

WHAT DO WE KNOW ABOUT THE SUBSTITUTION EFFECT IN TRANSNATIONAL TERRORISM?

by

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The success of the terrorist attacks on the World Trade Center and the Pentagon on 11 September 2001 (henceforth, 9/11) has resulted in profound economic and social consequences for the United States. In addition to the loss of life and property, total costs of the attacks are staggering. With the economy already on the brink of recession, the unemployment rate rose by almost 1%.¹ Some sectors bore the brunt of the loss in business and consumer confidence. Wall Street closed for a week; on its re-opening, various stock market indices fell substantially and investment funds seemed to dry up. The airline industry was temporarily shut down, the tourism industry was especially hard-hit, and several airlines never recovered. The opportunistic anthrax attacks that followed caused major disruptions of the mail.

The worldwide response to fighting terrorism has been equally dramatic. The U.S.-led coalition known as “Operation Enduring Freedom” quickly achieved its aim of eliminating the Taliban regime in Afghanistan. In total, seventeen nations contributed more than 16,500 troops to the initial operation. Other efforts included the enhancement of airport security and directives from nearly 150 countries to freeze terrorist assets totaling at least \$104.8.

Within the United States, President Bush created the Office of Homeland Security and the National Defense Authorization Act (S. 1438, 8 December 2001). This Act earmarked funds for extending the war on terrorism, which includes countermeasures against potential biological and chemical attacks. Future years promise even greater anti-terrorism measures. President Bush’s proposed budget for 2003 directs \$37.7 billion to homeland security (an \$18.2 billion increase over 2002). In particular, the budget proposal includes \$11 billion for border security, \$6 billion to defend against bioterrorism, \$3.5 billion (a 1,000-percent increase) for police, firefighters and Emergency Medical Teams, and \$700 million to coordinate the antiterrorism

¹ All data used in this section were obtained from the official website of the President of the United States: www.whitehouse.gov.

measures of the various branches of government.

Undoubtedly, a massive anti-terrorist campaign will reduce the overall level of terrorism. Nevertheless, an important strategic question remains, since some anti-terrorism policies are apt to be more successful than others. As surveyed in this paper, economists and political scientists have investigated the effectiveness of alternative policy responses (e.g., toughening punishments, retaliatory raids, installing technological barriers). Each anti-terrorism policy can influence a terrorist group's choice of operations by either affecting their resources or the relative costliness of different kinds of attacks. Such policies can have an "income effect" or "substitution effect" or both. The income effect involves the overall level of available resources – e.g., freezing terrorists' assets reduces their "war chest" and their overall ability to conduct a campaign of terror. If a government action increases the resource outlays necessary to undertake a particular type of operation, then there is a motive to substitute into some less costly operation that achieves a similar outcome at less cost. For example, the installation of screening devices in US airports in January 1973 made skyjackings more difficult, thus encouraging terrorists to substitute into other kinds of hostage missions or to stage a skyjacking from an airport outside of the United States.

Unlike the two examples above, the income and substitution effects of an anti-terrorism policy are often interrelated. For example, the seizure of a cache of explosive devices has a clear income effect (since resources decline) and a substitution effect (since terrorists are less likely to stage incidents that rely on explosives). The essential point is that the overall effectiveness of any anti-terrorism policy depends on the direct *and* indirect effects that arise through various substitutions. The purpose of this chapter is to provide a careful examination of the terrorists' decision-making process, so as to understand and predict the likely responses.

1. Transnational Terrorism

Since the events of 9/11, the popular press has run articles arguing over the precise meaning of “terrorism.”² We define terrorism as the premeditated use, or threat of use, of extranormal violence to obtain a political objective through intimidation or fear directed at a large audience. An event, no matter how brutal, is not a terrorist incident unless it involves the presence of a political objective. Incidents that have no specific political motive are criminal rather than terrorist acts: a barroom shooting is a criminal act, while the assassination of an ambassador to coerce political change is a terrorist act. Another fundamental ingredient in the definition is the creation of widespread intimidation or fear. Unlike warfare, where the aim is to destroy opposing combatants, terrorists also seek to affect those not immediately involved with the political decision-making process. The 9/11 attack on the World Trade Center clearly fits this pattern.

As part of the attempt to create a general climate of intimidation, terrorists strike at a variety of targets using attack modes ranging from skyjackings to simple threats and hoaxes. The mix of operations makes it difficult for the authorities to predict the nature and location of the next incident. From the perspective of the authorities, terrorist incidents appear to be random, so that society must expend relatively large amounts of resources to protect against all forms of potential attacks.

Most terrorist events directed against the United States do not occur on U.S. soil. The kidnapping and murder of reporter David Pearl in Pakistan, the destruction of the Al Khubar Towers housing US airmen in June 1996 near Dhahran, Saudi Arabia, and the bombs destroying the U.S. embassies in Kenya and Tanzania in August 1998 are but three gruesome examples of *transnational* terrorism. Terrorism is transnational when an incident in one country involves

² Carr (2002) raises a number of issues concerning the appropriate definition of terrorism. *Slate* (<http://slate.msn.com/?id=2062267>) contains a discussion of the premise that terrorism necessitates that the victims be non-combatants.

perpetrators, victims, targets, institutions, governments, or citizens of another country.

