TERRORISM IN A BARGAINING FRAMEWORK*

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Few terrorist missions are suicidal. Most terrorist missions are against so-called soft targets and embody fairly elaborate escape plans. The threat of the political terrorist generally emanates less from his desire for suicide than from his preparation, both mental and physical, to take hostages and wait out the dialogue of negotiations.¹

I. INTRODUCTION

ALTHOUGH hostage seizures are a small percentage of terrorist incidents, they represent some of the most spectacular and influential events.² The takeover of the American embassy in Tehran on November 14, 1979, the seizure of eleven OPEC oil ministers on December 21, 1975, and the capture and killing of nine Israeli athletes on September 5, 1972, are incidents not easily forgotten. From 1968 through 1982, of the approximately 8,000 reported terrorist events, 540 (7 percent) were transna-

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¹ Abraham H. Miller, Hostage Negotiations and the Concept of Transference, in *Terrorism: Theory and Practice* 137, 147 (Yoram Alexander, David Carlton, & Paul Wilkinson eds. 1979).

² Terrorism has been defined as the premeditated "threatened or actual use of force or violence to attain a political goal through fear, coercion, or intimidation." Charles A. Russell, Leon J. Banker, & Bowman H. Miller, Out-Inventing the Terrorist, in *id.* at 3.

tional³ hostage-taking acts involving 3,162 hostages.⁴ Twenty percent of these acts resulted in death or personal injury to the victims. Since 1968, 188 terrorist groups have seized hostages in incidents involving kidnapping, skyjacking, and barricading. The bulk of these acts have been directed at the industrialized democracies, especially the United States and Western Europe.⁵ Even though governments are dealing more effectively with these incidents, terrorists have been very successful. (1) In kidnappings, terrorists successfully capture their hostage(s) in 80 percent of the acts and receive their ransom demands in 70 percent of the incidents. (2) In barricade and hostage incidents, the terrorists achieve at least a portion of demands in 75 percent of the cases.

The purpose of this paper is to examine formally terrorist incidents as bargaining situations between the terrorists and government officials⁶ and then to test econometrically a number of hypotheses that emerge from the theoretical bargaining literature. Using data on international terrorism events, we investigate the effects that changes in bargaining costs have on the incident's length and its outcome (for example, the amount of ransom paid). In so doing we test for the underlying probability distribution associated with an incident's duration. We attempt, furthermore, to discern the effect of bluffing on the terrorist's payoff. We use both a Tobit regression to explain ransoms paid and a time-to-failure regression to explain incident duration.

The body of this paper contains three sections. The bargaining framework of terrorist incidents is discussed in Section II, our empirical analysis follows in Section III, and conclusions are contained in Section IV.

II. TERRORISM IN A BARGAINING FRAMEWORK

During the past eighteen years, terrorists have often seized hostages as a means of circumventing legislative and electoral processes to make their political demands directly to either government officials or the public.

³ For transnational terrorism, terrorists or government participants from two or more countries are involved. Incidents originating in one country and terminating in another are transnational in character, as are incidents involving demands made of a nation other than one in which the incident occurs.

⁴ Unless indicated otherwise, the facts reported in this paragraph are taken from the U.S. Department of State, *International Terrorism: Hostage Seizures* (1983).

⁵ U.S. Central Intelligence Agency, *Patterns of International Terrorism: 1980* (1981).

⁶ A theoretical model of terrorism is presented in Todd Sandler, John T. Tschirhart, & John Cauley, *A Theoretical Analysis of Transnational Terrorism*, 77 *Am. Pol. Sci. Rev.* 36 (1983). William M. Landes, *An Economic Study of U.S. Aircraft Hijacking, 1961–1976*, 21 *J. Law & Econ.* 1 (1978), analyzed skyjackings using a basic deterrence model to ascertain the effectiveness of antiskijacking measures introduced in the 1970s. He did not examine bargaining in these incidents.

Once the hostages are captured, in either a barricade or a kidnapping situation, a form of bargaining between the terrorists and the government ensues. Terrorists typically demand money, the release of prisoners, or the airing of propaganda statements to further political objectives. For these incidents, terrorists can usefully be described as net-payoff maximizers with the net payoff being the differences between government concessions and the costs of bargaining. For the government, officials are also concerned with maximizing net payoffs when deciding their concession-granting response. As the incident drags on, the government experiences bargaining and waiting costs that include terrorists' publicity, negotiating resources, and the detrimental effects of apparent government ineffectiveness. After accounting for bargaining costs, the terrorists desire to achieve the greatest possible demands, while the government wishes to yield the least possible concessions.

We reject the argument of the news media that terrorists are characteristically madmen who cannot be bargained with. Stohl has argued that the madman depiction is a myth because many terrorist groups have particular goals that are sought as part of an ongoing political struggle.⁷ Stohl also cited numerous instances in which careful negotiations regarding the terrorist demands led to peaceful solutions to hostage incidents.⁸ Miller noted that very few terrorist missions are suicidal because captured terrorists often have escape plans.⁹ A recent Rand conference report supports this by stating that "[a] CIA estimate shows that 62 percent of terrorist missions had elaborate escape plans built into them."¹⁰ Mickolus¹¹ and the U.S. Central Intelligence Agency¹² have shown that political terrorists rank the tactics that they adopt with respect to such factors as risk, time, and the probability of confrontation with authorities. Such high-risk activities as hijacking and barricade missions have the smallest incidence; such low-risk tactics as bombings and assassinations have the highest. The majority of terrorists appear to be very concerned with their own lives as well as with their cause; hence negotiation is a means to end some incidents.

