorist gets funding from a benefactor proportional to its resources, subtracting an amount as punishment proportional to its crime effort. The benefactor either has fixed parameter preferences, or optimizes its two proportionality parameters, funding and punishment of the terrorist. The government exerts terrorism protection effort. The START database (http://www.start.umd.edu/gtd/) and Fragile States Index (http://fsi.fundforpeace.org/rankings-2016) are used to estimate twelve parameters in the model; two parameters for resources, three unit costs, two crime production parameters, two proportionality parameters for the benefactor's funding, and three valuation parameters. The fragile states index expresses, in varying degrees, low resourcefulness, weak governmental institutions, limited police willingness to repress terrorism, and high societal tolerance for terrorism.

First, we find that the terrorist exerts more crime effort when 1. the unit cost of crime effort decreases, 2. the benefactor's punishment of crime effort decreases, 3. the crime production proportionality parameter increases, and 4. the crime production efficiency increases provided that the unit cost of crime and punishment of crime are low. These four results establish a terrorist's relative ideological orientation on a continuum from being highly ideological, if no crime is exerted, to being highly criminal.

Government policy can influence a terrorist's orientation for these four results as follows: 1. Make it costly for terrorists to exert crime effort through laws, surveillance, detection, prosecution, etc. 2. Encourage benefactors not to fund terrorists engaged in crime. 3. Make crime effort less lucrative. 4. Prevent organized crime and increasing returns to scale (Varian 2010) in crime production, i.e. prevent the development of large efficient organizations which can enjoy cost advantages from increased crime production.

Second, we find that the terrorist exerts more terrorism effort when 5. the unit cost of terrorism effort decreases, 6. the unit cost of crime effort decreases, 7. the benefactor's punishment of crime effort

IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

24

decreases, 8. the terrorist's resources increase, 9. the benefactor's funding increases, 10. the crime production proportionality parameter increases, and 11. the crime production efficiency increases provided that the unit cost of crime and punishment of crime are low. These seven results determine the terrorist threat.

Government policy can influence these seven results as follows: 5. Make it costly for terrorists to exert terrorism effort. 6. Make crime effort costly. 7. Encourage benefactors to punish crime. 8. Decrease terrorist resources, and confiscate, freeze, and prevent the accumulation of terrorist resources. 9. Block benefactors' funding of terrorists, block the channels of funding, criminalize terrorist funding, etc. 10. Inhibit crime production. 11. Prevent efficient crime production.

Third, we find that the government's terrorism protection 12. is inverse U shaped in the terrorist's terrorism effort, 13. decreases when its unit cost increases, and 14. increases when its valuation of terrorism objectives increases.

Government policy can influence the expected utilities for these three results as follows: 12. Increase terrorism protection effort to prevent terrorists from exceeding terrorism levels where protection is inefficient. 13. Decrease the government's unit cost of terrorism protection through mechanisms such as efficiency, increasing returns to scale, competence. 14. Decrease the government's valuations of terrorism and crime objectives, which may be impossible when faced with terrorists with opposing interests.

Fourth, we find that 15. the terrorist's expected utility increases when its terrorism effort, valuation, and the government's unit cost increase, and decreases when the government's valuation increases, 16. the government's expected utility decreases concavely when its unit cost, valuation, and terrorism effort increase, and 17. the benefactor's expected utility increases when the terrorist's expected utility and its valuation increase.

Government policy can influence the expected utilities for these three results as follows: 15. Decrease the terrorist's valuations of terrorism objectives, and the government's unit cost, and increase the government's valuation (weighted against the concern in point 14). 16. Decrease the government's unit cost, valuation, and terrorism effort. 17. Prevent benefactors from valuing terrorist expected utilities positively.

