

5-2008

Clearing Murders: Is It about Time?

Wendy C. Regoeczi

Cleveland State University, w.regoeczi@csuohio.edu

John P. Jarvis

Federal Bureau of Investigation

Marc Riedel

Southeastern Louisiana University

Follow this and additional works at: https://engagedscholarship.csuohio.edu/clsoc_crim_facpub

 Part of the [Criminology Commons](#)

How does access to this work benefit you? Let us know!

Publisher's Statement

(c) 2008 SAGE Publications

Original Citation

Regoeczi, W. C., Jarvis, J., & Riedel, M. (2008). Clearing Murders: Is It about Time? *Journal Of Research in Crime and Delinquency*, 45(2), 142-162. doi:10.1177/0022427807313706

Repository Citation

Regoeczi, Wendy C.; Jarvis, John P.; and Riedel, Marc, "Clearing Murders: Is It about Time?" (2008). *Sociology & Criminology Faculty Publications*. 81.

https://engagedscholarship.csuohio.edu/clsoc_crim_facpub/81

This Article is brought to you for free and open access by the Sociology & Criminology Department at EngagedScholarship@CSU. It has been accepted for inclusion in Sociology & Criminology Faculty Publications by an authorized administrator of EngagedScholarship@CSU. For more information, please contact library.es@csuohio.edu.

CLEARING MURDERS IS IT ABOUT TIME?

Wendy C. Regoeczi, *Cleveland State University*
John Jarvis, *Federal Bureau of Investigation*
Marc Riedel, *Southeastern Louisiana University*

This article was originally published in:

Regoeczi, Wendy C. , Jarvis, John and Marc Riedel (2008). Clearing Murders Is It about Time?. *Journal of Research in Crime and Delinquency*, 45(2), 142-162.

Post-print standardized by MSL Academic Endeavors, the imprint of the Michael Schwartz Library at Cleveland State University, 2013



Clearing Murders

Is It about Time?

Wendy C. Regoeczi

Cleveland State University, Cleveland, OH

John Jarvis

Federal Bureau of Investigation, Quantico, VA

Marc Riedel

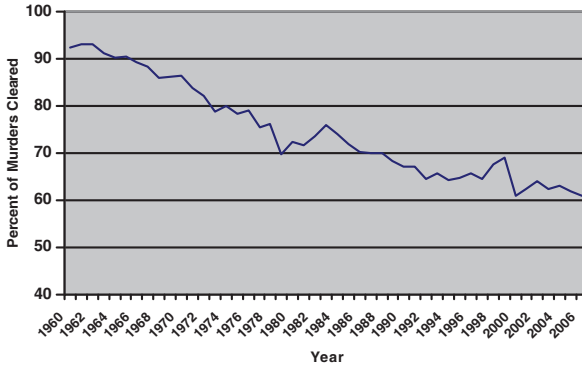
Southeastern Louisiana University, Hammond

This study uses data from the National Incident-Based Reporting System (NIBRS) to explore the impact of model selection on determining the association of victim-level and incident-level factors to the likelihood of homicide clearance. We compare both traditional operationalizations of clearance rates as well as the time to clearance as dependent variables in examinations of correlates of solvability in homicide cases. Using a different approach than most other analyses of this problem, the results affirm the consistency of some effects but also reveal some important differences when the aspect of time is factored into the model. Implications for analyses of efficiency and effectiveness of police response to homicide, cold-case analyses, and other strategies for solving crime are discussed.

Keywords: *clearance rates; homicide; NIBRS*

In recent years crime rates have fallen from the historic highs of the late 1980s. However, crime clearances have fallen over the years as well (see Figure 1). In fact murder clearances were as high as 94 percent in 1961 and currently are at about 62 percent (Federal Bureau of Investigation [FBI] 2006). This rather dramatic decline has sparked debate regarding the causes and correlates of homicide clearances. Unfortunately, the current literature devoted to this question is mostly equivocal as to the determinants of homicide clearance. This point is highlighted by the following assertions: “There is no prospect of seeing the homicide clearance rate return to the good old days when it was in the 90% range” (Fox 2000:1A) as juxtaposed to “there are few homicide cases

Figure 1
Murder Clearance Rates in the United States, 1960–2006



Source: Federal Bureau of Investigation, *Crime in the United States* various years.

that given the right initial response, the right timing, and the right dedication of resources cannot be solved” (Wellford and Cronin 1999:7).

One reason for these seemingly contradictory contentions may be the conceptualization of the traditional dependent variable—case clearance. That is, perhaps a better conception of this problem may be one of time to clearance rather than the traditional dichotomous variable reflecting cleared or uncleared. Examining the timing of clearance is important in understanding homicide investigations as cases become more difficult to clear the more time that passes without an arrest. Detectives investigating homicides that are not cleared quickly run the risk of encountering offenders who have long fled the scene, witnesses who have forgotten key information or cannot be located again, and tainted physical evidence (Geberth 1996; U.S. Department of Justice 1999, 2000).

In the next section we begin examining each of these problems with a review of the existing literature and introduce a discussion of many of the issues that remain unclear relative to the dynamics of homicide clearances. After this we turn to analyses of homicide incident data in an attempt to assess our hypotheses relative to the correlates of homicide clearance. Lastly, we examine models contrasting the results of traditional operationalizations of the dependent variable with a time-to-clearance measure. Through these efforts, we hope to demonstrate consistencies and highlight

other discrepancies in efforts to further understand law enforcement efforts to clear homicide cases.

Literature Review

A small body of research on homicide clearances, as well as a larger literature on policing more generally, identifies a number of factors that may affect the likelihood of clearing a case.

