Abortion and Crime: Unwanted Children and Out-of-Wedlock Births

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Abstract

Previous empirical work linking abortions and crime has assumed, with the exception of five states, that no abortions took place prior to the Roe v. Wade decision in January 1973. In fact, abortion data from the Centers for Disease Control indicate that states which allowed abortions prior to the Roe v. Wade only when the life or health of the mother was in danger actually had higher abortion rates than some states where it was legal. The use of data from the Supplemental Homicide Report also allows the direct linkage between the current age of the murderer and the abortion rate when those murders were born.). One more abortion per 1,000 females age 15-44 (i.e., about four percent of the average) is associated with between a 0.12 to 0.9 percent increase in murders in any given year. Similar estimates are obtained using abortions per 1,000 live births. Linear estimates indicate increased annual victimization costs by at least $3.2 billion.

While it is indeed quite plausible that abortion would result in fewer "unwanted" children who have smaller investments in human capital and higher probabilities of engaging in crime, this discussion does not exhaust the possible impacts of abortion on crime. Recent work by Akerlof, Yellen, and Katz (1996), in fact, suggests the opposite conclusion. They note that the legalization of abortion and the increased availability of contraception to unmarried women increased the number of out-of-wedlock first births.[6] Everything else equal this theory predicts a reduction in human capital investments in children after the legalization of abortion and, while they don't extend these implications to crime, the prediction for crime is the opposite of the Bouza-Morgentaler-Donohue-Levitt hypothesis. Others note that the legalizing of abortion might contribute to a coarsening of society that might itself lead to more crime (Will 2001).

Joyce (2004) uses the same measure of abortion employed by Donohue and Levitt to examine the changes in homicide rates for people born before and after the legalization of abortion. He finds no clear impact of abortion legalization on crime rates. Donohue and Levitt (2004) argue that Joyce's non-result arises because he examines what they suggest is a "non-representative six year period" because of the impact of crack cocaine. In this paper we use data over the entire period. We also use data to account for cocaine prices, and compare data by year of age for the murderers within a state so that any change in murder rates from cocaine would hopefully have similar effects on neighboring age cohorts.

As of now, the Donohue and Levitt studies are the only published work that have directly linked legalizing abortion to the crime rate. According to the Uniform Crime Reports, the peak in U.S. crime rates occurred in 1991, eighteen years after Roe v. Wade was decided in 1973. Whether that should be the exact point where any impact of Roe should be felt is not clear, though it is surely suggestive. Their evidence depends on crime falling first in the five states that legalized abortion prior to Roe v. Wade as well as whether the crime rates have fallen the most in the states with the highest abortion rates. However, rather than regressing total crime on a measure of total abortions, this paper directly links the number of abortions when a cohort was born to the crimes that cohort later commits. We find that legalizing abortion was associated with a statistically significant increase in murder rates.

II. The Relationship between Legalizing Abortion and Crime

The central question is really how abortions alter human capital investments in marginal children. To Donohue and Levitt, the marginal children are ones who would have been born into substantially less favorable circumstances. They cite evidence that aborted pregnancies would have resulted in children who "would have been 60 percent more likely to live in a single-parent household, 50 percent more likely to live in poverty, 45 percent more likely to be in a household collecting welfare, and 40 percent more likely to die

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changing quality of people within groups as opposed to eugenics type claim that the drop in crime results from culling out those portions of the population who are likely to engage in crime. However this paper goes further and examines the results both with and without demographics.

[6] Recent work by Klick and Stratmann (2003) indicates that sexually activity increased dramatically after legalized abortion. Grossman and Joyce (1990, pp. 1000-1) provide interesting results that the number of abortion providers in New York City is negatively related to birth weight.

during the first year of life" (Gruber, et al. 1999, p. 265). They then point to evidence that unwanted children and those raised in "an adverse family environment" are "strongly linked to future criminality" (p. 11).[7]

In a very different approach, Akerlof, Yellen, and Katz focus on the fate of the children who were born (not on what fate would have awaited each child had they not been aborted). From the 1960s through to the late 1980s (the last years in which births could have any effect on crime rates during the 1990s), there has been a tremendous increase in the rate of out-of-wedlock births. On average during 1965-69, only 4.8 percent of whites were born out-of-wedlock, rising to 16.1 percent twenty years later (1985 to 1989). For blacks, the numbers rose from 34.9 to 61.8 percent. As Akerlof et. al. point out, unmarried women used to be much more likely to put up their children for adoption. In 1969 only about 28 percent of children born out-of-wedlock were being raised by mothers who were still unmarried within three years. By 1984, that same fraction had doubled to 56 percent. Hence, most of the children born out-of-wedlock before legalized abortion ended up in families with a father.

To Akerlof, et. al., the legalization of abortion reduced women's ability to withhold pre-marital sexual favors from men. Women who are willing to obtain an abortion are more likely to engage in premarital sexual activity without a promise of marriage should pregnancy occur. However, other women who are unwilling to obtain an abortion face competition from women who are willing to obtain an abortion as men "seek satisfaction elsewhere" (pp. 296-7). Further, as premarital sex and out-of-wedlock births became more common, the stigma declined and social pressure for couples to marry also declined, hence reducing investment in the child.[8]

The two effects are likely to be going on at the same time. "Unwanted" children may indeed become less common after abortion, with those potential children avoiding the problems of an adverse family environment and a higher likelihood of crime. At the same time, other women who want children and are unwilling to have abortions find that they are having to raise children on their own, which also entails a smaller investment in human capital compared to the situation that existed before abortion was legalized.[9] It is unclear which effect will dominate, and thus whether the investment in children's human capital will increase or decline.

Both effects are also consistent with an observed reduction in fertility rates. Women who do not want children obviously can terminate pregnancies. Women who do not want to avail themselves of abortions are now more willing to engage in risky pre-marital sex would end up with more out-of-wedlock births, but this is still a less attractive option than they faced before abortion was legal when they would have been able to wait until

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[7] The discussion relating human investments in crime is more complicated than this because assumptions must be made about how the reduction reduces the return to legitimate relative to illegitimate activities (Lott 1987).

[8] Contraceptives make abortion less of an issue, and it seems likely that the knowledge and correct use of contraceptives is much higher among intelligent women. For them the cost of premarital sex is less and they will face relatively few unwanted pregnancies.

[9] However, Bronars and Grogger (1994) find no evidence of the detrimental impact of out-of-wedlock births on the mother being transmitted to her children.

marriage for sex and have had children within a marriage. Women with children may also find marriage at a later date more difficult.

Finally, both theories relate abortion to crime rates through the level of investment in a child's human capital. The percentage of children born out-of-wedlock and the rate at which those children are raised by their unwed birth mother are easily observable, yet it is more problematic to link such time-series evidence to the legalization of abortion. In contrast, the types of homes in which children had they not been aborted would have grown up in is even more hypothetical. By 1980, 665,747 children were born out-of-wedlock and almost 1.3 million being aborted, both numbers are large, but more information is needed to answer what happens to investment in human capital and thus crime.

III. Changes in Murder Rates by Age Range

Five states are classified by Donohue and Levitt as legalizing abortion prior to the Roe v. Wade decision in January 1973. California's Supreme Court legalized abortion in late 1969 and Alaska, Hawaii, New York, and Washington legalized abortions through legislation the following year. The data used in their regressions assume that no abortions occur in any state other than these five prior to 1973.[10] However, there are doubts whether this simple classification accurately reflects the ease of obtaining abortions: abortion data from the Centers for Disease Control indicate that other states which allowed abortions only when the life or health of the mother was in danger actually had higher abortion rates than some states where it was legal (see Table 1).[11] For example, in 1972, Maryland, Oregon, New Mexico, Kansas, and the District of Columbia had abortion rates that were as high or higher than the states where abortion was legal. Still other states such as Wisconsin, Colorado, and Delaware were not very far behind. Overall 23 states in 1972, 20 in 1971, and 5 in 1970 are incorrectly listed in their data as not having abortions.[12] Two other papers also use this abortion data (Joyce (2004) and Garmaise and Moskowitz (2004)).

The assumption of zero legal abortions in the late adopting states prior to Roe v. Wade is not a random error and systematically lowers their abortion rates relative to the early

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[10] The correlation between the CDC's measure of abortions and those used by Donohue and Levitt is .91 for abortions from 1973 to 1985, but it falls to .84 from 1970 to 1985 because of the assumption that there are no abortions in the nonlegalizing states prior to 1973. Donohue and Levitt (2004, p.34) do report three regressions with the CDC data up until 1981 (not 1985), but these are only for the regressions that create their aggregate measure of abortion and not the arrest rate data that they also use which roughly tries to link the criminal's year of birth with the year of the murder. While the discussion around Figure 5 in this paper analyzes the assumptions made in their aggregate "effective abortion rate," the estimates employed here will be more equivalent to their more disaggregated regressions that use the arrest rate data. As discussed later, the Supplemental Homicide Report is the standard data set used for linking the characteristics of the murderer with the victim (not the Uniform Crime Report used by Donohue and Levitt) and that is the data set that we will use in this paper. On comment should also be made. We were the ones who supplied both Donohue and Levitt as well Joyce with the CDC data on abortion rates.

[11] We used the abortion data from the Centers for Disease Control rather than the data that Donohue and Levitt used from the Alan Guttmacher Institute because that data was not made available to us when we put this paper together. There might be some questions of political biases involving the Guttmacher Institute, which is affiliated with Planned Parenthood.

[12] Donohue and Levitt do not include data on the number of abortions prior to 1970.

adopting states during the years between when the early adopting states started allowing abortions and the Roe v. Wade decision.

Donohue and Levitt have argued since the publication of their paper that excluding abortions in the "nonlegal" states is justified because only relatively well-to-do mothers were able to "game the system" and obtain abortions and that the offspring of these mothers were not the type who would likely have engaged in criminal activity.[13] Unfortunately there is no direct data on the wealth of the women who have abortions, but we can proxy their wealth by using information on a woman's race. Two different racial categories are available from the CDC: blacks and others or whites. The evidence indicates that if anything relatively poorer women made up a larger share of abortions in the "nonlegal" states. Blacks and other women make 24 percent of the female population between 10 and 49 years of age and the same percentage of live births, but they account for 30 percent of the abortions in "nonlegal" states prior to 1973. By contrast, they make up 32 percent of the female population and 33 percent of live births in the 5 "legal" states, but only 21 percent of the abortions.

While we will rely on Donohue and Levitt's classification in this section, including other states as "early adopters," with abortion rates at least as high as those where it was legal, produces results that were more inconsistent with their hypothesis.[14] We will graphically examine the changes in crime rates: first comparing murder rates across different age groups in United States over time and second by comparing crime rates in the states that first legalized abortion to other states.

Also important, we will use the Supplemental Homicide Reports instead of the arrest reports in the Uniform Crime Reports because they allow us too much more accurately disaggregate the number of murders committed by each age for each state.[15] Suppose the legalization of abortion can explain up to half the drop in crime as suggested by Donohue and Levitt. Such a huge drop in crime should be readily observed first in the youngest age categories and then gradually appear in progressively older age groups as they were born after abortion was legalized. To examine this, we broke down the number of murderers into five age categories: 10 to 15 year olds, 16 to 20 year olds, 21 to 25 year olds, 26 to 30 year olds, and over age 30. By far the highest murder rates (the number of murderers in an age category divided by the number of people of that age) are concentrated in two age categories 16 to 20 and 21 to 25, with the murder rate for 26 to 30 year olds ranking third.

Figure 1 shows how the murder rates varied by age for the period from 1976 to 1998. The murder rate changes appear to be more consistent with the theory that legalizing abortion increased, rather than reduced, murder rates. The murder rates for the two oldest age

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[13] Based upon comments made at the 2001 American Law and Economics Association meetings.

[14] Simply to be consistent with Donohue and Levitt we primarily use the number of abortions reported in a state, though it is possible to adjust for whether people are coming from other states to have their abortion. We measure the total number of abortions by state, though the results are extremely similar if we simply used the number of abortions for a state's residents. This is shown in Table 4 and doing so tends to make the affect of abortion more positive and statistically significant.

[15] Arrests are a poor measure of crimes because arrests can frequently occur in different years from when the crime took place. The Supplemental Homicide Reports also do a much better and much more complete linking of the characteristics of the murderer with those of the victim. The simple arrest rate data from the UCR contains many missing observations for the age of the murder that are not found in the SHR.

groups (26 to 30 and over 30 years of age) fall almost over the entire time period. The next two oldest age groups (16 to 20 and 21 to 25 years of age) both peak in 1993. Finally, the youngest age group peaks last in 1994.[16]

The next set of figures contrasts the changes in crime over time for five "early" legalizing states with all the other "late" legalizing states. Figures 2A-2E make this comparison for 10 to 15 year olds, 16 to 20 year olds, 21 to 25 year olds, 26 to 30 year olds, as well as for those murderers where the age of the murderer is not known. Murders by those over age 30 are excluded because no one in that category was born after the legalization of abortion. Besides the murder rates for the "early" and late legalizers, the dotted vertical lines indicate the years when legalization begins to apply to people in the age range.[17] For example, the first people born after the legalization of abortion in the "early" legalizing states were born in 1970 and didn't start to enter the 10 to 15 age category until 1980. Since legalization is not assumed by Donohue and Levitt to have occurred in the "late" adopters until 1973, there should be no affect on crime by 10 to 15 year olds in those states until 1983.

Figures A, B, and C show several striking similarities. The patterns are remarkably similar over time when one compares the "early" legalization patterns across age groups to each other. The 10 to 15 year olds in the early adopters in Figure A can not be affected by abortions until 1980 and the early adopters in the older age groups in Figures B and C can not affected until 1986 and 1991, respectively. Thus, if abortion is driving the murder rates for the early adopters in the first three figures, the patterns should be lagged by about six years for 16 to 20 year olds and then another five years for 21 to 25 year olds. Instead the three early adopter patterns are remarkably similar to each other. All three rise from 1976 to 1980, then fall from 1980 to 1984, then rise into the 1990s, and finally fall together again over the last five years. The same similarity also holds true for the three late adopting patterns. All three decline from 1980 to 1984, then rise, and then fall together again.

Figures 2A to 2D further show a remarkably similar pattern across early and late adopting states despite abortion legalization affecting the late legalizers with a three-year lag. It is also clear that despite legalization beginning to affect people in the different age groups at different times there is little obvious relation to any changes in murder rates. While murder rates declined when abortions were legalized for early adopters for 10 to 15 year olds and early and late adopters for 21 to 25 year olds, murder rates rose after legalization for late adopters in the 10 to 15 year old age range and early and late adopters for 16 to 20

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[16] While we are focusing on who is committing the crimes, it is also possible to produce a figure for the victimization rate and it produces a similar pattern where the victimization rate for the oldest people begins to decline first.

Another way of summarizing this information is to examine the average age of murderers. If murder rates first declined among the youngest, the average age of murderers should be rising. Yet, as Figure 1 implies, the average age of murderers fell almost continually from the mid-1970s to the 1994, declining from 30.9 years of age in 1977 to 27 in 1994. Only after 1994 has there been a slight rebound in the average age as the younger age groups began to reverse their increase in rates of committing murder which began in the mid-1980s. By 1998, the average age of murderers had risen back up to 28 years of age.