Four strategies by which the benefactor determines its funding are assessed. First, the benefactor may have intrinsic preferences not determined by optimization. Second, the benefactor may optimize funding

IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

25

proportional to the terrorist's resources and optimize punishment proportional to the terrorist's crime effort. Hence the benefactor operates as an unconstrained economist, i.e. an economist weighing benefits against costs without being subject to budget constraints or other confinements or limitations. Then the benefactor chooses not to punish, and funding weighs benefits against costs. Third, the benefactor may optimize funding provided that punishment is specified at a certain level, which may be high or low. This is realistic when the benefactor risk-aversely or due to bounded rationality does not tolerate that the terrorist degrades its operation to criminal activity. Interestingly, since the benefactor has already implemented a safeguard in the form of punishment, in this situation the benefactor funds more than in the absence of punishment. Fourth, the benefactor may optimize punishment provided that funding is given, which is realistic when the benefactor has a fixed budget but prefers to punish terrorists who resort to crime.

We have considered data for sixty-five terrorist organizations to estimate parameter values and the impact on the players' strategies. This method is suggested as a tool. Governments, policymakers, analysts, researchers, and others can apply the theoretical results, and assess how empirical data impacts the parameter values and strategic choices of the players. The twelve parameter values can be varied systematically, based either on empirical support or hypothetically, and the impact on the players' strategic choice variables as determined by the model can be assessed.

Future research should compile more extensive empirical support for the twelve parameters in particular, and models of this kind in general, seek to quantify the overall validity of models like this, and use this and similar models to predict future behavior of terrorists, governments, and benefactors.

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IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

26

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IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

27

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IJCV: Vol. 11#05/2017
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28

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IJCV: Vol. 11#05/2017
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29

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IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

30

Appendix

Appendix A: Solving the Model for the Terrorist When Benefactor Funding b and Punishment Are Parameters

The terrorist's and government's optimization programs are determined by

$$x = \arg\max_{x \geq 0} t(x), \quad T = T(t(x)) = \arg\max_{T \geq 0} U(t(x), T) \tag{A1}$$

where $\arg\max_{x \geq 0} t(x)$ is the value of x which maximizes t(x), assuming x≥0. Solving with backward induction, common in game theory since conditioning on future behavior is removed, we start with the last period, i.e. period 2. The terrorist's first order condition, which is a necessary condition for maximum or minimum of t(x), is

$$\frac{\partial t}{\partial x} = \begin{cases} \dfrac{-c-d+hkx^{h-1}}{a} = 0 \;\; if \;\; rb > dx \, (benefactor) \\[4mm] \dfrac{-c+hkx^{h-1}}{a} = 0 \;\; otherwise \, (no\ benefactor) \end{cases} \tag{A2}$$

That is, the first derivative $\partial t/\partial x$ expresses the change in t as x changes. If t does not change as x changes, i.e. $\partial t/\partial x = 0$, a maximum or minimum is reached. The second order condition, which is a necessary condition for maximum of t(x), is

$$\frac{\partial^2 t}{\partial x^2} = \frac{(h-1)hkx^{h-2}}{a} \tag{A3}$$

which is satisfied as negative when h<1, i.e. concave crime production. The second derivative $\partial^2 t/\partial x^2$ expresses the change in $\partial t/\partial x$ as x changes. That change is negative if $\partial t/\partial x$ first increases, and thereafter decreases, as x increases from below to above that value causing maximum t(x). Solving (A2) with respect to x gives the crime effort in (6).

IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

31

Appendix B: Solving the Model for the Government When Benefactor Funding b and Punishment Are Parameters

We then solve period 1 for the government. The government chooses the optimal terrorism protection T to maximize its expected utility U in (5), i.e.

$$\frac{\partial U}{\partial T} = \frac{tS}{(t+T)^2} - A = 0 \Rightarrow T = \begin{cases} \left(\sqrt{\dfrac{S}{A}} - \sqrt{t}\right)\sqrt{t} & if \ \ t < \dfrac{S}{A} \\ \\ 0 \ \ if \ t \geq \dfrac{S}{A} \end{cases} \tag{B1}$$

which is solved to yield (8), where t is given by (7). The second order condition is always satisfied,

$$\partial^2 U / \partial T^2 = -2St/(t+T)^3 < 0.$$

IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

32

Appendix C: Solving the Model When Benefactor Funding b and Punishment D Are Free Choice Variables

We finally solve period 1 for the benefactor, for the event that the benefactor can choose funding b and punishment d. Inserting (6), (7), and (8) into v in (5) and differentiating for period 1 gives

$$\frac{\partial v}{\partial b} = \frac{r}{2}\left(\frac{sw}{\sqrt{\dfrac{aS}{A}}\sqrt{(1-h)k\left(\dfrac{hk}{c+d}\right)^{\frac{h}{1-h}}+r+br}} - 2 \right) = 0 \tag{C1}$$

$$\Rightarrow b = \frac{1}{r}\left(\frac{As^2w^2}{4aS} - (1-h)k\left(\frac{hk}{c+d}\right)^{\frac{h}{1-h}} \right) - 1, \quad \frac{\partial^2 v}{\partial b^2} < 0$$

$$\frac{\partial v}{\partial d} = \frac{1}{2}\left(\frac{hk}{c+d}\right)^{\frac{1}{1-h}}\left(2 - \frac{2d}{(1-h)(c+d)} - \frac{sw}{\sqrt{\dfrac{aS}{A}}\sqrt{(1-h)k\left(\dfrac{hk}{c+d}\right)^{\frac{h}{1-h}}+(1+b)r}} \right) = 0 \tag{C2}$$

which are solved to yield (10).

IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

33

Table 1: Categorization of sixty-five terrorist organizations according to target type, attack type, funding, country or countries of basing and operations, and the Fragile States Index (FSI)

