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ABORTION AND CRIME: UNWANTED CHILDREN AND OUT-OF-WEDLOCK BIRTHS

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Legalizing abortion can either increase or decrease investments in children's human capital. This article finds that abortion increases the number of out-of-wedlock births. Using data that more directly links the criminal with age when the crime was committed, not age when arrested, and fixing the assumption in previous research that no abortions took place prior to the Roe v. Wade *decision in the 45 states affected by that decision, we find consistent significant evidence that legalizing abortions increased murders by over 7%. Linear estimates indicate that legalization increased total annual victimization costs by at least $3.2 billion.* (*JEL* K42, K14, J24)

I. INTRODUCTION

With violent crime rates dropping by 31% from their peak in 1991 to 1999 and murder rates declining by 42%, many explanations have been offered. This drop is all the more interesting because it occurred while some academics had predicted the rise of super predators and an explosion of crime.[1] In the debate, many plausible explanations for this decline have been advanced, such as increased arrest and conviction rates, longer prison sentences, "broken windows" or "problem-oriented" police policies, the ending of the crack epidemic, a strong economy, right to carry concealed handgun laws, and legalizing abortion during the early 1970s.[2] Generally, all these explanations could be simultaneously true. Most scholars agree that the crime reduction must be due to a range of factors, though they disagree on which ones are important.

Recently Donohue and Levitt (2001) suggested that "legalized abortion may account for as much as one-half of the overall crime reduction" during the 1990s, legalization accounted for even more of the drop in murder rates. One of their estimates implies legalizing abortion accounts for 25 percentage points of the 31-percentage-point drop in murder between 1991 and 1997 (2001, table IV, column 6). Two possible hypotheses were advanced. Abortion may have prevented "unwanted" children from being born. These unwanted children might, if born, have had smaller investments in human capital by their parents and thus been more prone to end up in trouble when they grew older (e.g., Bouza (1990) or Morgentaler (1998)).[3] Second, there is the less savory issue of whether abortion simply heavily culls out certain groups disproportionately involved in crime (e.g., poor black males).

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1. Lynette Clemetson, "The Gospel According to John," *Newsweek*, February 12, 2001, p. 25.

2. For evidence on all these explanations except for abortion see Lott (2000, chap. 9).

3. Henry Morgantaler, one of the leading proponents of abortion in Canada for several decades, notes (1998) that "it is well documented that unwanted children are more likely to be abandoned, neglected and abused. Such children inevitably develop an inner rage that in later years may result in violent behaviour against people and society.... I predicted a decline in crime and mental illness 30 years ago when I started my campaign to make abortion in Canada legal and safe. It took a long time for this prediction to come true. I expect that things will get better as more and more children are born into families that want and desire them, and receive them with joy and anticipation" (Morgentaler 1998). Similarly, Bouza, the Minneapolis police chief, wrote (1990) that abortion is "arguably the only effective crime-prevention device adopted in this nation since the late 1960s."

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Given the possible racial implications, it is important to separate these two hypotheses. This concern has been particularly raised by those pointing out that blacks account for over 30% of the abortions since the early 1970s.[4] One simple test would have been to measure whether the drop in crime still occurred after directly accounting for the changing racial composition of the population.[5]

Although 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, the legalization of abortion may have increased the number of out-of-wedlock first births.[6] If true, 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 and thus lead to more crime.[7]

This article directly links the number of abortions when a cohort was born to the crimes that cohort later commits using the Supplemental Homicide Report to more directly link murders to the age of the murderer and the Centers for Disease Control (CDC) estimates on the number of abortions. 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 "unwanted" ones whose parents would not have taken good care of them.[8]

But the legalization of abortion might also cause women to have children out of wedlock. Akerlof et al. (1996) 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% of whites were born out of wedlock, rising to 16.1% 20 years later (1985 to 1989). For blacks, the numbers rose from 34.9% to 61.8%. As Akerlof et al. (1996) point out, unmarried women used to be much more likely to put up their children for adoption. In 1969 only about 28% of children born out of wedlock were being raised by mothers who were still unmarried within three years. By 1984, that same fraction doubled to 56%. Hence, before legalized abortion most of the children born out of wedlock ended up in families with a father.

To Akerlof et al., the legalization of abortion reduced women's ability to withhold premarital 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" (Akerlof et al. 1996, pp. 296–97). Furthermore, 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.[9]

4. *Abortion Surveillance: Preliminary Analysis—United States, 1996*, CDC, December 4, 1998, 47(47); 1025–1028, 1035.

5. In a response to this article when it was presented at the American Law and Economic Association meetings in 2001, Donohue argued, "If abortion is changing a state's demographics, then controlling for demographics is inappropriate when trying to measure the impact of legalized abortion." We argue that is precisely what you want to account for if you want to see whether the impact of crime is due to the 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 article goes further and examines the results both with and without demographics.

6. Recent work by Klick and Stratmann (2003) indicates that sexual 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.

7. George F. Will, "More Abortions, Fewer Crimes?" *Newsweek*, April 30, 2001, p. 84.

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

9. 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 lower, and they will face relatively few unwanted pregnancies.

Both 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 raising children on their own, which also entails a smaller investment in human capital compared to the situation that existed before abortion was legalized. 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 premarital sex and more likely to 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 marriage for sex and have had children within a marriage. Women with children may also find marriage at a later date more difficult.