[17] The numbers in Figure 2A prior to 1980 are calculated slightly differently than the other numbers because of the inability to precisely link the ages of population with crimes by this age group. To make this link we assumed that the population group for 5 to 13 year olds was uniformily distributed.

year olds. Examining both early and late adopters for the 26 to 30 year old age group, the legalization of abortion does not seem to speed up what had been a fairly continuous drop in murder rates over the whole period. If legalizing abortion is having any effect on murder rates, it is not obvious from this raw data.[18]

Figure 2E, which shows the murder rates for murderers of unknown age, indicates the murder rate peaking in 1993 for the early adopters and 1994 for the late adopters. Again, the timing of these peaks do not seem consistent with legalized abortion: there is no difference in when the peaks in murder rates occurred and there is too long of a lag after legalization.

It is also possible to track some cohorts over time. The top panel in Figure 3 is for people born immediately two years before or two years after the legalization of abortion in the five early adopting states. The second panel does the same thing for those living in the 45 states and the District of Columbia who were affected by Roe v. Wade. The graphs tack these cohorts crime rates from their teens through their twenties. There is some difference in murder rates as these cohorts age, particularly during the late teenage years. For example, in panel B while the murder rate among those born after legalization rises faster up until age 18, this group also has a slightly faster decline in murder rates after that point. In panel A, those born prior to legalization have higher murder rates for 9 ages and the reverse is true for 5 ages. It is possible to include additional years before and after legalization and this does show a somewhat higher murder rates during middle age years for those born after legalization (e.g., see Appendix Figure A1 which shows a period of four years before and after legalization), but allowing more years to elapse between cohorts makes comparisons more difficult because other factors may be changing.[19]

Finally, a breakdown according to the sex of the murderer is also possible. Some abortions are done to selectively choose the sex of infants, and this has become progressively easier over time. The presumption is usually that female offspring are less desired than males and thus aborted at relatively higher rates.[20] Even if this is not so, the Bouza-Morgentaler-Donohue-Levitt hypothesis about unwanted children would seem to predict at least some drop in murders by women during the 1990s. Yet, murders by women fell almost continually during the 1980s and 1990s (See Figure 4). The entire difference between overall murder rates increasing in the last half of the 1980s and the dropping during the 1990s is driven by males. Breaking down murders for women and

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[18] The gap between early and late adopters also does not vary in ways that can be explained by the legalization of abortion. For example in Figures 2A and 2B the gap between early and late adopters falls from 1980 to 1985 in both graphs even though legalization cannot possibly begin to impact the 16 to 20 year olds in Figure 2B until 1986. After 1990 the differences between early and late adopters narrow in both states, but the legalization of abortion can not explain the narrowing in crime rates between early and late adopters after 1990 since by that time the relevant cohorts in both sets of states were affected by legalization.

[19] Graphs showing one and three years before and after the legalization are also available from the authors.

[20] The explicit systematic use of abortion to select male offspring appears most widespread in Asian countries and India, but discussions also arise in the American press. See Michael Breen, "Daugthers Unwanted: Asian's preference for sons makes abortion rate soar," Washington Times, Saturday, February 13, 1993, p. A1; Sharon Rutenberg, " 'Custom-made' families by sex selection," United Press International May 31, 1983, Tuesday; Owen D. Jones, "Made-to-Orders Babies," Connecticut Law Tribune, September 6, 1993, p. 19; and Reuters News Service, "China Outlaws Sex-screening; Beijing Follows India's Lead to Prevent Mass Abortion of Girl Fetuses," St. Louis Post-Dispatch, November 20, 1994, p. 11C.

men by the age of the killer (not shown here) again confirms what was reported in Figure 1: the drop in murder rates is first observed for the oldest age categories.

IV. How to Test the Relationship between Abortion and Crime

Past research has examined how the legalization of abortion altered crime rates, but it did not disaggregate the crimes by the age of the criminal.[21] To try to deal with this, Donohue and Levitt create an "effective abortion rate" which weights the number of abortions in different past years by the percent of total arrests for a particular crime that occur for people who were born in that year. It is a creative approach, but, as with most aggregation problems, there are risks. One of the dangers in using the aggregate crime rate across all ages is that they may incorrectly link changes in total crime rates to the wrong age groups. At the end of their paper they do breakdown the data age of arrest, but that data does not link the arrest to the year in which the crime was committed (Lott 2000) and a high proportion of violent and property crimes are never solved through arrest.[22]

Donohue and Levitt also made other compromises in creating the "effective abortion rate." They assume that the relative rates at which different age groups commit crime is not only the same across all states but is also constant over time. A breakdown by the age of the criminal is only readily publicly available by state by year for murderers through the Supplemental Homicide Reports. These data show that this assumption is not empirically supported. The share of murders by different age groups varies tremendously over time. For example, while murders by 16 to 20 year olds made up 12 percent of total identified murders in 1984, they made up 21 percent in 1994.[23]

Similarly, the assumption that crime is committed at the same rate by different age groups across states and over time is another oversimplification. Figure 5 shows how the standard deviation of age group shares varies across states over time. The standard deviation across states in the share of murders attributable to 16 to 20 year olds and 26 to 30 year olds fell by over 50 percent in a single year (1982 and 83 and 1990 and 91, respectively). On two occasions (1986 to 87 and 1991 to 92) the standard deviation across states in their share of murders committed by those between 10 and 15 doubled. Similar large jumps occurred for the share of murderers over age 30.

While it is unclear what types of biases this aggregation creates, what is clear is that the aggregation eliminates a great deal of information, not only on how the age distribution of criminals is changing over time but also how it is varying across states. Comparing the

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[21] More recently work by Joyce (2001) also breaks down the data by cohorts, though he uses selective cohorts with a difference-in-difference-in-difference method. Like our work here, he did try using count data models to estimate these results but was unable to do so because the specifications did not converge (p. 14, fn. 14). He does report though a large number of estimates and generally concludes that there is no relationship between the legalization of abortion and the level of violent crime, property crime and homicide. Among the differences between our work and his is that he limits the sample to those who were born immediately before and after legalization (similar to what we have shown in Figure 3). He also follows Donohue and Levitt and assumes that there were no abortions in the "nonlegal" states prior to 1973.

[22] Donohue and Levitt (fn. 34) themselves acknowledge the problem with arrest rate data of linking the criminal's age to the year of the crime.

[23] Even though Figure 1 shows the variation in rates and not shares, a figure showing different age groups' share of total murderers also varies similarly over time.

total number of murders with their aggregate measure of "effective abortions" and assuming a 15 to 20 year lag before abortion materially affects crime makes it difficult to know what we can infer from the type of panel data set that Donohue and Levitt have constructed.

However, we can examine whether their weighting scheme or assumption that abortion rates were zero in the "nonlegalizing" states has any systematic effects. To do this, we replicated the results reported in Donohue and Levitt's Table IV using the data that they supplied us and then examined three types of variations: 1) assuming that no abortions occurred when not defined as "Legal" by Donohue and Levitt or using CDC abortion data for all years in calculating the "effective abortion rate," 2) using national average weights for 1985 or state and year specific weights in calculating the "effective abortion rate," and 3) using either the UCR murder rate or the murder offender rate from the Supplemental Homicide Report. Despite repeated requests, we were unable to ascertain exactly what age ranges were used in calculating the weights used by Donohue and Levitt in constructing the "effective abortion rate." Fortunately, the Supplemental Homicide Report supplies information on offender rates by individual year of age. We can thus weight the index by abortions in the year of birth for all the criminals for all ages that are affected by abortion.

The results for these different permutations are shown in Table 2. Using the data supplied by Donohue and Levitt, we had no problem replicating the statistically significant and large abortion coefficients in their columns 5 and 6 and these are reported in our rows 1 and 5 for column 1. The control variables and the sample period are exactly the same as they used, and the coefficients on these other variables are also the same as those they report. Continuing to focus on the UCR murder rate, replicating their effective abortion rate using the Supplemental Homicide Report in rows 2 and 6 drastically reduced the impact of abortion on murder by between 50 and 69 percent and was no longer statistically significant.[24] When we dropped the assumption that abortions only took place in the five states that Donohue and Levitt identify as "legal" abortion states the size of the coefficients in rows 3 and 7 were further reduced by another 20 to 40 percent. Finally, using state and year specific weights instead of a national average (which is constant across all states for all years) reverses the sign of the coefficients and implies that more abortions increase murder rates, though neither coefficient was found to be statistically significant at the 10 percent level.[25] A similar pattern also arises when the UCR murder rate is replaced by the offender rate in column 2.

Donohue and Levitt's results in their Table IV column 6 implied a 0.43 percent drop in murder for each one percent increase in abortions. This accounts for 25 percent of the 30 percent drop in murder between 1991 and 1997. By contrast, when we used all the abortion data available and used state and year weights in determining the share of crimes committed by each age group rather than assuming constant shares across states and years,

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[24] About 20 percent of the difference between rows 1 and 2 in column 1 is due to our attempt to replicate their effective abortion measure. We have been unable to replicate their measure, but our requests for help on this issue have not been responded to.

[25] One possible reason for using the national weighting that is constant across years and states that has been mentioned to us by Steve Levitt is that allowing the weights to vary would induce an artificial correlation between the murder and effective abortion rates. Presumably, the relationship is similar to that which exists between the murder and arrest rate in crime regressions. Yet, that does not appear to be relevant here because what is really being compared is the share of murders by people under age 29 and the murder rate.

the same specification implies that each one percent increase in abortion raises the murder rate by 0.08 percent. Everything else equal, abortion would have slightly increased murder rates by 1.3 percent between 1991 and 1997.

As we noted earlier, the major benefit of the Supplemental Homicide Report is to move beyond these aggregate crime and abortion numbers and directly link the age of the murderer with the year in which the crime occurs. To use this data in a regression analysis, we set up panel data to examine the number of murders committed by each year of age by state by year. We break down the individual ages by year from 10 to 30 years of age and then aggregate together all the murders committed by those over age 30. The age groupings are disaggregated by year born for those born when abortion may have been allowed. This panel allows us to track each cohort as they age and account for the number of legal abortions in their state in their year of birth. If abortion eliminates those in the population who are most likely to commit murder, we should observe a significantly lower murder rate among those who were born immediately after legalization. Further, that difference should be traceable over time as each cohort ages.

In their estimates explaining arrests for violent crime (Table VII), Donohue and Levitt drop observations where there are zero arrests for a given age. Yet, excluding observations based upon on the realization of the dependent variable creates a potential selection bias. This problem is particularly acute for murder, which is less frequently committed than either overall violent or property crime, and it is the reason they cite for not reporting these estimates for murder. Following Plassman and Tideman (2001), we deal with the count nature of the data by estimating Poisson regressions. For those who are interested, a distribution of the murder data from the Supplemental Homicide Report is presented in Appendix Figure A2.

Obviously many factors affect the rate at which people commit murder. The most basic regressions include age, state, and year fixed effects. We also include the population in the state that are the same age as the murderers. Law enforcement efforts against murder are measured by arrest rates for murder, the execution rate in the year that the crime occurred, and the percent of the population in prison.[26] Both the last two variables are problematic since crime and enforcement rates in the past as opposed to current efforts are much more important in determining their current values. This is probably less of a difficulty for execution rates since changes in who is governor or changes in the composition of the state supreme court can have a big impact on the number of executions that take place. Using the general prison population as a percent of the total population also has the problem that only about one or two percent of prisoners are incarcerated for murder and any changes in enforcement against murder are likely to have small changes in even this tiny fraction because prison sentences for murder are so long.[27] The bottom line is that the variable we would like to measure -- prison sentences as deterrence against murder -- would likely be swamped by the changes in enforcement for other crimes. However, the results reported here are not much affected by the inclusion of any of these variables and we include the

[26] For discussions of these variables see Lott (2000) and Marvell and Moody (1994).

[27] There are other theoretical problems with using the prison population. For example, prison population is a stock while the crime rate is a flow. The difficulty that this creates is that the prison population is determined by enforcement over many years, but it is the current level of enforcement that is important for determining the crime rate.

percent of the population in prison simply to make our results consistent with Donohue and Levitt's.

Other factors that we account for are the unemployment rate; the poverty rate; real per capita personal income; real per capita government payments for income maintenance; unemployment insurance and retirement payments; state population density in miles; a set of demographic variables that subdivide a state's population into 36 different race, sex, and age groups (see Appendix 1); and the trends before and after the passage of right-to-carry laws. With the exceptions of broader measures of income and the inclusion of demographics, the variables are very similar to those used by Donohue and Levitt. We have included these other variables because they have been used in our past work (e.g., Lott 2000) and because of the discussion in the introduction about the importance of demographics in determining that any changes in crime are not simply due to groups which commit crime at high rates being culled out of the population. Still, as we will show below, for this panel the results we report are not dependent upon any particular set of control variables.[28]

V. Measuring the Impact of Abortion on Crime

The panel data set covers murders committed by murderers in 22 age categories (by year of age from 10 to 30 and over 30), 50 states and the District of Columbia, and years from 1976 to 1998. In addition, 23 percent of the murders are in a 23rd category covering murders committed by criminals of unknown age. Potentially there are 26,979 observations, though that is reduced to 21,480 because of missing observations, particularly the population by year of age, which is only available starting in 1980.

The first issue is what to do with the unknown age category. There are several possible approaches: 1) exclude murders where the age of the criminal is unknown, 2) include all murders but use additional dummy and trend variables to proxy for the impact of abortion for those observations since abortions numbers are not available for murderers of unknown age, or 3) use estimates included in the Supplemental Homicide Reports that distribute the unknown murderers based on the known distribution by age/race/sex of offenders by state

[28] While it is difficult to directly measure the violence caused by cocaine/crack, limited cocaine price data is available for a portion of the sample from 1980 to 1992 (with the exceptions of 1988 and 1989) to proxy for the relative accessibility of cocaine in different markets. Using yearly state-level pricing data (as opposed to more short-run changes in prices) also has the advantage of picking up cost and not demand differences between counties, thus measuring the differences in availability across counties. The data was obtained from Grossman et. al. (1996). The county level data is aggregated to the state level by weighting the prices by the population in the counties. The reduced number of observations provides an important reason why we do not include this variable in the regressions shown in the text. Including it leaves the coefficient on abortions virtually unchanged. While simply using the price does not allow one to perfectly disentangle local differences in demand and supply, arbitrage basically assures that except for short periods of time the differences in prices between these local markets will equal differences in selling costs. If the total cost of selling cocaine was the same in two different cities, any price differentials resulting from sudden shifts in demand would result in distributors sending cocaine to the city with the higher price until the price had fallen enough so that the prices between the two cities were equal. Distributors could even remove cocaine from the low price city and move it to were it could obtain a higher price. Sellers in a city could also hold inventories and not sell their cocaine during periods with unusually low demand. To the extent that it is costly to instantly move drugs between different cities or to store drugs, any price differentials in the short run can be due to demand shifts, but since we are dealing with a period of a year, it seems difficult to believe that any noncost based price differentials will not be arbitraged away.

and year. The first two approaches create problems by either censoring the endogenous variable or not being able to link the unknown murderer category to the abortion variable. The third approach is problematic because unknown murderers may be different from murderers who have been identified if only because they are more difficult cases.[29] The chief advantage of the second approach is that it does not discard any information. While we shall primarily report the results using the second approach, we tried all three, though the results for the abortion variable differed very little across specifications.

