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MORE GUNS, MORE CRIME

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ABSTRACT

This paper examines the relationship between gun ownership and crime. Previous research has suffered from a lack of reliable data on gun ownership. I exploit a unique data set to reliably estimate annual gun ownership rates at both the state and the county level during the past two decades. My findings demonstrate that changes in gun ownership are significantly positively related to changes in the homicide rate, with this relationship driven entirely by the impact of gun ownership on murders in which a gun is used. The effect of gun ownership on all other crime categories is much less marked. Recent reductions in the fraction of households owning a gun can explain at least one-third of the differential decline in gun homicides relative to non-gun homicides since 1993. I also use this data to examine the impact of Carrying Concealed Weapons legislation on crime, and reject the hypothesis that these laws led to increases in gun ownership or reductions in criminal activity.

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I. Introduction

Do changes in gun ownership influence the crime rate? Although guns are involved in nearly 70% of all homicides and a substantial share of other violent crimes, the direction of this relationship is theoretically ambiguous. For example, if guns increase the likelihood that any particular dispute will result in an individual's death, then increases in gun ownership will serve to increase the number of homicides. Alternatively, if criminals are deterred from committing crimes when potential victims are more likely to possess a firearm, then more gun ownership may lead to a reduction in criminal activity.

Until recently, empirical work that attempted to answer this question typically took one of two approaches. In the first, researchers estimated the effect that changes in the total stock of guns in the U.S. had on the nation's crime rate (Kleck, 1984; Magaddino and Medoff, 1984). A more developed branch of studies estimated the level of gun ownership in a region, state, or city, and then explored whether crime and gun ownership were significantly related (Cook, 1982; Kleck and Patterson, 1993). The results of these studies were mixed, with some implying that guns increased the amount of criminal activity and others finding the opposite.

Both types of studies had important limitations. The time-series analyses that used annual, national-level data were limited because of the small number of observations that could be used for estimating the relationship between gun ownership and crime. Furthermore, the level of aggregation prevented researchers from examining whether the relationship held within smaller geographic areas, or if instead gun ownership was changing in one region of the country while criminal activity was changing in another. The cross-sectional studies had two weaknesses. First, because reliable data on gun ownership were only available at the national level, researchers constructed proxies, such as

the fraction of crimes committed with a gun, to estimate the level of gun ownership in an area. It is not clear, however, if these proxies accurately captured differences in gun ownership across areas. More importantly, any significant statistical relationship between guns and crime could have been driven by reverse causation or omitted variables.

The main impediment to applied work in this area was the absence of a reliable measure of gun ownership that could be measured across geographic areas over time. In this paper I propose a new way to measure gun ownership at both the state and county level on an annual basis. Specifically, I argue that state and county-level sales data for one of the nation's largest gun magazines, *Guns & Ammo*, provide a much more accurate way to measure both the level and the change in gun ownership within an area.

I use several methods to test the validity of this new proxy variable. First, I show that gun magazine sales rates are significantly higher in counties with average individual-level characteristics similar to those of the average gun owner. Second, I use death data from the National Center for Health Statistics to show that there is an approximate one-for-one relationship between sales rates and the death rate from gun accidents. Third, using gun show data from National Rifle Association publications, I show that the number of gun shows per capita is significantly positively related to the sales rate of this magazine. Fourth, using annual, state-level data on NRA membership, I demonstrate that *Guns & Ammo* sales are significantly positively related to the level of and changes in NRA membership rates. And finally, I use data from the General Social Survey to show that state-level estimates of gun ownership are significantly positively related to gun magazine sales rates, and that this proxy also captures variation within a state over time in rates of gun ownership. While none of these tests individually proves that this magazine is a sufficiently accurate proxy variable, taken

together they suggest that this panel data set represents the richest one ever assembled for measuring gun ownership.

Having demonstrated the validity of this proxy variable, I next use this data to examine the dynamic relationship between gun ownership and crime. My findings reveal that changes in homicide and gun ownership are significantly positively related. This relationship is almost entirely driven by the relationship between lagged changes in gun ownership and current changes in homicide, suggesting that the relationship is not driven simply by individuals purchasing guns in response to increases in criminal activity.

One possible explanation for this finding, however, is that individuals purchase guns in response to expected future increases in crime. My finding that lagged changes in gun ownership are strongly positively related to changes in gun homicide rates, but bear no corresponding relationship with non-gun homicide rates, does not support this hypothesis. Instead, it suggests that an increase in the number of guns leads to a substantial increase in the number of homicides. The relationship with all other crime categories is much less marked, implying that firearms increase criminal activity primarily through their impact on homicides.

The finding that changes in gun ownership are significantly positively related to changes in homicide rates contradicts the results from recent work suggesting that the increases in gun ownership caused by the passage of Carrying Concealed Weapons (CCW) legislation led to a significant decline in violent crime (Lott and Mustard, 1997). I therefore use the magazine sales data to revisit in greater detail the impact of state CCW laws on crime rates. Theoretically, CCW legislation could have reduced the crime rate by increasing the likelihood that potential victims would be carrying a firearm. This could change if (1) the fraction of individuals owning a gun

increased or (2) the frequency with which existing owners carried their guns increased.

Using the magazine sales data, I first examine whether the passage of CCW laws led to increases in the rate of gun ownership, and find no evidence of such a pattern. I then investigate whether criminals were deterred from committing crimes because of a perception that the existing set of gun owners would carry their guns with them more frequently. I find no evidence that counties with above-average rates of gun ownership within CCW states experienced larger declines in crime than did low ownership counties, suggesting either that gun owners did not increase the frequency with which they carried their guns or that criminals were not deterred by the greater likelihood that their victims would be armed. These findings weaken the claim that CCW legislation could plausibly have reduced violent crime rates. Consistent with this, a simple robustness check of the Lott-Mustard results demonstrates that their central results are not accurate. I therefore reject the hypothesis that Carrying Concealed Weapons laws significantly reduced the rate of violent crime.

From 1993 to 1998, the number of gun homicides declined by 36% while the number of non-gun homicides declined by only 18%. During that same time period, national survey estimates suggest that the fraction of households with at least one gun fell from more than 42% to less than 35%. My point estimates suggest that this decline in gun ownership can explain approximately one-third of the differential decline in gun homicides during this time period, with the largest declines occurring in areas with the largest reductions in firearms ownership. Whether this decline in gun ownership also partially explains the substantial decline in the number of gun suicides during this same time period is an important topic for future research.¹

¹After reaching a peak of 18,964 in 1993, the number of gun suicides fell in each of the next five years, and stood at 17,424 in 1998. During that same time period, the number of non-gun suicides actually increased (although by a smaller amount) from 12,200 to 13,151.

II. Do *Guns & Ammo* Sales Accurately Estimate Gun Ownership?

Guns & Ammo is the nation's fourth largest firearms magazine. Approximately 600,000 copies were sold in 1998, with almost 90% of these sales resulting from subscriptions and the remainder sold as single copies. Unlike the three gun magazines with greater circulation,² sales data for this magazine are available annually at both the state and the county level. More importantly, *Guns & Ammo* is focused relatively more on handguns than these other three magazines. Because handguns are the weapon of choice in the vast majority of firearms-related crimes and are more likely to be purchased for self-defense purposes than are rifles or shotguns, this magazine is a more appropriate one for analyzing the dynamic relationship between crime and gun ownership.

In this section, I first examine whether gun magazine sales rates are significantly higher in counties with average individual-level characteristics similar to those of the typical gun owner. Recent work by Glaeser and Glendon (1998) uses data from the annual General Social Survey to determine which types of individuals are most likely to own guns. Their findings reveal that people living in Western and Southern states are significantly more likely to own one or more guns than are Midwesterners, with people from Eastern states being the least likely. The authors also find that high-school dropouts and college graduates are relatively unlikely to own a firearm, and that white males living in rural areas are the most likely to own a gun. Controlling for an individual's educational status, the probability of gun ownership is an increasing function of a person's income.

