TESTING A RATIONAL CHOICE MODEL OF AIRLINE HIJACKINGS*

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Using data that combines information from the Federal Aviation Administration, the RAND Corporation and a newly developed database on global terrorist activity, we are able to examine trends in 1,101 attempted aerial hijackings that occurred around the world from 1931 to 2003. We have especially complete information for 828

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hijackings that occurred before 1986. Using a rational choice theoretical framework, we use continuous-time survival analysis to estimate the impact of several major counterhijacking interventions on the hazard of differently motivated hijacking attempts and logistic regression analysis to model the predictors of successful hijackings. Some of these interventions use certainty-based strategies of target hardening to reduce the perceived likelihood of success. Others focus on raising the perceived costs of hijacking by increasing the severity of punishment. We also assess which strategies were most effective in deterring hijackers whose major purpose was related to terrorism. We found support for the conclusion that new hijacking attempts were less likely to be undertaken when the certainty of apprehension was increased through metal detectors and law enforcement at passenger checkpoints. We also found that fewer hijackers attempted to divert airliners to Cuba once that country made it a crime to hijack flights. Our results support the contagion view that hijacking rates significantly increase after a series of hijackings closely clustered in time—but only when these attempts were successful. Finally, we found that the policy interventions examined here significantly decreased the likelihood of nonterrorist but not that of terrorist hijackings.

Over the past several decades, the rational choice perspective has been applied to a wide variety of criminal behavior, including drunk driving (Nagin and Paternoster, 1993), burglary (Wright and Decker, 1994), robbery (Wright and Decker, 1997), shoplifting (Piquero and Tibbetts, 1996), income tax evasion (Klepper and Nagin, 1989), drug selling (Jacobs, 1996), and white-collar crime (Paternoster and Simpson, 1996; Simpson, Piquero and Paternoster, 1998). In this paper we use a rational choice perspective to develop a series of hypotheses about the success, benefits and costs of aerial hijacking. Rational choice theory would seem to be an especially appropriate perspective for understanding hijackings, given that many are carefully planned and appear to include at least some consideration for risks and rewards. But at the same time, the aerial hijackings of September 11, 2001 vividly demonstrate that perpetrators of terrorist action sometimes appear to be largely indifferent to the kinds of individual costs and benefits most commonly measured in criminology research. In this research we apply the rational choice perspective to both terrorist and nonterrorist hijackings.

We develop a series of hypotheses about hijackings and test them with a database obtained from the Federal Aviation Administration with additional data from the RAND Corporation and a newly developed database on global terrorism (LaFree and Dugan, 2002). Based on hazard modeling, our results support the conclusion that some certainty of

apprehension measures (metal detectors and law enforcement at passenger check points) did significantly reduce the rate of new hijacking attempts. Also, a severity of punishment measure that made hijacking a crime in Cuba was significantly related to a drop in the hazard that a hijacked flight would be diverted there. We also found support for a contagion view that the rate of hijackings significantly increases after a series of successful hijackings closely clustered in time. Finally, we found evidence that policy interventions significantly impact the likelihood of nonterrorist but not terrorist hijackings.

Before we present the results, we provide an overview of rational choice theory and prior research on rational choice theory and aerial hijacking.

RATIONAL CHOICE THEORY

The belief that credible threats of apprehension and punishment deter crime is as old as criminal law itself and has broad appeal to both policy makers and the public. As elaborated by social reformers like Bentham and Beccaria, or jurists like Blackstone, Romilly or Feuerbach, rational actor perspectives assume that crime can be deterred by increasing the costs of crime or increasing the rewards of noncrime (Gibbs, 1975; Ross and LaFree, 1986; Paternoster, 1987). In particular, Bentham's principle of utility proposed that individuals act in view of their own self-interest and that the effective use of punishment serves to deter individuals from specific actions (including crime) that serve their self-interest.

Many contemporary rational choice models of crime (Becker, 1968; Carroll, 1978) express utilitarian philosophy in mathematical terms, with individuals maximizing satisfaction by choosing one of a finite set of alternatives, each with its particular costs and benefits (Cornish and Clarke, 1986; Clarke and Felson, 1993:5). At their core, these models suggest that crime can be deterred through appropriate public policy. In general, the choice of crime is more appealing when legal options are less rewarding, when crime is less punishing, or when crime is more rewarding. Research on the rational choice perspective has increased our understanding of the costs and benefits associated with both crime and noncrime alternatives (Piliavin, Gartner, Thorton and Matsueda, 1986; Clarke and Cornish, 1985), and recent evidence suggests that the criminal justice system can exert a deterrent effect on crime (for a review, see Nagin, 1998).

Mathematically, a rational choice explanation of crime suggests that if p(success)*benefits > [1-p(success)]*costs, then crime is more likely to occur, and conversely, if p(success)*benefits < [1-p(success)]*costs, then crime is less likely to occur. The probability of success, p(success), is a

function of the offender's perception. The rational choice perspective assumes that offenders calculate their probability of success when evaluating criminal opportunities. In general, a major goal of policy makers who design formal systems of punishment is to control or alter this calculation through policies aimed at reducing the certainty of success. In the case of policies on aerial hijacking for the past half century, this goal has been pursued primarily through target hardening including metal detectors, posting security personnel at airport gates and baggage-screening.

According to the rational choice perspective, benefits can be both internal (for example, monetary gain) and external (for example, achieving political recognition) to offenders. Further, as prospective perpetrators witness others' hijacking successes, they may be more likely to use hijacking to achieve their own goals. Piquero and Pogarsky (2002) and others (Stafford and Warr, 1993; Paternoster and Piquero, 1995; Piquero and Paternoster, 1998) have found that this vicarious experience with punishment avoidance is an important determinant of both the perception of sanctions and criminal behavior. Examples of such benefits in the case of aerial hijacking include the rapid growth of hijackings to Cuba in the late 1960s and early 1970s (before Cuba defined hijacking as a crime) and the rash of hijackings for the extortion of money after the widely publicized success of D.B. Cooper in November 1971.[1] The role of benefits in rational choice theory is closely related to the concept of contagion, which we discuss below.

The rational choice perspective also posits that offenders interpret and weigh the costs associated with their offending decisions. Such costs include the probability of apprehension, as well as the severity of punishment experiences. Accordingly, policy makers try to raise the perceived costs of aerial hijacking by increasing the certainty of detection and strengthening the severity of punishment. For example, several laws passed in the United States during the 1960s and 1970s were aimed at increasing punishment severity for airplane hijacking. At the same time, policies such as posting security personnel at airport gates and placing sky marshals on aircraft were efforts aimed at increasing the certainty of apprehension.

To summarize, the rational choice perspective predicts that the frequency of aerial hijackings will decrease if the probability of success is decreased, the perceived benefits are reduced, and the perceived costs are increased. In addition to testing specific hypotheses developed from

1. A hijacker using the name D.B. Cooper seized control of a Northwest Orient airliner and threatened to blow it up during a flight from Portland to Seattle. After he extorted $200,000 he parachuted from the flight and has never been found. This event gained national attention and the fact that Cooper successfully avoided detection gave him folk legend status with admirers (Dornin, 1996).

rational choice theory, our analysis permits us to explore whether these general expectations hold equally well depending on the location of the incident and the likely motivation of hijackers. In particular, we distinguish in the analysis between hijacking incidents that originated in the United States, those that originated elsewhere, offenders whose major purpose appears to be transportation to Cuba, and offenders who we classify as having a terrorist purpose.

PRIOR RESEARCH

We were able to identify three early studies that explicitly examined the rational choice perspective within the context of aerial hijacking (Chauncey, 1975; Landes, 1978; Minor, 1975). All three of these studies focus only on the cost component of the rational choice framework. Chauncey (1975) examined five deterrence-based policy efforts related to hijacking incidents. Two represented changes in the probability of success or certainty, two represented changes in severity, and one combined the two. Findings indicated that only the two certainty events led to reductions in the rate of attempts, the largest reduction being a function of the metal detector screening and carry-on baggage inspection policy implemented in the first quarter of 1973 in U.S. airports. Minor (1975) applied deterrence and prevention concepts to understand skyjacking in the United States and worldwide, and concluded that there was no major deterrent effect of skyjacking control programs before 1973, but that there was a prevention effect in 1973 and 1974 due to the implementation of baggage screening and metal detectors. Unfortunately, neither Chauncey nor Minor offer systematic statistical tests of their hypotheses about deterrence and prevention.

