Gun shows and universal background check laws across state lines

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Abstract

States with more gun laws have fewer gun assaults, and associations are strongest for background check laws. However, sales between private buyers and sellers (i.e., gun shows) are exempt from some background check requirements according to federal and most state laws. The aim of this study was to determine whether gun shows are more likely to take place in counties that are near states with universal background check laws. This cross-sectional study used gun show data from a 2018 public online listing aggregated within 3,107 counties in the contiguous 48 states. The main independent variable was the presence of a universal background check law in neighboring states. We controlled for potential drivers of demand for gun shows, including the total number of gun laws within-state and in neighboring states, local and in-flowing population size, and proportion of the local and in-flowing population who were gun owners. Bayesian conditional autoregressive Poisson models estimated associations between neighboring-state universal background check law and the presence of a gun show in each county while accounting for spatial dependencies and nesting of counties within states. Of the 1,869 identified gun shows, nine of the states in which they occurred had a universal background check law. The presence of excess gun shows in counties near states with universal background check laws is consistent with the hypothesis that gun shows service demand from people seeking to circumvent prohibitions against gun purchases.

INTRODUCTION

Gun violence is a major public health problem in the United States.[1,2] Areas where gun ownership is highest have higher suicide and homicide rates.[3,4] A gun in the home increases the risk of adolescent suicide, homicide, and accidental death even when controlling for sex, family income differences, risk-taking, and delinquency.[1–3,5–9] States with higher gun ownership are associated with domestic homicide, with states in the highest quartile of gun ownership having a 65% higher rate of domestic homicide than states in the lowest quartile.[10,11] Spikes in the acquisition of guns are noted after mass shootings and are

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associated with increases in gun injuries in the years following such spikes.[12] Decreasing the number of guns in circulation appears to decrease violence such as with gun buybacks.[20] However, the enormous disparity in laws between states which range from the single digits of laws regulating guns in many states to more than 100 in California and Massachusetts results in the flow of guns from states with permissive legislation to states with tighter regulation.[13,14] The availability of guns to prohibited persons and traffickers is largely unchanged as the permissive laws of neighboring states undermine attempts to decrease gun homicide in states with more restrictive laws.[15]

Data from national surveys show that 22% of all gun owners have acquired a gun within the last two years through private sales without a background check.[16] This is possible because in the US, there is no federal standard for background checks with private sales or transfers of guns (i.e., universal background check) to prevent the sale to convicted felons and other persons who are forbidden from the legal purchase of guns under federal law. Under universal background checks, both licensed dealers and private sellers must conduct background checks at the point of purchase for all guns. Further, federal laws such as the Firearms Owner Protection Act (FOPA) have made it difficult for federal agencies to enforce these laws, or prevent the resale of guns to criminals, by requiring sellers to have *knowingly* sold to prohibited persons to be prosecuted for criminal sales.[17] In a survey of incarcerated gun offenders who would not have been able to legally purchase a gun, 96% indicated they obtained their weapon via a private transaction.[18]

Universal background check laws are a popular policy that 90% of the public supports including 84% of gun owners and 74% of NRA members.[19] In fact, the overwhelming majority of gun owners support background checks, and instituting greater oversight of gun dealers to prevent the selling and trafficking of guns to people with criminal records. Universal background check laws are unique among gun policies in that passage of such laws appears to effectively reduce gun homicide in states that have adopted them. In particular, African American homicide has reduced by as much as 19%.[2,20–23] Evidence is limited for most other gun policies having a clear benefit in the prevention of gun homicide. Conversely, evidence exists from states such as Missouri, which has removed a background check requirement and resulted in a significant 23% increase in gun homicides.[24] The magnitude of the effect of universal background check laws, however, will be influenced by the level of enforcement and availability of guns through alternative markets, such as gun shows.[25] Moreover, most guns are purchased by people who already own them. A recent study found that gun owners, on average, had five guns and over 60% purchased their most recent weapon from a licensed dealer.[26] For individuals who are already gun owners, universal background check laws may have little or no effect.

