DOES GUN PREVALENCE AFFECT TEEN GUN CARRYING AFTER ALL?*

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KEYWORDS: gun carrying, gun prevalence, youth crime

Previous research suggests that American adolescents usually have ready access to guns, and that the extent of misuse of guns by adolescents is not much affected by local gun prevalence or regulation. This "futility" claim is based on one interpretation of survey data from several cities, but has not been tested directly. Here we do so using microdata from a nationally representative survey, the 1995 National Survey of Adolescent Males. Using the restricted geo-coded version of these data, and conditioning on an extensive set of covariates, we find (among other results) that the likelihood of gun carrying increases markedly with the prevalence of gun ownership in the given community. We also analyze the propensity to carry other types of weapons, finding that it is unrelated to the local prevalence of gun ownership. The prevalence of youths carrying both guns and other weapons is positively related to the local rate of youth violence (as measured by the robbery rate), confirmatory evidence that weapons carrying by youths is motivated in part by self-protection.

INTRODUCTION

When it comes to gun policy, one of the few uncontroversial assertions is that unsupervised adolescents should not carry them in public. This consensus has been codified in both national and state laws. The federal

* Thanks to Bob Malme, Jason Ost and Stacey Phillips for excellent research assistance, to Freya Sonnenstein for facilitating our access to the NSAM data, to the faculty and affiliated experts of the Johns Hopkins Center for Gun Policy and Research for helpful comments, and to the Joyce Foundation for financial support. All opinions and any errors are our own.

Gun Control Act of 1968 prohibits licensed dealers from selling to minors under 18 (for rifles and shotguns) or under 21 (for handguns). A 1994 amendment established 18 (with limited exceptions) as the national minimum age for possessing or buying handguns or handgun ammunition. Most states have imposed similar legislation. State laws governing concealed-weapon permits always specify a minimum age (Vernick and Hepburn, 2003). These laws highlight the problem, but clearly have not solved it.

The problem, in essence, stems from the fact that adolescents tend to be irresponsible and prone to violence. When they settle their conflicts with guns, death is a likely result (Cook, 1991; Felson and Messner, 1996; Kleck and McElrath, 1991; Wells and Horney, 2002; Zimring, 1968). By most accounts the national epidemic of youth violence, which began in the mid-1980s and peaked in 1993, was as deadly as it was because more guns were carried and used than had been before that time, many more. Homicide death rates for males aged 13 to 17 tripled, due solely to gun assaults (Blumstein, 1995), and remained high in the years following the 1993 peak (Cook and Laub, 2002).

Efforts to reduce the numbers of (violence-prone) adolescents involved with guns could in principle focus on either "demand," the motivation for and legal consequences of carrying a gun, or "supply," the availability of guns. The first approach was adopted in Boston's well-known and apparently successful Operation Ceasefire (Braga et al., 2001).[1] The second has not been well tested and remains controversial. A baseline issue is whether guns will be more readily available to teens in communities where guns are more common. The answer may seem obvious. Prominent scholars, however, have argued that teens at risk for criminal gun use are not affected by prevalence, because (1) those who want a gun for self-protection are insensitive to the time, money or risk associated with acquiring one, and (2) in any case guns are sufficiently common, and underground markets sufficiently efficient, that those who want one can easily get one (Kates and Polsby, 2000; Polsby, 1994; Wright and Rossi, 1994). We dub this perspective the "futility hypothesis," because it maintains that restrictions on gun markets do not reduce the misuse of guns (Cook and Leitzel, 1996).

1. In response, policymakers sought methods for separating youths and guns. The seminal example is Operation Ceasefire in Boston, in which a consortium of law enforcement agencies banded together beginning in 1996 to deliver a credible message to youth gangs that any gun use would lead to serious legal consequences (Braga et al., 2001). Other jurisdictions have adopted variants on this strategy. Despite these efforts, the percentage of youth homicides involving guns, which climbed rapidly during the epidemic, remained high in the years following the 1993 peak (Cook and Laub, 2002).

The empirical evidence on whether prevalence matters is surprisingly limited. In their pioneering study Sheley and Wright (1995) conclude that American teens generally have ready access to guns and that feasible regulations on gun ownership or transactions would have little effect on whether they were involved with them. But the conclusion, rather than being based on a direct test such as a comparison of gun-involvement rates across jurisdictions with different levels of gun ownership, is speculative.

In this paper we use the 1995 National Survey of Adolescent Males (NSAM), which included items on weapons carrying and use, to conduct such a test. These data indicate that gun carrying is remarkably prevalent among 15- to 17-year-old males—10 percent reported carrying at least once a month—and positively associated with the individual's drug use, involvement in violence and criminal activity. Our key finding is that in this group the likelihood of carrying a gun increases with the prevalence of gun ownership in the community. That result obtains after controlling for individual and county-level characteristics.

There is of course some possibility of reverse causation, that teen gun carrying affects the household demand for gun ownership. To rule this out we estimated our gun-carrying regressions using two-stage least squares, in which the second-stage estimate is based on the variation in county-level gun prevalence in the 1990s explained by variation in the proportion of the state population living in rural areas in 1950. It turns out that "percent rural in 1950" is strongly predictive of county-level gun prevalence in 1995. Second-stage estimates are qualitatively similar to our original estimates, and in particular suggest a positive effect of gun prevalence on adolescent gun carrying.[2]

We also analyze the propensity of adolescent males to carry any type of weapon (including a gun). Gun prevalence, it turns out, affects the decision of *what type* of weapon to carry, but not *whether* to carry one. The propensity to carry a weapon *is* associated with indicators of the threat facing youthful males, and increases with the local robbery rate and with residence in public housing.

We begin with a review of previous findings and interpretations, and then proceed to introduce NSAM, reporting national patterns for gun and other weapon carrying estimated from the NSAM data. We then use a multivariate analysis to explore the effects of the community context on the likelihood of gun carrying while controlling for an array of individual, household and county-level characteristics. We conclude by relating the key results to the policy context.

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2. As discussed below, this estimation approach does not logically rule out the possibility of omitted-variable bias.

PREVIOUS RESEARCH AND COMMENTARY

Much of what is known about adolescent gun involvement comes from the 1991 Youth Gun Survey (Sheley and Wright, 1995). This study interviewed 758 male students in ten inner city high schools in five cities across four states. It was a sample of convenience, not intended to be representative of any well-defined population. Items on gun possession, carrying and access were included. Overall, 22 percent of respondents said they owned a gun and 35 percent said they carried a gun at least on occasion—4 percent all the time, 8 percent "most of the time" and 23 percent "now and then" (Sheley and Wright, 1995:43). Respondents who said they carried a gun on a regular basis usually said that they did so to protect themselves (Sheley and Wright, 1995:70). The higher prevalence of carrying a gun over owning one is attributed to how easy it is to borrow one, whether from a gang or other sources (Sheley and Wright, 1995:99). When asked "How would you go about getting a gun if you decided you wanted one?," a majority said that they would borrow or buy from family or friends (Sheley and Wright, 1995:47). But Sheley and Wright believe that theft is also an important source (Sheley and Wright, 1995:151).