1	2	3	4	5	6	7
No	Terrorist organization	Target type[a]	Attack type[b]	Funding[c]	Countries	FSI[g]
1	Abu Nidal Organization	V,TN,GD,142	As,B,AA,225	Syria,Libya,Iraq,18	International[e]	72.50
2	Abu Sayyaf Group	Pr,Bu,M,841	B,Hk,AA,1310	E rackets and K-for-ransom,9	Philippines	84.7
3	al-Aqsa Martyrs Brigade	Pr,M,Bu,364	B,AA,Hk,717	al-Fatah,18	Israel(and West Bank)	79.7
4	al-Gama'at al-Islamiyya	P,Bu,Pr,613	As,AA,B,997	Iran,Afghan militant groups, Islamic NGOs,18	Egypt	90.2
5	al-Haramayn Brigades	P,9	B,As,10	Saudi intelligence,18	Saudi Arabia	72.2
6	al-Ittihaad al-Islami	N,Pr,Bu,10	As,B,AA,18	Middle Eastern financiers,remittances,18	Ethiopia, Somalia	105.6
7	al-Qaeda	Pr,M,Bu,217	B,AA,As,271	Ch,18	International[f]	96.42
8	al-Qaeda in Iraq	Pr,P,M,1420	B,AA,As,2059	Ch,18	Iraq	104.7
9	al-Qaeda in Lebanon	M,4	B,3	Ch,18	Lebanon	89.6
10	al-Qaeda in Saudi Arabia	Bu,Pr,GG,12	B,AA,Hb,32	Ch,18	Saudi Arabia	72.2
11	al-Qaeda in the Arabian Peninsula	M,GG,Pr,2802	B,AA,As,3150	Ch,18	Yemen	111.5
12	al-Qaeda in the Indian Subcontinent	J,P,Pr,27	As,AA,B,54	Ch,18	Bangladesh, Pakistan	96.2
13	al-Qaeda in the Islamic Maghreb	M,P,Pr,740	B,AA,Hk,875	Ch,18	Algeria	78.3
14	al-Qaeda in Yemen	GD,P,M,30	B,AA,42	Ch,18	Yemen	111.5
15	al-Qaeda Network for Southwestern Khulna Division	GG,4	B,6	Ch,18	Bangladesh	90.7
16	al-Qaeda Organization for Jihad in Sweden	GG,2	F,2	Ch,18	Sweden	22.6
17	All Tripura Tiger Force	Pr,P.GG,21	AA,Hk,54	E,9	India	79.6
18	Amal	TN,J,M,60	B,Hk,As,79	G,C,M,18	Lebanon	89.6
19	Ansar al-Islam	P,GG,M,77	B,As,AA,103	al-Qaeda,18	Iraq	104.7
20	Armed Islamic Group	Pr,M,J,415	AA,B,As,864	E,R,C,M,Bu,9	Algeria	78.3
21	Asbat al-Ansar	GD,O,Rf,4	AA,As,B,15	al-Qaeda, etc, 18	Lebanon	89.6
22	Aum Shinri Kyo	Pr,T,Ai,17	Un,As,B,17	C,M,P,18	Japan	35.1
23	Basque Fatherland and Freedom (ETA)	Bu,P,GG,4096	B,As,AA,6553	K,E,R,9	Spain	39.8
24	Communist Party of India-Maoist	Pr,P,GG,3288	AA,B,F,6037	E,R,remote villagers,9	India	79.6
25	Communist Party of Nepal-Maoist (Baidya)	V,Un,T,58	B,F,AA,91	expatriate Nepalese,E,bank R,15	Nepal	91.2
26	Communist Party of Nepal-Maoist (CPN-M)	P,GG,M,71	B,AA,Un,87	expatriate Nepalese,E,bank R,15	Nepal	91.2
27	Communist Party of Nepal-Maoist (CPN-Maoist-Chand)	B,Pr,8	F,B,Hb,19	expatriate Nepalese,E,bank R,15	Nepal	91.2
28	Continuity Irish Republican Army	P,Bu,Pr,64	B,AA,F,98	E,bomb-making for hire,R,9	Ireland, United Kingdom	27.45
29	Eastern Turkistan Islamic Movement	P,Pr,GG,22	AA,B,F,28	al-Qaeda,Taliban,15	China	74.9
30	Eritrean Liberation Front	Bu,Ai,GD,43	Hk,AA,B,50	Iraq,Syria,18	Ethiopia	97.2
31	Garo National Liberation Army	P,Pr,Bu,301	AA,Hk,B,495	K,E,9[d]	India	79.6

IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

34

32	Hamas (Islamic Resistance Movement)	Pr,M,T,916	B,AA,Hk,1411	Iran,Islamic Ch,Arab expatriates,enterprises,18	Israel(and West Bank)	79.7
33	Harakat ul-Mujahidin	GG,Ai,P,10	AA,Hi,Hk,20	Pakistanis Kashmiris,PISI,18	India, Pakistan	90.65
34	Hezbollah	M,TN,Pr,1109	B,AA,Hk,1240	Iran,Syria,world-wide,18	Lebanon	89.6
35	Irish Republican Army	M,P,Bu,6577	B,As,AA,8803	E,bank R,Catholic-Irish descendents,12	Ireland, United Kingdom	27.45
36	Islamic State of Iraq (ISI)	Pr,GG,P,278	B,AA,As,498	Iran,Qatar,Yemen,18	Iraq	104.7
37	Islamic State of Iraq and the Levant (ISIL)	Pr,M,P,7078	B,Hk,AA,8430	Iran,Qatar,Yemen,18	Iraq	104.7
38	Jaish-e-Mohammad (JeM)	P,M,Pr,138	AA,B,F,198	Do,18	India, Pakistan	90.65
39	Jama'atul Mujahideen Bangladesh (JMB)	GG,Pr,Rf,73	B,AA,As,148	Pri,C,Persian Gulf NGOs,18	Bangladesh	90.7
40	Jemaah Islamiya	Rf,Bu,Pr,115	B,AA,As,243	Ch,al-Qaeda,18	Indonesia, Philippines	79.8
41	Jund al-Sham for Tawhid and Jihad	M,V,O,35	AA,B,As,40	al-Qaeda,18	Lebanon	89.6
42	Kach	Pr,GG,TN,20	B,F,AA,33	Do,18	Israel(and West Bank)	79.7
43	Kahane Chai	GD,J,3	AA,B,7	Do,18	Israel(and West Bank)	79.7
44	Kurdistan Workers' Party (PKK)	M,P,Pr,4506	AA,B,F,5849	D,E,Ch,Syria,Iran,Iraq,12	Turkey	77.3
45	Lashkar-e-Jhangvi	Pr,P,Rf,213	AA,B,As,445	Karachi benefactors,18	Pakistan	101.7
46	Lashkar-e-Taiba	Pr,P,M,470	AA,B,Hk,751	PISI,18	India, Pakistan	90.65
47	Liberation Tigers of Tamil Eelam (LTTE)	M,Pr,P,4425	B,AA,As,5471	Tamil communities,18	Sri Lanka	87.7
48	Loyalist Volunteer Forces	Pr,Rf,Bu,31	F,AA,B,81	D,narcotics,crime,9	United Kingdom	32.4
49	Mahdi Army	Pr,GG,Bu,27	B,AA,Hk,64	Iran,18	Iraq	104.7
50	Moro National Liberation Front	Bu,Pr,M,408	B,AA,Hk,609	Tun Mustapha,Malaysian state of Sabah,Iran,15	Philippines	84.7
51	Mujahedin-e Khalq	M,GG,GD,257	B,As,AA,364	Iraq,expatriate Iranians,Ch,18	Iran	86.9
52	National Democratic Front of Bodoland	Pr,Bu,T,287	AA,B,Hk,564	K,E,9	India	79.6
53	National Liberation Army of Colombia	Ut,Bu,Pr,3055	B,AA,Hk,4451	Cuba,E,K,15	Colombia	80.2
54	Palestinian Islamic Jihad	Pr,M,Bu,412	B,AA,As,732	Iran,18	Israel(and West Bank)	79.7
55	People's Revolutionary Party of Kangleipak	GG,Pr,M,46	B,AA,Hk,67	E,9	India	79.6
56	Popular Front for the Liberation of Palestine	Pr,M,Bu,302	B,AA,As,512	Syria,Libya,USSR,and China,18	Israel(and-West Bank)	79.7
57	Real Irish Republican Army	P,Pr,GG,97	B,AA,F,127	Do,18	Ireland, United Kingdom	27.45
58	Revolutionary Armed Forces of Colombia (FARC)	Pr,M,P,5821	B,AA,Hk,8028	Co,E,K,Hi,9	Colombia	80.2
59	Shining Path (SL)	Pr,GG,Bu,8815	B,AA,As,15084	Co,9	Peru	72.0
60	Sipah-e-Sahaba/Pakistan	Pr,GG,GD,34	AA,As,B,66	Ch,Sunnis,madrasses,18	Pakistan	101.7
61	Students Islamic Movement of India	Pr,T,Bu,42	B,AA,F,69	Hizb-ul-Mujahideen,PISI,18	India	79.6
62	Tehrik-i-Taliban Pakistan	Pr,M,P,2593	B,AA,Hk,4109	D,PISI,12	Pakistan	101.7
63	Ulster Freedom Fighters	Pr,Bu,TN,352	As,F,B,919	D,E,counterfeiting,9	United Kingdom	32.4

IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

35

| 64 | Ulster Volunteer Force | Pr,Bu,TN,361 | As,B,AA,997 | D,E,R,9 | United King-dom | 32.4 |
| 65 | United Self Defense Units of Colombia (AUC) | Pr,GG,Bu,83 | AA,Hk,Un,244 | D,Do,12 | Colombia | 80.2 |