Victim Characteristics

Several researchers contend that victim characteristics may impact the likelihood of case clearance, albeit for different reasons. One line of reasoning is that cases involving certain kinds of victims are likely to receive greater attention and effort on the part of police in solving the crime. Extralegal factors like social class and race are of primary importance here (e.g., Black 1980). Other predictions regarding the association between victim characteristics and homicide clearance are premised on the notion that cases that are more difficult to clear (e.g., felony-related, stranger homicides) are more likely to involve certain types of victims (e.g., males, the elderly).

One of the more consistent findings in the literature on homicide clearances is the high likelihood of clearing cases involving child victims, and the greater difficulty of clearing cases involving the elderly (Addington 2006; Cardarelli and Cavanagh 1992; Puckett and Lundman 2003; Regoeczi, Kennedy, and Silverman 2000; Riedel and Rinehart 1996). These findings suggest that victim age may not have a linear relationship with homicide clearance. Victim age may also be associated with the timing of clearance, but not necessarily in the same way. In particular, though children are most often killed by someone known to them, making it more likely the homicide will result in arrest, the collection of medical and social service history evidence that is often needed to build a case that the death was caused at the hands of another (because the cause of death is often less obvious than that of adults killed with guns, knives, etc. and many times there are no witnesses) may delay the arrest for a time.

Studies examining the influence of characteristics such as victim race and gender on homicide clearance have produced mixed results. Some research finds that cases involving non-White victims are more likely to be solved (Mouzos and Muller 2001; Regoeczi et al. 2000), whereas other studies find the opposite (Litwin and Xu 2007). One study reports a higher likelihood of clearance for female victim cases (Regoeczi et al. 2000) whereas others find

no gender differences (Addington 2006; Mouzos and Muller 2001) or a greater likelihood of clearance for male victims (Litwin and Xu 2007). We predict that gender will be related to the timing of clearance, with female victim homicides having faster clearance times given their greater likelihood of being killed by an intimate partner. If those who believe that the social status of victims affects the investigative efforts of police are correct, homicides involving White victims should be cleared more quickly than those involving minorities.

Investigative Characteristics

Prior research indicates that several aspects of the offense pertaining to the investigation, including the circumstances, weapon used, and location, are associated with the likelihood of clearing the case.

Homicide circumstances. A number of studies report that felony-related homicides are more difficult to clear than homicides resulting from other circumstances (Cardarelli and Cavanagh 1992; Mouzos and Muller 2001; Regoeczi et al. 2000; Riedel and Rinehart 1996; Rinehart 1994; Roberts 2007). Explanations of this pattern point to the greater involvement of strangers in felony homicides, making it harder to identify a suspect. However, it may be the case that felony circumstances do not impact the timing of clearance. In particular, though many felony-related homicides may never be solved, of those that are, there is no reason to expect that they would consistently take much longer to solve than other kinds of homicides that produce similar kinds of investigative leads (witnesses, physical evidence, etc.).

Weapons. Homicides committed with weapons that bring the offender and victim into contact with one another (such as a knife) increase the likelihood of clearing the case (Addington 2006; Mouzos and Muller 2001; Puckett and Lundman 2003; Roberts 2007). With respect to firearms, the findings are mixed. While Marché (1994) finds that the use of guns increases the likelihood of clearance, which he suggests may be the result of ballistics providing physical evidence that can be linked with an offender, other studies find homicides committed with firearms are less likely to be cleared (Litwin 2004; Litwin and Xu 2007; Mouzos and Muller 2001; Regoeczi et al. 2000; Rinehart 1994). With respect to the impact of weapon on time to clearance, we predict that homicides resulting from assaults (i.e., those committed with hands and feet) will be cleared more

quickly on the assumption that (1) the very close contact between victim and offender will produce more useful physical evidence and (2) these deaths are less likely to be intended than those committed with weapons such as guns or knives, increasing the likelihood there will be witnesses and other evidence available. In contrast, homicides committed with firearms may take longer to clear, given the notion that these incidents are more likely to involve socially distant disputants as compared to killings using more intimate weapons. The physical dynamics when using more personal weapons require close contact and increase the likelihood of a number of factors including not just the presence of evidence (DNA transfer, blood spatter, etc.) but, in general, also increase the likelihood that the offender may in some way be known to the victim.

Location. Among the more consistent findings concerning homicide clearance is the greater likelihood of clearance for cases occurring in homes (Addington 2006; Litwin and Xu 2007; Mouzos and Muller 2001; Wellford and Cronin 1999). We also expect that home locations may lead to shorter times to clearance, as they are more likely to be the site of killings involving people who know one another and should better preserve physical evidence.

Time. The impact of time of day on homicide clearance has rarely been examined. The two studies we located that included measures of time did not find a significant effect (Puckett and Lundman 2003; Roberts 2007). With little to work with in terms of prior findings, we tentatively hypothesize that homicides occurring in the late evening and early morning may take longer to clear due to delays in interviewing witnesses, collecting and processing physical evidence, and publicizing calls for assistance through the media that can occur when someone is killed in the middle of the night.