Following Becker (1968) and Ehrlich (1973), Landes (1978) developed and tested an economic model of hijacking, conducting a quarterly analysis of mainly U.S. aircraft hijacking between 1961 and 1976. His results show that an increase in the probability of apprehension, the conditional probability of incarceration, and the length of sentence for those convicted of hijacking were all associated with significant reductions in hijacking during the 1961 to 1976 period. Additionally, using regression estimates from the sample period ending in 1972, Landes developed forecasts of the number of hijackings that would have taken place between 1973 and 1976 if (1) mandatory screening had not been instituted and (2) the probability of apprehension (once the hijacking was attempted) had remained constant and equal to its 1972 value. He concluded that without these interventions there would have been between forty-one and sixty-seven additional hijackings during the 1973 to 1976 period compared to the eleven that occurred.

Although they do not specifically adopt a rational choice perspective, Hamblin, Jacobsen and Miller (1973) and others (Rich, 1972; Phillips, 1973) rely on contagion or diffusion explanations of hijacking attempts to make predictions that are closely related to the reward component of the rational choice perspective. Thus, researchers supporting a contagion model assume that when potential aerial hijackers perceive that previous hijacking attempts have been rewarded (for example, successful outcomes, avoidance of punishment) and that they can avoid punishment in the commission of a hijacking, they will be more likely to offend. For example, Holden (1986) argues that successful airline hijackings will foster more and that unsuccessful episodes will lead to fewer attempts. Related arguments include Rich's (1972) claim that a "skyjack virus" may be transmitted through the media, Phillips' (1973) argument that imitation explains the frequency of hijackings, and Hamblin, Jacobsen and Miller's (1973) assertion that hijackings are spread by diffusion and modification of a basic invention, as new hijackers attempt to outdo previous ones by inventing more effective hijacking strategies.

In the most detailed empirical study of the contagion hypothesis to date, Holden (1986) develops a mathematical model of contagion and applies it to aircraft hijackings in the United States between 1968 and 1972. Defining contagion as an increase in the rate of new hijacking attempts, Holden (1986:886) tests five hypotheses. First, that the rate of aircraft hijacking attempts in the United States will increase following other hijacking attempts. Second, that the rate will increase following publicized hijacking attempts, but not following unpublicized attempts. Third, that compared to unsuccessful attempts, successful (that is, rewarded) attempts will have a greater stimulating effect on additional hijackings. Fourth, that because the motivation for transportation and extortion hijacking attempts may be very different and because history shows that the peak periods for transportation (1969–1970) and extortion (1972) hijackings were separated by three years, transportation hijackings should be stimulated only by prior transportation hijackings, and extortion hijackings only by prior extortion hijackings. And, finally, that the stimulating effect on the U.S. hijacking rate will be far greater for hijackings on U.S. carriers than on non-U.S. carriers.

Holden's research shows that successful hijackings generate additional attempts of the same type (transportation or extortion), but finds no contagion effects of unsuccessful attempts in the United States or either successful or unsuccessful attempts outside the country. In particular, each successful transportation hijacking in the United States generated an average of .75 additional attempts, with a median delay of 60 days. This effect accounted for 53 percent of the total rate of U.S. transportation hijacking attempts in Holden's analysis. Each successful extortion

hijacking in the United States generated an average of two additional attempts, with a median delay of 44 days, accounting for 85 percent of the total rate. Holden's results also show (1986:898–899) that though U.S. hijackers were not influenced by incidents outside the country, the likelihood of foreign extortion-based hijackings (including parachute hijackers) were increased by hijackings within the United States.[2]

Although instructive, prior research on aerial hijacking from the rational choice perspective is limited in several ways. First, although there is some descriptive information available on overall trends in hijacking events (Merari, 1999; Karber, 2002), much less is known about the effect of hijacker motives on the frequency and success of the crime in the United States and elsewhere. Second, much of the prior research did not use formal statistical tests to determine if deterrent and preventive policies significantly reduce hijacking. Third, most studies (Chauncey, 1975; Minor, 1975) have focused on the costs component of the rational choice framework, and the only major study to examine the benefits component (Holden, 1986) did so through a contagion approach using data from a limited time span, 1968 to 1972. And, finally, past efforts have not examined the specific variables associated with hijacking success. For example, Holden's research distinguished successful from unsuccessful hijackings, but he included no analysis of the variables that estimate successful hijackings. Our study specifically addresses these limitations.

CURRENT FOCUS AND HYPOTHESES

We use hazard modeling (Cox, 1972) to identify how a set of theoretically relevant variables (for example, success and purpose of attack) affect the time between hijacking incidents. This approach allows us to determine the variables that reduce the temporal frequency of hijacking incidents. We then use logistic regression analysis to identify the qualities of hijacking attempts that are most likely to contribute to their success.

We develop five hypotheses derived from success, benefits and cost-related assumptions of the rational choice perspective.[3] For the purposes

2. Holden's (1986:879) extortion category "includes incidents involving both extortion (that is, demands other than for transportation) and diversion to a particular destination because the primary motive in these cases is presumed to be other than transportation."
3. Because we have no direct data on actors' perceptions, our research is similar to other macro-level tests of deterrence/rational choice theory (for example, Blumstein et al., 1978; Nagin, 1978; Levitt, 2002) in assuming that potential hijackers' decisions were based at least in part on their knowledge of the probability of success and the costs of failure.

of this paper, and because much of our data come from a longitudinal database coded and published by the FAA, we rely on the FAA's (1983) definition of a successful hijacking as one in which hijackers gain control of the plane and reach their destination, whether by landing or by a parachute escape, and are not immediately arrested or killed on landing; unsuccessful hijackings are those in which hijackers attempt but fail to take control of an aircraft or take control but are immediately killed or arrested on landing.[4] Our success-related hypothesis:

> H1: The hazard of a new hijacking attempt will decrease when the certainty of apprehension is increased.

Hypothesis 1 is based on the fundamental rational choice prediction that the chances of additional prohibited behavior will decline when perpetrators believe or might believe that the likelihood of success has lessened. We discuss below how we will use the timing of two certainty-based security policies to test this hypothesis. We also conduct an exploratory analysis to determine which flight characteristics and policies actually do increase the chances that hijackers will be apprehended.[5]

The three benefits-related hypotheses are based on the premise that offenders will be more likely to attempt aerial hijackings when the expected benefits of hijacking increase:

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4. The definition of success employed in this study was the one adopted by the FAA for their construction of the longitudinal data base we employ. While the FAA definition of success is the one that has been most commonly used in prior research (for example, Holden 1986), it is clear that it is more in keeping with a criminal rather than a terrorist interpretation of hijacking incidents. For example, the FAA definition would classify the hijackings of September 11, 2001 as unsuccessful—even though many might argue that the immediate goals of the hijackers in this case were fully realized. Definitions of aerial hijacking also disagree about the precise physical location at which an aerial hijacking begins. The FAA data count as aerial hijackings only those cases in which hijackers get past airline security gates. Hence, a hijacker apprehended in the bridge connecting the airplane to the airport would be included in the data base (as an unsuccessful hijacking attempt), but someone who was apprehended outside the airport or at an airport ticket counter would not be included (cf., Merari 1999). We return to these definitional issues in the discussion section.
5. Although we do not empirically distinguish between deterrent and preventive effects, it is useful to briefly explain the two. Prevention, according to Andenaes (1974) and Jeffery (1971) refers to the elimination of the opportunity for crime through modification of the environment in which crime occurs. Zimring and Hawkins (1973:351) suggest that "if the probability that a particular type of offender will be apprehended is greatly increased, then the increased apprehension rate may achieve a substantial *preventive* effect which is quite independent of the *deterrent* effect of the escalation in enforcement…. Nevertheless … it is crime prevention rather than deterrence which is the ultimate object of crime control measures."