Finally, whereas Akerlof et al. don't extend their discussion to crime, 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 were 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 CDC indicate that other states that 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] Other publications also use Donohue and Levitt's abortion data (e.g., Joyce 2004; Garmaise and Moskowitz 2004; though Joyce 2006 now makes similar points to the ones raised here).

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

10. The correlation between the CDC's measure of abortions and those used by Donohue and Levitt is 0.91 for abortions from 1973 to 1985, but it falls to 0.84 from 1970 to 1985 because of the assumption that there are no abortions in the nonlegalizing states prior to 1973. Using data we provided them, 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 that roughly tries to link the criminal's year of birth with the year of the murder. The estimates employed here will be more equivalent to their more disaggregated regressions that use the arrest rate data, not their estimates using the aggregate effective abortion rate. As will be 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 article. One comment should also be made: We were the ones who supplied Donohue and Levitt with the CDC data on abortion rates.

11. We originally discovered the abortion data from the CDC when the data that Donohue and Levitt used from the Alan Guttmacher Institute was not made available to us when we put this article together.

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

TABLE I

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 in Danger

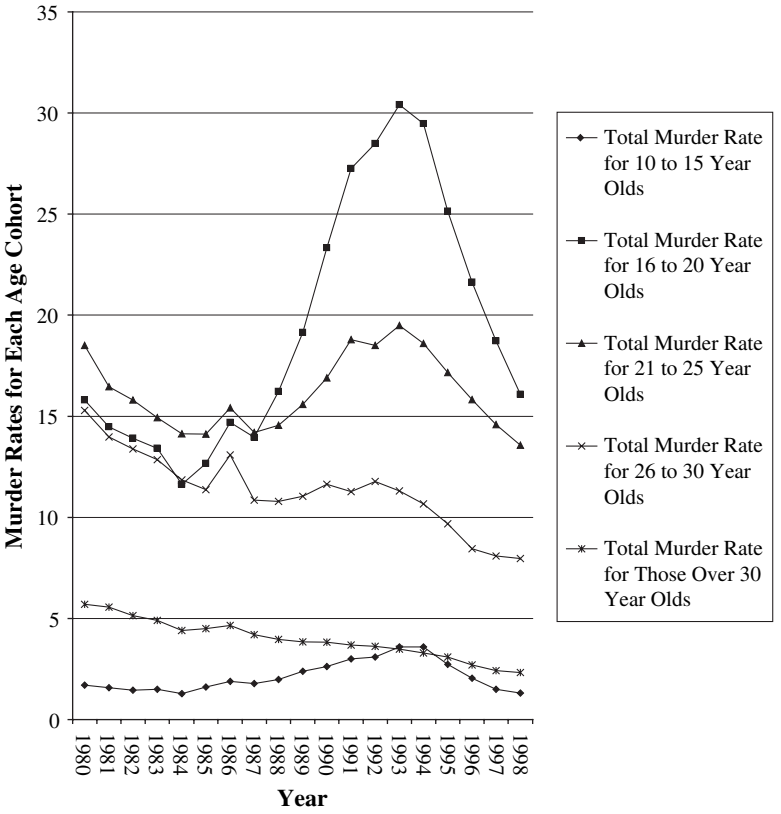
1969		1970		1971		1972	
State	No. Abortions per 1,000 Live Births	State	No. Abortions per 1,000 Live Births	State	No. Abortions per 1,000 Live Births	State	No. Abortions per 1,000 Live Births
California	**35**	**Alaska**	**120**	Alabama	7	Alabama	19
Colorado	25	**California**	**172**	**Alaska**	**160**	**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	DC	703	DC	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

Donohue and Levitt have argued since the publication of their article 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]Although there is no direct data on the wealth of the women who have abortions, 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% of the female population between 10 and 49 years of age and the same percentage of live births, but they account for 30% of the abortions in nonlegal states prior to 1973. By contrast, they make up 32% of the female population and 33% of live births in the five legal states, but only 21% of the abortions.

Although 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

13. Based on comments made at the 2001 American Law and Economics Association meetings.

FIGURE 1
Timing of Changes in Murder Rates for Different Age Cohorts



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 to 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 80% of the drop in murder during the 1990s, 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

14. Joyce (2004) and Foote and Goetz (2006) argue that the District of Columbia should also be included as an early adopter, and making this change would strengthen our findings that legalization increases crime. Simply to be consistent with Donohue and Levitt, we primarily use the number of abortions reported in a state, though we also provide results that 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 3, and doing so makes 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 Uniform Crime Report contains many missing observations for the age of the murder that are not found in the Supplemental Homicide Reports.