Definition and Measurement

Complicating the entire issue of homicide clearance are the definitions and metrics used to measure these processes. Following the FBI (UCR [Uniform Crime Reporting] definition), a criminal case is considered cleared when an arrest for that incident is made. The research, however, has delineated a myriad of circumstances that indicate variation in clearance. Most commonly this has taken the form of providing, as the FBI does, for exceptional clearances. This would include, for example, providing for cases where the homicide is cleared due to the death of the offender.¹ In

other instances, the measurement of clearance has also accounted for those cases that, although cleared, do not require very much true investigative effort. Presumably, these are cases where the offender is readily identified and the case is cleared perhaps at the scene or shortly thereafter. To account for these instances, some research has further limited clearance data by eliminating cases that were cleared in the first 24 hours. Elsewhere, some have chosen to consider these as “dunker” cases (those involving plenty of evidence and a clear suspect; see Simon 1991) and expanded the time frame to exclude cases that are solved in the first week of occurrence. There may be some merit in considering such factors in clearing homicide. However, these methodological choices, at least in part, substantively change the research from case-clearance research to cold-case research. We argue instead that conceptualizing the dependent variable of case clearance as a time-to-clearance variable would account for more of the variation that these circumstances present. Additionally, we argue that conceptualizing the clearance metric in this fashion provides for some other advantages as noted below.

Time and Homicide Clearances

Homicide is a statistically rare event. This means that homicide clearance research is limited to information available from police, medical examiners, or other officials connected with responding to the incident. Rather than direct observations, the data available for examining homicide investigations are most often a reflection of the responders’ judgments. In turn, the limits of the data available sets limits on the nature of the research that can be done. Researchers have to rely on the static attributes generated from investigations such as whether the offense is cleared or uncleared; what is missing in these files is information about the time expended to determine such attributes.

Fundamental organizational dilemmas may affect the time available to investigate cases. On the one hand, police and detectives have little control over the number of cases that come to their attention and that require investigation. Crimes occur daily in various amounts and with varying degrees of seriousness. Therefore, police may have caseloads that are so voluminous that adequate time to explore every conceivable avenue of investigation is unavailable given new cases that require attention as well. On the other hand, police, or in this case homicide detectives, are often held to standards of production—arrests—that remain relatively invariant. That is, there clearly exists pressure to make arrests. For example, Waegel (1981)

reports that it was an understanding in the police department that he studied that one or two lockups per week were the expectation if one was to remain a detective. Additionally, a detective's progress may be monitored by supervisors in terms of the number of arrests. If the number of arrests declines precipitously, the investigative unit and the department are scrutinized for their overall abilities to police the community.

What this suggests is that detectives manage their time to meet organizational goals. The management of time to meet organizational goals is not limited to police and appears in different contexts. Sudnow (1965) and Swigert and Farrell (1977) found that social and demographic characteristics are filtered through stereotypic conceptions that have an impact on legal processing. Waegel (1981) talks about case routinization in investigative work; in a later paper, Waegel (1982) applies a more useful concept: casework orientation.

For the police department studied by Waegel, detective work is not rooted in supervisory surveillance, which is minimal. The major constraints require the production of investigative reports for all cases assigned to them in 14 days and two or more arrests per week. To meet these twin goals, detectives were found to engage in "skimming," that is, selecting out for extensive investigation those cases likely to result in arrests while giving only minimal attention to the remainder. For example, burglaries and robberies that are viewed as unlikely to be cleared by arrest were termed "routine cases" and given little attention. Assaults, rapes, and homicides fared somewhat better, but that is because the perpetrators are more frequently known and the quality of information is likely to be better.

With respect to homicides, detectives sometimes distinguish between "killings" and "murders" (Waegel 1981). Two prominent case features of killings are (1) whether information at the scene can be linked to an offender and (2) whether the victim and offender had a prior relationship. If motive and circumstance can be mapped onto a common pattern for domestic or bar-room killings, the offense is treated as a routine case. If not, then the case is treated as a murder that requires additional methodical investigation. Simon makes the same kind of distinction in differentiating between "dunkers" and "whodunits." "Whodunits are genuine mysteries; dunkers are cases accompanied by ample evidence and an obvious suspect" (Simon 1991:42).

Whether we are talking about common homicides, routine vs. nonroutine homicides, stereotypic conceptions that guide investigations, dunkers or whodunits, or casework orientation, the underlying theme is the organization and use of time. In other words, one maxim may apply here: Justice delayed is justice denied. This importance of time was recognized in the

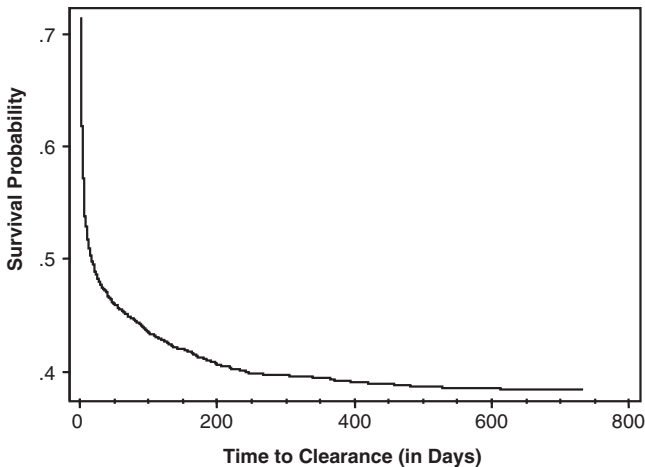
final report for the revision of the UCR that led to the establishment of the National Incident-Based Reporting System (NIBRS). In addition to severe criticism of the traditional measures of clearances, the UCR report recommended including dates both for incidents and arrests (Poggio et al. 1985). The importance of the implementation of this recommendation in NIBRS is clear from the following research, which indicates that a variety of time-related factors impinge on clearances.