Unlicensed private sellers are a significant contributor to trafficked guns.[27] Gun shows are venues that have long been suspected to contribute to trafficking due to the gathering of a large number of unlicensed sellers in an unregulated sales environment conducive to unchecked and straw purchases. Only states with a universal background check law require background checks at gun shows. In 2018, eleven states had an active universal background check law. Moreover, gun shows may serve as an intermediate source of crime guns for organized interstate gun traffickers. Research shows that as many as 30% of guns used in

crime were at one point sold in gun shows.[28–32] In the US, interstate commerce of guns is prohibited without the use of a Federal Firearms License (FFL).[33] However without universal background check laws, this "gun-show loophole" allows for the potential of private sales to serve as a persistent source of the flow of trafficked guns to prohibited persons across state lines and into states with a higher degree of regulation as there is no requirement to check that buyers are not criminals in these transactions.

The aim of this study was to examine the geographic distribution of gun shows in relation to universal background check laws. We hypothesized gun shows concentrate geographically near states with a universal background check law—independent of other drivers of demand for guns, such as population size and the proportion of people who own guns—because gun shows could service demand from people who are otherwise restricted from making legal purchases.

METHODS

Study Sample

The units for the spatial ecological analysis were 3,107 counties nested within the 48 contiguous states. We excluded Alaska and Hawaii because our measure of gun laws in neighboring states assumed that the effect of distance was uniform across geographic space, and travel between these noncontiguous states would likely have different properties. We excluded Washington, DC, as gun law data were not available for this territory.

Dependent Measure

The main dependent variable of interest was the presence of a gun show in a county. We compiled dates and locations of gun shows in the 48 contiguous states using published gun shows listed in *Gun Shows USA*[34] for 2018. This was the most comprehensive publicly available online source of gun shows. *Gun Shows USA* is a digital advertising platform for promoters to advertise their upcoming shows and related businesses to promote their products. Promoters are the hub of the industry.[35] We dichotomized the outcome to indicate the presence or absence of any gun show in that county in 2018.

Independent Measure

The main independent variable of interest was the presence of a universal background check law in neighboring states. We obtained these data from the State Firearm Law Database[36], a publicly available catalog of state-level gun laws.[13] This database reports whether 133 gun laws were in effect from 1999 to 2020 for all 50 states. Boston University researchers grouped the 133 identified gun laws into 14 different categories and several subcategories, including universal background check laws.[13] We calculated the total number of active gun laws in each state during 2018. To calculate measures for gun laws in neighboring states we used an inverse distance weighting procedure (i.e., a gravity function) that we have used previously based on a matrix of great circle distances between county centroids.[37] Counts of gun laws and presence of a universal background check law in counties in neighboring states were weighted by the square of the inverse distance and their population size. We

standardized this "gravity-weighted" universal background check measure by subtracting the mean and dividing by the standard deviation.

Confounding by Demand for Guns

Associations between universal background check laws in neighboring states and the presence of gun shows could be confounded by the economic geographic characteristics of the market for guns. In particular, demand for guns in local and surrounding areas is likely to be associated with an increased presence of gun shows. Unfortunately, however, prevalence estimates of gun ownership at the state and county level are limited. This is in part due to legislative restrictions on access to gun purchase data and the absence of registration requirements.[38,39] Due to these limited data researchers have relied on a number of proxy variables. At the state level, the most frequently used proxy measure is the proportion of suicides committed with a gun, which has been shown to be highly correlated with gun ownership estimates obtained through national surveys.[40,41] There has been some research into estimates of county-level gun ownership but these estimates have predominately been limited to populous counties.[42,43] Due to the lack of data, we used the following procedure to develop small-area estimates of gun ownership within US counties, which we interpret as the "market potential" for guns. Market potentials are a common approach to calculating small-area estimates of demand in the absence of sales data.[44,45]

Sample—We accessed publicly available data from the General Social Survey (GSS)[46] for 2018, which is a nationally representative survey of adults conducted annually by the National Opinion Research Center (NORC) at the University of Chicago funded by the National Science Foundation since 1972.[46] Participants are recruited using an area-probability design that randomly selects respondents in households across the US. The approximately 90-minute survey is conducted face-to-face with an in-person interview by NORC at the University of Chicago. Participants are asked to respond to a standard core of demographic, behavioral, and attitudinal questions, in addition to topics of special interest.