Obviously, the four skyjackings on 9/11 constitute transnational terrorist attacks since the events were staged by individuals who crossed into the United States from abroad and because victims came from many countries. However, the bombing of the Murrah Federal Building in Oklahoma City by Timothy McVeigh in April 1995 was not a transnational terrorist incident.

From the late 1960s until the late 1980s, transnational terrorism was primarily motivated by nationalism, separatism, Marxist ideology, anti-racism, nihilism, and the desire for economic equality (Wilkinson 1986). In the 1990s, a driving motivation of terrorism has changed with "the emergence of either obscure, idiosyncratic millennium movements" or religious-based groups (Hoffman 1997, 2; 1998, 185-99). When religion provides the dominant objective of a group that employs terrorist tactics, it is identified as a religious terrorist group (e.g., Hamas, Algerian Armed Islamic Group (GIA), Hezbollah, Egyptian Gamat al-Islamiya). Since the start of 1980, Hoffman (1997) reports that the number of religious-based groups has increased as a proportion of the active terrorist groups: 2 of 64 groups in 1980; 11 of 48 groups in 1992; 16 of 49 groups in 1994; and 25 of 58 groups in 1995. This increase can be attributed to a growth of religious fundamentalism worldwide, the diffusion of the Islamic revolution from Iran, and the approach of the millennium. With this motivational change for some terrorists, Hoffman (1997, 1998) and Juergensmeyer (1997) view the new generation of terrorists as posing a more deadly threat than earlier groups.

The demise of many leftist groups in the late 1980s and 1990s is attributable to at least three factors: (i) domestic efforts by some terrorism-prone countries (e.g., France, Germany, Spain, the United Kingdom) to capture and to bring to justice group members; (ii) reduced state sponsorship of left-wing groups by East European and Middle Eastern countries (Chalk 1995; Clutterbuck 1994; Jongman 1992); and (iii) the reduced interest in Marxism following the

collapse of many communist regimes. These factors were bolstered by collective initiatives by the European Union to foster cooperation in terms of extradition, shared intelligence, and accreditation of foreign diplomats (Chalk 1995; Wilkinson 1992; Zagari 1992). In recent years, NATO has also begun a program to address collectively the risks posed by transnational terrorism (Wilcox 1997). Another recent development in terrorism has been the increase in “splinter” groups that are less disciplined, often more violent, and more nebulous than the parent group (Hoffman 1997, 1998). The IRA splinter group responsible for the Omagh bombing in Northern Ireland on 15 August 1998 is a clear-cut example. They did not follow standard IRA procedures and issued a warning that herded people nearer to the subsequent blast. Some days later, the group apologized and ceased operations. If members’ actions are not constrained, then a few fanatical individuals can cause great carnage.

The greater prevalence of religious groups has apparently increased the lethality of post-Cold War terrorism, because such groups view civilians as legitimate targets of a "decadent" society. Religious groups that declare a Jihad or holy war against another nation consider its people, not just its officials, as the enemy. Moreover, religious terrorist groups act out of a desire to satisfy their own goals (e.g., ascend to heaven) rather than to win favor with an external constituency. Violence may be viewed as a purifying act. Although it is tempting to attribute the increased casualties per incident, documented below, to better technology available to terrorists, most of the incidents have not really relied on new technologies. Old-fashioned bombs were used at Oklahoma City, Nairobi, and most other targets. The difference today is that these bombs are set to explode where and when maximum carnage will result.

2. The Choice-Theoretic Model of Terrorism

The choice-theoretic model of rational terrorists considers a terrorist group as choosing how to allocate scarce resources to maximize the expected value of its objective function. The

model developed by Landes (1978) considers a potential skyjacker contemplating the forcible diversion of a commercial aircraft for political purposes. A simplified version of the Landes' model considers three states of the world: there is no skyjacking, the skyjacking is successful, and the skyjacking fails.

In order to highlight the risky nature of terrorism, we assume that utility in the no-skyjacking state is certain; if the terrorist decides not to attempt to undertake the skyjacking, utility is given by U^N . If, however, the skyjacking occurs, the outcome is uncertain. Expected utility can be represented by:

$$EU^{SKY} = \mathbf{p} U^S + (1 - \mathbf{p})U^F, \quad (1)$$

where EU^{SKY} = expected utility if there is a skyjacking;

\mathbf{p} = skyjacker's subjective estimate of the probability of a successful skyjacking;

$1 - \mathbf{p}$ = skyjacker's subjective estimate of the probability of a failed skyjacking;

U^S = utility if the skyjacking is successful;

U^F = utility if the skyjacking fails.

The terrorist will attempt the skyjacking if the expected utility derived from undertaking the skyjacking exceeds the utility level U^N when there is no skyjacking:

$$U^N < EU^{SKY} = \mathbf{p} U^S + (1 - \mathbf{p})U^F. \quad (2)$$

Thus, anything that lowers U^N or raises EU^{SKY} increases the probability of a skyjacking.

