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Terrorist group survival: ideology, tactics, and base of operations

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Abstract The paper applies survival analysis to identify the determinants of terrorist group duration. Our sample includes 367 terrorist organizations that operated during 1970–2007. Consistent with the theory, determinants of these groups' survival include their tactics, sizes, ideological basis, regions of operation, and base-country characteristics. Cross-sectional and panel estimates are reported. Terrorist organizations fare better if they are larger in size, diversify their attack modes, are animated by religiosity rather than secular political goals, and base their operations in the Middle East or Africa. Groups' longevity is bolstered by democratic institutions and an intermediate level of ethnic fractionalization at home.

Keywords Terrorist group survival · Terrorist tactics · Terrorist groups' ideology · Panel estimates · Cross-sectional estimates

JEL Classification D74 · C41 · H56

1 Introduction

In the study of terrorism, a key unanswered question concerns what determines the survival or demise of terrorist groups that engage in both transnational and domestic terrorist attacks. How do terrorist organizations' tactics, ideologies, base locations, or peak sizes influence their longevity? Are economic, political (e.g., democracy), or geological (e.g., elevation)

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and geographical considerations in the terrorists' base country conducive to survival? Why do some terrorist groups last for 50 or more years while others fail in their first year of operation? This article addresses these and related questions by applying survival analysis to a diverse set of 367 terrorist organizations that conducted operations, at times, during 1970–2007. To date, most studies on terrorist group survival have used a comparativist approach, in which comparisons of a few cases identified some factors (e.g., achieved political goal, military defeat, and reduced popular support) associated with selected groups' demise (e.g., Cronin 2006, 2009). Such studies offer anecdotal evidence that, by their nature, cannot be applied to terrorist groups in general. Case comparisons do not capture average tendencies that follow from a statistical survival analysis applied to a large number of terrorist groups with diverse ideologies. Such an analysis, as offered here, can identify the key determinants of terrorist group survival.

The *Global Terrorism Database* (GTD) (National Consortium for the Study of Terrorism and Responses to Terrorism (START) 2009) provides almost 40 years of data on terrorist groups' tactics (e.g., diversification of attacks and the share of transnational terrorist attacks). This event data are combined here with RAND's information (Jones and Libicki 2008) on terrorist groups' characteristics (e.g., peak size and base of operations) and ideologies to form a unique data set for studying the influences on terrorist groups' longevity. A knowledge of these determinants can inform policymakers as to where and how to allocate counterterrorism resources, so that groups' survival is shortened. If, for instance, one region of the world has more resilient terrorist groups than other regions, then more counterterrorism measures are needed where terrorist group survival is more assured. If, moreover, democracy promotes group survival owing to due process, constitutional restraints, and freedom of association, then governments may have to rethink their promotion of democracy in troubled countries as the first-best counterterrorism policy or else institute additional countervailing actions. An understanding of terrorist tactics that promote group longevity indicates how counterterrorism resources may be best allocated against alternative types of terrorist attacks.

The current study differs greatly from four earlier studies of terrorist organizational survival. In their data-rich study, Jones and Libicki (2008) found little, except the peak size of groups, that was correlated significantly with terrorist group longevity. In a subsequent study, Blomberg, Engel, and Sawyer (2010) (henceforth, BES) used only transnational terrorist attacks in their analysis of terrorist group survival, even though most terrorist groups engage in both transnational and domestic terrorist incidents. In fact, most terrorist groups rely on domestic terrorist attacks. The current study uses GTD data to study groups that engage in both types of attacks. BES (2010) included socio-economic, political, and other aspects from the *targeted* countries, while our analysis incorporates these aspects from the groups' base countries (consistent with Basuchoudhary and Shughart 2010), because we believe that groups' survival hinges on conditions where they train and seek refuge. For example, the defeat of the Tamil Tigers in May 2009 took place in Sri Lanka, their home base of operations. BES (2010) did not have a measure for terrorist groups' endpoints; instead, they only knew when the groups had been inactive for three years. In their study, a three-year hiatus signaled group failure. However, many terrorist groups may suspend operations for three or more years—e.g., Ejército Popular de Liberación (EPL), Euskadi ta Askatasuna (ETA), and Sendero Luminoso (Shining Path)—but have not died. Without information on groups' actual endpoints, BES (2010) could not really identify the determinants of groups' survival. Based on the data in Jones and Libicki (2008), we can identify these endpoints to do a survival analysis.

A third statistical study by Cronin (2009) examined the dynamics of 457 terrorist groups, identified by the Memorial Institute for the Prevention of Terrorism (MIPT) event database.

Cronin's study focused on documenting the groups' life spans and their achieved goals, if any, rather than conducting a survival analysis. Her study correlated groups' ages with their propensities to engage in negotiations; however, the study did not show that negotiations resulted in longer-lived groups. By examining only the set of long-lived groups, there was a selection bias. Moreover, Cronin (2009) did not relate groups' tactics, sizes, ideologies, regional locations, or base-country characteristics to their longevity.

A duration study by Young and Dugan (2010) used variables relating to the attack venue rather than the base country. Although their study contained both domestic and transnational terrorist incidents, these incidents were not distinguished for each terrorist group. Additionally, our study devises continuous tactic variables, while Young and Dugan (2010) included a set of binary tactic variables. The latter study used a one-year hiatus in attacks to mark the ending of a group's operation.

A primary purpose of our paper is to provide a large *n*—367 terrorist groups—study of the determinants of terrorist organizations' survival using information on groups' tactics, base locations, and peak sizes. Moreover, our survival study distinguishes terrorist groups by their ideologies. Over the years, the dominance of these ideologies of active terrorists has gone from the nationalists/separatists to the leftists and then to the religious fundamentalists, who have been dominant since the 1990s (Enders and Sandler 2006a; Rapoport 2004; Shughart 2006). Both cross-sectional and panel estimates are provided and compared for alternative specifications of the hazard function. A secondary purpose is to specify a theoretical foundation that extends the model in Berrebi and Lakdawalla (2007) to group strategic choices.

Our empirical findings show that terrorist tactics matter for survival—terrorist groups survive longer if they diversify their attacks and rely more heavily on domestic terrorism. Larger terrorist groups are more resilient, consistent with the findings of Feinstein and Kaplan (2010) and Jones and Libicki (2008). Relative to other ideologies, religious terrorist groups display better survival prospects, which is not good news for the current era when religious fundamentalist terror is dominant. Regional location may be conducive to survival; terrorist groups based in the Middle East and North Africa (henceforth, Middle East) survive longer than groups based in other regions. Since the terrorist attacks on 11 September 2001 (i.e., 9/11) and the enhanced security precautions taken in North America and Europe, terror attacks have moved to the Middle East (Enders and Sandler 2006b).

2 Some preliminaries

Terrorism is the premeditated use or threat to use violence by individuals or subnational groups against noncombatants to obtain political or social objectives through the intimidation of a large audience beyond that of the immediate victims. Terrorism is intended by its perpetrators to make the general population (i.e., the audience) suffer sufficient anxiety so that they pressure their government to grant political and/or social policy concessions. The presence of these political and social demands is necessary to distinguish terrorism from criminal extortion for gain.

Terrorism comes in two types: domestic and transnational. Domestic terrorism is homegrown and home directed, in which the venue, target, and perpetrators are all from the same country. In domestic hostage incidents, the victims are citizens abducted by domestic perpetrators, whose ransom demands are made to domestic entities (e.g., private citizens, corporations, or the domestic government). A domestic bombing or armed attack has consequences, victims, and perpetrators from the venue country exclusively. The overwhelming majority of terrorist attacks are domestic (Enders et al. 2011). By contrast, transnational terrorism involves victims, targets, supporters, or perpetrators from at least two countries. The 24 January 2011 suicide bombing of the international arrival hall at Domodedovo Airport in Moscow is a transnational terrorist act because the victims included foreigners. Terrorist acts directed at international organizations, foreign diplomats, and international peacekeepers are transnational in nature.

Although transnational terrorism comprises a minority of incidents, most of the empirical literature on terrorism has employed just transnational event data—in particular, the ITERATE data has been used extensively (Enders 2007; Sandler 2009). This practice is beginning to change with the wide release of GTD by the National Consortium for the Study of Terrorism and Responses to Terrorism (START) (2009). Currently, GTD is not partitioned into domestic and transnational terrorist incidents; instead, the data set reports all events with no marker for the type of incident.