For example, Figure 2 illustrates the survival of cases over time. This baseline survivor curve indicates the cumulative probability of a case “surviving” (remaining uncleared) with the passage of time from the occurrence of the incident. The median lifetime of this curve, indicating the amount of time passing before half of the cases experience the event of interest (Singer and Willet 1991), is 17. This means that half of the cases do not “survive” beyond 17 days. The drop off after the median lifetime is tremendous, reflecting the steep decline seen in Figure 2 until the curve flattens out. For example, whereas 50 percent of the cases “survive” beyond 17 days, 45 percent survive beyond 70 days, 40 percent survive beyond 243 days, and 35 percent survive beyond 400 days. In other words, 173 days must pass before the number of cases surviving (remaining uncleared) reduces from 45 percent to 40 percent, which is a substantial amount of time (nearly six months) for a small increase in the amount of cases cleared. Another five months or more passes before the percentage uncleared is reduced another 5 percent to 35 percent. This figure suggests a number of research questions. For example, it would be worth knowing how these cases are cleared on a day-to-day basis. Are those cases with arguments cleared first, followed by other types of homicides? What kinds of homicides are not cleared as time passes? By conceptualizing homicide clearance as time to clearance each of these lines of inquiry becomes possible.

Data and Methods

To examine some of these questions, this study draws upon the FBI’s NIBRS data for the years 1996 to 2002. NIBRS is the result of a redesigning of the traditional summary UCR Program that collects national data on crime. Like the UCR, NIBRS is based on data supplied by law enforcement agencies in the United States, and in the case of NIBRS all data are submitted electronically. Unlike the UCR, NIBRS is incident-based, with data collected on each single incident and arrest within “22 offense categories made up of 46 specific crimes called Group A offenses” (FBI 1992:1). The data are organized

Figure 2
Survival Curve of Time to Clearance of Homicide Cases Submitted through the National Incident-Based Reporting System, 1996–2002



into six segments: administrative, offense, property, victim, offender, and arrestee. Two or more segments can be linked using key variables.

NIBRS data are particularly suitable for this analysis for the following reasons. First, NIBRS data, though not nationally representative as yet, are reported by as many as 5,271 agencies in 25 states representing 20 percent of the U.S. population. And although NIBRS data have been commonly thought to overrepresent rural and small jurisdictions,² the variation in both police practice and the nature and scope of homicidal behavior in these data are likely to be superior to any other available sources of data. Further tempering this criticism is the fact that several other analyses of homicide and policing have shown remarkable consistency between NIBRS and Supplementary Homicide Report (SHR) data as well as other sources of more nationally representative data (see FBI 1999; and Chilton and Jarvis 1999a, 1999b). Lastly, unlike many other data sets, and essential to the analysis here, NIBRS data contain information on the date of the criminal incident and the date of the arrest of an offender associated with that incident. As such, time calculations can be made to produce the dependent variable of interest—time to clearance. This variable, along with as many as 51 other case details are captured in

NIBRS that are not contained in other multijurisdictional data sources such as summary UCR and SHR. Clearly, these data provide many fruitful avenues for exploration of not only general crime but also homicide clearances. As such, these data are used to provide both descriptive and inferential analyses of the questions surrounding the problem of homicide clearances.

We use all murder and non-negligent manslaughter offenses for the years under investigation ($N = 5,680$). The unit of analysis is the murder incident. We limit our study to cases involving single victims due to the overlap of information on incident characteristics for homicides with multiple victims. In so doing we also avoid the problem of violating assumptions of independence in statistical modeling.

Measures

The two dependent variables used in this study, and discussed in more detail in the Analyses section, consist of a dichotomous measure (cleared vs. uncleared) and a continuous measure (number of days until the case was cleared or has remained unsolved) of clearance.

We focus on victim and incident characteristics as predictors of whether a homicide case will be cleared and the timing of that clearance. Victim characteristics include gender (female victim) and race (White victim). Victim age is measured in years. We also test for nonlinear relationships between age and clearance by creating squared and cubed versions of victim age.

We also include case-specific variables that are likely important to police and reflective of investigative strategy. These include the location of the homicide (residence, other indoor location, outdoor location, and other location); time of the homicide (occurring between 8 a.m. and 3:59 p.m., or what is commonly first policing shift; between 4 p.m. and 11:59 p.m., or what is commonly the second shift; or occurring between midnight and 7:59 a.m., or what is commonly the third shift); weapon used in the offense (gun, knife, blunt object, hands and/or feet, and other weapon)³; and the discovery of any known circumstances relevant to the case (argument, felony-related, other circumstances,⁴ and unknown circumstances). Clearly, law enforcement efforts to collect these investigative data pertaining to the incident, such as the day and time of the incident, weapon used, suspected circumstances involved, and location, are likely to be related to the successful investigation of the reported homicide. To examine this contention we selected the residence as the reference category for locations because killings occurring in homes have been found in prior studies to have a greater likelihood of clearance (Addington 2006; Litwin 2004; Wellford and Cronin 1999). Knives and

arguments are the reference categories for weapon and circumstances, respectively, as they are predicted to have higher clearance rates given their relation to domestic killings. Finally, first shift was selected as the reference category for time given the potentially greater visibility of homicides occurring during daylight and the lack of needing to wait for investigators in departments using third shift call-ups. Descriptive statistics of all of the variables included in the analysis are reported in the appendix.

