RANSOM AND TERRORIST HOSTAGE RELEASE

COMPETING RISKS ANALYSIS USING THE FINE-GRAY SUBDISTRIBUTION HAZARDS MODEL

Abstract

This study investigates how the demand and payment of ransom affect the chances of being released in terrorist hostage situations. We construct a proportional subdistribution hazards model predicting the effects of explanatory variables on the cumulative incidence of release. Using a likelihood ratio test to compare models with and without ransom variables, we find no evidence that the demand and payment of ransom has an effect on the cumulative incidence of release.

Introduction

The usefulness of paying ransoms in terrorist hostage situations has long been debated. It is the policy of the United States not to provide concessions in negotiations with terrorist organizations. Other countries, however, have a less consistent policy, and occasionally or regularly pay ransoms demanded by terrorists (Callimachi, 2014). Some claim that paying ransom encourages terrorist organizations to commit further attacks, while others defend ransoms on the basis of saving lives (Mellon, Bergen, & Sterman, 2017). Unfortunately, many of these debates are not informed by analyses of previous incidents and data. In this study, we examined how both the demand and payment of ransom affect the hazard of release. We performed our analyses accounting for the competing risks of other outcomes such as the death or rescue of hostages. We found no evidence to suggest that either ransom demands or ransom payment have a significant effect on the cumulative incidence of release. Our results support claims that, even when hostage recovery is of primary importance, governments should not negotiate or pay ransoms to terrorists.

Data

Our dataset of study is the Global Terrorism Database, which is compiled by the National Consortium for the Study of Terrorism and Responses to Terrorism (START) at the University of Maryland. It consists of detailed information on more than 170,000 terrorist attacks worldwide since 1970. Information on casualties, location, motivating ideology, methods, and targets are all available and accompanied by references to the original sources.

We selected all hostage-taking incidents from the database—those classified as kidnappings, hijackings, or in-place barricades. The database records seven possible outcomes of hostage incidents: hostage escape, hostage release, hostage death, successful hostage rescue, attempted hostage rescue, a combination of outcomes, and unknown outcomes. Of these incidents, we eliminated cases with an attempted rescue or combination outcome, and treated unknown outcomes as censored.

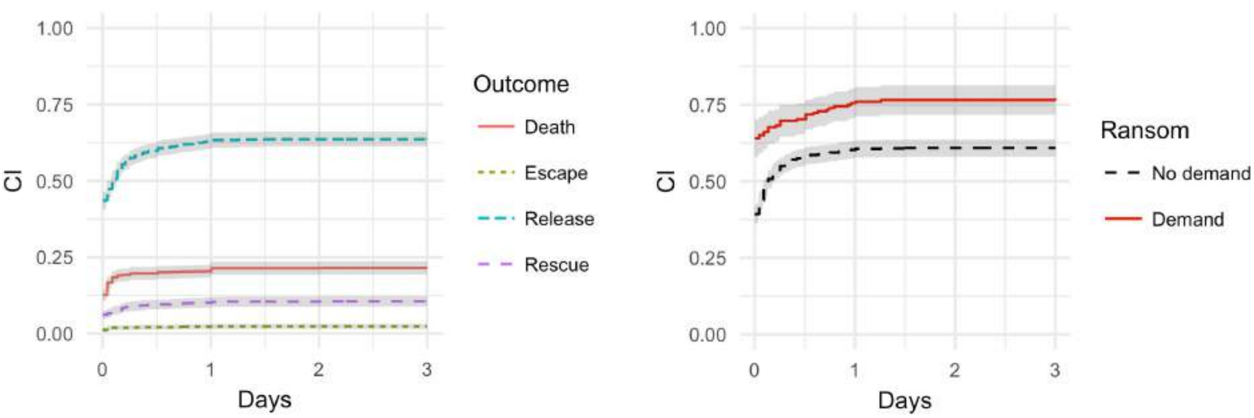

Figure 1: Cumulative incidence estimates over the first three days of hostage incidents.

We excluded the nine cases where a ransom was paid without it being demanded, leaving 1,221 observations, 756 of which contained all relevant variables necessary for our models. Last, we created several indicator variables and transformed versions of other covariates. Details of these transformations, as well as descriptions and summary statistics for each of our explanatory variables, are included in appendices A and B.