Measures—Gun ownership data was collected in the GSS as self-reported possession in the home. Participants were asked, "Do you happen to have in your home any guns or revolvers?". We coded gun ownership as a binary measure (1 = yes, 0 = no).

Independent measures for the person-level analysis were the demographic characteristics available in the GSS that have been theoretically or empirically linked to gun ownership and that have analogies in the American Community Survey (ACS). We coded these variables into categories that corresponded with those used to report ACS data. Six variables were dichotomized: sex (male vs. female); employment (employed vs. unemployed); highest educational achievement (≤ High school/GED vs. > High school/GED); geography (urban vs. rural); annual household income (<$25,000 vs. ≥ $25,000); and ethnicity (non-Hispanic vs. Hispanic). Other measures were coded as categorical variables: race (White, Black, and Other); age (18 to 29, 30 to 39, 40 to 49, 50 to 59, 60 to 69, and ≥ 70); and region (Pacific, East North Central, East South Central, Middle Atlantic, Mountain, New England, West South Central, South Atlantic, and West North Central).

Estimating Gun Ownership in US Counties—A logistic regression model estimated the odds that participants self-reported possession of a gun in the home. The person-level demographic measures were included as independent variables—sex, employment, education, geography, income, ethnicity, race, age, and region.

Results of the person-level logistic regression model were used to estimate the market potential for guns in US counties. We extracted the coefficients for each characteristic, then multiplied these coefficients by the proportion of the population in each county that had the corresponding characteristic (using ACS 5-year estimates for 2018[49]) and by the point estimate for the constant term. This procedure provided a county-level estimate of the proportion of the population who had a gun in their home, which we used as a proxy for the market potential for guns. We used these estimates to measure gun ownership at three spatial scales—within counties; other counties within the same state; and counties in neighboring states.

Other Confounders

In addition to the demand for guns, other characteristics of the economic geography could affect the associations of interest. We estimated the size of the in-flowing population to each county from other counties within the same state and counties in neighboring states using the gravity function described above (without multiplying the estimate by gun laws). Using data from the Bureau of Alcohol, Tobacco, Firearms, and Explosives for 2017, we calculated counts of FFL within counties—separated into dealers and importers—to account for the possibility that gun shows concentrate in counties with fewer retail gun stores.

Statistical Analysis

The final step used multi-level Bayesian conditional autoregressive Poisson models to estimate the rate of gun shows in counties neighboring states with universal background check laws, independent of whether universal background check laws apply within that county. This construction controls for two forms of dependence between the spatial units of analysis. A state-level random effect accounts for the expectation that counties from the same state will be more similar to each other than they are to counties from other states, and a conditional autoregressive (CAR) prior allow the possibility that individual counties will be more similar to their neighbors than they are to distant counties (i.e., spatial autocorrelation).

The general form of the multilevel model was used:

$$ln\left(\frac{p}{1-p}\right) = (\beta_0 + u_0) + \beta \cdot X'_a + \Theta_a + \phi_a$$

where $p = \Pr(Y = 1)$ for the binary variable Y, which measured the presence of a gun show during 2018 in county a. The term β_0 is a state-specific intercept and u_0 is a random state-specific residual component, such that $\beta_0 + u_0$ can be thought of as representing adjusted state-level means on the outcome variable. β are regression coefficients expressing the associations (slopes) for the matrix of county- and state-level independent measures X'. The

terms θ_a and ϕ_a are random effects that capture spatially unstructured heterogeneity and CAR spatial dependence respectively. To determine whether un-modeled spatial dependencies in the data had affected our estimates, we applied Moran's I test to the deviance residuals and compared the results of a null model to our final model.

Sensitivity analysis

We conducted a sensitivity analysis comparing the results of the county-level analysis to an analysis conducted at the state level. Our dependent measure for the state-level analysis was the sum of all gun shows in the counties in each respective state. Consistent with the county-level analysis, our independent measure was the presence of a universal background check law in neighboring states. To estimate gun ownership at the state level, we calculated the proportion of suicides that were committed with a gun in each state.[50] As previously mentioned, this is the most frequently used proxy measure of state level gun ownership. We used Bayesian conditional autoregressive Poisson models to estimate the rate of gun shows in states neighboring states with universal background check laws, controlling for state-level confounders.