Landes' model is useful for understanding the choice between legal and illegal terrorist activities. Given that utility from success exceeds utility from a failure [*i.e.*, $U^S > U^F$], it follows that an increase in the probability of a success will make it more likely that the skyjacking will occur. Formally, the change in expected utility from a skyjacking due to a change in \mathbf{p} is:

$$dEU^{SKY} / d\mathbf{p} = U^S - U^F > 0. \quad (3)$$

Hence, if the authorities undertake a policy (such as enhanced airport security) that reduces the probability of a successful skyjacking (lowering \mathbf{p}), the Landes' model predicts that the terrorists will be more likely to forego the skyjacking, owing to the associated reduction in EU^{SKY} . Policies that lower the utility from a skyjacking failure, such as longer jail sentences, also reduce the expected utility from skyjackings, thus decreasing the likelihood of such events. Moreover, policies that limit the utility from success, such as reduced media coverage, also reduces the number of skyjackings.

Although some Hamas and al-Qaida terrorists engage in suicide missions, the vast majority of terrorists do not resort to such attacks and respond predictably to security enhancements and other policy actions. Nevertheless, the model is capable of addressing suicide attacks. If a terrorist is concerned with living, then U^F is likely to be low, thereby inhibiting EU^{SKY} from exceeding U^N – the necessary requirement for an attack. A fanatical terrorist, who does not fear death and may welcome it, has a higher U^F , which makes an attack more likely in (2). Fanaticism brings U^F closer to U^S in (3); thus the policy effectiveness of lowering the success probability diminishes. If, for example, $U^F = U^S$ in (3), then efforts to lower \mathbf{p} have no effect on EU^{SKY} . Consequently, policy becomes completely ineffective. Fanatical terrorists must be apprehended or killed for attacks to stop.

Landes presented two regressions for US skyjackings based on US Federal Aviation Administrative data on skyjackings for the 1961-1976 period. The first regressed the quarterly total of skyjackings on the probability of apprehension, the probability of conviction, sentencing, and other policy efforts. The second regressed the time interval between skyjackings and the same set of variables. Both regressions found the length of sentence and the probability of apprehension to be significant deterrents. For most regressions, the probability of conviction

was marginally significant. Landes also estimated that between 41 and 50 fewer skyjackings occurred in the U.S. from the start of 1973 following the installation of metal detectors in US airports.

More generally, substitutions can be analyzed with a household production function (HPF) approach for which the utility of a terrorist group is a function of a shared political goal. The HPF model was first applied to transnational terrorism by Enders and Sandler (1993). Given the groups' budget constraint, this shared goal is produced from a number of *basic commodities* that may include both terrorist and non-terrorist activities. To be more specific, basic commodities may include political instability, media publicity, an atmosphere of fear, or extortion. Alternative terrorist attack modes can be substitutable if they produce the same basic commodities. Substitution possibilities are augmented when attack modes are logistically similar and yield the same basic commodities in nearly identical proportions. An assassination of a key public official or a skyjacking might be substitutes if they provide a terrorist group with similar amounts of media attention. Complementarity results when a *combination* of attack modes is required to produce one or more basic commodities or when the success of one type of attack reinforces the effects of a second type of attack. For example, in the wake of 9/11, the anthrax mailings had an especially demoralizing (complementary) effect on a public already sensitized to terrorism.

The advantage of the HPF approach is that it allows for substitutions between legal and illegal activities *and* for substitutions within the set of illegal terrorist activities. Choices within the set of terrorist activities are many and include the intended lethality of the act, its country of location, and whom or what to target (Sandler and Lapan, 1988). In each period, an overall resource constraint limits the terrorist group's expenditures to a magnitude not exceeding its monetary and non-monetary resource endowments. The expenditures on any activity consist of

the product of the activity's level and its per-unit price. Each terrorist and non-terrorist tactic has a per-unit price that includes the value of time, the use of personnel, funding and capital equipment, including weapons. A skyjacking is a high-priced incident because it is logistically more complex to plan and execute and thus requires more resources than do many other types of incidents. At the other extreme, threats and hoaxes require few resources and are low-priced incidents. Nevertheless, such incidents can add to the overall level of fear and intimidation. The recipients of various powders disguised as anthrax felt the same initial fear and undertook the same precautions as did the recipients of the real thing.

In addition to such technological considerations, the prices terrorists pay for each tactic are influenced by anti-terrorism policies. If, for instance, the government were to secure its embassies or military bases, then attacks against such facilities would become more costly on a per-unit basis. If, moreover, the government were not at the same time to increase the security for embassy and military personnel when outside their facilities, then attacks directed at these individuals (e.g., assassinations) would become relatively cheaper.