For the current study, we require the distinction between domestic and transnational terrorist events since we hypothesize that a terrorist group's share of transnational terrorist events (i.e., transnational terrorist attacks as a percentage of total domestic plus transnational attacks) influences the riskiness of terror campaigns and, thus, group survival probabilities. We rely on the split between domestic and transnational terrorist incidents engineered by Enders et al. (2011). These authors first culled the 82,536 terrorist incidents in GTD for 1970–2007 down to 66,383 incidents by removing those that were not motivated by political or related goals; that were not intended to intimidate a wider audience; and that did not exceed the boundaries set by international humanitarian law. Moreover, they removed incidents that are classified by START as "Doubt Terrorism Proper," which include mass killings, insurgent attacks against combatants, and criminal acts. Ender et al.'s (2011) five-step procedure for classifying terrorist incidents resulted in 12,862 transnational and 46,413 domestic terrorist incidents. The remaining 7,108 terrorist incidents cannot be pigeonholed into transnational or domestic per se owing to missing data. These unclassified incidents are excluded from our sample events, which number 59,215 attacks for 1970–2007.

3 Terrorist groups: descriptive overview

Table 1 parses the data for the longest-lived terrorist organizations in the sample. This representation provides some impressionistic evidence on some covariates for determining the likelihood of survival. Table 1 is a list of terrorist organizations in the top 10th percentile of longevity, which translates to a survival period of at least 32 years during 1970–2007. The first column indicates the name of the terrorist group. The second column reports the share of transnational terrorist attacks for each listed organization, while the third column shows number of nonterrorist victims (killed and wounded) associated with each organization. The fourth column lists each group's peak size with discrete cut-offs of each terrorist organization during the sample period. The fifth column contains a measure of the groups' diversity of attacks across the different modes of attack. If a terrorist group uses a single mode of attack—say, bombings during its lifetime, then its diversity index is 0. Higher diversity index values reflect greater attack variation—see Sect. 5. The seventh column provides the terrorist organization's primary regional base of operation, based on World Bank (2010) definitions (eap = East Asia and Pacific, lac = Latin America and Caribbean, eca = East Europe and Central Asia, na = North America, sas = South Asia, mena = Middle East and North Africa, ssa = sub-Saharan Africa). The seventh column identifies the ideology of the organization, employing the RAND definitions (lw = left wing, nat = nationalist/separatist (henceforth, nationalist), rel = religious, rw = right wing) (Jones and Libicki 2008).

Table 1 demonstrates that many of the terrorist groups that one would anticipate to be long-lasting are indeed in the top 10th percentile. ETA, the Irish Republican Army (IRA),

Table 1 Most wanted terrorist organizations—longest duration

Group	Trshare	Victims	Size	Divers	Dur	Region	Ideo
Chukakuha (Japan)	0.04	4	100	0.06	38	eap	lw
Japanese Red Army	0.75	106	10	0.03	32	eap	lw
Kabataang Makabayan	1	0	1,000	0	38	eap	lw
New People's Army	0.13	2,743	10,000	0.44	38	eap	lw
First of October Antifascist Group	0.14	136	100	0.17	32	eca	lw
Movement of the Rev. Left (Chile)	0.04	127	100	0.14	35	lac	lw
National Liberation Army of Colombia	0.28	1,653	1,000	0.49	38	lac	lw
Popular Liberation Army of Colombia	0.28	352	1,000	0.24	38	lac	lw
Revolutionary Armed Forces (FARC)	0.19	5,202	10,000	0.57	38	lac	lw
Rev Worker Clan Union People Party	0.33	2	100	0	38	lac	lw
Animal Liberation Front	0.09	3	10	0.1	32	na	lw
Maoist Communist Center	0.04	212	1,000	0.05	35	sas	lw
National Union for the Ind. Angola	0.11	3,094	1,000	0.28	33	ssa	lw
Free Papua Movement	0.5	20	100	0.02	38	eap	nat
Karenni National Progressive Party	0	16	1,000	0	38	eap	nat
ETA	0.18	2,191	1,000	0.47	38	eca	nat
Irish Republican Army	0.3	3,883	1,000	0.45	36	eca	nat
Kurdistan Workers' Party	0.33	2,861	1,000	0.36	34	eca	nat
Mujahedin-e-Khalq	0.38	746	100	0.21	37	eca	nat
Ulster Freedom Fighters	0.36	260	10,000	0.18	37	eca	nat
Ulster Volunteer Force	0.48	372	1,000	0.2	38	eca	nat
al-Fatah	0.19	306	10,000	0.14	38	mena	nat
al-Saiqa	1	1	100	0	38	mena	nat
Amal (Lebanon)	0.63	32	100	0.05	33	mena	nat
Dem Front for Lib of Palestine	0.06	266	100	0.03	38	mena	nat
Palestine Liberation Organization	0.27	381	10,000	0.11	38	mena	nat
Polisario Front	1	20	10,000	0.03	33	mena	nat
Pop Front for the Lib of Palestine (Israel)	0.43	644	100	0.25	38	mena	nat
Pop Front for the Lib of Palestine (Leb)	0.5	156	100	0.01	38	mena	nat
Syrian Social National Party	0.33	33	10,000	0	36	mena	nat
Liberation Tigers of Tamil	0.1	14,709	10,000	0.46	32	sas	nat
Oromo Liberation Front	0	293	1,000	0	35	ssa	nat
Moro National Liberation	0.26	1,144	10,000	0.24	36	eap	rel
Pattani United Liberation Org	0	222	10	0.03	38	eap	rel
Takfir wal-Hijra	0	61	100	0	37	eca	rel
Kach	0.22	36	10	0.03	37	mena	rel
Ku Klux Klan (U.S.)	0	16	1,000	0.01	38	na	rw
Average	**0.3**	**1,143.32**	**2,790.27**	**0.16**	**36.32**		
Average from the full sample	**0.44**	**348.12**	**840.6**	**0.08**	**12**		

the Tamil Tigers (now inactive), and the Ku Klux Klan are a few of the ignominious names on the list. Other organizations such as al-Qa'ida are notably absent since they are relative newcomers.

Table 1 also suggests that there may be a few factors that have played instrumental roles in promoting the survivorship of these organizations. If terrorist groups pursue a strategy of diversifying their attack modes directed against domestic interests, then they appear to have favorable survival prospects. Moreover, larger terrorist groups whose attacks cause greater carnage survive longer on average than groups in the full sample. Terrorist organizations, such as the Tamil Tigers, illustrate this point. Table 1 shows that only 10% of the terrorist attacks by the Liberation Tigers of Tamil are transnational in nature. Moreover, the Tamil Tigers' attacks are quite diverse with an index of 0.46. Our theory later suggests that such diversity is an effective antidote to counterterrorism—see Sect. 4. It may also explain why the Tamil Tigers were active for 32 years, claiming 14,709 victims and garnering the support of as many as 10,000 insurgents.

Table 1 demonstrates further that the Tamil Tigers were not an outlier organization. Only three of the 37 terrorist organizations in Table 1 concentrated on attacking transnational targets (transnational share of 0.43 or greater) and only seven of the 37 display no diversity of attacks. This empirical regularity is supported by the bottom two rows, which compare the average of the subsample included in Table 1 to the average from the full sample of terrorist groups. The longest-lasting terrorist organizations appear to have smaller shares of transnational attacks, produce more carnage, are larger, and diversify their attacks to greater extents than the average group.

The final point captured by Table 1 is that durable organizations operate in a reasonably wide range of regional theaters and exhibit varied ideologies. Each region and ideology is represented in Table 1, although there appear to be relatively fewer attacks by right-wing organizations on North American targets. The left-wing and nationalist ideologies are represented most frequently and the Middle East and North Africa predominate as attack venues.

Table 2 provides the results of a similar exercise that parses the data for the terrorist organizations that are the most deadly. Table 2 is a list of organizations in the top 10^{th} percentile, ranked by number of casualties—victims killed and wounded. The table is organized in the same fashion as Table 1.

Interestingly, Table 2 provides a different list of organizations than shown in Table 1. In fact, more than half of the longest-lived terrorist organizations are not the deadliest, which is likely due to the more recent rise of the religious groups (Enders and Sandler 2000). Religious terrorist groups are characterized as being more indiscriminate, producing large body counts (Hoffman 2006; Rapoport 2004; Shughart 2006). While many of the names are the same (e.g., ETA, IRA), some of the names in Table 2 are different, though more recognizable in the latest era. These groups include al Qa'ida, Hamas, Hezbollah, and Jemaah Islamiyah. Even though the group names may be different, the empirical regularities are similar. Terrorist organizations that operate predominantly in the domestic theater with more attack diversity are generally deadlier than their counterparts. This is apparent in the final two rows, which report subsample (37 groups) and full sample averages.