Ethics

This study was granted an exemption from the Columbia University Institutional Review Board.

RESULTS

Descriptive Statistics

There were 1,869 gun shows in 2018. A total of 631 (20.3%) of the 3,107 study counties had any gun show (Figure 1). Table 1 reports these values and the county-level characteristics for the independent measures of interest. Measured at the county-level, there was a mean of 22.2 (SD = 21.6) within-state gun laws, and 4.6% (SD = 7.9%) were universal background check laws. There was a mean of 31.1 (SD = 12.4) gun laws in neighboring states, and 8.8% (2.9%) of these were universal background check laws.

Market Potential for Guns

A total of 2,348 individuals participated in the General Social Survey in 2018. Descriptive statistics for this sample are shown in Table 2. Around one fifth of participants reported owning a gun in home (22.9%). Unemployed middle-aged men (40–49) living in rural areas were more likely to own guns.

Table 3 shows the results of the person-level logistic regression model for gun ownership. Female participants were 36% less likely to report gun ownership than male participants (OR = 0.64; 95%CI: 0.68, 1.38). Black participants were 52% less likely to report gun ownership than White participants (OR = 0.48; 95%CI: 0.35, 0.65). The constant term for this model was 1.08 indicating that participants who had all referent characteristics (e.g., female, white, age 18–29 years) had expected odds of gun ownership of 1.08 (95% CI: 0.93 – 3.00).

Combining the point estimates from the person-level logistic regression model and the county-level estimates of population demographic composition of US counties, we estimated the county-level distribution of gun ownership. On average, 22.5% (SD = 9.9%) of the population were estimated to own a gun within the 3,107 included counties. This estimate ranged from 3.7% (e.g., in Hudson County, NJ) to 53.0% (e.g., in Magoffin County, KY). Estimated gun ownership was generally higher in the South and Midwest regions.

The estimated proportion of gun owners (i.e., the market potential for guns) was 9.8% (SD = 9.6) within counties, 20.7% (SD = 3.0%) in other counties within the same state, and 18.6% (SD = 3.0%) in counties in neighboring states.

Statistical Analysis

Table 4 presents the results of the multi-level Bayesian conditional autoregressive Poisson model. After controlling for the potential confounders—the market potential for guns, the total number of within-state and neighboring-state gun laws, the presence of FFLs, and the presence of a universal background check law within-state—a 1 SD increase in the gravity-weighted average of the presence of a universal background check law in neighboring states is associated with a 65% increase in the incidence rate of gun shows per county population in 2018 (OR: 1.650, 95% CI: 1.163, 2.351). The results of the state-level analysis were similar and can be found in the appendix. Moran's I test found a reduction in spatial autocorrelation in the deviance residuals for the full model (Moran's I = 0.006, p < 0.001) compared to the null model (Moran's I = 0.013, p < 0.001).

DISCUSSION

This spatial ecological analysis of cross-sectional county-level data identified that there were more gun shows than expected in counties that are proximate to states with universal background check laws, independent of whether universal background check laws apply within that county. Given that private purchases are exempt from background check requirements in many states, these excess gun shows may service demand for guns from people living in the states with universal background check laws who are prohibited from making legal retail gun purchases in their home states. Thus, this study provides evidence that sales at gun shows may contribute to the illegal flow of guns across state lines.

Gun violence is a severe problem in the US, contributing to our diminishing life expectancy relative to other countries.[1,2,13,44,45] While there are many unknowns about the efficacy of individual gun laws, existing evidence suggests states with fewer guns and more gun laws generally experience lower gun homicide and suicide rates.[13,51–54] Specifically, laws that regulate who has access to guns (i.e., universal background check laws) appear to be more effective than those regulating the type of guns that can be obtained.[21] States without universal background check laws create opportunities for the trafficking of guns to criminals and other persons prohibited from owning guns under federal law.[22] Our results provide evidence that proximity to states without universal background check laws inherently supports gun trafficking. Since commerce of guns across state lines is prohibited without the use of a FFL, gun shows involving large numbers of private sales not subject to strict background check requirements may be used to evade these restrictions or to serve

as a supply of guns to organized traffickers.[34–40] The preferential geographic aggregation of gun shows in counties bordering states with a universal background check law suggests an economic incentive towards trafficking in the organization of these shows.

