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CBRN Attack Perpetrators: An Empirical Study

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Based on zero-inflated negative binomial regressions applied to the Monterey weapons of mass destruction data, this article assesses the future risks from chemical, biological, radiological, and nuclear (CBRN) terrorism. Once the threshold for CBRN attacks is surpassed, further attacks arise: the expected number of CBRN incidents is over one and a half times higher than past events. Religious cults and groups with a transnational orientation pose the largest CBRN threat to society. Other things constant, nationalists/separatists and religious fundamentalists are not more apt to engage in CBRN terrorism than compared to ''other groups.'' Democratic and corrupt regimes are the likely venues for CBRN incidents. Based on past incidents, rich countries are especially vulnerable to CBRN terrorism. Thus, recent actions by the U.S. Department of Homeland Security to put more resources into guarding against CBRN attacks appear sound. This study indicates that nonfundamentalist terrorists also present CBRN risks to democracies. From a foreign policy viewpoint, CBRN terrorism is not a problem that rich democratic countries can confront alone, because the terrorists will move to where there is the least vigilance. Our study indicates the likely perpetrators and types of attacks that nations must cooperate to avoid.

Since the hijackings on September 11, 2001 (henceforth, 9/11) and the Tokyo subway sarin attacks on March 20, 1995, there is a worry that terrorists will resort to chemical, biological, radiological, and nuclear (CBRN) attacks (Roberts 2000; Tucker 2000; Gressang IV 2001). Such attacks would provide a means for surpassing the ''media bar'' imposed by 9/11, where future terrorist incidents must be sufficiently catastrophic or costly to warrant media coverage beyond that of 9/11, with its near 3,000 deaths. The U.S. Department of Homeland Security (DHS) is taking the use of biological agents as a serious terrorist threat by allocating

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billions of dollars to Project BioShield that stockpiles vaccines to counter a biological attack (US [DHS] 2005). DHS Secretary Michael Chertoff stated that defense against CBRN terrorism and other potentially devastating terrorist incidents is an essential priority of the DHS budget in the near-term (Chertoff 2005).

Terrorist experts, however, disagree about the threat posed by CBRN terrorism. One group of experts stresses a host of deterrents to the use of CBRN weapons that include losing constituency support and funding, drawing a massive retaliation (e.g., U.S. actions against the Taliban and al-Qaida after 9/11), surmounting the weaponization hurdle, accepting the handling risks, and ignoring the cost-effectiveness of conventional terrorist attacks (Rapoport 1999; Dishman 2001; Enders and Sandler 2006: 251–252). For example, Rapoport (1999) indicates that, on a per-incident basis, conventional terrorist attacks kill more people than CBRN attacks.[1] Another group of experts highlights factors that promote such attacks. These factors include the availability of information and expertise, heightened frustrations of terrorists, demonization of a target population, deep-seated grievances of perpetrators, and the possession of a millenarian, apocalyptic, or messianic vision (Vegar 1998; Roberts 2000; Simon and Benjamin 2000; Blum, Asal, and Wilkenfeld 2005; Enders and Sandler 2006:253).

Experts also differ on the likely perpetrator of CBRN incidents if such attacks were to take place. Many researchers characterize religious cults and religious fundamentalists as the likely users of CBRN weapons, particularly when these groups address an ethereal audience, emphasize hatred of nonbelievers, and display an inapposite relationship (see, especially, Gressang IV 2001; but also see Hoffman 1995; Betts 1998; Cameron 1998; Dishman 2001; Palfy 2003; Post 2005). In contrast, other researchers argue that nationalists/separatists and other secular actors (including loners) presented the greatest CBRN risk in the past and will likely present the largest such risk in the future (Rapoport 1999; Tucker 2001; Sinai 2005). In many ways, assessing CBRN risks and the likely perpetrators is an empirical question that requires studying past events, because there are compelling arguments on both sides of these debates.

The primary purpose of this paper is to apply statistical inferential procedures to ascertain the likely perpetrators of CBRN terrorist attacks, based on data on CBRN incidents collected by the Monterey Institute of International Studies (2005). Although we suggest some logically drawn hypotheses, our main task is to ascertain which side of competing hypotheses in the literature is supported by the data gathered to date on CBRN incidents. In addition, we determine if past CBRN incidents are a determining factor of future attacks—that is, does the past portend the future for CBRN attacks? We also investigate whether a terrorist group's transnational orientation supports its proclivity to employ CBRN attacks. For each class of potential perpetrators, we relate regime characteristics (i.e., democracy, rule of law, and corruption) to its likely use of CBRN weapons in terrorist attacks. We find that, among groups, religious cults pose the greatest CBRN threat to date. Other things constant, a transnational orientation (i.e., engaging in transnational terrorist attacks) also increases a group's reliance on CBRN attacks. Past CBRN incidents increase the likelihood of future CBRN attacks for all perpetrators as a group and nationalists/separatists as a cohort. For each type of perpetrator, democracy increases the risks of CBRN attacks, while corruption also heightens this risk. Wealth, as measured by income per capita, augments the likelihood of CBRN incidents. These findings can inform governments about likely threat and perpetrators of CBRN attacks.

The current study differs in a number of ways from a recent paper by Ivanova and Sandler (2006) that also relied on the Monterey Institute's weapons of mass

[1] Ivanova and Sandler (2006) note that the average conventional terrorist incident killed one person, while the average CBRN attack killed just a half a person.

destruction (WMD) dataset (henceforth, called Monterey WMD data). This earlier study primarily presented odds ratio tests to investigate *correlates* to CBRN attacks; the current study presents a variety of regressions that explain the variation in CBRN attacks. Unlike the earlier study, the current paper identifies influences on various cohorts of potential CBRN terrorists. For example, we indicate how regime characteristics affect a cohort's likely use of CBRN weapons. In addition, the current study investigates the underlying dynamics of CBRN attacks by ascertaining how past CBRN incidents affect current CBRN incidents. Each cohort of perpetrators is analyzed separately, thereby displaying how regime characteristics can impact types of perpetrators differently.

The body of the paper contains five sections. In the first section, essential definitions and concepts are given, along with a discussion of the datasets and variables. Justifications are also indicated for examining CBRN incidents in isolation from traditional terrorist incidents. The second section puts forward the six empirical hypotheses that underlie the empirical study. The relationship between group type and CBRN terrorism is investigated in the third section. Following the presentation of the statistical model, we provide and discuss the statistical results. For alternative cohorts of perpetrators, we investigate the influence of regime type, country wealth, and past CBRN terrorist incidents on current CBRN incidents in the fourth section. Conclusions and policy implications are drawn in the final section. Our study is in the spirit of Ackerman's (2005:141) recommendation for careful empirical analysis of past CBRN incidents to identify potential terrorists and the factors that may determine their use of CBRN terrorism. Such an exercise can inform intelligence and law enforcement agents, while helping to formulate public policy.