Sheley and Wright were impressed by the apparent ease with which their respondents could obtain a gun and concluded that gun control, as a strategy to reduce adolescent involvement, is futile. If the general prevalence of gun ownership were somehow reduced, they speculate, and there were thus "fewer guns to steal from the gun-owning public" (Sheley and Wright, 1995:151), those who wanted guns would find other informal and illicit sources for them. Wright has developed this argument in other writings as well. For example, he argues that "the 200 million guns now in circulation would be sufficient to sustain roughly another century of gun violence at the current rates. . . . Because of the large number of guns already in circulation, the violence-reductive effects of even fairly draconian gun-control measures might not be felt for decades (Wright, 1995:64)." He goes on to say that the "survival motive among the bad guys means exactly that the 'wrong kinds of people' will be carrying guns pretty much all the time" (Wright, 1995:66).

The futility hypothesis, then, holds that changes in the general prevalence of guns will have no effect on whether adolescents (and, Wright would add, dangerous adults) carry or own guns. In economic terms, either the demand for guns is inelastic, or the supply is unaffected by prevalence and regulation—or both. Arguments along these lines are often offered in the national debate over gun control (Cook and Leitzel, 1996; Jacobs and Potter, 1995), but are rarely subjected to direct test.

There is more evidence available in other areas of problematic behavior on how youths respond to availability, price and consequences. Smoking

and drinking by teens are both highly sensitive to prices (Gruber and Zinman, 2001; Cook and Moore, 2001). Minimum-age laws have been somewhat effective in reducing highway fatality rates among underage drivers (Dee and Evans, 2001). Out-of-pocket cost is also a major factor for 18- to 19-year-old low-income women in deciding whether to have an abortion (Cook et al., 1999). Levitt (1998) has demonstrated that youths reduce criminal activity the year that they make the transition from juvenile to adult status. Such findings are suggestive: They indicate that teenagers as a group are responsive to incentives when making decisions concerning risky or criminal behavior.

What little is known about the elasticity of demand for guns by teens and dangerous adults comes from surveys of convenience samples, among them the 1995 Sheley-Wright survey of youths and the 1994 Wright-Rossi survey of incarcerated adults. The Wright-Rossi study provides evidence that at least some high-risk adults were sensitive to the money, time or risk associated with acquiring a gun.[3] Of those prisoners who committed their crimes armed with something other than a gun, 45 percent reported "against the law for me to own a gun" as at least a little important in their decision to not use a firearm, and 28 percent reported this for "too much trouble to get one" and 28 percent reported this for "costs too much" (Wright and Rossi, 1994:128–129). Similarly, 27 percent of those who were unarmed during their most recent crime said that the cost was at least a little important in this decision, and 27 percent that their ignorance about how to acquire a gun was relevant.

Testing the "futility hypothesis" directly entails observing adolescent involvement with guns under a range of conditions of gun availability. The only instance of such a test is Wintemute's (2003) analysis of data from the 1999 Youth Risk Behavior Surveillance survey, which provides state-level aggregate data for 30 states. High school students were asked whether they had carried a gun on one or more of the 30 days prior to the survey. Wintermute estimated a bivariate regression and found that each 1 percent increase in the prevalence of private gun ownership within a state is associated with a 0.18 percent increase in teen gun carrying. However, as Wintemute notes, causality cannot be reliably inferred from these findings because the analysis does not control for any other cross-state differences. A test with greater power to rule out rival explanations for an association between gun carrying and gun prevalence would begin with micro- rather than aggregate-level data and control for observable heterogeneity among teens. The NSAM data provide the basis for just such a test.

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3. Cook, Molliconi and Cole (1995) interviewed a small group of incarcerated teens in North Carolina, several of whom reported frequent firearms transactions influenced in part by their financial circumstances.

NATIONAL SURVEY OF ADOLESCENT MALES

Our empirical analysis utilizes data from the National Survey of Adolescent Males (NSAM), and in particular from the cohort of participants interviewed in 1995. A sample of eligible participants—defined as all adolescent males aged 15 to 19 living in households in the United States between February and November 1995—was drawn through a multistage procedure that assigned a higher probability of participation to Hispanic and African American males. Sampling weights are provided to adjust for this oversampling process, and are used in all of the analyses reported here. A total of 1,729 respondents completed the general NSAM questionnaire, yielding a response rate of 75 percent. Most of our empirical analysis focuses on the sample of respondents who were under age 18 at the time of the survey, in part to focus on the population for whom unsupervised handgun possession is unambiguously illegal. This age restriction reduces the available sample to 1,151.

After completing a 68-minute interview and administered questionnaire about peers, social background, and sexual attitudes and activity, 98 percent of respondents agreed to complete a 99-item self-administered questionnaire regarding unusually sensitive risky behaviors.[4] Of primary interest for our analysis are two questions on the self-administered questionnaire concerning weapons: "During the *past 30 days*, on how many days did you carry a gun?" and "during the *past 30 days*, on how many days did you carry some other type of weapon such as a knife, razor or club?" [emphasis in the original]. We also examine items that capture the frequency with which the respondent was in a physical fight, was threatened with a weapon, or threatened others with a weapon during the 12 months prior to the interview.[5]

The NSAM is designed to produce unbiased estimates for the relevant segment of the American public (see Table 1: column 1, males aged 15–19; and column 2, the subset for males aged 15–17).

Focusing on the second group, we see that a remarkably high proportion—10 percent—carried a gun at least once a month in 1995, and that those who carried at least once carried an average of six times

4. Sonenstein et al. (1998), provide additional details about the survey.

5. These questions read: "During the last 12 months, how many times were you in a physical fight?"; "In the last 12 months, how many times has someone, not including a member of your own family, threatened to beat you up or hurt you with a weapon, such as a gun or knife?"; "In the last 12 months, how many times has someone pulled a gun, knife or razor on you?"; "In the last 12 months, how many times have you threatened to beat up someone or to hurt them with a weapon, such as a gun or knife, not including any members of your own family?"; "In the last 12 months, how many times have you pulled a gun, knife or razor on someone else?"

(0.63/0.104).[6] A still greater proportion—27 percent—carried a knife, razor or other weapon in the previous 30 days, and those who carried at least once averaged nearly 12 times. These weapons are often put to use, as suggested by the statistics on threats during the previous 12 months: 20 percent had been threatened by a gun or knife, and nearly 25 percent had threatened someone else.[7]

Table 1. National Estimates of Risky Behaviors by Adolescent Males, 1995

Variable	Full NSAM sample (N=1,729)	NSAM sample <18 (N=1,151)
Weapons Carrying		
% gun last 30 days	11.1 (0.8)	10.4 (0.9)
# days	0.80 (0.10)	0.63 (0.10)
% other weapon, last 30 days	24.9 (1.3)	27.3 (1.8)
# days	3.27 (0.26)	3.22 (0.32)
Violence involvement		
% in physical fight last 12 months	42.5 (1.6)	47.5 (1.7)
# fights	2.33 (0.34)	2.77 (0.41)
% threatened with beating or weapon, last 12 months	32.2 (1.4)	34.1 (2.1)
% gun or knife pulled on them, last 12 months	20.1 (1.2)	20.2 (1.7)
% threatened someone else with beating or weapon, last 12 months	24.3 (1.2)	24.6 (1.5)
# times	3.40 (0.88)	3.32 (1.05)
Sex and Drugs		
% ever had sex with female	55.3 (1.9)	42.6 (2.0)
% ever made girl pregnant	19.3 (1.3)	12.8 (1.3)
% ever smoked marijuana	43.1 (2.3)	39.7 (2.2)
% used cocaine, last 12 months	5.5 (0.7)	5.1 (0.7)

NOTES: Statistics calculated using NSAM sampling weights; parentheses present standard errors that are adjusted for the cluster-sampled design of the NSAM.