Note. a. This column shows the three most prevalent target types and a numerical target type index that was derived from the START database (see text in Section 3 for detail): Ai=airports & aircraft, Bu=business, , GD=government (diplomatic), GG=government (general), J=journalists & media, M=military, N=NGO, O=other, P=police, Pr=private citizens & property, Rf=religious figures/institutions, T=transportation, TN=terrorist/non-state militia, Un=unknown, Ut=utilities (gas, electricity, oil), V=violent political parties.

b. This column shows the three most prevalent attack types and a numerical attack type index that was derived from the START database (see text in Section 3 for detail): AA=Armed assault, As=assassination, B=bombing/explosion, F=facility/infrastructure attack, Hb=hostage taking (barricade incident), Hi=hijacking, Hk=hostage taking (kidnapping), Un=unknown.

c. This column shows benefactors and other funding sources, as well as a funding index that is based on an assessment of the strength of financial support (see text in Section 3 for detail): Bu=business, C=citizens, Ch=charities, Co=cocaine, D=drugs, Do=donations, E=extortion, G=government, Hi=hijacking, K=kidnapping, M=military, P=police, PISI=Pakistani Inter-Services Intelligence, Pri=private, R=robberies.

d. The START database states that Garo National Liberation Army is not funded through drug trafficking, and no further information. The group has links to the National Democratic Front of Bodoland with no benefactor and funding "K,E,9", which we assume also for Garo National Liberation Army. For further information see http://www.satp.org/satporgtp/countries/india/states/meghalaya/terrorist_outfits/GNLA.htm, retrieved January 31, 2017.

e. The START database lists 51 incidents against 17 countries, ranging from two in Austria (FSI=27.5) via 17 in Lebanon (FSI=89.6) to two in Syria (FSI=110.8). Averaging the FSIs of the 17 countries, weighted for the number of incidents in each country, gives 72.50.

f. Weighting the 80 incidents for the FSIs in 13 countries in the START database gives 96.42.

g. Fragile States Index, http://fsi.fundforpeace.org/rankings-2016, retrieved January 31, 2017.

(Source: http://www.start.umd.edu/gtd/ and http://www.start.umd.edu/baad/database).

IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

36

Table 2: Categorization of sixty-five terrorist organizations according to existence of benefactor, and estimation of parameter values