FIGURE 2
Comparing Early versus Late Legalizing States

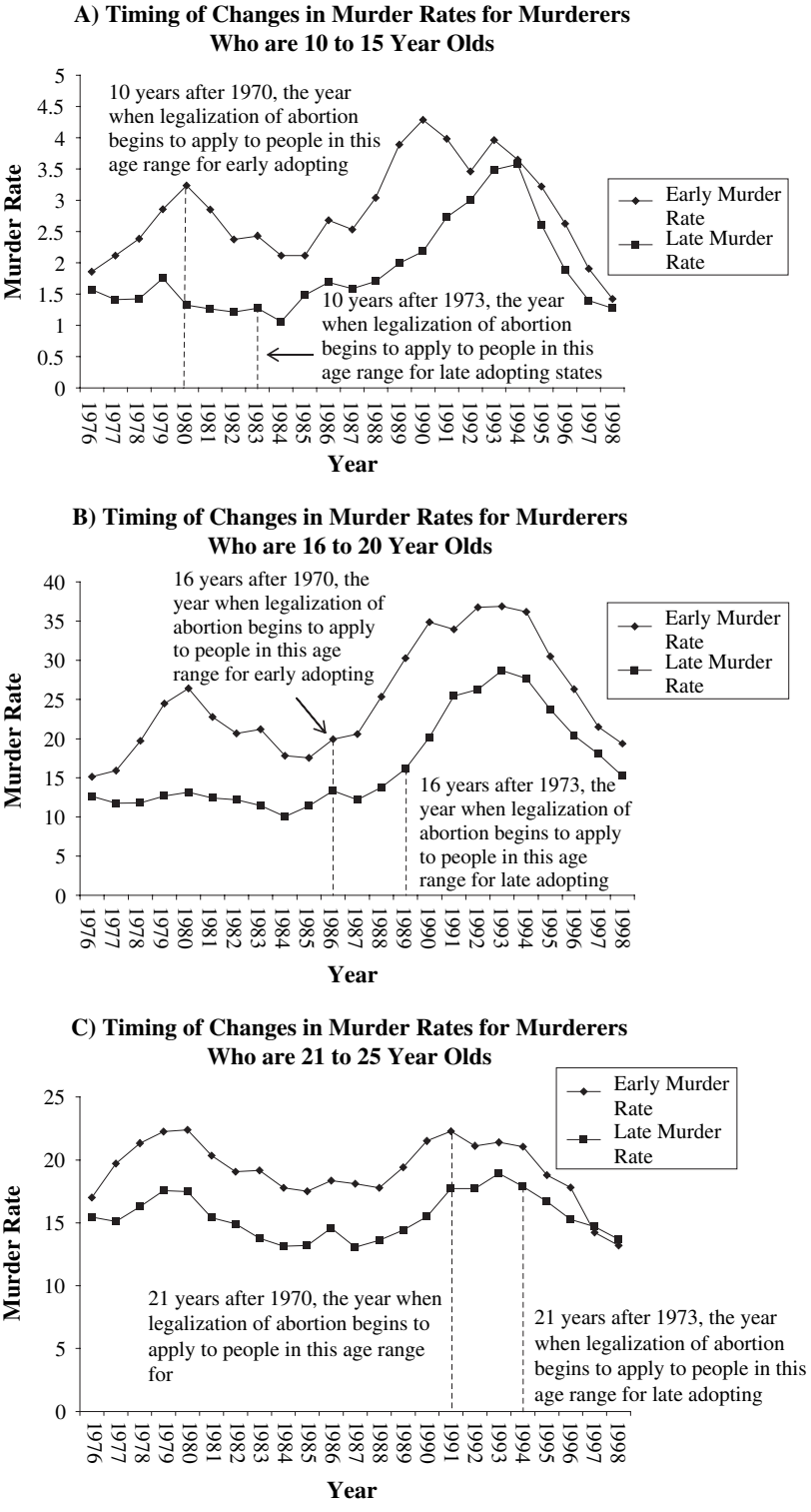
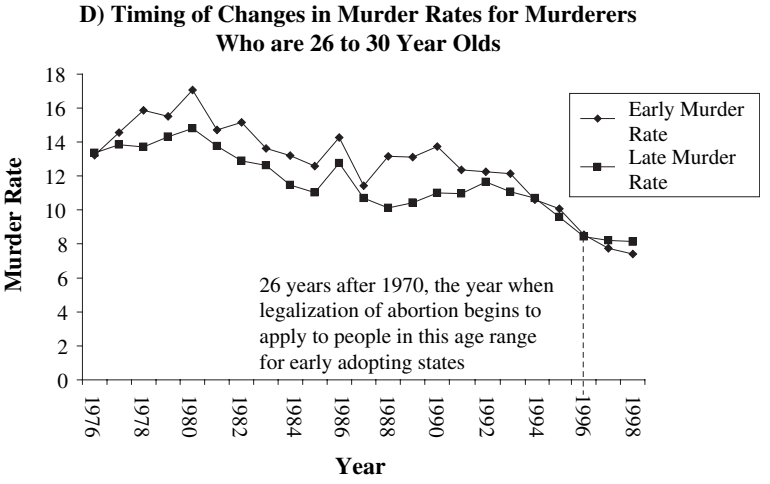


FIGURE 2
Continued



of people of that age) are concentrated in two age categories 16–20 and 21–25, with the murder rate for 26–30-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 groups (26–30 and over 30 years of age) fall almost over the entire time period. The next two oldest age groups (16–20 and 21–25 years of age) both peak in 1993. Finally, the youngest age group peaks last in 1994.[16]