Another school of thought supports the notion that terrorists should not

⁷ Michael Stohl, Introduction: Myths and Realities of Political Terrorism, in *The Politics of Terrorism 1* (Michael Stohl ed. 1979).

⁸ *Id.* at 6–7.

⁹ Miller, *supra* note 1, at 147.

¹⁰ Brian M. Jenkins, *Terrorism and Beyond: An International Conference on Terrorism and Low-Level Conflict* (1982).

¹¹ Howard F. Mickolus, *Transnational Terrorism: A Chronology of Events, 1968–1979*, at xix, xxv (1980).

¹² U.S. Central Intelligence Agency, *supra* note 5, at 11.

be bargained with. In fact, the standing policy for the United States and Israel is one of no negotiation.¹³ We neither argue against this policy nor promote the negotiation approach. We merely observe that negotiations do take place in many terrorist incidents involving hostages, and we intend to study these negotiations in a bargaining framework.¹⁴ Thus we examine terrorist incidents in which bargaining took place and test several hypotheses derived from bargaining theory.

While there exists a rich literature on the theory of bargaining, very little can be found on the empirical testing of real world bargaining situations. Ashenfelter and Johnson and Farber have studied wage disputes, the former testing hypotheses concerning the conditions likely to lead to union strikes¹⁵ and the latter using data taken from strikes to estimate union concession rates on wages.¹⁶ However, strikes are complicated by the fact that they arise only after bargaining has failed. To our knowledge, our paper represents the first attempt to test a number of hypotheses based on bargaining costs using data from intense, real world bargaining environments.

The lack of empirical results in the literature is probably indicative of the difficulty in deriving hypotheses from bargaining theory that can be tested using data. Since the seminal work of Nash,¹⁷ an elegant body of mathematics has been formulated to explain this most pervasive problem in economics—two-party bargaining. Most of the literature revolves around how a single pie will be divided between the parties. The time required to reach agreement is typically omitted from the analysis, and the only communications between the parties are statements concerning acceptable shares. Yet even in this setting the data needed for empirical testing are often limited. Additional difficulties arise because real world bargaining situations never conform to the relatively simply structure analyzed in the theory. For example, consider a terrorist incident with

¹³ Even the Israelis have made exceptions to their no-negotiation policy, as was the case in a barricade event on May 15, 1974, involving ninety children hostages in Maalot. Negotiations eventually broke down, the Israelis stormed the school, and twenty-one children were killed.

¹⁴ Negotiations helped end infamous incidents such as the 1979 Iranian takeover of the American embassy in Tehran, the M-19 terrorists' seizure of forty-five diplomats at the Dominican Republic's embassy in Bogota, Columbia, on February 27, 1980, and the terrorist capture of the OPEC ministers in Austria in 1975. Details about these incidents are available in U.S. Department of State, *International Terrorism: Hostage Seizures* (1983).

¹⁵ Orley Ashenfelter & George Johnson, *Bargaining Theory, Trade Unions, and Industrial Strike Activity*, 59 *Am. Econ. Rev.* 35 (1969).

¹⁶ Henry S. Farber, *Bargaining Theory, Wage Outcomes, and the Occurrence of Strikes*, 68 *Am. Econ. Rev.* 262 (1978).

¹⁷ John F. Nash, *The Bargaining Problem*, 18 *Econometrica* 155 (1950).

hostages. Terrorists often have multiple demands. Moreover, bluffing is commonly observed when terrorists permit self-imposed deadlines to pass. Threat points may change over the course of the incident as terrorists, hostages, or officials are killed or wounded. And prior to the final settlement, which may be a negotiated agreement or a shoot-out, other secondary negotiations may be ongoing over issues concerning whether the terrorists will release some hostages early.

In spite of the complexity surrounding terrorist negotiations, we find that the available data do provide an opportunity to test several bargaining theory hypotheses that involve bargaining costs, bluffing, and the duration of the incident. These three variables are emphasized in varying degrees throughout the literature,¹⁸ but we will refer chiefly to the extensive work of Cross, in which all three are analyzed.¹⁹ Applying the Cross model, we view the terrorists (government officials) as maximizing the difference between their time-discounted utility, which is a function of their demands (concessions), and the time-discounted costs of bargaining. Each side maximizes its respective difference. Each party perceives that the duration of the incident equals the difference between current demands and concessions divided by the concession rate of the opponent. In choosing demands (concessions) in each period, the terrorists (government officials) can trade away large (small) values of demands (concessions) at the expense of a longer incident with its concomitant greater costs. The incident ends in a settlement when demands equal concessions. Instability exists in the Cross model when either party's time discount rate exceeds its rate of learning or the rate at which it perceives the opponent's concession rate to be changing. For a terrorist incident, instability often results in a violent conclusion.