This study should be interpreted with its limitations in mind. First, our outcome measure was not validated. There is no public database with the count of gun shows in every county. *Gun Shows USA* is the most comprehensive source available, but it is possible it is an underestimate as promoters must opt into advertising on the website. If an underestimation, however, our results would be biased towards the null and the true effect would be even greater than we found. Second, all nonexperimental studies are subject to residual confounding. We minimized the impact of potential confounders by accounting for market characteristics at three spatial scales; however, counties differ on many more characteristics that affect the geographic distribution of gun shows in relation to universal background check laws than the available variables we included in our statistical analysis. For example, state-level implementation and enforcement of gun laws, as well as gun culture vary in ways this study cannot capture.[55] Finally, our cross-sectional analysis makes it hard to assume there is an equilibrium between the supply and demand for guns. Gun sales fluctuate in response to major events such as mass shootings and legislative changes.[56,57] Future longitudinal research would permit validation of the equilibrium assumption and should clarify whether gun shows are truly geographically organized in a way that undermines states with restrictive gun legislation.

CONCLUSION

This study justifies further inquiry into the effect of the "gun show loophole" and the potential role of universal background check laws in preventing trafficking of guns across state lines. Further research should center on trying to quantify how private sales and gun shows potentially service the demand for a steady flow of guns between states and ultimate use in crime. Additionally, as states either adopt universal background check laws, or remove them, effects on trafficking patterns and geographic distribution of gun shows could strengthen these analyses by ecologic and difference-in-difference analysis. Finally, these data lend further support for the potential benefit of universal background check laws which have received broad support, in preventing the transfer of guns from private individuals into criminal networks supplying guns for crime.

FUNDING

APPENDIX

Appendix

Table 1.

Descriptive statistics for 48 contiguous states in US

Variable	Mean	SD	Min	Max
Gun Shows	33.4	45.1	0.0	256.0
Within State Gun Laws				
Laws (count)	27.6	26.9	1.0	109.0
Universal background check (count)	0.3	0.4	0.0	1.0
Neighboring State Gun Laws				
Laws (gravity weighted count)	40.3	17.4	20.4	87.9
Universal background check (gravity weighted count)	0.3	0.2	0.0	0.9
Within State				
Population	6,705,124.0	7,370,930.0	581,024.0	39,283,497.0
Gun owners (%)	52.0	11.9	20.0	74.4
Neighboring State				
Population inflow (gravity weighted)	601.8	581.1	105.2	3462.2
Gun owners (%)	47.8	7.6	26.4	57.5
Federal Firearm Licensees				
Dealers (count)	1145.0	1068.0	0.0	6143.0
Importers (count)	22.5	30.0	0.0	164.0

Table 2.

Rate ratios and 95% confidence intervals for gun shows for 48 states in the US

	IRR	95% CI	
Within State Gun Laws			
Laws (count)	0.994	0.960	1.030
Universal Background Check	1.802	0.479	6.959
Neighboring State Gun Laws			
Laws (gravity weighted count)	1.065	0.969	1.177
Universal background check (gravity weighted)	1.206	0.477	3.152
Within State			
Population [expectancy]	1.000		
Gun owners (%)	1.016	0.948	1.087
Neighboring State			
Population inflow (gravity weighted)	1.000		
Gun owners (%)	**1.310**	**1.020**	**1.719**
Federal Firearm Licenses			
Dealers (count)	**1.002**	**1.001**	**1.003**