6. These results cannot be compared directly with those from the Sheley-Wright survey due to differences in item wording. As noted above, 12 percent of their inner-city sample carried "all" or "most" of the time.
7. The fact that more of them report threatening than being threatened has its parallel in the homicide statistics: Adolescent males kill more often than they are killed (Cook and Laub, 2002).

Table 2. National Estimates for Prevalence of Weapon Carrying and Use Subgroups of Males Aged 15–17

(Estimated prevalence for designated subgroups, and SE)

Subgroup	N	Carried gun last 30 days (%)	Carried other weapon last 30 days (%)	Threatened someone else with beating or weapon, last 12 months (%)
Race?				
White	432	8.8 (1.3)	27.3 (2.5)	22.6 (2.1)
Black	325	15.2 (2.4)	24.5 (2.5)	29.7 (3.0)
Hispanic	354	12.4 (1.9)	28.2 (3.6)	24.6 (3.4)
Other	40	14.0 (6.4)	32.0 (7.1)	35.8 (9.9)
Size of place?				
Urban	532	9.4 (1.5)	29.2 (3.4)	26.6 (2.4)
Rural	231	14.6 (1.4)	30.0 (3.3)	23.2 (2.0)
Suburban	388	8.4 (1.6)	23.6 (2.8)	23.7 (2.7)
Carried gun?				
Yes	138	100	73.6 (5.2)	53.9 (5.9)
No	978	0	21.9 (1.9)	21.2 (1.4)
Fight in last 12 months?				
Yes	533	16.7 (1.9)	44.3 (2.6)	40.6 (2.5)
No	585	4.7 (1.0)	11.8 (1.8)	10.1 (1.6)
Been threatened?				
Yes	358	17.2 (1.9)	46.8 (3.3)	43.5 (2.9)
No	758	6.9 (1.1)	17.1 (2.1)	14.7 (1.9)
Weapon pulled on them?				
Yes	257	26.8 (3.6)	57.6 (4.3)	51.7 (3.5)
No	859	6.2 (0.9)	19.6 (1.8)	17.7 (1.7)
Ever use marijuana?				
Yes	444	15.4 (2.1)	41.2 (2.6)	36.4 (2.5)
No	671	7.3 (0.9)	18.1 (2.0)	17.0 (1.8)
Ever use cocaine?				
Yes	58	27.2 (8.1)	57.1 (10.6)	47.4 (10.3)
No	1059	9.5 (0.9)	25.6 (1.8)	23.3 (1.6)
Suspended in last 12 months?				
Yes	257	18.2 (2.6)	42.1 (3.4)	36.2 (3.9)
No	854	8.4 (1.0)	23.1 (2.0)	21.7 (1.7)
Ever stopped by police?				
Yes	375	15.6 (2.0)	38.1 (3.2)	39.1 (3.3)
No	740	7.8 (1.1)	21.8 (2.0)	17.2 (2.0)
Ever arrested?				
Yes	223	21.8 (3.7)	35.3 (4.0)	45.0 (3.7)
No	893	7.9 (0.9)	25.6 (2.0)	20.1 (1.5)
Ever in jail?				
Yes	114	29.9 (5.7)	28.7 (5.7)	50.0 (5.6)
No	1002	8.7 (0.9)	27.2 (1.9)	22.4 (1.6)
Season of Interview:				
Fall	43	6.1 (2.9)	14.3 (7.4)	16.7 (7.4)
Winter	115	12.1 (3.2)	37.4 (4.9)	35.0 (6.2)
Spring	661	10.5 (1.3)	24.6 (2.6)	25.4 (2.0)
Summer	332	10.1 (2.1)	31.5 (3.8)	19.8 (2.6)

NOTES: Point estimates are calculated using NSAM sampling weights. Parentheses contain standard errors, which are adjusted to account for the cluster sampling design of the NSAM.

Gun carrying is more likely among blacks than non-Hispanic whites, and relatively likely among those involved in drugs, violence and the criminal-justice system (see Table 2). The same patterns are evident for other weapons, with some notable exceptions: There is little difference in prevalence between blacks and whites, and little between those who are in trouble with the law and those who are not. In any event, it is noteworthy that carrying a gun is not necessarily an alternative to carrying another weapon—74 percent of those who carried a gun at least once also carried another weapon at least once.

The threats tabulated here arise from responses to the question "In the last 12 months, how many times have you threatened to beat up someone or to hurt them with a weapon, such as a gun or knife, not including any members of your own family?" Again the prevalence rates tend to be much higher for those involved in violence or in trouble with the law. The differences across racial groups are small. Those who carried a gun (in the previous 30 days) were nearly five times as likely to have threatened someone in the preceding year as those who did not.

It is important to note that the NSAM item on the frequency of gun carrying does not ask why the respondent was carrying a gun, and it is therefore possible that some who did so were engaged in lawful hunting or target practice with responsible adults. But the prevalence patterns tabulated here suggest that such innocuous circumstances are the exception. That conclusion is further reinforced by the seasonal pattern of carrying. While most hunting seasons occur in the fall,[8] that season shows, in the NSAM data, the lowest prevalence of gun carrying.

LOCAL GUN PREVALENCE

According to the futility hypothesis, local gun prevalence and availability have no effect on adolescent involvement with guns. The decision to possess or carry a gun will be driven by other considerations, especially self-protection. To test this hypothesis we utilized a geo-coded

8. For example, in the state of Wisconsin the seasonal hunting dates are as follows: white tailed deer (gun), 11/23–12/1; black bear, 9/4–10/8 (dates vary depending on whether dog is used); ring-necked pheasant, 10/19–12/31; ruffed grouse, 9/14–1/31; sharp-tailed grouse, 10/19–11/10; bobwhite quail, 10/19–12/11; gray partridge, 10/19–12/31; jack rabbit, 10/19–11/15; cottontail rabbit, 9/14–2/28; gray fox squirrels, 9/14–1/31; raccoon, 10/19–1/31; fox (all species), 10/19–2/15; bobcat, 10/19–12/31; ducks and other migratory game birds, 9/28–12/8; American woodcock, 9/21–11/4; and early Canada goose, 9/3–9/15. The hunting seasons for wild turkeys and crows include periods in both the fall and spring, while coyote, opposum, skunk, weasel and snowshoe hare may be hunted year-round in the state. (Wisconsin Department of Natural Resources, www.dnr.state.wi.us/org/land/wildlife/hunt/seasdate.htm).

version of the NSAM data,[9] which includes an indicator of the county of residence for each respondent. The prevalence of gun ownership at the county level cannot be measured directly from available data, but an excellent proxy is available for most large counties—the percentage of suicides committed with guns (FS/S).