The HPF approach yields a number of important predictions concerning the substitution phenomenon. The critical result is that a government policy that increases the relative price of one type of terrorist tactic produces a substitution out of the now-more-costly tactic into those terrorist and non-terrorist activities whose prices are now relatively less costly. If, for example, embassies are fortified, then attacks against embassy personnel and property *within* the mission's ground become more costly for the terrorists – *i.e.*, there is a rise in the price of such attacks. Similarly, in choosing a venue, the price is anticipated to differ based on security measures taken by the authorities; therefore, a country with more porous borders will be the staging ground for attacks against targets from other, more secure, countries. A further prediction of the model is that complementary tactics would respond in a similar fashion to relative price changes. For

example, assassinations and bombings tend to be substitutes, while bombings and threats are complementary. Thus, the model predicts that a policy that makes it more costly to obtain assault weapons (an important input in an assassination) will reduce the number of assassinations but increase the number of bombings and threats. In contrast, government interventions that raise the price of all terrorist tactics or that reduce terrorists' resources will cause non-terrorist activities to increase relative to terrorist actions. However, there is no reason to suppose that this type of policy will induce substitutions among the various attack models.

To be more formal, suppose that a group only uses two kinds of operations – hostage taking (h) and bombings (b). Further, suppose that the per-unit costs of each kind of operation are P_h and P_b for hostage taking and bombings, respectively. In general, these unit costs will depend on the level of operations and on the anti-terrorism expenditures of the authorities:

$$P_h = P_h(h, g_h), \quad \partial P_h / \partial h \geq 0 \text{ and } \partial P_h / \partial g_h \geq 0 \quad (4)$$

$$P_b = P_b(b, g_b), \quad \partial P_b / \partial b \geq 0 \text{ and } \partial P_b / \partial g_b \geq 0 \quad (5)$$

where g_h and g_b are the government's anti-terrorism expenditures on hostage-takings and bombings, respectively.³

Taking as given the government's anti-terrorism expenditures and their own total level of resources (R), the terrorists choose h and b to maximize their utility

$$U(h, b), \quad (6)$$

subject to:

$$R = P_h(h, g_h) h + P_b(b, g_b) b. \quad (7)$$

Under the standard assumptions, it is possible to show that hostage taking and bombings

³ Notice that in our 2-incident example, we abstract from direct substitutability and complementarity. In a more general setting, we could allow the price of bombings to depend on the number of hostage takings and the price of hostage-takings to depend on the number of bombings. Moreover, anti-terrorism spending directed towards one type of incident might be expected to increase the price of the alternative incident types.

decrease when the authorities manage to limit the terrorist's resource base R . Moreover, actions by the authorities to increase the unit cost of, say, hostage taking cause terrorists to switch some operations to the now relatively cheaper bombing events.

A third choice of terrorists involves an intertemporal allocation of resources. Analogous to other investors, terrorists can invest resources to earn a rate of return, r , per period. When terrorists want to augment operations, they can cash in some of their invested resources.

Suppose that terrorists have a two-period horizon and must decide terrorist activities today (T_0) and tomorrow (T_1) based on resources today (R_0) and tomorrow (R_1). The intertemporal budget constraint is:

$$T_1 = R_1 + (1 + r)(R_0 - T_0), \quad (8)$$

where tomorrow's terrorism equals tomorrow's resource endowment plus (minus) the earnings on savings (the payments on borrowings) from the initial period. Terrorists maximize an intertemporal utility function, $U(T_0, T_1)$, subject to (8) and, in so doing, decide terrorist activities over time. Thus, terrorists can react to shocks by augmenting operations not only from curbing non-terrorist activities, but also through an intertemporal substitution of resources.

Unlike a standard intertemporal optimizing framework, the capital market is not perfect – terrorist groups cannot fully borrow against their expected future income levels. As such, there may also exist a liquidity constraint. If high-terrorism periods are to be supported by an intertemporal substitution, it may be difficult for terrorists to maintain a prolonged campaign. As such, particularly long and intense terrorist campaigns are not as readily sustained as lower levels of conflict. This prediction may not characterize non-resource-using threats and hoaxes.

We can summarize some of the key predictions and implications of the household production approach as follows:

Substitutions across attack modes: An increase in the probability of success, a decrease in the relative price, or an increase in the payoff of any one type of attack mode will increase that type of attack.

Effects of government policies: Government policies aimed at a single type of terrorist event (e.g., the installation of bomb-sniffing equipment in airports) adversely changes its relative price and results in a *substitution* into now less expensive modes of attack. Thus, Landes' (1978) measure of the success of metal detectors, in terms of fewer skyjackings, does not go far enough, because the application of this technology may have induced a large number of other kinds of events.

Substitutions across countries: A decrease in the probability of success or a reduction in the payoff in successfully attacking any one country will reduce the number of attacks on that country. Given their available resources, terrorists will move planned attacks into similar, relatively less-protected countries.

Intertemporal Substitutions: High-terrorism states deplete resources and so are followed by low-terrorism states. Particularly long and intense terrorist campaigns are not as readily sustained as are lower campaign levels.

3. Evidence of the Substitution Effect

The data we use is constructed from the source files of ITERATE (*International Terrorism: Attributes of Terrorist Events*). ITERATE was originally developed by Edward Mickolus (1982) and has been extended by Mickolus, Sandler, Murdock, and Fleming (1989, 1993) and Fleming (2001). Todd Sandler updated select variables through 1999-2000. ITERATE uses information from publicly available sources to construct a chronology of transnational terrorist events. The sources for ITERATE include the Associated Press, United Press International, Reuters tickers, the Foreign Broadcast Information Service (FBIS) *Daily Reports*, and major US newspapers (e.g., the *Washington Post*, *New York Times*).