> H2a: The hazard of new hijacking attempts will increase shortly after earlier attempts.

Consistent with Holden's (1986) arguments about contagion, in Hypothesis 2a we predict that the incentives to hijack may manifest externally when prospective hijackers witness the hijacking attempts of others. Such attempts likely generate much media attention.

> H2b. The hazard of new hijacking attempts will be greater following a series of successful hijackings.

Also consistent with Holden's arguments, we examine in Hypothesis 2b whether successful hijacking attempts affect the hazards of additional attacks. By comparing the results for H2a and H2b, we will also be able to determine the extent to which any contagion effects are driven by all events or only by successful events.

> H2c: Compared to those who hijack for other reasons, the hazard of hijacking attempts by terrorists will be less affected by counter hijacking measures that raise the severity or certainty of punishment.

This last hypothesis is based on the observation that terrorist-motivated hijackings may not follow the same risk-reward calculus that is typical of more common criminal offenders. It is not that we expect terrorists to avoid deliberation about their activities because of their strongly held beliefs or religious fanaticism. In fact, the evidence suggests that terrorists often deliberate deeply and with profound patience about their attacks (Rapoport, 2001; National Commission on Terrorist Attacks, 2004). But though advancing group goals may be a paramount concern on the part of terrorists, individual-level perceptions of benefits often appear to be different for terrorists than for ordinary criminals. The obvious example here is the suicide bomber who is largely oblivious to any formal threat of punishment. In short, compared to common criminals, perpetrators motivated by terrorist causes are likely to represent a somewhat different set of perceptions regarding the costs and benefits of their attacks. Although we cannot directly measure the differential motivation for terrorists to hijack an aircraft, in H2c we hypothesize that compared to those who hijack for monetary gain or for transportation to another country (most often Cuba), terrorist hijackers will be less affected by traditional measures that increase the certainty or severity of individual punishment.

Our final hypothesis is derived from the cost-related portion of rational choice theory:

> H3: The hazard of a new hijacking attempt will drop after harsher punishments are announced.

This hypothesis is based on the deterrence–rational choice expectation that sanction severity will reduce criminal activity.

DEVELOPING AN AERIAL HIJACKING DATA BASE

As used here the term "aerial hijacking" is limited to situations in which perpetrators either seized control of an aircraft or clearly announced their intention to do so but were thwarted in their efforts.[6] To examine long-term trends in hijacking we obtained data on 1,101 aerial hijackings (285 originated from U.S. airports and 816 from foreign) from 1931 to 2003. Much of the data from 1931 to 1985 are from the FAA and include 268 hijackings that originated from U.S. airports and 560 from elsewhere. We updated the original FAA database with published FAA reports through 1999[7] and collected hijacking event data from 2000 to 2003 from the aviation safety network (http://aviation-safety.net/index.shtml). We then supplemented the resulting FAA data base with thirty-nine additional hijacking cases identified from publicly available data from RAND (http://www.db.mipt.org/index.cfm) and from our own newly created database on terrorist events (LaFree and Dugan, 2002). Data for 828 cases from 1931 to 1985 are especially complete, including whether the event was successful, as well as information on city-country of origin-destination, number of passengers and weapons used.

To distinguish terrorist hijackings from others, we relied on the RAND data and our own terrorism database. For the purposes of this study, we defined terrorist hijackings as those that involve "the threatened or actual use of illegal force and violence to attain a political, economic, religious or social goal through fear, coercion or intimidation" (LaFree and Dugan, 2002:14). For example, an incident identified in our database as a terrorist hijacking happened on January 31, 1980 when three Shi'ite Moslems hijacked an Air France airliner with pistols and a grenade over Beirut, Lebanon, to draw attention to the disappearance of

6. Other definitions of hijacking are of course possible. For example, Merari's (1999:11) detailed analysis of "attacks on civil aviation" includes attacks not only against airliners, but also against airports and airline offices. In general, the FAA data exclude these latter cases unless the perpetrators were in the airline loading area or beyond and made it clear that their intentions were to hijack an airplane (these cases were treated as unsuccessful hijackings). Because most of the deterrence-based policies that are the main subject of this research focus on airliners rather than airports or airline offices, the operationalization of aerial hijacking used here seems defensible.

7. Until the mid-1980s FAA hijacking data were publicly and freely available in hard copy format. However, after the publication of a 1986 report that contained an impressive amount of detailed information (much of which is used in this study), the FAA reports contained far less detailed information and are currently available for a fee from the National Technical Information Service (NTIS). Since the last published report (2003), which listed the cutoff date for aerial hijackings as December 31, 2000, we were unable to identify any publicly available reports from the NTIS or FAA regarding aerial hijackings.

spiritual leader Iman Musa Sadr in Libya (LaFree and Dugan, 2002).[8] The resulting composite database includes information on all known aerial hijackings from 1931 to 2003 and more detailed information on hijackers, their affiliations and their main purpose for hijacking an aircraft from 1931 to 1985 (828 cases). Because our analysis includes an independent variable that incorporates information on two previous incidents (described below) we drop the first two (1931 and 1947) leaving us with 826 cases for the quantitative analysis.

AERIAL HIJACKING AND COUNTER HIJACKING MEASURES, 1947 TO 2003

Figure 1 shows trends in total hijackings of flights originating inside and outside the United States. Because our data include no incidents between 1931 and 1946, we limit Figure 1 to the 1947 to 2003 period. According to Figure 1, the total number of skyjackings, domestic- and foreign-origin, never rose above ten per year until the mid-1960s. In fact, our data show no foreign hijackings for the years 1954, 1955 and 1957 and following the first U.S. hijacking in 1961. There were no reported U.S. hijackings in the years 1963 and 1966. But the total number rose dramatically after the mid-1960s. Annual hijackings first exceeded ten in 1968 (twenty in the United States and fifteen elsewhere). Figure 1 shows an especially sharp rise in both from 1968 to 1973. The highest number of hijackings of flights originating in the United States was in 1969 (thirty-nine) and of flights originating in other countries was 1970 (sixty-four).

The number of hijackings then declined notably, especially for flights originating in the United States. In 1973, for example, we saw only two incidents in the United States. Declines in foreign-origin hijackings were less dramatic, but still substantial. The foreign low came with fourteen incidents in 1975. Following the early 1970s, non-U.S. hijackings saw high points in 1990 (thirty-nine), 1985 (thirty-four), 1993 (thirty-one), 1977 (twenty-eight) and 2000 (twenty-one). The high points in the United States, by comparison, came in 1983 (twenty-one) and 1980 (twenty). There were no recorded incidents in the United States, however, for eight years beginning 1992 until an unsuccessful attempt by a lone offender in 2000.[9] The next incident was the attack involving four aircraft on September 11, 2001.

