

A.1 DATA APPENDIX

This paper uses several datasets collected through the Federal Bureau of Investigation (FBI) Uniform Crime Reporting (UCR) System. Although the datasets themselves are all compiled by the same agency, the reporting occurs from each locality through their statewide reporting agencies. Because of this, there may be irregularities in the data, many of which are discussed in detail in the methodology section of the *Crime in the United States* reports available from the FBI.¹ In addition some variation in the reliability of the data, due to the nature of the criminal justice system, there is some incompatibility of the data across different stages of the Criminal Justice System. In particular, the classification of crimes and the level of collection varies for each measure and a discussion of the relationship between the datasets may be useful for interpretation of the differences between the tables.

In addition to the aggregate data, the FBI Uniform Crime Reporting System collects detailed offenses level data for all of the known homicides across the United States that year in the Supplementary Homicide Reports (SHR). These reports are collected regardless of whether a suspect is identified and (obviously) regardless of reporting. Thus, the supplementary homicide reports appear independent of reporting and provide detailed information about offenders. However, using SHR data to analyze offender characteristics is problematic because of the growing number of unsolved homicides contained in the data file. Overall, 26 percent of the SHR offender records describe the perpetrator as unknown (based on situation codes), and this percentage has grown from just under 20 percent in 1976 to nearly 30 percent by the mid-1990s (Fox and Zawitz, 2004).

In the analysis presented in this paper, little attention is paid to the bias that unknown homicides might introduce into evidence. Underlying this is the assumption that it is less likely that family homicides are not likely to be unsolved as the offender would be a known individual (as opposed to a stranger-on-stranger crime in which the offender may be entirely unknown to the police). This assumption is not entirely accurate and indeed may produce some bias in measuring homicide rates (see Riedel, 1999). However, a broad range of studies (e.g. Williams and Flewelling, 1987; Pampel and Williams, 2000) have suggested that family homicides need substantially less adjustment than intimate partner homicides and as such this assumption may not be too harmful.

Of particular concern is if the types of homicides that remain unsolved are changing over time and perhaps even such changes are correlated with changes in mandatory arrest laws. For example, if more intimate partner homicides remain unsolved in non-mandatory arrest law states than in

¹ For the 2002 report which discusses much of the data collection procedures, see http://www.fbi.gov/ucr/cius_02/html/we/appendices/07-append01.html

mandatory arrest law states, then the count constructed in this paper could reflect this rather than a true effect from the mandatory arrest law policy.

I begin to determine the consequences of missing offender data on the identification by testing if the probability that the victim-offender relationship is known is significantly related to the whether a state passed a mandatory arrest laws or not. In particular, I am concerned if the measurement error in the victim-offender variable is correlated with the law change thus generating bias in the estimates. I test this relationship in two ways. First, I do a simple correlation between the fraction of cases with known offenders and an indicator for states that passed mandatory and recommended arrest laws after the passed the law. I find that mandatory arrest laws are not significantly correlated and recommended arrest laws are mildly positively correlated. However, such correlations may be misleading because it conflates year, state, and year-state variation. As such, I also test to see if the fraction of cases with known offenders increased before and after arrest law passage. Note that I am not testing if states that have mandatory or recommended arrest laws are more likely to have more unknown victim-offender relationships because the identification problem occurs only if the *adoption* of the law is associated with a *change* in the fraction of homicides with missing relationships. I estimate a difference in difference specification for the fraction of homicides with unknown relationships in states that passed arrest laws relative to those that did not before and after the law change. I find no significant relationship between law change and the fraction of unknown cases suggesting that simply omitting the unknown offenders may not be important.

To test the sensitivity of the estimated mandatory arrest programmatic effect, I use three imputation procedures and re-estimate the results from Table 5. The first method used is a within-state measure (Williams and Flewelling, 1987). This procedure assumes that the distribution of homicides with an unknown distribution equals the distribution of homicides with a known distribution in a given state-year. If intimate partner homicides, for example, constitute 10 percent of the known distribution within a state, then this procedure assigns 10 percent of the unknown homicides to the intimate partner homicide category.

The second measure is a weighted sum approach which predicts the probability that a homicide was committed by an intimate partner (based on Pampel and Williams, 2000). This model uses the data on victim and circumstance characteristics of homicides incidents to predict the relationship between victim and offenders at the incident level. This procedure then assigns a probability that the relationship is an intimate partner relationship. I then use these probabilities to construct a weighted count of the incidents, essentially an expected value of the number of intimate partner homicides based on observed characteristics.