The county-level regression results presented in Table 1 suggest that the readers of this magazine are quite similar to typical gun owners. These regressions explain the log of the sales rate

²*American Rifleman*, *American Hunter*, and *North American Hunter*.

(per 1000 residents) for *Guns & Ammo* at the county level in 1990.³ Consistent with the findings of Glaeser and Glendon, the first column reveals that counties with more high school dropouts or college graduates have significantly lower sales rates than do other areas. The coefficient estimates on the region dummies demonstrate that counties in the West or South have much higher sales rates than do counties in the East or Midwest. Rural counties with relatively many white males also have more gun magazine sales per capita than do other areas, and average income is significantly positively related to sales of this magazine. In the second column I include state fixed effects in the regression and find that the estimates from the first specification are largely unchanged. This suggests that the proxy variable is not simply picking up variation across states in gun ownership but that there is substantial within-state variation as well. In the third column I include additional explanatory variables in the regression, and find that densely populated counties and those with relatively many children or elderly individuals have lower rates of gun ownership. This first set of regressions suggests that the observable characteristics of those individuals who purchase this magazine are quite consistent with those of gun owners, implying that *Guns & Ammo* sales rates are a good proxy for the level of gun ownership in an area.⁴

³The magazine sales data include both single copy sales and subscriptions. These data are based on publisher's compilations of sales data at the county level. This magazine is marketed primarily to handgun owners, but there are numerous references to rifles and shotguns as well. The 444 counties with a population of 100,000 or more in 1990 are included in the regression, with all other counties combined into a "rest-of-state" category. While these 444 counties account for only 14% of the 3142 counties, approximately 75% of the U.S. population resides in one of these counties.

⁴Cook (1987) uses the fraction of robberies committed with a gun to proxy for the rate of gun ownership in 44 U.S. cities. While this may be a reasonable proxy at the city level, the *Guns & Ammo* sales rate appears to be a significantly better measure overall. Specifically, the correlation between my proxy and the estimated ownership from the General Social Survey at the state level is significantly positive at 0.61, while the correlation is only 0.09 (and statistically

The next set of regressions summarized in Table 2 provides further support for the accuracy of this proxy. In places with more gun ownership, one would expect to find more sales of firearms. While state-level data on gun sales are unavailable, the first specification utilizes data on the location of gun shows⁵ in the U.S. to examine whether states with high *Guns & Ammo* sales rates have relatively more gun shows (and presumably more gun sales) per person. The significant coefficient estimate of 0.995 implies that there is approximately a one-for-one relationship between the number of gun shows per capita and the gun magazine sales rate.

The next three columns use state-level data from the National Center for Health Statistics on the underlying cause of all deaths in the United States in 1996. The second specification shows that there are significantly more deaths (per capita) from gun accidents in those states with higher gun magazine sales rates,⁶ and that there is again an approximate one-for-one relationship. The third and fourth specification show that gun suicide rates are significantly greater in states with relatively high gun magazine sales rates, while there is no corresponding relationship between estimated rates of

insignificant) between the fraction of robberies committed with a gun and the GSS ownership estimates.

⁵This data is obtained from the National Rifle Association's publication *American Rifleman*. Every issue of this magazine was obtained in 1996, and the data were constructed from each issue's NRA Regional Report. Because each issue only has information on gun shows in surrounding states, five sets of issues (for each of the NRA's five regions) were necessary to get complete gun show data for each state. Eight states had no gun shows reported in this year. Including these states in the regression by replacing the dependent variable with $\text{Log}(0.1 / \text{pop})$ leads to a slightly greater and more significant coefficient estimate.

⁶Both gun accidents and gun injuries are included. The latter category includes those gun deaths in which authorities could not determine whether the injury was accidentally or intentionally inflicted. The coefficient estimates are virtually identical if I run the regressions separately for gun accidents and gun injuries (1.228 and 1.201, respectively). The ICD9 (International Classification of Disease) cause-of-death codes for gun accidents begin with 922 and gun injuries include codes beginning in 9850-9854.

gun ownership and non-gun suicides. Previous work has used the fraction of suicides that are committed with a gun as a proxy for gun ownership (Cook, 1995), and this pair of regressions demonstrates that this fraction is significantly higher in places with more gun ownership.⁷

The results of the first two specifications displayed in Table 3 use state-level data from 1982-1998⁸ on membership in the National Rifle Association to investigate its relationship with *Guns & Ammo* sales. The significant coefficient estimate of 0.807 in the first specification shows that states with more NRA members per capita have significantly higher sales rates for this magazine. The second specification uses annual state-level data and includes both year and state fixed effects. The significant estimate of 0.389 implies that, within a state, rates of NRA membership are significantly positively related with magazine sales rates, providing additional evidence that this proxy is a good measure both of the level and of the change in gun ownership within an area.

In the last two specifications I use data from the General Social Survey to provide a final test of the validity of this proxy. In many of the GSS surveys, respondents are asked whether they own a gun. I use data from the 1980-1998 surveys to examine whether states with more reported gun

⁷ICD9 codes for gun suicides begin with 9550-9554, while suicides include those with a code beginning with 95. The findings of Sloan, et al (1990) and Kellerman, et al (1993) suggest that gun ownership leads to more suicides because of the greater success rate for this method than alternative ones. Whether their findings are due to a true causal effect or are instead driven by unobserved differences in the propensity to commit suicide by gun and non-gun owners is unclear.

⁸This paper focuses on the 1980-1998 time period but NRA data are unavailable before 1982. To calculate membership, I use data from the Audit Bureau of Circulations and calculate the sum of magazine subscriptions for *American Rifleman* and *American Hunter* (and *American Guardian* beginning in 1998). Each member of the NRA receives a subscription to one of these magazines, and the magazine is not sold on the newsstand. Only NRA members can subscribe.

ownership have higher sales rates for this gun magazine during the same time period.⁹ In the third column of Table 3 I use all of the GSS survey data and find that states with higher average gun ownership rates during this time period have significantly more magazines sold per state resident. The significant coefficient estimate suggests an approximate one-for-one relationship between the reported rate of gun ownership and the sales rate for this magazine. The specification summarized in the final column uses annual state-level data and includes both state and year fixed effects. The significantly positive estimate of 0.354 suggests that this magazine's sales are a valid measure both of the level and of the change in gun ownership within an area.

Taken together, the results in this section strongly suggest that this panel data set of *Guns & Ammo* sales rates provides a much richer set of information about gun ownership than any that has previously been assembled. One potential concern, however, is that very few readers of this magazine may be criminals. Even if only law-abiding citizens read this magazine, nearly 500,000 guns are stolen annually,¹⁰ suggesting that increases in gun ownership among law-abiding citizens will increase the availability of firearms for criminals. Moreover, a substantial share of criminals purchase their firearms on the secondhand market.¹¹ Thus the ease with which criminals can acquire

⁹It is worth noting that the General Social Survey was designed to be nationally representative, and therefore the samples from any individual state will not necessarily be a representative sample of state residents. Furthermore, the number of respondents for the average state in a typical year is only 27. Small sample sizes, coupled with the potential non-representativeness of respondents, have prevented researchers from using GSS data to reliably estimate the dynamic relationship between gun ownership and crime. Absent a better source of survey data, I nevertheless use the GSS to provide one final test of the validity of my proxy.

¹⁰This is likely an underestimate, as it includes only those guns that are reported stolen.

¹¹Evidence from the Bureau of Alcohol, Tobacco, and Firearms reveal that a substantial share of the transactions at gun shows, which are much less regulated than are sales from federally licensed dealers, involve at least one previously convicted criminal (HCI, 1999).

their guns is bound to be much greater in those places with the most gun ownership among law-abiding citizens.¹²

III. The Relationship Between Crime and Gun Ownership

Because firearms are used in a substantial share of violent crimes, but are also frequently used for self-defense purposes, changes in the number of guns within an area could have an important impact on the level and average seriousness of criminal activity. Kleck (1991, 1993) argues that, because guns are used frequently in self-defense, they act as an effective deterrent to criminal activity. Thus increases in gun ownership reduce the crime rate,¹³ suggesting there may be positive externalities associated with gun ownership. As the fraction of individuals owning a firearm increases, the expected punishment from committing a crime may also increase.¹⁴ Findings to the contrary claim that increases in gun ownership serve to increase crime, either by increasing the likelihood that any crime will result in a victim's death¹⁵ (Cook, 1979), or by increasing the chance

¹²Cook (1995) argues that greater gun ownership among law-abiding citizens reduces the cost to any individual criminal of obtaining a firearm.

