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UNDERSTANDING RANSOM KIDNAPPING AND ITS DURATION

Claudio Detotto
Bryan C. McCannon
Marco Vannini

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CRENoS – Cagliari
Via San Giorgio 12, I-09100 Cagliari, Italia
tel. +39-070-6756406; fax +39-070- 6756402

CRENoS - Sassari
Via Torre Tonda 34, I-07100 Sassari, Italia
tel. +39-079-2017301; fax +39-079-2017312

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Understanding Ransom Kidnapping and Its Duration

Claudio Detotto[*]
University of Sassari and CRENoS

Bryan C. McCannon[†]
Saint Bonaventure University

Marco Vannini[‡]
University of Sassari and CRENoS

Abstract

What factors drive the length of a kidnapping experience? A theoretical model is developed to conduct comparative statics. A unique data set covering all kidnappings for ransom in Sardinia between 1960 and 2010 is analyzed. Factors related to the ability to pay and cost of abduction matter. The effect of policies aimed at deterring the crime have mixed effects on its duration.

JEL codes: C41, K42

Keywords: crime, kidnapping, ransom, Sardinia, survival analysis

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[*](DiSEA) University of Sassari and CRENoS, 34 via Torre Tonda, 07100 Sassari, Italy, cdetotto@uniss.it

[†]corresponding author, School of Business, P.O. Box 42, Saint Bonaventure, NY 14760 U.S.A., bmccannon@sbu.edu, (716) 375-2145

[‡](DiSEA) University of Sassari and CRENoS, 34 via Torre Tonda, 07100 Sassari, Italy, vannini@uniss.it

1 Introduction

Kidnapping is a serious crime causing pain and suffering to the victim and his/her family. Occasionally it ends in death. Attention has been focused almost exclusively on the decision to pay ransom and the deterrence of the crime. What has not received attention is the duration of the kidnapping experience. This is important since an extended duration escalates the harm of the crime.

Kidnapping for ransom, which is the focus here (rather than, for example, politically-motivated kidnapping[1]), is an economic crime designed to enrich the perpetrators. A number of economic dilemmas arise once the kidnapping has occurred. Each day the criminal holds the victim there is a chance of being caught and punished. It also provides another day for the victim to escape or to die. On the other hand, monetary compensation may be obtained from a ransom payment. Time may be needed to collect funds from family or liquidate assets. The family may also become more desperate causing the willingness to pay the ransom to increase. Understanding the determinants of the duration of a kidnapping experience should aid policymaking designed to combat this crime.

In fact, policymakers around the world have responded to this problem. Enforcement expenditures have increased, limitations to insurance markets have been enacted, and policy dissuading ransom payments has been implemented. While the deterrent effects are well understood, the impact of such policies on the duration is not.

Sardinia provides an ideal environment to study this phenomenon. First, kidnapping has a long tradition in Sardinia. Marongiu and Clarke (2004) note that kidnapping on the island dates back more than five hundred years. Sec-

[1] Alix (1978) provides a classification system for the myriad of types of kidnapping. Applying this taxonomy we restrict attention to *classic ransom kidnapping* along with the subcategory of *express kidnappings*.

ond, despite a significant drop in recent years, its prevalence is still substantial. They provide evidence that in 1968, for an example, 76.8% of the kidnappings in Italy took place in Sardinia. The prevalence of kidnapping in Sardinia has also adjusted over time as enforcement, policy, and economic conditions have changed. Wright (2009) characterizes Italy as a "worldwide leader [in kidnappings] throughout that late 1970s and 1980s" (p.23), but credits policy reforms for a significant reduction. How policies and characteristics of the crime and the victim affect the duration of the crime provides a crucial contribution to the debate of these policies.

To investigate the determinants of the duration of abductions a unique data set of all kidnappings in Sardinia between 1960 and 2010 is analyzed. A theoretical model is employed to link the observable variables to the anticipated effect on the duration. A semi-parametric survival model is estimated to identify the determinants of extended kidnapping experiences and assess the accuracy of the theoretical model.

A number of interesting results arise. The age and gender of the victim are not important determinants, but his/her nationality is. The occupation has a significant impact on the duration. Those in occupations where one's wealth is more likely in illiquid assets experience longer kidnappings. The time of year is a driver of duration. Kidnappings that take place in the summer months are associated with much longer experiences. With regards to public policy, our measure of anticipated apprehension probability does not have a significant effect, but policies designed to deter families of the victim from paying the ransom lead to significantly shorter kidnappings. This suggests that policy focusing on the benefit to kidnapping may be more effective at reducing the harm caused by the crime than enforcement expenditures.

As stated, few have investigated the economic dilemma faced by kidnapping for ransom and its duration. Those that have looked into the problem focus exclusively on the issue of whether to engage in negotiations and pay a ransom or whether to create policies that restrict the bargaining (Lapan and Sandler, 1988; Richardson et al, 2007). Game-theoretic investigations date back to Selten (1976). Block and Tinsley (2008) discuss the dilemma that policy which prohibits the pay of ransom creates. They point out that such laws end up punishing the victim rather than the criminal and argue, while such policies may have an impact on the negative externalities caused to others, they are hard to justify. Academic debates on the properness of restrictions to ransom paying date back to proposed laws in California after the abduction of Patricia Hearst (Jenkins, 1974).

Empirical investigations of hostage-taking as a terrorism strategy has been done by Brandt and Sandler (2009) and Gaibulloev and Sandler (2009). In the former a time series of hostage-taking events is considered. They emphasize that concessions in one hostage-taking episode provide a negative influence/externality on the perceived credibility of other targets who have stated policies of non-negotiation. It is estimated that each concession to kidnappers results in two to three future additional abductions. In the latter the authors consider terrorist attacks. They differentiate between kidnapping and non-kidnapping incidents. They show that kidnapping improves the logistical success of an event and that the success of the negotiation in kidnapping events is greater when more hostages are involved and as the duration of the kidnapping experience increases.