One organization that illustrates these points is the Shining Path. Table 2 shows that only 5% of that group's attacks are transnational in nature. That figure is particularly notable since, at 0.41, Shining Path's attacks are quite diverse. Deadly groups are also large. These observations are broadly consistent with our theory on group success and survival laid out in Sect. 4 and may also explain why some terrorist groups are more deadly and longer-lived than the average terrorist group.

Notably, Table 2 indicates that there are a significant number of organizations that adhere to religious ideologies. Religious terrorist groups comprise 42% of the organizations listed

Table 2 Most wanted terrorist organizations—by victims

Group	Trshare	Victims	Size	Divers	Dur	Region	Ideo
Khmer Rouge (Cambodia)	0.39	640	1,000	0.11	29	eap	lw
New People's Army	0.13	2,743	10,000	0.44	38	eap	lw
Farabundo Marti National Lib. Front	0.04	3,153	10,000	0.49	13	lac	lw
National Liberation Army of Colombia	0.28	1,653	1,000	0.49	38	lac	lw
Revolutionary Armed Forces (FARC)	0.19	5,202	10,000	0.57	38	lac	lw
Shining Path (Peru)	0.05	20,152	1,000	0.41	28	lac	lw
Tupac Amaru Revolutionary Movement	0.17	596	10	0.25	26	lac	lw
National Union for the Ind. Angola	0.11	3,094	1,000	0.28	33	ssa	lw
Tigray Peoples Liberation	0.86	517	1,000	0	17	ssa	lw
ETA	0.18	2,191	1,000	0.47	38	eca	nat
Irish Republican Army	0.3	3,883	1,000	0.45	36	eca	nat
Kurdistan Workers' Party	0.33	2,861	1,000	0.36	34	eca	nat
Mujahedin-e-Khalq	0.38	746	100	0.21	37	eca	nat
Abu Nidal Organization	0.78	756	100	0.15	29	mena	nat
al-Aqsa Martyrs Brigade	0.16	1,128	100	0.45	8	mena	nat
Front for the Lib of Lebanon	0.54	781	100	0.06	7	mena	nat
Hamas	0.1	3,274	1,000	0.28	21	mena	nat
Pop Front for the Lib of Palest. (Israel)	0.43	644	100	0.25	38	mena	nat
Liberation Tigers of Tamil	0.1	14,709	10,000	0.46	32	sas	nat
United Liberation Front of Assam	0.14	1,321	1,000	0.16	29	sas	nat
African National Congress	0.03	1,627	10,000	0.27	21	ssa	nat
Abu Sayyaf Group	0.31	1,155	100	0.39	17	eap	rel
Jemaah Islamiyah	0.53	1,247	100	0.02	15	eap	rel
Moro Islamic Liberation	0.22	741	100	0.14	25	eap	rel
Moro National Liberation Front	0.26	1,144	10,000	0.24	36	eap	rel
Abu Hafs al-Masri Brigade	0.45	2,033	10	0	5	eca	rel
al Qa'ida in Iraq	0.42	2,939	1,000	0.58	4	mena	rel
Armed Islamic Group	0.15	2,106	1,000	0.38	14	mena	rel
Hezbollah (Lebanon)	0.51	1,070	1,000	0.29	26	mena	rel
Aum Shinrikyo	0.17	6,023	10,000	0.04	17	na	rel
al Qa'ida	0.53	9,818	1,000	0.12	20	sas	rel
al-Gama'a al-Islamiyya	0.08	900	100	0.1	31	sas	rel
Harakat ul-Jihad-i-Isl	0.33	655	100	0.02	28	sas	rel
Lashkar-e-Jhangvi	0	621	100	0	12	sas	rel
Lashkar-e-Taiba	0.06	2,066	1,000	0.27	19	sas	rel
Taliban (Afghanistan)	0.27	2,403	1,000	0.36	14	sas	rel
Lord's Resistance Army	0.15	1,333	1,000	0.38	16	ssa	rel
Mozambique Natl Resist Movement	0.2	3,155	1,000	0.42	17	ssa	rw
Average	**0.27**	**2,923.14**	**2,345.26**	**0.27**	**23.84**		
Average from the full sample	**0.44**	**348.12**	**840.6**	**0.08**	**12**		

in Table 2, which is a slight increase over the percentage in Table 1. Moreover, only 18% of our sample terrorist organizations are religious. This may mean that ideology plays an important role in determining organizational productivity and survival. We will examine this conjecture in the empirical portion of our analysis.

4 Theoretical underpinning

We consider terrorist groups as engaged in rational decision making in keeping with the extant literature (e.g., Enders and Sandler 1993; Landes 1978; Sandler et al. 1983). Thus, a terrorist group maximizes an objective function subject to one or more constraints. We adapt a model of Berrebi and Lakdawalla (2007) and depict a terrorist group as allocating its total resources, R, among alternative attack modes in each period to maximize its expected payoffs from terrorism (Shughart 2011).

In depicting the problem, the probability of success for attack type i, denoted by π^i, is dependent on three key variables—the resources devoted to attack type i, r_i; the share of transnational terrorist attacks, S_i, tied to attack type i; and environmental considerations, E_i, associated with attack type i. Attack type i may refer to the mode of attack (e.g., kidnapping, skyjacking, or bombing) or the target type (e.g., private parties or government officials). An increase in resources assigned to attack type i increases its probability of success but at a diminishing rate. The share of transnational terrorist incidents augments the risks and, therefore, also decreases the marginal success probability at a diminishing rate. Transnational terrorist attacks are, ceteris paribus, more risky than domestic attacks because borders may have to be crossed by the terrorists or supplies necessary to attack their target. In addition, transnational terrorist events motivate other impacted governments to bolster counterterrorism actions either through their own measures or with foreign aid (Bandyopadhyay et al. 2011; Fleck and Kilby 2010). Finally, environmental considerations—e.g., regional location, trade openness, regime type, and group ideology—may have positive or negative influences on the marginal probability of success. For example, terrorist groups located in the Middle East may enjoy greater marginal success relative to groups in other regions owing to more ready access to indigenous support and infrastructure (e.g., training camps). Moreover, democratic environments may foster success as a result of tighter constraints on governments' anti-terror tactics, greater freedom of association, better intra-group communication channels, a media that reliably will publicize attacks and their damage to lives and property (Hoffman 2006; Li 2005). Thus, the probability of success for type i attacks is

$$\pi^i = \pi^i(r_i, S_i, E_i) \quad \text{with } \pi^i_r > 0, \pi^i_{rr} < 0, \pi^i_S < 0, \pi^i_{SS} > 0, \pi^i_E \gtreqless 0. \tag{1}$$

In (1), E_i is a vector of environmental considerations.

The terrorist group's maximization problem is to

$$\max_{\bar{r}} \left\{ \sum_{i=1}^{N} \pi^i(r_i, S_i, E_i) P_i \middle| R = \sum_{i=1}^{N} r_i \right\}, \tag{2}$$

where $\bar{r} = \{r_i\}_{i=1}^N$ and P_i denotes the payoff for attack i. In effect, the terrorist group must maximize its expected payoff by allocating its resources over N different attack modes. The necessary first-order conditions (FOCs) associated with this maximization problem require that

$$\pi^i_r(\bullet) P_i = \lambda \quad \text{for } i = 1, \ldots, N, \tag{3}$$

where λ is the Lagrangian multiplier associated with the resource constraint. The sufficient second-order conditions are satisfied since the bordered Hessians alternate in sign—i.e., $|\bar{H}_2| > 0$, $|\bar{H}_3| < 0$, $|\bar{H}_4| > 0$, and so on, where the subscript indicates the number of alternative target types, starting with two. These signs follow because the probability of success function is strictly concave and the constraint is linear.

Based on the FOCs in (3), some riskier attacks may be desirable because they offer a larger payoff, so that a rational terrorist group must trade off risks and return in choosing how to mix or diversify its attack modes. Diversification pays because terrorist groups can keep the authorities guessing by engaging in more than one type of operation. Specialization in a single type of attack mode—an inequality in (3)—would allow the authorities to counter terrorist operations more effectively. A terrorist group that has larger expected payoffs by judicious allocation of its resources will improve its survival prospects.