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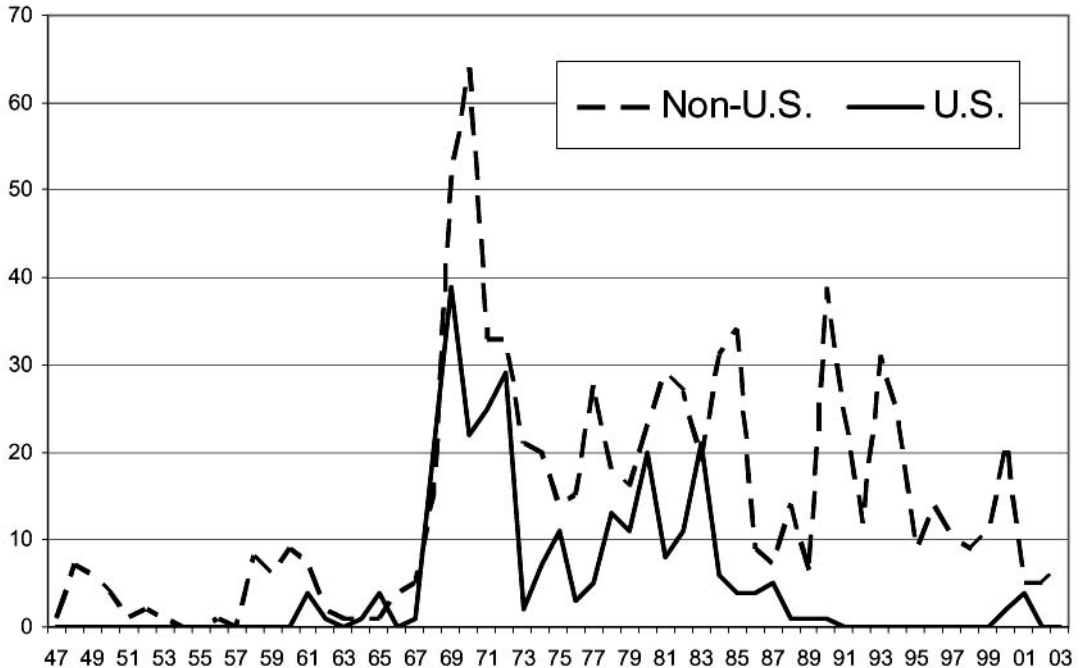
8. We had separate research assistants identify the terrorism cases independently. The correlation in selection of terrorism cases across assistants was 0.91. We reexamined disagreements and resolved discrepancies.
9. The lone U.S. hijacking in 2000 occurred on July 27th and involved an individual who boarded a plane at Kennedy Airport in New York City with the intent of hijacking it, but was captured before the plane left the ground.

Figure 1. U.S. and Non-U.S. Hijacking Attempts, 1947–2003



Not surprisingly, as aerial hijackings increased in the 1960s and 1970s, policy makers in the United States and elsewhere responded with a growing number of counter-hijacking strategies. After an extensive review of national policies (FAA, 1983; Karber, 2002), we identified six major changes aimed at reducing aerial hijackings from 1947 to 1986.[10] The first was in October 1970, when the Cuban government made skyjacking a crime. The second came in January 1972, when the FAA issued rules ordering tighter screening of all air passengers and baggage using one or more suggested methods: "behavioral profile, magnetometer, identification check, physical search" (National Materials Advisory Board, 1996:6). The third was in August 1972, when the FAA mandated that airlines refuse to board any passengers who fit a hijacking behavioral profile before they were physically or electronically searched. The fourth came on January 5, 1973, when metal detectors were installed in U.S. airports and, though the dates and times differ substantially, similar devices were gradually introduced to major airports around the world. The fifth came on February 3, 1973, when the United States and Cuba signed a Swedish-brokered agreement that defined hijacking as a criminal act in both nations and promised to either return hijackers or put them on trial. The sixth came on February 5, 1973 when the FAA required that local law enforcement officers be stationed at all passenger check points during boarding periods.[11]

ESTIMATING THE HAZARDS OF AERIAL HIJACKING

To test our hypotheses, we use Cox proportional hazard models to estimate the impact of the current flight context, hijacking motives, and policy intervention on the hazard of an additional hijacking attempt.[12] We

10. We identified but eliminated three other possible policy interventions. On November 1, 1969, Cuba extradited six American hijackers to the United States. We judged this to be a one-time event rather than a formal policy change. In February 1969, the FAA authorized physical searches of passengers and in October, 1969, three major U.S. airlines implemented an FAA system that used weapons detection devices for passengers that fit a behavioral profile of past hijackers. However, neither of these two interventions were mandatory and in any event, neither received widespread press coverage—a critical element in rational choice models.
11. We have no data on non-U.S. global airline policies designed to stop aerial hijacking. It is worth noting that of the 516 non-U.S. originating flights with a known flight plan through 1985, the largest percentage originated in Colombia (8.5 percent) followed by Poland (4.8 percent) and then Lebanon (4.3 percent). However, by far the largest number of hijacking attempts during this period originated in the United States (267 versus 44 in Colombia).
12. We use the exact method to resolve ties in survival time (Allison, 1995). This method assumes that the underlying distribution of events is continuous rather than

use continuous-time survival analysis with the dependent variable measured as the number of days until the next hijacking attempt and the independent variables measured at the time of the current hijacking attempt. Most applications of the Cox model estimate the hazard of a single event using many observations. Here, we instead apply the Cox model to estimate the hazard of many events (hijacking attempts) using only one observation (the world). By conditioning all events on one observation, we reduce the chances of dependence across observations. Yet, the rational choice theory underlying this research predicts dependence across some observations. We assume that the observations are conditionally independent once we control for characteristics of current and previous hijacking attempts.[13] With conditional independence, the multiple events in the current research should be synonymous with the more typical hazard model's multiple observations. If this assumption is unmet, then the parameter estimates will be biased and inconsistent, and the standard errors will be biased downward making our results vulnerable to Type II error. Thus, findings with marginal levels of significance should be interpreted with caution.[14]

To test the hypotheses outlined above, we estimate models separately for six subsets of hijacking attempts: (1) total, (2) those originating in the United States, (3) those originating outside of the United States, (4) those diverted to Cuba, (5) terrorist-related, and (6) not terrorist-related. We use the following specification for the proportional hazard models in the analysis:

$$h(Y) = \lambda_0(Y)\, exp(\beta_1 Policies + \beta_2 MajorPurpose + \beta_3 Context)$$

We estimate the coefficients associated with the hazard of a new hijacking attempt (estimated by the number of days until the next attempt, Y) as a function of an unspecified baseline hazard function and other risk or protective variables measured at the time of the current hijacking

discrete and incorporates the likelihood of all possible ordering of events. This is the most appropriate strategy because airline hijacking can occur at any time.

13. If dependence exists even after conditioning on previous hijacking attempts, it will likely be strongest for the most recent attempt. The models include the length of the previous "spell" (time between the 1st previous and current hijacking attempt, as shown in Figure 2) as a test for contagion (H2a). As suggested by Allison (1995), we tested for further dependence by including the next previous spell (between the 2nd previous and 1st previous hijacking attempts as defined in Figure 2). Its null association ($p>0.10$) supports the assumption of conditional independence. However, as with all dynamic research models, the findings are vulnerable to bias due to the omission of an unmeasured time-dependent variable that increases or decreases the probability of hijacking leading to temporal clustering of events.
14. An earlier version of this paper included a quarterly time-series analysis that produced similar results. Because the hazard model allows us to test all of the hypotheses and because of space limits, we have excluded the time-series results.

attempt represented by the vectors Policies, Major Purpose, and Context, which reflect our hypotheses and a set of control variables.

We use the temporal ordering of hijacking attempts to create both our dependent variable and two important independent variables. The temporal relationships underlying the measurement of these variables are shown in Figure 2. Our dependent variable, Y, is measured by the number of days until the next attempt. Last Attempt measures the number of days since the previous hijacking attempt. We create a success density measure by taking the current and two previous flights, and calculating the proportion of those flights that were successful over the number of months spanning the three events. Thus, a large success density indicates that most events were successful over a relatively short period.[15]

In Figure 3 we show the specific dates of the antihijacking policies just outlined. The most striking feature of Figure 3 is that all six major policy interventions happened over only two and one-half years, from October 1970 through February 1973. This, of course, makes it more challenging to evaluate the individual impact of specific policies.