Economic investigations into other types of kidnappings have been done. Orset (2008) builds a theoretical model of child kidnapping (and protection) motivated by human trafficking/labor. Crettez and Deloche (2009) build a theoretical model of political kidnappings to explain the murder of the victim in equilibrium. Elster (2004) discusses the use of kidnapping in civil wars and the variety of motivations the kidnappers may have.

Investigations into kidnapping in Sardinia are even more rare. Caramazza and Leone (1984) provide an early investigation into the characteristics of kidnapping and, especially, kidnappers, in Sardinia. Marongiu and Clarke (2004) discuss the "subculture of violence" thesis put forth to explain the high rate of kidnapping in Sardinia and contrast it with a limited rational choice theory. Descriptive statistics and anecdotes of the kidnapping process are discussed. Favaro et al (2000) conduct interviews with twenty-four Sardinian kidnap victims to assess mental health effects. They identify enhanced rates of post-traumatic stress disorder and Stockholm syndrome. Briggs (2001), in an overview of kidnapping policies and insurance in the U.K., speculates on the anticipated effects of Italian policy on the prevalence and duration of kidnapping. No formal analysis of it, though, is provided. To the best of our knowledge, this is the first economic investigation of ransom kidnapping and its duration.

Section 2 presents the theoretical model. The data, econometric methods, and testable predictions are elaborated on in Section 3. Section 4 presents the results and Section 5 concludes.

2 Theoretical Model

Our first objective is to develop a theoretical model to explain the duration of the kidnapping experience. Doing so will allow us to identify the determinants of extended kidnappings so that an empirical assessment of the abductions can be undertaken.

Hence, consider a criminal (or criminal organization) who has kidnapped an individual. There is an infinite horizon with each period indexed by $t = 0, 1, 2, ...$ One may think of each period as a day. In each stage the kidnapper has one of three choices to make. First, he may accept the current ransom offer, R_t. This is equivalent to assuming that in each period there exists an amount in which the hostage's family, friends, employer, etc. is willing to pay to have him/her safely returned. Second, the kidnapper may continue (denoted c) with the kidnapping. Third, he may free the hostage, which is denoted by h. One may think of this as simply letting the hostage return home without having to pay a ransom, but may also be thought of as killing the hostage.[2] Since we are primarily interested in the decision to continue with the negotiations or to end it, we simply want to differentiate between ending it with a payment versus completing it without. If either h is selected or the ransom offer is accepted, then the decision problem ends.

Let $V(R_t)$ denote the value of having the ransom offer R_t available in period t. A few assumptions are made regarding the payoffs. If the ransom offer is accepted the kidnapper receives $R_t - P_r$ where $P_r > 0$ is the expected punishment (probability of apprehension multiplied by the sanction if convicted). In other words, if the kidnapper takes the ransom there is some chance that he will be caught. The punishment is assumed to not depend on the time period, the victim, or the duration of the kidnapping experience. Also, this implies that the kidnapper is risk neutral. Alternatively, if the kidnapper selects h, then $0 - P_h$ is earned where $P_h > 0$ is the expected punishment when he frees the hostage.

Finally, consider the payoff if the kidnapper continues with the kidnapping. Define $\delta_i \in (0, 1)$ as the probability that in the period the hostage either dies, $i = k$, or flees, $i = f$. Both outcomes provide the kidnapper with no ransom

[2] While the difference between the two from the perspective of the hostage is stark, we take them from the kidnapper's perspective to be equivalent. One may think of this as assuming law enforcement activities are not affected by the kidnapper's decision. Alternatively, one may expect significant differences in the sanction and the enforcement activity separating these two. In this case, define the action h as the choice between freeing the victim and killing the victim that maximizes the kidnapper's payoff.

and expose him to potential sanctions, P_i. Assume $P_k > P_f$.[3] Let $p \in (0,1)$ denote the probability that the kidnapper is caught in the period between the ransom offers and let $S > 0$ be the sanction experienced if this happens. Assume time is discounted at the rate $\beta \in (0,1)$. Also, there is a cost M to maintain the hostage, which includes the actual expenses of food and shelter as well as the opportunity cost of guarding the hostage. As a result, if the kidnapper selects option c in period t, then he receives $\beta(1-\delta_k)(1-\delta_f)(1-p)V(R_{t+1}) - \beta\delta_k P_k - \beta(1-\delta_k)\delta_f P_f - \beta(1-\delta_k)(1-\delta_f)pS - M$.[4] To simplify the notation let ψ and χ be defined such that this payoff is equal to $\psi V(R_{t+1}) - \chi$.[5] Hence, $\psi \in (0,1)$, $\chi > 0$, and they are time invariant. One may interpret χ as the expected cost to continuation. This setup assumes the expected sanction if the hostage flees or dies is the same regardless of whether the kidnapper intended the outcome or not, which seems likely since the actions are likely unverifiable.

A very simple setup is considered for the theoretical model. Assume $R_{t+1} = R_t + z$ where $z > 0$. In other words, assume that as time passes the family and friends of the hostage become more willing to pay the ransom so that the amount collected increases. Also, liquidity constraints can be relaxed over time. This presumes that there is no uncertainty over the amount that could be achieved in the future, which obviously is an oversimplification. The assumption is made, though, because it is not the uncertainty *per se* but the benefits and costs to extending the duration that we are interested in exploring. Finally, to guarantee that nonzero durations are possible, the incremental increase in the ransom must be sufficiently greater than the expected cost to continuation. Hence, we assume

[3] One can rationalize this assumption as deaths are punished more severely, but with the potential for reduced rates of apprehension, the inequality can be reversed. This assumption is made for convenience and is not crucial for the analysis.