Figure 1 displays the quarterly totals of all transnational terrorist events over the 1968:1 - 2000:4 period. In contrast to the impression cast by the media, the number of transnational terrorist incidents has been declining since 1993. Bombings are the favorite mode of operation of terrorists, accounting for about half of all transnational terrorist incidents on average in any

given year. As is evident from the figure, transnational terrorism displays a number of sharp peaks and troughs. Some of the fluctuations are due to landmark political events. The jump in 1979 can be attributed to the political ramifications surrounding the takeover of the U.S. embassy in Tehran (Enders and Sandler, 2000). The spike in 1986 is associated with the U.S. retaliatory raid against Libya that occurred on 15 April 1986. The latter half of the 1990s represents a downturn in transnational terrorism due, in large part, to fewer states sponsoring terrorism in the post-Cold War era (Enders and Sandler, 1999).

Substitutions and religious based terrorism

Despite the decline in overall terrorism, Figures 2 and 3 paint a grim picture. Figure 2 shows the number of individuals KILLED per quarter in all transnational events, and Figure 3 shows the quarterly proportion of incidents with CASUALTIES and the proportion with deaths. Notice that the values of the KILLED series have generally increased since 1993. Over the entire sample period, an average of 63 individuals have been killed in each quarter. Beginning in 1993, the average number of deaths has increased to 79 per quarter. This pattern is reinforced by the data shown in Figure 3. The proportion of incidents with CASUALTIES (the dashed line in the figure) has remained fairly stable since 1973; however, the proportion of incidents with deaths has more than doubled over the same period. In fact, the proportion of casualty incidents without deaths (i.e., those with only wounded individuals) has declined. In recent years, there has been little difference between the proportion of incidents with casualties and the proportion of incidents with deaths. The strong impression from Figures 1-3 is that the number of incidents has been declining while the typical incident is becoming much more lethal. The increase in the proportion of deadly incidents is consistent with the HPF model. Enders and Sandler (2000) trace the increase in the severity of a typical terrorist incident to the takeover of the US Embassy in Tehran. The change in the composition of terrorists from less leftist groups to more religious

groups means that terrorists no longer fear death. Moreover, fundamentalist terrorist groups purposely seek out mass casualties, viewing anyone not with them as a legitimate target. As such, the typical incident is more likely to involve the death of a terrorist and/or the public.

The assassination series shown in Figure 4 includes both successful and failed assassinations. As such, the values shown exceed the number of assassinations resulting in deaths. Notice that the overall pattern of the series follows the pattern of transnational incidents shown in Figure 1. The disturbing feature is that assassinations are declining while the number of incidents with deaths is increasing; as such, more KILLED incidents involve non-protected persons and multiple victims.

Substitutions and government policy interventions

Enders and Sandler (1993, 1995) apply vector autoregression (VAR) analysis to capture the potential interactions among various terrorist attack modes (e.g., skyjackings and other hostage events) in response to government policies. They find that the installation of metal detectors in airports (begun in 1973) decreased skyjackings and threats, but increased other kinds of hostage incidents, not protected by detectors. Specifically, metal detectors were estimated to reduce skyjackings and threats and hoaxes by 13 and 9.5 incidents per quarter, respectively. However, the number of other hostage-taking incidents and assassinations rose by almost 10 incidents per quarter. The measured trade-off between skyjacking and other logistically complex events was nearly one for one (also see Enders, Sandler, and Cauley, 1990; Im, Cauley, and Sandler, 1987). In terms of the HPF approach, the installation of metal detectors in US airports increased the relative price of a skyjacking. Skyjackings fell and so did the complementary threats and hoaxes. This policy intervention had primarily a substitution effect, because it did not deplete the resources, knowledge, or wherewithal of the terrorists. Substitutions across attack modes were also found to be important when the United States fortified its embassies in

1985 in accord with public law 98-533. Although direct attacks on embassies were reduced, an indirect consequence was that the number of political assassinations was increased by 5.4 incidents per quarter.

Intertemporal Substitutions

Both Brophy-Baermann and Conybeare (1994) and Enders and Sandler (1993) examine the effects of retaliatory raids on intertemporal substitutions. Brophy-Baermann and Conybeare (1994) find that retaliations by Israel against Palestinian terrorists had no lasting effects on the level of terrorism. They posit a model such that rational terrorists select a long-run or 'natural' rate of attacks. The actual level of attacks will differ from the 'natural' level only in the presence of an unanticipated event. In 1972, Israel conducted nine air raids against PLO camps in Syria in retaliation for Black September's attack on Israeli athletes in the 1972 Munich Olympic games. These attacks were estimated as *increasing* the number of PLO attacks against Israel by 9.39 incidents on impact. After three quarters, the PLO attacks were only 0.5 incidents above the natural rate. Five other Israeli attacks were found to have no long-run statistical effect on PLO terrorism.