Definitions, Datasets, and Variables

Terrorism is the premeditated use or threat of use of violence by individuals or subnational groups against noncombatants to obtain political or social objectives through intimidation of a large audience beyond that of the immediate victim. The presence of a political or social motive is a key ingredient of terrorism. In contrast, criminal acts—for example, kidnappings for ransom, murder, or extortion—are not terrorist acts when there is no political or social agenda. Our definition excludes state terror by identifying the terrorists as individuals or subnational groups. Noncombatants are viewed as targets of terrorism, so that roadside bombs against an occupying military force are not classified as terrorist events. To pressure a targeted country, terrorists try to create a general atmosphere of anxiety where everyone feels at risk. If terrorist attacks appear to be random, then this elevates fear and a sense of general vulnerability. Governments then must guard everywhere to reassure citizens that they are safe. By resorting to mass-casualty terrorism (e.g., 9/11), terrorists achieve even greater anxiety that necessitates more elaborate and expensive countermeasures. Even a suggestion of a CBRN attack cajoles a liberal democracy, entrusted with protecting lives and property, to spend massive amounts on homeland security to counter such attacks. Thus, there are circumstances where some terrorists may resort to such unconventional measures despite inhibitors, mentioned earlier.

Terrorist attacks are also distinguished by their national/international implications. Domestic terrorism is homegrown with consequences for just the host country, its institutions, citizens, property, and policies. For domestic terrorism, the victims, perpetrators, and audience are all from the venue country. By these criteria, the anthrax letter attacks following 9/11 was domestic terrorism, since the unknown terrorist appears to have been a U.S. citizen and the other criteria for a domestic incident are met. In contrast, transnational terrorism involves perpetrators *or* victims from two or more countries and has international

implications. The Madrid commuter train bombings of March 11, 2004 represent a transnational terrorist incident because the perpetrators were foreign, as were some of the victims. The 9/11 hijackings were transnational terrorist incidents, whose financial implications were felt on stock markets worldwide (Chen and Siems 2004). Moreover, 9/11 involved foreign perpetrators whose attacks harmed victims from over 80 countries.

At the outset, we must be clear about the relationship between CBRN and WMD terrorism. The terrorism literature has in a misleading fashion characterized WMD terrorism as terrorist events employing any mine, bomb, or device that releases chemicals, biological agent, or radiation in sufficient amount to cause deaths (Bunker 2000; Blum et al. 2005). There is *no* requirement in the literature that mass casualties must result; the mere use of a CBRN device is sufficient to qualify as WMD terrorism. In practice, CBRN terrorism may kill or injure many or few and, to date, have killed few. The anthrax letters in the United States in 2001 murdered 5 and sickened 22 individuals, while the sarin attack on the Tokyo subway killed twelve and sickened 1,038 people. Although the Monterey WMD data equates CBRN and WMD incidents, as does much of the literature, we resist this practice and do not refer to CBRN incidents as WMD events. Rather, we refer to CBRN incidents when CBRN substances are sought after, acquired, or used for a terrorist attack.

To date, much larger casualty totals have been associated with some conventional terrorist events (e.g., 9/11 and the bombings of the U.S. embassies in Kenya and Tanzania on August 7, 1998). Nevertheless, it is important to analyze CBRN terrorist incidents, as they have the potential to involve large numbers of casualties and cause billions of dollars in damage (i.e., a dirty bomb in a densely populated city). Most conventional terrorist attacks do not have the same potential to cause mass casualties or significant long-term expenses from cleanup. The study of CBRN incidents as a separate phenomenon provides insights as to perpetrators and likely venue, such as rich liberal democracies. If CBRN and standard terrorist incidents are combined into a single dataset, then the distinguishing characteristics of CBRN events—for example, the marginal impact of yesterday's CBRN incidents on today's incidents—will be lost to the analyst. These specific features can inform public policy—for example, DHS efforts to redirect resources to guarding against CBRN attacks.

The Monterey WMD terrorism database tracks politically and criminally motivated incidents by substate actors that involve the acquisition and/or deployment of CBRN agents since 1900. Because we are only interested in the application of CBRN materials for terrorist purposes, we apply rigorous criteria for the inclusion of CBRN incidents in our investigation. First, we include incidents from 1988 to 2004, because before 1988 CBRN incidents were relatively rare so that there is little variation in CBRN events to explain by inferential statistics. Second, we cull criminally motivated incidents (classified as Type II in the Monterey WMD data) that do not constitute terrorism. Third, we only include those events that involve: (i) the actual use of CBRN substances by the terrorists; (ii) a CBRN threat combined with possession (or simply possession); and (iii) attempted CBRN acquisitions *supported by substantial evidence*. All ''plots only'' instances, where the perpetrators never took steps to acquire the CBRN substances are culled from the data. Moreover, hoaxes, pranks, and threats are also removed. If the terrorists claimed to have used CBRN material but no such substance was used, the incident is a prank. When a similar claim is accompanied by a fake substance, the act is a hoax. Cases, where CBRN use is threatened but there is no evidence of possession, attempted acquisition, or execution, are termed threats. Such incidents are removed from our sample, because they do not really represent a CBRN risk even though they may result in inconvenience and costs. Thus, we only maintain about 30% of the Monterey WMD incidents.

TABLE 1. Descriptive Categories for Sample Drawn from Monterey WMD Terrorism Database

Category	*Subcategory*	*Incidents*
Region	Asia	98
	Australia and Oceania	7
	Europe	44
	Latin America	16
	Middle East and North Africa	20
	Russia and newly independent states	29
	sub-Saharan Africa	12
	United States and Canada	85
	Worldwide	3
Type of agent	Biological	42
	Chemical	205
	Combination	7
	Nuclear	8
	Radiological	26
	Unknown	26
Type of group/perpetrator	Criminal organization	1
	Left-wing	29
	Lone actor(s)	23
	Nationalists/separatists	66
	Religious cults	28
	Religious fundamentalists	28
	Right-wing	9
	Single-issue	21
	Unknown	108
Type of delivery	Aerosol/spray	19
	Casual/personal/direct contact	42
	Consumer product tampering	18
	Explosive device	27
	Food/drink	22
	Injection/projectile	19
	Jug/jar/canister	13
	Letter/package	46
	Not applicable (case of possession)	45
	Reaction device	3
	Water supply	12
	Ventilation system	1
	Unknown	47

Table 1 categorizes our 314-event sample by geography, type of agent (substance), type of perpetrator, and delivery system. Asia and North America (the United States and Canada) experienced the greatest incidence of CBRN terrorism for the sample period, followed by Europe. The remaining areas were associated with many fewer CBRN events. The most common CBRN agent was chemical substances (205 incidents), which account for almost two-thirds of all sample incidents. Biological events are second with 42 instances that include two unsuccessful attempts by Aum Shinrikyo to sicken people with anthrax. Radiological events (26) involve serious efforts by terrorists to obtain radiological substances, as well as dirty bombs by Chechen rebels that did not explode. The eight nuclear events mostly involved al-Qaida's efforts to acquire enriched uranium or Chechens' actions to secure nuclear material or nuclear devices from ex-Soviet facilities. In the latter case, the evidence is mixed as to whether the Chechens ever obtained a ''suitcase bomb'' or an SS-20 missile. Perpetrators include a variety of terrorists: unknown perpetrators are associated with 108 incidents or over a third of the sample. Nationalists/separatists engaged in 66 events,

TABLE 2. Basic Statistics According to Group Identity (1988–2004)

	Nationalists/ Separatists	*Religious Cults*	*Religious Fundamentalists*	*Others*	*All*
Number of groups	18	2	14	21	55
Number of transnational groups	11	0	8	6	25
Number of incidents	55	28	22	56	161
Mean	3.06	14.00	1.57	2.67	2.93
Standard deviation	4.75	18.38	1.34	3.83	4.92
Min	1	1	1	1	1
Max	20	27	6	18	27
Number of injuries	58	1192[1]	0	201	1451[2]
Mean	3.22	596.00	0.00	9.57	26.38
Standard deviation	11.97	842.87	0.00	27.65	161.15
Min	0	0	0	0	0
Max	51	1192	0	121	1192
Number of fatalities	38	818[3]	305[4]	39	1200[5]
Mean	2.11	409.00	21.79	1.86	21.82
Standard deviation	5.61	521.84	81.23	6.23	111.77
Min	0	40	0	0	0
Max	21	778	304	28	778

[1]With one outlier removed, total injuries for religious cults equal 153 with a mean of 76.5, standard deviation of 108.19, and maximum of 153.