[4] To simplify the analysis it is assumed that the maintenance costs must be paid regardless of the outcome.

[5] Hence, $\psi = \beta(1-\delta_k)\left(1-\delta_f\right)(1-p)$ and $\chi = \beta\delta_k P_k + \beta(1-\delta_k)\delta_f P_f + \beta(1-\delta_k)\left(1-\delta_f\right)pS + M$.

that $z-\chi>T$ where $T>0$ is a minimum threshold.[6]

As a consequence,

$$V(R_t)=\max\{R_t-P_r,-P_h,\psi V(R_{t+1})-\chi\}. \tag{1}$$

It is straightforward to derive the optimal decision of the kidnapper. There exists an optimal stopping period where he is no longer willing to take the chance of being caught to increase the amount collected in ransom. Suppose the kidnapper takes the ransom in period n (after n selections of c). Then it must be that this is better than waiting one more period, or rather,[7]

$$R_n-P_r\geq\psi(R_{n+1}-P_r)-\chi.$$

Since $R_{t+1}=R_t+z$ and $R_t=R_0+tz$, this simplifies to $R_0+nz-P_r\geq\psi(R_0+(n+1)z-P_r)-\chi$, or rather,

$$n\geq\frac{\psi}{1-\psi}+\frac{P_r-R_0}{z}-\frac{\chi}{(1-\psi)z}. \tag{2}$$

Similarly, it must that that the kidnapper prefers to wait until stage n rather than accepting the lower ransom in period $n-1$. Rather, $R_{n-1}-P_r<\psi(R_n-P_r)-\chi$, which simplifies to

$$n<\frac{1}{1-\psi}+\frac{P_r-R_0}{z}-\frac{\chi}{(1-\psi)z}. \tag{3}$$

Therefore, defining $\underline{n}$ as the value of the RHS of (2) and $\overline{n}$ as the RHS of (3), if a ransom offer is selected it will be done so after n' stage where n' is the unique value within $[\underline{n},\overline{n})$.[8]

[6] Formally, define $T=\max\left\{(1-\psi)(R_0-P_r+z),\frac{(1-\psi)(pS-P_f)}{1-p},0\right\}$.

[7] Assume that if indifferent the kidnapper prefers to take action earlier rather than later.

[8] The interval $[\underline{n},\overline{n})$ is nonempty and has at most one integer within it since $\overline{n}-\underline{n}=1$. The existence of such a n' requires that $\frac{\psi}{1-\psi}+\frac{P_r-R_0}{z}-\frac{\chi}{(1-\psi)z}>0$, which will be assumed to hold (see Footnote 6).

The outcome of accepting the ransom after n' periods generates an expected game payoff to the kidnappers of

$$V_n = \psi^{n'} \left(R_0 + n'z - P_r \right) - \chi \sum_{t=0}^{n'-1} \psi^t. \tag{4}$$

Alternatively, the kidnapper may choose to end the situation by setting him free. Since it is assumed that the payoff to this outcome is time invariant, then if it is selected it will be done so in period 0 since the value to taking the ransom offer grows as time proceeds. Thus, holding the hostage for n' periods is optimal if its payoff is greater than $-P_f$. A sufficient condition is that $R_0 + n'z - P_r - \frac{\chi}{1-\psi} > 0$, which reduces to

$$n' \geq \frac{P_r - R_0}{z} - \frac{\chi}{(1-\psi)\, z}. \tag{5}$$

Since $\psi \in (0,1)$, if (2) holds, then this inequality will hold as well, or rather, it is not a binding constraint.[9]

What does this tell us about the duration of the kidnapping? The following result provides the comparative statics.

Proposition 1 The duration of the kidnapping is greater when

[1] the initial ransom offer, R_0, is lower

[2] the probability of apprehension during the kidnapping, p, is lower

[3] the incremental increase in the ransom, z, is greater (so long as $R_0 - P_r$ is not too large)

[4] the probability the hostage dies, δ_k, is lower

[5] the probability the hostage flees, δ_f, is lower

[9] If the growth in the willingness to pay was random, then it would be possible that a large, negative shock would lead the kidnappers to prefer to free the captive in a later period.

[6] the maintenance costs, M, are lower.

Proof. The proof of claim [1] is obvious. For [2] note that $\frac{d\psi}{dp} > 0$ and $\frac{d\chi}{dp} < 0$. Hence, from (3) $\frac{dRHS}{dp} = \frac{-(1-\chi)\frac{d\chi}{dp}+(z-\chi)\frac{d\psi}{dp}}{(1-\psi)z} < 0$ since it is assumed that $z > \chi$. For [3] since $\frac{d\psi}{dz} = \frac{d\chi}{dz} = 0$, $\frac{dRHS}{dz} = \frac{(1-\psi)(R_0-P_r)+\chi}{(1-\psi)z^2}$ so that [3] holds when $R_0 - P_r < \frac{\chi}{1-\psi}$. For [4] note that $\frac{d\psi}{d\delta_k} = -\beta(1-\delta_f)(1-p)$ and $\frac{d\chi}{d\delta_k} = \beta P_k - \beta\delta_f P_f - \beta(1-\delta_f)pS$ so that $\frac{dRHS}{d\delta_k} = \frac{-\beta}{(1-\psi)^2 z}$ x $[(z-\chi)(1-\delta_f)(1-p)$ $+ (1-\psi)(P_k - pS - \delta_f[P_f - pS])]$. Since $P_k > P_f$, then $\frac{dRHS}{d\delta_k} < 0$. For [5] note that $\frac{d\psi}{d\delta_f} = -\beta(1-\delta_k)(1-p) < 0$ and $\frac{d\chi}{d\delta_f} = \beta(1-\delta_k)(P_f - pS)$. Thus, $\frac{dRHS}{d\delta_f} = \frac{\beta(1-\delta_k)}{(1-\psi)^2 z}[(pS-P_f)(1-\psi)-(1-p)(z-\chi)]$, which is negative when $pS - P_f < \frac{(1-p)(z-\chi)}{1-\psi}$, which is assumed to hold (footnote 6). Finally, for [6] $\frac{d\psi}{dM} = 0$ and $\frac{d\chi}{dM} > 0$ so that $\frac{dRHS}{dM} < 0$. ■