Recent research demonstrates that among the readily computed proxies used for this purpose, FS/S has the highest correlation with survey-based estimates of gun prevalence. This proxy "outperforms" such measures as the percentage of homicides committed with a gun, the subscription rate to gun-oriented magazines and the prevalence of NRA membership (Azrael, Cook and Miller, 2004). For example, the cross-section correlation between this proxy and survey-based estimates available for 21 states (from the Behavioral Risk Factor Surveillance System) is 0.90; the corresponding correlation for the subscription rate to *Guns & Ammo* is 0.67, to the NRA membership prevalence is 0.55 and to the percent of homicides with guns only 0.19.

The limitation of FS/S as a county-level proxy stems from the fact that suicide is a rare event. Only larger counties have enough suicides to produce a statistically reliable result. To ensure reliability we combine suicide data for the 1987–1996 period and use only the measure for counties that have at least 50 suicides during that period and at least 100,000 residents. (The latter limitation is dictated by the fact that the National Center for Health Statistics suppresses the county of residence in the vital statistics mortality data if the county has fewer than 100,000 residents.) Combining a number of years' data in this fashion is a reasonable procedure given that the cross-section structure of gun prevalence in the United States has been highly stable over time (Azrael, Cook and Miller, 2004). For example, the correlation across counties between FS/S computed for our 10-year period with FS/S computed on just a 5-year period (1992–96) is 0.964.

As it turns out, the prevalence of gun ownership differs widely across jurisdictions in the United States. At the state level, estimated prevalence ranges from about 12 percent in Hawaii and Massachusetts to over 55 percent in Louisiana, Alabama and Mississippi (see Table A1, derived from Azrael, Cook and Miller, 2004). While much of this cross-sectional variation is regional, there is also considerable variation across states within the same region, and variation among counties within the same state.

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9. Because the geo-coded NSAM data are restricted-use, we subcontracted with a research associate on staff at the Urban Institute to conduct the analyses that we specified on site. Our thanks to Freya Sonnenstein for her assistance in developing this arrangement.

ANALYSIS OF WEAPONS CARRYING

In what follows, the effects of county gun prevalence (FS/S) on the individual NSAM respondent's likelihood of carrying a gun and other outcome variables are analyzed using multivariate logistic regression that includes a long list of individual characteristics. These characteristics are intended to control for demographic and socioeconomic circumstances. Included are the respondent's school status, age, race and region. A number of other measures of family socioeconomic status are included: mother's education, whether the respondent's first language as a child was English, whether an adult male lived in the household when the respondent was 14 and whether the respondent's mother was a teenager when she had her first child. We also control for the respondent's frequency of church attendance at age 14. Household income is not included as such due to data problems.[10]

To preserve a clear causal ordering, we do not include indicators of the respondent's current behavior, as opposed to his ascribed circumstances, from our preferred specification. The exception to this rule is our measure of the respondent's school enrollment status. Given the strong correlation between family socioeconomic status and children's eventual education level (Mayer, 1997), conditioning on schooling helps limit the scope for bias from unmeasured socioeconomic status. School status is also likely to have important implications for each respondent's "routine activities," which may be relevant for his opportunities and motivation for carrying a firearm. In any case, as a check on the robustness of our findings we also present the results of more parsimonious specifications that exclude school status.

The key findings concern the prevalence of gun ownership in the community. Of specific interest is how community context may influence the motivation for carrying a gun or other weapon. According to Sheley and Wright (1995) the predominant reason was self-protection. While such "self-help" may not be effective (Wilcox, 2002), it is certainly a plausible motivation. Presumably the felt need differs depending on the threat of violence, which—other things (such as how violence prone the individual is, and how extensive the association with bad company) being equal—will be objectively greater in some communities than others. Because the robbery rate tracks serious youth violence well (Blumstein, 2001), all regressions include the county-level robbery rate.

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10. The NSAM's measure of family income is problematic because it is reported by teens rather than parents, and therefore perhaps not reliable, and because of potential coding problems in the creation of the variable within the NSAM itself. (Personal communication, Jason Ost with Freya Sonnenstein, September 10, 2002.)

We also examine the sensitivity of our results to more comprehensive specifications that include other behavioral choices, and in particular those related to the NSAM respondent's need for self-protection. The challenge for more formally testing how significant external threats are as a motivator for firearm use is that gun carrying and exposure to dangerous people or situations are both likely to stem from the same underlying individual choices and characteristics. Below we conduct a crude test of the "self-protection" hypothesis by expanding our baseline regression specification to include explanatory variables measuring whether the respondent was ever threatened, or had a weapon pulled on him.

The regression model also includes two measures of neighborhood disadvantage, which recent research suggests may be an important predictor of gun use in crime (Baumer et al., 2003). The neighborhood proxies available with the NSAM include the respondent's housing type (freestanding private home, row house, private apartment, public housing or trailer), and the condition of buildings in the respondent's neighborhood (very rundown, rundown, a little rundown, well kept). Both variables are coded by the NSAM interviewer based on her own observations. Census-tract characteristics are unfortunately not available even with the geo-coded version of the NSAM.

All regression results reported in this section are estimates of the parameters of equations of the following form, calculated using the standard logit maximum-likelihood procedure:

$$(1)\ \ln\left(p_{ics}/\,1-p_{ics}\right) = b_0 + b_1\,FS/S_{cs} + b_2\,Rob_{cs} + b_3\,X_{ics} + e_{ics}$$

where p is the (unobserved) probability of individual i, living in county c in state s, exhibiting the behavior in question. FS/S is the proxy for the prevalence of gun ownership, namely the fraction of suicides committed with a gun. (We also include an indicator for missing values on FS/S, which occur if the respondent lives in a county with small population.) "Rob" is the 1995 county robbery rate from the Uniform Crime Reports. X is a vector of measured individual characteristics, and e is an "error" term that accounts for residual variation. If the parameter estimates are to be consistent, this error term must be uncorrelated with the independent variables. After reporting the results of the baseline specification, we go on to estimate alternative specifications in order to explore the possibility of unmeasured but systematic variation at the individual, county or state level.

BASELINE RESULTS

Table 3. Determinants of Gun and Other Weapon Carrying (Carried at least once in previous 30 days), NSAM Respondents, ages 15-17, Logit Regression Results

(Estimated coefficients and standard errors)