[2]With one outlier removed, total injuries for all groups equal 412 with a mean of 7.49, standard deviation of 27.27, and maximum of 153.

[3]With one outlier removed, total deaths for religious cults equal 40. Since only one group then remains, the mean and maximum are 40.

[4]With one outlier removed, total deaths for religious fundamentalists equal 1 with a mean of 0.08, standard deviation of 0.28, and maximum of 1.

[5]With two outliers removed, total deaths for all groups equal 118 with a mean of 2.23, standard deviation of 7.34, and maximum of 40.

while religious fundamentalists and cults together executed 56 CBRN incidents. Left-wing terrorists are associated with 29 CBRN incidents. Finally, Table 1 indicates the various delivery devices in which unknown (47), letter/package (46), and contact (42) garnered the highest frequencies.

Table 2 reports basic statistics for all identified groups for 1988–2004.[2] Group-wise data are subdivided into five cohorts—nationalists/separatists, religious cults, religious fundamentalists, other groups (e.g., leftists), and all sample groups—to showcase differences. In the top row, the number of groups for each cohort is indicated. The second row reports the number of transnational groups for each category. Table 2 also lists the number of incidents, the number of injuries, and the number of fatalities associated with CBRN activities by group cohorts. For each of these event characteristics, we report the mean, standard deviation, minimum (min) value, and maximum (max) value over the entire period.

According to Table 2, groups participating in CBRN events included 18 nationalists/separatists, two religious cults, 14 religious fundamentalists, and 21 other groups. Over half of the nationalists/separatists (11) and religious fundamentalists (8) engaged in some transnational terrorist attacks, while less than a third of other groups (6) had perpetrated transnational terrorist attacks. Although nationalists/separatists and other groups had been responsible for two-thirds of CBRN sample incidents, religious cults had by far the highest mean (14). Of the 28 incidents, involving cults, Aum Shinrikyo was implicated in all but a single incident, which was perpetrated by the Movement for the Restoration of the Ten Commandments of God, a doomsday cult in Kanungu, Uganda.

[2] Incidents involving unknown perpetrators or lone actors are not covered in these statistics.

Before a couple outliers are removed, cults were responsible for the largest number of casualties for the sample period—1,192 of 1,451 injuries and 818 of 1,200 deaths. After the removal of one injury incident and one death incident,[3] these figures drop to 153 of 412 injuries and 40 out of 118 deaths. For religious fundamentalists with the removal of an outlier, deaths drop from 305 to just 1.[4] Generally, CBRN incidents by religious cults and other groups involved the largest number of casualties, while these incidents by religious fundamentalists are likely to result in very few casualties, especially with the Nigerian outlier (see footnote 4) removed. We, however, keep the three outliers in the regression, because the unit of analysis is the number of incidents perpetrated by the groups and not the number of associated casualties.

Based on the Monterey WMD data, Figure 1 displays the annual number of CBRN terrorist events by group type for 1988–2004. These time series exclude criminal and unsubstantiated incidents, as described earlier. For the overall series, the two most prominent peaks in CBRN activity took place in 1995 and 2000. The former peak with 25 incidents coincided with increases in CBRN terrorists by cults, other groups, and nationalists/separatists, with cults being the largest contributor. The 2000 peak is primarily due to a rise in CBRN terrorism by nationalists/separatists. Cycles appear to characterize CBRN events.

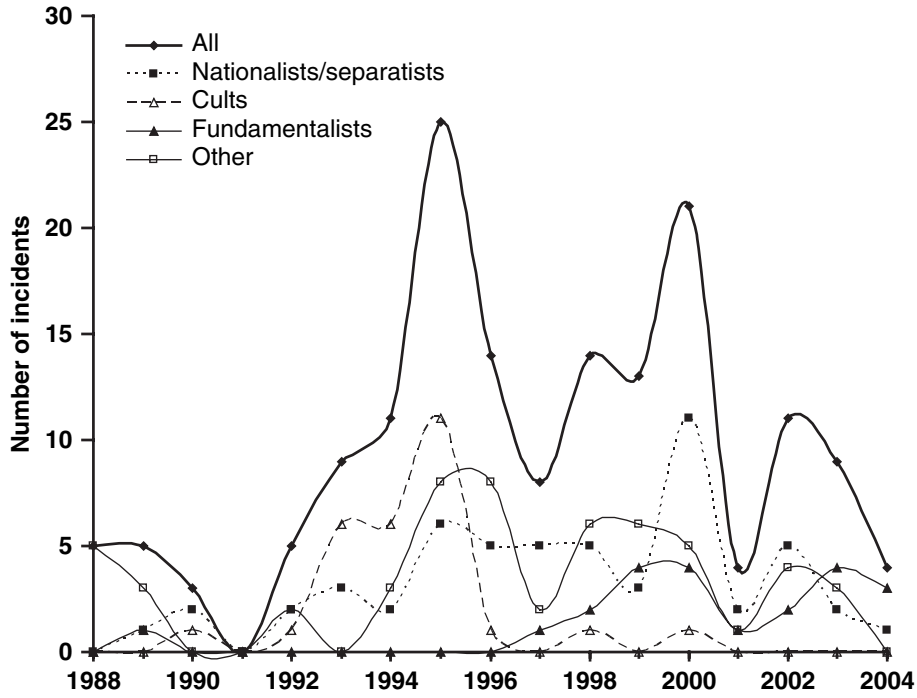

FIG. 1. Annual Number of CBRN Incidents by Group Type, 1988–2004.

[3] The injury incident is the Tokyo subway sarin attack on March 20, 1995 by Aum Shinrikyo; the death incident is the mass poisoning on March 17, 2000 of the followers of the Movement for the Restoration of the Ten Commandments of God. The Tokyo attack involved 1,039 injuries while the mass poisoning included 778 deaths.

[4] The outlier is the massacre of Hausa military youths in Nigeria on February 21, 2000 where 304 died, some by arrows tipped with poison.

Other Data and Variables

To capture the relationship between perpetrators and regime characteristics, we, in part, utilize annual data drawn from the Polity Project, ''Political Regime Characteristics and Transitions, 1800–2003'' (Marshall and Jaggers 2004). Polity data are gathered by the Integrated Network for Societal Conflict Research (INSCR) at the University of Maryland. The Polity database is constructed on the premise that a political system does not have to be represented as either democratic or autocratic. Thus, INSCR treats democracy and autocracy as two dimensions that can be measured independently. According to Polity, democracy reflects three interdependent elements: (1) institutions and procedures that foster political participation, (ii) procedural constraints that curb executive power, and (iii) government-backed guarantees that protect civil liberties (e.g., freedom of association, freedom of speech, protection against unwarranted search and seizure, and due process under the law). Each of these three elements are assigned subjective codes that are then combined into an overall indicator between 0 and 10, with higher values associated with more democracy. In contrast, autocracy involves restraints on political participation, few limits on executive power, and significant restrictions on civil liberties. Subjective scores assigned to these three factors are also aggregated into a single index that varies between −10 and 0, with lower values indicative of more autocratic rule. An overall composite is derived by summing the democracy and autocracy indicators. This democracy composite score ranges from −10 to 10 with higher values reflecting democratic principles. Given Polity's coverage only up through 2003, the democratic indicator is not available for 2004.