Next, we turn to comparative-static analysis by treating, R, P_i, S_i, and E_i as exogenous choice parameters. It can be easily shown (see the Appendix, available on request) that

$$\partial\bar{r}_i/\partial R > 0, \quad i = 1, \ldots, N; \tag{4}$$

$$\partial\bar{r}_i/\partial P_i > 0, \quad \partial\bar{r}_j/\partial P_i < 0, \quad i = 1, \ldots, N, j \neq i; \tag{5}$$

$$\partial\bar{r}_i/\partial S_i < 0, \quad \partial\bar{r}_j/\partial S_i > 0, \quad i = 1, \ldots, N, j \neq i; \tag{6}$$

$$\partial\bar{r}_i/\partial E_i \gtreqless 0, \quad \partial\bar{r}_j/\partial E_i \lesseqgtr 0, \quad i = 1, \ldots, N, j \neq i; \tag{7}$$

where the overhead bar indicates the optimal allocation of r_i before the system is perturbed. Each of these results generates intuitive interpretations. For (4), an increase in the group's resources increases the probability of all types of attacks, thereby adding to the group's expected payoff and ultimate success. An increase in resources may also imply a larger group size, which fosters survival (see, also, Gutfraind 2009). If, in (5), the payoff to attack type i increases, ceteris paribus, then the terrorist group will shift resources from other attack modes to type i. In so doing, the terrorist group gains a higher expected payoff and survival prospect. In (6), as the share of transnational terrorist attacks increases for mode i, the terrorist group substitutes into other types of attacks, thereby increasing its anticipated payoffs and survival as risk is limited.[1]

The environmental variable captures multiple considerations—hence, the indeterminacy of the sign in (7). Drawing from the literature, we make some educated predictions as to the impact of various environmental factors on group success and longevity. We anticipate that more terrorist casualties will decrease expected payoffs and undermine success, because of its effect in reducing group size. However, suicide attacks may move this prediction in the opposite direction. Nonterrorist casualties should decrease both expected payoffs and probabilities of success as the government is pressured to spend more on counterterrorism, thereby increasing a group's risk. Similarly, government spending will decrease terrorist groups' success and chances of survival. In contrast, gross domestic product (*GDP*) and population (*POP*) should bolster a terrorist group's prospects at home. GDP provides a target-rich environment; GDP may also provide more skilled recruits (Benmelech and Berrebi 2007). There are opposing GDP influences (e.g., less popular discontent with the current regime) that may limit terrorist groups' success. Larger populations can serve as

[1] If there are just two attack modes, then $\partial\bar{r}_i/\partial P_i = -\partial\bar{r}_j/\partial P_i$ and similarly for the other comparative-static derivatives, because the attack types must then be perfect substitutes for one another to ensure an interior solution.

a shield, making it more difficult to find the terrorists hiding in plain sight. In addition, large populations supply bigger pools from which terrorist groups can recruit new members. Trade openness may contribute to terrorist group success if it provides more cover for transnational terrorists to import supplies. Openness to trade is less favorable to domestic terrorists. Consistent with the literature (Enders and Sandler 2006a; Hoffman 2006; Wilkinson 2001), we hypothesize that democratic institutions in a terrorist group's base of operations promote terrorist success and survival because of governmental restraints and individual freedom. Following Abadie (2006) and Fearon and Laitin (2003), mountains and jungles offer terrorist groups potential sanctuaries that promote survival. In its base of operations, a terrorist group may prosper by locating in a nation characterized by an intermediate level of ethnic fractionalization, insofar as a homogeneous society is unlikely to tolerate terrorist threats. Moreover, a very heterogeneous society is probably better able to assimilate groups with different agendas, thereby limiting the appeal of terrorism groups (Basuchoudhary and Shughart 2010). Terrorist ideology may also play a role in a group's success; however, this influence is at bottom really an empirical question that can be answered only by seeing how other ideologies fare against religious groups. Finally, the terrorist groups' region of operation may promote or inhibit success. We anticipate that the Middle East may be especially conducive to a terrorist group's success and survival. This prediction stems from indigenous support, terrorist infrastructure, large recruitment pools, and some weak governments.

5 Methods and data

We first present the survival methodology underlying the cross-sectional and panel estimates reported herein. Second, the data and variables are discussed.

5.1 Empirical methods

Our empirical approach is as follows. We start by considering conventional continuous-time survival models as our baseline approach. Next, we introduce the discrete-time duration analysis by arguing that it is more appropriate for our investigation. For a sample of n individual terrorist groups, we observe each group at some starting point $t = 0$. A group i continues to survive until time t_i, when the group either ceases to exist or our sample period ends. Let $T \geq 0$ be a random variable measuring the length of time that a terrorist group is active, in which t denotes a particular value of T. In this study, time is measured in years. At the core of survival analysis is the concept of a hazard rate (Allison 1982; STATA 2009). For each t, the hazard rate, $h(t)$, is the instantaneous estimate of the probability of dying per unit of time. Formally, the hazard function for T is

$$h(t) = \lim_{\delta \to 0} \frac{\Pr(t \leq T < t + \delta | T \geq t)}{\delta}, \tag{8}$$

where the numerator is the probability of a group dying in the interval $[t, t + \delta)$, conditional on its survival until time t. Proportional hazards models are employed commonly to specify the hazard rate as a function of time and covariates. In a proportional hazards specification, the hazard rate is defined as

$$\log h(t_i, x_i) = \alpha(t_i) + \mathbf{x}_i \boldsymbol{\beta}, \tag{9}$$

where $\alpha(t_i)$ is an unknown function of time; $\mathbf{x}_i$ denotes a vector of explanatory variables; and $\boldsymbol{\beta}$ is a vector of corresponding coefficients. When $\alpha(t_i) = \alpha_0 + \alpha_1 \log t_i$, we have the Weibull distribution for T. Accelerated time-to-failure (ATF) models are also popular specifications. Formally, an ATF is specified as

$$\log t_i = \mathbf{x}_i \boldsymbol{\beta} + \theta_i, \tag{10}$$

where $\log t_i$ is the natural logarithm of survival time, and θ_i is an error term with probability density function $f(\bullet)$. Distributional assumptions about the error term yield different ATF models. For example, for a Weibull regression, the error term has extreme-value density, while for the lognormal regression the error term is distributed normally. We use the ATF specification to estimate our baseline models, since a number of parametric models (e.g., lognormal), in addition to Weibull, can be interpreted as ATF.

The above models assume that groups' durations are distributed continuously in time. However, although the terrorist group data are not intrinsically discrete (a transition period can occur at any particular instant in time), our data is grouped into discrete intervals (years). Therefore, the more appropriate method for our study of terrorist group survival is to implement discrete-time hazard models (Allison 1982; Jenkins 1995; STATA 2009). To specify a discrete-time hazard rate, we let T_i be a random variable measuring the longevity of a terrorist group. Conditional on the regression's covariates, the probability of failure in a given time interval $[t_s, t_{s+1})$, $s = 1, 2, \ldots,$ and $t_1 = 0$, given that a group survives until t_s, is

$$P_{is} = \Pr(T_i < t_{s+1} | T_i \geq t_s, x_{is}) = F(\mathbf{x}_{is} \boldsymbol{\beta} + \alpha(s)), \tag{11}$$

where $\mathbf{x}_{is}$ is a vector of covariates for group i at time s and $\boldsymbol{\beta}$ denotes a vector of corresponding coefficients. The term $\alpha(s)$ is an unknown function of duration and $F(\bullet)$ is a cumulative distribution function. We assume a logistic cumulative distribution and estimate (11) using a logit estimator.

The discrete-time model specification has a number of advantages. First, with discrete-time design, we effectively have a panel data set with each group observation consisting of a vector of binary choices along with explanatory variables. Therefore, it is straightforward to introduce time-varying covariates. Second, the model is easily implemented using conventional binary choice panel estimators. Furthermore, the model in (11) can be extended to control for unobserved heterogeneity. We later implement random-effects logit regressions to control for unobserved heterogeneity. Third, a discrete-time specification leads to convenient methods for estimating flexible hazard functions. In particular, we use three alternative specifications: a quadratic specification with $\alpha(s) = \alpha_0 t_s + \alpha_1 t_s^2$; a piecewise constant specification with a set of dummy variables for a set of periods sharing the same hazard rate; and a semiparametric model with a separate dummy variable for each year. Fourth, the discrete-time model allows us to account for multiple terrorist group failures in the same year. In particular, a discrete-time duration model avoids the complications that would arise in continuous-time duration models due to interdependent failure times.