We wish to test three hypotheses that emerge from the Cross model. (1) Increases (decreases) in bargaining costs to the terrorists induce them to decrease (increase) their demands owing to opportunity costs of waiting. Similarly, increases (decreases) in bargaining costs to the government cause it to raise (reduce) concessions. (2) Increases (decreases) in bargaining costs to either side will shorten (lengthen) the duration of the incident. (3) Bluffing will diminish a party's payoff.²⁰ Hypothesis 3 follows because exaggerated demands lead to a faster concession rate, which

¹⁸ Thomas C. Schelling, *An Essay on Bargaining*, 46 *Am. Econ. Rev.* 281 (1956), emphasized the role of bluffing and threats; and numerous authors have included bargaining costs in their models. Bishop was one of the first to include time; see Robert L. Bishop, *A Zeuthen-Hicks Theory of Bargaining*, 32 *Econometrica* 410 (1964).

¹⁹ John G. Cross, *The Economics of Bargaining* (1969); and John G. Cross, *Negotiation as a Learning Process*, 21 *J. Conflict Resolution* 581 (1977).

²⁰ Cross, *The Economics of Bargaining*, note 19 *supra*, at 170–76.

induces the opponent to hold fast. That is, it slows the learning rate of the opponent, and slower learners achieve higher payoffs. Bluffing might also take the form of a threat that is not carried out. For example, the terrorists might set a deadline by which the government must respond and then allow that deadline to pass uneventfully. Cross shows that such an unfulfilled threat reduces the imposed cost on the opposing party and hence lowers the expected payoffs to the bluffer.²¹

III. EMPIRICAL ANALYSIS

We proceed to describe in greater detail a terrorist incident involving bargaining and, in so doing, introduce the variables used in our econometric models. Table 1 provides precise definitions of the variables along with their means and standard deviations for the two regression models described below. An incident can be divided conceptually into five consecutive stages. The first stage is the initiation of the terrorist act. The terrorists, brandishing varying types of weapons (HIPWRW), seize a number of hostages (NUMHOS) in either a barricade, kidnapping (KIDNAP), or skyjacking (SKYJACK) situation. The hostages may represent a number of nationalities (NNATH), including victims from the United States (USVICT).

The second stage is the presentation of demands, during which the terrorists may begin a negotiating process by making their demands known to the government. Their demands may include a ransom (RANDE), the release of prisoners, and the airing of propaganda statements.

The third and longest stage is that of negotiation. During the course of bargaining, a number of terrorists (NUMTW) or hostages may be wounded (NUMHOSW). With current data sources we are unable to pinpoint when any wounds are inflicted, and they may occur during a different stage of the incident. The government may seek the early release of some hostages during negotiations, and the terrorists may respond by allowing sequential release (TASR). Another possibility is that some hostages may be substituted for nonhostages (ASUBHOS). The terrorists may also make threats and establish deadlines for official action on their demands but then allow the deadlines to pass without acting (DEADPAS).

The fourth stage marks the completion of bargaining. At this point some of the terrorist demands, such as the ransom to be paid (RANPD), may have been wholly or partly agreed to. Alternatively, the bargaining may

²¹ *Id.*, ch. 6 and at 167–70.

TABLE 1
DEFINITIONS, MEANS, AND STANDARD DEVIATIONS

Variables	Definition	Mean	Standard Deviation
ln(TI)	Natural log of the duration of the incident	.2626	2.329
NUMTW	Number of terrorists wounded	.2541 (.2381)	.6750 (.6555)
HIPWRW	1 if terrorists used high-powered weapons; 0 otherwise	.5410 (.4762)	.5004 (.5055)
NUMHOS	Number of hostages taken	38.34 (37.50)	53.37 (60.49)
TASR	1 if terrorists allowed sequential release of hostages; 0 otherwise	.3934 (.3333)	.4950 (.4771)
KIDNAP	1 if incident was a kidnapping; 0 otherwise	.3771 (.5714)	.4867 (.5009)
NUMHOSW	Number of hostages wounded	3.405 (2.143)	9.512 (7.087)
ASUBHOS	1 if terrorists allowed hostage substitution; 0 otherwise	.0984 (.0476)	.2990 (.2155)
USVICT	1 if one or more hostages were U.S. victims; 0 otherwise	.3689 (.4286)	.4845 (.5009)
SHOOT	1 if incident ended in a shoot-out; 0 otherwise	.2131	.4122
NNATH	Number of nationalities of hostages	2.377 (2.667)	2.734 (3.900)
SKYJACK	1 if incident was a skyjacking; 0 otherwise	.7131 (.7381)	.4542 (.4450)
DEADPAS	1 if terrorists allowed a deadline to pass; 0 otherwise	.1475 (.1667)	.3561 (.3772)
RANDE	Ransom initially demanded	130.05 (377.76)	555.98 (903.54)
RANPD	Ransom paid	59.89 (173.98)	457.79 (773.41)

NOTE.—The values in parentheses are for the forty-two observations included in the Tobit regressions. All other values are for 122 observations.

not have resulted in agreement, and one side may initiate a shoot-out (SHOOT).

The fifth and final stage covers the time between the acceptance of terms and the termination of the incident, at which time terrorists depart and hostages are released. The termination usually will not coincide with agreement to the set of concessions since the terrorists must still escape or the hostages be released.²² The time between concession acceptance

²² In the incident involving the OPEC ministers, a member of the hostages accompanied the terrorists on their safe conduct to Algeria. Only after landing in Algeria were the remaining hostages released. This pattern, in which some hostages are kept to ensure that concessions are received, appears to be typical.

and the release of the hostages may be especially long in kidnappings. Adding the time consumed by each of the five stages yields the total time of the incident (TI).