3 Kidnapping in Sardinia

Now that we have established a straightforward theory of the duration of the experience, we turn to empirical evidence of kidnapping in Sardinia.

3.1 Data

A data set is compiled of all kidnapping events on the island of Sardinia between 1960 and 2010. The primary sources used are *Anonima Sequestri Sarda* (Casalunga, 2007) and *Sardegna Criminale* (Ricci, 2009). Both publications collect factual information on kidnapping in Sardinia. They provide much information on each recorded kidnapping experience. Additionally, background information on the victims is collected from local newspaper articles. Such accounts are also used to expand the data set to the year 2010. A total of one hundred and thirty-four observations resulted.[10]

[10] There were no missing or incomplete observations, but only completed kidnappings where the victim survived is considered. Hence, failed attempts, threats, and kidnappings that end in

The primary variable of interest, DAY, measures the number of days the kidnapping experience lasted. Our data include one observation for each victim which survived. For each kidnapping event we have a set of covariates that describes characteristics of the victim. They include gender, age, residence, and occupation. The victims' residence is divided in three groups depending on if the hostage comes from Sardinia, Italy (except Sardinia), and abroad. These are measured by the dummy variables SAR, ITA, and ABR respectively. The victims' occupation is divided in three categories: farming, manager-entrepreneur, and freelancer. Freelancers are independent professionals and examples include doctors and accountants with their own private practices. Occasionally, a spouse or child of a more wealthy individual is kidnapped. In these situations the occupation of the primary income-earner is used. The dummy variables FAR, MAE, and FRL capture these occupational classes.

Also, information on the crime event is recorded. Specifically, the year, time of year, place, and people involved are included. The place of the kidnapping is in one of the four provinces of Sardinia: Nuoro, Sassari, Oristano and Cagliari. To control for the timing four dummy variables are created to account for the season in which the crime was instigated (winter, spring, summer, or autumn). Also, five dummy variables are created for each of the five decades covered in the sample. Kidnapping can involve only one victim or a group (e.g. a family). Hence, the dummy variable GR is equal to one if the victim was kidnapped within a group.

Furthermore, we know how the crime ended. The victim can flee, be freed by law enforcement officials, or be released by the kidnappers. The release typically occurs when a ransom has been paid. Also, to control for the effectiveness of

death are not included. Since our objective is to analyze the duration of the kidnapping we are unable to accurately assess the end of a kidnapping experience when the individual does not return alive. There were twenty-eight deaths during the time span of interest. Kidnappings before 1960 suffer from incomplete data.

law enforcement, we attempt to estimate the probability of capturing the kidnappers. Let DET denote the proportion of the previous five kidnapping cases that resulted in an arrest and conviction.[11] This measures gives us an approximation for the successfulness of law enforcement, which may deter kidnappers from extending the crime.

Finally, there is one external, public policy of note. In 1991 the Italian government imposed an asset-seizure policy (known as *Blocco dei Beni*). Prior to the act, law enforcement authorities were allowed to freeze the assets of the family of the victim. This was implemented at the discretion of law enforcement officials. The act in 1991 made the asset-seizure mandatory. Furthermore, the law restricted the use of insurance to deal with the uncertainty of kidnapping. Obviously, the intent of the law is to reduce the number of these crimes by mitigating the benefits. We control for the act, though, to assess its impact on the duration given that the crime has occurred. The variable ASP is equal to one if the kidnapping occurs after the implementation of the asset-seizure policy.

Table 1 provides the variables and the descriptive statistics.

Kidnappings in Sardinia, while they range from one to three hundred and twenty-five days, average just less than two months in duration. Figure 1 shows such heterogeneity by displaying, for each kidnapping in our sample, the number of days. We find the evidence of a positive trend in the duration. Furthermore, a vertical reference line is drawn at 1991, representing the implementation of the asset-seizure policy. The right side of (Figure 1) exhibits a slump in criminal activity and the existence of two opposite extremes: very long (about 200 days, on average) and express kidnappings.

[11] The data set is restricted to observations before1960 due to incomplete information on the facts of the kidnapping. Information on conviction, though, is available. Thus, we do not lose any observations by measuring deterrence in this way.