	IRR	95% CI	
Importers (count)	1.009	0.989	1.030

*
Bolded values are statistically significant at an alpha of 0.05

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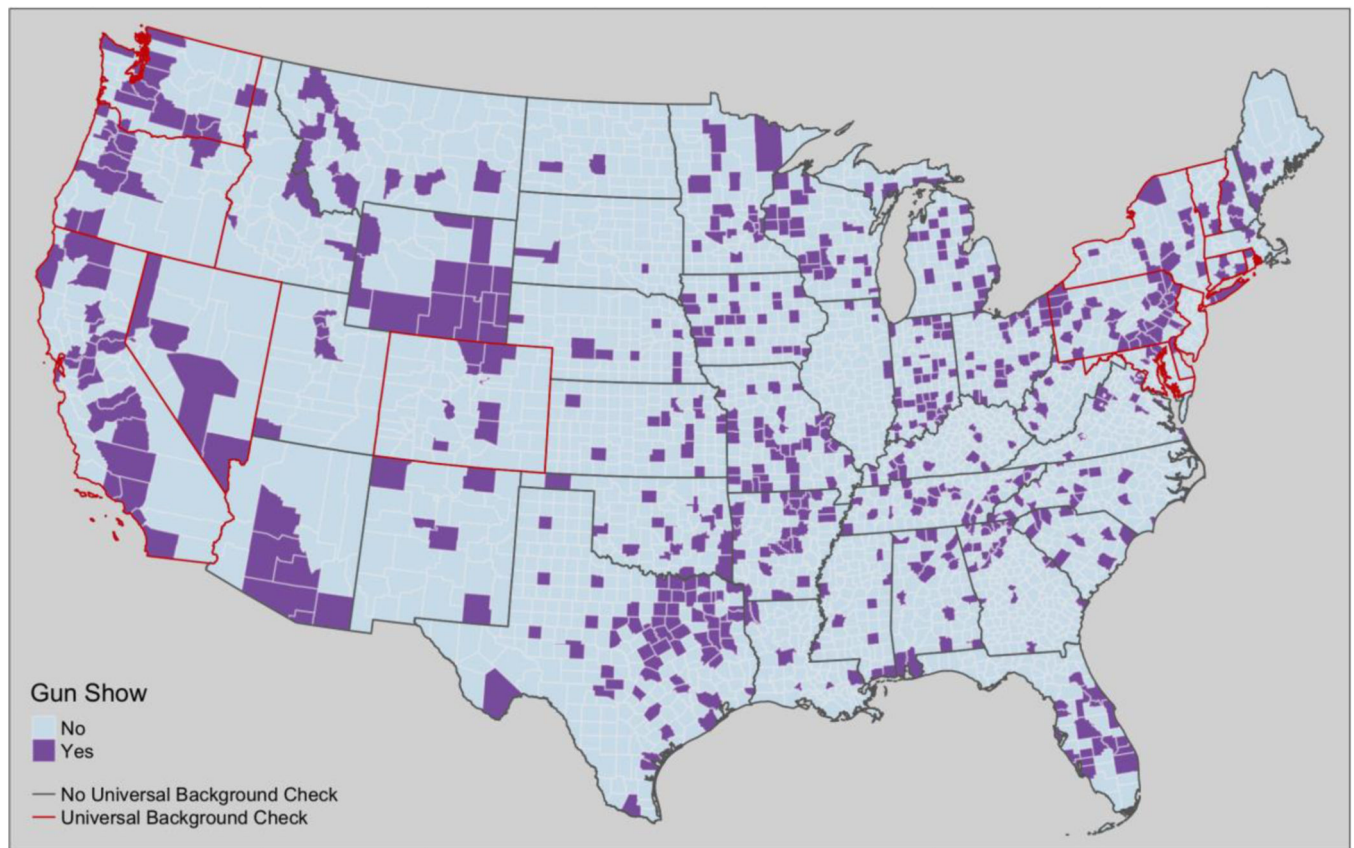
Figure 1.
US counties with at least one gun show in 2018 (n = 3,107)

We compiled dates and locations of gun shows in the 48 contiguous states using published gun shows listed in *Gun Shows USA* for 2018. This was the most comprehensive publicly available online source of gun shows. Counties in purple had at least one gun show in 2018.

Table 1.

Descriptive statistics for 3,107 counties in contiguous US

Variable	Mean	SD	Min	Max
Gun Shows	0.6	1.8	0.0	33.0
Within State Gun Laws				
Laws (count)	22.2	21.6	1.0	109.0
Universal background check (count)	0.1	0.3	0.0	1.0
Neighboring State Gun Laws				
Laws (gravity weighted count)	31.1	12.4	7.5	97.3
Background check (%)	8.8	2.9	2.0	25.2
Universal background check (gravity weighted count)	0.2	0.2	0.0	1.0
Within County				
Population	104408.0	334725.8	152.0	10105518.0
Gun owners (%)	22.5	9.9	3.7	53.0
Within State				
Population inflow (gravity weighted)	1743.4	7411.0	8.3	351541.8
Gun owners (%)	20.7	3.0	4.2	41.8
Neighboring State				
Population inflow (gravity weighted)	1616.5	2529.9	156.3	97822.8
Gun owners (%)	18.6	3.0	4.6	30.6
Federal Firearm Licensees				
Dealers (count)	20.4	29.9	0.0	681.0
Importers (count)	0.4	1.6	0.0	42.0

Table 2.