Analyses

Two different analytic techniques were used to examine the impact of victim and incident characteristics on homicide case clearance. The first technique uses binary logistic regression to examine the more traditional conception of case clearance: cleared or not. Homicide clearance for this model was coded as 0 if the case was uncleared and 1 if the case was cleared by arrest or exceptionally cleared.⁵

The second technique examines time to clearance using survival analysis. Dichotomizing the dependent variable results in a loss of information (Allison 1984), obscuring the difference between cases cleared within days and those taking months or years. Survival models have the added advantage of mechanisms to deal with the problem of censoring. In particular, though uncensored observations contribute information on the time the event occurs, the information contributed by censored observations is only on survival (Box-Steffensmeier and Jones 2004). Thus, the existence of censoring in the data is handled directly by the survival-estimation methods used.

In NIBRS, as a matter of policy, censoring occurs when the administrative reporting dates for that year's crime data collection are past the two-year window for updates to the NIBRS reporting system. This results in a maximum time to clearance of 730 days or two years. A variable was created indicating the number of days between the incident and the clearance of the case (for cleared cases), or the number of days the case had remained open for those that had not been cleared during the time the NIBRS data were subject to updating (for censored cases). Hence, the maximum value on this variable was 730, reflecting the two-year window as noted above.⁶

For the survival analysis, we used a Cox proportional hazards model (Cox 1972). There are a number of advantages to this approach. First, this semiparametric model does not require any assumptions regarding the shape of the hazard over time (Allgulander and Fisher 1986; Cleves, Gould, and Gutierrez 2004), which when incorrect can produce misleading results. This results in a very flexible model that produces estimates of covariates

without specifying the precise form of the dependency of the duration (Box-Steffensmeier and Jones 2004). Although it assumes a constant ratio of hazards between two subjects, even a violation of this assumption often results in an approximation that is satisfactory (Allison 1984).

Because the ordering of subjects in terms of the times at which they experience the event of interest (case clearance) is a component of the Cox model, a method must be selected for dealing with “ties” (cases that experience the event at the same time). We use the “exactm” method in Stata, which is the exact-marginal calculation of the conditional probability of tied failure events (Cleves et al. 2004).

For the logistic and survival analyses, our initial models included all of the variables except the squared and cubed versions of victim age. We then tested for quadratic and cubic relationships between victim age and clearance by successively adding each of these terms to the model. In both the logistic and survival models, the cubic term was significant, so we retained all three victim-age measures in our final models.

Results

Table 1 compares the results of using the traditional dichotomous variable of clearance and the time-to-clearance metric discussed earlier. Both the logistic regression and Cox proportional hazards models confirm the increased likelihood of clearance for cases involving younger victims and females. This supports our hypothesis regarding the predicted faster clearance time for female victim homicides. The logistic regression model confirms the findings of earlier studies regarding the higher likelihood of clearing cases involving very young victims. The cubic relationship between victim age and clearance can be described as indicating that the likelihood of clearing the case progressively declines as the age of the victim increases beyond the first year of life until the mid-thirties, at which point the probability of clearing the case successively increases up to the early sixties, and then begins to decrease again. Our prediction that child victim homicides may take longer to clear is not supported. However, we do find that homicides involving older victims are less likely to be cleared and remain open longer, underscoring the difficulty of solving homicides for this subgroup.

Both models also indicate that clearing a homicide is less likely for cases involving other or unknown circumstances (compared to arguments), and for those occurring in nonresidential indoor, outdoor, or other locations (compared to residences). These findings not only confirm the importance

Table 1
Logistic Regression and Cox Proportional Hazards Model Results of
Factors Predicting Clearance for Homicide Cases Submitted through
the National Incident-Based Reporting System, 1996–2002^{a, b}

Predictor	Logistic Regression Model ^c		Cox Proportional Hazards Model ^d	
	Odds Ratio	Std. Error	Hazard Ratio	Std. Error
Female victim	1.195*	.083	1.175**	.072
White victim	1.381*	.090	1.103	.067
Victim age	.930***	.013	.941***	.010
(Victim age) ²	1.002***	.0003	1.002***	.0003
(Victim age) ³	.999***	.0000	.999***	.0000
Nonresidential indoor	.699**	.078	.769*	.084
Outdoor location	.545***	.041	.797**	.057
Other location	.609***	.077	.742*	.091
Second shift	1.062	.083	1.101	.077
Third shift	.941	.076	.948	.071
Gun	.698***	.065	.840	.073
Blunt object	.890	.134	1.230	.150
Hands and/or feet	1.006	.135	1.280*	.137
Other weapon	.498***	.053	.829	.083
Felony-related	.512***	.068	1.043	.111
Other circumstances	.414***	.038	.636***	.053
Unknown circumstances	.174***	.013	.411***	.030

a. $N = 5,352$.

b. Reference categories are: residence, first shift, knife, and argument.

c. Likelihood ratio chi-square = 985.79, $p < .001$.

d. Likelihood ratio chi-square = 378.04, $p < .001$.

* $p < .05$ ** $p < .01$ *** $p < .001$

of these factors in impacting homicide clearances, but also demonstrate that the influence of these characteristics extends beyond lethal violence in urban areas to small-size and mid-size American cities (those most likely to be represented in NIBRS data).

The other consistent finding for both models is the lack of a significant effect of time of day (or police shift) on clearing a case. This finding is consistent with two earlier studies that included time of day in their homicide-clearance models (Puckett and Lundman 2003; Roberts 2007). We had tentatively hypothesized that homicides occurring during the middle of the night would take longer to clear, but this prediction was not supported. For police departments dealing with budget constraints, our findings suggest

that, though patrol officers are necessary on a 24-hour basis, it may be possible to avoid having homicide detectives and forensic personnel working regular third shifts on the justification that the success of homicide investigations does not appear to be impacted by the shift during which the killing occurs.