5.2 Data

We construct two types of data sets for our analysis: a rich panel data set of 367 terrorist groups for 1970–2007, and a cross-sectional data set of the same 367 terrorist groups. We rely on two key sources on terrorist groups: Jones and Libicki (2008) and GTD (START 2009).

Jones and Libicki (2008) collected information on a large number of terrorist groups that operated between 1968 and 2006. Their information is utilized to construct variables representing terrorist groups' longevities, peak strengths, and ideologies. Jones and Libicki (2008) identified the starting and ending year for a terrorist group, which is used to create our dependent variable. For the cross-sectional data, the dependent variable is the duration of a group's survival, in years, for the period in which it was active. For the panel data, the dependent variable is terrorist group failure, which is a dummy variable equal to zero if a group is active in a given year and one if it dies in that year. If the group is still active by the end of our sample period, then it is coded as zero. To control for the strength of a terrorist group, we use the group's membership at its peak, transformed logarithmically and labeled log(*size*). Groups' ideologies are denoted by one of four dummy variables for *Left wing*, *Nationalist*, *Right wing*, and *Religious* groups. Information on group size and ideology is cross-sectional; there is no alternative time-variant data available. Therefore, for the panel data, terrorist group strength and ideology are treated as time-invariant. This should not cause an empirical problem for ideology, since a group's ideology rarely changes over its lifetime.

GTD has rich information about terrorist groups' identity, terrorist attacks, attack modes, targeted countries, and other variables. The following four variables are constructed using GTD data. The diversity variable, *Attack diversity*, is computed as one minus the Hirschman-Herfindahl index of diversity corresponding to a terrorist group for a given year. In particular, $\mathit{Attack\ diversity} = 1 - \sum_i s_{ijt}^2$, where s_{ijt} is the share of the ith type of attack in total attacks for group j in year t. GTD distinguishes eight types of attacks (e.g., assassinations, armed assaults, and bombings). The variable ranges between 0 and 1, with larger numbers corresponding to greater diversity. Since GTD does not distinguish domestic and transnational terrorist incidents, we use Enders et al.'s (2011) categorization to compute a group's share of transnational terrorist attacks in each year (*Transnat_terr.share*). For each terrorist group, this share equals the annual number of transnational terrorist events divided by its yearly total (transnational and domestic) terrorist attacks. Information on the number of casualties related to a terrorist group in a given year is used to construct two variables: the logarithm of the number of terrorist casualties [log(*terr_casualty*)] and the logarithm of the number of nonterrorist casualties [log(*nonterr_casualty*)]. For the cross-sectional data, we use the initial values of these four variables. Initial values are used in favor of values averaged over time to avoid possible endogeneity issues.[2]

Next, we merge the two data sets. We are able to match 367 terrorist groups between the two data sets from the larger number of terrorist groups reported in these data. In some cases, group names are slightly different between the data sets, so we went through the list and corrected them manually prior to the merge.

We then found economic, demographic, political, geological, and geographical information associated with terrorist groups' bases of operation, as identified by Jones and Libicki (2008). Some terrorist groups have more than one base country of operation. Around 18%

[2]For example, suppose that GDP is a factor in determining survival. For illustration, we assume that larger markets (large GDP) are the venues for terrorist groups to have their greatest impact with the least risk of being caught. By choosing initial values, we can appropriately capture the decisions of the terrorist groups on where to operate at the start of their life-cycles. However, further suppose that the terrorist groups have negative economic ramifications for their bases of operation. As terrorist organizations mature, base-country GDP may suffer. In so doing, there may result a negative relationship between GDP and terrorist group survival. Averaging the two effects together may annihilate the primary effect that a researcher seeks to measure; i.e., does market size influence survival of terrorist groups? Our panel data analysis should provide more information with regard to contemporaneous measures.

of the sample groups operated in two base countries, and 8% of the groups have more than two base countries of operation. For these cases, we averaged variables across the multiple base countries. Annual macroeconomic data on base country for a given terrorist group are drawn from *Penn World Table Version 6.3* (Heston et al. 2009). For each base country, we obtain the logarithm of the real gross domestic product in 2005 constant prices [log(*GDP*)], the logarithm of population [log(*POP*)], the percentage share of international trade in GDP (*Openness*), and the percentage share of government spending in GDP (*Gov. spending*) for base-country years. The polity variable (*Polity*) is available in the *Polity IV dataset* (Marshall and Jaggers 2009). This indicator ranges between −10 (strongly autocratic) and +10 (strongly democratic), and consists of three key interrelated components: opportunities for political participation, constraints on executive power, and government support and protection of civil liberties. For cross-sectional estimates, we use the initial values of the variables.

An index of countries' ethnic fractionalization (*Ethnic frac.*) is taken from Alesina et al. (2003). Larger values indicate greater ethnic diversity. To control for geographical parameters of groups' base countries of operation, three geological variables are collected (Gallup et al. 1999a, 1999b). The log(*elevation*) is the logarithm of a country's mean elevation, *Tropics* represents the percentage of land area in the tropics (as a proxy for jungle cover), and *Landlocked* is a dummy variable equal to one if a country has no direct access to international waters and zero otherwise. In addition, regional dummy variables for East Asia and Pacific, Europe and Central Asia, Latin America and Caribbean, North America, South Asia, sub-Saharan Africa, and Middle East and North Africa are introduced using the World Bank's (2010) regional definitions.

6 Empirical results

We begin by estimating duration models using our cross-sectional data. As explained in Sect. 5.2, we use time-varying variables' initial values. Table 3 presents the results of lognormal duration models. Model 1 is our baseline specification, which includes only group-specific characteristics, such as membership size, ideology, diversity of attacks, share of transnational attacks, and casualty information. Model 2 adds socio-economic, political, and demographical variables to the baseline model, while Model 3 further includes geological and geographical variables. The lognormal distribution is preferred based on Akaike Information Criterion and other model-fitting criteria; however, a Weibull distribution produces generally similar results (available upon request).

In accordance with our prior expectations (see Sect. 4), an increase in the size of a terrorist group enhances its survival, whereas an increase in its share of transnational terrorist attacks, a rise in nonterrorist casualties, or both limits the organization's survival. Religious terrorist organizations have greater longevity compared to left-wing, nationalist, or right-wing groups. In contrast to our theoretical prediction, the impact of attack diversity is negative; but it is not statistically significant. These results are robust across all models. In terms of base-country variables, ethnic diversity has a positive impact on a group's survival, while its squared term has a negative influence, thus indicating that an intermediate level of ethnic diversity at home maximizes a group's active life. Thus, very homogeneous or very heterogeneous countries are not conducive base locations for a group's survival, which agrees with our priors. As anticipated, terrorist organizations whose base of operation are in the Middle East and North Africa, survive longer compared to groups located in Europe and Central Asia, Latin America and the Caribbean, North America, or sub-Saharan Africa. For

Table 3 Maximum likelihood estimation of terrorist group survival: lognormal model

Variable	Model 1	Model 2	Model 3
log(*size*)	0.334***	0.359***	0.376***
	(0.038)	(0.044)	(0.046)
Left wing	−0.809***	−0.710***	−0.502*
	(0.235)	(0.267)	(0.264)
Nationalists	−0.624**	−0.577**	−0.522**
	(0.243)	(0.253)	(0.247)
Right wing	−0.941***	−0.806**	−0.670**
	(0.328)	(0.355)	(0.333)
Attack diversity	−0.120	−0.297	−0.404
	(0.347)	(0.356)	(0.363)
Transnat_terr. share	−1.067***	−1.039***	−1.008***
	(0.161)	(0.165)	(0.160)
log(*terr_casualty*)	0.565	0.744*	0.674
	(0.411)	(0.427)	(0.414)
log(*nonterr_casualty*)	−0.181**	−0.147**	−0.157**
	(0.072)	(0.074)	(0.074)
log(*GDP*)		−0.160	−0.076
		(0.102)	(0.155)
log(*POP*)		0.218*	0.108
		(0.112)	(0.168)
Openness		−0.293	−0.817***
		(0.298)	(0.311)
Gov. spending		0.810	0.250
		(1.124)	(1.218)
Polity		0.002	0.009
		(0.011)	(0.012)
Ethnic frac.		2.478*	2.511*
		(1.329)	(1.516)
Ethnic frac. squared		−4.090***	−3.486*
		(1.483)	(1.798)
log(*elevation*)			−0.020
			(0.137)
Tropics			0.070
			(0.291)
Landlocked			−0.136
			(0.273)
East Asia & Pacif.			0.054
			(0.371)
Europe & Centr. Asia			−0.722**
			(0.293)
Lat. America & Car.			−0.951***
			(0.262)