Table 1: Descriptive Statistics

Variable	Code	Mean	St. Dev.
kidnapping duration	DAY	57.29	67.20
released	REL	0.90	0.30
fled	FL	0.04	0.19
freed	FR	0.06	0.24
gender	FEM	0.15	0.36
age	AGE	40.05	16.95
Sardinia	SAR	0.77	0.42
Italy	ITA	0.19	0.40
abroad	ABR	0.04	0.19
farmer	FAR	0.33	0.47
manager-entrepreneur	MAE	0.51	0.50
freelancer	FRL	0.16	0.37
Cagliari	CA	0.07	0.26
Nuoro	NU	0.52	0.50
Oristano	OR	0.07	0.25
Sassari	SA	0.33	0.47
winter	SEA1	0.22	0.42
spring	SEA2	0.22	0.42
summer	SEA3	0.26	0.44
autumn	SEA4	0.29	0.45
asset-seizure policy	ASP	0.13	0.33
ransom paid	RAN	0.75	0.43
victim in a group	GR	0.23	0.42
deterrence	DET	0.06	0.11
1960s		0.23	0.42
1970s		0.35	0.48
1980s		0.28	0.45
1990s		0.12	0.32
2000s		0.02	0.15

A large percentage of them are resolved with a releasing of the victim; often with a ransom paid. Male Sardinians are the common demographic group for the victims, while their occupations are distributed over the three major occupation classes. Kidnappings occur rather equally across the seasons of the year, but not equally across the regions. Interestingly, the distribution of crimes across time follows an inverse U-shaped patter (Figure 2). Enhanced enforcement and, potentially, economic growth seem to have contributed to the decline in its prevalence in the last two decades.

Figure 1: **Duration of kidnappings in Sardinia (1960-2010)**

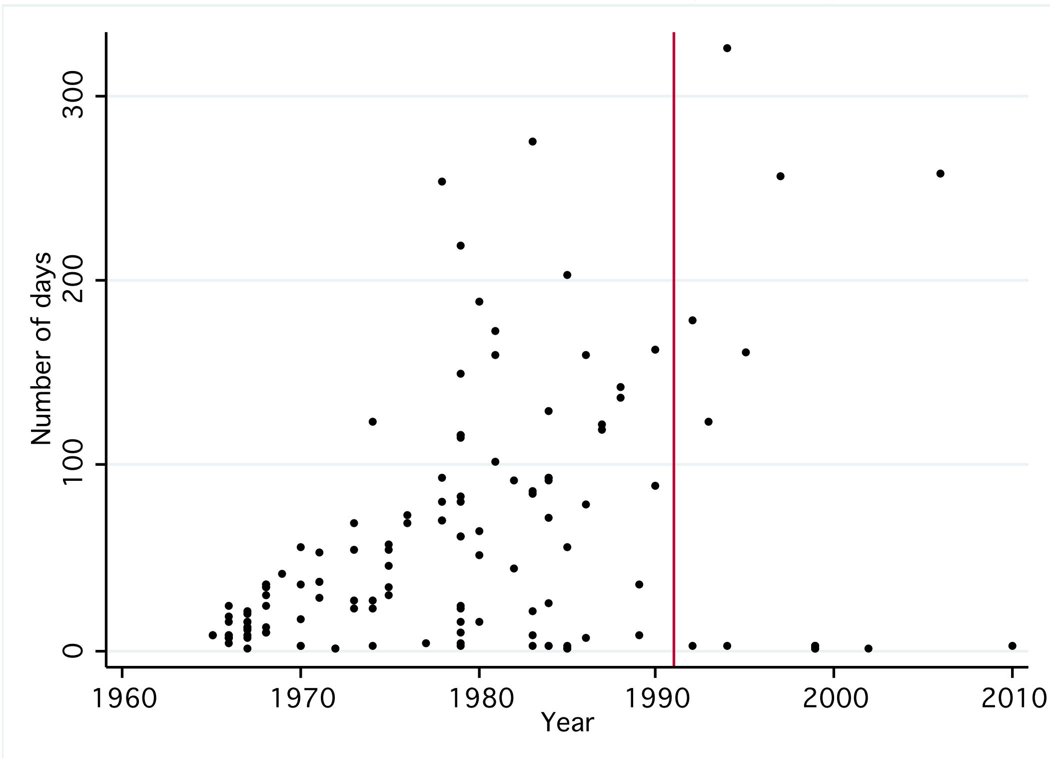
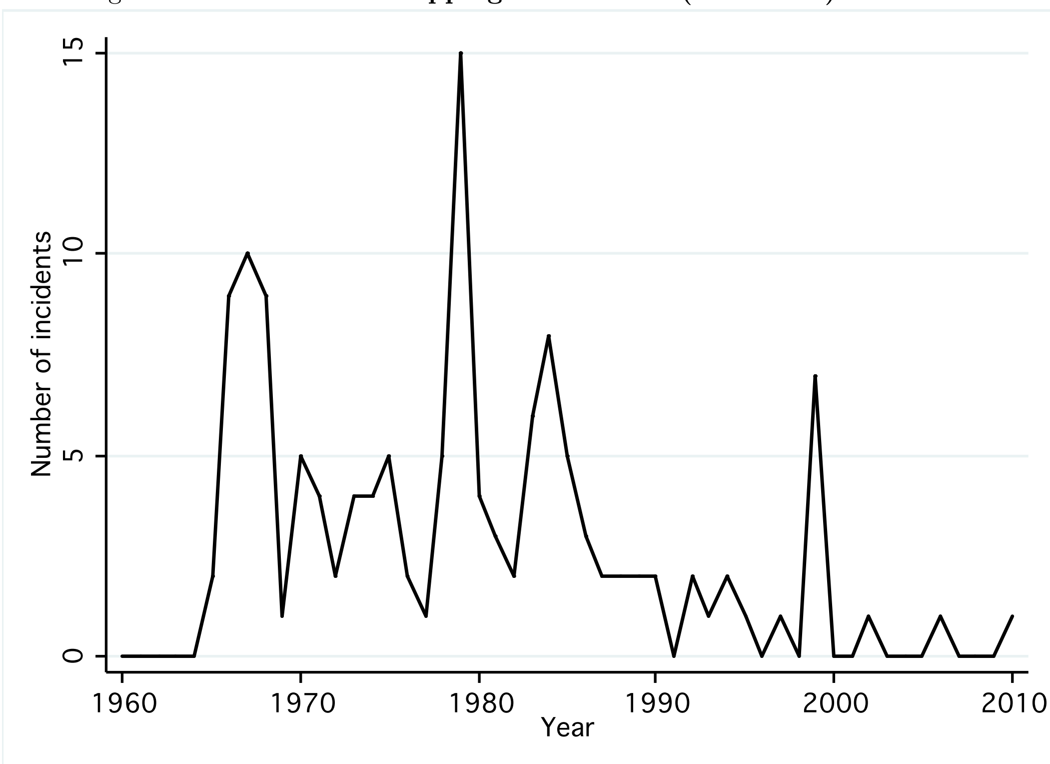