For 1998–2004, we rely on the International Country Risk Guide (ICRG), produced by the Political Risk Services (PRS) Group (2004), for two additional regime characteristics: rule of law and honesty (or the absence of corruption). The ICRG index of law and order (i.e., rule of law) is based on two subcomponents: (i) the impartiality of the legal system; and (ii) people's observance of the law.[5] The second component is needed because a country with a high judicial system rating may still suffer from high crime rates and routine violation of the law. The rule of law variable is scaled from 0 to 6, where higher scores reflect strong rule of law and lower scores indicate ''a tradition of depending on physical force or illegal means to settle claims'' (Knack and Keefer 1995:225). The ICRG corruption index primarily measures the extent to which ''high government officials are likely to demand special payments'' (Knack and Keefer 1995:25), but it also accounts for illegal payments associated with import and export licenses, exchange rate transactions, tax assessments, policy activities, or loans. Like the rule of law index, the corruption indicator ranges from 0 to 6, with low values indicating corrupt regimes. We will, however, employ high values to reflect *honest* regimes with scrupulous government officials. Annual values of the rule of law and honesty indices are available for 1988–2004.

A final variable is an annual wealth measure for venue countries associated with CBRN incidents. Income per capita data come from the World Bank Group (2006).

Empirical Hypotheses

To underline the empirical investigation, we present six hypotheses. These hypotheses are either drawn from the literature or else are logically deduced. The first hypothesis involves the temporal nature of CBRN incidents. Technological innovations diffuse through the terrorism community owing to linkages among

[5] See International Country Risk Guide (2005) (ICRG) for definitions for these components.

terrorist groups—that is, groups are known to share information and tactics. Thus, the discovery of a novel form of attack by one group may be passed along to other groups. In some cases, the media greatly facilitate this transmission by making the method of attack public. Terrorists can then search libraries or the Internet for the necessary technical information to carry out the attack in practice. When the same group is involved in multiple attacks, as was true for Aum Shinrikyo, economies of scale (i.e., falling unit costs with incidents) then make future CBRN attacks cheaper per incident once setup costs have been met. These setup costs include surpassing weaponization barriers, building a laboratory, obtaining the substances, acquiring knowledgeable personnel, and establishing the requisite infrastructure. Owing to these factors, today's CBRN events are anticipated to be positively influenced by yesterday's events, so that $CBRN_t$ (i.e., events in period t) is positively influenced by $CBRN_{t-1}$ (i.e., events in period $t - 1$). This relationship may also hinge on learning economies that also lower unit costs due to experience gained from past actions. Another positive aspect of yesterday's incidents on today's actions stems from crossing the psychological and technical threshold that yesterday's CBRN incidents may signal. Thus, we have:

Hypothesis 1:

Past CBRN incidents are an important positive determinant of today's CBRN incidents

As mentioned at the outset, the views on likely perpetrators of CBRN incidents are controversial with two contrasting predictions in the literature. One group of experts sees religious cults and fundamentalists as more apt to engage in CBRN attacks than other groups, because these religious factions may demonize their enemies, appear less restrained in their actions, view all nonsupporters as legitimate targets, and not maintain a constituency (see, e.g., Betts 1998; Cameron 1998; Dishman 2001; Palfy 2003). In the case of cults, leaders may be pursuing millenarian, apocalyptic or messianic visions that justify any number of casualties—for example, Aum Shinrikyo's apocalyptic redemption (Blum et al. 2005). One set of experts emphasizes such factors as promoting CBRN terrorism with its greater carnage potential in the case of religious terrorists. In contrast, other experts view opportunistic nationalists/separatists or others as a potential threat (e.g., Sinai 2005), while still others do not envision CBRN terrorism as appealing to nationalists/separatists owing to powerful inhibitors, that includes the benefit-cost effectiveness of conventional terrorism (Rapoport 1999). Monetary support from a Diaspora may inhibit nationalists/separatists from CBRN attacks that may alienate their funders. Quite simply, there is no agreement in the literature as to whom are the likely perpetrators of CBRN attacks—it is an empirical question owing to opposing factors. As a refutable hypothesis, we offer:

Hypothesis 2:

Religious cults, followed by religious fundamentalists, are more prone to CBRN attacks against nonbelievers than other groups

We place cults ahead of fundamentalists because the latter terrorists have better defined political goals (e.g., an Islamic state) that may make them possess some constituency concerns.

A third hypothesis involves terrorist groups that engage in one or more transnational terrorist events.[6] Transnational terrorist groups can draw expertise and funding from abroad, thereby putting CBRN terrorism within their reach.

[6] Transnational orientation is ascertained by examining International Terrorism: Attributes of Terrorists Events (ITERATE) for CBRN perpetrators, who executed at least one transnational terrorist acts (Mickolus, Sandler, Murdock, and Flemming 2005).

Moreover, these transnational groups may be in a better position to obtain CBRN substances from laboratories and other facilities abroad (Blum et al. 2005). Given their transnational orientation, such groups can stage a CBRN attack away from their home country, so that their nationals will not be in harm's way. Thus, foreign venues may make the associated risks more acceptable. Transnational group may also execute large-scale, newsworthy CBRN attacks to gain worldwide media attention. Given past incidents like 9/11 and the Madrid commuter train bombings, transnational terrorists must ratchet up the carnage to command similar media attention. Transnational terrorist groups are in a more competitive news market than domestic terrorists and this induces the former to seek more ghastly actions. Such considerations lead to:

Hypothesis 3:

Groups with a transnational orientation are more prone to engage in CBRN attacks

The next three hypotheses involve the likely venue for CBRN terrorism. There is a growing literature that views democracy as encouraging terrorism owing to freedom of association, availability of information, sources of funding, rights to privacy, protection under the law, targets of opportunity, and restraints on government (see, e.g., Eubank and Weinberg 1994, 2001; Weinberg and Eubank 1998; Enders and Sandler 2006). Democracies also provide potential media coverage that terrorists seek. The same factors that support conventional terrorism also provide a favorable environment for CBRN terrorism in democracies. This is particularly true for CBRN incidents owing to a knowledge base (through higher-learning institutions and laboratories), protection from unwarranted searches, and myriad funding opportunities. Moreover, the shear volume of shipping in most rich democracies offers opportunities for CBRN ingredients to enter ports undetected. These risks of CBRN incidents are augmented by the volume of tourism and business travelers to democracies. Hypothesis 4 indicates that the above considerations make democracies a likely venue for CBRN terrorist attacks.