	Carried gun	Carried other weapon	Carried either gun or other weapon	Carried gun (for those who carried weapon)
FS/S (% suicides with gun in county 1987-1996)	4.903 (1.305)**	-.266 (1.156)	.079 (1.110)	7.250 (1.981)**
Indicator for suicide data missing	3.717 (0.847)**	-.030 (.768)	.142 (.739)	5.294 (1.248)**
County robbery rate per 1,000 residents (from UCR)	6.010 (1.877)**	2.921 (1.612)*	2.771 (1.450)*	6.310 (2.468)**
Age (15 omitted)				
16	-.197 (.351)	-.175 (.267)	-.127 (.264)	-.398 (.505)
17	.074 (.466)	-.178 (.329)	-.156 (.301)	. 012 (.728)
Respondent educational attainment (8th grade omitted)				
9th grade	.382 (.375)	-.081 (.271)	.083 (.273)	.581 (.527)
10th grade	.392 (.299)	-.439 (.337)	-.360 (.315)	.978 (.581)*
11th grade	.181 (.496)	.108 (.481)	.287 (.430)	-.081 (.785)
12th grade	.381 (.923)	-.124 (.914)	-.072 (.897)	.896 (1.213)
> High school	-2.397 (1.409)*	-4.085 (1.184)**	-4.011 (1.187)**	0
School status (out of school omitted)				
Full time	.250 (.462)	-1.083 (.305)**	-1.052 (.299)**	1.109 (.542)**
Part time	.267 (.991)	-1.647 (.697)**	-1.259 (.586)**	1.258 (1.149)
Race (White or other omitted)				
Black	.565 (.287)*	-.453 (.310)	-.295 (.289)	1.274 (.482)**
Hispanic	.923 (.325)**	.105 (.315)	.236 (.297)	.907 (.454)**
Mother educational attainment (less than HS omitted)				
High school or GED	-.159 (.453)	-.132 (.290)	-.027 (.298)	-.123 (.755)
Some college	-.074 (.473)	.047 (.316)	.100 (.285)	-.218 (.734)
College degree (BA)	-.739 (.627)	-.291 (.381)	-.292 (.367)	-.699 (.919)
More than college degree	-.072 (.569)	-.010 (.418)	-.015 (.401)	.314 (.946)
Mother ed missing	-.105 (.509)	-.199 (.486)	-.052 (.478)	-.444 (.700)
Father / other adult male lived with R at age 14	-.010 (.362)	-.183 (.235)	-.199 (.245)	-.159 (.439)
R's mother had first child before age 20	.293 (.282)	.114 (.173)	.095 (.161)	.317 (.390)

Urbanicity (urban omitted)				
Suburban	.617 (.315)*	-.065 (.241)	-.088 (.229)	1.126 (.432)**
Rural	.462 (.322)	.009 (.315)	.215 (.275)	.660 (.527)
Region (Northeast omitted)				
West	-.106 (.445)	.319 (.364)	.368 (.320)	-.754 (.566)
Midwest	.012 (.437)	.446 (.400)	.524 (.361)	-.590 (.642)
South	.409 (.454)	.690 (.331)**	.753 (.295)**	-.477 (.614)
R's housing type (single-family home omitted)				
Rowhouse	-.124 (.362)	-.117 (.348)	-.163 (.335)	.164 (.702)
Private apartment	-.722 (.508)	-.263 (.468)	-.308 (.463)	-.322 (.719)
Public housing	.761 (.731)	.964 (.649)	1.579 (.666)**	-.718 (.987)
Trailer	-.168 (.509)	.276 (.360)	.277 (.375)	-.325 (.588)
Condition of buildings in R's neighborhood (very rundown omitted)				
Rundown	1.125 (.957)	.968 (.612)	.950 (.656)	.317 (.946)
A little rundown	.724 (1.013)	.755 (.556)	.679 (.597)	-.269 (.946)
Well kept	.691 (.873)	.570 (.586)	.551 (.600)	-.032 (.833)
R's first language as a child was English	.907 (.370)**	.373 (.425)	.412 (.421)	.150 (.499)
Church-going at age 14 (never attended church omitted)				
Less than 1 / month	-.130 (.546)	.189 (.292)	.226 (.275)	-.494 (.739)
1-3 times / month	-.353 (.402)	.101 (.281)	-.007 (.288)	-.578 (.444)
Once / week	-.055 (.360)	-.157 (.233)	-.130 (.229)	.042 (.443)
Intercept	-8.332 (1.586)**	-.905 (1.090)	-1.286 (1.078)	-7.167 (1.583)**
N	1,063	1,062	1,064	324
Chi-square	75.76	68.42	82.17	76.41
-2 × Log likelihood	620.3	1,174.2	1,216.5	337.78

NOTES: Table presents logit coefficients from a maximum-likelihood model that uses the indicator for gun carrying (columns 1 and 4) or other-weapon carrying (column 2) or any-weapon carrying (column 3) as the dependent variable. Figures in parentheses are Huber-White standard errors, adjusted for cluster sampling design of the NSAM survey (see text). All estimates are calculated using NSAM sampling weights. R= "respondent." ** = Statistically significant at 5%. * = Statistically significant at 10%.

Among the baseline results (reported above in Table 3), the most notable is that, controlling for individual characteristics, the likelihood of gun carrying is positively related to gun prevalence in the county, and strongly so. On the other hand, the likelihood of carrying another type of weapon, or any type of weapon (including a gun), is unrelated to the prevalence of gun ownership—the coefficients on FS/S are just a fraction of the standard errors.[11] The county robbery rate is positively associated with both guns and other weapons, but especially guns.

11. The fact that the coefficient on the missing-data indicator is positive and significant suggests that the prevalence of gun ownership is above average in counties for

Is the estimated magnitude of the effect of gun prevalence on carrying large enough to be of interest? Using the standard formula to derive the marginal effect (dp/dx) implied by a logit coefficient evaluated at the sample means (Greene, 1993:639), the coefficient of 4.903 implies a marginal effect of +0.46.[12] The mean values for the gun-carrying and gun-prevalence variables are 0.104 and 0.580 respectively. The logit coefficient therefore implies that a 50 percent increase in county gun ownership is associated with approximately a doubling of the prevalence of teen gun carrying ($0.29 \times 0.46 = 0.13$). Put differently, the estimated elasticity of teen gun carrying with respect to county gun prevalence equals +2.5.[13]

While we are unable to detect any effect of gun prevalence on the *frequency* with which gun-carriers carry guns, our lack of supporting evidence does not rule out the possibility of such a relationship. When the analytic sample is restricted to NSAM respondents under 18 who report having carried a gun during the past 30 days, only 131 respondents remain. Using this sample, the natural log of the number of times a gun was carried was regressed against FS/S and covariates shown in Table 3. The point estimate was equal to -0.3 but with a large standard error, so that the t-statistic is only 0.2. In what follows we focus our analyses on the dichotomous indicator for whether the teen has ever carried.

Gun prevalence has little systematic relationship with the likelihood that the teen has carried a knife or other weapon during the past 30 days (Table 3, column 2). Gun prevalence also has little effect on the likelihood that the teen carries any type of weapon, either a gun, knife or something else (Table 3, column 3). While FS/S does not affect the likelihood that a teen carries a weapon, the availability of guns clearly increases the likelihood that those teens who do carry weapons choose guns (Table 3, column 4).

Surprisingly, there is little differentiation along individual characteristics (see Table 3). Gun carrying is not strongly associated with age, grade or household socioeconomic status. Blacks and Hispanics are more likely to carry a gun than others, though in the case of Hispanics, the effect appears to be limited to those who grew up in English-speaking homes.[14] School-enrollment status has little effect on gun carrying overall.

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which the gun-prevalence proxy cannot be computed. That makes sense, since these counties tend to be more rural than average—lower population density, and outside of a metropolitan area. Nationwide, gun ownership tends to higher in rural areas (Cook and Ludwig, 1996).

12. In comparison, the marginal effect implied by a linear probability model is around three-fourths the size of the marginal effect implied by the logit maximum-likelihood estimates.
13. This elasticity is defined as the percentage change in teen gun carrying associated with a one percent increase in gun prevalence.
14. Note that the coefficient on Hispanic in the second column is almost canceled by the effect of growing up in a home where English is not the first language.