Perhaps the most important difference between the models using a dichotomous measure of clearance and the survival model is the effect for felony-related homicides, which is significant in the logistic but not in the Cox model; that felony-related homicides are more difficult to clear, is a finding that has emerged in a number of prior studies on murder clearances (e.g., Cardarelli and Cavanagh 1992; Litwin 2004; Regoeczi et al. 2000; Riedel and Rinehart 1996; Rinehart 1994). When using a model that incorporates additional information on the time to clearance (as opposed to simply whether the case was cleared or not), this factor no longer appears to have an impact on clearance. This suggests that knowing a homicide involved a concomitant felony is influential in the all-or-nothing distinction between cleared and uncleared cases, but is less important in distinguishing between cases cleared quickly and those that have long survival times. This is an interesting finding because it suggests that at least some robbery and other felony-related homicides may actually result in relatively swift arrests of their perpetrators, in spite of the conception that these cases are notoriously difficult to solve. An interesting avenue for future research would be an in-depth study examining the details of felony-related cases that are cleared quickly and those that remain open for an extended period of time to attempt to determine what factors impact the timing of clearance among this subset of cases. Such research, however, would require access to police investigative files, something that can be difficult to obtain (see Puckett and Lundman 2003 for a discussion of the difficulties of gaining access to homicide case files).

The other major discrepancy between the different conceptualizations of the dependent variable concerns the association between victim race and case clearance: it is significant for the logistic but not the Cox model. Existing research on homicide clearances reveals mixed findings on the impact of race. The current research suggests that taking advantage of the benefits of a survival approach leads to a different conclusion than the traditional dichotomous approach. Whereas cases involving White victims are more likely to be cleared overall, how quickly a case is cleared is not associated with the race of the victim. If the length of time it takes to identify a suspect can be taken as an indication of the amount of attention and energy police have invested in the case, our findings with respect to race and sex indicate no apparent devaluing of lower social status victims by police.

The final difference between the two models concerns the impact of weapon type on homicide clearance. Though homicides involving guns are less likely to be cleared than those involving knives, guns do not impact the length of time to clearance, contrary to our hypothesis. Homicides involving other weapons are significantly less likely (50 percent) to be cleared in the logistic model. However, we do not find a significant effect for other weapons in the survival model. In contrast, using hands or feet slightly increases the time to clearance by about 26 percent in the survival model only, which is consistent with our hypothesis.

Discussion and Conclusion

In this article we present arguments for an alternative conceptualization of case clearance in understanding the impact of factors on whether homicides are cleared. We believe that the availability of data on the timing of incidents, arrests, and exceptional clearances as a result of the implementation of the NIBRS opens a window for a class of models that permits the incorporation of additional valuable information in understanding not just whether cases are cleared but the length of time it takes for this to happen. We find that changing the conceptualization of the dependent variable of clearance from a success–failure dichotomy to a continuum of time to clearance does make a difference in terms of our conclusions regarding the impact of victim race, circumstances, and weapons on clearing a case. We focus our discussion on the results for the Cox proportional hazards model because it takes advantage of these additional data on time.

Our findings indicate that two victim characteristics are associated with the occurrence and timing of clearance: gender and age. The positive coefficients for female and very young victims signify a high hazard, or alternatively, a low survival time. In other words, cases involving women and young children are cleared sooner. This pattern is likely attributable to the high likelihood of being killed by a family member for females and young persons (Alderden and Lavery 2007; Cardarelli and Cavanagh 1992; Regoeczi et al. 2000). Homicides involving older victims have a longer survival time until the event of interest, clearance, occurs. Although it may be difficult for police to improve their solvability rate of elderly victim homicides given the more general obstacles associated with identifying suspects in stranger-related and felony-related homicides, public education campaigns and increased neighborhood ties and social support for elderly residents aimed at reducing their vulnerability to violent predators may result in fewer uncleared elderly victim homicides.

In terms of investigative-related characteristics, the survival time is longer for homicides occurring in nonresidential indoor, outdoor, or other locations compared to residences. The higher likelihood and faster clearance time of homicides occurring in homes may be the result of more domestic-related incidents occurring in these locations and/or greater quantity or quality of evidence in areas protected from the elements (Addington 2006; Litwin 2004; Wellford and Cronin 1999). Homicides occurring outdoors and/or in public locations, in contrast, may have longer survival times because they rely on a number of factors, not the least of which is the assistance of witnesses, and it may take time to correctly establish the identification of such persons, locate these individuals, and/or secure their cooperation.

Compared to homicides committed with knives, cases involving hands and feet have shorter survival times (clear more quickly). This finding supports the common contention that personal weapons (hands, fists, and feet) are more characteristic of interpersonal violence between intimate partners, which has both higher and quicker clearance rates (Cardarelli and Cavanagh 1992; Simon 1991; Wilbanks 1984). Finally, compared to killings resulting from arguments, homicides involving other or unknown circumstances are more likely both to remain uncleared and remain open for longer periods of time. It makes sense that in cases where the circumstances cannot clearly be identified, longer survival times would result; the lack of known circumstances likely reflects a lack of information, evidence, and/or witnesses needed to quickly identify a suspect. The “other circumstance” category includes situations involving gangs, which may pose difficulties in terms of securing witnesses who are willing to identify the perpetrator. Under such circumstances, it may only be when the witnesses (gang members) are in need of a deal with police or prosecutors because they have become “jammed up” themselves that they become willing to cooperate, leaving the case uncleared for a time. The lack of a significant effect for felony-related homicides in the survival model suggests that this may be a more heterogeneous category than previously thought, with some cases being cleared quickly and others posing significant obstacles to clearance. This finding has important implications for researchers as it may be difficult if not impossible to differentiate between the two in the types of police data typically used to study homicide clearances.