Hypothesis 4:

Democratic values and the rule of law are conducive to the staging of CBRN attacks

Following 9/11, the Interpol chief, Ronald K. Noble (2001), stated that, ''The more sophisticated security systems, the best structures, or trained and dedicated security personnel are useless, if they are undermined from the inside by a simple act of corruption.'' Corruption can foster CBRN terrorism by allowing terrorists to acquire the material through bribes of officials or individuals at sensitive laboratories. The presence of corruption also means that the acquisition of CBRN substances may go unnoticed and/or unreported owing to questionable record-keeping practices. Corrupt businesses may sell essential ingredients to terrorists that can be used to assemble a CBRN weapon. Such considerations give:

Hypothesis 5:

Corrupt (honest) regimes are more (less) likely to experience CBRN incidents

A final hypothesis concerns the wealth of potential venue countries as measured by the natural log (Ln) of the country's income per capita. Rich countries are apt to be the venue for CBRN terrorism, insofar as these attacks are likely to draw more attention in wealthy than in poor countries. If the terrorists are after a ransom, then wealthier countries present greater extortion possibilities. Rich countries also possess more laboratories and research facilities where CBRN

substances are available. Additionally, there are more individuals with access to and knowledge of CBRN materials in wealthy countries. Funds are more readily available in rich countries to support CBRN weapon acquisition. Thus, we have:

Hypothesis 6:

Rich countries are a more likely venue for CBRN terrorism

Group Type and CBRN Terrorism

We first investigate the determinants of CBRN terrorism, based on past attacks and group characteristics. To construct our dependent variable, we calculate the number of CBRN incidents in period t, $CBRN_t$, perpetrated by each identified group. The dataset of 55 terrorist groups excludes loners and unknown perpetrators (see Table 2). We assume that a group's count of CBRN incidents either start from the year of their first incident, or from 1988 if its CBRN operations predated the start of our sample period. Thus, we implicitly assume that the group's first CBRN incident indicates its genesis or its ability to employ CBRN substances for terrorist acts. Because terrorist groups may not exist or use CBRN agents at the beginning of the sample period, the number of years varies among groups.

The dependent variable consists of the number of CBRN terrorist incidents per year, which is characterized by a preponderance of zeros and small values. The standard model for ''thin'' count data is a Poisson regression (Cameron and Trivedi 1998:3; Greene 2003:740). However, a shortcoming of a Poisson regression is that the conditional mean of the dependent variable is assumed to equal its conditional variance. If this underlying distributional assumption fails to hold (a likely scenario), then the coefficient estimates may be consistent, but their standard errors will be underestimated. A negative binomial regression generalizes the Poisson regression and permits greater variation (overdispersion), not constrained to equal the mean.

The negative binomial regression assumes, for a given set of regressors, that y_{it}—the number of CBRN incidents perpetrated by group i in year t in our model—is distributed with a probability density function:

$$f(y_{it}|x_{it}) = \frac{\Gamma(y_{it}+\alpha^{-1})}{\Gamma(y_{it}+1)\Gamma(\alpha^{-1})}\left(\frac{\alpha^{-1}}{\alpha^{-1}+\mu_{it}}\right)^{\alpha^{-1}}\left(\frac{\mu_{it}}{\alpha^{-1}+\mu_{it}}\right)^{y_{it}}, \quad (1)$$

with mean parameter $\mu_{it} = \exp(\mathbf{x}'_{it}\boldsymbol{\beta})$ in which $\boldsymbol{\beta}$ is a vector of coefficients to be estimated. In equation (1), α is the dispersion parameter. This model implies that the conditional mean is given by:

$$\mu_{it} = \exp(\beta_0 + \beta_1 Nationalists_{it} + \beta_2 Cults_{it} + \beta_3 Fundamentalists_{it} + \beta_4 Transnational_{it}). \quad (2)$$

In equation (2), $Nationalists_{it}$ refers to a dummy variable that equals 1 if the perpetrator is classified as a nationalist/separatist group in the Monterey WMD data and 0 otherwise. Similarly, $Cults_{it}$ and $Fundamentalists_{it}$ denote dummy variables for religious cults and fundamentalists, respectively, with all other groups used as the reference category. Finally, $Transnational_{it}$ equals 1 if the group has a transnational orientation and equals 0 otherwise. Maximum-likelihood methods are applied to estimate the negative binomial regression model.

We assume that observations from different years for the same group are correlated, whereas any two observations from different years for alternative groups are independent. To account for this correlation without assuming any particular

within-group correlation or form of heteroscedasticity, we use a robust variance estimator clustered over groups. The estimator allows for heteroscedastic variance between and within groups (Williams 2000:645). An advantage of this variance estimator is that the nature of the within-group dependence does not have to be specified. As a consequence, estimations are robust not only to heteroscedasticity, but also serial correlation.

The interpretation of coefficients for the negative binomial is less straightforward than a linear regression model, for which estimated coefficient β_j means that a one-unit change in the jth explanatory variable increases the expected value of the dependent variable by β_j units. Taking the natural log of the conditional mean and differentiating with respect to x_j, we obtain:

$$\beta_j = \frac{\partial E[y|\mathbf{x}]}{\partial x_j} \frac{1}{E[y|\mathbf{x}]}, \tag{3}$$

which is the percentage change in the dependent variable owing to a one-unit change in the jth explanatory variable. As such, equation (3) is a semielasticity. If, however, an explanatory variable enters logarithmically, then the associated coefficient is a full elasticity giving the ratio of percentage change in the dependent variable to the percentage change in the independent variable. For indicator (dummy) variables, it is convenient to interpret the coefficients transformed to incidence rate ratios. For the negative binomial model, the incidence rate ratio for a one-unit increase in indicator variable d, with all of the other variables ($\mathbf{x_2}$) held constant, equals

$$\frac{E[y|d=1,\mathbf{x_2}]}{E[y|d=0,\mathbf{x_2}]} = \exp(\beta_j).$$

This indicates that the expected count (or incidence rate) of an event is exp β_j times larger if the indicator is unity rather than zero. For a continuous variable, this would correspond to a one-unit increase.

Results

Table 3 presents the estimates of equation (2) with standard errors in parentheses. Models 1 and 2 have 433 observations for 55 terrorist groups for 1988–2004. In contrast, Models 3 and 4 have just 378 observations, because 55 observations are lost by lagging CBRN. To test between the negative binomial and Poisson regressions, we focus on the dispersion parameter α. For all four models, we reject the hypothesis that the dispersion parameter is zero at the .01 level, so that the negative binomial model is appropriate. The Wald test indicates that the overall model is significant at the .01 level.

Models 3 and 4 include $CBRN_{t-1}$, which allows us to test Hypothesis 1, while controlling for potentially relevant but omitted variables. $CBRN_{t-1}$ is highly significant in both models, thus indicating that, for each group, the expected number of CBRN incidents is over one and a half times higher than that in the pervious year. This finding strongly supports Hypothesis 1. The chi-squared statistic with one degree of freedom for the likelihood ratio test to compare Model 1 and 3 is 295,[7] which is significant at the .01 level indicating a much better fit for Model 3 than for Model 1. A similar calculation supports Model 4 over Model 2; hence, our remarks are focused on the coefficients in Model 3 and 4. Comparing coefficient estimates, we see that the models display reasonable robustness.

Because most of the independent variables are indicator variables, the coefficients are transformed to incidence rate ratios—that is, exp β_j. For model 3, the

[7] This statistic equals $2 \times |-317.92 + 170.12|$.