For the second approach, we estimated the following regression:

$$Murders_{ijk} = \beta_1 (Abortions/1{,}000\ Females\ age\ 15\text{-}44)_{ijk} + \beta_2\ Population\ of\ Age\ Cohort_{ijk} + \boldsymbol{\beta_3}\ Control\ Variables_{jk} + \boldsymbol{\beta_4}\ (State\ Fixed\ Effects * Time\ Trend\ that\ is\ non\text{-}zero\ when\ the\ age\ of\ murderer\ is\ unknown) + \boldsymbol{\beta_5}\ State\ Fixed\ Effects + \boldsymbol{\beta_6}\ Age\ Fixed\ Effects + \boldsymbol{\beta_7}\ Year\ Fixed\ Effects + \alpha + \varepsilon_{ijk} \quad (1)$$

"Murders" are the number of murders committed by a murderer of age i in state j and year k. "Abortions/1,000 Females age 15-44" are the abortions that took place in that state when that cohort was born divided by the number of women age 15-44 in that state and year (multiplied by 1,000), and "population" is the number of residents of age i in state j and year k. For murders where the age of the murderer is unknown, the abortion variable equals zero but the vector of state specific time trends for just that category is non-zero (so as to account for the otherwise unmeasured impact of abortion for unknown age murderers). We also have vectors of control variables and state, age, and year fixed effects.

Table 3 examines the simplest specifications that include all the variables and observations and examines whether the results are affected by how the law enforcement variables are accounted for. The columns show different specifications with various sets of control variables, though all include state, year, and age fixed effects. Yet, in order to account for clustering at the state level STATA requires that a population-averaged estimator is included. The t-statistics are calculated using clustering at the state level and use robust standard errors.[30]

The first column in Table 3 shows the relationship between the number of murders and abortions, and the second specification includes all the other control variables. One concern with this simple specification is that the total arrest rate for all ages for murder affects the number of murders and the reverse is also true. A similar simultaneity exists for the overall prison population, but it is much less of a problem since murderers make up only a percent or so of the total prison population. The next two columns show methods to deal with these simultaneity problems. The third specification uses lagged values for the arrest rate and prison population,[31] while the fourth specification replaces the arrest rate for

[29] Joyce (2001) uses imputation method provided by the Supplemental Homicide Report and he is aware of the problems that this creates, though he appears to be unaware that the data is available without this lumping of known and unknown data together..

[30] The results without clustering are available on request, though the difference is that the estimates are much more statistically significant.

[31] Lagged values are problematic because in theory it is the current arrest and punishment levels that should matter most in deterring criminals. The benefit from lagging the prison population also seems extremely small because murderers make up such a small portion of prisoners.

murder with the arrest rate for overall violent crimes. The arrest rate for violent crimes will still proxy for the effectiveness of police but avoid being very closely effected by contemporaneous changes in the number of murders.

The final two specifications use a dummy variable for the legalization of abortion as well as the natural log of all the abortion and population variables.[32] An advantage of using the simple dummy variable as opposed to the number of abortions is that it is more clearly exogenous, especially because other social factors might be changing over time that influence both the abortion rate and how children are raised. On the other hand, while the dummy variable will give us a measure of the average impact of the law, the number of abortions allows us to measure the differential impact of legalization across different states. The log specification not only allows the interaction of the abortion and population variables, but it allows us to use nonlinear values for those variables and puts a smaller weight on the impact of abortion in the larger states.

The top row of Table 3 reports the percent change in murders by people of a certain age from a thousand abortions for people of that age. These incident rate ratios are reported throughout the paper and indicate that murders are increasing when the coefficient is greater than one and declining when the values are less than one. Interestingly, all the estimates imply that more abortions produce significantly more murderers when children get older, and the coefficients for the first four specifications are remarkably consistent.

To interpret the coefficients, note that the average state had 25,443 abortions in 1980 and 1,039,797 females age 15-44. The average abortion rate (abortions per 1,000 females age 15-44) was thus 24.5 (the simple average across states was 23.2). One more abortion per 1,000 females age 15-44 (i.e., about four percent of the average) is associated with about a 0.9 percent increase in murders in any given year.[33]

The last two columns imply somewhat different impacts from abortion. The dummy variable reported in column 5 indicates that legalizing abortion was associated with, on average, a 7.2 percent increase in murder. Whether this increase is due to the legalization of abortion for the two sets of states in 1970 and 1973 and not other general cultural factors that are also changing at about this same time is hard to say simply because there is so little difference in the adoption dates. When evaluated at the mean, the sixth column, which examines the log of the number of abortions per 1,000 females age 15-44, implies that one more abortion per female age 15-44 is associated with an increase in murders of 0.12 percent, about one-seventh the magnitude estimated by the linear specification. While not reported, we also ran the simple dummy variable and natural log specifications that correspond to specifications 1, 3, and 4 and the abortion results changed little from those reported in columns 5 and 6.

The specifications corresponding to those in Table 3 when we use the Supplemental Homicide Reports' method of distributing unknown murderers or exclude murders where

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[32] For observations where the abortion variable equals zero we added .1 before taking the natural log.

[33] There is also the issue of whether the results are consistent across states or are being driven by a few unusual outliers. To test this, we interacted the abortion variable with a set of state dummy variables. With Alabama serving as the left out state, 41 states have higher crime rates as abortion increases, 39 of them statistically significant at least at the 10 percent level for a two-tailed t-test. For six states the effect was negative, but more abortions significantly reduced murder rates in only two states (Nebraska and Vermont).

the age of the criminal is unknown are reported in Appendix 3. In all but one of these specifications the impact of abortion is statistically significant at well above the .01 level for a two-tailed t-test, and the effect ranges from between 33 percent smaller than what was reported in Table 3 to 48 percent larger.[34]

Most of the law enforcement variables have the expected effects, with more executions and more people in prison associated with reductions in murder, though the effect is not significant for the execution rate (the arrest rate effect appears positive, but statistically insignificant). Consistent with past research, murder rates fall at least 1 percent per year faster after the adoption of right-to-carry laws.[35] The population density coefficient estimates show a negative relationship, but are not statistically significant. Surprising results include the negative relationship estimated for the unemployment rate and the positive relationship for income levels, but these results are generally not statistically significant. The estimates for the impacts of the demographic variables and age dummies that correspond to column 2 are shown in Appendix 2. Estimates using weighted least squares to examine the murder rate instead of the Poisson regression examined here are reported in Appendix 4, and five of the six results are similar in size to those shown in Table 3.

The bottom section of Table 3 shows the impact of changes in abortions per 1,000 live births on the murder rate. The results continue to show a strong consistent positive relationship between abortions and murder. The average abortion ratio (abortions per 1,000 live births) was thus 359 (the simple average across states was 294). The estimate for the specifications where abortions enter linearly (columns 1-4) imply that an increase of one abortion per live birth (about 0.3 percent of the total) is associated with a 0.06 percent increase in murders, about the same magnitude of the results using abortions per 1,000 females age 15-44. The log specification with abortions per 1,000 live births is similar to the log specification with abortions per 1,000 females age 15-44.

To put these results differently, if legalizing abortion meant that the abortions per female and per birth went from zero to those observed from 1973 to 1988, Table 3's estimates (specifications 2, 6, 8, and 11) imply that there will be between 854 and 1,916 more murders in 1998. The simply dummy estimate implies about 1,543 more murders.[36]

The results in Table 4 correspond with the sensitivity test provided in Donohue and Levitt's Table V, with two exceptions: an additional row limiting the sample to just those of known ages affected by the legalization of abortion and replacing all the nonage specific

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[34] However, as we were concerned that would happen, excluding those cases for which the age of the offender was never known did alter other coefficients such as the arrest and execution rates.

[35] A data set with information on other gun control laws for a portion of the time period studied here from 1980 to 1997 was also used to estimate these regressions, but their inclusion had little impact on the size or significance of the abortion variable. The data are discussed in Lott and Landes (1999) and include information on waiting periods, background checks, penalties for using guns in the commission of crime, and so-called safe storage laws which imposes penalties on adults who do not lock up there guns if the guns are used improperly by a juvenile.

[36] If legalizing abortion meant that one went from zero abortions to the mean abortions per female and per birth seen in 1980, specifications 2, 6, 8, and 11 respectively imply 22, 27.5, 20, and 52 percent increase in murder rates. If instead of going from zero murders to those that were actually allowed prior to "legalization," specifications 2, 6, 8, and 11 respectively imply 16, 16, 6, and 9.3 percent increase in murder rates.

state-year level variables with state specific year fixed effects. For the linear and log specifications, a column with results using abortions per 1,000 females age 15-44 and a column with results using abortions per 1,000 live births are presented. The full set of control variables and sample is reported in the first row as the baseline. Each row represents a separate specification. Donohue and Levitt tested whether the results were sensitive to "large states," states with "very high or low abortion rates" as well as different types of trends and fixed effects. The large states excluded are California and New York and the jurisdiction with the high abortion rate that is excluded is Washington, D.C.. Each is excluded separately and then all three are excluded as a group. Individual state specific trends and separate regional fixed effects by year are also tried. Because of our statistical package's (STATA) limit on the number of control variables using state specific year fixed effects may more effectively control for year to year variations in factors that affect the overall level of crime but it comes at a cost of having to restrict the number of years that can be examined. The last row in each of the three sections in Table 4 reports regressions that account for the number of abortions, the age specific population, a state specific trend variable for unknown age murders, as well as state specific year effects for the period from 1989 to 1998.

The results remain consistent across the various sensitivity tests. Excluding the California, the District of Columbia, and New York individually or together generally increases the magnitude of the results. Controlling for fertility generally reduces the results and makes them statistically insignificant in the log specification.

There are other sensitivity tests that can be made. We categorized the control variables used in Table 3 into 10 different sets: the execution rate, prison population, arrest rate, the four measures of income, population density, unemployment rate, poverty rate, right-to-carry laws, population of the age group committing murder, and the 36 demographic variables. Running all combinations of these control variables results in 1,024 regressions. The estimates all account for state, age, and year fixed effects. Doing this for all the linear, dummy variable, and the natural log specifications with abortions/1,000 females age 15-44 triples the number of regressions. Adding the linear and natural log specifications with abortions/1,000 live births adds an additional 2,048 regressions. Taken together, we ran 5,200 regressions.

The results from this specification search are summarized in Table 5. The range of coefficient estimates for the linear specification with abortions/1,000 females age 15-44 is 0.732 percent to 0.966 percent. As can be seen, the coefficient estimates are extremely consistent across perturbations for the other four specifications as well.[37]

We finally examined whether abortion had a different effect on crime as people aged. It is not obvious that the percentage increase in crime should be the same for all ages. To do this, the five measures that we have been using (abortions per 1,000 females age 15-44, abortions per 1,000 live births, the natural logarithm of these two measures, and the dummy variable for legalization) were interacted with the age dummy variables. The results reported in Table 6 imply a much more complicated story than we have seen thus far. While abortions are on net associated with increased murderers, the impact is not the

[37] In an earlier version of the paper, we ran these 6,144 specifications without the category of unknown murderers. The ranges of estimates were similar to those reported here.

same for all ages nor consistent across all the specifications. The different specifications only consistently imply higher crime rates for criminals between the ages of 13 and 17. (Comparing the rate regressions there are consistently higher murder rates from for abortions for ages 13 to 22 and ages 27 and 29.) Only the coefficients for one year of age -- 29 year olds -- show a consistent decline in murder rates from abortions. The two rate regressions (1, 2, 4, and 5) show much more consistency both in terms of the ages associated with increases or decreases in crime as well as when the rates begin to rise and fall.

There is one possible explanation for why the only consistent significant results are for children in their teens. The real differences occur between the different rate measures and the law dummy. Part of this may arise because prior to "legalization" abortions took place when the life or health of the mother was in danger. As noted earlier, abortion data from the Centers for Disease Control indicate that states which allowed abortions prior to the Roe v. Wade only when the life or health of the mother was in danger actually had higher abortion rates than some states where it was legal. For some states, these life or health restrictions appear to have produced no real limit on the abortion rate. The dummy variable for the law assumes that "legalization" resulted in more abortions than when abortions were "illegal" (only allowed when the life or health of the mother were endangered) and that is obviously not true. We take these results as additional evidence against using specifications that assume that no abortions took place in states prior to "legalization."

VI. Disaggregating Crime and Abortion Rates by Race and Sex

Legalized abortion need not affect all population groups equally. White, blacks, and other groups obtain abortions and have out-of-wedlock births at different rates. The net effect of legalization is unclear since the groups that have a high levels of abortions also tend to have out-of-wedlock births more frequently. For example, while blacks account for 29 percent of abortions during our sample, they account for about 40 percent of the out-of-wedlock births from 1980 to 1995. Fortunately, the Supplemental Homicide Report disaggregates murders by race, sex, as well as age. The Centers for Disease Control abortion data does list the number of abortions in each state by whether the mother is white or nonwhite, though this information is missing for 1969 and 1982 to 1986. With the exception of replacing the earlier endogenous variable for the total number of murders with the number of murder broken down by race and sex, replacing the total number of abortions with the number of abortions by the birth mother's race, and examining only those murders for which the race and sex of the murder is available, the regressions correspond to those reported earlier in Table 3. Unfortunately, because the abortion data does not disaggregate nonwhite abortions further by race.

The regressions imply that more abortions by white or nonwhite mothers are associated with more murders by people in their respective groups. White males consistently and statistically significantly are more adversely affected by higher abortion rates than white females, and the difference are always statistically significant at least at the 5 percent level for a two-tailed test. For nonwhites the difference between males and females is more mixed: in one cases males face the significantly greater loss, in two case females.

The different specifications do not imply that anyone group is harmed consistently more than another. The linear and natural log estimates imply that on average additional

abortions harm nonwhites the most, while the dummy variable indicates that this is true for whites.

The bottom line is that increasing the abortion rate consistently results in more murderers when the remaining offspring of that race come of age, and the effect is larger for white males than white females. Generally the coefficients are similar in size to what was reported earlier, though some are as large as two or three times as large as the average effects reported earlier. Why white males exhibit a larger percentage increase than white females in becoming murderers from additional abortions is not clear but the effect is consistent and large.

There is also the question of who are the victims of this increased crime. Overwhelmingly, most murder victims are killed by people of the same race, but those ratios could change as more murders occur. We disaggregated murders by the race of the victim and criminal. For example, the endogenous variable is the number of murders by whites of nonwhites. Since this regression only examines murders by whites, only the number of abortions by white mothers is controlled. Similarly, murders by whites of whites is also examined and so on for murders committed by nonwhites against whites as well as nonwhites. Abortions seem to produce similar increases in murders by whites of both groups. The data is more mixed with for nonwhites and others with the linear and natural log specifications implying much bigger percentage increases in murders of nonwhites and others than for whites, but the reverse being true for the dummy variable specification.

VII. Measuring the Impact of Abortion on Arrest Rates

Donohue and Levitt directly link abortions to the arrests by year for 15 to 24 year olds using data from 1985 to 1996.[38] As noted earlier, there are problems with using arrest rates as opposed to the Supplemental Homicide Report because arrest data does not directly link the criminal to the crime and arrests frequently do not occur in the year the crime was committed. The Supplemental Homicide Report also includes information that the local law enforcement agency has on who they thought committed the crime even if an arrest does not take place. The correlation between arrests for murder and the Supplemental Homicide Report for 15 to 24 year olds is still a substantial .93. Any problems will be much greater for overall violent and property crime because of the much lower rate at which arrests are made and the longer lags that tend to exist between the crime and an arrest.

While there are some control variables that differ from our research (e.g., the lack of any demographic variables in their regressions), the last two regressions reported at the end of the sections for violent and property crime and murder correspond to the odd numbered regressions in their Table 7.[39] The big difference between their results and ours stems

[38] We limited our sample to that reported by Donohue and Levitt for consistency, but using a sample that for the ages and years reported earler produces results which are generally less consistent with their estimates.