Thus our work, similar to other studies, suggests that the efficiency and effectiveness of police response to homicide may be influenced by certain case characteristics. However, what may be more important are the implications for when a case is likely to become cold. The descriptive analyses clearly showed that the probability of case clearance markedly declines with the passage of time. In fact, these analyses suggest that homicides go

cold as soon as two weeks after the case becomes known. Such results suggest that cold-case squads and other resource allocation may be better employed if mobilized earlier in the investigation of homicides.

NIBRS data provide significant advantages for studying clearances with the inclusion of information on the timing of both the incident and the arrest. However, they encompass some of the same limitations as other secondary data sets on crime. In particular, they lack detailed information on the procedural aspects and time-varying characteristics of specific homicide investigations, which limits our ability to test a strong predictive model of clearances.

Overall, our results confirm that much is to be learned from shifting the conceptualization of clearance from the traditional dichotomy of cleared/uncleared to an examination of the length of time to clearance. In terms of future research, the inclusion of other data such as the structure, operations, and resources of police departments may help to improve the models. Using such data pose their own set of challenges, but the future of understanding more about the ways to increase case clearances for not only homicide but other crimes may well depend upon such efforts. It is about time that homicide clearance and other strategies for solving crime be studied in this or similar fashion.

Appendix

Descriptive Statistics, Homicide Clearance Analysis, NIBRS 1996–2002

Variable	Frequency (Percent)
Victim sex	
Female	1925 (33.9)
Male	3716 (65.4)
Missing	39 (0.7)
Victim race	
White	3076 (54.2)
Non-White	2461 (43.3)
Missing	143 (2.5)
Victim age	
Under 10 years	327 (5.8)
10 years and over	5112 (90.0)
Missing	241 (4.2)
Location	
Residence	3316 (58.4)
Nonresidential indoor	489 (8.6)
Outdoor location	1501 (26.4)
Other location	374 (6.6)

(continued)

Appendix (continued)

Variable	Frequency (Percent)
Time of incident	
First shift	1465 (25.8)
Second shift	2189 (38.5)
Third shift	1833 (32.3)
Missing	193 (3.4)
Weapon ^a	
Gun	3037 (53.5)
Knife	853 (15.0)
Blunt object	329 (5.8)
Hands and/or feet	601 (10.6)
Other weapon	1048 (18.5)
Circumstances	
Argument	2006 (35.3)
Felony-related	341 (6.0)
Other circumstance	1157 (20.4)
Unknown circumstance	2265 (39.9)
Homicide clearance	
Cleared	3482 (61.3)
Uncleared	2198 (38.7)
Time to clearance	
Less than 1 day	1438 (46.3)
1 day to 1 week	977 (31.5)
8 days to 1 month	281 (9.0)
1 to 6 months	299 (9.6)
More than 6 months	111 (3.6)

NIBRS = National Incident-Based Reporting System.

a. Percentages add up to more than 100 because of multiple weapons being used in a single incident.

b. Percentages add up to more than 100 because of multiple circumstances being identified in a single incident.

Notes

1. This reporting category also provides for lack of victim cooperation, prosecution declined, extradition denied, and some provisions for juveniles in minor offenses. For the purposes of homicide cases, exceptional circumstances do occur and these cases are often excluded from studies examining homicide-clearance data.

2. NIBRS (National Incident-Based Reporting System) reports were primarily submitted from smaller police departments in the early 1990s. However, by 2002 much larger urban jurisdictions (for example Austin, TX; Virginia Beach, VA; Memphis, TN; Cincinnati, OH; Nashville, TN; and others) have submitted crime data to the Federal Bureau of Investigation according to the NIBRS specifications.

3. Other weapon includes motor vehicle, poison, explosives, fire, drugs/narcotics, asphyxiation, other, unknown.

4. Other circumstances includes assault on law enforcement officers, gangland, juvenile gang, mercy killing, other.

5. Exceptional clearances are small in number (6.6 percent of all homicide cases in the current data set) and included in other research on homicide clearances (e.g., Puckett and Lundman 2003).

6. We also conducted a sensitivity analysis by limiting the data set to only the first six months to see if any differences we found between the logistic and survival models were influenced by a small number of outlying cases that took an unusually long time to clear. The results when limited to the first six months were very similar to those reported here and did not change any of our conclusions regarding the differences we found. But we thank the anonymous reviewer for suggesting we could assess the strength of our findings by doing this sensitivity analysis.