TABLE 3. Negative Binomial Regressions (Standard Errors Adjusted for Clustering on Terrorist Groups) (1988–2004)

	Model 1	*Model 2*	*Model 3*	*Model 4*
$CBRN_{t-1}$			1.61*** (0.13)	1.62*** (0.13)
Nationalists/separatists	1.05 (0.44)	1.53* (0.36)	1.22 (0.70)	0.76 (0.70)
Religious cults	7.90*** (2.85)	9.10*** (3.27)	11.07*** (6.22)	9.33*** (5.32)
Religious fundamentalists	0.73 (0.30)	1.15 (0.48)	0.47 (0.29)	5.80E-07*** (4.37E-07)
Transnational groups	2.82*** (0.92)	3.81*** (1.97)	6.28*** (3.53)	4.80** (3.62)
Nationalists × transnational		0.56 (0.36)		1.83 (2.10)
Fundamentalists × transnational		0.48 (0.35)		1.02E+06*** (1.05E+06)
α	2.15***	2.12***	2.81***	2.81***
Wald test (χ^2)	45.64***	46.17***	112.78***	969.69***
Log-likelihood	−317.92	−317.10	−170.12	−169.43
Observations	433	433	378	378

Note: Dependent variable is the number of CBRN incidents per year. Coefficients are transformed to incidence-rate ratios [i.e., exp(b) rather than b]. Standard errors (in parentheses) are similarly transformed. The constant is not shown.

*Significant at the .10 level.

**Significant at the .05 level.

***Significant at the .01 level.

expected number of CBRN incidents for nationalists/separatists and fundamentalists is *not* significantly different than that for ''all other groups.''[8] In Model 3, the expected number of CBRN incidents for religious cults is over 11 times higher than that for all other groups. Moreover, this coefficient is significant at the .01 level, thus partly supporting Hypothesis 2. The same general message comes from Model 4 regarding religious cults being much more prone than the comparison group to engage in CBRN terrorism. In Model 3, the coefficient on transnational orientation indicates a six time greater likelihood than the comparison group to engage in CBRN attacks. Thus, Hypothesis 3 is supported.

In Model 4, we add transnational interaction terms for nationalists/separatists and for fundamentalists to ascertain whether such an orientation has any influence on the use of CBRN terrorism by these two types of groups. We do not include an interaction with cults since neither sample cult is classified as transnational. The coefficient on the nationalists interaction term is insignificant. This suggests that nationalists/separatists with a transnational orientation do not get more or less involved in CBRN terrorism. Although the expected number of CBRN incidents for fundamentalists is much lower than that for the comparison group in Model 4, a transnational orientation slightly increases the anticipated use of CBRN terrorism by fundamentalists.

Regime and Group Type: Their Influence on CBRN Terrorism

Next, we investigate whether regime characteristics and country wealth affect four perpetrator cohorts' use of CBRN substances in terrorist acts. These cohorts include all perpetrators, nationalists/separatists, religious cults and fundamentalists, and all other actors. Unlike the last section, all other actors refer not only to terrorist groups that do not belong to one of the three group categories, but also to lone and unknown actors (see Table 1 where there are 23 lone and 108 unknown perpetrators). We combine cults and fundamentalists into a single cohort, because there are only two cults. By subdividing perpetrators, we can

[8] ''All other groups'' involve groups that are not nationalists/separatists, cults, or fundamentalists.

determine whether regime characteristics, past CBRN incidents, and wealth affect the classes of perpetrators differently. Regime characteristics include democracy, rule of law, and honesty indices described earlier. The ensuing empirical investigation allows us to test Hypotheses 1, 4–6.

To explain the variation in the number of CBRN incidents for the various cohorts based on regime characteristics, we compute the number of CBRN incidents that took place in each sample country in each year. Our sample includes not only countries that did not experience *any* CBRN attacks, but also countries that experienced one or more CBRN incidents during the sample period. Because the value of the dependent value is always zero for the former countries, while the value is positive for some years and zero otherwise for the latter countries, we assume that the zero and nonzero counts in this setting are generated by different processes. That is, there are countries that are never at risk of CBRN terrorist attacks (i.e., terrorists never find them to be attractive targets), while there are other countries that are at risk of CBRN terrorist events where terrorists may or may not strike in any given year. Terrorists' locational choice for a specific CBRN event is based on a two-step process. First, they decide which countries are potential venues. Second, in a particular year, terrorists choose which of these potential sites to stage a CBRN incident.

The negative binomial regression model, discussed in the previous section, only accounts for one source of overdispersion, namely unobservable individual heterogeneity (i.e., certain unidentified socio-political characteristics of the countries that may or may not attract terrorists). In addition to individual heterogeneity, a zero-inflated negative binomial (ZINB) model considers another source of overdispersion—that is, excess zeros arising from the two-step data-generating process (Greene 1994). Countries can fall into two categories: with probability ϕ, a country may never experience a CBRN incident, and with probability $1-\phi$, a country may be at risk for CBRN incidents. Probability ϕ is a function of the characteristics z of the country and is determined by a logit model. Both zero and positive counts in the second group are generated by a negative binomial process in which the exponential mean is modeled as

$$\mu_{it} = \exp[\beta_0 + \beta_1 Democracy_{it} + \beta_2 Honesty_{it} + \beta_3 Law_{it} + \beta_4 \mathrm{Ln}(GDP/Population)_{it}], \tag{4}$$

where $Democracy_{it}$, $Honesty_{it}$, and Law_{it} refer to the polity, rule of law, and honesty indices, respectively, and $\mathrm{Ln}(GDP/Population)_{it}$ denotes logged gross domestic product (*GDP*) per capita. Hence,

$y_{it} = 0$, with probability ϕ_{it};

y_{it} = negative binomial$[\mu_{it}]$, with probability $1-\phi_{it}$; and

$$\phi = \frac{\exp(\mathbf{z}'_{it}\boldsymbol{\gamma})}{1+\exp(\mathbf{z}'_{it}\boldsymbol{\gamma})};$$

where $\boldsymbol{\gamma}$ is a vector of coefficients to be estimated for the logit model.

We include a constant and past CBRN incidents (i.e., $CBRN_{t-1}$) in vector $\mathbf{z}_{it}$ $CBRN_{t-1}$ is used as an explanatory variable in the logit model to test for any possible state-dependence effects. Terrorists may repeatedly stage their attacks in the same countries on account of networks and infrastructure formed from past actions. If, moreover, terrorists have to meet setup costs to achieve their first attack in a particular venue, they will choose to strike in those countries where CBRN attacks have been previously perpetrated by other terrorists, with whom they can form linkages to reduce initial costs. Thus, under the zero-inflated model, countries that have never experienced CBRN incidents will be predicted to have zero CBRN events in the current period.

We again assume that observations across countries are independent but that any two observations within a country are correlated. Thus, we apply a robust variance estimator clustered over countries. Although our sample includes both countries that have and have not experienced CBRN incidents, our sample size is restricted by the availability of data on the countries' regime characteristics, used to predict the number of CBRN events. Since we only have data on democracy until 2003, the time span of our study is from 1988 to 2003. Furthermore, we do not have data on democracy, corruption, and rule of law for all of the countries in each of the years, so that we end up with 126 countries. The number of available years for each country ranges from 2 to 16 (with an average of 14.6 years per country). The resulting number of observations is 1729. (We ''lose'' 106 observations due to the inclusion of the lag of the number of CBRN incidents in the logit model.)