¹³Estimates regarding the frequency with which gun owners successfully defend themselves from criminals vary widely. Data from the National Crime Victimization Survey suggests approximately 75,000 cases of self-defense annually, amounting to approximately 2% of all violent crimes (McDowall, Loftin, Wiersema, 1992). Using the same data, Cook (1991) finds that only 3% of victims successfully used a gun against a criminal who intruded while they were home. Kleck's estimates (1991, 1993), at more than one million, are greater by an order of magnitude.

¹⁴Becker (1968) develops a model in which criminal behavior is substantially affected by the expected costs of committing a crime. Positive externalities have been found for other types of victim protection (Ayres and Levitt, 1998).

¹⁵A comparison of gunshot and stab victims (Zimring, 1972) provides support for this hypothesis, as gunshot victims were much more likely than stab victims to die as a result of their wounds.

that a domestic dispute will result in the death of one or more individuals (Kellerman, 1992). Donohue and Levitt (1998) develop a model in which firearms may reduce the predictability of fight outcomes, thereby increasing the number of violent confrontations that occur.

Much of the previous empirical work that examined this issue used cross-sectional estimates of gun ownership. These studies were unable to control for unobserved differences across areas that could plausibly affect both gun ownership and crime, and the estimates were typically quite sensitive to precisely which control variables were included in the regressions. Furthermore, any significant relationship could have been a result of a causal effect of guns on crime or the reverse.¹⁶ In this section I build upon previous work by exploiting nearly twenty years of both state and county-level gun magazine sales data to explore the dynamic relationship between gun ownership and crime.

A. The Relationship Between Changes in Homicide and Gun Ownership

I first use the annual, state-level gun magazine sales data described above to investigate whether changes in gun ownership are positively related to changes in homicide rates by running specifications of the following form:

$$(1) \Delta \text{Log}(\text{Homicides}_{it}) = \alpha + \beta \Delta \text{Log}(\text{Guns}_{it}) + \rho \Delta X_{it} + \lambda + \mu_i + \varepsilon_{it}$$

In this regression Guns_{it} equals the gun magazine's sales rate in state i during year t . I obtain homicide data from two different sources - the Federal Bureau of Investigation (FBI) and the National Center for Health Statistics (NCHS). The NCHS data are a more accurate source of

¹⁶Using instrumental variables, Kleck and Patterson (1993) use cross-sectional data to estimate this relationship. To be valid, these instruments must be related with crime only through their relationship with gun ownership. Their instruments, which include city-level gun control laws, are likely to respond to criminal activity and thus fail to meet this test.

homicide data, as 5-8% of homicides are not reported in the FBI state-level data each year.¹⁷ The variables X_{it} include control variables for the log of per-capita personal income, the unemployment rate, and the fraction of state residents that are between the ages of 18 and 24. Throughout this section, the crime and gun ownership measures are defined in per-capita terms.

The coefficient estimates presented in Table 4 demonstrate that changes in state-level homicide rates are significantly positively related to changes in gun ownership. The first three specifications use FBI homicide data when calculating the left-hand side variable, while the latter three employ the corresponding data from the National Center for Health Statistics.¹⁸ The coefficient estimates are not significantly affected by the inclusion of state trend dummies or by state-level economic and demographic controls, as the second and third specifications reveal. The coefficient estimates suggest that a 10 percent increase in the rate of gun ownership is associated with approximately a 2 percent increase in the homicide rate.

This finding is consistent with the theory that increases in gun ownership lead to a rise in criminal activity, but provides equal support for the hypothesis that an increase in crime leads individuals to purchase a gun for self-defense. The set of regressions summarized in Table 5 aims to differentiate between these alternative stories by examining whether lagged increases in gun ownership are associated with increases in crime or if instead the opposite is true. The first four

¹⁷Summary statistics for these variables are included in the rightmost column of Table 7.

¹⁸These data are tabulated from death certificates. NCHS homicides include those with an ICD9-code beginning in 96 and therefore exclude deaths from legal executions or other legal interventions.

columns summarize the results from specifications of the following form:¹⁹

$$(2) \Delta \text{Log}(\text{Homicide}_{it}) = \alpha + \sum_{\tau=1}^2 \beta_{\tau} \Delta \text{Log}(\text{Guns}_{i,t-\tau}) + \sum_{\tau=1}^2 \gamma_{\tau} \Delta \text{Log}(\text{Homicide}_{i,t-\tau}) + \rho \Delta X_{it} + \lambda_t + \mu_i + \varepsilon_{it}$$

The coefficient estimate on $\Delta \text{Log}(\text{Guns}_{i,t-1})$ in the first specification implies that a ten percent increase in gun ownership in the current year is associated with a 2.14 percent increase in the homicide rate in the following year. The significantly negative estimate of -.356 on the $\Delta \text{Log}(\text{Homicide}_{i,t-1})$ demonstrates that there is substantial regression to the mean in state-level homicide rates. Results from the second specification show that this relationship between lagged changes in gun ownership and current changes in the homicide rate continues into the subsequent year as well. To control for differences in homicide trends across states during the time period of interest, I next include state trend dummies in specification three. The estimates for $\Delta \text{Log}(\text{Guns}_{i,t-1})$ and $\Delta \text{Log}(\text{Guns}_{i,t-2})$ decline slightly, but remain significantly positive. Adding state-level control variables to this regression has virtually no impact on the coefficient estimates for $\Delta \text{Log}(\text{Guns}_{i,t-1})$ and $\Delta \text{Log}(\text{Guns}_{i,t-2})$.

In columns five through eight, I summarize the results from analogous regressions with $\Delta \text{Log}(\text{Guns}_{i,t})$ as the dependent variable. In most cases, the estimated relationships between lagged changes in homicide rates and current changes in gun ownership are significantly positive, providing

¹⁹Summary statistics for the dependent variables are included in the final column of Table 7. The mean and standard deviation of $\Delta \text{Log}(\text{Guns})$ are .003 and .074, respectively.

support for the hypothesis that individuals purchase firearms in response to an increase in criminal activity. However, the estimated effect is much smaller in magnitude than in the previous four regressions - a ten percent increase in the homicide rate is associated with only a 0.2 - 0.3 percent increase in gun ownership in the subsequent year. If these dynamic specifications are accurately capturing a causal relationship, then it appears that gun ownership has a much greater impact on murder rates than murder rates have on gun ownership.

B. Gun Versus Non-Gun Homicides

One factor not addressed above is that individuals may purchase guns in response to expected future increases in criminal activity. Rather than demonstrating a causal effect of gun ownership on crime, the observed relationship in the first four columns on Table 5 may instead represent a causal effect of expected increases in crime on current gun ownership.²⁰ One way to differentiate between these two hypotheses is to divide homicides into two categories - those committed with a firearm and those committed with some other weapon. If changes in gun ownership have a similar relationship with both types of homicide, then one might conclude that individuals are purchasing more firearms in response to expected increases in crime, or that increases in gun ownership simply proxy for increases in the average criminal tendencies of the population. Alternatively, if current increases in gun ownership are more strongly related to future increases in gun homicides, then the theory that more gun ownership is causing an increase in the homicide rate would be much more plausible.

The regression results summarized in Table 6 uses the NCHS data to run specifications analogous to those presented in Table 5. A comparison of the coefficient estimates for $\Delta\text{Log}(\text{Guns}_{i,t})$

²⁰Heckman (2000) points out, for example, that past X_t often determines future Y_t in dynamic economic models.