Descriptive statistics of respondents to the General Social Survey in 2018 (n = 2,348)

Variable	Total	%
Gun in the home	537	22.9
Male	1052	44.8
Age		
18–29	398	17.0
30–39	450	19.2
40–49	365	15.5
50–59	410	17.5
60–69	361	15.4
70+	364	15.5
Race		
White	1693	72.1
Black	385	16.4
Other	270	11.5
Ethnicity		
Non-Hispanic	1984	84.5
Hispanic	364	15.5
Region		
Pacific	343	14.6
East North Central	388	16.5
East South Central	163	6.9
Middle Atlantic	232	9.9
Mountain	183	7.8
New England	124	5.3
West South Central	277	11.8
South Atlantic	513	21.8
West North Central	125	5.3
Employment status		
Unemployed	955	40.7
Full time employed	1393	59.3
Education		
High school/GED	962	41.0
> High school/GED	1386	59.0
Income		
$25000	1444	61.5
< $25,000	140	6.0
Geography		
Rural	187	8.0
Urban	2161	92.0

Table 3.

Odds ratios and 95% confidence intervals for self-reported possession of a gun in the home

Variable	OR	95% CI
Intercept	1.08	(0.60, 1.92)
Sex		
Female	1.00	
Male	1.55	(1.27, 1.90)
Age		
18–29	1.00	
30–39	0.97	(0.68, 1.38)
40–49	1.17	(0.82, 1.68)
50–59	1.07	(0.75, 1.52)
60–69	1.08	(0.75, 1.55)
70+	1.05	(0.72, 1.53)
Race		
White	1.00	
Black	0.48	(0.35, 0.65)
Other	0.43	(0.27, 0.66)
Ethnicity		
Non-Hispanic	1.00	
Hispanic	0.55	(0.38, 0.80)
Region		
East South Central	1.00	
East North Central	0.65	(0.43, 0.99)
Pacific	0.50	(0.31, 0.80)
Middle Atlantic	0.27	(0.16, 0.47)
Mountain	0.88	(0.54, 1.44)
New England	0.38	(0.21, 0.68)
West South Central	0.99	(0.64, 1.55)
South Atlantic	0.72	(0.48, 1.09)
West North Central	0.70	(0.41, 1.19)
Employment status		
Unemployed	1.00	
Employed	0.86	(0.68, 1.09)
Education		
> High school/GED	1.00	
High school/GED	0.90	(0.72, 1.11)
Income		
$25,000	1.00	
< $25,000	0.59	(0.47, 0.74)
Geography		
Rural	1.00	

Variable	OR	95% CI
Urban	0.54	(0.38, 0.76)

Table 4.

Rate ratios and 95% confidence intervals for gun shows for 3,107 counties in the US

	IRR	95% CI	
Within State Gun Laws			
Laws (count)	**0.970**	**0.959**	**0.982**
Universal Background Check	**2.257**	**1.137**	**4.500**
Neighboring State Gun Laws			
Laws (gravity weighted count)	0.999	0.975	1.023
Universal background check (gravity weighted)	**1.650**	**1.163**	**2.351**
Within County			
Population [expectancy]	1.000		
Gun owners (%)	1.002	0.990	1.013
Within State			
Population inflow (gravity weighted)	1.000		
Gun owners (%)	1.021	0.992	1.051
Neighboring State			
Population inflow (gravity weighted)	1.000		
Gun owners (%)	**1.130**	**1.025**	**1.244**
Federal Firearm Licenses			
Dealers (count)	**1.007**	**1.004**	**1.011**
Importers (count)	**0.941**	**0.886**	**0.998**

*
Bolded values are statistically significant at an alpha of 0.05