1	2	3	4	5	6	7	8	9	10	11	12
No	Terrorist organization	Be	r	R	a	c	A	Ben	x	t	T
1	Abu Nidal Organization	Y	18.6	33.7	1.53	2	1.6	17.0	1.6	27.4	26.5
2	Abu Sayyaf Group	N	12.3	28.8	1	1	1.71	0	12.3	26.3	24.9
3	al-Aqsa Martyrs Brigade	Y	19.6	30.6	1.01	2	1.66	18.0	1.6	43.6	23.1
4	al-Gama'at al-Islamiyya	Y	20.4	27.1	1	2	1.75	18.9	1.6	45.6	20.9
5	al-Haramayn Brigades	Y	18	33.8	2.04	2	1.6	16.5	1.6	19.9	26.1
6	al-Ittihaad al-Islami	Y	18	23.1	2.03	2	1.88	16.5	1.6	20.1	22.5
7	al-Qaeda	Y	18.8	25.3	1.4	2	1.8	17.2	1.6	30.3	23.1
8	al-Qaeda in Iraq	Y	23.4	23.3	1	2	1.87	21.8	1.6	51.4	16.9
9	al-Qaeda in Lebanon	Y	18	27.2	2.05	2	1.75	16.4	1.6	19.8	24.1
10	al-Qaeda in Saudi Arabia	Y	18.1	33.8	2.01	2	1.6	16.5	1.6	20.3	26.1
11	al-Qaeda in the Arabian Peninsula	Y	27.5	21.9	1	2	1.93	25.9	1.6	59.6	12.9
12	al-Qaeda in the Indian Subcontinent	Y	18.1	25.4	1.97	2	1.8	16.6	1.6	20.7	23.5
13	al-Qaeda in the Islamic Maghreb	Y	20.6	31.2	1	2	1.65	19.0	1.6	45.7	22.9
14	al-Qaeda in Yemen	Y	18.1	21.9	2	2	1.93	16.5	1.6	20.5	22.0
15	al-Qaeda Network for Southwestern Khulna Division	Y	18	26.9	2.05	2	1.76	16.5	1.6	19.9	24.0
16	al-Qaeda Organization for Jihad in Sweden	Y	18	108	2.05	2	1.19	16.4	1.6	19.8	33.4
17	All Tripura Tiger Force	N	9.11	30.7	1.97	1	1.66	0	9.1	11.5	22.8
18	Amal	Y	18.2	27.2	1.92	2	1.75	16.7	1.6	21.4	24.2
19	Ansar al-Islam	Y	18.3	23.3	1.87	2	1.87	16.7	1.6	22.1	22.7
20	Armed Islamic Group	N	10.9	31.2	1	1	1.65	0	10.9	24.7	25.7
21	Asbat al-Ansar	Y	18	27.2	2.04	2	1.75	16.5	1.6	20.0	24.1
22	Aum Shinri Kyo	Y	18.1	69.5	2.03	2	1.29	16.5	1.6	20.1	31.3
23	Basque Fatherland and Freedom (ETA)	N	25.2	61.3	1	1	1.33	0	25.2	37.6	31.7
24	Communist Party of India-Maoist	N	22.9	30.7	1	1	1.66	0	22.9	35.9	24.7
25	Communist Party of Nepal-Maoist (Baidya)	Y	15.2	26.8	1.9	1.67	1.76	13.2	2.0	18.8	23.8
26	Communist Party of Nepal-Maoist (CPN-M)	Y	15.2	26.8	1.91	1.67	1.76	13.3	2.0	18.8	23.8
27	Communist Party of Nepal-Maoist (CPN-Maoist-Chand)	Y	15	26.8	2.03	1.67	1.76	13.1	2.0	17.4	23.6
28	Continuity Irish Republican Army	N	9.25	88.9	1.88	1	1.23	0	9.2	12.1	28.8
29	Eastern Turkistan Islamic Movement	Y	15.1	32.6	2.02	1.67	1.62	13.1	2.0	17.6	25.3
30	Eritrean Liberation Front	Y	18.1	25.1	1.98	2	1.81	16.6	1.6	20.7	23.4
31	Garo National Liberation Army	N	10.2	30.7	1.06	1	1.66	0	10.2	22.6	25.5
32	Hamas (Islamic Resistance Movement)	Y	21.6	30.6	1	2	1.66	20.0	1.6	47.8	22.1
33	Harakat ul-Mujahidin	Y	18	26.9	2.03	2	1.76	16.5	1.6	20.1	24.0
34	Hezbollah	Y	21.7	27.2	1	2	1.75	20.2	1.6	48.2	20.3
35	Irish Republican Army	Y	35.9	88.9	1	1.33	1.23	33.4	2.6	77.9	25.9
36	Islamic State of Iraq (ISI)	Y	19.2	23.3	1.06	2	1.87	17.6	1.6	40.7	20.1
37	Islamic State of Iraq and the Levant (ISIL)	Y	42.5	23.3	1	2	1.87	41.0	1.6	89.7	0.5
38	Jaish-e-Mohammad (JeM)	Y	18.5	26.9	1.61	2	1.76	17.0	1.6	26.0	24.2
39	Jama'atul Mujahideen Bangladesh (JMB)	Y	18.3	26.9	1.75	2	1.76	16.8	1.6	23.6	24.2
40	Jemaah Islamiya	Y	18.5	30.6	1.47	2	1.67	17.0	1.6	28.3	25.5
41	Jund al-Sham for Tawhid and Jihad	Y	18.1	27.2	2	2	1.75	16.6	1.6	20.5	24.2
42	Kach	Y	18.1	30.6	2.01	2	1.66	16.5	1.6	20.3	25.2
43	Kahane Chai	Y	18	30.6	2.05	2	1.66	16.5	1.6	19.9	25.2
44	Kurdistan Workers' Party (PKK)	Y	28.2	31.6	1	1.33	1.64	25.6	2.6	62.4	17.9