) and $\Delta\text{Log}(\text{Guns}_{i,t-2})$ in the $\Delta\text{Log}(\text{Gun Homicides}_{i,t-1})$ and $\Delta\text{Log}(\text{Non-Gun Homicides}_{i,t-2})$ specifications reveal that increases in gun ownership are significantly positively related to increases in gun homicides, but bear no corresponding relationship with non-gun homicides. This finding strongly supports the hypothesis that increases in gun ownership lead to future increases in homicides, as it is not plausible that individuals would purchase firearms in response to predictable increases in gun homicides but be unresponsive to expected increases in non-gun homicides.

C. Other Crime Categories

The results from previous research suggest that guns influence criminal activity primarily by increasing the likelihood that a victim will be murdered and by raising the probability that an individual criminal will be successful (Cook, 1995), but that changes in gun ownership have a smaller impact on the number of other crimes committed. If this hypothesis is true, then one would expect to find a much weaker relationship between changes in gun ownership rates and future changes in other crime rates.

To test this hypothesis, I run specifications similar to the ones described above for every individual crime category. In each specification, I include lagged changes both for the gun magazine sales and for the appropriate crime category. I use data from the FBI's *Uniform Crime Reports*, which provides annual, state-level data on the number of homicides, robberies, aggravated assaults, rapes, burglaries, larcenies, and auto thefts. The coefficient estimates for $\Delta\text{Log}(\text{Guns}_{i,t-1})$ and $\Delta\text{Log}(\text{Guns}_{i,t-2})$ are displayed in Table 7, which also provides summary statistics for each of the variables of interest.

As is clear from the coefficient estimates, the relationship between state-level changes in gun ownership and future increases in robberies, aggravated assaults, and rapes is much smaller than the

corresponding one with gun homicides. In all three cases, the two coefficient estimates of interest are statistically insignificant.²¹ Similarly small estimates are found for the three property crime (burglary, larceny, and theft) specifications, although two of the six coefficient estimates are significantly positive. Given that nearly 500,000 guns are reported stolen annually, guns are apparently considered a valuable commodity to criminals. It is therefore plausible that increases in firearms ownership may increase the payoff to crimes of theft. In any case, the estimated effect is much smaller than the corresponding one for homicides, which is driven entirely by a relationship between changes in gun ownership and gun homicides. This set of findings strongly suggests that increases in gun ownership lead to increases in the number of homicides, but the evidence for impacts on other crime categories is less clear. The next section uses county-level FBI crime data to further probe these results.

D. County-Level Estimates of the Relationship Between Gun Ownership and Crime

The FBI's *Uniform Crime Reports* data provides annual, county-level information on the number of crimes in each of the seven categories described above. An examination of these data reveal that there is substantial under-reporting, with many states neglecting to provide county-level crime data for multiple years.²² In constructing the state-level crime data utilized above, the FBI

²¹If firearms increase the probability that a robbery, assault, or rape will result in the death of the victim, then there will mechanically be a negative relationship between changes in gun ownership and changes in each of these violent crime categories because, for any particular violent encounter, only the most serious of the crimes committed is recorded. Thus a robbery-murder is recorded only as a murder.

²²See the referenced paper by the Bureau of Justice Statistics (1999) for a detailed description of the reporting problems with county-level crime data. The states that are especially bad at reporting at the county level are Vermont, Illinois, Montana, and Mississippi. Many other states, including Florida, Georgia, Iowa, and Kentucky, fail to report any crime data for one or more years. A comparison of the summary statistics at the state and county level reveals that

attempts to account for under-reporting or changes in the reporting practices of police precincts. Thus state-level data is likely to be a more reliable guide to changes in crime patterns. Despite the problems associated with the county-level crime data, I use it here to probe the state-level results described above. I include all counties with populations of 100,000 or more in the empirical analysis in this section, and collapse the remaining counties within each state into 48 “rest-of-state” observations.²³

Table 8 summarizes a set of specifications analagous to the ones presented in Table 5 that examine the dynamic relationship between changes in gun ownership and changes in homicide rates.²⁴ The statistically significant estimate of 0.142 in the first column implies that a 10 percent increase in gun ownership is associated with a 1.42 percent increase in the homicide rate. This result is similar to the state-level estimate, although it is slightly smaller in magnitude. The coefficient estimate for the second lagged change in gun ownership is also significantly positive, as the second column shows. Including county trend dummies in the third column does not appreciably affect the two coefficient estimates, although the second one becomes insignificantly positive. In the final column I account for the possibility that changes in homicides or changes in gun ownership within

county-level data are substantially noisier, with standard deviations that are typically two to three times as large as the corresponding ones from state-level data (Tables 7 and 10).

²³While accounting for less than 14% of all counties, those with a population of 100,000 or more in 1990 account for almost 75% of the U.S. population in 1990. Without this adjustment, approximately half of the county-year observations will have zero murders. After the adjustment, virtually none do. Due to reporting inconsistencies with the magazine sales data, St. Louis County and St. Louis City are combined into one observation, as are Baltimore County and Baltimore City, and the five counties in New York City. For the same reason, there is only one observation annually for the state of Alaska and one annually for the state of Hawaii.

²⁴Summary statistics for the county-level specifications are included in the final column of Table 10. The mean and standard deviation of $\Delta \text{Log}(\text{Guns})$ are .003 and .114, respectively.

a state may not be independent²⁵, and after adjusting the standard errors appropriately both the $\Delta \text{Log}(\text{Guns}_{it-1})$ and $\Delta \text{Log}(\text{Guns}_{it-2})$ are significantly positive. The next four columns reveal that, as was true in the state-level regressions, the relationship between lagged changes in homicide rates and current changes in rates of gun ownership are much smaller in magnitude.

In Table 9 I present the results from analagous regressions of the relationship between lagged changes in gun ownership and current changes in the other three types of violent crime. The first two specifications for each of the individual crimes imply a significantly positive relationship between lagged changes in gun ownership and current changes in robbery and rape rates, and an insignificantly positive relationship with the rate of aggravated assault. These estimates are not robust, however, to the inclusion of county-specific trend dummies. Table 10 includes the corresponding coefficient estimates for the three property crime categories. Once again, the estimates are much smaller than the corresponding ones for the homicide rate, and are typically insignificant.

Taken together, the results in this section provide strong support for the hypothesis that increases in gun ownership lead to future increases in the homicide rate. From 1993 to 1998, the number of gun homicides fell by more than 36%, while the number of homicides in which some other weapon was used fell by only 18%.²⁶ GSS estimates suggest that the share of households with at least one gun fell from more than 42% to less than 35% during that same time period. Using the

²⁵For example, there may be state-level changes in legislation that similarly impact county-level rates of gun ownership within a state, or the police within a state may change the accuracy with which they report homicides in particular years.

²⁶See Donohue and Levitt (2001) for a discussion of other factors leading to recent reductions in the overall crime rate.

coefficient estimates from Table 6 and the GSS estimates of gun ownership, my findings suggest that approximately one-third of the *differential* decline in gun homicides, relative to non-gun homicides, can be explained by reductions in the fraction of households owning a gun.²⁷ These gains have been concentrated in the states with the largest relative reductions in gun ownership.

I also find some support for the theory that gun ownership increases other crime rates, but in all cases, the estimated effects are much smaller than the corresponding ones for homicides. This set of findings conflicts with recent research suggesting that the increases in gun ownership caused by the passage of Carrying Concealed Weapons legislation led to reductions in rates of violent crime (Lott and Mustard, 1997; Lott, 1998). In the next section, I use the gun magazine sales data to examine the reason for this discrepancy.

IV. Testing the Impact of CCW Laws

Recent work has explored whether states that enacted Carrying Concealed Weapons (CCW) laws experienced significant declines in crime relative to other states. The seminal paper in this literature argued that the passage of this legislation in ten states between 1985 and 1991 led to a substantial reduction in violent crimes, as criminals were deterred by the greater likelihood that potential victims would be armed and therefore able to defend themselves (Lott and Mustard, 1997). A long series of studies probed the robustness of the Lott-Mustard results (Black and Nagin, 1998; Ludwig, 1998) with some finding support for their central conclusions and others finding that the estimated effects were quite fragile and sensitive to the precise specification used.