[39] We have been unable to determine what they meant by "state*age interactions, but have assumed that they are referring to fixed age effects by year, though interacting state fixed effects with the age variable does not appreciable alter the results.

from them assuming that no abortions took place in the late adopting states from 1970 to 1973 and particularly that no observations were included for births that took place prior to 1970. Expanding the data set so that it covers arrests over the period from 1980 to 1996 also produces stronger evidence that abortion increases arrests for violent crime and murder. The other estimates are based upon the Poisson regressions that we reported earlier. However, with few of the age groups examined experiencing zero violent crime arrests in any given state during a year and none of the age groups experiencing this for property crime, the benefit from using Poisson regressions is limited primarily to arrests for murder.

The results reported in our Table 7 generally show either a positive relationship or no relationship between abortion and arrests for violent crime and murder while suggesting a weak negative relationship between abortion and property crime.. For the weighted OLS regressions that most closely correspond with their original estimates only the regressions for property crimes imply that higher abortion rates reduce that type of crime. Overall only the arrest for murder regressions always imply the same relationship between abortion and crime, and indeed the effect is similar to what we found using the Supplemental Homicide Report, though this is really a result of the narrower age group being examined. It is unfortunate that Donohue and Levitt do not provide results for this crime category so that we can make a comparison. While there are estimates for both violent and property crime that imply both increases and decreases from abortion, one conclusion is clear: the effects are always small and imply that going from zero abortions to the mean number in 1980 had only around a percentage point or so effect on crime.

While there are difficulties with using arrests and not data such as that provided by the Supplemental Homicide Report, neither the different data source nor the limited sample is alone sufficient to explain the different results. Part of the difference between our results and theirs goes away when we assume that abortions only occurred in the five states they define as early legalizers, still that does not qualitatively change our results.

Combining our earlier results from Table 3 with these general estimates for violent and property crime allow some rough estimates of the victimization costs of crime. Donohue and Levitt suggest that abortion reduces annual victimization costs by $30 billion, with most of this coming from reductions in murder (Miller et. al. 1993). Using their same calculations for our results from Table 3 for 1998 imply that abortion raises victimization costs from these higher murder rates alone by between $3.3 and $7.4 billion per year in 2003 dollars. Even if we take our estimates on the most optimistic reductions in property crime, the net effect of abortion is to increase victimization costs by over $3.2 to $7.3 billion per year.

VIII. Does Abortion Lead to More Out-of-Wedlock Births?

The research by Akerlof et. al. raises the issue of abortions and contraceptives leading to more out-of-wedlock births. Yet, their empirical work is preliminary and is based on purely time-series evidence.[40] ARMA regressions are used to examine whether there was a change in abortions, use of the pill during first intercourse, and the percent of women

[40] The careful work of others such as Gruber et. al. (1999) have questioned the Akerlof et. al. empirical findings.

before and after 1970 or 1971 who had sex by 16 years of age. They also examine whether there was a change in so-called "first-birth shotgun marriages," where couples were pressured to marry, before and after 1968. All the variables change in the expected way. Abortions, use of the pill, and early intercourse are all higher after the early 1970s, and shotgun marriages are lower, but only for whites.

Compared to panel data, it is rather difficult to disentangle different factors using time-series data alone. Fortunately, state level data are available by year on the rate of out-of-wedlock births and as we have discussed there is a clear difference over time and across states in abortion rates. On the other hand, state level measures of the availability and use of contraceptives are less obvious, though we hope that year fixed effects combined with data on demographics and income will proxy for these differences.

With a few exceptions, we estimated Poisson regressions that account for the same factors that we used in the earlier regressions.[41] The three differences are: excluding the deterrence variables, including a variable for the number of births, and excluding the age fixed effects. Deterrence variables and age fixed effects are no longer relevant to explaining out-of-wedlock births.

The results in Table 8 provide some inconsistent support for the Akerlof et. al. hypothesis, though the effect represents just a tiny fraction of a percentage point. In column 1, each one thousand more abortions is associated with a .6 percent increase in out-of-wedlock births. With about 1.6 million abortions taking place a year from around 1980 on that implies about 9,600 more out-of-wedlock births annually. The linear estimates for abortion implied that legalization resulted in around 700 more murders annually in 1998, about 4 percent of a year's worth of out-of-wedlock births. Obviously the effective rate of murderers is much lower as these people may commit multiple murders over many different years. If the higher estimates of around a thousand more murders per year arising from abortion are true, this figure represents around 11 percent of the annual number of out-of-wedlock births and this number only appears plausible if a small number of these people are responsible for a large number of murders over multiple years. The other estimates in the second and third columns indicate similarly small though inconsistent effects. They imply that it is not the legalization of abortion per se that is associated with more out-of-wedlock births but that those states which had the biggest increase in abortion which are some how different than other states. While higher unemployment, poverty, and income are associated with more out-of-wedlock births, one surprising result is that when controlling for other factors more densely populated states have slightly fewer out-of-wedlock births.

Other possible explanations for why abortions increase crime (e.g., the legalization of abortion leading to a coarsening of society) are beyond the scope of this paper, though the results in this section raise questions about exactly how abortion increases crime.

IX. Conclusion

[41] Recent interesting work by Klick and Stratmann (2003) indicates that sexually activity increased dramatically after legalized abortion, though they use weighted least squares.

There are many factors that reduce murder rates, but the legalization of abortion is not one of them. Of the over six thousand regressions that we estimated here, only one regression implied even a small reduction in murder rate. All the other estimates implied significant increases in murder rates: allowing abortions after 1973 would increase the number of murders by at least 850 in 1998. Donohue and Levitt suggest that abortion reduces annual victimization costs by $30 billion, with most of this coming from reductions in murder. Our results indicate that total annual victimization costs rose by at least $3.2 billion as a result of abortion.

Many times academics can not avoid using aggregate crime data. Yet, the linking of abortion and crime is not such a situation: examining total crime rates and not directly linking abortions and the crimes committed by individual cohorts missed catching obvious patterns. Yet, even if Donohue and Levitt believe that the correct approach is to link crimes committed by all ages with their aggregate "effective abortion rate," sensible minor adjustments such as allowing the share of crime committed by different ages to vary across states and years rather than assuming that the weights are constant reverses the sign on their estimates.

This is not to suggest that the hypothesis provided by Bouza-Morgentaler-Donohue-Levitt is not plausible, but at least that it is not the most important part of the story. Abortion can eliminate unwanted children and can benefit many women, but it can also make other women who are unable to bring themselves to have an abortion worse-off and more likely to have out-of-wedlock births. Like many laws there appear to both winners and losers, and here the affect appears to be a net reduction in human capital.

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Figure 1: Timing of Changes in Murder Rates for Different Age Cohorts Using Data for the Entire United States

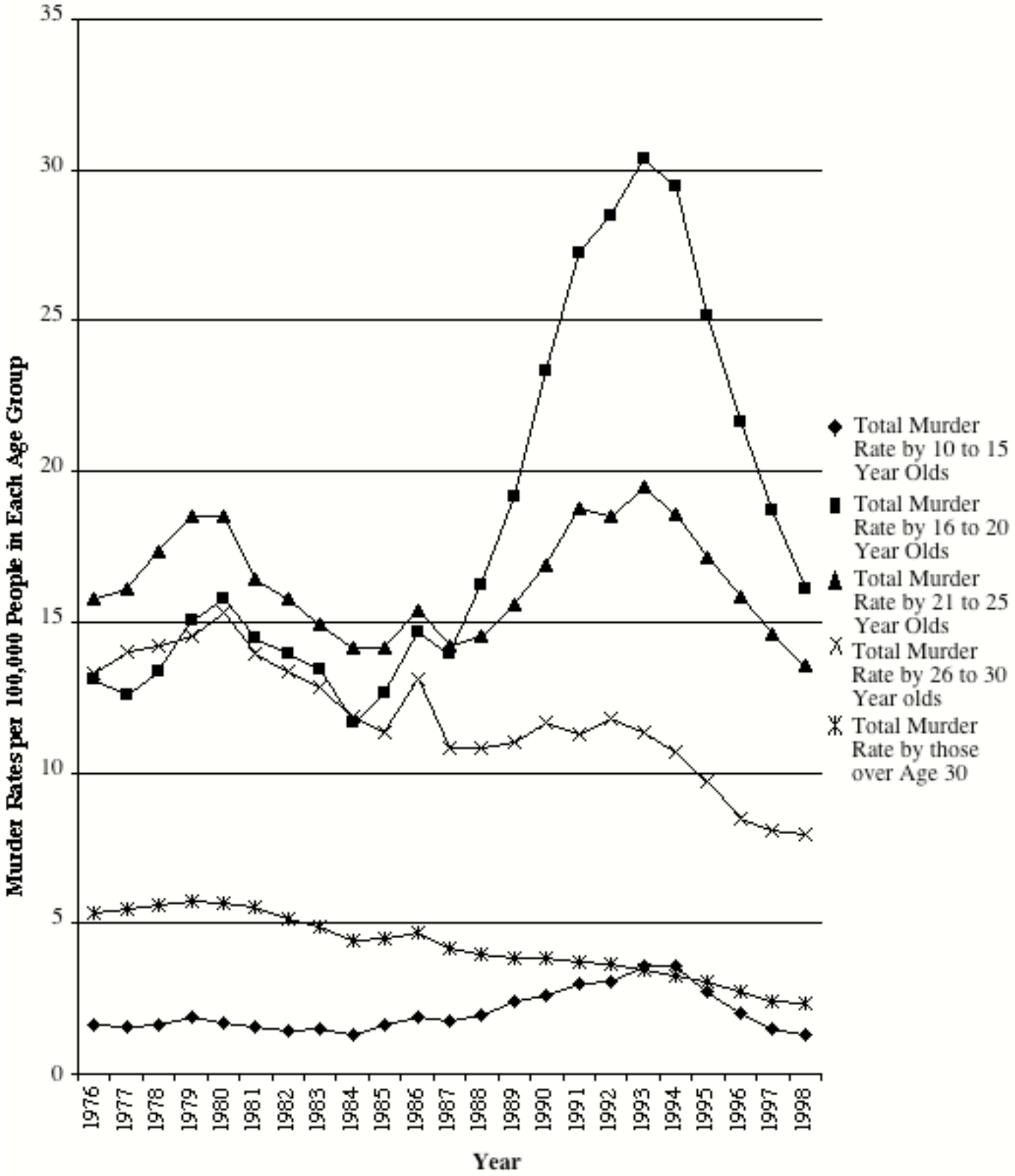
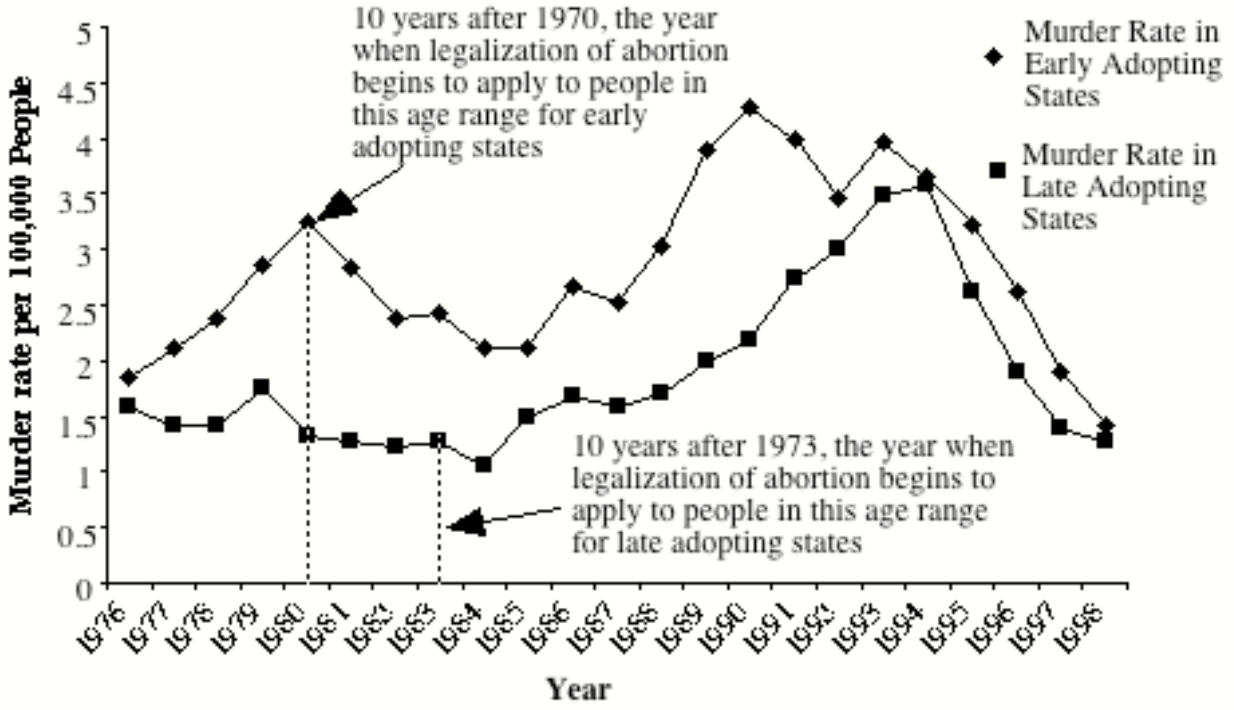
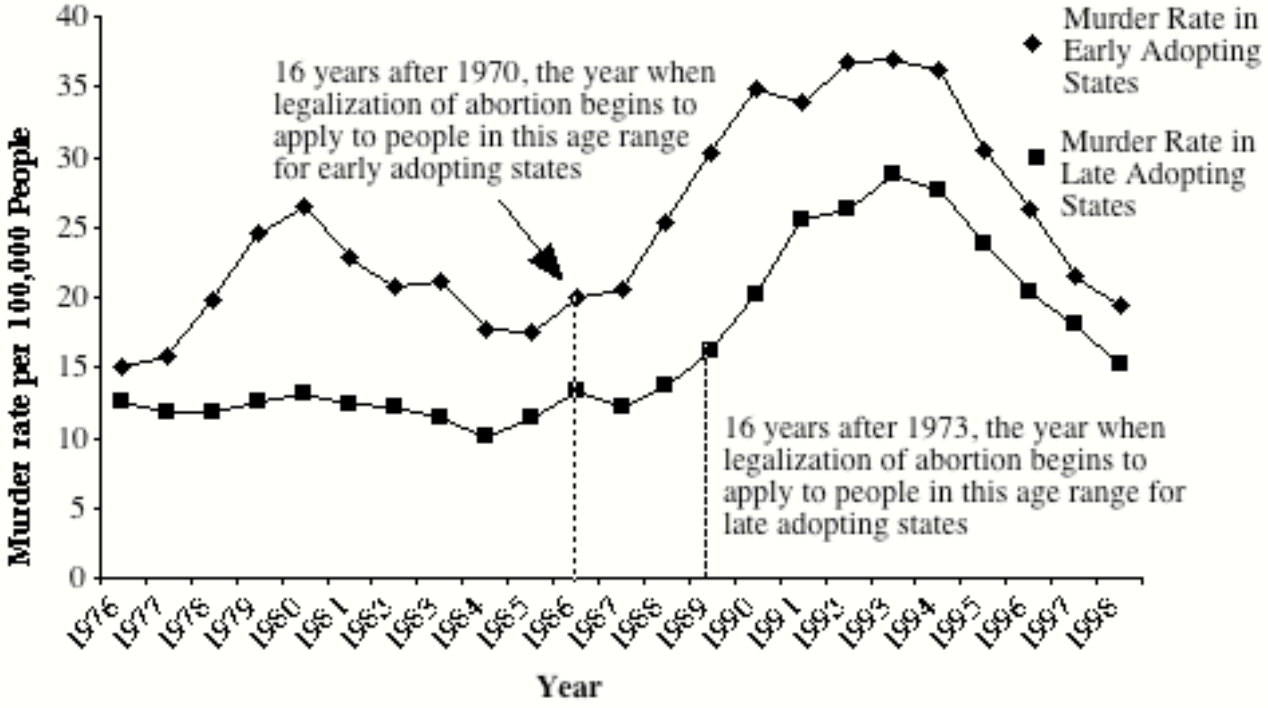