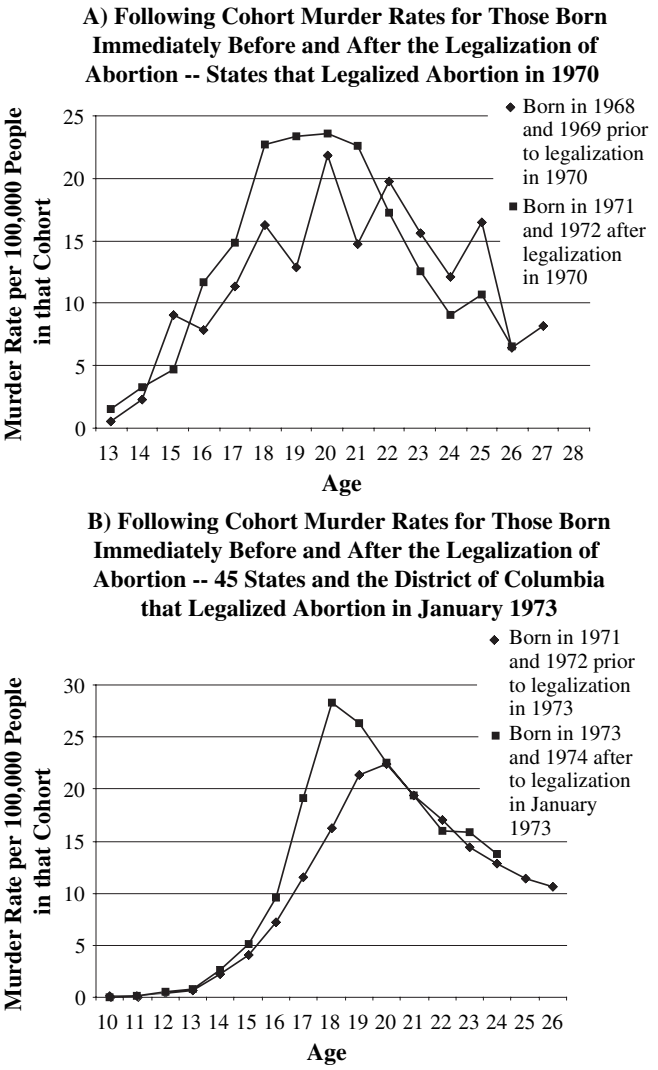
The next set of figures contrasts the changes in crime over time for five early legalizing states with all the other late legalizing states. Figures 2A–2D make this comparison for 10–15-year-olds, 16–20-year-olds, 21–25-year-olds, and 26–30-year-olds. We also investigated murderers where the age of the murderer is not known were also examined, but not shown. 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 10–15 age category until 1980. Because legalization is not assumed by Donohue and Levitt to have occurred for the late adopters until 1973, there should be no affect on crime by 10–15-year-olds in those states until 1983.

Figures 2A, 2B, and 2C 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

16. Foote and Goetz (2006) provide similar figures for violent and property crime rates. Although 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. This diagram also provides a caution for Donohue and Levitt's use of an aggregate abortion rate that creates an index that assumes the share of murders committed by different ages remains constant over time. Using a constant weighting over time causes the early drop in murder rates to be driven by the oldest cohort of criminals even though their theory depends on the drop occurring because of a change in the behavior of younger people.

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 5–13-year-olds was uniformily distributed.

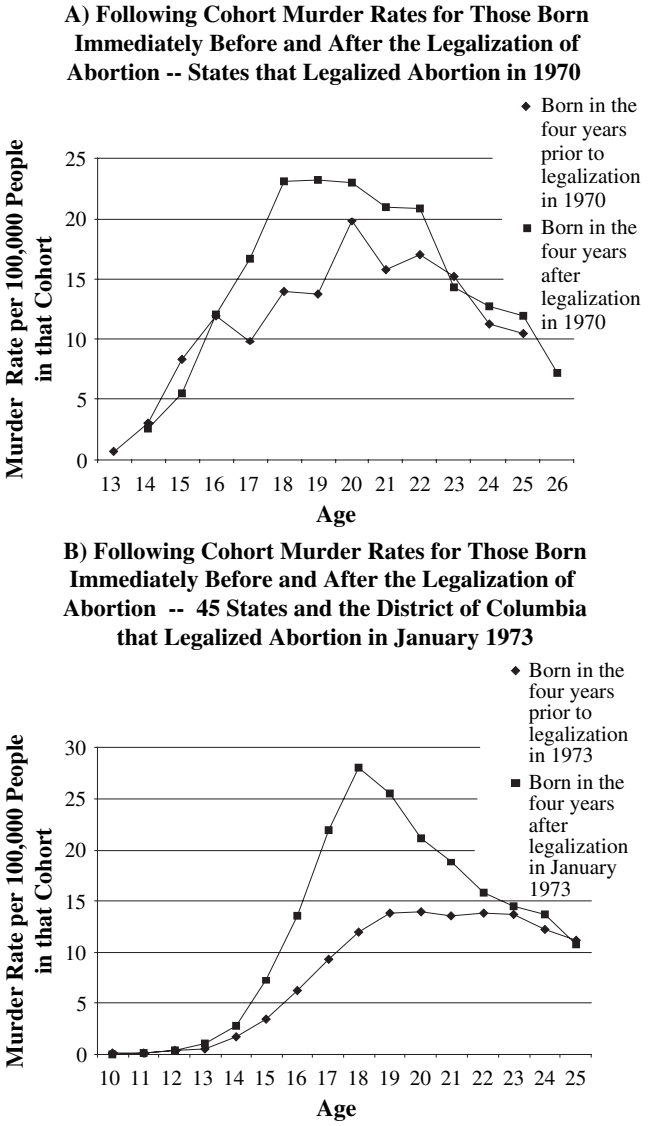
FIGURE 3
Tracing Cohorts over Time by Using a Two-Year Period on Either Side of the Legalization of Abortion



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. Although murder rates declined when abortions were legalized for early

FIGURE 4
Tracing Cohorts over Time by Using a Four-Year Period on Either Side of the Legalization of Abortion



adopters for 10–15-year-olds and early and late adopters for 21–25-year-olds, murder rates rose after legalization for late adopters in the 10–15-year-old age range and early and late adopters for 16–20-year-olds. Examining both early and late adopters for the 26–30-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]

The murder rates for murderers of unknown age also show a similar pattern in murder rates for both sets of states. The murder rates peak in 1993 for the early adopters and 1994 for the late adopters. Again, the

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 16–20-year-olds in Figure 2B until 1986.