Despite the abundance of recent papers in this area, none have investigated the extent to

²⁷Errors-in-variables problems with the proxy variable will tend to bias downward my estimates of the relationship between changes in gun ownership and changes in crime, suggesting that the true impact of the reduction in gun ownership may be even greater.

which CCW legislation increased the likelihood that potential victims would be armed. This probability could change if (1) the fraction of individuals owning a gun increased or if (2) the frequency with which existing owners carried their guns increased.²⁸ Using the gun magazine sales data, I test whether CCW legislation had an impact through either of these causal pathways. Finding no evidence of this, I then go on to probe the Lott-Mustard results. One proper adjustment to their empirical specifications demonstrates that their central results are inaccurate. Taken together, the three sets of findings in this section lead me to reject the hypothesis that the passage of Carrying Concealed Weapons legislation led to a significant decline in violent crime rates.

A. The Impact of CCW Legislation on Gun Ownership

Ten states²⁹ passed legislation between 1985 and 1991 that allowed individuals to carry concealed handguns. If the option to carry a firearm increased the perceived benefit associated with owning a gun, then one would expect to find an increase in the fraction of individuals owning one. To test whether gun ownership did increase in CCW states following the passage of this legislation, I run specifications of the following form:

$$(3) \Delta \text{Log}(Guns_{it}) = \alpha + \rho CCW_{it} + \beta \Delta X_{it} + \mu_t + \lambda_i + \varepsilon_{it}$$

In this regression, i and t index states and years, respectively. $GUNS_{it}$ equals the number of gun magazines sold in state i in year t . CCW_{it} is a dummy variable set equal to one if a state allows individuals to carry concealed weapons and zero otherwise. If Carrying Concealed Weapons

²⁸This is analagous to the participation (extensive) and hours-of-work (intensive) margins in the labor supply literature.

²⁹Maine (1985), Florida (1987), Virginia (1988), Georgia, Pennsylvania, and West Virginia (1989), Idaho, Mississippi, and Oregon (1990), and Montana (1991). The Pennsylvania law did not include the county of Philadelphia.

legislation led to substantial increases in the fraction of individuals owning a gun,³⁰ then one would expect to find a significantly positive coefficient estimate on CCW_{it} .

The set of regressions summarized in Table 11, however, suggest that gun ownership did not increase significantly in the states that passed CCW legislation relative to other states. In the first specification I regress the change in the state-level estimates of gun ownership on a CCW dummy variable. Year fixed effects are included to control for changes in gun ownership that are occurring at the national level. The insignificant estimate of .0038 in the first specification suggests that gun ownership did not increase substantially more in those states that enacted CCW legislation. This estimate remains small and statistically insignificant if I include state trend dummies or control variables for states' economic indicators and demographic characteristics, as the second and third specifications demonstrate. The results are similar if I run these regressions instead at the county level with a similar CCW dummy variable, run the regressions in levels of gun ownership with state and year fixed effects, or if I extend the time period under consideration. Thus it does not appear that the CCW legislation reduced crime by significantly increasing the rate of gun ownership, suggesting that the benefits of carrying a firearm were not sufficiently large to induce many individuals who did not already own a firearm to purchase one. This finding weakens the evidence for one of the two causal pathways described above.

B. Did Crime Decline More in High Ownership Counties?

Despite the apparent absence of an effect on gun ownership, the passage of Carrying

³⁰In analagous studies of the effect of changes in the prison population and the police force on the crime rate, Levitt (1996, 1997) first demonstrates that his instruments (prison overcrowding legislation and the timing of mayoral elections) had a significant impact on the number of prisoners and on the number of police. He then uses this plausibly exogenous variation to examine the impact on crime.

Concealed Weapons laws could still have caused a reduction in crime rates. Criminals in CCW states may have been deterred from committing crimes because of a perception that the existing set of gun owners would now carry their guns with them more frequently. If CCW legislation did lead to a reduction in crime through this channel, one would expect to detect the greatest change in those counties with relatively higher rates of gun ownership within CCW states. The logic of this argument is fairly straightforward. Suppose that there are two types of counties - those with high gun ownership and those with low ownership. If the frequency with which any individual owner carried her gun increased uniformly across counties, then the probability that a potential victim would be armed would increase more significantly in high ownership areas.³¹ As long as criminals did, on average, accurately perceive differences in gun ownership rates across areas, one would expect to see the largest declines in crime in those counties with the highest gun ownership when the legislation was enacted.³²

In Table 12 I explore whether, within CCW states, those counties with the highest rate of pre-CCW gun ownership had the largest changes in their violent and property crime rates. I include only those counties located in the ten states that passed CCW legislation during the time period of

³¹One potential problem with this line of reasoning is that the increased propensity to carry a firearm may vary systematically with the level of gun ownership. It seems likely, however, that this carrying probability for any individual gun owner would increase most in areas with the highest rates of ownership, as these individuals are likely to have a greater taste for gun ownership. This would therefore strengthen the claim that crime should decline most in high-ownership counties after the passage of CCW legislation.

³²Although there is no perfect way to test whether criminals accurately estimate gun ownership rates, it seems implausible that criminals would systematically mistake high-ownership areas for low-ownership ones and vice-versa. The fact that guns are frequently stolen and that criminals frequently purchase their firearms at gun shows would provide them with two direct sources of information regarding the rate of gun ownership within an area.

interest. In these regressions, the gun ownership measure is simply the log of the gun magazine sales rate in a county in the year before the CCW legislation was passed. The left-hand side variables, $\Delta\text{Log}(\text{Violent Crime}_{it})$ and $\Delta\text{Log}(\text{Property Crime}_{it})$, are the natural log of the difference between the crime rate two years after the passage of CCW legislation and one year before.

Specification one suggests there were not significantly greater reductions in rates of violent crime in those counties with high levels of pre-CCW gun ownership. The estimate on the $\text{Log}(\text{Guns}_{it})$ coefficient is not affected much by the inclusion of pre-existing trends in violent crime rates, as specification two shows. The corresponding regressions for changes in property crime rates, summarized in the third and final columns, are not consistent with the hypothesis that property crime changed differentially in places with more gun ownership following the passage of CCW legislation. Similar specifications for each of the individual crime categories demonstrate that there is no significant relationship between the pre-CCW level of gun ownership and the subsequent change in any type of violent or property crime.

Thus it appears that violent crime did not decline significantly more in counties within CCW states that had high rates of gun ownership, suggesting either that existing gun owners did not increase the frequency with which they carried their guns or that this carrying had a negligible impact on the behavior of criminals. In either case, this finding weakens the evidence for the second channel through which CCW legislation could have affected the crime rate.

C. Robustness Checks on the Lott-Mustard Results

Given that CCW legislation did not lead to significant increases in gun ownership, nor did it reduce crime relatively more in places with high pre-CCW rates of gun ownership, it does not appear that carrying-concealed weapons legislation could plausibly have caused a reduction in crime

rates. Therefore, it would be surprising if one did find a strong reduction in violent crime rates following the passage of CCW legislation. After all, what would the causal pathway be? If there were a significant relationship between the passage of CCW legislation and the subsequent change in violent crime, then possible explanations would be that (1) CCW states were simultaneously taking other, more effective, measures to reduce violent crime, (2) states pass CCW legislation when crime is peaking, or (3) there is an omitted variable that is leading to a spurious relationship.³³

In this section I probe the Lott-Mustard results to investigate whether there is, in fact, a significant relationship between the passage of CCW legislation and the crime rate. The first set of specifications summarized in column one replicate the Lott-Mustard results, and represent regressions of the following form:

$$(4) \text{Log}(Crime_{ijt}) = \alpha + \beta X_{ijt} + \rho CCW_{jt} + \lambda_t + \mu_i + \varepsilon_{ijt}$$

In this equation, *i*, *j*, and *t* index counties, states, and years, respectively. The coefficient estimates in the first column of Table 13 suggest that violent crime rates are significantly lower after states pass CCW legislation, and that property crime rates are correspondingly higher.