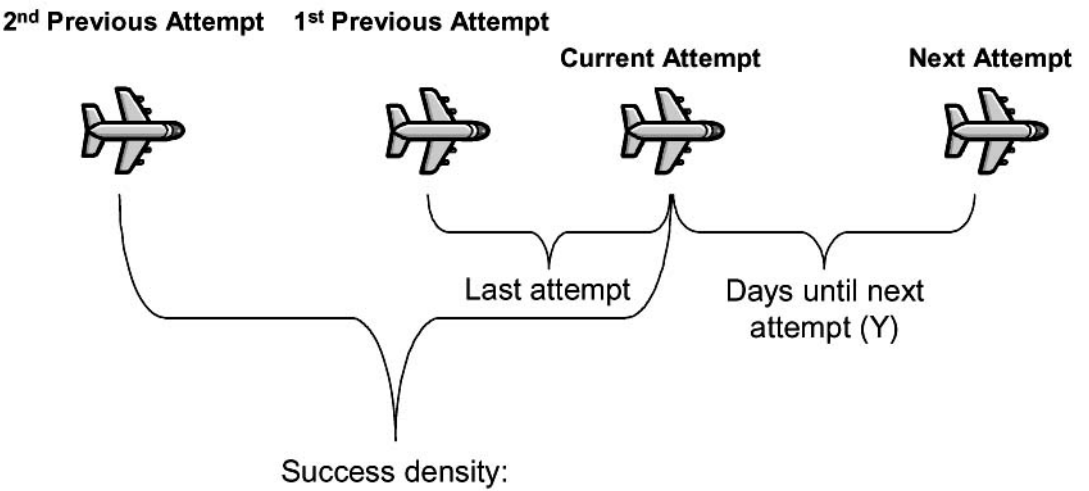
In Table 1 we summarize the variables included in the analysis and their possible values. Based on the temporal ordering of the antihijacking policies, we identified three strategic policy dates.[16] If the policy was intact at the time of the current hijacking attempt, that policy variable is coded as one, and zero otherwise. The first selected policy was enacted on October 31, 1970, the date that Cuba made hijacking a crime (Cuba Crime). Because the policy goal was specific to Cuban hijacking, it provides a direct way to examine its effects. If there is truly a policy impact as a result of this law it should have a significant effect in the model that uses data from hijackings diverted to Cuba—and because 57.5 percent of these flights originated in the United States, we would expect a U.S. effect as well.[17] The second is the FAA policy (enacted on January 31, 1972) of ordering tighter screening of all U.S. aircraft passengers and baggage. This

15. We initially calculated this measure using 3, 5, 7, 10, 15, 20, 30 and 40 incidents. The substantive findings remained the same, although they weakened as we increased the number of incidents. We decided to report only the results for three incidents here because this strategy retained the most observations.

16. Five cases in the data base were missing information on specific dates. For three of these cases, month of the hijacking was available and we estimated the dates by using the last day of the month (February 1931, August 1966, and November 1978). This assures that any policy intervention occurred prior to the event. For the remaining two cases we knew only that the case occurred in the "Fall" and we therefore set the dates equal to October 31 of the appropriate year—the middle of the Fall season.

17. Although this measure could also be interpreted as increasing the certainty of punishment (Chauncey, 1975), we chose to conceptualize it here in terms of severity because of its reliance on the administration and degree of punishment.

Figure 2. Diagram of Hijacking Attempts



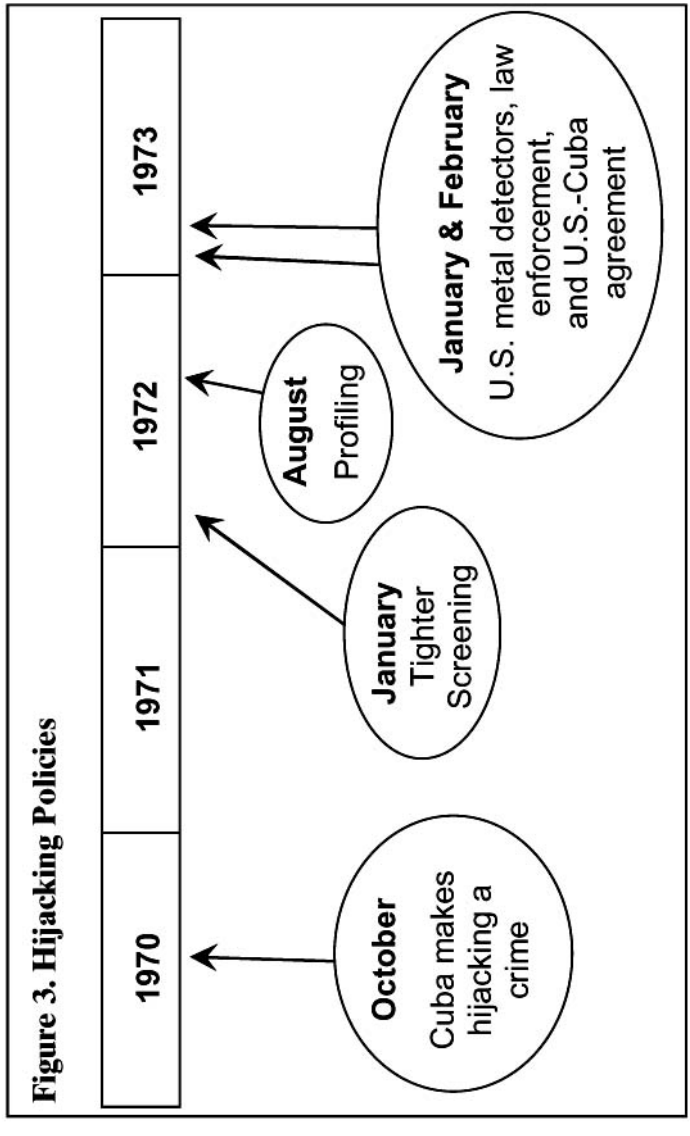


Figure 3. Hijacking Policies
1970
1971
1972
1973
October
Cuba makes hijacking a crime
January
Tighter Screening
August
Profiling
January & February
U.S. metal detectors, law enforcement, and U.S.-Cuba agreement

intervention is strategic for two reasons. First, because it was imposed by the FAA only for flights from U.S. airports, any effect should be limited to the United States. Second, although several policy interventions are clustered closely during this period, tighter screening was implemented more than a year after the prior policy intervention, thus reducing the chance of simultaneous effects of the interventions.[18]

Table 1. Variable Descriptions

Variable	*Possible Values*	*Description*
Policies		
Cuba Crime	0, 1	The October 1970 Cuban law made hijacking a crime (date set at October 31, 1970)
Tighter Screening	0, 1	The January 1972 order required tighter screening of all U.S. air passengers and baggage (date set at January 31, 1972)
Metal Detectors	0, 1	Three separate policies were enacted within a month: 1) January 1973 metal detector installation in U.S. airports, 2) February 1973 U.S./Cuba agreement to return or prosecute hijackers, and 3) February 1973 U.S. requirement that local law enforcement officers be stationed at all passenger checkpoints (date set at February 5, 1973)
Major Purpose		
Terrorism	0, 1	The motive was to terrorize for political or social reasons.
Extortion	0, 1	The motive was to extort money.
Transportation to Cuba	0, 1	The hijacker was attempting to diverted the flight to Cuba.
Context		
Success Density	$[0, \infty)$	$\frac{P\text{ (success for current and two previous attempts)}}{(event\ date_{current} - event\ date_{second\ previous})/365}$
Last Success	0, 1	The previous hijacking attempt was successful.
Last Attempt	$0, \infty$	The number of days from the previous to the current hijacking attempt.
Private Flight	0, 1	The current flight was privately owned.
U.S. Origin	0, 1	The current flight originated in the United States.
Year	[1947, 1985]	The year of the current hijacking attempt.

18. After a preliminary analysis of the effect of the August 1972 profiling policy, we could find no effect and chose to omit it from the analysis. However, its close proximity to the early 1973 policies raises the possibility that its effects are being picked up by these later interventions.

Finally, we selected three major policies that were implemented in January and February of 1973 (labeled Metal Detectors). Although these policies were implemented about the same time, we might expect them to have somewhat different effects on the sub-samples being analyzed. Metal detectors should have an especially strong impact on flights departing from U.S. airports—because these policies were first implemented in the United States (Enders and Sandlers, 1993). But at the same time, these policies spread fairly quickly to other highly industrialized nations and were gradually adopted by most countries across the world. By contrast, the agreement between Cuba and the United States should only affect Cuba-U.S. flights.