To more formally represent the estimation procedures used in this procedures, define H^I as the total number of intimate partner homicides (this aggregation occurs within a state-year but for ease of notation I omit the st subscripts. For a sample of N homicide reports, the true H^I would require the knowledge of all intimate partner relationship. For the first two imputation processes, we need to define $I = 1$ [Victim-Offender relationship is Intimate], and $p^I = \Pr(I = 1)$, the true $H^I = p^I N$. However, the SHR does not have the full set of victim-offender relationships and as such, the estimated H will be a function of imputed values. Specifically, suppose I impute I from the other characteristics, using parameters estimated from homicides with known offenders. That is, I estimate $I = f(\alpha Z + u)$ for all homicides with known offenders and then we predict \hat{I} using the values of $\hat{\alpha}$ from the homicides with known offenders and the Z 's from the homicides with unknown offenders (note that Z need not be a set of characteristics and indeed in the Williams and Flewelling it is simply state and year). This then generates a predicted $\hat{I} \in (0,1)$ where we define:

$$\hat{I} = \begin{cases} 1 & \text{Victim - Offender relationship known and intimate} \\ 0 & \text{Victim - Offender relationship known and not intimate} \\ \hat{\alpha}Z & \text{Victim - Offender relationship unknown} \end{cases}$$

For the first correction (WF), we get for $N_1 < N$, estimate $\Pr(I = 1) = \hat{\alpha}$ and thus

$$H^{WF} = \sum_{j=1}^{N_1} I_j + \hat{\alpha}(N - N_1) \text{ For the second method (PW), for } N_1 < N \text{ I estimate } \Pr(I = 1) = \phi(\hat{\alpha}Z + u),$$

where Z is victim and case characteristics, we get: $H^{PW} = \sum_{j=1}^{N_1} I_j + \sum_{j=N_1+1}^N \hat{\alpha}Z_j$. Note that in Pampel and

Williams, the authors seek to predict the specific relationship (e.g. husband, daughter, etc.) while the process I use simply predict the probably that these relationships are intimate partner. Thus Pampel and Williams do not ever predict that the relation is an intimate partner over for example a friend, while the adjusted procedure does predict positive probabilities for the probability that the victim-offender relationship was intimate. However, the mean predicted probability from this approach is not significantly different than the mean predicted probability across the sample is not significantly different than the mean probability in the known offender sample, suggesting relatively low probability values.

The third measure (Fox, 2004) is a weighted sum approach which predicts the fraction of unsolved cases which may be intimate partner homicides. This approach takes as unknown the true number of intimate and non-intimate partner homicides but as known the total number of homicides and q , the factor that governs the mix of intimate and non-intimate homicides among unsolved cases.

Using q it is possible to determine the solve rate for intimate and non-intimate homicides. Thus for $i =$ intimate, non-intimate, the solve rate $_i = \frac{\# \text{ solved homicides of type } i}{\text{total } \# \text{ homicides of type } i}$. The solve rate and number of

homicides are estimated within a state-year. With solve rate $_i$ it is possible back out the number of unknown cases of type i by simply subtracting the numerator from the denominator. For this imputation procedure, I used the q values provided by Fox (2004):

q Parameter Values for Imputation Procedure

<i>Victim Age</i>	Men	Women
Under 14	0	0
14-18	0	.1
19-24	0	.3
25-34	.1	.5
35-49	.1	.5
50-64	.1	.3
Over 65	.1	.1

More formally, this imputation process, I estimate $M_I = \sum_{j=1}^{N_I} I_j$ for all those cases with known

offenders. I also estimate $M_{NI} = \sum_{j=1}^{N_I} (1 - I_j)$ (note that I is missing, rather than zero, for unknown

offenders). M_I and M_{NI} are the number of murders by intimate and non-intimate homicides known to police (note $M_I = N_I$ and $M_{NI} = (N - N_I)$ from above). Define P_I as the solve rate for intimate homicides and P_{NI} as the solve rate for intimate homicides. Also define N_I as the true count of intimate homicides

and N_{NI} as the true count of intimate partner homicides. Thus $P_i = \frac{M_i}{N_i}$ for $i = I, NI$. Taking q and

using the procedure described in Fox (2004), I solve (numerically) $P_I = qP_{NI} + (1 - q)$

and $\frac{M_I}{P_I} + \frac{M_{NI}}{P_{NI}} = N$. This gives an estimated intimate homicide rate $\hat{H}^F = \hat{N}_I = \frac{\hat{P}_I}{N - N_I}$.

