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RESEARCH ARTICLE

Associations Between Socioeconomic, Political, and Violence-Related Factors and State Firearm Policies

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ABSTRACT: Gun violence and the debates surrounding how to address it remains one of the most divisive and prominent issues in the United States today, sparking arguments from presidential debates to dinner table discussions. The United States loses tens of thousands of people to gun violence each year. This study aims to analyze how twelve socioeconomic, political, and violence-related factors from 2014 are associated with changes in the strictness of gun policies between 2014-2024, the implementation of eleven subcategories of gun legislation, and the adoption or repeal of eight specific laws by using multiple statistical models. The study found that a higher rate of overall gun-related mortality, but not mass shootings, correlated with stricter gun policies, while states with Republican voting majorities and legislatures were more likely to have lenient policies (*presvotingmargin*: β = -4.618, p = 0.003; *legislature*: β = -2.950, p = 0.005). Socioeconomic factors were not significantly associated with the overall strength of state firearm laws or with the adoption or repeal of specific individual gun laws. These results are consistent with the interpretation that the enactment of gun violence prevention legislation is more strongly associated with deeply rooted partisan ideologies. The lack of association from mass shootings suggests that while major gun violence events do bring attention to the issue, it is still the political environment that largely relates to whether and how a state will respond.

KEYWORDS: Social and Behavioral Sciences, Political Sciences, Gun Violence, Firearm Policies, Socioeconomic Factors.

Introduction

Firearms have been deeply entrenched in American culture ever since the Bill of Rights was ratified back in 1791, establishing the right to bear arms as a constitutionally protected right, with limitations later clarified by the United States Supreme Court's decisions in District of Columbia v. Heller (2008) and McDonald v. City of Chicago (2010).[1,2] The cultural and political perceptions of firearms have shifted in the last few decades. While some view firearms as symbols of freedom and liberty, others see them as dangerous and perpetuating a growing public health crisis. Every 12 minutes, someone dies of gun violence.[3] U.S. gun violence ranks within the 93rd percentile among all countries globally and number one in firearm mortality per capita among high-income countries, over six times higher than the number two-ranked Switzerland.[4] However, the burden of gun violence in the U.S. is unevenly distributed. While states like Massachusetts had only 3.7 firearm deaths per 100k, others like Mississippi and Montana had nearly six times and eight times the number of deaths, respectively, nearing the level of countries like Guatemala.[5,6] Furthermore, the leniency of gun legislation varies dramatically between states, with some like California boasting one of the strongest gun policies in America by implementing universal background checks and extreme risk laws. Extreme risk laws allow courts to temporarily remove firearms from someone who poses a danger to themselves and others. In contrast, others, such as Alaska, have some of the loosest gun laws with few preventative measures.[7,8]

Federal law establishes a baseline for firearm regulations that apply throughout the nation. The Gun Control Act of 1968, signed under President Lyndon B. Johnson, established strict regulations on firearm dealers, requiring federal licenses and transaction records.[9] The Lautenberg Amendment of 1996 prohibits individuals convicted of misdemeanor domestic violence from possessing firearms.[10] However, federal law leaves significant discretion for gun regulations to the states, and how far state regulations extend beyond this minimum floor differs drastically. This study examines how socioeconomic, political, and violence-related variables are associated with how far states extend their gun regulations beyond the federal minimums.

Existing literature has shown that states with more lenient gun policies were correlated with higher rates of firearm-related injuries, higher gun mortality, and a significant amount of years of life that may be lost.[11] Other studies reinforce this idea, demonstrating a correlation between stricter gun policies and decreased rates of gun homicides.[12] Likewise, studies have found that a state's poverty was significantly correlated with firearm homicide rates, while urbanization and political lean had a significant association with firearm suicide rates.[13] Although there has been plenty of research on how gun laws link to firearm violence-related metrics, only a few have examined the other way around: how socioeconomic, political, and violence-related metrics are associated with gun violence legislation. That is not to say there is no existing research. One survey found that Democrats are far more likely to support more restrictive policies, such as a ban on assault-style weapons (85% for Democrats, 42% for Republicans). At the same time, Republicans are more likely to support more permissive policies, such as allowing teachers and school officials to carry guns in K-12 schools (74% for Republicans, 27% for Democrats).[14]

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Another study found that progressive state governments were more likely to adopt stricter gun laws.[15] Moreover, internal state factors are statistically significant predictors of law adoption alongside the actions of neighboring states or network connections.[16] Socioeconomic factors like poverty, unemployment, and access to health insurance, alongside demographics, had a stronger influence on firearm homicides than gun laws did.[17] Support increased for stricter gun permits among Democrats after mass shootings, but this effect did not carry through to individuals of other political stances, with one exception being school shootings.[18] Yet, few studies have analyzed how socioeconomic, political, and violence-related factors are associated with the strictness of firearm legislation across multiple policy areas, leaving a gap in understanding of how various forces drive state-level gun legislation.