As shown in Table 1, we distinguish between three major hijacking purposes for the current hijacking attempt: Terrorism, Extortion, and Transportation to Cuba. By comparing the FAA flights to hijackings found in terrorism databases, we were able to classify hijackings as terrorist when the hijackers made political, economic, religious or social demands. The FAA classified as extortion all cases in which the hijackers demanded money. Finally, the FAA coded all Cuban-related flights. We examined the FAA reports and determined whether the hijackers attempted to use the flight to get to Cuba. If so, we classified the case as transportation to Cuba. Altogether, we classified 51.8 percent of the cases as having at least one of these three purposes. The remaining cases were classified as "other" because they included no indication that perpetrators made terrorist demands, tried to extract a monetary ransom or demanded transportation to Cuba.[19] In thirty-five cases (4.2 percent) we classified a single event in two of three substantive categories and in two cases (0.2 percent) we classified a single event in three of the substantive categories. One of the cases included in all three categories occurred on November 10, 1972, when three members of the Black Panther Party hijacked (made political demands, therefore terrorist) a Southern Airways jet to Havana, Cuba (transportation to Cuba) and demanded $2 million in ransom (extortion; RAND, 2001).

We include five variables to measure the context of the current hijacking attempt: Last Attempt, Success Density, Private Flight, U.S. Origin, and Year. We described the last attempt and success density measures above (see Figure 2). We also include indicators of whether planes were privately owned, whether flights originated from U.S. airports, and what year each incident occurred. By including the year of

19. An examination of these cases shows that "other" hijackings include attempts for purposes of transportation to somewhere other than Cuba, political asylum, escape from Cuba, juvenile behavior, robbery of passengers, mental instability, and other reasons.

the current event, we control for any increase or decrease in the overall hazard of hijacking over time. This variable is especially important because an increased hazard could lead to the noted policy interventions being adopted, thus biasing our findings and making the policy appear ineffective or even countereffective. Fortunately the time-ordering of the data also reduces our vulnerability to this type of bias. For example, if a surge of hijackings led to new counterhijacking policies, cross-sectional data could erroneously appear as if the new policies "caused" the hijackings. Related to this, year can also serve as a proxy for increased air traffic over time, which is likely a component of the "opportunity" to hijack. However, we expect that hijacking opportunity is less related to air traffic since the 1950s because since then flights take off at a nearly constant rate.

ESTIMATING THE HAZARDS OF HIJACKING ATTEMPTS

Table 2 shows the hazard model results for total incidents, U.S.-origin incidents, foreign-origin incidents, Cuba-diverted incidents, terrorist-related incidents, and not terrorist-related incidents. In each model, the dependent variable is the number of days until the next event. A positive coefficient suggests that the variable increases the hazard of another hijacking attempt in a shorter time whereas a negative value decreases it.

Hypothesis 1 predicts that the hazard of hijacking attempts will decrease following the adoption of measures that increase the certainty of apprehension. We examined the effect of two certainty-based measures: tighter U.S. security screening adopted in January 1972 and the metal detectors and enhanced U.S. airport security adopted in February 1973. The results show partial support for the certainty of apprehension hypothesis. Consistent with H1, the hazard of hijacking in the U.S.-origin model dropped significantly after February 1973. Those 1973 policies were in fact the only interventions that significantly reduced hijacking hazards in all models, except those limited to terrorism.[20] By contrast, the tighter U.S. screening protocols reduced the hazard for foreign-origin flights but failed to do so for U.S. flights (which interestingly saw instead a short-term increase).

Our next set of hypotheses examines the impact of perceived benefits of hijacking on the hazard of new hijacking attempts. Hypothesis 2a is a test of the hypothesis that new hijacking attempts will be more likely shortly after earlier attempts (Last Attempt). This hypothesis is unsupported. Instead Table 2 shows that the hazard of another hijacking

20. To be sure that this result is specific to the date, we reestimated the model replacing February 5, 1973 with later dates. None of these reestimates were significant.

decreases significantly if the current and previous hijackings were attempted within a short period.

Table 2. Coefficients and Standard Errors for Cox Proportional Hazard Model

	All	*U.S.*	*Non-U.S.*	*Cuba*	*Terrorist*	*Not Terrorist*
	n=826	*n=265*	*n=556*	*n=272*	*n=123*	*n=700*
Policies						
Cuban Crime	-0.095	-0.500*	0.233	-0.421*	0.782	-0.145
	0.147	0.232	0.199	0.219	0.569	0.155
Tighter Screening	-0.084	0.686	-0.505*	0.070	-1.020	-0.016
	0.184	0.311	0.246	0.381	0.637	0.198
Metal Detectors	-0.949**	-1.598**	-0.653**	-0.967*	-0.644	-0.996**
	0.166	0.371	0.204	0.434	0.410	0.184
Major Purpose						
Terrorism	0.146	0.359	0.163	0.311		
	0.104	0.470	0.109	0.246		
Extortion	0.147	0.142	0.052	0.178	-0.239	0.218
	0.139	0.260	0.176	0.412	0.331	0.154
Transportation to Cuba	0.171*	0.086	0.287**		0.439	0.141
	0.092	0.148	0.119		0.275	0.099
Context						
Last Attempt	-0.004	-0.003	-0.003	-0.002	0.001	-0.004
	0.001	0.001	0.001	0.001	0.001	0.001
Success Density	0.002**	0.002	0.002*	0.001	0.000	0.002*
	0.001	0.001	0.001	0.001	0.001	0.001
Private Flight	-0.098*	-0.037	0.009	-0.130	0.517	-0.107
	0.119	0.193	0.161	0.238	1.152	0.120
US Origin	0.050			0.029	0.533	0.052
	0.087			0.137	0.532	0.089
Year	0.078**	0.074**	0.075**	0.091**	0.041	0.081**
	0.010	0.028	0.011	0.031	0.031	0.010

* = $p \leq 0.05$ and ** = $p \leq 0.01$, all one-tailed tests

In Hypothesis 2b we examine whether a series of successful hijackings increases the likelihood of additional hijackings. In support, Table 2 shows that if the three most recent events were primarily successful and close together, the hazard of a new hijacking attempt increased for the full sample as well as for non-U.S. and nonterrorist hijackings. As noted, these two hypotheses are both related to the contagion concept—that the widespread publicity attached to hijacking incidents will encourage other incidents. Interestingly, these results suggest that contagion seems to operate only through the rapid occurrence of *successful* hijackings.

Our other benefits-related hypothesis (H2c) predicts that compared to those who hijack for other reasons, those with terrorist-related motives

will be affected less by the counter-hijacking measures being examined here. The results are shown in the last two columns of Table 2. The null associations of the coefficients for tighter screening and the Cuban crime policy neither support nor reject the hypothesis because neither policy significantly impacted terrorist or nonterrorist hijackings. By contrast, the 1973 policies (Metal Detectors) are significantly related to nonterrorist hijackings but null for terrorist events, thus supporting the hypothesis. However, we should note that the differences in magnitude between the coefficient in the terrorism model (-0.644) and the nonterrorism model (-0.996) suggest only weak support for the hypothesis (z=0.78).

Hypothesis 3 predicts that as the severity of punishment increases, the hazard of a new hijacking will decline. We test this hypothesis by including a variable that indicates when it became a crime in Cuba to hijack a plane. Indeed, the hazard of hijacking decreased substantially after this policy was enacted for both Cuban and U.S. flights. As indicated above, the latter finding makes sense because nearly three-fifths of flights diverted to Cuba originated in the United States. Note also the null impact of this policy on other types of hijackings not closely related to Cuban flights.

VARIABLES ASSOCIATED WITH HIJACKING SUCCESS

The significant effect of our success density measure strongly suggests that a successful hijacking attempt (as defined by the FAA) will likely lead to more attempts. Yet, little is known about the characteristics of successful hijackings. How closely do prospective hijackers' perceptions of the likelihood of success correspond to their actual likelihood of success? In the next part of the analysis, we use logistic regression to examine the determinants of successful hijackings. Our detailed hijacking data allows us to track trends in successful and non-successful U.S. and non-U.S. hijackings from 1947 to 1985.[21] Figure 4 shows that while the total number of successful hijackings originating in U.S. and non-U.S. airports are highly correlated until the 1970s, they diverge somewhat thereafter, with successful hijackings of U.S. origin flights declining more rapidly than successful hijackings of non-U.S. flights for most years after 1973 (the exceptions are 1975, 1980 and 1983). And, as we have seen, there are no hijackings originating in the United States between 1991 and 1999. In short, the total numbers of both hijackings and successful hijackings fall off more sharply for the United States than for other countries after 1972.