To correct for the use of imputed homicide counts in the regression estimates, I use a bootstrapped measure of the standard errors in the regressions. The imputed homicide rate regressions are reported in Table A.1. The standard errors calculated from the multiple imputation bootstrap. For the first and second imputation procedures (WF and PW), the standard errors are calculated by drawing with replacement and estimating the α parameters, conducting the imputations for missing values using these parameters, and then aggregating to get \hat{H}^{WF} and \hat{H}^{PW} for each state-year. For the third

procedure (F), I draw a sample, with replacement and use that sub-sample to construct the N , M and thus P variables. This yields an \hat{H}^F .

For each imputed homicide count, I next estimate the regression of \hat{H} on the mandatory arrest law indicator (which equals one in states that passed the law after the law changed), the recommended arrest law indicator (which equals one in states that passed the law after the law changed), and state and year fixed effects. I repeat the estimation of this regression 1,000 times which yields a distribution for each parameter in the regression and thus implied standard error.²

As shown in Table A.1, there appears to be nearly no difference in the point estimates from the imputed samples. Although the coefficients are only marginally significant, there appears to be little evidence of biased introduced from the unknown offender cases.

² I re-estimated this using 10,000 repetitions with little change. The standard errors reported are from the 1,000 repetition.

Table A.1: Difference-in-Difference Estimates of Mandatory and Recommended Arrest Laws

	(1)	(2)	(3)	(4)	(5)
	<i>All Intimate Partner Homicides per 100,000 inhabitants</i>				
<i>Adjusted Mean</i>	2.26	2.41	2.44	2.62	
<i>Mandatory Arrest Law Effect</i> (=1 in MA law states after law change)	0.81*** (0.37)	0.61* (0.37)	1.02* (0.57)	0.88* (0.42)	0.90* (0.41)
<i>Recommended Arrest Law Effect</i> (=1 in RA law states after law change)	-0.65 (0.62)	-0.63 (0.63)	-0.63 (0.63)	-0.59 (0.67)	-0.61 (.62)
Imputation Procedure	Unweighted	Within State Frequency	Weighted Characteristic	Weighted Solve Rate	Average across all 3 imputations
State Fixed Effects	Y	Y	Y	Y	Y
Year Fixed Effects	Y	Y	Y	Y	Y

Notes: All regressions include 994 observations. The dependant variable for each column is the column title per 100,000 inhabitants. Standard errors calculated from multiple imputations presented in parentheses. Coefficients that are significant at the .05 (.01, .1) percent level are marked with ** (***, *). Intimate partner homicides include homicides of husbands, wives, ex-husbands, ex-wives, common-law husbands and common-law wives. Mandatory Recommended arrest states are defined as states where officers are instructed but not required to make a warrantless arrest when an intimate partner offense is reported.

A.2 LEGAL APPENDIX

Underlying the data analysis presented in this paper is the analysis of arrest law statutes from several states. In particular, the classification of these statutes into “mandatory” and “recommended” arrest laws was based on a textual analysis and confirmed by speaking to domestic violence advocates in various states about the actual implementation of these laws.

This section documents the procedures used to classify the statutes presented in this paper.

To determine which states have statutes regarding mandatory and recommended arrest laws I began with Kirsch (2001) which provides a list of states with arrest law statutes (either mandatory or recommended). Using this list and West (2003), I retrieved the statutes for all states listed in Kirsch (2001). I next checked states not listed, searching for arrest law key words and reading domestic violence statutes and criminal procedures to determine if any additional states should be included. This resulted in a compiled list of the text of statutes regarding domestic violence incident arrest procedures. Due to space consideration, I have omitted this document but it is available upon request.

Using these laws I next read the text and looked for the elements of arrest law the preserved some levels of discretion for police officers. Words such as “may” or “can” resulted in laws being classified as recommended arrest laws while words such as “shall” and “must” resulted in laws being classified as mandatory arrest law states. In addition, many states with discretion provided some set of procedures that were required of officers declining to make an arrest after a domestic violence incident report. Any state with such procedures was classified as a mandatory arrest law states. The full set of statutes (including those passed too late for analysis) and their classification into categories is presented in Table A.2.

After considering the classification into type of law, I used the definition of domestic violence, spousal violence, family violence and other included terms to determine the coverage of these laws. While there is broad overlap in the relations covered across states, there are notable differences especially with regard to non-married, non-cohabitating partners (boyfriend/girlfriend), same-sex partners, and family members outside the nuclear family. The coverage of the laws used for analysis are presented in Table A.4.