One problem with these regression estimates is that Lott and Mustard are implicitly assuming that these laws are varying at the county level, when in fact they are varying only at the state level.³⁴ Therefore, one must adjust the standard errors appropriately to account for the fact that county-level

³³Regression to the mean would lead to a negative estimate for the impact of Carrying Concealed Weapons legislation in the second example.

³⁴One exception to this is Philadelphia, which was exempt from Pennsylvania's CCW legislation during the time period under consideration.

disturbances are likely to be correlated within a state.³⁵ The second column presents coefficient estimates for ρ from nine analogous regressions that properly account for the within-state correlation in errors. In all cases, the standard errors increase more than threefold, and only the auto theft estimate remains statistically significant. Thus it appears that the passage of CCW legislation is not associated with a significant decline in rates of violent crime, though all four violent crime coefficient estimates are negative.

The coefficient estimates listed in the third column are estimated from nine analogous specifications that include only year and county effects with the CCW dummy variable. Because many counties are missing arrest or other data, this change leads to a substantial increase in the number of observations in each of the regressions. After this adjustment, the estimates for the rape and robbery rates flip sign while the estimates for both the murder and assault rates become less negative.³⁶ The final column adjusts the Lott-Mustard SHALL issue dummy to be consistently defined across states.³⁷ Once again, the violent crime estimates become either less negative (murder and assault) or more positive (rape and robbery). These simple robustness checks therefore reveal that CCW legislation did not lead to a significant decline in violent crime rates.

Carrying Concealed Weapons legislation could have impacted the crime rate through two

³⁵See Moulton (1990) for a discussion of this issue. In essence, Lott and Mustard are assuming that there are 700 independent “natural experiments”, when in fact there are only ten.

³⁶This change in coefficient estimates is driven primarily by the inclusion of counties that were excluded in the first and second set of regressions due to missing data. Thus the sample selection caused by the Lott-Mustard specification choice appears to lead to a systematic overestimate of the impact of CCW legislation on criminal activity.

³⁷In their regressions, the shall issue dummy is set equal to one in the year that legislation was passed and in all years thereafter for eight of the ten states. For Florida and Georgia the dummy variable is set equal to one in the year after the legislation was passed.

plausible channels. Using the magazine sales data, I find no evidence to suggest that CCW laws did lead to a reduction in the violent crime rate through either of these two pathways. Consistent with this, one proper adjustment to the Lott-Mustard specifications reveals that their central findings are not accurate.

V. Conclusion

This paper uses a unique data set to demonstrate that increases in gun ownership lead to substantial increases in the overall homicide rate. This is driven entirely by a relationship between firearms and homicides in which a gun is used, implying that the results are not driven by reverse causation nor by omitted variables. The relationship between changes in gun ownership and changes in all other crime categories is smaller and often insignificant, suggesting that the primary channel through which guns influence crime is the homicide rate. I then use this data to show that recent work exploring the impact of Carrying Concealed Weapons legislation has reached inaccurate conclusions.

The data employed in this paper should allow researchers to answer other important questions regarding the impact of alternative gun control policies and the effect of gun ownership on other outcomes of interest. After peaking at more than 39,000 in 1993, the number of individuals dying from gun-inflicted injuries fell by 23% during the next five years. While much of this decline is due to a reduction in gun homicides, the number of deaths from gun suicides has also fallen substantially. Whether recent reductions in firearms ownership have caused the reduction in the nation's suicide rate is an important topic for future research.³⁸

³⁸During this same time period, the number of non-gun suicides increased by 8% while the number of gun suicides declined by more than 8%. Because guns are used in a majority of all suicides, the overall suicide rate has declined.

More generally, the magazine sales data employed in this paper suggest an alternative strategy for estimating variables that have previously been considered unobservable. Similar applications of this data in other settings may allow researchers to answer more convincingly other important empirical questions.

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Table 1: Determinants of Gun Magazine Sales at the County Level

Variable	Log(<i>Guns & Ammo</i> Sales in 1990 per 1000 Residents)		
	(1)	(2)	(3)
% College Grads ₉₀	-1.39*** (.27)	-1.66*** (.24)	-2.06*** (.32)
% No HS Degree ₉₀	-1.95*** (.25)	-1.88*** (.23)	-1.39*** (.27)
Log(Income per Capita ₉₀)	.205** (.080)	.313*** (.079)	.356*** (.116)
% Rural ₉₀	.249*** (.059)	.160*** (.056)	.216*** (.055)
% White ₉₀	.396*** (.101)	.364*** (.101)	.008 (.123)
% Males ₈₁	5.18*** (1.08)	5.07*** (1.05)	3.20*** (1.17)
% Age 0-17 ₉₀			-2.45*** (0.55)
% Age 65+ ₉₀			-1.67*** (0.50)
% Poor ₉₀			-.446 (.427)
Pop Density ₉₀			-0.198*** (.0028)
Midwest	.049* (.028)		
South	.162*** (.028)		
West	.267*** (.034)		
State Fixed Effects?	No	Yes	Yes
# Observations	492	492	492
R ²	0.548	0.747	0.780

Dependent variable is the log of the *Guns & Ammo* sales rate per 1000 residents. The data set consists of all counties in the U.S. in 1990 with a population of 100,000 or more. All other counties are collapsed into “rest-of-state” observations. County-level demographic and economic indicators are obtained from the 1990 census. Standard errors are included in parentheses.

Table 2: Relationship of Gun Magazine Sales with Gun Shows, Gun Accidents, and Gun Suicides

	Log(Gun Shows)	Log(Gun Acc)	Log(Gun Suic)	Log(Non Suic)
Log(<i>Guns & Ammo</i>)	0.995*** (0.363)	1.183*** (0.370)	1.437*** (0.169)	0.044 (0.128)
R-squared	.155	.179	.595	.002
# Observations	43	50	51	51

The dependent variable in the first specification is the log of the number of gun shows per state resident in 1996. The next three dependent variables are the log of the 1996 state-level death rate from gun accidents, gun suicides, and non-gun suicides, respectively. Regressions are weighted by state population and standard errors are included in parentheses.

Table 3: Relationship of Gun Magazine Sales with NRA Membership and GSS Gun Ownership

	Log(NRA Membership)		Log(GSS Ownership)	
	(1)	(2)	(3)	(4)
Log(<i>Guns & Ammo</i>)	0.807*** (0.132)	0.389*** (0.022)	0.975*** (0.188)	0.354*** (0.114)
R-squared	.431	.967	.384	.712
# Observations	51	867	45	488
Year Fixed Effects?	-	Yes	-	Yes
State Fixed Effects?	-	Yes	-	Yes

The dependent variable in the first specification is the log of the average NRA membership rate (per 1000 state residents) from 1982-1998. The dependent variable in the second column is the log of the NRA membership rate, with annual state-level observations from 1982-1998. The dependent variable in the third specification is log of the fraction of 1980-1998 GSS respondents within a state who claim to own at least one gun. Only 45 states are included because GSS data are not available for six of the smaller states. The dependent variable in the fourth specification contains annual, state-level observations for the same variable. There were 18,755 respondents to the question during the 1980-1998 surveys. Regressions one and two are weighted by the state population and the subsequent two are weighted by the number of GSS survey respondents within each state. Standard errors are included in parentheses.

Table 4: Relationship Between Changes in Homicide Rate and Changes in Gun Ownership

	$\Delta \text{Log}(\text{FBI Homicides}_{it})$			$\Delta \text{Log}(\text{NCHS Homicides}_{it})$		
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta \text{Log}(\text{Guns}_{it})$	.226*** (.079)	.187** (.083)	.194** (.085)	.226*** (.072)	.191** (.077)	.178** (.078)
State Trend Dummies?	No	Yes	Yes	No	Yes	Yes
R-squared	.159	.173	.174	.222	.237	.240

The dependent variable in the first three specifications, $\Delta \text{Log}(\text{FBI Homicides}_{it})$, is the change in the log of the state-level homicide rate as reported to the FBI, with the dependent variable in the latter three specifications, $\Delta \text{Log}(\text{NCHS Homicides}_{it})$, equal to the change in the log of the state-level homicide rate using data from the National Center for Health Statistics. $\Delta \text{Log}(\text{Guns}_{it})$ equals the change in the log of the state-level gun magazine sales rate. The sample includes state-year observations from 1980-1998. Number of obs is 918 in all regressions. Each regression includes year fixed effects and is weighted by state population. White standard errors are in parentheses.