In Table 3 we summarize the effects on hijack success of variables measuring Policies, Major Purpose and Context generated from a logistic

21. The first incident in 1931 was excluded because two of the independent variables measure the previous incident.

regression analysis. All variables are constructed in the same way as described in Table 1, except that instead of using the success density measure we include an indicator of whether the previous flight was successful (Last Success). Because Table 3 reports odds ratios, all coefficients less than one indicate a negative effect and all coefficients greater than one indicate a positive effect.

Table 3. Odds Ratios and Standard Errors for Logistic Models Estimating Success

	All	*U.S.*	*Non-U.S.*	*Cuba Diverted*	*Terrorist*	*Not Terrorist*
	n=827	*n=267*	*n=559*	*n=273*	*n=119*	*n=702*
Policies						
Cuba crime	0.286**	0.239**	0.254**	0.157**	1.112	0.251**
	0.091	0.131	0.105	0.077	1.406	0.085
Tighter screening	1.528	3.813	1.143	3.598	0.554	1.563
	0.643	2.945	0.607	3.638	0.763	0.753
Metal detectors	1.021	0.156*	1.506	0.081*	0.691	1.021
	0.379	0.138	0.659	0.088	0.619	0.447
Major purpose						
Terrorism	3.604**		3.369**	6.157*		
	0.852		0.820	4.830		
Extortion	0.418**	0.717	0.378*	0.171	2.871	0.223**
	0.140	0.469	0.152	0.192	2.444	0.101
Transportation to	3.623**	12.948**	1.843*		2.661	3.648**
Cuba	0.755	5.252	0.482		1.862	0.810
Context						
Last attempt	1.004	1.004	1.001	0.999	1.000	1.004
	0.003	0.003	0.001	0.001	0.001	0.003
Last success	1.226	1.004	1.064	0.463*	0.961	1.061
	0.198	0.325	0.205	0.168	0.443	0.191
Private flight	2.813**	7.096**	2.520**	2.522		2.961**
	0.758	3.855	0.902	1.684		0.814
U.S. origin	0.660*			1.642		0.650*
	0.129			0.538		0.132
Year	0.992	1.089	0.981	1.149*	1.048	0.994
	0.020	0.074	0.021	0.076	0.069	0.021

* = $p < 0.05$ and ** = $p < 0.01$, all one-tailed tests

Turning first to the policy results, perhaps the most striking finding is that all hijackings except terrorist-motivated attacks were less likely to succeed following the passage of a Cuban law making hijacking a crime. The magnitudes of these results are quite large. For example, the ratio for Cuban flights suggests that the odds that an attempted hijacking to Cuba was successful dropped by 84.3 percent (100–15.7) after the policy was

implemented. Thus the probability of a successful Cuban flight after this law is implemented drops from 0.863 to 0.495.[22] Table 3 also shows that following the implementation of metal detectors and the other interventions in 1973 there was a significant decline in the likelihood of success for both hijackings originating in the United States and those diverted to Cuba. Again, the magnitude of these reductions is quite large. For flights originating in the United States, the probability of success dropped from 0.30 to 0.05. The probability of success for hijackings intended to divert the flight to Cuba dropped by more than half (from 0.90 to 0.43). Finally, the results show that the tighter screening policy had no effect on hijacking success.

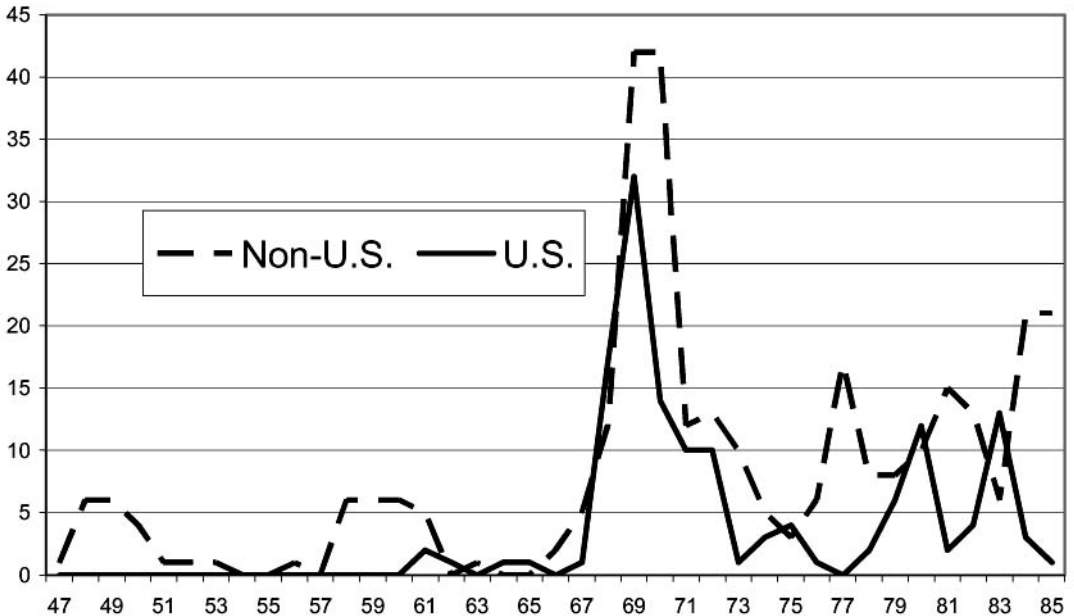
The next series of findings relate to the major purpose of the hijackers. Because there were only five cases of terrorism-related hijacking that originated in the United States and four of these were successful, we dropped the U.S.-origin model from this part of the analysis. Table 3 shows that compared to other flights, those hijacked by terrorists are much more likely to be successful for total, non-U.S. and Cuban diverted incidents. Conversely, flights motivated by extortion were much less likely to be successful for total flights, non-U.S.-origin flights and nonterrorism-related flights. Flights diverted to Cuba were more likely than other flights to be successful in the analysis of total incidents, U.S.-origin incidents, non-U.S.-origin incidents and nonterrorist incidents. In fact, the odds of a successful hijacking originating in the United States are more than fourteen times higher if the purpose of the hijacking was transportation to Cuba (or more than twice as probable, 0.285 versus 0.134). This last finding likely reflects the long-standing U.S. policy of not offering physical resistance to hijackers who had forced aircraft to fly to Cuba on the assumption that this response was least likely to result in casualties (Holden 1986:881; Phillips 1973).

Finally, turning to the findings related to the context of the flight we see that a previous success only produces significant reductions in the success of Cuban flights. The odds of another successful Cuban hijacking after a successful Cuban hijacking are less than half of those that follow unsuccessful attempts. This finding might be due to the fact that a successful hijacking leads to greater vigilance on the part of authorities, making subsequent successful attempts less likely—especially immediately after the successful incident. However, if this is the case, it is unclear why the effect is limited to the Cuban flights.

Table 3 also shows that the likelihood of success is unrelated to the time that has passed since the last attempted hijacking. Whereas our analysis of the probability of new hijackings (see Table 2) showed that private planes

22. These probabilities were calculated by setting all other values to the median.

Figure 4. U.S. and Non-U.S. Successful Hijackings, 1946–1985[a]



[a]A success is defined when hijackers gain control of the plane and reach their destination, whether by landing or by a parachute escape, and are not immediately arrested or killed on landing; unsuccessful hijackings are those in which hijackers attempt but fail to take control of an aircraft (FAA, 1983).

were no more likely to be hijacked than commercial aircraft, the results in Table 3 show that when private planes are hijacked, the hijacking is more likely to be successful—for all flights except Cuban.[23] Finally, flights originating from U.S. airports faced a lower probability of success both for the full sample and for the nonterrorist cases.