A.2 Domestic Violence Arrest Laws by State

<i>State</i>	<i>Code/Statute</i>	<i>Year</i>	<i>Classification</i>
AK	Alaska Stat. §18.65.530(a)	1996	Mandatory
AZ	Ariz. Rev. Stat. Ann. §13-3601(B)	1991	Recommended
CA	Cal. Penal Code §836(c)(1)	1993	Recommended
CO	Colo. Rev. Stat. Ann. §18-6-803.6(1)	1994	Mandatory
CT	Conn. Gen. Stat. §46b- 38b(a)	1987	Mandatory
DC	D.C. Code Ann. §16-1031(a)	1991	Mandatory
IA	Iowa Code §236.12(3)	1990	Mandatory
KS	Kan. Stat. Ann. §22-2401(c)(2)	2000	Recommended
ME	Me. Rev. Stat. Ann. tit. 19-A, §4012(6)(D)	1995	Mandatory
MS	Miss. Code Ann. §99-3-7(3)(a)	1995	Recommended
MO	Mo. Ann. Stat. §455.085(1)	1989	Recommended
NV	Nev. Rev. Stat. Ann. §171.137(1)	1989	Mandatory
NJ	N.J. Stat. Ann. §2C:25-21(a)	1991	Mandatory
NY	N.Y. Crim. Proc. Law §140.10(4)	1994	Recommended
OH	Ohio Rev. Code Ann. §2935.032(A)(1)(a)	1994	Recommended
OR	Or. Rev. Stat. §133.055(2)(a)	2001	Mandatory
RI	R.I. Gen. Laws §12-29-3(c)(1)	2000	Mandatory
SC	S.C. Code Ann. §16-25-70(B)	2002	Recommended
SD	S.D. Codified Laws §23A-3-2.1	1998	Mandatory
UT	Utah Code Ann. §7-36-2.2(2)(a)	2000	Mandatory
VA	Va. Code Ann. §19.2-81.3(B)	2002	Mandatory
WA	Wash. Rev. Code Ann. §10.31.100(2)	1999	Mandatory
WI	Wis. Stat. Ann. §968.075(2)(a)	1996	Mandatory

A.3 Coverage of Mandatory and Recommended Arrest laws by Relationship of Victim to Offender

State	Arrest Statute	Intimate Partner Violence						Family Violence				Other Relations			
		husband	wife	common-law husband	common-law wife	Ex-husband	Ex-wife	Parent	Step-parent	Child or step-child	Sibling	Other Family	Boy-friend	Girl-friend	Homosexual Relation
AK [†]	§18.65.530(a)	X	X	X	X	X	X	X	X	X	X		X	X	X
AZ	§13-3601(B)	X	X			X	X	X	X	X	X	X			
CA	§836(c)(1)	X	X	X	X	X	X	X	X	X	X		X	X	X
CO [†]	§18-6-803.6(1)	X	X	X	X	X	X								
CT [‡]	§46b-38b(a)	X	X			X	X	X	X	X	X				
DC [‡]	§16-1031(a)	X	X	X	X			X	X	X	X				
IA	§236.12(3)	X	X	X	X	X	X	X	X	X	X	X	X	X	X
ME [‡]	Ann. tit. 19-A, §4012(6)(D)	X	X	X	X	X	X	X	X	X	X				
MO ^a	§455.085(1)	X	X	X	X	X	X	X	X	X	X				
MS [†]	§99-3-7(3)(a)	X	X	X	X	X	X	X	X	X	X		X	X	X
NJ	§2C:25-21(a)	X	X	X	X	X	X	X	X	X	X		X	X	X
NV	§171.137(1)	X	X	X	X	X	X	X	X	X	X	X	X	X	X
NY	§140.10(4)	X	X			X	X	X	X	X	X	X			
OH ^{†b}	§2935.032(A)(1)(a)	X	X	X	X	X	X	X	X	X	X				
SD	§23A-3-2.1	X	X	X	X	X	X		X	X	X				
WA	§10.31.100(2)	X	X	X	X	X	X	X	X	X	X	X			
WI	§968.075(2)(a)	X	X	X	X	X	X								

Notes: Coverage based on legal definitions in statutes at time of initial passage (some alterations have been made). Statutory text retrieved from Westlaw (West, 2005). Relationship of victims to offenders based on FBI Uniform Crime Reports, Supplementary Homicide categories. Matching of legal terms to FBI coverage based on author's own interpretations. Other family is assumed to be blood relatives of an level of relation.

[†] Signifies states in which degree of blood relation is specified. In these states, I assume other family members are not covered although some family members may be covered by arrest laws.

[‡] Signifies states in which residential family is included. I exclude "other family" because residency is not observable

^a Missouri law requires arrest if police are called more than once in any 24 hour period

^b Ohio specifies officers *must* separate the victim and abuser if they fail to arrest the abuser. Separate statements must be taken from each individual as well as the officer who declined the arrest