Figure 2: Comparing "Early" versus "Late" Legalizing States

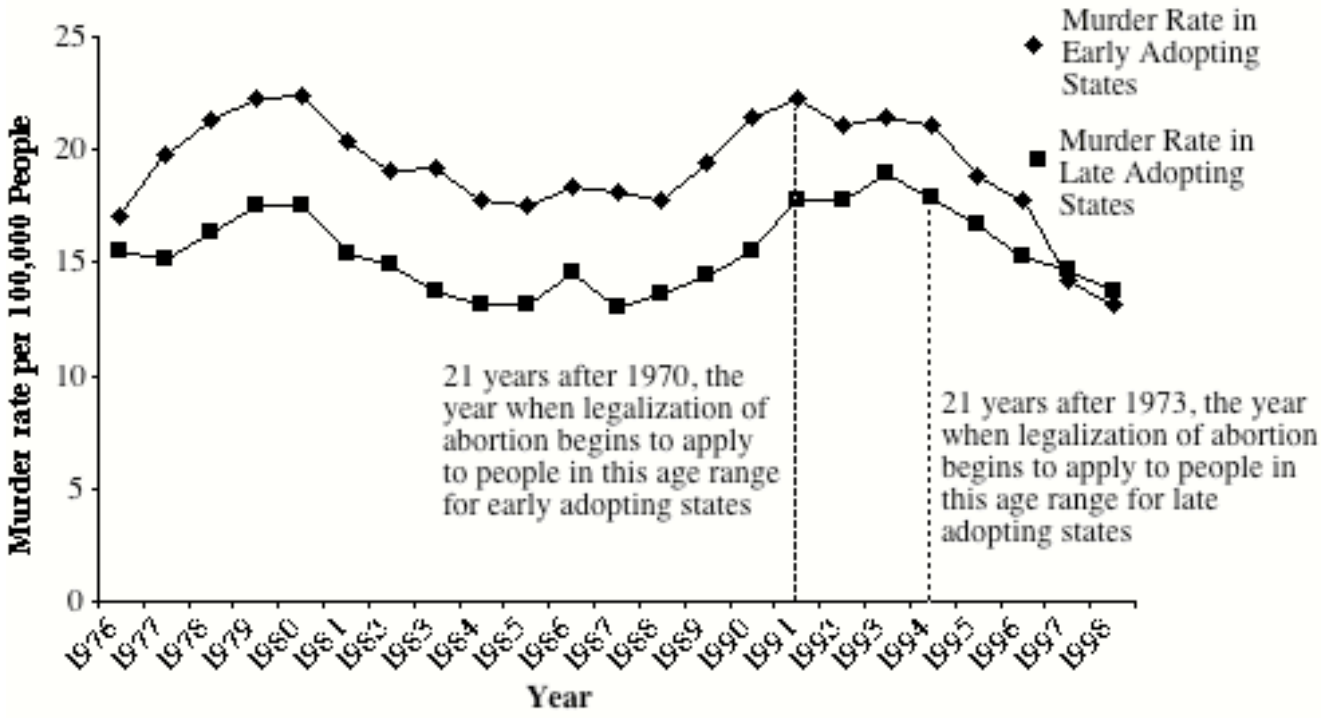
A) Timing of Changes in Murder Rates for Murderers Who are 10 to 15 Year Old



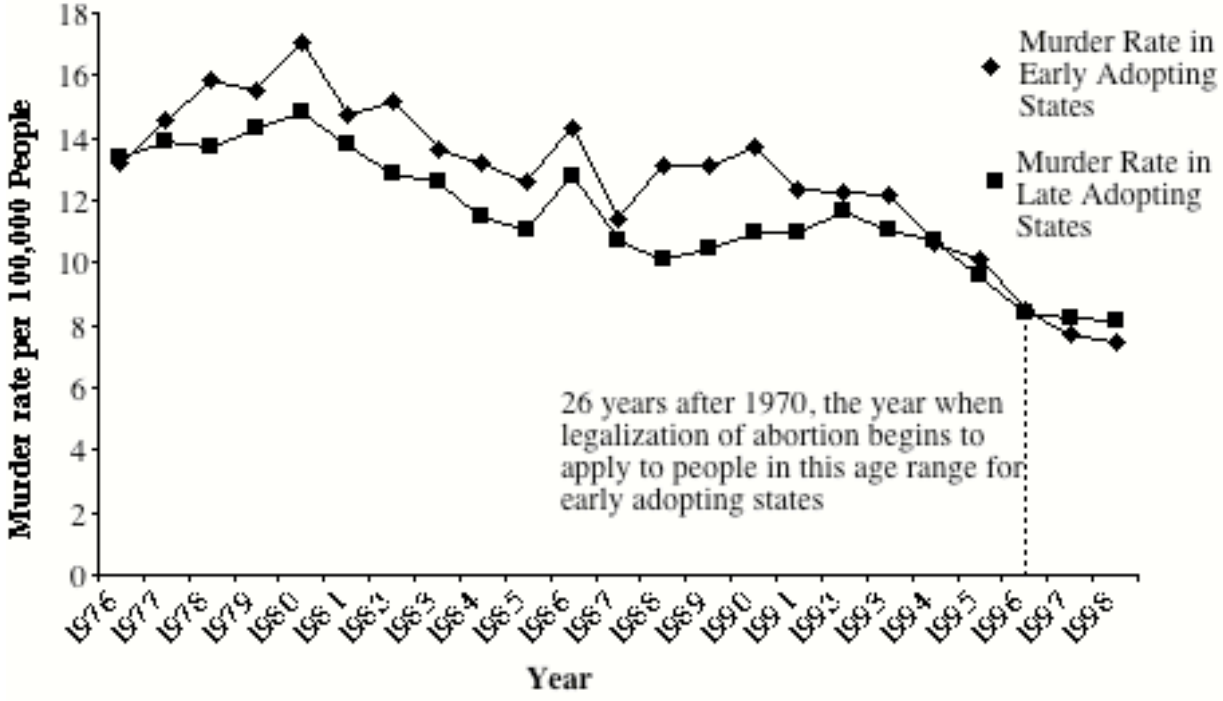
B) Timing of Changes in Murder Rates for Murderers Who are 16 to 20 Year Olds



C) Timing of Changes in Murder Rates for Murderer who are 21 to 25 Year Olds



D) Timing of Change in Murder Rates for Murderers Who are 26 to 30 Year Olds



E) Timing of Changes in Murder Rates for Murderers Whose Ages are Unknown

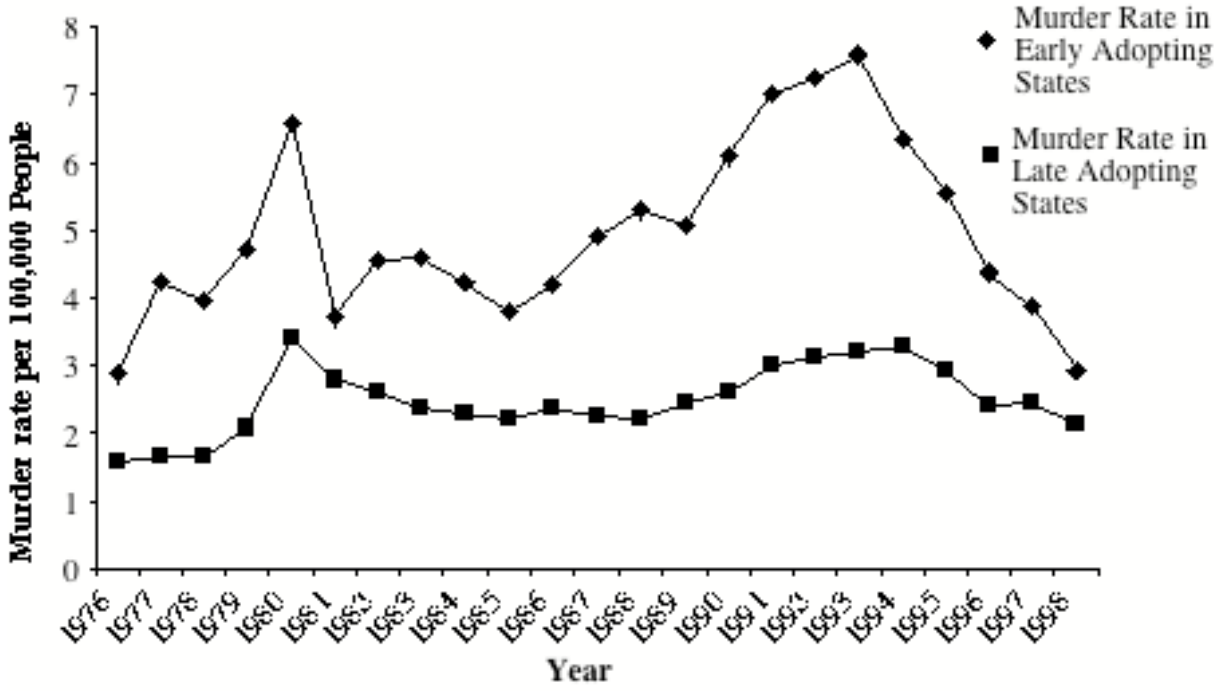
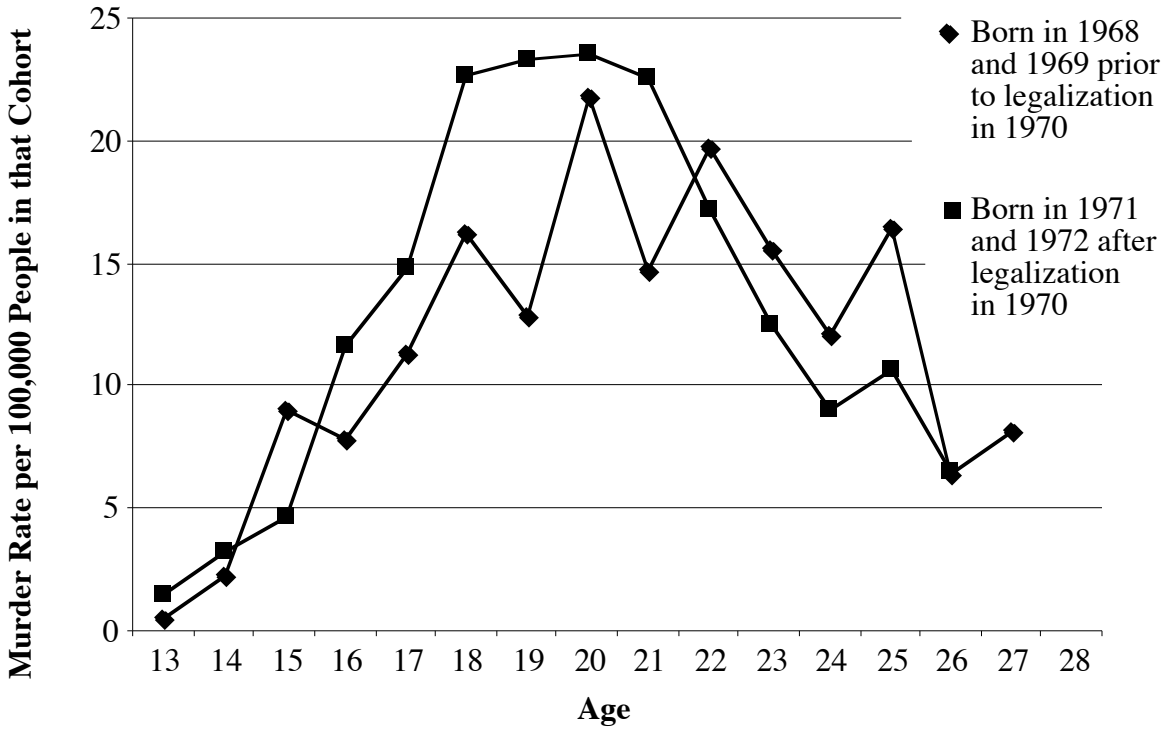


Figure 3: Tracing Cohorts Over Time

A) Following Cohort Murder Rates for Those Born Immediately Before and After the Legalization of Abortion -- States that Legalized Abortion in 1970



B) Following Cohort Murder Rates for Those Born Immediately Before and After the Legalization of Abortion -- 45 States and the District of Columbia that Legalized Abortion in January 1973