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 compare the murder rates by people born immediately before and after abortion legalization. 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 that 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 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 A, those born prior to legalization have higher murder rates for nine ages, and the reverse is true for five 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 Figure 4 for 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, possibly implying greater drops in violent crime by women.[20] Yet murders by women fell continually during the 1980s and 1990s. 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 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. The abortion argument does not seem to apply to abortions of females.

IV. HOW TO TEST THE RELATIONSHIP BETWEEN ABORTION AND CRIME

As just noted, 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.[21] To use this data in a regression

19. Graphs showing one and also three years before and after the legalization are also available.

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 U.S. press. See Michael Breen, "Daugthers Unwanted: Asian's Preference for Sons Makes Abortion Rate Soar," *Washington Times*, February 13, 1993, p. A1; Sharon Rutenberg, "'Custom-Made' Families by Sex Selection," United Press International, May 31, 1983; Owen D. Jones, "Made-to-Orders Babies," *Connecticut Law Tribune*, September 6, 1993, p. 19.

21. Donohue and Levitt create an "effective abortion rate" that 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. 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. This assumption causes these results to miss that it is the drop in murders by older people that is responsible for the drop in murder rates to occur during the early 1990s (Figure 1). For example, while murders by 16–20-year-olds made up 12% of total identified murders in 1984, they made up 21% in 1994. Similarly, the assumption that crime is committed at the same rate by different age groups across states and over time is another oversimplification (see figure 5 at http://ssrn.com/abstract=270126). We redid the results reported in Donohue and Levitt's table IV: (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 Uniform Crime Report murder rate or the murder offender rate from the Supplemental Homicide Report (more details are available in table 2 at http://ssrn.com/abstract=270126). Donohue and Levitt's (2001) results in their table IV column 6 implied a 0.43% drop in murder for each 1% increase in abortions. This accounts for 25% of the 30% 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 instead of assuming constant shares across states and years, the same specification implies that each 1% increase in abortion raises the murder rate by 0.08%. Everything else equal, abortion slightly increased murder rates by 1.3% between 1991 and 1997. Results are available that examine how the results found by Donohue and Levitt change even when the FBI's Uniform Crime rate data are used. See the discussion in section IV here: http://ssrn.com/abstracat-270126.

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. Furthermore, 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 on on the realization of the dependent variable creates 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. The distribution is clearly not normal. In our sample, almost a third of the observations by age by state by year have zero murders (see Appendix Figure A2 at http://ssrn.com/abstract=270126 for the entire distribution). Though the mean and variance of murders is consistent with a Poisson distribution, we deal with the count nature of the data by estimating both Poisson and negative binomial regressions (Plassman and Tideman 2001).

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.[22] Both the last two variables are problematic because 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 because 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 1% or 2% 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.[23]

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

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 Table 1);[24] and the trends before and after the passage of right-to-carry laws. With the exceptions of demographics and broader measures of income, the variables are 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 importance of demographics in accounting for whether changes in crime are simply due to groups that commit crime at high rates being culled out of the population. Still, as we will show shortly, the

22. For discussions of these variables, see Lott (2000).

23. 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.

24. Available online at http://ssrn.com/abstract=270126.

results we report are not dependent on any particular set of control variables.[25]

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% of the murders are in a twenty-third category covering murders committed by criminals of unknown age. Potentially there are 26,979 observations, though missing observations reduce it to 21,480, 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 because 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 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.[26] The chief advantage of the second approach is that it does not discard any information. We primarily report the results using the second approach, but we tried all three, and the abortion variable estimate differed little across specifications.

For the second approach, we estimated the following regression:

$$
\begin{aligned}
(1)\quad & \text{Murders}_{ijk} \\
&= \beta_1(\text{Abortions}/1,000 \text{ Females age } 15\text{–}44)_{ijk} + \beta_2 \text{Population of Age Cohort}_{ijk} \\
&\quad + \beta_3 \text{Control Variables}_{jk} + \beta_4(\text{State Fixed Effects} \\
&\quad \times \text{Time trend that is nonzero when the age of murderer is unknown}) \\
&\quad + \beta_5 \text{State Fixed Effects} + \beta_6 \text{Age Fixed Effects} + \beta_7 \text{Year Fixed Effects} + \alpha + \varepsilon_{ijk}.
\end{aligned}
$$

"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),[27] and "population" is the number of residents of

25. Although 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 that we do not include this variable in the regressions shown in the text. Including it leaves the coefficient on abortions virtually unchanged. Whereas simply using the price does not allow one to perfectly disentangle local differences in demand and supply, arbitrage basically ensures 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 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 because 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.

26. Joyce (2004) uses the 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 are available without this lumping of known and unknown data together.

27. If the number of murders is regressed on the number of abortions, there is a scaling problem. Estimates that do those types of regressions produce similar results to those reported here (see http://ssrn.com/abstract=270126).