Figure 1 shows the cumulative incidence estimates for each of the four endpoints, and the estimates for the release depending on whether ransom is demanded or not. We used the cumulative incidence estimates instead of the Kaplan-Meier since the latter are biased in the presence of competing risks (Gooley, Leisenring, Crowley, & Storer, 1999). As the plots demonstrate, hostage release is the most common outcome, and most events occur within the first twenty-four hours. Additionally, before accounting for other factors, ransom demands appear to have an effect on release.

Methodology

In hostage situations, it is clearly not possible to separate the various outcomes—there is no scenario in which only the hostages' release is possible but their death, rescue, and escape are not. Consequently, these competing risks are extremely relevant to our analysis. If a variable has no direct effect on the hazard of release, but significantly increases the risk of another outcome such as death, the cumulative incidence of release will be lower because of the higher incidence of the other outcome. Our goal, then, is to model the effects of our covariates on the cumulative incidence of release. To do this, we used the proportional subdistribution hazards model developed by Fine and Gray (1999). They define the subdistribution hazard at time t as the instantaneous risk of failing from a cause K, given the individual has not failed from K by time t. This has the effect of treating failures from a competing risk as censored with a censoring time greater than all other event times. Analogous to the Cox proportional hazards model, the subdistribution hazard is then modelled as proportional to some unspecified baseline hazard, $\lambda_0(t)$, with the constant of proportionality an exponential function of the covariates.

In our analysis, we first performed backward elimination on the following full model, M_1, using the Akaike information criterion as our selection criteria:

$$\begin{aligned}\lambda(t) = \lambda_0(t)\exp(&\beta_0 + \beta_1 \mathit{multiple} + \beta_2 \mathit{hijacking} + \beta_3 \mathit{kidnapping} + \beta_4 \mathit{barricade} \\ &+ \beta_5 \mathit{individual} + \beta_6 \mathit{international} + \beta_7 \mathit{property} \\ &+ \beta_8 \mathit{log(hostages)} + \beta_9 \mathit{few.hostages} + \beta_{10} \mathit{many.hostages} \\ &+ \beta_{11} \mathit{d1970s} + \beta_{12} \mathit{d1980s} + \beta_{13} \mathit{d1990s} + \beta_{14} \mathit{d2000s} + \varepsilon)\end{aligned}$$

We then created model M_2 by adding a ransom demand indicator, and model M_3 by adding both ransom demand and ransom payment indicators. In all three models, we checked the validity of the proportional hazards assumption through examination of the Schoenfeld residuals (see Appendix C).

We compared M_3 to M_2, M_2 to M_1, and M_1 to a null model using the likelihood ratio test. This allowed us to determine whether ransom demand and payment have a significant effect on the cumulative incidence of release, while avoiding the complications introduced by performing multiple significance tests on our key variables.

Results

Our results are summarized in Table 1 below. The backward elimination from the full model yielded our baseline model M_1 with four variables, from which M_2 and M_3 were constructed. The baseline model was highly significant, with a p-value of 1.34×10^{-12} compared to a null model, which suggests that at least one of our explanatory variable is important. Compared to M_1, M_2 was not significantly more predictive, with a p-value of 0.3275. Compared to M_1, M_3 was also not significantly more predictive, with a p-value of only 0.6031. So after accounting for the covariates in the baseline model, the ransom variables do not provide a significantly better fit between model and data.

The hazard ratios in Table 1 cannot be directly interpreted as the effect on the cumulative incidence of release; however, the direction hazard ratio (greater or less than one) does indicate the direction of the effect on the cumulative incidence (Austin & Fine, 2017). Thus from the regression results we have that internationally planned or executed terrorist incidents were more likely to end in the release of hostages. Likewise, compared to more recent incidents, hostage situations in the 1970s, 1980s, and 1990s were also more likely to end in release.

Variable	Subdistribution hazard ratio		
	M_1	M_2	M_3
international	1.27*	1.26*	1.26*
d1970s	2.47*	2.33*	2.33*
d1980s	1.91*	1.87*	1.88*
d1990s	1.62*	1.61*	1.62*
ransom.demanded	–	1.12	1.09
ransom.paid	–	–	1.10
Number of observations	756	756	756
Likelihood ratio test p-value	1.34×10^{-12}	0.3275	0.6031

Table 1: Regression and likelihood ratio test results. Hazard ratios significant at the 1% level indicated by an asterisk.