Figure 2: **Number of kidnappings in Sardinia (1960-2010)**



3.2 Testable Predictions

The variables in the theoretical model can be linked to the observable variables in the data set to guide the econometric methods.

It is shown in Proposition 1 that anything that enhances the likelihood of a negative outcome for the kidnappers results in a reduced duration. Specifically, an increased chance of apprehension (p), an expanded likelihood of the victim escaping (δ_f), or an increased probability of the victim's death (δ_k) all are expected to reduce the duration of the kidnapping. Furthermore, the maintenance costs, M, add to the incentive to shorten it.

The demographic variables are anticipated to be related to the cost-side conditions. For example, one might expect older victims to be unable to flee, but also more vulnerable to the trials of being a hostage. Hence, it is difficult to predict the relationship between age and kidnapping duration. Presumably, the effect of age and death is greatest for the very old and, hence, the relationship may be nonlinear. The nationality of the victim can be expected to be related to the knowledge of the terrain and ability to find help. We expect individuals from abroad to be less able to escape than Italians, with Sardinian's especially having a better chance of getting away.

With regards to the maintenance costs we anticipate that group kidnappings and seasons of the year affect these costs. It seems reasonable to presume that the cost and difficulty of the kidnapping is escalated when entire groups of people are abducted. Furthermore, improved weather can make the crime (and its continuation) easier.

The benefits to kidnapping are decomposed into two components in the theoretical model. First, R_0 denotes the initial value of the potential, acceptable ransom. This is driven by the wealth of the victim. Hence, the occupation of the victim is expected to be correlated. Presumably, though, the victims are chosen because of their wealth levels and, therefore, all have high abilities to pay. The difference, though, is in z. One factor that can contribute to the escalation in the payment is the liquidity of the victim and his family. If one's wealth is mainly in cash, then it is easy to use this as a ransom payment. Alternatively, if much of one's wealth is in land, buildings, or a business, then immediate liquidation is difficult. Wright (2009) in his first-hand accounts of the kidnapping phenomenon and ransom-bargaining attests to this fact. He observes that kidnappers not only "investigate the potential victim's financial situation to estimate the ability to pay" but also assess their "apparent liquidity" (p.44). In this scenario one would expect R_0 to be low, but z be be great. As shown in Proposition 1, this is associated with extended durations. We anticipate farmers and, especially, manager-entrepreneurs to have much illiquid wealth.

Table 2: Linking Theory to Data

Variable Code	Anticipated Effect on the Duration	Variable from the Theoretical Model
AGE	$+$	δ_k, δ_f
AGE^2	$-$	δ_k
SAR, ITA, ABR	SAR $>$ ITA $>$ ABR	δ_f
FAR, MAE, FRL	FAR $>$ FRL	R_0, z
	MAE $>$ FRL	
SEA3	$+$	M
GR	$-$	M
ASP	$-$	R_0, z
DET	$-$	p

Similarly, the asset-seizing policy of Italy can be expected to add frictions to the ability to pay in the future. Immediate payments, before the authorities are able to act, are possible. Wright (2009), writing based on his experiences, reports that the freezing of assets results in either families not reporting the crime or seeking friends to raise the ransom. The effect of these efforts likely deteriorate over time. Hence, such a law affects, specifically, the ability to pay over time and not necessarily the immediate payout. Thus, we would expect R_0 to be large and z to be small and generate shorter kidnapping experiences. Table 2 provides the anticipated effects (from Proposition 1) of some of the observable variables.

3.3 Econometric Method

As said in the introduction, we propose a semi-parametric survival model (for details on such models refer to Cleves, Gould, and Gutierrez, 2004). The use of survival models is not a novelty in the criminology literature (Chung, Schmidt, and Witte, 1991; Dejong, 1997). They are used to analyze the length of time that elapses from the beginning of some events until their ends, such as strike duration, length of unemployment status or between arrests. Using such models, it is possible to estimate how various treatments and/or socio-economic characteristics affect the duration variable (Wooldridge, 2002).

Duration is represented by the continuous random variable $\tau \in (0, T)$, which has a conditional probability distribution $f(t|x)$ where t is a realization of τ and x is a vector of explanatory variables. The cumulative distribution function (c.d.f.) of t given x is the following:

$$F(t|x) = P(t' \leq t|x), \tag{6}$$

with $t \geq 0$. The survivor function measures the probability that the spell is at least t:

$$S(t|x) = 1 - F(t|x). \tag{7}$$

Given the c.d.f. and the survivor function, we can define the hazard function as follows:

$$\lambda(t|x) = lim_{\Delta t \to 0} \frac{P(t < T < t + \Delta t | T > t, x)}{\Delta t}. \tag{8}$$

The hazard function indicates the probability of leaving the initial state in the short interval of time Δt, given it has survived until time t. Often the analysis is focused to detect the effect of x_j on $\lambda(t|x)$, that is whether the j^{th} explanatory variable impacts, *ceteris paribus*, the instantaneous probability that an event occurs given that it has not occurred until that moment.