The dominance of political factors in determining the direction of gun legislation is consistent with existing frameworks. In *The Politics of Gun Control*, Robert J. Spitzer argues that firearm policy is a product of deeply entrenched ideological identity rather than rational response, where party affiliation functions as a filter for any piece of regulation proposed.[19] This framework predicts that socioeconomic conditions will have limited direct influence on legislative outcomes, as lawmakers focus on the ideological preferences of their constituents rather than public health data. This is consistent with the initial idea that political variables were more strongly associated with gun policy rather than socioeconomic ones.

This study uses Ordinary Least Squares (OLS) and logistic regression models to analyze how socioeconomic, political, and violence-related metrics from 2014 are associated with the changes in state firearm legislation between 2014 and 2024. It further examines whether or not these associations differ across the 11 subcategories of gun laws and the adoption or repeal of eight specific pieces of legislation.

Methods

This study uses a longitudinal design using state-level socioeconomic, political, and violence-related data from 2014 to observe how these factors link to the change in the strictness of states' gun legislation from 2014 to 2024. 2014 was chosen as it follows the legislative period after the tragic shooting in Sandy Hook in December 2012. Another reason was that the year followed a decade of gridlock marked by the defeat of background checks and assault weapon bans federally, and marked the point of state-level divergence.[20] In addition, the study analyzes how these same factors link to the adoption of 11 subcategories of gun legislation and the adoption of eight specific individual laws. This analysis covers all 50 U.S. states but excludes the District of Columbia, as it has a fundamentally different way of enacting legislation. The leniency of a state's gun policy was quantified with a strictness score, essentially how many of the 72 key laws a state implemented.

Table 1 shows the twelve socioeconomic, political, and violence-related factors that were used in the study. Social characteristics were either pulled from the United States 2010 census, which estimated 2014 values, or the numbers were pulled from the Federal Reserve Bank of St. Louis with exact 2014 values. *Legislature* refers to the party control of the state legislature, coded as 0 for Democratic control, 1 for Republican control, and 0.5 for split control. *Governor* refers to the state governor's office party control, coded as 0 for Democratic control and 1 for Republican control. Poverty refers to the percentage of a state's population living below the federal poverty line. *Income* refers to the Real Median Household Income in each state, adjusted to CPI-U 2023 dollars. *Gini* refers to the Gini Index as a measure of income inequality, ranging from zero to one, where zero represents perfect equality (everyone has the same wealth), and one represents perfect inequality (one person has all of the wealth).[21] *BA+* refers to the percentage of a state's population holding a bachelor's degree or above. *Density* refers to the population density of a state, which is calculated by dividing the total population by the total land area, a proxy for urbanization. *Unemployment* refers to the percentage of a state's population that is unemployed. *Gun percent* refers to the percentage of a state's population that owns a firearm. The measurements were drawn from Professor Michael Siegel's database compiled in 2024 that contained state-level socioeconomic metrics from 1976 to 2024. *Massshootingrate* refers to the number of mass shootings per 1 million, calculated by compiling all mass shootings in a state in a year and dividing by the total population. For this study, a mass shooting is defined as an incident with at least four victims injured or killed, excluding the shooter.[22] *Gundeathrate* refers to the firearm mortality per 100k in each of the 50 states. *Presvotingmargin* is calculated as the percentage of Republican votes minus the percentage of Democratic votes in the 2012 presidential election, such that positive values indicate a Republican-leaning state. All data used are publicly available. All independent variables were standardized by subtracting the variable's mean and dividing by the standard deviation, which allows the coefficients to be compared directly.

Although considered, the 2014 strictness scores for the 50 states were kept out of the regression analysis as the dependent variable is the change in strictness score, which already incorporates the strictness score from 2014. Including the variable on both sides of the equation may introduce regression to the mean bias and suppress the coefficients of the substantive predictors of interest. The study chose to avoid a possible multicollinearity problem that could undermine the entire model. An alternative approach would include the 2014 baseline score as a covariate; the decision to exclude it represents a modeling choice that future research could revisit.

Political variables (*legislature, governor, presvotingmargin*) capture partisan control at different levels of government. Existing research has consistently found that partisanship has been associated with the direction of state gun policy. Socioeconomic variables (*income, Gini, poverty, BA+, unemployment, density*) were included because prior work has found that economic conditions and urbanization were linked to both firearm violence rates and policy preferences.