Table 5: State-Level Estimates of the Relationship Between Changes in Rates of Homicide and Gun Ownership

	Log(FBI Homicides _{it})				Log(Guns _{it})			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log(Guns _{i,t-1})	.214** (.099)	.210** (.100)	.180* (.103)	.190* (.103)	.100* (.054)	.102* (.054)	.032 (.050)	.011 (.050)
Log(Guns _{i,t-2})		.243** (.092)	.210** (.094)	.214** (.095)		.134*** (.038)	.080** (.035)	.070** (.034)
Log(FBI Homicides _{i,t-1})	-.356*** (.050)	-.386*** (.050)	-.428*** (.049)	-.427*** (.050)	.013 (.010)	.025** (.011)	.019* (.011)	.019* (.011)
Log(FBI Homicides _{i,t-2})		-.065* (.048)	-.102*** (.050)	-.102** (.050)		.032*** (.012)	.027** (.012)	.029** (.012)
Log(Per Capita Income _{it})				-.276 (.390)				.694*** (.134)
Unemployment Rate _{it}				-.300 (.749)				.588** (.276)
% Aged 18-24 _{it}				-.673 (3.957)				1.946 (1.788)
State Trend Dummies?	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	.270	.281	.317	.317	.600	.628	.661	.677

The dependent variable in the first four specifications, $\Delta \text{Log}(\text{FBI Homicides}_{it})$, is the change in the log of the state-level homicide rate (using FBI data), with the dependent variable in the latter four specifications, $\Delta \text{Log}(\text{Guns}_{it})$, equal to the change in the log of the state-level gun magazine sales rate. The sample includes state-year observations from 1980-1998. Number of obs is 816 in all regressions except (1) and (5), which have 867 each. Each regression includes year fixed effects and is weighted by state population. White standard errors are in parentheses.

Table 6: The Relationship Between Lagged Changes in Gun Ownership and Current Changes in Gun and Non-Gun Homicides

	Log(Gun Homicides _{it})				Log(Non-Gun Homicides _{it})			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log(Guns _{i,t-1})	.316*** (.111)	.302*** (.112)	.306*** (.117)	.291** (.118)	.117 (.087)	.118 (.088)	.020 (.092)	.022 (.093)
Log(Guns _{i,t-2})		.236** (.107)	.223** (.112)	.215* (.114)		.111 (.096)	.040 (.099)	.037 (.100)
Log(Gun Homicides _{i,t-1})	-.322*** (.039)	-.337*** (.044)	-.372*** (.046)	-.376*** (.047)				
Log(Gun Homicides _{i,t-2})		-.038 (.040)	-.071* (.042)	-.071* (.042)				
Log(Non-Gun Homicides _{i,t-1})					-.453*** (.042)	-.557*** (.044)	-.589*** (.044)	-.588*** (.045)
Log(Non-Gun Homicides _{i,t-2})						-.222*** (.040)	-.253*** (.042)	-.253*** (.042)
Log(Per Capita Income _{it})				.197 (.424)				.000 (.421)
Unemployment Rate _{it}				.691 (.905)				-.453 (.798)
% Aged 18-24 _{it}				.045 (4.693)				3.474 (4.620)
State Trend Dummies?	No	No	Yes	Yes	No	No	Yes	Yes
R-squared	.294	.299	.328	.329	.257	.303	.336	.337

The dependent variable in the first four specifications, $\Delta \text{Log}(\text{Gun Homicides}_{it})$, is the change in the log of the state-level gun homicide rate, with the dependent variable in the latter four specifications, $\Delta \text{Log}(\text{Non-Gun Homicides}_{it})$, equal to the change in the log of the state-level non-gun homicide rate. These data are obtained from the National Center for Health Statistics. The sample includes state-year observations from 1980-1998. Number of obs is 816 in all regressions except (1) and (5), which have 867 each. Each regression includes year fixed effects and is weighted by state population. White standard errors are in parentheses.

Table 7: The Relationship Between Changes in Gun Ownership and Future Changes in Crime

	$\Delta \text{Log}(\text{Guns})$ Coefficient Estimates		μ and σ
	(t-1)	(t-2)	
$\Delta \text{Log}(\text{Gun Homicide}_{it})$	.306*** (.117)	.223** (.112)	-.026 (.166)
$\Delta \text{Log}(\text{Non-Gun Homicide}_{it})$	.020 (.092)	.040 (.099)	-.028 (.163)
$\Delta \text{Log}(\text{FBI Homicide}_{it})$	.180* (.103)	.210** (.094)	-.027 (.123)
$\Delta \text{Log}(\text{FBI Robbery}_{it})$	-.016 (.097)	.069 (.069)	-.017 (.104)
$\Delta \text{Log}(\text{FBI Assault}_{it})$	-.007 (.085)	-.013 (.061)	.010 (.091)
$\Delta \text{Log}(\text{FBI Rape}_{it})$	-.052 (.073)	-.092 (.060)	-.003 (.085)
$\Delta \text{Log}(\text{FBI Burglary}_{it})$	-.002 (.054)	.094* (.049)	-.038 (.065)
$\Delta \text{Log}(\text{FBI Larceny}_{it})$	.081** (.036)	.032 (.035)	-.009 (.048)
$\Delta \text{Log}(\text{FBI Auto Theft}_{it})$	.043 (.077)	.019 (.073)	-.004 (.096)

The dependent variables are listed in the first column, with the coefficient estimates for $\Delta \text{Log}(\text{Guns}_{i,t-1})$ and $\Delta \text{Log}(\text{Guns}_{i,t-2})$ (from a specification analogous to specification three in Table 6) displayed in the second and third columns. Each specification includes lagged changes of the appropriate crime category, and summary statistics for each of the dependent variables are provided in the fourth column. The mean and standard deviation for $\Delta \text{Log}(\text{Guns}_{it})$ are .003 and .074, respectively. For all specifications, the sample includes state-year observations from 1980-1998, resulting in 816 observations. Each regression includes year fixed effects and is weighted by state population. White standard errors are in parentheses.

Table 8: County-Level Estimates of the Relationship Between Changes in Rates of Homicide and Gun Ownership

	Log(FBI Homicides _{it})				Log(Guns _{it})			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Log(Guns _{i,t-1})	.142*** (.054)	.152*** (.055)	.145** (.055)	.145** (.065)	-.030 (.032)	-.028 (.033)	-.081*** (.034)	-.081*** (.028)
Log(Guns _{i,t-2})		.098* (.055)	.087 (.057)	.087* (.052)		-.078*** (.017)	-.123*** (.017)	-.123*** (.017)
Log(FBI Homicides _{i,t-1})	-.425*** (.024)	-.548*** (.025)	-.570*** (.023)	-.570*** (.023)	.001 (.003)	.003 (.003)	.003 (.003)	.003 (.003)
Log(FBI Homicides _{i,t-2})		-.255*** (.021)	-.276*** (.020)	-.276*** (.021)		.004 (.003)	.004 (.003)	.004* (.003)
County Trend Dummies?	No	No	Yes	Yes	No	No	Yes	Yes
# Observations	7766	7181	7181	7181	7963	7359	7359	7359
R-squared	.201	.260	.287	.287	.260	.267	.318	.318

The dependent variable in the first four specifications, $\Delta \text{Log}(\text{FBI Homicides}_{it})$, is the change in the log of the county-level homicide rate, with the dependent variable in the latter four specifications, $\Delta \text{Log}(\text{Guns}_{it})$, equal to the change in the log of the county-level gun magazine sales rate. The sample includes county-year observations from 1980-1998. Counties with a population of 100,000 or more in 1990 are included, with all other counties collapsed into rest-of-state categories for each state. Certain county-year observations are missing due to missing crime data. Each regression includes year fixed effects and is weighted by county population. White standard errors are in parentheses.