We view the terrorist incident as a recursive process. Variables that are endogenous at earlier stages become exogenous at later stages. Prior to stage 1, the terrorists must decide which weapons to brandish and whether to commit a kidnapping, skyjacking, or barricade incident.²³ Once the incident begins, it is usually too late for the terrorists to alter the type of weapons or the resources that they will use to manage the incident.²⁴ This is particularly true in barricade missions and skyjackings since the terrorists are themselves hostages to the authorities. During stage 1, the terrorists must also decide the number of the available hostages to take. Once demands are presented in stage 2, the authorities will not afford the terrorists another chance to capture hostages. As a hostage-taking event moves into stage 2, all the choice variables in stage 1 are treated as exogenous. Similarly, variables in stages 1 and 2, which include, among others, the number of hostages and the size of the terrorist attack force, typically cannot be changed during the negotiation stage (stage 3). In essence, once a decision is made in one stage either by the terrorists, by the government officials, or jointly, the parties are then committed to the consequences of that decision in all ensuing stages. Since we attempt to explain the variation in the actual demands paid and the duration of the incident—both of which are stage 4 and 5 variables—we can regress each of these variables on variables determined in earlier stages without concern about simultaneous equation bias. Data limitations, in terms of lack of information on the time occurrence of variables, require that we confine our empirical estimation to variables determined during stages 4 and 5 of an incident.

Our data are from the set *International Terrorism: Attributes of Terrorist Events* (ITERATE 2), which contains the attributes of all international terrorist events from 1968 to 1977; these are described by Mickolus.²⁵ We

²³ We do not examine the terrorists' choice of such endogenous variables as HIPWRW since data are not available on factors determining this and other stage 1–3 variables.

²⁴ During the June 1985 hijacking of TWA flight 847 originating in Athens, terrorists appeared to increase their weapons and personnel as the incident ensued. Authorities now believe that the additional weapons had been hidden on the plane (perhaps by baggage handlers) and that reinforcements had been arranged prior to the hijacking. This same pattern of prearrangement appeared to characterize the well-publicized March 2, 1981, hijacking of a Pakistani airline during a domestic flight. The incident finally ended in Kabul when authorities conceded to demands.

²⁵ Edward F. Mickolus, *International Terrorism: Attributes of Terrorist Events, 1968–1977* (ITERATE 2) (1982). This data bank is available through the Inter-University Consortium for Political and Social Research, University of Michigan, Ann Arbor.

examined three major types of terrorist activities that involved negotiation: kidnappings, barricade incidents, and skyjackings; and we ignored the other types of terrorist activities (such as bombings) since no effort was made by the terrorists to negotiate. In all, 387 events fall into these three categories. Because a number of incidents are not followed until completion, our final sample consisted of 122 observations. For variables with missing observations (up to 10 percent of all observations for some variables), we substituted the average for all recorded observations for that variable.

A. Ransom Paid as a Bargaining Solution

1. *Data and Discussion of Variables.* Of the 122 observed accidents, the terrorists issued multiple demands that included both ransom and prisoner release in twenty-three cases. In eighty cases, at least one of these two demands was made. Although we earlier cited the airing of propaganda statements as a third type of demand, our data set does not contain adequate information on this variable to include it in our analysis.

We modeled the negotiated prisoner releases but were unsuccessful in finding any significant factors that explain this stage 4 variable. Part of the difficulty lies in the fact that, while there were sixty-one incidents in which prisoner releases were demanded, in only thirteen were any prisoners actually released. Apparently, governments were very reluctant to bargain over prisoners. The average number of prisoners released in the thirteen incidents was small, so that the variance in prisoners released is small and difficult to explain.

In forty-two of the 122 incidents, ransom was demanded. These forty-two incidents were used in a Tobit regression to explain ransom paid (RANPD), which is a solution to the bargaining problem. The ransom paid was zero twenty times and was always less than or equal to the terrorists' initial demand. Zero can be thought of as the government's initial concession. We want to test hypotheses concerning how costs to the parties affected the ransom paid and whether bluffing was detrimental to one's cause. Since the ransom is paid in either stage 4 or stage 5 of the incident, variables in earlier stages are eligible as explanatory variables.

First, consider four variables that are expected to be positively related to the government's costs of bargaining and that therefore positively influence the amount of ransom paid (RANPD). If the terrorists use high-powered weapons (HIPWRW), there is a greater threat of damage to the hostages and property, and the expected costs are greater. The greater is the number of hostages taken (NUMHOS), the greater the expected cost to the government in terms of personal injuries and deaths. Greater initial

ransom demands (RANDE) by the terrorists increase the stakes for the government. *Ceteris paribus*, the more the terrorists demand, the more we expect them to receive. The number of nationalities represented by the hostages (NNATH) is an indication of how many foreign governments may bring pressure to bear on the victimized government. An increase in this variable increases the costs for the authorities and can be expected to result in higher ransom payments. An increase in the number of hostages wounded (NUMHOSW) should also increase the costs to the government, thereby having a positive effect on the ransom paid. However, this would also increase the costs to the terrorists, as the possibility that hostages might die diminishes the terrorists' threat point in bargaining. Also, wounded hostages may intensify the bloodthirsty image of the terrorists and the risk of a breakdown in bargaining; consequently, we cannot sign this variable *a priori*.