DISCUSSION AND CONCLUSIONS

Based on a rational choice perspective, we developed a set of five hypotheses about the likelihood of hijacking attempts using data from the FAA, RAND and a newly developed terrorist events database to determine whether aerial hijacking attempts respond to situations and policies expected to affect the probability of hijacking success and its perceived benefits and costs. Our results support three main conclusions. First, and most policy relevant, we found considerable support for the conclusion that new hijacking attempts are less likely to be undertaken when the certainty of apprehension or severity of punishment increases. But in this regard, one of the certainty measures we examined (metal detectors and increased enforcement) had significant effects whereas another (tighter baggage and customer screening) did not. Perhaps the metal detectors and increased law enforcement at passenger check points was simply a more tangible, public and identifiable intervention than the tighter screening policies introduced 18 months earlier.[24] The drop in the hazard of hijacking attempts after the Cuban crime policy was implemented strongly suggests that the threat of sanctions was useful here. Taken together, these results suggest that of the major policies we investigated, the public (and would-be hijackers) may be more likely to gain immediate knowledge of the metal detectors (which are highly visible) and the Cuban law (a public act), than the tighter screening (which may not have been as visible or as public). However, that these policies were implemented closely in time also raises the possibility that it was the accumulation of policies as opposed to one specific policy that made the difference.

Second, we found partial support for a contagion view of hijacking: the rate of hijackings significantly increased following a series of successful hijackings but actually declined following a series of hijacking attempts that did not take success into account.

Finally, we found that the counterhijacking policies examined had no impact on the hazard of terrorism-related hijacking attempts. By contrast,

23. Because there was only one terrorist hijacking of a private flight (it failed), we omitted the private flight variable from the terrorism model.

24. We tested for a lagged impact of tighter screening and found none.

we found that metal detectors and increased police surveillance significantly reduced the hazard of nonterrorist-related hijackings. Moreover, tighter screening significantly reduced the hijacking hazard of non-U.S. flights and a policy that made hijacking a crime significantly reduced hijackings to Cuba. Similarly, the policies examined had no significant impact on the success of terrorist-related hijackings. By contrast, metal detectors and increased police surveillance significantly reduced the likelihood that U.S.-origin and Cuba-diverted flights would be successful. Additionally, a policy criminalizing hijacking in Cuba significantly reduced the likelihood of success of all nonterrorist-related flights.

Although we have assembled the most comprehensive longitudinal data base on international hijackings of which we are aware, our study has several limitations. Like many earlier macro-level tests of the deterrence–rational choice perspective, we had no perceptual data that would have allowed us to examine the individual motivations of hijackers. Data on individual motivations from hijackers or would-be hijackers appear especially difficult to collect, but such information would allow researchers to better understand how hijackers actually interpret policies and sanctions. Second, because most of the major antihijacking interventions happened very close in time, it was difficult to separate independent effects. Thus our analysis of the three policies of January and February 1973 had to be combined. Third, although our database includes many of the variables shown by prior research to be associated with aerial hijackings, it is certainly plausible that other variables not available to us (and likely unavailable elsewhere) would be useful to have. This is especially the case regarding our measure of benefits specific to terrorist-related hijackings. For example, a hijacking could draw attention to a terrorist group's political agenda, could increase its standing with its followers, or could increase its membership.

Finally, because we relied on FAA data for this analysis, we were limited to the FAA definition of hijacking success. This limitation may be especially important for terrorist-related hijackings, where simply drawing attention to a cause can be considered a measure of success, even if the incident results in the death or capture of the perpetrators. Additionally, it is possible that from the perspective of a would-be terrorist hijacker, getting past security at the airport gate before being apprehended or killed would be considered a success. These and other alternative conceptions of hijacking success should be considered in subsequent research. That said, we also find the FAA definition of hijacking success—where hijackers gain control of the plane and reach their destination, whether by landing or by a parachute escape, and are not immediately arrested or killed on landing—to be a defensible one. It includes the behavior that until

recently was traditionally perceived as a successful hijacking. This view has changed dramatically following the suicide hijackings of 9/11. However, our quantitative analysis ends before the 9/11 hijacking cases. The main types of hijackings not considered successful under the FAA definition are those involving hijackers who manage to get into a plane that never departs the airport.

Although this study is a first attempt at applying the deterrence–rational choice framework to aerial hijacking using these data, much remains to be documented and understood. We envision at least four additional projects. First, because aerial hijacking occurs over space and time, it is important to examine the specific sources of this variation. Perhaps certain countries or airlines are more hijack-prone than others at various times.

Second, we need to better understand the motivation of terrorists. In particular, to what extent are their perceptions of costs and benefits different from those typically applied to common criminal offenders? Along these lines, it would be useful in future research to more thoroughly document individual and group-based motivations across different types of hijackings and hijackers.

Third, because much of our analysis was confined to the period before 1986, we cannot comment on the efficacy of the many recent efforts (for example, sky marshals, reinforced cockpit doors) currently employed by Washington and other governments to thwart aerial hijacking. And, in fact, the very infrequency of aerial hijackings in the United States since 1986 limits the utility of statistical tests of specific countermeasures. Nevertheless, research on these policies will be important to determining their effectiveness weighed against their costs. Additionally, it is likely that such policies will be effective only to the extent that potential offenders recognize these efforts and consider them in their decision making. As with other types of prohibited behavior (Nagin, 1998:1, 36–37), designing effective deterrence policy in the case of aerial hijacking ultimately depends on knowledge about the relationship of sanction risk perceptions to specific policies.

Finally, and as noted, it will be useful to develop different conceptions and operationalizations of success and to examine how these alternative definitions relate to terrorist and nonterrorist incidents. From a policy perspective, our analysis indicates that some certainty- and severity-based interventions were effective at reducing some types of hijacking attempts and lowering the probability of some types of successful hijackings. That some policies are more effective at certain times and places and for certain kinds of acts than others is consistent with the policy implications emanating from situational crime prevention (Clarke and Cornish, 1985; Smith and Cornish, 2004), an approach based largely on the assumptions

about individual motivation underlying the deterrence–rational choice framework. Policy makers need to study the effectiveness of their policies carefully, continue implementing the ones that work, modify the ones that may work, and abandon the ones that do not work.

Taken together, our results provide mixed evidence regarding the effectiveness of deterrence–rational choice policies. The certainty-based 1973 metal detector and police surveillance policies appear more effective than the 1972 tighter screening policy. There was evidence that the Cuba crime policy was effective in reducing Cuba-related hijackings. These findings support Nagin's (1998) conclusion that some deterrence efforts do work. At the same time, they also suggest considerable variation in the effectiveness of the hijacking counter measures that were implemented.

Our results also suggest that policy interventions had less impact on the success of terrorist-related hijackings than on the success of other hijacking types. In fact, none of the three policies examined were significantly related to the attempts or success of terrorist-related hijackings. Perhaps the rational choice perspective is not the most appropriate theoretical framework for understanding terrorist-motivated hijackings, and other theoretical models may be more useful (LaFree and Dugan, 2004; Rosenfeld, 2004).[25] However, much more research is needed before this conclusion can be supported. This is so because traditional deterrence–rational choice models in criminology have been primarily aimed at understanding the behavior of individual offenders. A rational calculus at a group level may look very different. For example, a group-level calculus may privilege outcomes such as publicizing group grievances, countering feelings of hopelessness and humiliation, and obtaining international status ahead of the perceived individual costs of increased certainty and severity of punishment. Even among individual measures, there is much difference between concern about legal punishment versus the attractions of martyrdom or eternal bliss. Hence it may be that we need different measures of costs and benefits in the study of terrorist-motivated hijackings.

25. For example, two theories in particular, general strain (Agnew, 1992) and social learning (Akers and Silverman, 2004) could serve as viable alternative perspectives for understanding terrorism generally, and hijacking in particular. Regarding general strain, it may be that terrorists perceive noxious stimuli, either personally or vicariously, become angry and full of rage and resentment, and then lash out violently. Regarding social learning theory, individuals could be exposed to definitions favorable to hijacking and through the learning process, develop rationales and neutralizations that lead to criminal activity.

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