Discussion

We found that after accounting for other relevant factors, ransom demands and payments have no significant effect incidence of release, adding no further explanatory capacity to our baseline model. This suggests that paying ransom, or even responding to a ransom demand, may not be a successful means of achieving the release of hostages.

The United States' existing policy is not to provide concessions in negotiations with terrorist organizations. While this stems from a desire to avoid encouraging further attacks, our findings provide an alternative justification: even if the overriding concern is safe recovery of the hostages, we do not have evidence to show that ransom payment is effective.

Our results should be interpreted with considerable caution. First, we had to exclude a significant number of cases from our analysis due to missing data on the length or outcome of the hostage incident. It is impossible to fully check whether these data were missing at random; indeed, it seems plausible that smaller-scale incidents or hostage situations in smaller, poorer countries would receive less news coverage and consequently not have full data. Therefore it is possible that our results could be biased and would not generalize well to these types of incidents.

Second, we treated ransom demand and payment as binary variables, where the reality is more complicated. It is possible that the size of the ransom, or the proportion of that ransom that is paid, could be important. We also had no data on whether or not direct negotiations with the hostage takers took place, which similarly could have a significant effect on the hazard of release.

Finally, plots of the standardized Schoenfeld residuals from each of our models indicated that the assumption of proportional hazards may have been violated for some of our covariates. Since our conclusions were not based on the actual values of the estimated hazard ratios, any bias introduced by this violation would be unlikely to change our results. However, the violation of proportional hazards does result in less efficient estimates, which could be a contributing factor to the lack of significance ascribed to the ransom variables (Borucka, 2014).

In future research, we hope to construct models for other endpoints as well. Can the variables in our baseline model accurately predict the incidence of hostage death or rescue? Does paying ransoms affect the hazard of these endpoints?

References

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Appendices

A. Variable Descriptions and Summary Statistics

Variable	No. obs.	Prop.*	Descriptions
multiple	1,221	4.0%	1 if the incident was part of a series of multiple terror attacks perpetrated by the same group, 0 otherwise.
hijacking	1,221	4.1%	1 if the incident was a hijacking, 0 otherwise.
kidnapping	1,221	88.3%	1 if the incident was a kidnapping, 0 otherwise.
barricade	1,221	7.9%	1 if the incident was an in-place barricade, 0 otherwise.
individual	1,221	1.1%	1 if the incident was perpetrated by a single individual, 0 otherwise.
international	770	38.7%	1 if the incident was planned or executed internationally, 0 if the incident was planned and executed domestically.
property	1,199	12.9%	1 if significant property damage occurred as a result of the incident, 0 otherwise.
suicide	1,221	0.9%	1 if the incident involved a suicide attack, 0 otherwise.
log(*hostages*)	1,221	—	The natural logarithm of the number of hostages taken. The median number of hostages was 1, and the mean was 9.9.
one.hostage	1,221	56.9%	1 if only one hostage was taken, 0 otherwise.
few.hostages	1,221	31.3%	1 if between 2 and 9 hostages (inclusive) were taken, 0 otherwise.
many.hostages	1,221	11.8%	1 if 10 or more hostages were taken, 0 otherwise.
d1970s	1,221	15.9%	1 if the incident occurred between 1970 and 1979, 0 otherwise.
d1980s	1,221	17.4%	1 if the incident occurred between 1980 and 1989, 0 otherwise.
d1990s	1,221	37.3%	1 if the incident occurred between 1990 and 1999, 0 otherwise.
d2000s	1,221	10.1%	1 if the incident occurred between 2000 and 2009, 0 otherwise.
d2010s	1,221	19.4%	1 if the incident occurred between 2010 and 2017, 0 otherwise.
ransom.demanded	1,202	20.1%	1 if the perpetrators demanded a ransom, 0 otherwise.
ransom.paid	1,221	7.2%	1 if the ransom was paid in full or in part, 0 otherwise.

** The proportion of observations which had a value of 1 for the specified variable.*

B. Event Counts

Endpoint	No. events	Proportion
Release	770	63.1%
Death	260	21.3%
Rescue	128	10.5%
Escape	28	2.3%
Unknown (censored)	35	2.9%

D. Residual Plots

For each model, we calculate Schoenfeld residuals for each covariate. We plot the standardized residuals versus the natural logarithm of time to identify violation of the proportional hazards assumptions. The residual plots suggest that the proportional hazards assumption may not be met for some variables, particularly *international* (notice the upward trend in the residuals).