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 nonzero (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 2 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 to account for clustering at the state level, STATA requires that a population-averaged estimator is included. Clustering is used at the state level, and we use robust standard errors.[28]

The first column in Table 2 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. Simultaneity also exists for the overall prison population, but it is much less of a problem because murderers make up only 1% or so of the total prison population. The next two columns deal with this problem. The third specification uses lagged values for the arrest rate and prison population,[29] whereas the fourth specification replaces the arrest rate for murder with the arrest rate for overall violent crimes. The arrest rate for violent crimes will still proxy for the effectiveness of police but avoids being very closely tied to current 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.[30] An advantage of using the simple dummy variable 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, although 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 2 reports the percent change in murders by people of a certain age from 1,000 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). One more abortion per 1,000 females age 15–44 (i.e., about 4% of the average) is associated with about a 0.9% increase in murders in any given year.[31]

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% 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

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

29. Lagged values are problematic because in theory the current arrest and punishment levels 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.

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

31. One concern is 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% 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).

TABLE 2
Do Abortions Affect Murders?: Using Poisson or Negative Binomials Regressions

Poisson Estimates	**No. of Murderers by Age by State by Year**					
Variable	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**
Number of abortions during the year in which people of that age were born/the number of births	1.405 (2.24)	1.3874 (2.32)	1.38753 (2.31)	1.3928 (2.33)		
Dummy variable for whether abortions are legal in a state					1.0718 (2.82)	
ln(Number of abortions rate during the year in which people of that age were born/the number of births)						1.105 (3.43)
Population in state that is the age of the murders		1 (−8.76)	1 (−8.78)	1 (−9.14)	1 (−9.48)	
ln(Population in state that is the age of the murders)						0.71834 (−3.17)
Population density per square mile in state		1.00054 (.95)	1.000622 (1.11)	1.000596 (1.08)	1.00047 (0.85)	
ln(Population density in state)						1.33101 (7.06)
Number of people in prison		0.999995 (−6.18)		0.9999952 (−6.56)	0.999995 (−5.87)	
Number of people in prison lagged one year			0.999995 (−6.26)			
ln(Number of people in prison)						0.763888 (−3.34)
Execution rate		0.4925 (−0.47)	0.3438 (−0.7)	0.44016 (−0.58)	0.4154 (−0.59)	0.4907 (−0.43)
Arrest rate for murder		0.99977 (−0.85)			0.9998 (−0.85)	0.999665 (−1.12)
Arrest rate for murder lagged one year			.9996363 (−1.39)			0.999665 (−1.12)
Arrest rate for violent crime				0.9994108 (−0.7)		
Unemployment rate		0.98944 (−0.86)	0.98995 (−0.85)	.0989052 (−0.83)	0.9904 (−0.78)	0.996341 (−0.28)
Poverty rate		0.99968 (−0.06)	1.000162 (0.03)	1.00004 (0.01)	0.99975 (−0.04)	0.99786 (−0.38)
Per capita income		1.00006 (1.8)	1.00005 (1.57)	1.000069 (2.26)	1.00006 (1.90)	1.00008 (2.5)
Per capita income maintanence		0.99908 (−.94)	0.999047 (−1.02)	0.99936 (−.71)	0.9991 (−0.90)	0.998223 (−1.79)
Per capita unemployment insurance payments		1.00058 (0.81)	1.00043 (0.64)	1.00068 (0.86)	1.0006 (0.84)	1.00044 (.69)
Per capita retirement payments for those over age 65		0.999763 (−2.09)	0.99968 (−2.98)	0.9997545 (−2.4)	0.9998 (−2.01)	0.99988 (−0.96)
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)		−1.87 (1.71)	−2.5 (2.77)	−2.4 (3.41)	−1.85 (1.69)	−1.0 (1.47)
Chi-square	196144	2563166	1649367	1641310	2911502	237549.
No. of observations	21756	21480	21411	21319	21480	21480
Same as Above but Using Negative Binomials	**(7)**	**(8)**	**(9)**	**(10)**	**(11)**	**(12)**
Three different measures of abortion are used in correspondence to the columns used above	1.29 (4.18)	1.317 (3.18)	1.3189 (3.15)	1.3165 (3.21)	1.127 (8.21)	1.097 (4.64)
Same as First Regressions but Using Number of Abortions	**(13)**	**(14)**	**(15)**	**(16)**	**(17)**	**(18)**
Number of abortions during the year in which people of that age were born/1000	1.00217 (1.90)	1.00179 (2.03)	1.0018 (2.03)	1.00182 (2.04)		
ln(Number of abortions during the year in which people of that age were born/1000)						1.033 (7.11)

Notes: The coefficients are incident rate ratios, with absolute z-statistics reported in parentheses. Values of the coefficients greater than 1 show the percent increase in crime, and values less than 1 indicate the percent decline. The demographics and fixed age, state, and year effects are not reported. Robust SEs with clustering are reported and a population-averaged estimator is used. The last set of estimates using the number of abortions have a scaling problem, but are provided for comparison purposes.