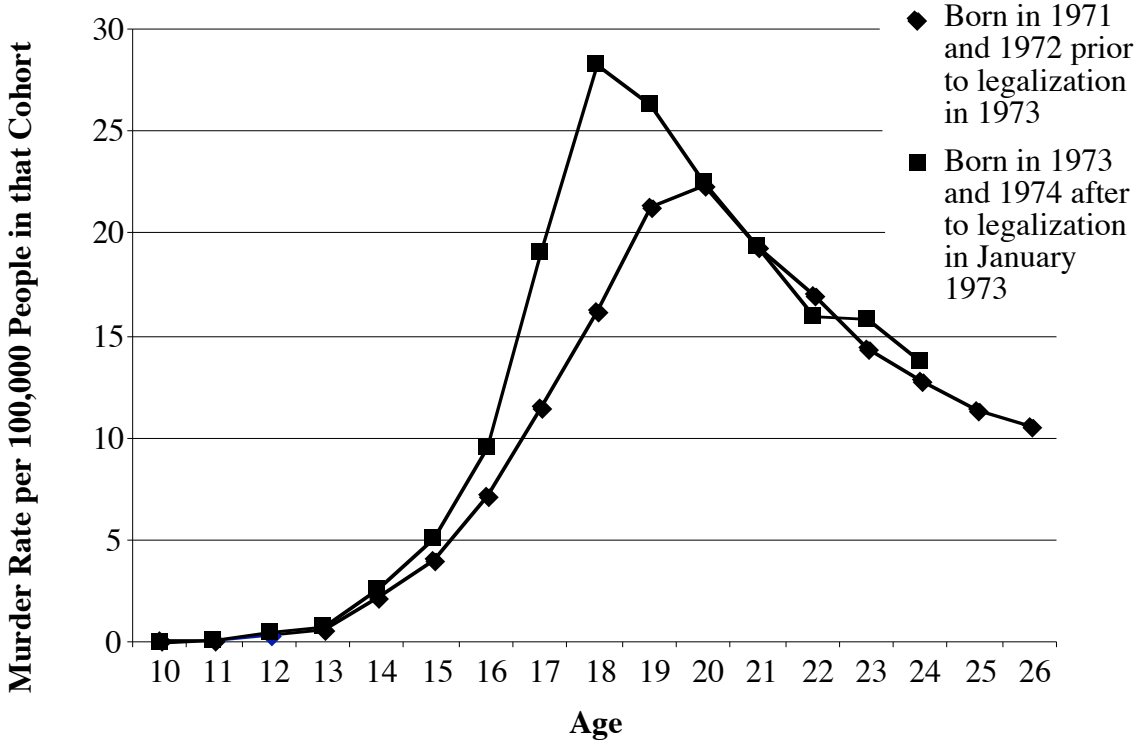


Figure 4: Comparing the Change in Murder Rates by Men and Women

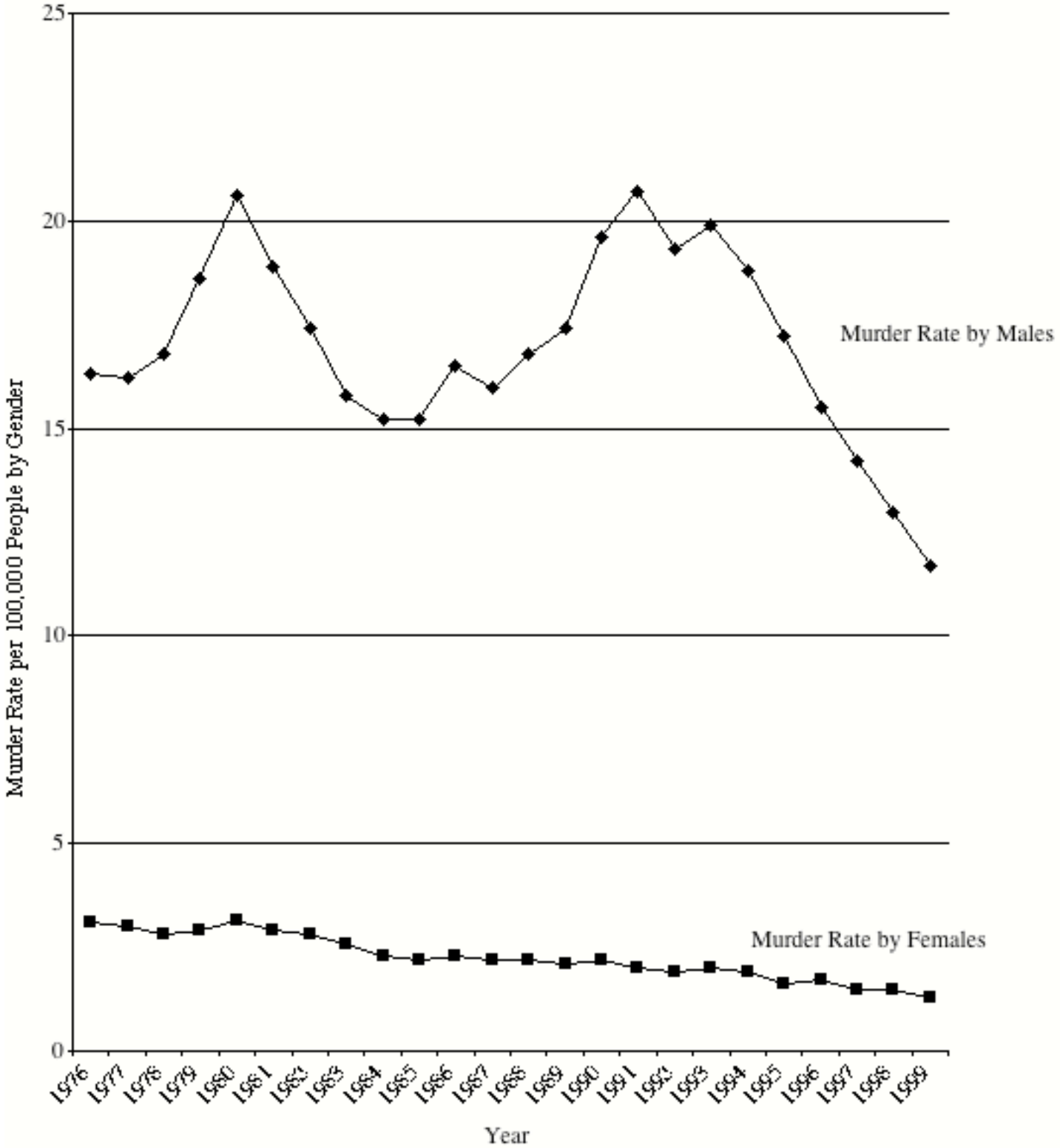
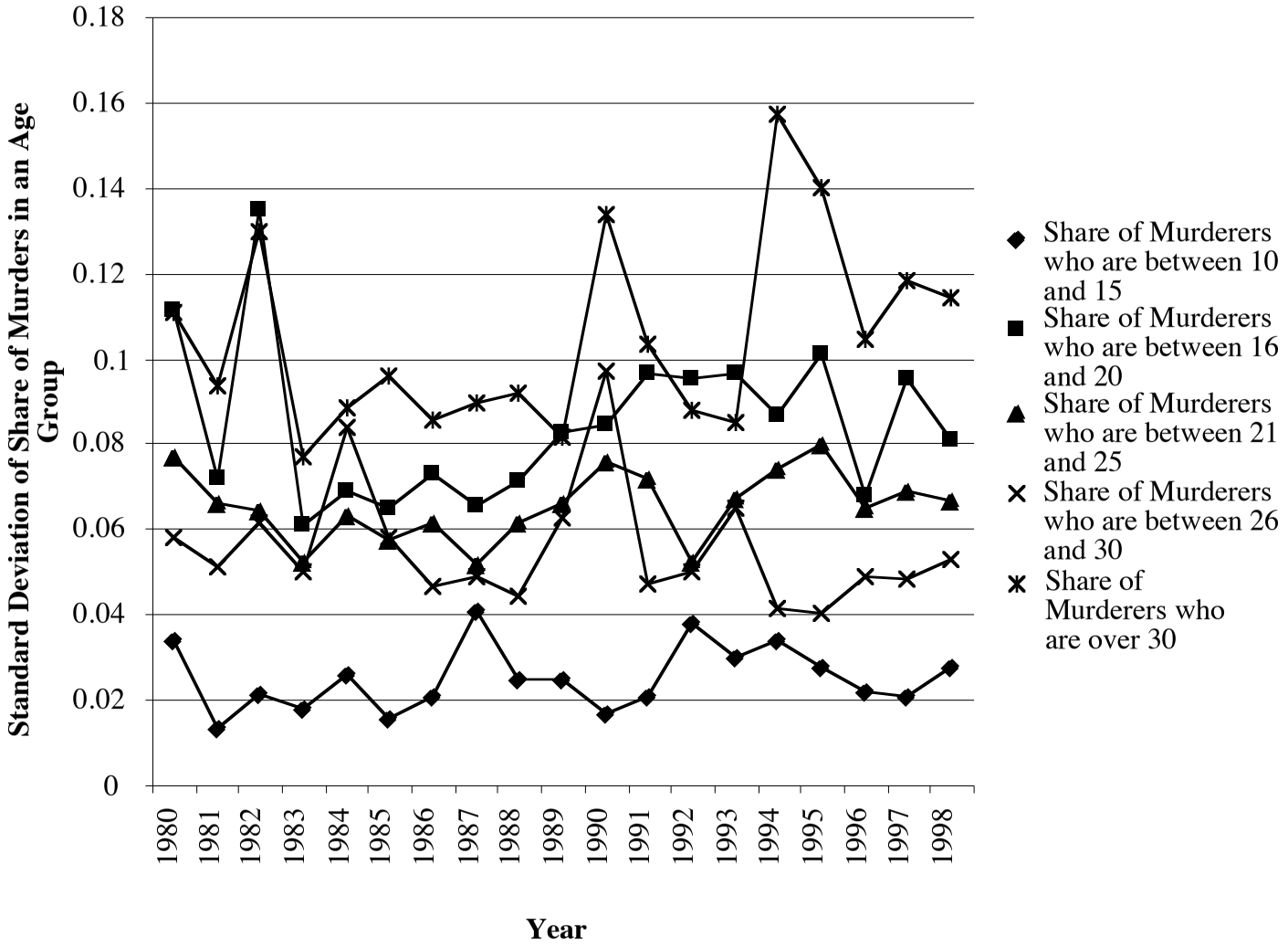
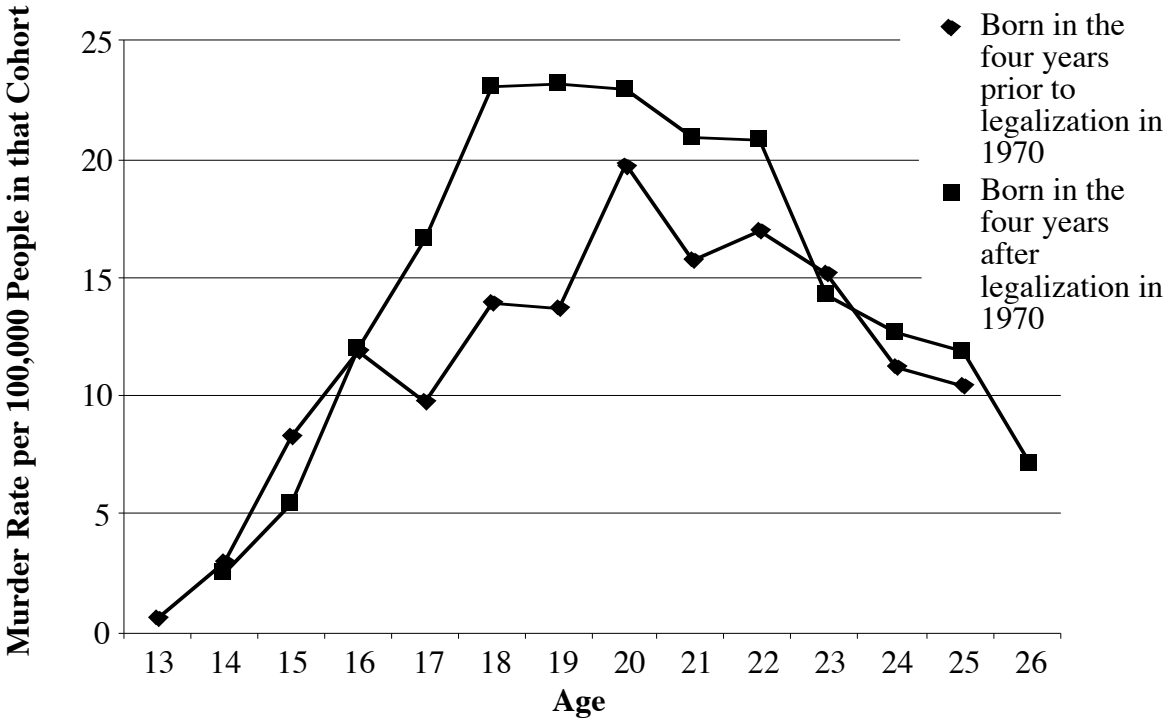


Figure 5: Standard Deviation of the Share of Murderers who are in Different Age Groups Across States Over Time

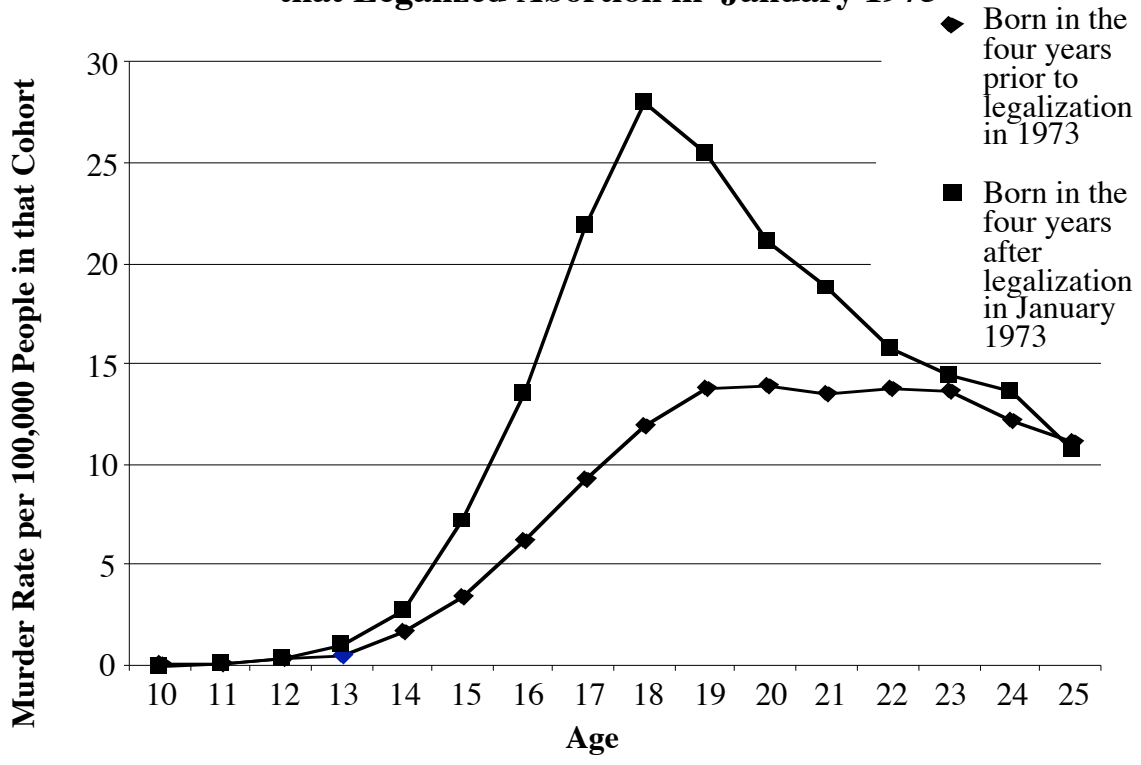


Appendix Figure A1: Tracing Cohorts Over Time By Using a Four Year Period on Either Side of the Legalization of Abortion

A) Following Cohort Murder Rates for Those Born Immediately Before and After the Legalization of Abortion -- States that Legalized Abortion in 1970



B) Following Cohort Murder Rates for Those Born Immediately Before and After the Legalization of Abortion -- 45 States and the District of Columbia that Legalized Abortion in January 1973



Appendix Figure A2:
The Distribution of Observations

Table 1: Comparing Abortion Rates for States Where Abortions were "Legal" (in bold) Versus Those where Abortions Could be Done When the Life or Health of the Mother is Endanger

1969		1970		1971		1972	
State	Number of abortions per 1,000 live births	State	Number of abortions per 1,000 live births	State	Number of abortions per 1,000 live births	State	Number of abortions per 1,000 live births
California	**35**	**Alaska**	**120**	Alabama	7	Alabama	19
Colorado	25	**California**	**172**	**Alaska**	**160**	**Alaska**	**169**
Georgia	2	Colorado	53	Arizona	20	Arizona	7
Maryland	31	D.C.	268	Arkansas	18	Arkansas	24
		Delaware	55	**California**	**344**	**California**	**420**
		Georgia	7	Colorado	101	Colorado	136
		Hawaii	**204**	Connecticut	16	Connecticut	66
		Maryland	101	D.C.	703	D.C.	1801
		New Mexico	73	Delaware	114	Delaware	151
		New York	**534**	Georgia	17	Florida	42
		North Carolina	13	**Hawaii**	**261**	Georgia	29
		Oregon	199	Kansas	277	**Hawaii**	**295**
		South Carolina	8	Maryland	145	Kansas	369
		Virginia	14	Massachusetts	33	Maryland	178
		Washington	**83**	Mississippi	2	Massachusetts	41
				New Mexico	219	Mississippi	1
				New York	**927**	Nebraska	34
				North Carolina	46	New Mexico	291
				Oregon	206	**New York**	**1183**
				Pennsylvania	36	North Carolina	94
				South Carolina	14	Oregon	228
				Vermont	1	Pennsylvania	52
				Virginia	46	South Carolina	17
				Washington	**265**	Tennessee	0
				Wisconsin	65	Vermont	32
						Virginia	60
						Washington	**377**
						Wisconsin	116

Table 2: Re-constructing Donohue and Levitt's "Effective Abortion Rate" for Murder Over the Period from 1985 to 1997 (Sample limited to period examined by Donohue and Levitt. The Regressions are Weighted Least Squares using state and year panel data. Control variables correspond to Columns 5 and 6 in Donohue and Levitt's Table 4.)