Table 9: The Relationship Between Changes in Gun Ownership and Future Changes in Other Violent Crimes

	Log(FBI Robberies _{it})			Log(FBI Assaults _{it})			Log(FBI Rapes _{it})		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Log(Guns _{i,t-1})	.061 (.039)	.096** (.039)	.069 (.043)	.037 (.031)	.043 (.031)	.035 (.032)	.082** (.038)	.070* (.037)	.011 (.048)
Log(Guns _{i,t-2})		.000 (.045)	-.026 (.047)		-.053 (.045)	-.062 (.054)		-.025 (.048)	-.059 (.060)
Log(FBI Robberies _{i,t-1})	-.210*** (.072)	-.335*** (.054)	-.366*** (.045)						
Log(FBI Robberies _{i,t-2})		-.083** (.032)	-.097** (.043)						
Log(FBI Assaults _{i,t-1})				-.226*** (.055)	-.259*** (.062)	-.312*** (.060)			
Log(FBI Assaults _{i,t-2})					-.094*** (.026)	-.136*** (.042)			
Log(FBI Rapes _{i,t-1})							-.396*** (.078)	-.466*** (.081)	-.504*** (.080)
Log(FBI Rapes _{i,t-2})								-.205*** (.047)	-.242*** (.051)
County Trend Dummies?	No	No	Yes	No	No	Yes	No	No	Yes
# Observations	8145	7604	7604	8107	7566	7566	7891	7331	7331
R-squared	.116	.150	.187	.101	.110	.166	.185	.205	.244

The dependent variable in the first three specifications, $\Delta \text{Log}(\text{FBI Robberies}_{it})$, is the change in the log of the county-level robbery rate, with the dependent variable in the two other sets of specifications equal to the change in the log of the county-level assault and rape rates, respectively. $\Delta \text{Log}(\text{Guns}_{it})$, equal to the change in the log of the county-level gun magazine sales rate. The sample includes county-year observations from 1980-1998. Counties with a population of 100,000 or more in 1990 are included, with all other counties collapsed into rest-of-state categories for each state. Certain county-year observations are missing due to missing crime data. Each regression includes year fixed effects and is weighted by county population. White standard errors are included in parentheses.

Table 10: The Relationship Between Changes in Gun Ownership and Future Changes in Crime

	$\Delta \text{Log}(\text{Guns})$ Coefficient Estimates		μ and σ
	(t-1)	(t-2)	
$\Delta \text{Log}(\text{FBI Homicide}_{it})$	.145** (.065)	.087* (.052)	-.028 (.499)
$\Delta \text{Log}(\text{FBI Robbery}_{it})$	.069 (.043)	-.026 (.047)	-.006 (.376)
$\Delta \text{Log}(\text{FBI Assault}_{it})$	.035 (.032)	-.062 (.054)	.006 (.270)
$\Delta \text{Log}(\text{FBI Rape}_{it})$	.011 (.048)	-.059 (.060)	.000 (.313)
$\Delta \text{Log}(\text{FBI Burglary}_{it})$	.019 (.036)	-.023 (.040)	-.042 (.226)
$\Delta \text{Log}(\text{FBI Larceny}_{it})$	.023 (.037)	-.038 (.049)	-.014 (.298)
$\Delta \text{Log}(\text{FBI Auto Theft}_{it})$	.071* (.040)	.007 (.046)	.000 (.333)

The dependent variables are listed in the first column, with the coefficient estimates for $\Delta \text{Log}(\text{Guns}_{i,t-1})$ and $\Delta \text{Log}(\text{Guns}_{i,t-2})$ (from a specification analogous to specification three in Table 6) displayed in the second and third columns. Each specification includes two lagged changes for the appropriate crime category, and summary statistics for each of the dependent variables are provided in the fourth column. For all specifications, the sample includes county-year observations from 1980-1998. Each regression includes year fixed effects and is weighted by county population. White standard errors are in parentheses.

Table 11: Impact of CCW Legislation on Estimated Changes in Gun Ownership

	$\Delta \text{Log}(\text{Guns}_{it})$		
CCW _{it}	.0038 (.0077)	.0009 (.0099)	.0038 (.0099)
# Observations	765	765	765
R-squared	.701	.717	.743
State Trend Dummies?	No	Yes	Yes
State Controls?	No	No	Yes

The observations include annual, state-level data from 1978-1992 (first change includes 1977 data). CCW_{it} is set equal to one in the year that Carrying Concealed Weapons legislation is passed within a state and equals one in all subsequent years as well. All regressions include year fixed effects and are weighted by state population. White standard errors are in parentheses.

Table 12: Effect of Pre-CCW Gun Ownership on Subsequent Changes in Crime

	$\Delta \text{Log}(\text{Violent}_{it})$		$\Delta \text{Log}(\text{Property}_{it})$	
Log(Guns _{it})	-.037 (.051)	.031 (.061)	-.007 (.040)	.031 (.045)
$\Delta \text{Log}(\text{Violent}_{i,t-1})$		-.433*** (.148)		
$\Delta \text{Log}(\text{Property}_{i,t-1})$				-.249 (.214)
# Observations	629	629	613	613
R-squared	.137	.243	.281	.306
State Effects?	Yes	Yes	Yes	Yes

Observations include those counties in the ten CCW states with non-missing crime data. $\Delta \text{Violent}_{it}$ is defined to be the change in the log of the violent crime rate from one year before the CCW legislation was passed to two years after. The property crime dependent variable is defined similarly. Regressions are weighted by county population and White standard errors are in parentheses.

Table 13: Robustness Checks on the Lott-Mustard Results

	Coefficient Estimates on CCW Dummy Variable			
	(1)	(2)	(3)	(4)
Log (Murder Rate _{it})	-.0733*** (.0157) 26,458	-.0733 (.0525) 26,458	-.0363 (.0557) 46,979	-.0093 (.0490) 46,979
Log (Rape Rate _{it})	-.0520*** (.0122) 33,865	-.0520 (.0422) 33,865	.0380 (.0954) 46,161	.0563 (.0949) 46,161
Log (Aggravated Assault _{it})	-.0699*** (.0144) 43,445	-.0699 (.0554) 43,445	-.0621 (.0596) 46,893	-.0460 (.0631) 46,893
Log (Robbery Rate _{it})	-.0225* (.0133) 34,949	-.0225 (.0443) 34,949	.0481 (.1072) 46,974	.0995 (.1230) 46,974
Log (Violent Crime Rate _{it})	-.0488*** (.0098) 43,451	-.0488 (.0364) 43,451	-.0207 (.0478) 46,070	.0029 (.0554) 46,070
Log (Burglary Rate _{it})	.0005 (.0076) 45,769	.0005 (.0352) 45,769	.0613 (.0730) 46,970	.0897 (.0811) 46,970
Log (Larceny Rate _{it})	.0334*** (.0089) 45,743	.0334 (.0316) 45,743	.0482 (.0506) 46,973	.0483 (.0578) 46,973
Log (Auto Theft Rate _{it})	.0701*** (.0113) 44,360	.0701* (.0409) 44,360	.0789 (.0959) 46,978	.1114 (.1032) 46,978
Log (Property Crime Rate _{it})	.0267*** (.0072) 45,940	.0267 (.0271) 45,940	.0504 (.0523) 46,963	.0686 (.0589) 46,963

Each cell contains a coefficient estimate for the CCW dummy variable from specifications analogous to equation (4) in the text. The first column replicates the results from Lott-Mustard (1997). The second column contains the same coefficient estimates with the proper adjustment to the standard errors, accounting for within-state correlation in disturbances. The third column summarizes the results from specifications in which only the CCW dummy variable, county fixed effects, and year fixed effects are included. The final column corrects the CCW dummy variable to be consistently defined for the ten CCW states. Regressions are weighted by county population and standard errors are included in parentheses.