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%, about one-seventh the magnitude estimated by the linear specification.[32]

The specifications corresponding to those in Table 2 when we use the Supplemental Homicide Reports' method of distributing unknown murderers or exclude murders where the age of the criminal is unknown are reported in Appendix 2 (available from the authors). In all but one of these specifications the impact of abortion is statistically significant at well above the 0.01 level for a two-tailed *t*-test, and the effect ranges from between 33% smaller than what was reported in Table 2 to 48% larger.[33]

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% per year faster after the adoption of right-to-carry laws.[34] 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. Estimates using weighted least squares instead of the Poisson and negative binomial regression examined here are reported in Appendix 3 found that five of the six results are similar in size to those shown in Table 2 (available from the authors).

The second section of Table 2 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% of the total) is associated with a 0.06% 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 2'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.[35]

The results in Table 3 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 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, DC. Each is excluded separately, and then all three are excluded as a group. Individual state-specific trends and

32. Though 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.

33. 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.

34. 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 (2000) and include information on waiting periods, background checks, penalties for using guns in the commission of crime, and so-called safe storage laws, which impose penalties on adults who do not lock up there guns if the guns are used improperly by a juvenile.

35. 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% increases 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% increases in murder rates.

TABLE 3
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	Coefficient for the No. Abortions by In-State Residents (divided by 1000) Except Where Noted	
	Incident Rate Ratio Coefficient	**Absolute *z*-Statistic**
(1) Linear value of abortion rate (corresponding to specification 2 in Table 2)		
Baseline	1.3874	2.32
Exclude New York	1.5155	1.56
Exclude California	1.3391	2.55
Exclude District of Columbia	1.89695	1.76
Exclude New York, California, District of Columbia	1.64996	8.25
Adjust abortion rate for nonresidents	1.99059	3.57
Include control for flow of immigrants	1.3868	2.33
Include state-specific trends	1.2575	1.96
Include region-year interactions	1.3878	2.33
Include control for overall fertility	1.1736	3.02
Limiting sample to only those ages affected by abortion (eliminating observations for those over 29 and of unknown age)	1.4707	2.62
Allowing for state-specific year fixed effects in addition to the number of abortions and the age specific population	1.388	2.33
(2) Dummy variable for legalizing abortion (corresponding to specification 5 in Table 2)		
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 number of abortions and the age specific population	1.0690	2.77
(3) Natural logs of abortion rate and population variables (corresponding to specification 6 in Table 2)		
Baseline	1.105	3.43
Exclude New York	1.125	3.82
Exclude California	1.081	3.35
Exclude District of Columbia	1.104	3.33
Exclude New York, California, District of Columbia	1.094	3.27
Adjust abortion rate for nonresidents	1.0958	3.30
Include control for flow of immigrants	1.1053	3.43
Include state-specific trends	1.1105	3.61
include region-year interactions	1.1044	3.45
Include control for overall fertility	1.0105	1.00
Limiting sample to only those ages affected by abortion (eliminating observations for those over 29 and of unknown age)	1.1066	4.81
Allowing for state-specific year fixed effects in addition to the ln(number of abortions) and the ln(age specific population)	1.1044	3.45

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 3 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 effect of abortion. Controlling for fertility reduces the abortion coefficient and makes it statistically insignificant in the log specification.

Other sensitivity tests are available. We categorized the control variables used in Table 2 into 10 groups: 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 groups 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. Altogether, we ran 5,200 regressions.

The results from this specification search show a very consistent set of results. The range of coefficient estimates for the linear specification for the number of abortions by in-state residents (/1,000) ranges from a low of 1.3449 to a high of 1.4564, with a median of 1.4002. For the dummy variable the estimates range from 1.069 to 1.087 and for the natural logs from 1.022 to 1.0275.[36]

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 log of these two measures, and the dummy variable for legalization) were interacted with the age dummy variables. The results (available from the authors) imply a more complicated story than we have seen thus far. Although abortions imply more murders, the impact is not the 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 13–22 and ages 27–29.) Only the coefficients for one year of age—29-year-olds—show a consistent decline in murder rates from abortions. The four regressions on the number of abortions as well as the natural logs of those values show much more consistency both in terms of the ages associated with increases or decreases in crime.

There is a possible explanation for why the legalization dummy produces different results from the abortion rate measures. As noted earlier, abortion data from the CDC indicate that many states where abortions were illegal actually had higher abortion rates than some states where it was legal. The dummy variable for the law wrongly assumes that legalization always produces more abortions than when abortions were illegal (only allowed when the life or health of mother are endangered), and that is obviously not true. These results raise concerns with assuming 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. Whites, blacks, and other groups obtain abortions and have out-of-wedlock births at different rates. The net effect of legalization is unclear because the groups that have a high levels of abortions also tend to have out-of-wedlock births more frequently. For example, whereas blacks account for 29% of abortions during our sample, they account for 40% of the out-of-wedlock births from 1980 to 1995. Fortunately, the Supplemental Homicide Report disaggregates

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

murders by race and sex, as well as age. The CDC 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 1982–86. 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 2. Unfortunately, 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% level for a two-tailed test. For nonwhites the difference between males and females is more mixed: In one case males face the significantly greater loss, in two cases, females did.

The different specifications do not imply that any one group is harmed consistently more than another. The linear and natural log estimates imply that on average additional abortions harm nonwhites the most, whereas 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 for 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 much 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.[37]

VII. MEASURING THE IMPACT OF ABORTION ON ARREST RATES

Donohue and Levitt's publications directly link abortions to the arrests by year for 15–24-year-olds using data from 1985 to 1996, though as Foote and Goetz (2006) discovered, they did not run the regressions that they thought they had and correcting the estimates showed a positive and significant increase in violent crime.[38] Also as noted earlier, there are problems with using arrest rates as opposed to the Supplemental Homicide Report because arrest data do not directly link the criminal to the crime and arrests frequently do not occur in the year the crime was committed. Unfortunately, an equivalent of the Supplemental Homicide Report does not exist for violent and property crimes.