	Different Measures of "Effective Abortion Rate": Using National Average Weights for 1985 or State and Year Specific Weights Assuming that No Abortions Occurred when not defined as "Legal" by Donohue and Levitt or Using CDC Abortion Data for All Years	Using the Natural Log of the UCR Murder Rate Data as employed by Donohue and Levitt (1)	Using the Natural Log of the Supplemental Homicide Report Measure of Murder Offender Rate (2)
A) Results correspond to Donohue and Levitt's Table 4, column 5			
1	Replicating the estimate that Donohue and Levitt report using the Effective Abortion Rate supplied by them	-0.108 (3.000)	-0.135 (3.4615)
2	Effective Abortion Rate with 1985 national average weights using ages 9 to 28 with zeros for all state/years where abortion on demand was not legal	-0.055 (1.5714)	-0.074 (1.8500)
3	Effective Abortion Rate with 1985 national average weights using ages 9 to 28 and all abortion data	-0.042 (1.2353)	-0.065 (1.7105)
4	Effective Abortion Rate with state and year specific weights using all abortion data	0.003 (0.2143)	0.005 (0.2941)
B) Results correspond to Donohue and Levitt's Table 4, column 6			
5	Replicating the estimate that Donohue and Levitt report using the Effective Abortion Rate supplied by them	-0.121 (2.5745)	-0.126 (2.3774)
6	Effective Abortion Rate with 1985 national average weights using ages 9 to 28 with zeros for all state/years where abortion on demand was not legal	-0.038 (0.9744)	-0.039 (0.8478)
7	Effective Abortion Rate with 1985 national average weights using ages 9 to 28 and all abortion data	-0.023 (0.6216)	-0.031 (0.7381)
8	Effective Abortion Rate with state and year specific weights using all abortion data	0.023 (1.5333)	0.03 (1.5789)

Table 3: Relationship between Abortion and Murders Using Poisson Regressions (Coefficients for the Poisson estimates are Incident Rate Ratios, with absolute z-statistics reported in parentheses. Values of the coefficients greater than one show the percent increase in crime, while values less than one indicate the percent decline. The demographics and fixed age, state, and year effects are not reported. Robust standard errors with clustering are reported and a population-averaged estimator is used.)

	Number of murderers by age by state by year					
Variable	1	2	3	4	5	6
Abortions per 1,000 females 15-45	1.0083	1.0090	1.0091	1.0090		
	(4.02)	(3.64)	(3.63)	(3.65)		
Dummy Variable for whether abortions are legal in a state					1.0718	
					(2.82)	
ln(Abortions per 1,000 females 15-45)						1.05053
						(14.71)
Population in state that is the age of the murders		1	1	1	1	
		(-4.93)	(-4.94)	(-5.20)	(-9.48)	
ln(Population in state that is the age of the murders)						1.49623
						(3.06)
Population density per square mile in state		.99974	.999798	.9997081	1.00047	
		(-.28)	(-.22)	(-.32)	(0.85)	
ln(Population density in state)						1.1955
						(4.31)
Number of people in prison		.999995		.9999947	.999995	
		(-3.73)		(-4.12)	(-5.87)	
Number of people in prison lagged one year			.999994			
			(-3.94)			
ln(Number of people in prison)						.877923
						(-1.20)
Execution rate		.0533	.055903	.0530947	.4154	.068682
		(-1.49)	(-1.53)	(-1.48)	(-0.59)	(-1.36)
Arrest rate for Murder		1.00016			.9998	1.00021
		(.72)			(-0.85)	(.93)
Arrest rate for Murder lagged one year			1.000092			
			(.60)			
Arrest rate for Violent Crime				1.000245		
				(1.03)		
Unemployment rate		.976300	.9780302	.9742942	.9904	.989471
		(-1.69)	(-1.59)	(-1.75)	(-0.78)	(-.71)
Poverty rate		1.00171	1.001991	1.001451	.99975	1.00312
		(.33)	(.38)	(.27)	(-0.04)	(.62)
Per Capita Income		1.00002	1.000012	1.000019	1.00006	1.00002
		(.56)	(.42)	(.67)	(1.90)	(.70)
Per Capita Income Maintenance		.999402	.9992687	.9994516	.9991	.999061
		(-.66)	(-.80)	(-.71)	(-0.90)	(-.98)
Per Capita Unemployment Insurance Payments		1.00075	1.000572	1.000857	1.0006	1.00081
		(.91)	(.70)	(.97)	(0.84)	(.92)
Per Capita Retirement Payments for those over age 65		.999568	.9995262	.9995706	.9998	.999718
		(-3.04)	(-3.48)	(-3.05)	(-2.01)	(-1.97)
Percent annual rate of change in murders after Right-to-carry law - annual rate of change in murders before Right-to-carry law (F-statistic in parentheses)		-.01489	-.017807	-2.4	-1.9	-.01056
		(-2.41)	(-2.64)	(3.41)	(-4.37)	(-1.47)
Chi-Square	1.97e+10	524527	1649367	1641310	2911502	51348
Number of observations	21680	21404	21335	21243	21,480	21404
Same as above but using abortions per 1,000 live births						
	7	8	9	10		11
Specifications correspond to those above but instead use abortions per 1,000 Live Births as the endogenous variable (specification 11 is the ln(abortions per 1,000 Live Births)	1.0005	1.00056	1.00057	1.00056	Same as	1.063
	(2.99)	(3.54)	(3.54)	(3.55)	column 5	(13.64)

Table 4: Sensitivity of Abortion Coefficients for the Poisson Estimates Using the Alternative Specifications Used by Donohue and Levitt (Only Incident Rate Ratios for abortion effects shown.)

Specification	Abortions per 1,000 females 15-45	Abortions per 1,000 Live Births
1) Linear value	(Corresponding to Specification 2 in Table 3)	(Corresponding to Specification 8 in Table 3)
Baseline	1.0090 (3.64)	1.00056 (3.54)
Exclude New York	1.0101 (3.18)	1.00064 (3.21)
Exclude California	1.0091 (3.54)	1.00056 (3.47)
Exclude District of Columbia	1.0173 (4.14)	1.0011 (4.09)
Exclude New York, California, District of Columbia	1.0255 (11.35)	1.0015 (11.56)
Adjust abortion rate for nonresidents	1.0091 (3.67)	1.00053 (3.44)
Include control for flow of immigrants	1.0084 (3.33)	1.00056 (3.52)
Include state-specific trends	1.0095 (3.49)	1.000598 (3.42)
include region-year interactions	1.0089 (3.67)	1.000558 (3.50)
Include control for overall fertility	1.0037 (4.48)	1.00014 (4.30)
Limiting sample to only those ages affected by abortion (eliminating observations for those over 29 and of unknown age)	1.0093 (3.45)	1.00057 (3.34)
Allowing for state specific year fixed effects in addition to the number of abortions and the age specific population	1.01095 (4.44)	1.00077 (4.39)
2) Natural logs	(Corresponding to Specification 6 in Table 3)	(Corresponding to Specification 11 in Table 3)
Baseline	1.0505 (14.71)	1.063 (13.64)
Exclude New York	1.0520 (15.39)	1.0650 (14.51)
Exclude California	1.0512 (14.68)	1.0638 (13.62)
Exclude District of Columbia	1.0499 (14.61)	1.064 (14.07)
Exclude New York, California, District of Columbia	1.0520 (15.22)	1.0674 (14.83)
Adjust abortion rate for nonresidents	1.0490 (14.30)	1.0589 (12.78)
Include control for flow of immigrants	1.0506 (14.73)	1.0630 (13.68)
Include state-specific trends	1.0500 (14.91)	1.0626 (13.87)
include region-year interactions	1.0499 (14.30)	1.0623 (13.42)
Include control for overall fertility	1.0088 (1.90)	1.0099 (1.67)
Limiting sample to only those ages affected by abortion (eliminating observations for those over 29 and of unknown age)	1.0485 (14.73)	1.0603 (14.02)
Allowing for state specific year fixed effects in addition to the number of abortions and the age specific population	1.0457 (13.42)	1.0575 (12.48)
3) Dummy variable for legalizing abortion (Corresponding to Specification 5 in Table 3)		
Baseline	1.0718 (2.82)	
Exclude New York	1.0701 (2.70)	
Exclude California	1.0621 (2.45)	
Exclude District of Columbia	1.0711 (2.78)	
Exclude New York, California, District of Columbia	1.0594 (2.35)	
Adjust abortion rate for nonresidents	1.1011 (3.43)	
Include control for flow of immigrants	1.0717 (2.81)	
Include state-specific trends	1.0997 (3.90)	
include region-year interactions	1.0706 (2.82)	
Include control for overall fertility	1.0452 (1.84)	
Limiting sample to only those ages affected by abortion (eliminating observations for those over 29 and of unknown age)	1.0541 (2.21)	
Allowing for state specific year fixed effects in addition to the ln(number of abortions) and the ln(age specific population)	1.0690 (2.77)	

Table 5: Range of Coefficient Estimates for the number of abortions by in-state residents (/1000) for Different Linear Combinations of the Control Variables (Coefficients are Incident Rate Ratios. Only the range of values for the abortion variable are reported.)

	Incident Rate Ratio Coefficient Range	
	Abortions per 1,000 females 15-45	Abortions per 1,000 Live Births
1) Linear value	(Corresponds to Specification 2 in Table 3)	(Corresponds to Specification 8 in Table 3)
High	1.00966	1.000627
Median	1.0082	1.000533
Low	1.00732	1.000472
2) Natural logs of Abortion Rate and population variables		
	(Corresponds to Specification 6 in Table 3)	(Corresponds to Specification 11 in Table 3)
High	1.0510	1.0623
Median	1.0458	1.0575
Low	1.0421	1.0560
3) Dummy variable for legalizing abortion (Corresponds to Specification 5 in Table 3)		
High	1.087	
Median	1.074	
Low	1.069	

Table 6: Breaking Down the Impact of Abortion by the Age of the Criminal (Using Poisson regressions and only reporting the interactions for those age groups that are young enough to be effected by the legalization of abortion. All coefficients are Incident Rate Ratios. The specifications correspond to columns 2, 5, and 6 in Table 3, though the other variables are not reported here. Robust standard errors with clustering are reported and a population-averaged estimator is used.)

	Abortions per 1,000 females 15-45 Interacted with Age Dummies (Specification 2 in Table 3) (1)	Abortions per 1,000 live births Interacted with Age Dummies (Specification 8 in Table 3) (2)	Legalization of Abortion Dummy Interacted with Age Dummies (Specification 5 in Table 3) (3)	Natural Log of Abortions per 1,000 females 15-45 Interacted with Age Dummies (Specification 6 in Table 3) (4)	Natural Log of Abortions per 1,000 live births Interacted with Age Dummies (Specification 11 in Table 3) (5)
Age 10	0.996	1.00002	0.9717	0.926	0.957
	(0.28)	(0.03)	(0.13)	(1.56)	(0.96)
Age 11	0.995	0.9997	1.1070	0.984	1.0139
	(0.66)	(0.77)	(0.58)	(0.47)	(0.53)
Age 12	1.002	0.9999	1.3706	1.007	1.0124
	(0.51)	(0.21)	(2.59)	(0.25)	(0.59)
Age 13	1.005	1.0003	1.3982	1.053	1.075
	(1.16)	(0.83)	(4.12)	(3.47)	(5.06)
Age 14	1.011	1.0007	1.4569	1.069	1.0904
	(2.82)	(2.75)	(5.47)	(6.3)	(8.04)
Age 15	1.012	1.0007	1.3500	1.072	1.0908
	(2.78)	(2.87)	(4.77)	(6.61)	(8.75)
Age 16	1.012	1.0008	1.2090	1.075	1.0942
	(3.05)	(3.27)	(2.69)	(8.19)	(13.18)
Age 17	1.011	1.0007	1.0709	1.069	1.0877
	(2.99)	(2.92)	(1.15)	(8.37)	(15.22)
Age 18	1.011	1.0007	0.9558	1.066	1.0817
	(2.78)	(2.85)	(0.71)	(8.64)	(13.59)
Age 19	1.009	1.0006	0.9102	1.053	1.0623
	(2.68)	(2.61)	(3.1)	(8.25)	(11.08)
Age 20	1.009	1.0006	0.9094	1.045	1.0521
	(3.34)	(3.39)	(2.69)	(7.31)	(9.41)
Age 21	1.002	1.0001	0.9599	1.027	1.0343
	(0.81)	(0.69)	(1.7)	(6.05)	(6.48)
Age 22	1.0008	1.00006	1.0159	1.0204	1.0164
	(0.34)	(0.39)	(0.51)	(4.41)	(2.82)
Age 23	0.997	0.9998	1.1064	1.0123	1.0008
	(1.69)	(1.6)	(4)	(2.91)	(0.11)
Age 24	0.997	0.9998	1.1934	1.009	1.0056
	(2.57)	(2.64)	(5.32)	(2.37)	(0.85)
Age 25	0.998	0.9999	1.2162	1.002	0.9979
	(1.67)	(1.56)	(4.03)	(0.51)	(0.29)
Age 26	0.998	0.9999	1.1428	1.0014	0.985
	(0.83)	(0.79)	(3.65)	(0.31)	(1.78)
Age 27	0.997	0.9998	1.2491	0.996	0.9795
	(0.56)	(0.51)	(3.35)	(0.51)	(1.72)
Age 28	0.982	0.9986	1.265	1.004	0.965
	(4.5)	(3.73)	(2.81)	(0.28)	(1.95)
Age 29	Dropped	0.9926	0.9717	0.495	0.912
		(2.47)	(0.13)	(33.16)	(2.34)

Table 7: Examining the Relationship Between Abortion and Arrest Rates (Using Arrest Rate Data from 1985 to 1996 for 15 to 24 Year Olds by Age by State by Year. Robust standard errors with clustering are reported and a population-averaged estimator is used.)