In Table 4, we present the results of the estimation of equation (4) using the four cohorts. For the three subsamples, we exclude certain perpetrators, but the number of countries and years that could serve as the venue and time of potential attacks remains the same. Hence, the number of observations (i.e., 1729) in each subsample is identical as that for the entire (All) sample. To account for collinearity between the log of GDP per capita and rule of law (the correlation is 0.65), we present the results of estimating an alternative specification where the log of GDP per capita is dropped from the model. Thus, there are eight alternative models, numbered (1)–(8), in Table 4. In Table 5, we include the lag of the dependent variable (i.e., $CBRN_{t-1}$) as an additional determinant of the exponential mean to account for any path dependence effects, associated with the number of CBRN incidents in a country. This additional variable allows for a test of Hypothesis 1 for the various cohorts of perpetrators.

To judge between the negative binomial and zero-inflated negative binomial models, Greene (1994) proposes the use of a test by Vuong (1989) for nonnested models. However, since we rely on a robust variance estimator clustered over countries, the Vuong statistic cannot be applied. We, thus, base our decision to use the zero-inflated model on substantive justification, which Long (1997) views as the most compelling evidence. In our case, there are countries where terrorists do not stage CBRN terrorist attacks for structural reasons. At the same time, there are other countries where CBRN events are potentially anticipated, but do not occur by chance in given periods. Additionally, the negative binomial model for positive counts appears preferable to the Poisson model, because it is likely that there are unobserved sources of heterogeneity that differentiate the countries. This latter assumption is supported by the fact that we can reject the hypothesis that the dispersion parameter α equals zero for all samples and specifications in Tables 4 and 5. Thus, we rely on the ZINB model to make predictions about the expected number of CBRN events based on regime characteristics in different countries. The Wald test for all 16 models indicates that we can reject the hypothesis that all coefficients are simultaneously zero at the .01 level of significance. The results are broadly consistent for all comparative samples and specifications in Tables 4 and 5.

For all samples, except Cults and Fundamentalists, the odds of CBRN events occurring depend significantly on the number of CBRN incidents in the preceding year. The negative coefficients on $CBRN_{t-1}$ in the logit model indicate that past CBRN incidents *decrease* the odds that the number of CBRN incidents will be zero in the next period. Moreover, the positive coefficients on past CBRN incidents in the negative binomial model in Tables 4 and 5 imply that the number of CBRN events is apt to be higher in those countries with more past CBRN incidents. The effect of $CBRN_{t-1}$ is marginally significant for the entire sample and for nationalists/separatists subsample. Thus, we conclude that past CBRN events have a much stronger influence on the odds of CBRN

TABLE 4. Zero-Inflated Negative Binomial Regressions on Regime Types (Standard Errors Adjusted for Clustering on Countries) 1988–2003

Independent	*All*		*Nationalists/Separatists*		*Cults and Fundamentalists*		*All Other Actors*	
Variables	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Negative binomial model								
Democracy	0.10** (0.04)	0.14*** (0.03)	0.12*** (0.04)	0.12*** (0.04)	0.12** (0.05)	0.14*** (0.05)	0.02 (0.08)	0.14*** (0.05)
Honesty	−0.52*** (0.11)	−0.42*** (0.11)	−0.56*** (0.11)	−0.56*** (0.10)	−0.32 (0.46)	−0.11 (0.44)	−0.65*** (0.16)	−0.64*** (0.21)
Rule of law	0.18 (0.16)	0.36** (0.16)	−0.004 (0.14)	−0.01 (0.13)	0.40 (0.27)	0.49* (0.26)	0.13 (0.24)	0.60** (0.29)
ln (GDP per capita)	0.38** (0.16)		−0.002 (0.15)		0.29 (0.22)		0.86*** (0.27)	
Constant	−2.81*** (0.97)	−0.96* (0.58)	0.44 (0.89)	0.43 (0.57)	−4.59*** (1.19)	−3.21*** (0.84)	−6.09*** (1.37)	−1.37 (1.22)
Logit model								
$CBRN_{t-1}$	−2.60*** (0.63)	−2.69*** (0.67)	−16.40*** (2.24)	−38.68*** (2.22)	−1.63 (1.08)	−1.73 (1.05)	−2.76*** (0.67)	−2.79*** (0.62)
Constant	2.07*** (0.35)	2.15*** (0.35)	3.23*** (0.30)	3.23*** (0.30)	2.99*** (0.74)	3.21*** (0.62)	2.46*** (0.53)	2.62*** (0.55)
α	1.40***	1.46***	0.79***	0.78***	1.39***	1.07***	1.36***	1.58***
Wald test (χ^2)	43.45***	39.24***	63.44***	59.89***	27.60***	18.16***	31.96***	16.08***
Log-pseudolikelihood	−477.24	−481.58	−162.44	−162.44	−130.27	−130.93	−294.54	−302.36
Observations	1729	1729	1729	1729	1729	1729	1729	1729

Notes: Dependent variable is the number of CBRN incidents per year ($CBRN_t$). Standard errors are in parentheses. Each column provides the estimates from different parsings of the data based on the perpetrator's identity—for example, all perpetrators (All) and nationalists/separatists.

*Significant at the .10 level.

**Significant at the .05 level.

***Significant at the .01 level.

terrorist incidents occurring than on the number of incidents in any particular year.

The application of a robust variance estimator clustered over countries prevents us from conducting likelihood ratio tests to compare different specifications of the model (such as Model 1 in Tables 4 and 5 or Model 1 and Model 2 in Table 5) owing to the presence of log pseudolikelihood values. As the odd numbered models in Table 5 represent the most complete specifications, we focus our discussion on the coefficient estimates obtained from these models.

Democracy has a significant positive influence on the number of CBRN incidents across different samples and specifications, thereby partly supporting Hypothesis 4. The rule of law, however, does not have a significant influence on the number of CBRN incidents in the odd numbered models. Based on Model 1 in Table 5, a one-point increase in the democracy index increases the expected number of CBRN incidents for all perpetrators by 9%. The size of this is approximately the same for all samples with cults and fundamentalists displaying the largest percentage increase. Honesty has a significant negative impact on the use of CBRN terrorism by different types of perpetrators taken separately and together, which supports Hypothesis 5. According to Model 1, a one-point increase in the honesty indicator results in 46% fewer CBRN incidents for the entire sample. The effect is particularly pronounced for religious cults and fundamentalists, where a one-point increase leads to a 56% decline in CBRN incidents. This suggests that corruption plays an important role in motivating religious groups to resort to CBRN substances. For the entire sample, the impact of corruption is about four times greater than that of democracy. Wealth is a significant positive influence of CBRN incidents for the entire sample and all other actors—the two biggest numbers of perpetrators—thus supporting Hypothesis 6 for these samples. Hypothesis 6 is not, however, supported for nationalists/separatists or cults and fundamentalists. For models 1 and 7, the influence of income per capita is fairly large.

For the negative binomial regression, the marginal effect of a regressor depends on the expected value of the count variable, which depends on the values of all independent variables. Marginal effects are computed with all variables held at their means. Based on the coefficient estimates of Tables 5 and 6 presents the marginal effect of democracy, honesty, rule of law, and log of GDP per capita on the expected number of CBRN events. Of all of the explanatory variables, $CBRN_{t-1}$ has the largest marginal impact on the expected number of CBRN incidents for all but the cults and fundamentalists sample. This impact is particularly important for nationalists/separatists, where an increase in one incident in the previous year, with all variables held at their means, raises the expected number of CBRN events by 0.36. The marginal effects of democracy and honesty, though significant, are not very large. For example, in Model 1, if a country's democracy score improves by one unit, then the expected number of CBRN events increases by just 0.007. If, similarly, a country's ranking in terms of the honesty index increases by one, then the expected number of CBRN incidents decreases by 0.036. These marginal effects are small since there have not been many CBRN incidents to date.