Similarly, Enders and Sandler (1993) establish that the US retaliatory raid against Libya on April 1986 (for its suspected involvement in the bombing of the La Belle Discothèque in West Berlin on 4 April 1986) was associated with an immediate increase in terrorist attacks against US and UK interests. The raid involved eighteen US F-111 fighter-bombers being allowed to take off from UK airbases in Lakenheath and Upper Heyford. The planes were deployed from UK airbases because European nations, geographically closer to Libya, refused to allow the United States to use their airbases or their airspace. This endangered the raid since it forced the US fighters to refuel in midair after flying through the Strait of Gibraltar.

As a result of the raid, terrorist attacks against US and the UK interests were estimated to

have increased by 39 incidents. However, the attacks had very little persistence as there was a temporary lull while terrorists built up depleted resources. In the long run, the mean number of attacks directed against US and UK interests was found to be unchanged. The evidence seems to be that retaliatory raids induce terrorists to *intertemporally* substitute attacks planned for the future into the present to protest the retaliation. Within a relatively few quarters, terrorist attacks resumed the same mean number of events.

However, the Israeli raids against the PLO and the US raid against Libya did destroy some of the terrorists' resource base, so that one must wonder why overall terrorism did not diminish as a result. One answer is that the retaliations were not sufficient to destroy a significant portion of the terrorists' bases or personnel. A second answer is that the raids actually made it easier for terrorists to recruit new members and to raise funds. A third answer is that Libya was not responsible for a lot of transnational terrorism.

Enders and Sandler (2002) find additional evidence of intertemporal substitutions using a threshold autoregressive (TAR) model. The HPF model implies that high-terrorism states are difficult to maintain if there are important liquidity constraints. In the midst of an intense terrorist campaign, weapons, funds, and personnel may be depleted. In contrast, a low-terrorism state can be maintained almost indefinitely; during this time, terrorists can recruit individuals, raise funds, and acquire weapons. As such, low-terrorism states should be more persistent than high-terrorism states. Enders and Sandler (2002) let y_t denote the number of incidents with deaths over the 1970:1-1999:4 period and estimate the TAR model (with t -statistics in parenthesis):

$$y_t = [21.53] I_t + [7.09 + 0.47y_{t-1}] (1 - I_t), \quad (9)$$

(23.02) (3.12) (2.41)

$$\text{where: } I_t = \begin{cases} 1 & \text{if } y_{t-1} \geq 18 \\ 0 & \text{if } y_{t-1} < 18. \end{cases}$$

The threshold model suggests that there is no single long-run equilibrium value for the number of incidents; instead, there are high- and low-terrorism regimes or states. In the low state (i.e., when the number of incidents is less than 18), the system gravitates toward 13 incidents per quarter [$7.09 \div (1.0 - 0.47) \approx 13$]. If, however, the number of incidents exceeds the threshold, there tends to be an immediate jump to 21.53 incidents. Whenever the number of incidents exceeds this threshold due to a shock or event, there will be an immediate decline to 21.53 incidents in the subsequent quarter. The high-incident state can be maintained until a shock of sufficient magnitude causes a switch of regime; however, the number of events in this heightened state cannot be maintained at more than 21.53 incidents. Insofar as the estimated standard deviation of is equal to 6.14, the magnitude of a typical shock is likely to cause a regime switch.

Policy Implications

The findings that substitution effects are important have a number of implications for government policymaking. Clearly, governments must act to reduce the terrorists' resource endowments (i.e., their finances, leadership, and membership) if an overall decrease in terrorism is to follow. Efforts to infiltrate and undermine terrorist groups and to freeze their assets have the consequence of reducing the overall amount of terrorism.

Even some piecemeal policies that cause substitutions by focusing on only part of the overall terrorism problem may have some net positive impacts. To the extent that the National Defense Authorization Act leads to a reduction in the likelihood of biological terrorism, substitutions into other attack modes will occur. The desirability of such policies is that they may force terrorists to substitute into *less harmful events*. Anti-terrorist policies can be most

effective when the government simultaneously targets a wide range of terrorist attack modes, so that the *overall* rise in the prices of terrorist attacks becomes analogous to a decrease in resources. A government must maintain the resolve to fight terrorism. Terrorists do not have the same ability as governments to maintain a sustained offensive. A short-lived governmental effort to fight terrorism will afford the group time to regroup and replenish its resources. Success in raising the price of all modes of terrorist attacks and/or in reducing terrorists' resources would induce them to shift into legal protests and other nonterrorist actions to air grievances.

Similarly, the development of technological barriers to thwart terrorism causes a substitution into other attack modes in the short run. In the long term, terrorists will develop ingenious countermeasures to circumvent the technology. Immediately after airport vigilance was increased as a result of 9/11, Richard Reid (aka Tariq Rajah) was discovered on a flight from Paris to the United States with an explosive device in his shoes. Now that airport security routinely inspects shoes, plastic guns, electronic jamming equipment, bottles of flammable liquid or other explosive devices are predicted to be hidden on (or in) the terrorist or in carry-on luggage. Thus, there are dynamic strategic interactions; authorities must be vigilant to improve technology by anticipating ways of circumventing current technological barriers. This vigilance must lead to periodic upgrades in the technology prior to the terrorists exposing the technology's weakness through a successful attack.