Table 3 (*Continued*)

North America			−0.755*
			(0.441)
South Asia			−0.554
			(0.399)
Sub-Saharan Africa			−0.970**
			(0.402)
N	367	350	349
Sigma	1.17	1.13	1.09
Log-likelihood	−450.46	−423.89	−413.55

Notes: Robust standard errors are in parentheses. Constant is suppressed. Significance levels: *** is < 0.01, ** is < 0.05, and * is < 0.10

the cross-sectional estimates, there is no statistical evidence to suggest that a country's GDP, level of democracy, government spending level, and terrain impact groups' survivability. Regional dummy variables for East Asia and the Pacific, and South Asia are not statistically significant. In Table 3, the results provide some evidence that larger populations foster survival, whereas more trade openness limits terrorist groups' longevity; these results are not robust across all models, however. We also report the coefficient for duration dependence (sigma). For Models 1 and 2, its value is statistically greater than one, suggesting positive duration dependence. This means that the longer a terrorist group operates, the more likely is its demise in the ensuing period. As we include more variables, the value of sigma decreases continuously from 1.17 to 1.09. By Model 3, the value of sigma is not statistically different from one.

In Table 4, we display the marginal effects of the variables on the median duration of a terrorist group's active operations. Only statistically significant variables are reported to conserve space. Based on Model 3, the coefficient for the natural logarithm of size is about 4. Relative to a median organization, a 10% increase in a group's size lengthens its survival by 0.4 years, or about five months, ceteris paribus. Terrorist organizations with religious ideologies operate about six years longer than left-wing, nationalist, or right-wing groups. A 10% increase in the share of a group's transnational attacks shortens the group's survival by about 1.2 years (= 12/10), whereas a 10% increase in the number of nonterrorist casualties reduces the life span of the group by around 0.2 year (or just under 2.5 months). Next, we consider the impact of the base country's socio-economic, geological, and geographical factors on terrorist groups' survival. Taking nonlinearity into account, we find that a one standard deviation increase in ethnic diversity (0.22) reduces a group's active life by about two years in Model 2. The marginal effect is not significant in Model 3. Terrorist groups with base(s) of operation in the Middle East and North Africa live about seven to eight years longer than their counterparts based in Europe and Central Asia, Latin America and the Caribbean, North America, or sub-Saharan Africa. Finally, a group's survival increases by about 0.3 years in response to a 10% increase in base-country population (Model 2), and decreases by about one year in response to a 10% increase in trade openness (Model 3); these effects are not robust across Models 2 and 3, however.

We now turn to the discrete-time duration analysis, which includes some time-varying covariates. Table 5 presents the logit estimations, for which the dependent variable is a binary choice variable equal to one if a group ceases operations in a particular year. Similar to Table 3, we first include only group-specific variables (Model 1), and then add socio-

Table 4 Marginal effects on duration of terrorist group survival: lognormal model

Variable	Model 1	Model 2	Model 3
log(*size*)	3.322***	4.373***	4.440***
	(0.479)	(0.760)	(0.745)
Left wing (d)	−7.566***	−8.250**	−5.702*
	(2.359)	(3.294)	(3.030)
Nationalists (d)	−5.800**	−6.601**	−5.805**
	(2.274)	(2.925)	(2.773)
Right wing (d)	−6.441***	−7.112***	−6.026**
	(1.647)	(2.446)	(2.409)
Transnat_terr. share	−10.627***	−12.667***	−11.896***
	(1.863)	(2.389)	(2.303)
log(*nonterr_casualty*)	−1.801**	−1.790**	−1.852**
	(0.725)	(0.904)	(0.877)
log(*POP*)		2.661*	1.278
		(1.388)	(1.973)
Openness		−3.578	−9.649**
		(3.683)	(3.928)
Ethnic frac.		−8.823*	−2.502
		(4.706)	(5.746)
Europe & Centr. As. (d)			−7.617***
			(2.949)
Lat. America & Car. (d)			−8.719***
			(2.240)
North America (d)			−6.576**
			(2.956)
Sub-Saharan Africa (d)			−7.856***
			(2.168)
N	367	350	349

Notes: Standard errors are in parentheses. Only statistically significant variables are shown to save space. Refer to Table 3 for complete specifications. (d) is for discrete change of dummy variable from 0 to 1. Significance levels: *** is < 0.01, ** is < 0.05, and * is < 0.10

economic, demographic, geological, and geographical factors for the terrorist group's base of operations (Models 2 and 3). In Models 1–3, we specify a duration dependence pattern that is quadratic. For Model 4, we re-estimate Model 3 with a piecewise constant specification by defining dummy variables for the 1970s, 1980s, 1990s, and 2000–2007.

Generally, the baseline results are qualitatively similar to those reported by the lognormal duration estimator (Table 3). The primary exception is attack diversity, which was statistically insignificant with an unexpected sign in Table 3. For the panel estimates, attack diversity is statistically significant and negative; as anticipated by our priors, attack diversity reduces the likelihood of a terrorist group's demise in a given year. There are also some differences in terms of base-country variables. In particular, population, openness, and sub-Saharan Africa variables are no longer significant, whereas the GDP and polity variables now are statistically significant, albeit not in all models. According to the results, both GDP

Table 5 Logit estimation of terrorist group failure: discrete-time duration models

Variable	Model 1	Model 2	Model 3	Model 4
log(*size*)	−0.329***	−0.404***	−0.422***	−0.451***
	(0.049)	(0.055)	(0.059)	(0.062)
Left wing	1.145***	0.930***	0.729**	0.659*
	(0.241)	(0.275)	(0.355)	(0.355)
Nationalists	0.799***	0.827***	0.725**	0.682**
	(0.252)	(0.272)	(0.310)	(0.321)
Right wing	1.394***	1.384***	1.324***	1.311***
	(0.348)	(0.388)	(0.433)	(0.428)
Attack diversity	−0.841*	−0.810*	−0.846*	−1.091**
	(0.464)	(0.490)	(0.491)	(0.499)
Transnat_terr. share	1.244***	1.172***	1.164***	1.192***
	(0.162)	(0.172)	(0.175)	(0.177)
log(*terr_casualty*)	−0.399	−0.380	−0.357	−0.223
	(0.283)	(0.301)	(0.302)	(0.279)
log(*nonterr_casualty*)	0.125*	0.130**	0.143**	0.157**
	(0.065)	(0.066)	(0.067)	(0.067)
log(*GDP*)		−0.047	−0.356*	−0.367*
		(0.119)	(0.189)	(0.193)
log(*POP*)		−0.161	0.131	0.208
		(0.131)	(0.213)	(0.210)
Openness		−0.578	0.017	0.372
		(0.390)	(0.399)	(0.359)
Gov. spending		−0.916	−0.280	−0.782
		(1.130)	(1.259)	(1.283)
Polity		−0.029**	−0.030*	−0.015
		(0.013)	(0.016)	(0.017)
Ethnic frac.		−2.330*	−3.347*	−3.517*
		(1.346)	(1.829)	(1.838)
Ethnic frac. squared		3.099*	3.716*	4.186*
		(1.602)	(2.230)	(2.251)
log(*elevation*)			−0.123	−0.116
			(0.167)	(0.174)
Tropics			−0.418	−0.530
			(0.412)	(0.412)
Landlocked			0.187	0.245
			(0.338)	(0.336)
East Asia & Pacif.			−0.029	−0.052
			(0.503)	(0.510)
Europe & Centr. Asia			0.768**	0.771**
			(0.313)	(0.322)
Lat. America & Car.			1.005**	1.199***
			(0.413)	(0.419)

Table 5 (*Continued*)

North America			1.333***	1.097**
			(0.435)	(0.435)
South Asia			0.411	0.416
			(0.479)	(0.492)
Sub-Saharan Africa			0.728	0.818
			(0.644)	(0.648)
Duration variables	Yes	Yes	Yes	Yes
N	4403	4253	4251	4251
Log-likelihood	−776.22	−740.38	−729.61	−731.78
Pseudo *R*-squared	0.14	0.16	0.17	0.17

Notes: Dependent variable is a binary variable for a group's failure. Robust standard errors are in parentheses. Constant and duration variables are suppressed. For Models 1–3, the duration dependence pattern is specified as quadratic. For Model 4, piecewise constant specification is used by defining dummy variables for a group of periods (1970–1979, 1980–1989, 1990–1999, and 2000–2007). Significance levels: *** is < 0.01, ** is < 0.05, and * is < 0.10

(Models 3 and 4) and democracy (Models 2 and 3) improve a group's probability of surviving in a given year.