Concluding Remarks

Currently, the Monterey WMD data indicates that CBRN terrorism has not been very deadly even though the number of terrorism-based CBRN events has increased since 1988. On average, a CBRN incident has been only half as deadly as a conventional terrorist incident. Nevertheless, the authorities must be concerned about such events because some terrorists are clearly interested in using CBRN substances. CBRN incidents could some day result in mass death and

TABLE 5. Alternative Zero-Inflated Negative Binomial Regressions on Regime Types (Standard Errors Adjusted for Clustering on Countries) 1988–2003

Independent	*All*		*Nationalists/Separatists*		*Cults and Fundamentalists*		*All Other Actors*	
Variables	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
Negative binomial model								
$CBRN_{t-1}$	0.18* (0.09)	0.19** (0.09)	0.21* (0.11)	0.21* (0.12)	0.48 (0.30)	0.48 (0.34)	0.11 (0.11)	0.15 (0.14)
Democracy	0.09** (0.03)	0.12*** (0.03)	0.11*** (0.04)	0.11*** (0.04)	0.13** (0.06)	0.15*** (0.05)	0.03 (0.07)	0.13** (0.05)
Honesty	−0.46*** (0.09)	−0.37*** (0.09)	−0.47*** (0.11)	−0.47*** (0.10)	−0.56* (0.29)	−0.44 (0.37)	−0.58*** (0.19)	−0.52** (0.23)
Rule of law	0.14 (0.15)	0.29* (0.15)	−0.04 (0.15)	−0.04 (0.14)	0.29 (0.32)	0.41 (0.29)	0.12 (0.24)	0.50* (0.26)
ln (GDP per capita)	0.32** (0.15)		0.01 (0.15)		0.28 (0.26)		0.75*** (0.26)	
Constant	−2.74*** (0.91)	−1.15** (0.57)	0.04 (0.84)	0.07 (0.57)	−4.53*** (1.48)	−3.18*** (0.85)	−5.70*** (1.23)	−1.65 (1.34)
Logit model								
$CBRN_{t-1}$	−2.84*** (0.95)	−2.97*** (1.09)	−16.83*** (1.23)	−16.66*** (1.23)	−1.31 (1.03)	−1.42 (1.08)	−2.92*** (0.85)	−2.99*** (0.89)
Constant	1.79*** (0.51)	1.85*** (0.50)	3.04*** (0.35)	3.04*** (0.35)	1.88 (1.28)	2.01 (1.47)	2.27*** (0.75)	2.37*** (0.81)
α	1.66***	1.73***	0.85***	0.84***	2.33***	2.21***	1.63***	1.94***
Wald test (χ^2)	78.12***	68.99***	80.18***	80.35***	36.95***	41.86***	82.37***	56.36***
Log-pseudolikelihood	−472.04	−475.48	−161.50	−161.50	−125.28	−126.08	−293.22	−299.90
Observations	1729	1729	1729	1729	1729	1729	1729	1729

Notes: Dependent variable is the number of CBRN incidents per year ($CBRN_t$). Standard errors are in parentheses. Each column provides the estimates from different parsings of the data based on the perpetrator's identity—for example, all perpetrators (All) and nationalists/separatists.

*Significant at the .10 level.

**Significant at the .05 level.

***Significant at the .01 level.

Table 6. Marginal Effects Evaluated at the Sample Mean of Regressors (Based on Table 5)

Independent	*All*		*Nationalists/Separatists*		*Cults and Fundamentalists*		*All Other Actors*	
Variables	*(1)*	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*
$CBRN_{t-1}$	0.194** (0.075)	0.218** (0.088)	0.358*** (0.125)	0.352*** (0.123)	0.015 (0.010)	0.017* (0.009)	0.090** (0.035)	0.114** (0.044)
Democracy	0.007** (0.003)	0.010*** (0.003)	0.002** (0.001)	0.002** (0.001)	0.001** (0.001)	0.001*** (0.001)	0.001 (0.002)	0.005** (0.003)
Honesty	−0.036*** (0.010)	−0.031*** (0.009)	−0.011** (0.005)	−0.011** (0.005)	−0.005** (0.002)	−0.004 (0.003)	−0.019** (0.009)	−0.021* (0.011)
Rule of law	0.011 (0.012)	0.024* (0.012)	−0.001 (0.003)	−0.001 (0.003)	0.003 (0.003)	0.004 (0.003)	0.004 (0.008)	0.020** (0.010)
ln (GDP per capita)	0.025** (0.012)		0.0002 (0.003)		0.003 (0.003)		0.025** (0.011)	

Notes: Dependent variable is the number of CBRN incidents per year ($CBRN_t$). Standard errors are in parentheses. Each column provides the estimates from different parsings of the data based on the perpetrator's identity—for example, all perpetrators (All) and nationalists/separatists.

*Significant at the .10 level.

**Significant at the .05 level.

***Significant at the .01 level.

significant economic losses. Thus, recent action by the DHS in the United States to prepare for such events appears to be prudent. The real question is how much to spend and whom to protect against. Another question concerns the foreign policy implications of this preparation.

We have applied inferential statistics to provide a picture of the likely risks from CBRN terrorism. The picture that emerges is that past CBRN incidents lead to future incidents regardless of the class of perpetrator. An increase of one CBRN incident in the previous year leads to a 0.194 to 0.358 increase of CBRN events in a given country per year. Once terrorists surpass the threshold associated with CBRN terrorism, they generally continue such attacks. Thus, past incidents inform policymakers as to where the greatest risks lie. Past CBRN incidents have the greatest marginal impact on future incidents, followed by corruption and then democratic principles.

Religious cults and groups with a transnational orientation pose the largest threat, based on an analysis of past data. Contrary to the views of some experts (e.g., Hoffman 1995; Cameron 1998; Post 2005), religious fundamentalists and nationalists/separatists do not present as significant of a CBRN concern. Democratic principles and protection are conducive to CBRN terrorism, while regime honesty is not supportive of such terrorism. Other things constant, rich countries are more likely venues for CBRN terrorism by loners and other actors, not usually identified in the literature as the likely culprits.

So what policy lessons should be drawn from this study? In terms of perpetrators, governments must be especially vigilant against cults, since they appear to be the most likely to deploy such attacks. In addition, transnational terrorist groups—for example, al-Qaida—present a CBRN risk as they try to surpass the carnage level of 9/11. The renewed strength of al-Qaida indicates CBRN concerns. Given the casualties associated with conventional terrorism relative to past CBRN incidents, authorities need to recognize that conventional attacks still represent the greater risks when allocating antiterrorism resources. Failed states may provide a haven for terrorists to organize and train, but rich democratic countries have been the location for past CBRN terrorist incidents and the likely venue for future attacks. Thus, some resources must be allocated to curb such attacks. This also means that rich liberal democracies must cooperate with one another in monitoring and addressing the CBRN threat. From a foreign policy viewpoint, this is not a problem that rich democracies can confront alone because the terrorist will set up shop where there is the least vigilance. Because corruption has been a prime determinant of CBRN incidents, rich democratic countries must take extra precautions to screen and monitor personnel at laboratories, universities, hospitals, and nuclear power plants where CBRN materials can be obtained. This is also true of infrastructure workers (e.g., truck drivers for nuclear waste). Given the current CBRN threat, governments must display a measured vigilance that does not squander funds on what remains a moderate threat.

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