Two often-used models of survivor functions for estimating the effects of the covariates x are the parametric and the semi-parametric proportional hazard (PH) model. In the both models, the hazard rate $\lambda(t|x)$ is expressed as a function of the covariates as follows:

$$\lambda(t|x) = e^{x\beta}\lambda_0(t)$$

where β is a set of parameters and $\lambda_0(t)$ is the baseline hazard function, which is common to all units and serves to scale the baseline hazard rate. Such models assume that $\lambda(t|x)$ is proportional to the baseline hazard function, and the proportionality constant is a function of x, $e^{x\beta}$, independent of the time variable t (Cox and Oakes, 1984). The functional form of $\lambda_0(t)$ determines the regression model: if we let the baseline hazard be unspecified, the semi-parametric Cox proportional hazard model (Cox, 1972) is obtained; otherwise setting a specific functional form, such as the exponential, Weibull and Gompertz distribution, different regression models can be implemented. In the latter case, the Wald test should be run in order to check for the appropriateness of the functional form in use.

Although Cox PH estimation is numerically complex, because $\lambda_0(t)$ "is a parameter for each observation that must be estimated" (Greene, 2003), it has the advantage of not requiring a priori a functional form of the baseline hazard rate. The semi-parametric approach is necessary in our case, because the theory offers little guidance for the shape of $\lambda_0(t)$. For this reason we apply the Cox estimator procedure that allows the baseline hazard rate to be free to vary.

4 Results

The econometric method identified in the previous section is applied to study the effect of victim characteristics and exogenous variables on the criminal choice, in terms of the duration of the kidnapping. Table 3 presents the results of the Cox PH model.

Table 3: Results ($N = 134$)

	I		II	
Variable	Hazard Ratio	std. error	Hazard Ratio	std. error
REL	6.14 ***	(3.32)	23.11 ***	(18.40)
FL	0.27	(0.23)	4.54 *	(4.04)
RAN	0.12 ***	(0.04)	0.10 ***	(0.04)
FEM	0.66	(0.20)	0.72	(0.22)
AGE	1.00	(0.03)	0.99	(0.03)
AGE^2	1.00	(0.00)	1.00	(0.00)
ITA	1.78 *	(0.53)	1.68 *	(0.52)
ABR	0.61	(0.32)	0.55	(0.30)
FAR	0.99	(0.31)	0.90	(0.29)
MAE	0.44 ***	(0.13)	0.46 ***	(0.13)
SEA1	0.71	(0.21)	0.65	(0.20)
SEA3	0.47 ***	(0.14)	0.39 ***	(0.12)
SEA4	1.13	(0.31)	1.10	(0.30)
GR	3.20 ***	(0.87)	3.62 ***	(1.01)
DET	0.31	(0.27)	0.79	(0.72)
ASP	1.11	(0.44)		
decade controls?	NO		YES	
region controls?	YES		YES	
log likelihood	-488.21		-479.13	

*** 1%; ** 5%; * 10%

The first column in Table 3 presents the results of the PH estimation including the asset-seizure policy, ASP. Region fixed effects are employed but, since the policy is based on a set period in time, decade effects cannot be included.[12] Column II in Table 3 drops ASP and includes the time controls to illustrate the minimal affect on the other independent variables.

The hazard function is the chance of an event occurring within a time interval divided by the width of the interval. The hazard ratio coefficient is interpreted as the proportional change when its covariate is increased by one unit. To illustrate using the results in Table 3, hostages who are able to flee reduce their experience by a factor of six (the FL hazard rate, HR_{FL}, is 6.14 in I) relative to the ones freed by police (the omitted variable). This means that police need more time to locate the criminals. Also, we observe that longer abduction times are associated with cases where the ransom was paid ($\mathrm{HR}_{RAN} = 0.12$). In other words, the probability that the failure occurs when the ransom is paid is 12% of the one when the ransom is not paid. Notice that this is significant controlling for the fact that the victim was released by the kidnappers. Thus, given that an individual is released if the family pays a ransom, then the act is likely to generate longer durations.

The results of the empirical estimation coincide with the predictions of the theory. Occupation plays a role. Manager-entrepreneurs experience longer durations relative to a freelancer ($\mathrm{HR}_{MAE} = 0.44$). This matches our predictions that those in these occupations tend to have lower initial abilities to pay, but experience more substantial increases over time.

Summer events are likely to result a longer survivor time than the ones occurring in spring ($\mathrm{HR}_{SEA3} = 0.47$): good weather conditions decrease the costs for the kidnappers increasing the duration of the crime. As expected, criminal events that involve more victims at the same time reduce the duration

[12] The mandatory asset-seizure was not implemented until the end of 1991. Hence, there does exist observations that occur in the 1990s but not with the policy in place. Thus, they are collinear but not perfectly so. The insignificance remains if both ASP and decade fixed effects are included.

of the kidnapping ($HR_{GR} = 3.20$).

The demographic variables, age and gender, do not play much of a role. There is evidence that Italians suffer longer kidnappings than Sardinians, which coincides with the argument that escape probabilities differ between the groups.

With regards to institutional intervention, the deterrence variable has no effect on the criminal behavior. In fact, the magnitude of the coefficient suggests that an increase in apprehensions of the most recent kidnapping actually increases the duration of the current kidnapping. We are, of course, unable to differentiate our inability to measure accurately the probability as assessed by the criminals from the result that, in fact, kidnappers doe not respond to successful law enforcement.