IJCV: Vol. 11#05/2017
Hausken: Government Protection against Terrorists Funded by Benefactors and Crime: An Economic Model

37

45	Lashkar-e-Jhangvi	Y	19	24	1.1	2	1.85	17.4	1.6	38.9	20.9
46	Lashkar-e-Taiba	Y	19.9	26.9	1	2	1.76	18.3	1.6	44.2	21.2
47	Liberation Tigers of Tamil Eelam (LTTE)	Y	33.6	27.8	1	2	1.73	32.0	1.6	71.8	12.2
48	Loyalist Volunteer Forces	N	9.16	75.3	1.92	1	1.27	0	9.2	11.8	28.0
49	Mahdi Army	Y	18.1	23.3	1.95	2	1.87	16.6	1.6	20.9	22.7
50	Moro National Liberation Front	Y	16.6	28.8	1.02	1.67	1.71	14.6	2.0	37.6	23.6
51	Mujahedin-e Khalq	Y	19	28.1	1.19	2	1.72	17.4	1.6	35.7	23.6
52	National Democratic Front of Bodoland	N	10.3	30.7	1.03	1	1.66	0	10.3	23.3	25.5
53	National Liberation Army of Colombia	Y	26.5	30.4	1	1.67	1.67	24.6	2.0	58.4	18.8
54	Palestinian Islamic Jihad	Y	19.7	30.6	1.01	2	1.66	18.2	1.6	43.9	23.1
55	People's Revolutionary Party of Kangleipak	N	9.17	30.7	1.95	1	1.66	0	9.2	11.7	22.9
56	Popular Front for the Liberation of Palestine	Y	19.2	30.6	1.05	2	1.66	17.7	1.6	41.1	23.7
57	Real Irish Republican Army	Y	18.3	88.9	1.81	2	1.23	16.8	1.6	22.9	33.4
58	Revolutionary Armed Forces of Colombia (FARC)	N	30.5	30.4	1	1	1.67	0	30.5	41.4	23.6
59	Shining Path (SL)	N	45	33.9	1	1	1.6	0	45.0	50.3	22.8
60	Sipah-e-Sahaba/Pakistan	Y	18.1	24	1.95	2	1.85	16.6	1.6	21.0	23.0
61	Students Islamic Movement of India	Y	18.2	30.7	1.95	2	1.66	16.6	1.6	21.1	25.3
62	Tehrik-i-Taliban Pakistan	Y	22.2	24	1	1.33	1.85	19.6	2.6	50.4	17.7
63	Ulster Freedom Fighters	N	10.8	75.3	1	1	1.27	0	10.8	24.6	32.8
64	Ulster Volunteer Force	N	10.9	75.3	1	1	1.27	0	10.9	24.8	32.8
65	United Self Defense Units of Colombia (AUC)	Y	12.5	30.4	1.47	1.33	1.67	9.9	2.6	21.1	25.3

Note. Y=Yes, N=No, Be=Benefactor, r=terrorist's resources, R=government's resources, a=terrorist's unit cost of terrorism effort, c=terrorist's unit cost of crime effort, A=government's unit cost of terrorism protection effort, Ben=Max{0,rb-dx}, x=terrorist's crime effort, t=terrorist's terrorism effort, T=government's terrorism protection effort.