Two conflicting tendencies explain why: Students enrolled in school are less likely to carry a weapon, but more likely to carry a gun if they do.

Our measures of neighborhood disadvantage are not systematically related to gun carrying (see Table 3), which contrasts with the strong results reported by Baumer et al. (2003) based on the geocoded National Crime Victimization Survey. It should be noted that their analysis is different in several ways that may account for the apparent differences in results: They analyze the likelihood of gun use in crimes of personal violence, rather than gun carrying; they include adult perpetrators in their study; and their spatial analysis is based on the location of the crime rather than the location of the perpetrator's residence. But the difference in results may also stem from differences in just what is being controlled for in the regression analysis. Where we control for a large set of background characteristics, the only offender characteristics controlled for by Baumer and his colleagues are age, race and gender (as reported by the victim). When we estimate a parsimonious model that controls only for age, race, gender, gun prevalence and neighborhood disadvantage, the effect on gun carrying of one of our two neighborhood proxies—the respondent's housing type (public housing, trailer etc.)—emerges as statistically significant. The findings of important "neighborhood effects" on gun carrying reported by Baumer et al. could reflect to some degree the confounding of neighborhood with offender characteristics.[15]

EXTENSIONS

The coefficient estimates for FS/S from a number of different regression specifications on weapons carrying, as well as for other dependent variables related to the respondent's involvement in violence, are reported in Table 4. Each cell includes the estimated coefficient and standard error for FS/S; each is taken from a different logistic regression. All specifications include the full set of individual characteristics and the county robbery rate, as with the baseline specification in Table 3. The

15. Because Baumer et al. rely on data from the National Crime Victimization Survey they are able to control for a rich set of characteristics of the crime victim, which may be correlated—but only imperfectly so—with the (unobserved) socio-demographic characteristics of the offender. In principle an alternative explanation for the discrepancy in results between studies is that our measures of the local housing stock are imperfect proxies for neighborhood disadvantage. But it is not clear how or even whether our neighborhood measures are inferior to those employed by Baumer et al.. Their census tract variables presumably provide a more detailed portrait of the socio-economic characteristics of the tract's residents. On the other hand, our measures capture what the NSAM coder takes to be the respondent's "neighborhood," which may be more closely tied to the geographic area that comprises the respondent's true neighborhood than does a census tract.

specifications here differ with respect to which additional control variables are included, or which sample is used.

Table 4. Effects of Gun Prevalence on Weapon Carrying and Violence Involvement, Logit Regression Results, NSAM Respondents age 15-17[a]

(Note: Each entry is from a different regression. Entries include the estimated coefficient and SE on "gun prevalence" for given dependent variable and model specification)

	Carried gun	Carried Other weapon	In fight last 12 months	Threatened with harm, last 12 mo	Had gun or knife pulled on them last 12 mo	Threatened someone with weapon last 12 mo
1. Base model (as in Table 3)	4.903** (1.305)	-.266 (1.156)	-.574 (.882)	-1.941 (1.206)	-1.402 (1.287)	-2.277* (1.214)
2. Use log of FS/S	2.531** (.748)	-.102 (.596)	-.489 (.445)	-1.102* (.648)	-.888 (.649)	-1.255** (.579)
3. Control for MSA residence & county pop. density	4.884** (1.363)	-.080 (1.149)	-.589 (.798)	-1.712 (1.197)	-1.451 (1.303)	-2.143* (1.225)
4. Control for other UCR crime rates[b]	5.570** (1.512)	.012 (1.333)	-.852 (.830)	-2.311* (1.327)	-2.020 (1.243)	-2.428** (1.162)
5. Control for month of interview	5.112** (1.350)	-.419 (1.185)	-.692 (.891)	-1.856 (1.155)	-1.430 (1.274)	-2.326* (1.196)
6. Control for sex, pregnant, drinking	5.009** (1.456)	-.615 (1.135)	-.404 (.952)	-2.218* (1.141)	-1.382 (1.315)	-2.270* (1.231)
7. Control for suspended, arrested, jailed	4.748** (1.580)	-0.349 (1.151)	-0.914 (0.942)	-2.389** (1.166)	-1.784 (1.332)	-2.594** (1.248)
8. Sample: Urban respondents only	6.776** (2.491)	-1.043 (1.761)	-1.516 (1.511)	-1.458 (.338)	-.866 (1.664)	-2.253 (1.825)
9. Sample: all ages (15-19)	5.387** (1.144)	.722 (.886)	-.305 (.838)	-1.286* (.734)	-1.972** (.785)	-.948 (.914)
10. Include state fixed effects	8.614** (1.896)	1.958 (1.479)	-.097 (1.222)	-1.019 (1.140)	-1.424 (1.816)	-.635 (1.580)
11. Exclude controls for schooling[c]	4.630** (1.227)	-.266 (1.141)	-.613 (.880)	-1.963 (1.201)	-1.392 (1.319)	-2.159* (1.181)
12. Sample: Stopped by police or suspended	5.815** (1.732)	.980 (1.591)	-.066 (1.439)	.171 (1.900)	1.245 (1.758)	.895 (1.454)
13. Control for "threatened"	5.205** (1.372)	.246 (1.164)	.098 (1.084)	N/A	-.464 (1.236)	-1.751 (1.389)
14. Control for "threatened" & "had weapon pulled on him"	5.223** (1.410)	.085 (.772)	.253 (1.194)	N/A	N/A	-1.638 (1.385)

NOTES:

a. Except in the row designated "Sample: all ages."

b. In addition to controlling for county's UCR crime rate for robbery as in Table 3, model includes controls for rates per 100,000 of murder, rape, burglary, motor vehicle theft, aggravated assault, simple assault, larceny / theft, weapons offenses, and drug offenses.

Table presents logit coefficients from a maximum-likelihood model, using a model specification similar to that reported in Table 3 unless otherwise noted. Figures in parentheses are Huber-White standard errors, adjusted for cluster sampling design of the NSAM survey (see text). All estimates are calculated using NSAM sampling weights.

c. Excludes controls for respondent's educational attainment and school enrollment status.

* = Statistically significant at the 10% level.

** = Statistically significant at the 5% level.

The first pattern to note is that our baseline results on gun carrying are remarkably robust. Every coefficient estimate for gun carrying is highly significant, with little variation in absolute magnitude.

A line-by-line synopsis of the variants on the baseline specification (reported in Table 4) follows:

- Repeats the result for the baseline model from Table 3.
- Replaces FS/S with the natural logarithm of FS/S.
- Adds two county-level variables to the baseline specification—an indicator for whether the county of residence is included in a metropolitan area, and the population density in 1995. Both variables serve as further controls for urbanicity.
- Adds to the baseline specification several additional county-level UCR crime and arrest rates to further account for the amount of crime and disorder that might be motivating gun carrying.
- Adds to the baseline specification indicators for the month of the interview to control for a possible chance confounding between the location and season of interview.
- Adds to the baseline specification three indicators of the respondent's behaviors that are not directly related to weapons and violence, but which may reflect something about his character: ever had sex with a female, ever made a woman pregnant, had five or more drinks on at least one occasion in the previous 30 days.
- Adds to the baseline specification three other indicators of the respondent's behavior: suspended from school in the last 12 months, ever arrested, ever jailed.
- Estimates the baseline specification using a sample of just those residents living in urban areas, where sporting uses of guns are least likely to be a factor.
- Estimates the baseline specification using the full sample of NSAM respondents, including those aged 18 and 19.
- Expands the baseline specification to include a full set of state fixed effects in place of the regional indicators, to account for the possible importance of state legislation, state-level differences in criminal-justice practice, or culture. With state fixed effects included in the regression specification, the estimated effect of county gun prevalence on teen gun carrying is identified from within-state across-county variation in gun prevalence.
- Excludes measures of the respondent's educational attainment and school-enrollment status.
- Estimates the baseline specification using only those NSAM respondents who have either been stopped by the police or

suspended from school. The coefficient on FS/S for this "high risk" subsample is somewhat larger than the full-sample result, but the difference in estimates is not statistically significant.