From the terrorists' viewpoint, we include two variables: one positively related and one inversely related to costs. An increase in the number of terrorists wounded (NUMTW) should augment the costs to the terrorists and have a negative influence on the ransom paid. If the incident is a kidnapping (KIDNAP), bargaining costs to the terrorists should be smaller than other types of hostage events since their whereabouts and those of the hostages are unknown. This secrecy of location should consequently increase the ransom paid.

Our priors on two additional variables are much weaker. If the hostages include U.S. victims (USVICT), the costs to the government may, on the one hand, increase since greater media coverage is likely or may, on the other hand, decrease given the no-negotiation policy of the United States. The terrorists may also feel safer with U.S. victims if they perceive that there is significant media pressure. Furthermore, if the media coverage is fulfilling propaganda demands, they may be inclined to settle for less ransom. Skyjackings (SKYJACK) differ from barricade incidents in certain ways, but *a priori* we cannot be sure of how the differences influence costs.

The last two variables we use to test the effect of costs on the bargained solution are whether the terrorists allow either sequential release of hostages (TASR) or substitution of hostages (ASUBHOS). These are stage 3 variables that can be thought of as preagreements between the parties. Presumably, if the terrorists submit to either of these preagreements, it is a result of ongoing negotiations. From the government's perspective, if some hostages are released or substituted, its costs of bargaining have decreased. Terrorists would presumably agree to these actions only if they perceived that their own costs would go down even more than those

of the government.²⁶ The terrorists' costs may go down if they receive needed food or medical supplies in return for the release or substitution of hostages or if they simply perceive that the government officials are unlikely to bargain further and may even storm the terrorists' stronghold unless some sign of cooperation is signaled. Thus we expect that the coefficients on both these stage 3 variables should be positive, indicating that a greater ransom follows this cooperation.

The second hypothesis that we test is whether bluffing is detrimental to one's cause. If the terrorists allow their self-imposed deadlines to pass (DEADPAS) without taking threatened actions, then, *ceteris paribus*, the final ransom paid should be smaller.

2. Results on the Ransom-paid Tobit Regression. Table 2 presents the results of the ransom-paid Tobit regression. Using a two-tailed test at the .05 level, all significant coefficients—those for TASR, RANDE, NNATH, and DEADPAS—have the theoretically predicted signs. These results hold in all three models displayed in Table 2. Model 1 includes all variables, while in models 2 and 3 various combinations of the three least-significant variables are excluded on the basis of asymptotic *t*-values to examine the sensitivity of model 1 results to different specifications. The R^2 's between observed and predicted values for all three models exceed .96, and the global chi-square statistic easily rejects the null hypothesis that all slope coefficients are zero at standard confidence levels. The statistic $-2 \ln \lambda$, where λ is the ratio of the restricted to the unrestricted likelihood functions, is distributed asymptotically as χ^2 with degrees of freedom equal to the number of restrictions.

The statistically significant coefficients for TASR, RANDE, and NNATH lend support to the hypothesis relating bargaining costs to the bargaining solution. The terrorists sequentially released hostages in fourteen of the forty-two incidents, apparently to decrease their cost relative to that of the government. Furthermore, terrorists receive greater ransom, *ceteris paribus*, when their initial demand is greater. Remembering that estimated coefficients must be transformed to yield partial derivatives, for models 1–3 at the mean of the data we compute that terrorists receive \$0.47–\$0.48 for each additional dollar they demand. However, we would not expect that this would necessarily hold for exorbitant ransom demands beyond the range of our data. Finally, the more nationalities

²⁶ Cross, *The Economics of Bargaining*, *supra* note 19, ch. 6, shows that one party would always take an action that would reduce its costs and either leave unchanged or raise its opponent's costs. In addition, the party would take an action that raises (lowers) its costs if it also raises (lowers) the opponents costs by a greater (lesser) amount.

TABLE 2
ESTIMATED PARAMETERS FOR RANSOM-PAID TOBIT REGRESSION

INDEPENDENT VARIABLES	MODELS		
	1	2	3
Constant	-883.74** (-1.8957)	-960.28* (-2.1665)	-920.06* (-2.1393)
NUMTW	-181.35 (-1.0122)	-188.77 (-1.1119)	-191.88 (-1.1244)
HIPWRW	19.454 (.13885)	...	...
NUMHOS	-3.0402 (-.95102)	-3.4546 (-1.0904)	-3.7870 (-1.2478)
TASR	901.99* (2.7023)	997.49* (3.2174)	1,000.5* (3.2299)
KIDNAP	216.10 (.86304)	264.97 (1.1540)	266.32 (1.1614)
NUMHOSW	-24.837 (-1.0816)	-23.292 (-1.0631)	-22.787 (-1.0246)
ASUBHOS	93.105 (.44847)	78.192 (.37560)	...
RANDE	.53973* (4.9495)	.55172* (5.0567)	.55036* (5.0441)
USVICT	-93.924 (-.75039)	...	...
DEADPAS	-1,015.0* (-3.9822)	-1,007.8* (-3.9597)	-1,013.1* (-3.9876)
NNATH	124.87* (3.8787)	121.55* (3.8320)	122.84* (3.9029)
SKYJACK	401.09 (1.0899)	404.95 (1.0911)	367.77 (1.0290)
Log of likelihood function	-162.86	-163.15	-163.23
Global chi square	69.34	68.76	68.60
Degrees of freedom	12	10	9
Probability value	.0000	.0000	.0000
R ² between observed and predicted	.9688	.9675	.9675

NOTE.—Data include forty-two incidents in which ransom was demanded. Asymptotic *t*-values in parentheses.