Although some control variables differ between our studies (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 4.[39] The big difference between their results and ours stems 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 1980–96 also produces stronger evidence that abortion increases arrests for violent crime and murder. The other estimates are based on the Poisson and negative binomial 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 the Poisson regressions is limited to analyzing murder.

The results generally show either a positive relationship or no relationship between abortion and arrests for violent crime and murder

37. There is also the question of who the victims are of this increased crime. We disaggregated murders by the race of the victim and criminal. Abortions seem to produce similar increases in murders by whites of both whites and nonwhites. The data are more mixed 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 is true for the dummy variable specification.

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. Our inability to replicate their "state × age interactions" turns out to be because they did not estimate the regressions they said that they had run (Foote and Goetz 2006). We were unable to determine this at the time we wrote this article because we were not provided with the regressions that Donohue and Levitt estimated.

TABLE 4
The Impact of Abortions on Out-of-Wedlock Births: 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	0.9999989 (0.35)	1.000003 (1.85)	1.000004 (3.93)
Population density in state	0.9999487 (0.38)	0.9998297 (1.28)	0.8965998 (2.16)
Unemployment rate	1.015146 (2.66)	1.005642 (1.17)	1.01354 (2.91)
Poverty rate	1.000791 (0.0011821)	1.002454 (1.97)	0.9999112 (0.07)
Per capita income	1.000017 (1.05)	1.000008 (0.62)	1.000027 (1.92)
Per capita income maintanence	1.000245 (0.83)	0.9998943 (0.30)	0.9997004 (0.80)
Per capita unemployment insurance payments	0.999859 (9.59)	0.9994682 (1.72)	0.9997257 (1.20)
Per capita retirement payments for those over age 65	1.000004 (9.19)	.9999284 (2.60)	1.00002 (9.57)
Chi-square	2453649	149e+07	6.90e+07
No. of observations	7640	7640	7640

Notes: Again the coefficients are incident rate ratios. Demographics and fixed state and year effects are not reported. Robust SEs with clustering are reported and a population-averaged estimator is used.

while suggesting a weak negative relationship between abortion and property crime (available upon request). For the weighted ordinary least squares 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. Although 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.

There are difficulties with using arrests and not data such as that provided by the Supplemental Homicide Report, but neither the different data source nor the limited sample alone is 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, but that stil does not qualitatively change our results.

Combining our earlier results from Table 2 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 2 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 $3.2 to $7.3 billion per year.

VIII. DOES ABORTION LEAD TO MORE OUT-OF-WEDLOCK BIRTHS?

Akerlof et al. raise the issue of whether abortions and contraceptives lead to more out-of-wedlock births. Yet their empirical work 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 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 when using time-series data. 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. Alternatively, state-level measures of the availability and use of contraceptives are less obvious, though year fixed effects combined with demographics and income data should serve as a proxy.

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 4 provide support for the Akerlof et al. hypothesis, though the effect represents just a fraction of a percentage point. In column 1, each 1,000 more abortions is associated with a 0.6% 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% 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 1,000 more murders per year arising from abortion are true, this figure represents around 11% 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 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 that had the biggest increase in abortion are somehow different than other states. Higher unemployment, poverty, and income are associated with more out-of-wedlock births, though surprisingly 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 article, though this section raises questions about exactly how abortion increases crime.

IX. CONCLUSION

There are many factors that reduce murder rates, but the legalization of abortion is not one of them. Of the over 6,000 regressions that we estimated here, only one implied even a small reduction in murder rate. All the other estimates implied significant increases in murder rates: allowing abortions after 1973 implies at least 850 more murders 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 cannot 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

40. Recent work by Alesina and Giuliano (2006), done after our paper was accepted, also finds that the legalization of abortion increases out-of-wedlock births and reduces births in marriages, thus confirming our results here. Gruber et al. (1999) question Akerlof et al.'s findings.

41. Klick and Stratmann (2003) use weighted least squares to find that sexual activity greatly increased after legalized abortion.

abortions and the crimes committed by individual cohorts missed catching obvious patterns and incorrectly attributes the initial drop in murder rates to older cohorts. Even if Donohue and Levitt believe that the correct approach links 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 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.[42] 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 be both winners and losers, but here the net effect appears to be a net reduction in human capital and an increase in crime.

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42. Kahane et al. (2006) provide strong evidence using British data that abortion legalization did not reduce crime rates when abortion is treated as endogenous. They also note (p. 26) the surprising point that "total recorded crime in the U.K. began to decrease at about the same time as in the U.S., despite the fact that abortion legalization occurred about five years earlier." Though the international evidence that does exist has not allowed the panel analysis by age offered here, it still does not really suggest a relationship between abortion and crime (Foote and Goetz 2006). The Romanian data do not differentiate the increase in crime that occurred after the fall in communism from the increase recorded all across Eastern Europe and Russia (an increase at least partly related to more accurately reported statistics). Foote and Goetz's graphs of the Australian data make it very difficult to see any pattern. The Canadian data are mixed but are estimated differently than the Donohue and Levitt regressions.