- Includes "ever been threatened" as an additional explanatory variable. The estimated effect of FS/S on gun carrying is almost identical to what is reported in our baseline model. The "threatened" variable itself has a positive and statistically significant relationship with gun carrying.
- Includes both "ever threatened" and "ever had gun or knife pulled on them" as explanatory variables in the model.

As a final specification check, we re-estimated the baseline specification against five other types of risky behavior that have no clear causal relationship to gun prevalence, including measures of sexual activity, alcohol binging, marijuana use and cocaine use. A finding that FS/S is statistically related to one or more of these outcomes would suggest the influence of an unobserved variable correlated with FS/S, calling into question whether it is gun prevalence per se that is influencing gun carrying. As it turns out, none of the coefficient estimates are statistically different from 0.[16]

The baseline result on the likelihood of carrying other weapons—namely, that the prevalence of gun ownership in the county has little or no effect—is also robust to the various alternative specifications (Table 4, column 3).

Table 4 also reports the results of regressions in which the dependent variables are various indicators of the respondent's involvement with violence in the preceding year: got in a fight, threatened with harm, had a gun or knife pulled on him, and threatened someone else with a gun or knife. For the last three of these there is some indication that gun prevalence is statistically relevant, though the results are sensitive to the specification and sample, and only occasionally significantly different from 0 at even the 10 percent level. In any event, it is noteworthy that all coefficient estimates are negative. These results provide some evidence, then, that when guns are prevalent, youths are more restrained about issuing threats. But this restraint does not necessarily engender greater safety; the NSAM does not provide any items from which we can adjudge the incidence of violent injury or death.

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16. For the five risky behaviors, the FS/S coefficient estimates and standard errors are as follows:
    - Ever had sex with a female: -1.17 (.77)
    - Ever made someone pregnant: 1.14 (1.11)
    - Had 5 or more drinks at least once in the previous 30 days: -.52 (.82)
    - Ever smoked marijuana: -.67 (1.46)
    - Used cocaine in the previous year: 3.27 (2.13)

ACCOUNTING FOR REVERSE CAUSATION

It is at least logically possible that the positive association between the prevalence of gun ownership and the likelihood that adolescents will carry guns is the result of reverse causation, whereby the demand by householders for guns is influenced by gun carrying by local adolescents. We explore this possibility by use of the standard two-stage least-squares estimation procedure. This procedure requires an "instrument" for gun prevalence that is not plausibly correlated with the error term in the gun-carrying regression. The ideal instrument must pass three tests: highly correlated with gun prevalence, not affected by the current rates of adolescent gun carrying and uncorrelated with any omitted variables that might affect gun carrying. The instrument that we use here exploits the fact that the cross-section structure of gun ownership rates has been highly stable over time and is driven in large part by each area's local rural tradition (Azrael, Cook and Miller, 2004). The instrument is the fraction of a state's population that lived in a rural area in 1950. It passes the first two tests: is highly predictive of each state's gun ownership rate in 1995 and is presumably not influenced by adolescent gun-carrying in 1995. We have less confidence in how it does by the third test; "rural tradition" in a state may be correlated with other factors that influence gun-carrying rates, not all of which are necessarily captured by the covariates in our specification. (Our specification checks described in the previous section help allay this concern.) In any event, the second-stage estimates utilizing the "percent rural in 1950" provide support for a conclusion that the prevalence of gun ownership affects adolescent gun carrying.

The "instrumental variables" estimates come from estimating equations (2) and (3) using two-stage least squares.[17] In the equations FS/S_{cs} represents the gun ownership rate for the period 1987-1996 in respondent i's county and state of residence, C_{ics} represents whether individual i reports carrying a gun in the preceding 30 days, X_{ics} represents the vector of covariates from the baseline specification (Table 3), and R_s represents the fraction of the state population that lived in rural areas in 1950 for individual i's state of residence. The first-stage equation (2) yields a predicted value for the gun ownership rate, G, which is then substituted for FS/S in the second-stage equation (3).

(2) $FS/S_{cs} = \alpha_0 + \alpha_1 R_s + \alpha_2 X_{ics} + v_{ics}$

(3) $C_{ics} = \theta_0 + \theta_1 G_{cs} + \theta_2 X_{ics} + e_{ics}$

17. It should be noted that we were forced to omit observations from counties with populations less than 100,000, because FS/S cannot be estimated for those counties. Hence these results are based on a smaller sample than those from Table 3.

Table 5. Determinants of Gun Carrying, NSAM Respondents, ages 15-17, Two-Stage Least Squares Estimates (Estimated coefficients and standard errors)

	First stage: Gun Prevalence	Second stage: Carried Gun
% Rural, 1950	.00278 (.00078)**	—
IV Gun Prevalence, 1987-1996	—	.778 (.397)*
County robbery rate per 1,000 residents (from UCR)	-.143 (.137)	.545 (.268)*
Age (15 omitted)		
16	.018 (.009)*	-.031 (.025)
17	.026 (.012)**	.002 (.048)
Respondent educational attainment (8th grade omitted)		
9th grade	-.010 (.008)	.057 (.024)**
10th grade	-.027 (.010)**	.029 (.029)
11th grade	-.026 (.019)	.040 (.049)
12th grade	-.075 (.023)**	.027 (.071)
> High school	.050 (.030)	.043 (.084)
School status (out of school omitted)		
Full time	-.020 (.012)	.037 (.027)
Part time	-.031 (.020)	.063 (.073)
Race (White or other omitted)		
Black	-.004 (.010)	.090 (.027)**
Hispanic	.003 (.012)	.077 (.020)**
Mother's educational attainment (less than HS omitted)		
High school or GED	.003 (.009)	.036 (.034)
Some college	.017 (.015)	.019 (.053)
College degree (BA)	.011 (.020)	-.014 (.032)
More than college degree	-.018 (.015)	.061 (.043)
Mother education missing	.001 (.014)	.040 (.036)
Father / other adult male lived with R at age 14	-.003 (.009)	-.014 (.031)
R's mother had first child before age 20	.010 (.006)	.029 (.047)
Urbanicity (urban omitted)		
Suburban	.008 (.010)	.035 (.027)
Rural	.120 (.056)**	-.114 (.107)
Region (Northeast omitted)		
West	.141 (.042)**	-.138 (.067)**
Midwest	.062 (.051)	-.104 (.057)*
South	.181 (.052)**	-.105 (.096)
R's housing type (single-family home omitted)		
Rowhouse	-.010 (.022)	-.017 (.058)
Private apartment	-.004 (.010)	-.032 (.045)
Public housing	-.012 (.016)	.050 (.120)
Trailer	.003 (.012)	-.034 (.064)