* Significant at .05 level for a two-tailed test.

** Significant at .05 level for a one-tailed test.

represented by the hostages, the greater the ransom conceded, *ceteris paribus*. We expect that pressures brought to bear from other governments explain this. Also, this suggests that certain types of targets, such as foreign embassies or international flights, may be more lucrative for terrorists. The terrorists allowed deadlines to pass in seven of the forty-two incidents, and the significant statistical coefficient on DEADPAS indicates that bluffing, as we hypothesized, does not pay.

B. *Bargaining Costs and the Duration of the Incident*

The terrorists and the government officials may have different attitudes toward the desirability of dragging out an incident. The terrorists may favor lengthy incidents as their particular cause is given greater media exposure; the government loathes longer incidents for the same reason. Regardless, both parties can be expected to seek an earlier end to the incident as their recurring bargaining costs increase.

1. *Time-to-Failure Regression Models.* To test this hypothesis, we estimate several time-to-failure regression models.²⁷ “Time to failure” refers to the length of time from the beginning of the incident to its end and is measured by TI. Recently, this technique has been used in the economics literature for studies of unemployment spells and labor force participation.²⁸

For time-to-failure models, the survivor function evaluated at t is equal to the cumulative probability that an incident of length T will last or survive at least to t , where $T \geq t$. As t increases, the survival probability declines, which, in turn, indicates that the cumulative probability of ending the incident increases. The hazard function specifies the instantaneous rate of terminating an incident at t conditional on its survival to $T \geq t$. Quite simply, the hazard function provides a “marginal” picture, while the associated cumulative distribution gives a “total” picture regarding ending the incident at time t . Even though the hazard function may rise, fall, or remain constant as an incident survives over time, the cumulative probability of terminating the incident must rise. The techniques utilized allow us to test both for the nature of the hazard function and for how the variables in the first four stages of an incident might influence the hazard function by proportionately shifting it up or down.

We first examine two of the more popular densities describing failure time—the exponential and the Weibull. The former restricts the hazard function to be constant and therefore is sometimes referred to as being “memoryless.” The latter allows for a monotonic hazard function and includes the exponential as a special case. The Cox partially non-parametric proportional hazards model allows still more flexibility of the estimated hazard since it does not require monotonicity.²⁹

²⁷ More detail on these time-to-failure regression techniques is available in Scott E. Atkinson & John Tschirhart, *Flexible Modelling of Time-to-Failure in Risky Careers*, 68 *Rev. Econ. Stat.* (1986); and in J. D. Kalbfleisch & R. L. Prentice, *The Statistical Analysis of Failure Time Data* (1980).

²⁸ James Heckman & Burton Singer, *The Identification Problem in Econometric Models for Duration Data*, in *Advances in Econometrics* 39 (Werner Hildenbrand ed. 1982).

²⁹ D. R. Cox, *Regression Models and Life Tables*, 34 *J. Royal Stat. Soc’y: Series B* 187 (1972).

Another consideration is whether there may be omitted explanatory variables in the above models; that is, there may be unobserved heterogeneity. The potential bias from ignoring unobserved heterogeneity can result in negative duration dependence in models with no duration dependence at the individual level.³⁰ That is, the estimated hazard falls more rapidly or rises less rapidly than it would under corrected heterogeneity. To perform estimation free of such heterogeneity bias, we assume that the unobservables are distributed as gamma, and we mix this distribution with a Weibull density to obtain a more flexible duration distribution called the Burr type 12, beta- P , or Singh-Maddala distribution.³¹ The hazard for this distribution can assume a monotonic decreasing or upside-down bathtub shape over time as opposed to the exponential and Weibull with their constant and monotonic hazards, respectively.³²

2. *Discussion of Variables.* With the exception of the skyjacking variable, whose sign we could not predict a priori and which was not significant in the Tobit regression, all the variables representing costs (previously used to explain ransom paid) are also employed to explain incident length (TI). The expected signs on these variables can be determined by noting whether they represent either increases or decreases in bargaining costs to either party.

Factors that should be positively related to government costs and, hence, should shorten the incident (TI) include the use of high-powered weapons (HIPWRW), number of hostages (NUMHOS), and number of hostage nationalities (NNATH). Increasing terrorists wounded (NUMTW) should raise the terrorists' costs and shorten the incident, while kidnappings (KIDNAP) should lower the terrorists' costs and lengthen the incident. Also, as argued above, since allowing either sequential release (TASR) or substitution of hostages (ASUBHOS) lowers costs to both parties, both these actions should lengthen the incident. An increase in the number of wounded hostages (NUMHOSW) raises the costs to both parties and should contribute to shorter incidents. Finally, the possible inclusion of a U.S. victim among the hostages (USVICT) has an ambiguous expected sign since it may lower or raise costs to the parties.

We also include a variable to indicate whether the incident ended in violence (SHOOT) since slightly more than one-fifth of the 122 incidents involve a shoot-out. A violent ending indicates that bargaining was not

³⁰ Heckman & Singer, *supra* note 28.

³¹ *Id.*; and P. R. Tadikamalla, A Look at the Burr and Related Distributions, 48 Int'l Stat. Rev. 337 (1980).

³² Atkinson & Tschirhart, *supra* note 27.

successful; one or both parties opted for their threat point rather than prolonging negotiations. We include SHOOT in our regression equation with no a priori expectation on the sign of its coefficient.