Specification	Abortion rate per 1,000 females aged 15-45	Abortion rate per 1,000 Live Births
1) Arrests for Violent Crime		
Number of Arrests by Age on the Abortion rate, Poisson Regressions with incident rate ratio, corresponding to columns 2 and 8 Table 3 Fixed Effects for Age, State, and Year	1.00035 (0.33)	1.00004 (0.57)
Number of Arrests by Age on the Natural Log Abortion rate, Poisson Regressions with incident rate ratio, corresponding to columns 6 and 11 Table 3 Fixed Effects for Age, State, and Year	.9998 (0.06)	1.00046 (0.11)
Natural log of Arrests by Age on the Abortion rate per 1,000 females aged 15-45 Weighted OLS with the other control variables used in columns 2 and 8 Table 3 Fixed Effects for Age, State, and Year to correspond to Donohue and Levitt's Table 7 Column 1	.00023 (8.85)	.00023 (8.85)
2) Arrests for Murder		
Number of Arrests by Age on the Abortion rate, Poisson Regressions with incident rate ratio, corresponding to columns 2 and 8 Table 3 Fixed Effects for Age, State, and Year	1.0024 (2.66)	1.00016 (2.67)
Number of Arrests by Age on the Natural Log Abortion rate, Poisson Regressions with incident rate ratio, corresponding to columns 6 and 11 Table 3 Fixed Effects for Age, State, and Year	1.0111 (2.06)	1.0141 (1.96)
Natural log of Arrests by Age on the Abortion rate per 1,000 females aged 15-45 Weighted OLS with the other control variables used in columns 2 and 8 Table 3 Fixed Effects for Age, State, and Year -- Corresponding regressions are not reported in Donohue and Levitt's paper	1.0116 (2.15)	.00042 (9.28)
3) Arrests for Property Crime		
Number of Arrests by Age on the Abortion rate, Poisson Regressions with incident rate ratio, corresponding to columns 2 and 8 Table 3 Fixed Effects for Age, State, and Year	Estimates diverging	
Number of Arrests by Age on the Natural Log Abortion rate, Poisson Regressions with incident rate ratio, corresponding to columns 6 and 11 Table 3 Fixed Effects for Age, State, and Year	Estimates diverging	
Natural log of Arrests by Age on the Abortion rate per 1,000 females aged 15-45 Weighted OLS with the other control variables used in columns 2 and 8 Table 3 Fixed Effects for Age, State, and Year to correspond to Donohue and Levitt's Table 7 Column 5	-.000054 (1.86)	-.00007 (3.23)

Table 8: The Impact of Abortions on Out-of-Wedlock Births
(Again the coefficients are Incident Rate Ratios. Demographics and fixed state and year effects are not reported. Robust standard errors with clustering are reported and a population-averaged estimator is used.)

Explaining the Number of Out-of-wedlock Births by State by Year

	Coefficients and absolute z-statistics		
Variable	1	2	3
Number of in-state abortions during the year in which people of that age were born /1000	1.006198 (3.27)	. . .	. . .
Dummy Variable for whether abortions are legal in a state	. . .	1.449155 (8.82)	. . .
ln(Number of abortions during the year in which people of that age were born /1000)	. . .	. . .	1.035199 (7.45)
Number of Births	.9999989 (.35)	1.000003 (1.85)	1.000004 (3.93)
Population density in state	..9999487 (.38)	.9998297 (1.28)	.8965998 (2.16)
Unemployment rate	1.015146 (2.66)	1.005642 (1.17)	1.01354 (2.91)
Poverty rate	1.000791 (.0011821)	1.002454 (1.97)	.9999112 (.07)
Per Capita Income	1.000017 (1.05)	1.000008 (.62)	1.000027 (1.92)
Per Capita Income Maintanence	1.000245 (.83)	.9998943 (.30)	.9997004 (.80)
Per Capita Unemployment Insurance Payments	.999859 (.59)	.9994682 (1.72)	.9997257 (1.20)
Per Capita Retirement Payments for those over age 65	1.000004 (.19)	.9999284 (2.60)	1.00002 (.57)
Chi-Square	2453649	149e+07	6.90e+07
Number of observations	7640	7640	7640

Appendix 1: Descriptions of the Variables

Variable	Number of Observations	Mean	Std. Dev.	Min	Max
Murders by Age					
Number of abortions by residents during the year in which people of that age were born /1000	24072	4.55687	17.06257	0	208.64
Total abortions during the year in which people of that age were born /1000	26979	6.13072	22.8805	0	334.887
Population by Age	22287	291995.4	1085186	4041	1.76E+07
Trend in Right-to-carry Law Prior to Adoption	24633	-1.701214	3.8879	-18	0
Trend in Right-to-carry Law After Adoption	24633	.22876	.9658	0	8
Execution Rate	25737	.0013425	.0058472	0	.0968
Prison Population	25806	12422.24	18497.47	186	160127
Arrest Rate for Murder	25139	87.44581	52.2373	0	1363.16
Arrest Rate for Violent Crime	25024	39.4515	20.439	0	558.81
Per Capita Income	25806	13205.14	2441.785	8301.76	22452.2
Per Capita Income Maintanence	25806	171.66	67.8494	45.5	484.7
Per Capita Unemployment Insurance Payments	25806	69.385	43.26112	10.73	398.17
Per Capita Retirement Payments for those over age 65	25806	462.8054	677.043	96.94	2668.671
DENSITYM	25806	355.018	1373.6	.7	11154.32
Unemployment rate	25806	6.32335	2.096	2.2	18
Poverty rate	25806	13.4406	4.164	2.9	27.2
Demographics in percentage points					
Black Males between 10 and 19	25806	.9993206	1.06586	0	6.87
Black Females between 10 and 19	25806	.98397	1.08	.02	7.08
White Males between 10 and 19	25806	6.5055	1.55009	.73	10.18
White Females between 10 and 19	25806	6.195	1.514	.699	9.9099
Other Males between 10 and 19	25806	.3772582	0.7256493	0.03	5.9
Other Females between 10 and 19	25806	0.3654634	0.7024143	0.03	5.71
Black Males between 20 and 29	25806	.9303967	.991895	.04	6.57
Black Females between 20 and 29	25806	1.004483	1.167354	.02	7.73
White Males between 20 and 29	25806	6.986535	1.326267	2.48029	10.85
White Females between 20 and 29	25806	6.8376	1.35847	1.89	9.66
Other Males between 20 and 29	25806	.362898	.6799	.03	5.33
Other Females between 20 and 29	25806	.3683684	.68913	.04	5.55
Black Males between 30 and 39	25806	.75191	.8392985	.02	5.28
Black Females between 30 and 39	25806	0.8589242	0.998534	0.01	6.11
White Males between 30 and 39	25806	6.733915	1.1991	2.45	9.88
White Females between 30 and 39	25806	6.680307	1.19537	2.29	9.44
Other Males between 30 and 39	25806	0.3240372	0.66903	0.03	5.44
Other Females between 30 and 39	25806	0.3547771	0.704148	0.03	5.54
Black Males between 40 and 49	25806	0.5181344	0.605498	0.01	4.08
Black Females between 40 and 49	25806	0.6079785	0.7384156	0.01	5.06
White Males between 40 and 49	25806	5.222173	1.18768	1.34	8.579
White Females between 40 and 49	25806	5.231165	1.152778	1.2	8.595
Other Males between 40 and 49	25806	0.2287975	0.528589	0.02	4.97
Other Females between 40 and 49	25806	0.2560106	0.569779	0.02	5.23
Black Males between 50 and 64	25806	0.5162729	0.664975	0.0076	4.79
Black Females between 50 and 64	25806	0.6497512	0.8637465	0.0085	6.1
White Males between 50 and 64	25806	5.759943	1.037858	1.61	8.12
White Females between 50 and 64	25806	6.160109	1.212294	1.4	8.71
Other Males between 50 and 64	25806	0.2104329	0.6049056	0.01	4.71

Other Females between 50 and 64	25806	0.2457903	0.6979353	0.02	5.23
Black Males 65 and older	25806	0.361785	0.488192	0.0053	3.506
Black Females 65 and older	25806	0.5603818	0.804035	0.00513	6.16
White Males 65 and older	25806	4.392195	1.16271	0.9	7.467
White Females 65 and older	25806	6.370538	1.68625	0.92	9.98
Other Males 65 and older	25806	0.1346945	0.4977181	0.01	4.267
Other Females 65 and older	25806	0.1594036	0.547367	0.01	5.339

Appendix 2: The Demographic and Age Dummy Coefficients for Specification 2 in Table 3

Variables	Incident Rate Ratio Coefficient	Standard Error	z-statistic	P>|z|	[95% Conf.	Interval]
Demographics in percentage points						
Black Males between 10 and 19	.7039295	. 6777919	-0.36	0.715	0.106643	4.646488
Black Females between 10 and 19	1.420874	1.284288	0.39	0.698	0.241645	8.354739
White Males between 10 and 19	8.591573	3.908689	4.73	0	3.522275	20.95667
White Females between 10 and 19	0.109982	0.053314	-4.55	0	0.042531	0.284409
Other Males between 10 and 19	3.033142	2.606462	1.29	0.197	0.562901	16.34382
Other Females between 10 and 19	0.574471	0.518523	-0.61	0.539	0.097941	3.369546
Black Males between 20 and 29	0.359204	0.254852	-1.44	0.149	0.089417	1.44298
Black Females between 20 and 29	2.182022	1.606494	1.06	0.289	0.51543	9.237374
White Males between 20 and 29	0.841494	0.213982	-0.68	0.497	0.511211	1.385165
White Females between 20 and 29	1.149379	0.334524	0.48	0.632	0.649715	2.033309
Other Males between 20 and 29	0.6918	0.522761	-0.49	0.626	0.157314	3.042238
Other Females between 20 and 29	0.411409	0.411586	-0.89	0.375	0.057904	2.923078
Black Males between 30 and 39	0.276266	0.30612	-1.16	0.246	0.031488	2.423885
Black Females between 30 and 39	2.186445	2.059069	0.83	0.406	0.345244	13.84686
White Males between 30 and 39	1.033162	0.447171	0.08	0.94	0.442337	2.413147
White Females between 30 and 39	0.924414	0.364494	-0.2	0.842	0.426816	2.002133
Other Males between 30 and 39	4.30278	4.407359	1.42	0.154	0.577909	32.03605
Other Females between 30 and 39	0.906906	0.892193	-0.1	0.921	0.131877	6.236692
Black Males between 40 and 49	0.790844	0.614504	-0.3	0.763	0.17246	3.626554
Black Females between 40 and 49	2.627225	1.781531	1.42	0.154	0.695496	9.924303
White Males between 40 and 49	0.747598	0.345757	-0.63	0.529	0.301992	1.850719
White Females between 40 and 49	1.34159	0.645697	0.61	0.541	0.522328	3.445852
Other Males between 40 and 49	0.412395	0.624628	-0.58	0.559	0.021186	8.027389
Other Females between 40 and 49	3.882929	4.788929	1.1	0.271	0.346217	43.54829
Black Males between 50 and 64	0.648112	0.629053	-0.45	0.655	0.096712	4.34331
Black Females between 50 and 64	0.551601	0.39744	-0.83	0.409	0.13437	2.264374

		9				
White Males between 50 and 64	0.510025	0.22389	-1.53	0.125	0.21574	1.205733
White Females between 50 and 64	1.618379	0.602463	1.29	0.196	0.780206	3.357
Other Males between 50 and 64	2.735995	2.517706	1.09	0.274	0.450636	16.61133
Other Females between 50 and 64	0.263135	0.229194	-1.53	0.125	0.047728	1.450726
Black Males 65 and older	2.418076	1.845292	1.16	0.247	0.541873	10.79052
Black Females 65 and older	0.581049	0.29866	-1.06	0.291	0.212175	1.591226
White Males 65 and older	0.877258	0.388271	-0.3	0.767	0.368458	2.088652
White Females 65 and older	0.855166	0.257934	-0.52	0.604	0.473492	1.544504
Other Males 65 and older	0.193388	0.272568	-1.17	0.244	0.01221	3.062997
Other Females 65 and older	0.767753	0.780438	-0.26	0.795	0.104703	5.629714
Age Dummies						
11 years old	1.92557	0.290932	4.34	0	1.432031	2.589203
12 years old	4.464117	0.534836	12.49	0	3.529839	5.645679
13 years old	12.32579	1.41573	21.87	0	9.841163	15.43771
14 years old	34.09685	4.106916	29.3	0	26.92701	43.17578
15 years old	77.57146	9.521582	35.45	0	60.98463	98.66963
16 years old	135.7298	16.58342	40.19	0	106.8257	172.4546
17 years old	196.3684	23.20976	44.67	0	155.7628	247.5593
18 years old	236.2637	27.2262	47.42	0	188.4983	296.1328
19 years old	244.6778	27.47161	48.99	0	196.3471	304.9051
20 years old	255.1435	27.62245	51.19	0	206.3628	315.4552
21 years old	209.963	22.97167	48.87	0	169.4394	260.1784
22 years old	202.9911	21.7368	49.62	0	164.5615	250.3951
23 years old	192.854	20.7493	48.91	0	156.1879	238.1278
24 years old	178.984	19.54351	47.51	0	144.5009	221.6962
25 years old	191.6337	21.05954	47.82	0	154.5003	237.6919
26 years old	156.5042	17.25396	45.83	0	126.0911	194.2529
27 years old	150.3458	16.12264	46.75	0	121.8459	185.5118
28 years old	144.3426	15.89921	45.14	0	116.3149	179.124
29 years old	133.9339	15.25902	42.99	0	107.1306	167.4431
30 years old	145.6944	15.72729	46.15	0	117.9121	180.0229
Over 30 years old	1998.841	239.1994	63.51	0	1580.942	2527.207
Unknown Age Category	1.69E-24	2.05E-23	-4.5	0	7.48E-35	3.80E-14

Appendix 3: Additional Permutations of Table 3: Using the Supplemental Homicide Reports' method of distributing unknown murderers and excluding murders where the age of the criminal is unknown (Coefficients are Incident Rate Ratios, with absolute z-statistics reported in parentheses. The other variables that were included in the specifications were not reported here.)

Number of murderers by age by state by year

	In Terms of the Variables Accounted for in Each Specification the Columns Correspond to the Columns in Table 3					
Variable	1	2	3	4	5	6
1)) Excluding murders where the age of the criminal is unknown using abortions per 1,000 females 15-45						
Number of abortions rate during the year in which people of that age were born /the number of births	1.0090 (2.50)	1.0096 (3.61)	1.0096 (3.35)	1.0097 (3.33)		
Dummy Variable for whether abortions are legal in a state					1.078641 (3.40)	
ln(Number of abortions rate during the year in which people of that age were born /the number of births)						1.0474 (8.92)
2) Excluding murders where the age of the criminal is unknown using abortions per 1,000 live births						
Number of abortions during the year in which people of that age were born /1000	1.00057 (2.38)	1.00063 (3.29)	1.00063 (3.30)	1.00064 (3.28)		
Dummy Variable for whether abortions are legal in a state					1.078641 (3.40)	
ln(Number of abortions during the year in which people of that age were born /1000)						1.0602 (8.35)

Appendix 4: Using the Specifications in Table 3 to Examine the use of Weighted Least Squares and the Murder Rate (The numbered specifications correspond to those in Table 3. Absolute t-statistics are shown in parentheses. All the other variables used in estimating Table 3 that were included in the specifications, but were not reported here.)

	Murderers per million people by age by state by year					
Variable (Only abortion variables are reported, but the other variables correspond to the regressions shown in specifications 1 through 6.)	1	2	3	4	5	6
Number of abortions rate during the year in which people of that age were born /the number of births	1.0334 (3.04)	1.3899 (3.87)	1.398 (3.88)	1.443 (4.03)		
Dummy Variable for whether abortions are legal in a state					.3520 (1.80)	
ln(Number of abortions rate during the year in which people of that age were born /the number of births)						-.8152 (4.26)
Adjusted R^2	.7880	.8858	.8837	.8864	.8858	.7904

* Statistically significant at the 1 percent level for a two-tailed t-test.
** Statistically significant at the 15 percent level for a two-tailed t-test.