Condition of buildings in R's neighborhood (very rundown omitted)		
Rundown	.020 (.020)	-.011 (.101)
A little rundown	.026 (.025)	-.024 (.077)
Well kept	.016 (.021)	-.029 (.081)
R's first language as a child was English	.015 (.010)	.016 (.020)
Church-going at age 14 (never attended church omitted)		
Less than 1 / month	.004 (.010)	-.021 (.048)
1-3 times / month	.004 (.010)	-.012 (.033)
Once / week	.013 (.009)	.024 (.033)
Intercept	.345 (.045) **	-.409 (.183) **
N	797	775
R-squared	0.707	0.090

NOTES: The table presents coefficients from a two-stage least squares model, where the first stage involves calculating the predicted value of % suicides w/ guns 1987-1996 in respondent's county as a function of % state rural in 1950 together with the other control variables shown here. The regression coefficients can thus be interpreted as with a standard linear probability model. Figures in parentheses are Huber-White standard errors, adjusted for cluster sampling design of the NSAM survey (see text). All estimates are calculated using NSAM sampling weights. R= "respondent."
** = Statistically significant at 5%
* = Statistically significant at 10%

The instrument R has a very strong relationship with cross-sectional variation in gun ownership rates (see Table 5). The F-statistic for the significance of the instrument in the first-stage equation is equal to 12.70 ($p<.01$), while the partial R-squared is equal to 0.0495. The second-stage estimate (Table 5, column 2) of the effect of gun prevalence is positive and significant at the 6 percent level. We conclude that the key results regarding gun carrying and prevalence are not the result of reverse causation.[18]

DISCUSSION

Our key results can be briefly summarized. In 1995, one in ten adolescent males nationwide carried a gun at least once a month. The likelihood of carrying by this group differed widely across counties according to the rate of robbery and the general prevalence of gun ownership, even after controlling for individual and household characteristics. On the other hand, the county prevalence of gun ownership had essentially no effect on the likelihood of an adolescent male carrying a knife, razorblade or some other sort of weapon—gun

18. The instrumental variables results for our other outcome measures are qualitatively similar to those shown in Table 4: The predicted value of FS/S only has a statistically significant relationship with gun carrying.

prevalence affected only the choice of weapon type. These findings are robust to a variety of statistical challenges that attempt to distinguish the effects of gun prevalence from those of other confounding factors. And, based on the two-stage least-squares estimates, it is possible to rule out an explanation in terms of reverse causation. Thus our findings provide suggestive evidence of a direct causal effect of community gun ownership on adolescent involvement with guns. [19]

The nature of that causal influence is not identified by the statistical results, but it seems plausible that the mechanism is gun availability. Where guns are prevalent, adolescents will find it easier to borrow or steal or buy them from family members or other people.[20] An alternative interpretation is that in counties where guns are more common, teens tend to be more experienced, knowledgeable or comfortable with guns. Both explanations grant a direct causal role to gun prevalence, whether it operates through availability (as in the first explanation) or learning (the second). In either case, adolescent behavior is closely linked to gun prevalence among adults, and would be modified in response to a change in that context.

Strictly speaking, we cannot rule out the possibility that both the prevalence of gun ownership and the propensity of youths to carry guns are influenced by some latent cultural factor that prizes owning and using guns. Note that our ancillary results rule out a number of related mechanisms by demonstrating that the prevalence of guns is not related to carrying weapons or being involved with violence or various sorts of delinquency, and hence is not a proxy for a "culture of violence" or a "scofflaw culture" that might encourage teens to become even more involved with guns. Nor (as we have shown) is the effect of prevalence on gun carrying mediated by whether the environment is urban or rural. But there remains a logical possibility that it is a cultural factor that we might call "gun appreciation" rather than the actual prevalence of guns that is driving our results. That distinction is relevant in predicting the effect of regulations designed to change the prevalence of gun ownership.

A more subtle "demand side" explanation is that teens are more likely to carry guns when other potential predators or victims have guns. This

19. Of course we do not claim that we have proven such an effect, since it is not possible to entirely rule out the possibility that there are one or more unmeasured variables that have an effect on the likelihood of gun carrying and happen to be correlated with gun prevalence.

20. Transactions that do not involve licensed dealers make up the "secondary" market; supply to this market is closely linked to the prevalence of gun ownership (Cook, Molliconi, and Cole 1995). Direct evidence that the theft rate in residential burglary increases with the prevalence of gun ownership is provided in Cook and Ludwig (2003).

"teen arms race" mechanism may amplify the magnitude of the effect of gun prevalence, but would not logically cause it in the first place.

Our central finding that county gun prevalence is closely associated with teen gun carrying appears to be at odds with the interpretation that Joseph Sheley and James Wright made of their survey results concerning gun involvement by inner-city high school males. But their conclusion—that the community context of gun ownership and availability was irrelevant to youthful involvement—was speculative, and not based on direct evidence from comparing different communities. Our analysis provides the first rigorous and nationally representative evidence on this issue. Adolescents' propensity to get involved with guns appears to be strongly influenced by the prevalence of guns in their community, a result that holds even for the highest-risk subset of our NSAM sample. If this relationship is driven by the link between gun prevalence and gun availability, which we believe to be the most plausible interpretation of our results, then supply-side interventions are not inherently "futile" and should not be ruled out a priori by policymakers.

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Table A1. Household Prevalence of Firearms by State

Rank	State	Estimated Prevalence from FS/S	Rank	State	Estimated Prevalence from FS/S
1	Hawaii	11.59	27	New Mexico	42.92
2	Massachusetts	13.08	28	North Dakota	43.80
3	New Jersey	15.44	29	Oregon	43.92
4	D.C.	20.13	30	Vermont	44.40
5	New York	20.19	31	Indiana	45.11
6	Rhode Island	22.36	32	Missouri	45.30
7	Connecticut	25.48	33	Texas	46.26
8	Illinois	29.39	34	Oklahoma	47.64
9	Delaware	30.74	35	Virginia	47.92
10	California	33.26	36	Nevada	47.97
11	Maryland	34.97	37	Arizona	48.30
12	Minnesota	35.42	38	Montana	48.83
13	Wisconsin	35.78	39	North Carolina	50.61
14	Colorado	37.70	40	Idaho	50.87
15	Pennsylvania	37.90	41	Alaska	50.91
16	Iowa	38.49	42	South Carolina	51.00
17	Michigan	38.96	43	Tennessee	52.35
18	Ohio	38.97	44	Arkansas	52.51
19	New Hampshire	39.30	45	Kentucky	53.20
20	Utah	39.61	46	Georgia	53.65
21	Washington	40.35	47	West Virginia	54.64
22	Florida	40.51	48	Wyoming	54.78
23	Nebraska	40.85	49	Louisiana	55.04
24	Maine	42.12	50	Alabama	57.51
25	South Dakota	42.30	51	Mississippi	60.25
26	Kansas	42.88			

Source: Azrael, Cook and Miller (2004).