The final two variables included in the time-to-failure regression models are the ransom demanded (RANDE) and the ransom paid (RANPD). The former represents the initial terrorist demand, while the initial government concession is presumed to be zero. Thus the greater is the initial ransom demanded, the broader is the contract zone, and, ceteris paribus, the longer we expect bargaining to last. The latter variable is less straightforward. Basically, we want to know how the amount of ransom paid influences the incident duration, given that this amount falls somewhere between zero and the ransom demanded. As the ransom paid approaches ransom demanded, we know that the government has conceded more and that the terrorists have conceded less of the initial gap between ransom demanded and zero. However, a small gap between the ransom demanded and the ransom paid might require a long or a short time to achieve. Thus we have no prior on the sign of RANPD.

3. Results of the Time-to-Failure Models. The estimated coefficients, their asymptotic standard errors, and the likelihood-ratio test statistics for the Cox and Weibull proportional hazards models are reported in Tables 3 and 4.³³ The coefficients of the Cox model are reparameterized to $-\beta$ for direct comparability. No intercept term is estimated for this model since the likelihood is independent of the scaling of TI. We first proceed to judge among density functions. The estimated value of the shape parameter, σ , in Table 4 is about 1.67 and is significantly greater than one at less than the .01 level. We therefore reject the exponential density, the results of which are not displayed, in favor of the Weibull. Since $\sigma > 1$, we conclude that the hazard function decreases over time.³⁴ This implies that the instantaneous rate of terminating an incident declines with the incident's duration: the longer an incident drags on, the less likely it will be ended in the next time period. An exponential density requires a constant or memoryless hazard, and this appears to be inappropriate for describing the duration of terrorist incidents. The Burr type 12 density, with its two shape parameters, allows for even greater flexibility than does the Weibull, which has only one. However, only one of the Burr type 12 shape parameters was significant. Moreover, the Burr type

³³ All our time-to-failure regressions employ maximum-likelihood estimation using a Newton-Raphson algorithm. For all models, convergence was rapid and highly insensitive to the choice of starting values. The Weibull and Cox proportional hazards and time-dependent covariate algorithms are based on a modified version of the FORTRAN computer programs listed in Kalbfleisch & Prentice, *supra* note 27.

³⁴ *Id.*

TABLE 3
ESTIMATED PARAMETERS FOR COX PROPORTIONAL HAZARDS MODEL

INDEPENDENT VARIABLES	MODELS		
	1	2	3
NUMTW	-.2236 (.1575)	-.1744 (.1433)	-.1901 (.1427)
HIPWRW	.1429 (.2446)	.1308 (.2452)	.1543 (.2434)
NUMHOS	.0008 (.0023)	.0004 (.0024)	.0010 (.0023)
TASR	1.0885* (.2878)	1.0355* (.2807)	1.0541* (.2805)
KIDNAP	1.7379* (.3046)	1.7598* (.3037)	1.7387* (.3028)
NUMHOSW	-.0192 (.0119)	-.0180 (.0111)	-.0172 (.0113)
ASUBHOS	-.3464 (.3351)	-.3618 (.3348)	-.3550 (.3342)
RANDE	.0009* (.0004)	.0008* (.0004)	.0009* (.0004)
RANPD	.0010* (.0004)	.0011* (.0004)	.0010* (.0004)
USVICT	.5079* (.2199)	.3987** (.2337)	.4836* (.2155)
SHOOT	.1413 (.2786)	...	...
NNATH	...	.0494 (.0570)	...
Log of likelihood function	-448.34	-448.08	-448.47
Global chi square	46.97	47.71	46.46
Degrees of freedom	11	11	10
Probability value	.0000	.0000	.0000

NOTE.—Negative of estimated coefficients reported for comparability with Weibull model. Asymptotic standard errors are in parentheses.

* Significant at the .05 level using a two-tailed test.

** Significant at the .05 level using a one-tailed test.

12 regression had fewer significant coefficients, and its log-likelihood function was substantially lower than was the Weibull's.³⁵ We therefore conclude that the added flexibility of the Burr type 12 is unnecessary and reject it in favor of the Weibull. Similar comparisons between the Cox and the Weibull are not possible since the former does not employ a true density function.

³⁵ The Burr type 12 regression results are available from the authors.

TABLE 4
ESTIMATED PARAMETERS FOR WEIBULL REGRESSION MODEL

INDEPENDENT VARIABLES	MODELS ^a		
	1	2	3
Constant	-.9652* (.4061)	-9.468* (.4072)	-.9248* (.3979)
NUMTW	-.4387** (.2573)	-.3779 (.2319)	-.3833** (.2309)
HIPWRW	.2662 (.4010)	.2654 (.4035)	.2795 (.3993)
NUMHOS	.0007 (.0038)	.0008 (.0040)	.0012 (.0038)
TASR	1.6261* (.4454)	1.5582* (.4320)	1.5671* (.4302)
KIDNAP	2.9578* (.4404)	2.9730* (.4437)	2.9599* (.4400)
NUMHOSW	-.0288 (.0188)	-.0261 (.0177)	-.0258 (.0177)
ASUBHOS	-.5438 (.5452)	-.5628 (.5444)	-.5593 (.5436)
RANDE	.0016* (.0007)	.0015* (.0007)	.0016* (.0007)
RANPD	.0018* (.0008)	.0019* (.0008)	.0018* (.0008)
USVICT	1.0712* (.3477)	.9921* (.3694)	1.0312* (.3398)
SHOOT	.2261 (.4621)	...	...
NNATH	...	.0250 (.0930)	...
Shape parameter σ	1.6615* (.1186)	1.6642* (.1189)	1.6619* (.1186)
Log of likelihood function	-255.41	-255.50	-255.53
Global chi square	55.22	55.04	54.98
Degrees of freedom	11	11	10
Probability value	.0000	.0000	.0000

NOTE.—Asymptotic standard errors in parentheses.