The marginal effects of statistically significant variables are reported in Table 6. A 10% increase in the size of a terrorist group reduces the probability of the group's termination in a given year by 0.001 or 0.1 percentage points, ceteris paribus. Left-wing or nationalist ideology increases the likelihood of a terrorist group's failure by about two to four percentage points, whereas right-wing beliefs raise the probability of a group's demise by about six to eight percentage points compared to religious ideology. The left-wing ideology, however, is not significant in Model 4. If attack diversity increases by one standard deviation (0.22), then the likelihood of a terrorist group's failure falls by about 0.7 percentage points. The probability of a group's failure increases by around 0.3 and 0.04 percentage points in response to a 10% increase in terrorist groups' transnational attack shares and number of nonterrorist casualties, respectively. If GDP rises by 10%, the probability of a group's failure falls by 0.1 percentage points (Models 3 and 4); if the degree of democracy increases by one unit, then the likelihood of a group's failure decreases by about 0.07 percentage points (Models 2 and 3). However, the GDP variable is statistically not significant in Model 2, whereas the polity variable is not significant in Model 4. The marginal effect of ethnic fractionalization is not statistically significant. Compared to a terrorist group with country base(s) in the Middle East and North Africa, the likelihood of a group's failure rises by two, three, and up to five percentage points when based in Europe and Central Asia, Latin America and the Caribbean, or North America, respectively. Unfortunately, we cannot compare these marginal effects directly to those presented in Table 4. In Table 4, we report the incremental effects of covariates on the median duration of a terrorist group, whereas in Table 6 we show the marginal probability of a group's termination in a given year.

Finally, we conduct some robustness tests. In Table 7, we re-estimate Model 4 of Table 5 using annual dummies for duration dependence (Column 1), as well as accounting for unobserved heterogeneity with the random-effects logit estimator (Column 2). Our main results are neither sensitive to using annual dummies nor to estimating the random-effects logit model. In addition, we do a preliminary investigation restricted only to religious groups in our sample (Column 3). For a subsample of religious groups, membership sizes, transnational attack shares, and nonterrorist casualties remain statistically significant, while attack

Table 6 Marginal effects of the logit estimation of terrorist group failure

Variable	Model 1	Model 2	Model 3	Model 4
log(*size*)	−0.010***	−0.010***	−0.010***	−0.010***
	(0.001)	(0.001)	(0.002)	(0.002)
Left wing (d)	0.043***	0.027***	0.019*	0.017
	(0.011)	(0.010)	(0.011)	(0.010)
Nationalists (d)	0.027***	0.023***	0.018**	0.017*
	(0.009)	(0.009)	(0.009)	(0.010)
Right wing (d)	0.081**	0.067**	0.057*	0.055*
	(0.033)	(0.032)	(0.032)	(0.030)
Attack diversity	−0.026*	−0.021	−0.020*	−0.025**
	(0.015)	(0.013)	(0.012)	(0.012)
Transnat_terr. share	0.039***	0.030***	0.027***	0.027***
	(0.006)	(0.006)	(0.006)	(0.006)
log(*nonterr_casualty*)	0.004*	0.003*	0.003**	0.004**
	(0.002)	(0.002)	(0.002)	(0.002)
log(*GDP*)		−0.001	−0.008*	−0.008*
		(0.003)	(0.004)	(0.004)
Polity		−0.0007**	−0.0007*	−0.0003
		(0.0004)	(0.0004)	(0.0004)
Europe & Centr. As. (d)			0.022*	0.022*
			(0.012)	(0.011)
Lat. America & Car. (d)			0.033*	0.042*
			(0.020)	(0.022)
North America (d)			0.057*	0.041*
			(0.030)	(0.024)
N	4403	4253	4251	4251

Notes: Dependent variable is a binary variable for a group's failure. Standard errors are in parentheses. Only statistically significant variables are shown to save space. Refer to Table 3 for complete specifications. (d) is for discrete change of dummy variable from 0 to 1. Significance levels: *** is < 0.01, ** is < 0.05, and * is < 0.10

diversity, important for the full sample, is no longer statistically significant. Also, polity has a negative influence on a terrorist group's failure, while basing operations in sub-Saharan Africa has a positive influence of a terrorist group's failure. Because of potential endogeneity concerns, we re-estimate Table 5 using the lagged values of the time-varying variables. The main findings generally hold except for attack diversity, non-terrorist casualties, and ethnic fractionalization, which become statistically insignificant (results available upon request); however, these variables were only marginally significant (at the 0.1 level) before. Nevertheless, endogeneity remains a concern. For example, while group size improves survival, longevity may also allow a group to recruit new members and grow. Unfortunately, finding appropriate instruments is a challenge. Our data set covers 1970–2007. However, the information on terrorist groups' life spans is available only until 2006. We are not aware of any groups in our sample that were active in 2006 and ended in 2007; we cannot be certain, though. Hence, we drop year 2007 from our sample and re-estimate Table 5. The qualitative results are robust to this change. Although our sample starts in 1970, 47 terrorist groups in

Table 7 Robustness analysis: re-estimating Model 4 of Table 5 using various specifications

Variable	Use year dummies for duration dependence	Frailty model (Random effects logit)	Sample with only religious groups
log(*size*)	−0.465***	−0.532***	−0.670*
	(0.064)	(0.067)	(0.403)
Left wing	0.699**	0.684*	
	(0.354)	(0.367)	
Nationalists	0.668**	0.807**	
	(0.323)	(0.345)	
Right wing	1.404***	1.353***	
	(0.432)	(0.483)	
Attack diversity	−1.139**	−0.893*	−1.787
	(0.495)	(0.499)	(2.201)
Transnat_terr. share	1.201***	1.009***	1.308*
	(0.183)	(0.210)	(0.746)
log(*nonterr_casualty*)	0.169**	0.148**	0.494***
	(0.068)	(0.072)	(0.125)
log(*GDP*)	−0.320	−0.378*	0.159
	(0.202)	(0.211)	(0.888)
Polity	−0.015	−0.023	−0.200***
	(0.018)	(0.019)	(0.067)
Ethnic frac.	−3.317*	−4.241*	−4.392
	(1.896)	(2.255)	(12.772)
Ethnic frac. squared	3.863*	5.208*	4.254
	(2.312)	(2.660)	(13.308)
East Asia & Pacif.	−0.178	0.066	4.203
	(0.530)	(0.525)	(3.928)
Europe & Centr. Asia	0.818**	1.069***	1.195
	(0.333)	(0.378)	(2.132)
Lat. America & Car.	1.115***	1.409***	
	(0.430)	(0.453)	
North America	1.032**	1.352**	0.041
	(0.444)	(0.539)	(3.867)
South Asia	0.450	0.438	−2.011
	(0.510)	(0.548)	(2.908)
Sub-Saharan Africa	0.870	0.887	5.621**
	(0.664)	(0.638)	(2.570)
N	4129	4251	794

Notes: Variables log(*terr_casualty*), log(*POP*), *Openness, Gov. spending,* log(*elevation*), *Tropics,* and *Landlocked* are not shown to save space. We note that they are not statistically significant in above models. Significance levels: *** is < 0.01, ** is < 0.05, and * is < 0.10

our data set began operating before then. We, therefore, examine what happens if we remove these groups. The results (available upon request) are again generally similar to those reported in Table 5.

7 Concluding remarks

This article reports the first survival analysis of terrorist organizations that includes the groups' tactics, peak sizes, ideologies, regional locations, and body counts. These independent variables are supplemented with socioeconomic, political, geological and geographical variables from the terrorist groups' bases of operation. The following pattern of survival emerges. Religious groups display better survival prospects than groups adopting three other ideologies (left wing, right wing and nationalist). Large groups that pursue a diversified mix of attack modes survive longer. Longer-lived terrorist groups employ a smaller share of transnational terrorist attacks. Being responsible for a large number of nonterrorist casualties bodes ill for survival as governments are pressured to be more proactive against the terrorist threat. Terrorist groups located in democratic countries with an intermediate amount of ethnic fractionalization tend to remain active longer, although these findings are not robust and need further study. Finally, terrorist groups based in the Middle East and North Africa generally last longer than their counterparts in other regions. The marginal effects of the significant variables are quantified for the cross-sectional and panel specifications. Surprisingly, base-country elevation and jungle cover did not favor group longevity.