References

- Addington, Lynn A. 2006. "Using National Incident-Based Reporting System Murder Data to Evaluate Clearance Predictors." *Homicide Studies* 10:140–52.
- Alderden, Megan A. and Timothy A. Lavery. 2007. "Predicting Homicide Clearances in Chicago: Investigating Disparities in Predictors across Different Types of Homicide." *Homicide Studies* 11:115–32.
- Allgulander, C. and L. D. Fisher. 1986. "Survival Analysis (or Time to an Event Analysis), and the Cox Regression Model—Methods for Longitudinal Psychiatric Research." *Acta Psychiatrica Scandinavica* 74:529–35.
- Allison, Paul D. 1984. *Event History Analysis: Regression for Longitudinal Event Data*. Beverly Hills, CA: Sage.
- Black, Donald J. 1980. *The Manners and Customs of the Police*. New York: Academic Press.
- Box-Steffensmeier, Janet M. and Bradford S. Jones. 2004. *Event History Modeling: A Guide for Social Scientists*. Cambridge, UK: Cambridge University Press.
- Cardarelli, Albert P. and David Cavanagh. 1992. "Uncleared Homicides in the United States: An Exploratory Study of Trends and Patterns." Presented at the annual meeting of the American Society of Criminology, November, New Orleans, FL.
- Chilton, Roland and John Jarvis. 1999a. "Using National Incident-Based Reporting System (NIBRS) to Test Estimates of Arrestee and Offender Characteristics." *Journal of Quantitative Criminology* 15:207–29.
- . 1999b. "Victims and Offenders in Two Crime Statistics Programs: A Comparison of the National Incident-Based Reporting System (NIBRS) and the National Crime Survey (NCVS)." *Journal of Quantitative Criminology* 15:193–206.
- Cleves, Mario A., William W. Gould, and Roberto G. Gutierrez. 2004. *An Introduction to Survival Analysis Using Stata*. College Station, TX: Stata Corporation.
- Cox, David R. 1972. "Regression Models and Life-Tables (with Discussion)." *Journal of the Royal Statistical Society, Series B* 34:187–220.
- Federal Bureau of Investigation (FBI). 1992. *Uniform Crime Reporting Handbook: NIBRS Edition*. Washington, DC: Department of Justice, Federal Bureau of Investigation.

- . 1999. *Crime in the United States 1998*. Washington, DC: Department of Justice, U.S. Government Printing Office.
- . 2006. *Crime in the United States 2005*. Washington, DC: Department of Justice, U.S. Government Printing Office.
- Fox, James Allan. 2000. Cited in Parker, L. 2000. "Unsolved Killings on the Rise: Percent of Cases Closed Drops from 86% to 69%." *USA Today*, February 22, p. 01A.
- Geberth, Vernon J. 1996. *Practical Homicide Investigation: Tactics, Procedures, and Forensic Techniques*. Boca Raton, FL: CRC Press.
- Litwin, Kenneth J. 2004. "A Multilevel Multivariate Analysis of Factors Affecting Homicide Clearances." *Journal of Research in Crime and Delinquency* 41:327–51.
- Litwin, Kenneth J. and Yili Xu. 2007. "The Dynamic Nature of Homicide Clearances: A Multilevel Model Comparison of Three Time Periods." *Homicide Studies* 11:94–114.
- Marché, Gary E. 1994. "The Production of Homicide Solutions—An Empirical Analysis." *American Journal of Economics and Sociology* 53:385–401.
- Mouzos, Jenny and Damon Muller. 2001. "Solvability Factors of Homicide in Australia: An Exploratory Analysis." *Trends and Issues in Crime and Justice* No. 216, Australian Institute of Criminology, Canberra.
- Poggio, Eugene C., Stephen D. Kennedy, Jan M. Chaiken, and Kenneth E. Carlson. 1985. *Blueprint for the Future of the Uniform Crime Reporting Program: Final Report of the UCR Study*. Washington, DC: U.S. Department of Justice.
- Puckett, Janice L. and Richard J. Lundman. 2003. "Factors Affecting Homicide Clearances: Multivariate Analysis of a More Complete Conceptual Framework." *Journal of Research in Crime and Delinquency* 40:171–93.
- Regoeczi, Wendy C., Leslie W. Kennedy, and Robert A. Silverman. 2000. "Uncleared Homicide: A Canada/United States Comparison." *Homicide Studies* 4(2):135–61.
- Riedel, Marc and Tammy A. Rinehart. 1996. "Murder Clearances and Missing Data." *Journal of Crime and Justice* 19(2):83–102.
- Rinehart, Tammy A. 1994. "An Analysis of Murder Clearances in Chicago: 1981–1991." Unpublished M.A. thesis, Center for the Study of Crime, Delinquency, and Corrections, Southern Illinois University, Carbondale.
- Roberts, Aki. 2007. "Predictors of Homicide Clearance by Arrest: An Event History Analysis of NIBRS Incidents." *Homicide Studies* 11:82–93.
- Simon, David. 1991. *Homicide: A Year on the Killing Streets*. New York: Houghton Mifflin.
- Singer, Judith D. and John B. Willet. 1991. "Modeling the Days of Our Lives: Using Survival Analysis When Designing and Analyzing Longitudinal Studies of Duration and the Timing of Events." *Quantitative Methods in Psychology* 110:268–90.
- Sudnow, D. 1965. "Normal Crimes: Sociological Features of the Penal Code in a Public Defender's Office." *Social Problems* 12:255–76.
- Swigert, Victoria Lynn and Ronald A. Farrell. 1977. "Normal Homicides and the Law." *American Sociological Review* 42:16–32.
- U.S. Department of Justice. 1999. *Death Investigation: A Guide for the Scene Investigator*. Washington, DC: National Institute of Justice.
- . 2000. *Crime Scene Investigation: A Guide for Law Enforcement*. Washington, DC: National Institute of Justice.
- Waegel, William B. 1981. "Case Routinization in Investigative Police Work." *Social Problems* 28:263–75.
- . 1982. "Patterns of Police Investigation of Urban Crimes." *Journal of Police Science and Administration* 10:452–65.

- Wellford, Charles and James Cronin. 1999. *An Analysis of Variables Affecting the Clearance of Homicides: A Multistate Study*. Washington, DC: Justice Research and Statistics Association.
- Wilbanks, William. 1984. *Murder in Miami: An Analysis of Homicide Patterns and Trends in Dade County (Miami) Florida, 1917–1983*. Lanham, MD: University Press of America.