4. What We Do Not Know About the Substitution Effect

ITERATE poses a number of shortcomings that researchers must take into account when testing theories. First, since it relies on public sources such as newspaper accounts, ITERATE picks up only *newsworthy* transnational terrorist incidents. However, what is deemed

“newsworthy” changes over time as the public becomes desensitized to terrorism. For example, ITERATE contains the following incident:

November 5, 1985— **GREECE** — Police discovered a bomb in a suspicious-looking cloth bag planted between the first and second floors of an Athens building at 8 Xenophon Street. The building housed the offices of Trans World Airlines. Bomb experts removed the bomb and detonated it without mishap.

Given the increased severity of terrorist events, such an attempted bombing might not be prominently reported in the newspapers. Thus, ITERATE might suggest that certain types of terrorist events may have declined simply because they are no longer reported. Of course, this bias is more likely for threats, hoaxes, and bombings without casualties than for incidents with deaths. The bias has worsened since mid-1996, when the FBI’s *Daily Reports* became unavailable to ITERATE coders. Moreover, by relying on newspaper accounts, ITERATE is better at describing the actions of terrorists than of the authorities. In some instances, government strategies are revealed and coded in ITERATE. However, anti-terrorism initiatives may have been undertaken in secret in response to an undisclosed terrorist threat. To circumvent such limitations of ITERATE, the US government should give proven researchers access to the unclassified portions of its more inconclusive data sets. The same is true of the RAND-St. Andrews data set on incidents, which we have tried unsuccessfully to acquire. The true biases in these data sets can only be ascertained by testing the same hypothesis with alternative data sets.

Clearly, there is much to learn about the substitution effect. Only a portion of the problem concerns data limitations. Instead of presenting a “laundry list” of unknowns, we conclude with three useful directions for future research involving substitutions associated with terrorist negotiations, terrorist recruitment, and terrorist networks.

Atkinson, Sandler, and Tschirhart (1987), Sandler and Scott (1987), Lapan and Sandler

(1988), Selton (1988), Islam and Shahin (1989), Scott (1991), and Shahin and Islam (1992) examine the effects of negotiating with terrorists. If terrorism becomes successful, the HPF model predicts that terrorists will devote more of their resources to terrorist activities and that new terrorist groups will emerge. However, the extent to which a concession to one terrorist group induces additional terrorist incidents needs to be satisfactorily established.

As posited, the HPF model treats the resources of a group as given. Nevertheless, groups can obtain resources through publicity. An extremely heinous or highly visible attack may provide a signal that the responsible group is particularly influential or powerful. Such attacks may lower recruiting costs so that major campaigns become more sustainable. This means that the recruiting decisions are not independent of the mode of attack.

The HPF model analyzes the choice-theoretic decision of a single terrorist group. If terrorists are tied together implicitly through similar hatreds (e.g., of Israel and the United States), then multiple terrorist groups may simultaneously act as a unified whole. However, there may be important *network externalities* or interdependencies not directly captured by the HPF model of a single group. Since attack modes may be complementary, the actions of one group may affect the behavior of other groups. For example, attacks by al-Qaida may make it more desirable for a second terrorist group to also attack the US interests. Moreover, strikes against terrorists in Afghanistan may make it easier for terrorists elsewhere to recruit individuals and resources. Such complementarities may induce terrorists worldwide to take on the appearance of a single group even though they have no direct links with each other.