^a Dependent variable = $\ln(TI)$.

* Significant at the .05 level using a two-tailed test.

** Significant at the .05 level using a one-tailed test.

TABLE 5
ELASTICITY OF EXPECTED LENGTH OF INCIDENT AND BETA COEFFICIENTS FOR COX AND
WEIBULL PROPORTIONAL HAZARDS REGRESSIONS: MODEL 3

INDEPENDENT VARIABLES	ELASTICITY		BETA COEFFICIENTS FOR ln(TI)	
	Cox	Weibull	Cox	Weibull
NUMTW	-.0483	-.0974	-.0551	-.1111
HIPWRW	.0835	.1512	.0332	.0601
NUMHOS	.0383	.0460	.0229	.0275
TASR	.4147	.6165	.2220	.3300
KIDNAP	.6557	1.1162	.3633	.6185
NUMHOSW	-.0586	-.0878	-.0702	-.1054
ASUBHOS	-.0349	-.0550	-.0455	-.0718
RANDE	.1170	.2080	.2148	.3820
RANPD	.0519	.1078	.1966	.3538
USVICT	.1618	.3804	.0912	.2145

NOTE.—Data for model 3 evaluated at sample means.

We then carry out tests of functional form for nested densities and tests of the null hypothesis that some or all slope coefficients are zero for each model using the chi-square statistic described above. Examining the estimates for the Cox and Weibull models, we first reject the null hypothesis that all slope coefficients are zero: the global chi-square has a probability value less than .0000 for both models.³⁶ We estimate three specifications for the Cox and Weibull models, by including various combinations of the variables SHOOT and NNATH, due to their low significance levels based on the asymptotic *t*-ratios. The exclusion of combinations of these variables had little effect on the magnitudes of the other coefficients.

For the Cox and Weibull models, the coefficients on the variables TASR, KIDNAP, RANDE, and RANPD are significant at the .05 level using a two-tailed test, and, in addition, TASR, KIDNAP, and RANDE have their expected sign. Using a one-tailed test for NUMTW, which is justified by our strong priors, we find it to be significant at the .05 level for two of the three Weibull regressions only. Finally, USVICT, for which our priors were inconclusive, has a positive coefficient and is significant at the .05 level using a two-tailed test in five of six specifications.

In Table 5 we report two additional measures of the influence of each covariate on TI. Since the values of the estimated coefficients in Tables 3

³⁶ We also examined interaction terms; none were found to be significant at standard levels. Data sufficient to examine time-dependent covariates internal to each incident were not collected in the ITERATE 2 data set.

and 4 are sensitive to scaling, we present for the Cox and Weibull models the elasticity of the expected length of the incident with respect to each covariate evaluated at its mean. The covariates with the largest absolute elasticities are TASR, KIDNAP, and USVICT. Since elasticities do not incorporate the expected variation of each covariate, we follow Goldberger and also report “beta” coefficients, which measure the importance of individual regressors in explaining the dependent variable.³⁷ Based on these beta coefficients, KIDNAP is by far the most important variable explaining TI. In kidnapping, terrorists apparently experience far lower recurring bargaining costs. Dwelling on the Weibull (although the Cox is very similar), we have next, in order of importance, RANDE, RANPD, and TASR. These three are fairly close in importance but little more than half as important as KIDNAP. Not surprisingly, broader contract zones, *ceteris paribus*, will prolong bargaining. Also, if the terrorists do not make clear their demands and are perhaps chiefly interested in lengthy media exposure, the incident will drag on. Finally, the terrorists’ decision to release hostages sequentially has the intended effect of shortening the incident. The least-important variables of the six statistically significant ones are USVICT and NUMTW. When U.S. victims are among the hostages, the incident is longer, perhaps because the terrorists may be enjoying greater media exposure or because the U.S. government prefers stonewalling. The number of terrorists wounded is only about one-sixth as important as is kidnapping. The government probably cares little about wounded terrorists, while the terrorists themselves may anticipate martyrdom.

IV. CONCLUDING REMARKS

To our knowledge this paper represents the first attempt to analyze terrorist negotiations in a bargaining framework and then to test bargaining-theory hypotheses econometrically. The theory’s ability to identify *a priori* significant variables affecting ransom payments and the duration of hostage negotiations lends support to the use of bargaining models to generalize and to predict terrorists’ behavior. We have presented empirical results not inconsistent with our hypothesis that increases (decreases) in bargaining costs will help lengthen (shorten) an incident. Moreover, the evidence lends support to the view that bluffing works against the bluffer’s final payoff. Finally, we have seen that changes in bargaining costs appear to have the predicted influence on demands paid to terrorists.

³⁷ These “beta” coefficients are discussed in A. S. Goldberger, *Econometric Theory* (1964).

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