Table 1: The twelve socioeconomic, political, and violence-related factors.

legislature	State Legislature Control
governor	State Governor Control
income	Real Median Household Income
poverty	Poverty Rate
gini	Gini Index
BA+	Bachelor's Degree or Above Rate
unemployment	Unemployment Rate
density	Population Density
gunpercent	Gun Ownership Rate
massshootingrate	Mass Shootings per 1 million
gundeathrate	Firearm Mortality per 100k
presvotingmargin	Presidential Voting Margin

Table 2 shows the 11 subcategories of gun legislation that were analyzed in the study. The 72 key laws were split into 11 subcategories according to their general regulation subcategory; for example a ban on non-commercial firearm dealers falls into the dealer regulation subcategory. dealers would fall into the *dealer regulation* subcategory. The 72 laws that were identified as key were determined through Professor Michael Siegel's database. The 11 subcategories were determined in Professor Michael Siegel's database and were created based on either to whom the laws applied or to what part of gun regulation the law addresses. Full descriptions of the 72 laws and their subcategory assignments follow the classifications in Professor Michael Siegel's state firearm laws database. *Dealer regulation* refers to laws that place regulations on how and where dealers sell firearms. *Buyer regulation* refers to laws that place regulations on how buyers purchase and possess firearms. *Prohibition for high-risk possession* refers to restrictions on how individuals who have committed violent crimes are able to possess firearms. *Background checks* refer to legislation that requires background checks to be performed on consumers at the point of purchasing a firearm. *Ammunition regulation* refers to legislation that regulates the buying and selling of ammunition. *Possession regulation* refers to legislation regulating who, where, and how they can carry a firearm. *Concealed carry permitting* refers to legislation that requires individuals to have a permit to carry a concealed firearm. *Assault weapons and large-capacity magazines* refer to restrictions placed on the sale, transfer, and possession of large-capacity magazines and assault weapons. *Child access prevention* refers to legislation that addresses how firearms must be stored in a household. *Stand your ground*, refers to how an individual is allowed to use deadly force. Lastly, *domestic violence* refers to how individuals convicted of domestic violence are able to possess firearms.

Table 2: Eleven subcategories of the 72 key gun laws.

buyerreg	Buyer regulations
prohighrisk	Prohibitions for high-risk gun possession
bgchecks	Background check
ammoreg	Ammunition regulation
possreg	Possession regulation
concarry	Concealed carry permitting
asweaplgcapmag	Assault weapons and large-capacity magazines
childaccprev	Child access prevention
nosyg	No stand your ground
domviolence	Domestic violence
dealerreg	Dealer regulations

Table 3 shows the eight specific individual laws that were analyzed in the study. These 8 laws were selected in particular because they represented key debates over specific gun policies during this time period. Many states chose to either implement or repeal these specific 8 laws, which may help us evaluate in which direction the state's gun policy is headed. Two of the specific laws, *permitconcealed*, which requires a permit to carry a concealed weapon, or bans all concealed weapons, and *nosyg*, which bans the use of deadly force as a first resort in public, were analyzed for repeal. In contrast, the other six were analyzed for adoption. These two were chosen as they were two key laws that were often repealed, rather than adopted, by states. All data used were publicly available.

All categories and laws that fell into each category remained exact with the classification done by Professor Michael Siegel's provided database. Reclassifications were avoided to prevent inconsistencies that may make future studies or replications more arduous. Some laws within the same subcategory could be considered redundant. For example, *universal* (point-of-purchase checks by all sellers) is a stricter version of *universalpermit* (checks at purchase or via permit). States that met the stricter criteria also met the weaker one, thus were double-counted. This was kept in place for this manuscript to stay consistent with Professor Michael Siegel's original database design, where each law was a distinct policy instrument. Keeping this consistent may make it easier for replications in future studies.

Table 3: Eight specific individual gun laws.

universalpermit	Universal Background Checks
permit	License or permit to purchase all firearms
permithandgun	License or permit to purchase all handguns
permitconcealed	A permit is required to carry concealed weapons.
age21handgunposs	No possession of handguns until age 21
collegeconcealed	No gun carrying on college campuses, including concealed weapons permittees
nosyg	No stand your ground law.
gvrolawenforcement	Law enforcement officers can confiscate firearms from high-risk individuals.

Two regression models were utilized: an OLS regression model and a ridge penalized logistic regression model. The OLS was used to examine how the 12 factors were associated with the strictness of state gun legislation and the implemen-

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tation of the 11 subcategories of the 72 laws. The dependent variable of the OLS model is the change from the 2014 strictness score to the 2024 strictness score. The ridge penalized logistic regression was used to analyze the uptake or repeal of the eight specific individual laws. The paper modeled a dichotomous variable: whether a state adopted or repealed a law, or it did not. Of the eight laws, six were analyzed for uptake, while *nosyg* and *permitconcealed* were analyzed for repeal. States that had already implemented a given law in 2014 when analyzing uptake were removed, and similarly, states that didn't have a given law in effect in 2014 when analyzing repeal were removed. A zero was coded if a state did not implement the law for uptake or did not remove a law for repeal between 2014 and 2024. A one was coded if a state implemented the law for uptake or removed a law for repeal between 2014 and 2024. All twelve factors mentioned above were used for the ridge penalized logistic regression model. The ridge logistic regression was used to stabilize coefficients, as there were limited cases of individual law adoption or repeal, which can cause standard logistic models to produce inflated and/or unstable coefficients.