Furthermore, the asset-seizure policy reduces the duration of the kidnapping, but the effect is insignificant. Theory predicts that this policy variable should specifically target the duration of the crime. The impact in the data, though, may be more nuanced. The asset-seizure policy can be anticipated to have two effects. First, it adds frictions to the use of a family's assets when a kidnapping occurs. In other words, there are ways the family can accumulate sums, but the law makes it difficult. For example, the family can (secretly) use a friend of the family or business acquaintance to collect funds from family and friends. This takes time and, thus, would be expected to increase durations. Second, the law can be subverted by both the family of the victim and the criminals by encouraging quick resolutions. As the days accumulate, the possibility that law enforcement both becomes informed of the crime and is able to freeze the assets grows. In fact, Wright (2009), using anecdotal evidence, notes the growing popularity of express kidnappings. Express kidnappings are kidnappings completed within the day or resolved in a couple of days. For example, kidnappers may abduct a victim, take him or her to an ATM machine, and under a threat of violence force the victim to withdraw all available funds. In a scenario such as this the duration can be simply a matter of hours.

This intuition is supported by analyzing Figure 1. There is an upward trend in the duration of kidnappings over time. After 1991, though, the distribution of kidnapping durations becomes bimodal. Either the kidnappings are completed in a very short period of time, or they extend over a longer period of time.

Consequently, the lack of statistical significance of ASP may arise, not from the policies ineffectiveness, but rather suffer from opposing effects. Additionally, with the deterrent effect the law is anticipated to create, fewer kidnapping observations arise. Descriptive statistics support this argument since only 14% of the observations occur in the twenty-year window of 1990 to 2010, which is less than any single decade earlier (see Figure 1 and Figure 2). Hence, a limited number of observations may be frustrating the hypothesis testing.

To identify effects of the asset-seizure policy two approaches are employed. First, a dummy variable is created to measure express kidnappings. Define EXPRESS as being equal to one if the kidnapping lasted four days or fewer. These represent the shortest of the experiences and is hypothesized to be more prevalent after the introduction of the policy. Four days is a natural break in the data as well since while one, two, three, and four days each have many observations, there are no observations in our data set for either five or six days.[13] The second approach we use is to introduce a time trend, TIME, into the PH model in order to account for the upward trend in duration as shown in Figure 1. A break in the time trend with the introduction of the policy allows us to identify an impact of the policy.

Table 4 presents the results. All independent variables used in Table 3 along with region fixed effects are also included in the specification, but not reported.

[13] The mean value of EXPRESS is 0.20 with a standard deviation of 0.40.

Table 4: Effect of Policy on Duration

	probit model dep. var. = EXPRESS	PH model dep. var. = DAY
ASP	6.54×10^{-48} ***	3.07 **
	(4.71×10^{-46})	(1.52)
TIME		0.94 ***
		(0.02)
log-likelihood	-7.90	-482.29
pseudo R^2	0.88	

*** 1%; ** 5%; * 10%

Marginal effects reported for the probit model, hazard ratio reported for PH model.

The results in Table 4 conform to our hypothesis. While small, the asset-seizure policy has a statistically significant effect on the prevalence of express kidnappings. The law acted to increase the frequency of their use, relate to all kidnappings. Similarly, in the PH model, the coefficient on the variable TIME confirms that over time the duration of the kidnappings is trending upwards. Thus, one would expect longer kidnappings in the 1990s and 2000s. The coefficient on ASP being greater than one indicates that the policy, controlling for this upward trend, also encouraged significantly shorter kidnappings. In other words, the policy created a divide in the kidnappings. Some kidnappings resulted in very short durations. Other kidnappings were extended longer than they would have been without the policy as the frictions imposed acted as a binding constraint.

5 Conclusion

Along with the contribution of showing that the "optimal stopping problem" model is a legitimate framework to use in modeling the kidnapping experience (which is valuable itself for understanding the phenomenon in general), we find mixed effects of policy, intended to deter kidnapping, on its duration. The asset-seizure policy has the effects that the theory predicts. Obviously, restricting the family's ability to pay should lead to deterrence - there is less expected gain to the crime - but what we have observed is that it also shortens the duration of the kidnapping experience. This provides an additional benefit to the controversial policy. This result points to a need for new policy intervention and/or private investments in order to reduce the criminal expected gain for short-term kidnappings in particular. On the other hand, if a kidnapping is not express some evidence was found that, in fact, duration might be expanded as the policy creates frictions in the collection of the ransom for the family. Improved law enforcement, measured as the proportion of recent kidnapping crimes successfully solved, does not seem to effect the duration. Taken together, these two results imply that policymakers may want to consider ways to reduce the anticipated benefit to kidnapping rather than focus on the costs.

One value of the theoretical model is that it illustrates that there is a significant difference between the immediate-term ability/willingness to pay and the escalation of the payment over time. With regards to deterrence these effects are aggregated into the benefit of the crime and any factor that reduces this benefit should result in deterrence. With regards to the duration of the kidnapping, though, factors that affect one component need not drive changes in the duration in the same manner as the other. While wealthy are kidnapped, the liquidity of the victim's assets, as proxied by their occupation, results in differential durations. Policies that target the benefit to kidnapping over time shortens its duration.

Also, of important note to policy is that increased enforcement and apprehension, as stated, cannot be shown to affect the duration of kidnapping. One potential explanation for this is that the marginal probability of being captured in any given day is very small. Apprehension may, for example, occur long after the kidnapping; especially since law enforcement's information improves after the victim is released or the ransom-payment is arranged. Duration is driven more by benefits and maintenance costs.

The primary shortcoming of the empirical results is that we are unable to identify how each of our independent variables affects the decision to kidnap. This selection bias can, for example, account for some of our inconclusive results. Additionally, we rely on kidnappings reported to law enforcement. This may exclude some express kidnappings completed in very short durations. Future work should further investigate specific policies implemented so as to aid policymakers on optimal strategies to combat this crime.

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