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Figure 1: All Incidents

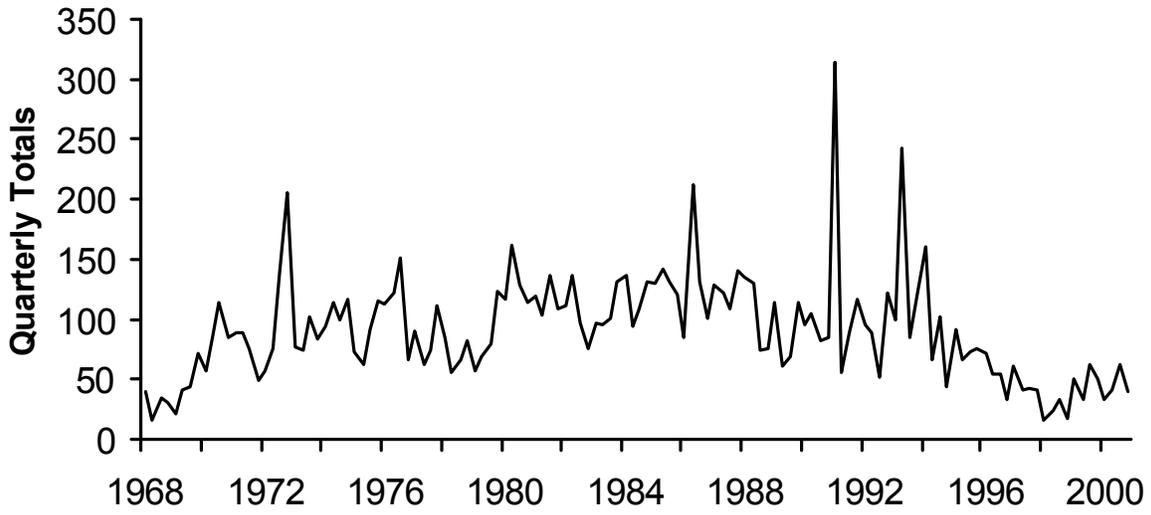


Figure 2: Individuals Killed

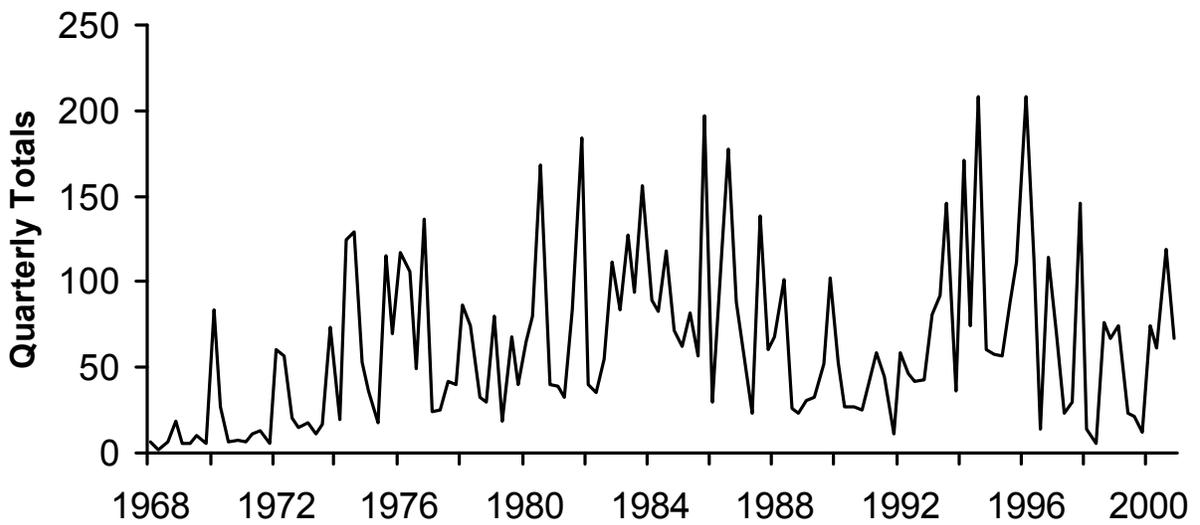
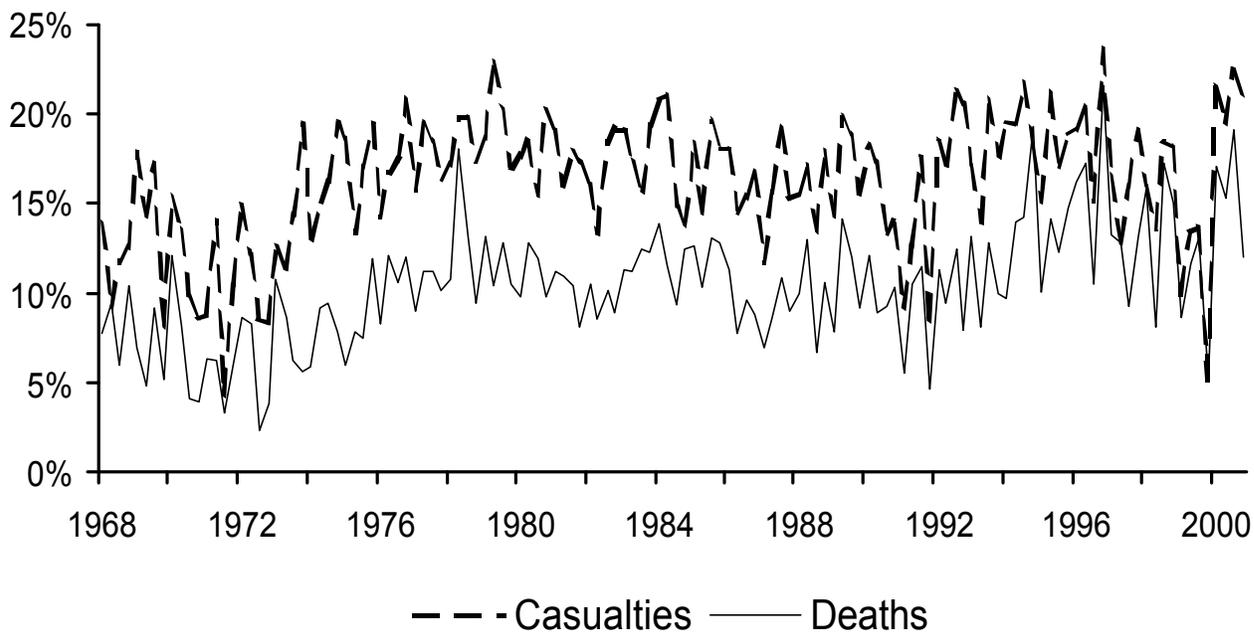


Figure 3: Proportions of Casualty and Death Incidents**Figure 4: Assassinations**