As stated in the introduction, our study differs from earlier studies of terrorist group survival in terms of data, our focus on bases of operations, division of groups by ideology, and other factors. These differences make it impossible to compare our results with earlier studies. Nevertheless, the importance of group size, found here, agrees with that of Jones and Libicki (2008). Similar to Young and Dugan (2010), we found that groups that diversify their attacks survived longer. We showed that larger base-country populations improved group survival prospects, while Blomberg et al. (2010) found that more populous attack venues contributed to long group life spans. Other than these minor similarities, our results differ markedly from those reported in earlier work.

A number of policy insights follow from this study. First, international assistance for bolstering counterterrorism is particularly needed in the Middle East and North Africa where terrorist groups are generally longer lived. This study indicates that terrorist organizations are relatively shorter lived in Latin America and North America. This empirical regularity should inform the geographical distribution of counterterrorism assistance. Second, given the current dominance of religious fundamentalist terrorism, it is not encouraging that these groups are more resilient. This then means that swift and effective effort is needed to eradicate upstart religious terrorist groups before they gain footholds. Third, longer-lived terrorist groups diversify their attacks, so that counterterrorism must not become fixated on concentrating resources on interdicting a small subset of attack modes. Fourth, since group size increases survival significantly, countries must act quickly to stem the growth of new terrorist organizations. Fifth, in their bases of operations, democratic institutions on average extend the lifetime of indigenous terrorist groups, so that pushing democracy in terrorism-plagued countries may not always be a fruitful counterterrorism strategy. This issue requires further study. Sixth, because terrorist groups with a larger share of domestic attacks survive longer, the international community should not restrict its cooperative efforts only on transnational terrorist groups. Cooperative action must also be directed at terrorist groups whose attacks largely, but not exclusively, are domestic terrorist attacks.

Future studies on terrorist group survival should extend the sample of terrorist groups. With a larger sample, one can conduct survival analysis for different cohorts of groups to augment our knowledge of the factors that contribute to groups' longevity. In addition, a spatial dimension can be introduced to better discern the importance of geographical location to terrorist groups' survival.

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References

Abadie, A. (2006). Poverty, political freedom and the roots of terrorism. *American Economic Review*, *96*(2), 50–56.

Alesina, A., Devleeschauwer, A., Easterly, W., Kurlat, S., & Wacziarg, R. (2003). Fractionalization. *Journal of Economic Growth*, *8*(2), 155–194.

Allison, P. D. (1982). Discrete-time methods for the analysis of event histories. *Sociological Methodology*, *13*(11), 61–98.

Bandyopadhyay, S., Sandler, T., & Younas, J. (2011). Foreign aid as counterterrorism policy. *Oxford Economic Papers*, *63*(3), 423–447.

Basuchoudhary, A., & Shughart, W. F. II (2010). On ethnic conflict and the origins of transnational terrorism. *Defence and Peace Economics*, *21*(1), 65–87.

Benmelech, E., & Berrebi, C. (2007). Human capital and the productivity of suicide bombers. *Journal of Economic Perspectives*, *21*(3), 223–238.

Berrebi, C., & Lakdawalla, D. (2007). How does terrorism risk vary across space and time? An analysis based on Israeli experience. *Defence and Peace Economics*, *18*(2), 113–131.

Blomberg, S. B., Engel, R. C., & Sawyer, R. (2010). On the duration and sustainability of transnational terrorist organizations. *The Journal of Conflict Resolution*, *54*(2), 303–330.

Cronin, A. K. (2006). How al-Qaida ends: the decline and demise of terrorist groups. *International Security*, *31*(1), 7–48.

Cronin, A. K. (2009). *How terrorism ends: understanding the decline and demise of terrorist campaigns*. Princeton: Princeton University Press.

Enders, W. (2007). Terrorism: an empirical analysis. In T. Sandler & K. Hartley (Eds.), *Handbook of defense economics: defense in a globalized world* (Vol. 2, pp. 815–866). Amsterdam: North-Holland.

Enders, W., & Sandler, T. (1993). The effectiveness of anti-terrorism policies: a vector-autoregression-intervention analysis. *The American Political Science Review*, *87*(4), 829–844.

Enders, W., & Sandler, T. (2000). Is transnational terrorism becoming more threatening? A time-series investigation. *The Journal of Conflict Resolution*, *44*(3), 307–322.

Enders, W., & Sandler, T. (2006a). *The political economy of terrorism*. Cambridge: Cambridge University Press.

Enders, W., & Sandler, T. (2006b). Distribution of transnational terrorism among countries by income classes and geography after 9/11. *International Studies Quarterly*, *50*(2), 367–393.

Enders, W., Sandler, T., & Gaibulloev, K. (2011). Domestic versus transnational terrorism: data, decomposition, and dynamics. *Journal of Peace Research*, *48*(3), 319–337.

Fearon, J. D., & Laitin, D. (2003). Ethnicity, insurgency, and civil war. *The American Political Science Review*, *97*(1), 75–90.

Feinstein, J. S., & Kaplan, E. H. (2010). Analysis of strategic terror organization. *The Journal of Conflict Resolution*, *54*(2), 281–302.

Fleck, R. K., & Kilby, C. (2010). Changing aid regimes? US foreign aid from the Cold War to war on terror. *Journal of Development Economics*, *91*(1), 185–197.

Gallup, J. L., Mellinger, A. D., & Sachs, J. D. (1999a). *Geography datasets*. Boston: Center for International Development, Harvard University.

Gallup, J. L., Sachs, J. D., & Mellinger, A. D. (1999b). *Geography and economic development* (CID working paper No. 1). Boston: Center for International Development, Harvard University.

Gutfraind, A. (2009). Understanding terrorist organizations with a dynamic model. *Studies in Conflict & Terrorism*, *32*(1), 45–55.

Heston, A., Summers, R., & Aten, B. (2009). Penn world table version 6.3. Philadelphia: Center for International Comparisons of Production, Income and Prices, University of Pennsylvania.

Hoffman, B. (2006). *Inside terrorism: revised and expanded edition*. New York: Columbia University Press.

Jenkins, S. P. (1995). Easy estimation methods for discrete-time duration models. *Oxford Bulletin of Economics and Statistics*, *57*(1), 129–138.

Jones, S. G., & Libicki, M. C. (2008). *How terrorist groups end: lessons for countering al Qa'ida* (Monograph MG-741-1). Santa Monica: RAND.

Landes, W. H. (1978). An economic study of US aircraft hijackings, 1961–1976. *The Journal of Law & Economics*, *21*(1), 1–31.

Li, Q. (2005). Does democracy promote transnational terrorist incidents? *The Journal of Conflict Resolution*, *49*(2), 278–297.

Marshall, M. G., & Jaggers, K. (2009). *Polity IV dataset version 2007* and *Dataset users' manual*. Fairfax: Center for Systemic Peace and the Center for Global Policy, George Mason University. http://www.systemicpeace.org. Accessed 1 July 2009.

National Consortium for the Study of Terrorism and Responses to Terrorism (START) (2009). *Global terrorism database (GTD)* (CD-ROM). College Park: University of Maryland.

Rapoport, D. C. (2004). Modern terror: the four waves. In A. K. Cronin & J. M. Ludes (Eds.), *Attacking terrorism: elements of grand strategy* (pp. 46–73). Washington: Georgetown University Press.

Sandler, T. (2009). The past and future of terrorism research. *Revista de Economia Aplicada*, *51*(1), 5–25.

Sandler, T., Tschirhart, T., & Cauley, J. (1983). A theoretical analysis of transnational terrorism. *The American Political Science Review*, *77*(1), 36–54.

Shughart, W. F. II (2006). An analytical history of terrorism, 1945–2000. *Public Choice*, *128*(1–2), 7–39.

Shughart, W. F. II (2011). Terrorism in rational choice perspective. In C. J. Coyne & R. L. Mathers (Eds.), *The handbook on the political economy of war* (pp. 126–153). Northampton: Edward Elgar.

STATA (2009). *Stata survival analysis and epidemiological tables reference manual* (Release 11). College Station: StataCorp LP.

Wilkinson, P. (2001). *Terrorism versus democracy: the liberal state response*. London: Frank Cass.

World Bank (2010). World development indicators (WDI). http://www.worldbank.org/data. Accessed 28 November 2010.

Young, J. K., & Dugan, L. (2010). *Why do terrorist groups endure?* Paper presented at the International Studies Association Meetings, New Orleans, LA.