Regression Model Equations:

1. Ordinary Least Squares (OLS) Regression Model Equation

$$\Delta Strictness = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \ldots + \beta_k X_k + \epsilon$$

$$Minimize = \sum_{i=1}^{n} (Y_i - \hat{Y}_i)^2$$

- $\Delta Strictness$ = the outcome variable
- β_0 = the constant
- $X_1, X_2, \ldots X_k$ = the predictor variables
- $\beta_1\ \beta_2 \ldots$ = coefficients, showing how much ΔStrictness increases by one unit
- ϵ = the error term

2. Ridge-Penalized Logistic Regression Model Equation

$$l_{ridge}(\beta) = \sum_{i=1}^{n} [y_i \log(p_i) + (1 - y_i) \log(1 - p_i)] - \lambda \sum_{j=1}^{k} \beta_j^2$$

$$p_i = \frac{1}{1 + e^{-(\beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \ldots + \beta_k X_{ik})}}$$

- p_i= predicted probability of adoption
- $\beta_0 + \beta_1 X_{i1} + \beta_2 X_{i2} + \ldots + \beta_k X_{ik}$ = linear predictor
- $\sum_{i=1}^{n} [y_i \log(p_i) + (1-y_i) \log(1-p_i)]$ = log-likelihood term
- $\lambda \sum_{j=1}^{k} \beta_j^2$ = ridge penalty

Data Analysis Process and Software:

Conducted using Python with the statsmodels package for regression model estimation. Data was organized and processed using pandas.

Multicollinearity was assessed using Variance Inflation Factors or VIFs. Table 4 shows the values of the VIFs for each of the 12 variables. Most predictors had an acceptable VIF of below 9, with *gunpercent* rate as an exception (VIF=10.92), thus the multicollinearity should not pose a broad threat to the coefficients. This elevated VIF value reflects the overlap between gun ownership rate and other predictors, such as political factors. A VIF value of above 10 warrants but does not invalidate the regression results, as it suggests that the standard error for the gun ownership coefficient may be slightly inflated. As a robustness check, the models were re-estimated excluding gunpercent. The remaining predictors were not substantively changed.

Table 4: Variance Inflation Factor Values.

Predictor	VIFs
legislature	2.97
governor	1.92
income	6.89
poverty	6.00
gini	2.96
BA+	7.43
unemployment	4.04
density	3.89
gunpercent	10.92
massshootingrate	1.85
gundeathrate	8.77
presvotingmargin	6.78

Results and Discussion

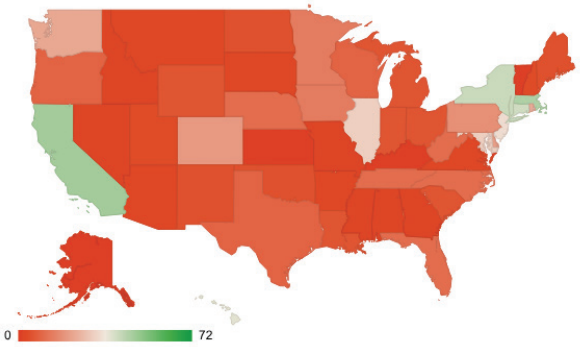

Figure 1: United States heat map of state firearm legislation strictness score in 2014. Most states had low scores for firearm strictness, where many states are grouped at the bottom of the scale. The concentration of consistent deep and light red color states with limited green states demonstrates the uneven distribution and leniency of gun policy in America.

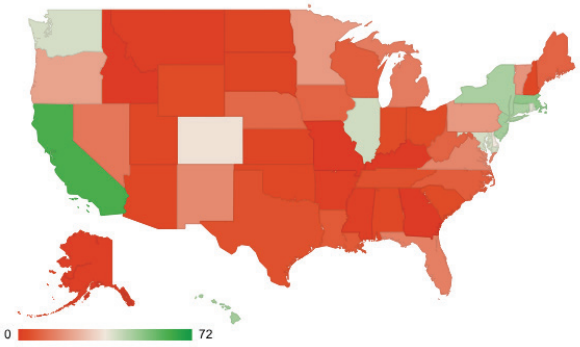

Figure 2: United States heat map of state firearm legislation strictness score in 2024. This demonstrates a clear shift away from the more permissive gun policies seen just a decade prior, as the map shifts away from the deep and light red colors and more toward the beige and green. This reflects an established trend of firearm policies strengthening throughout the past decade. Yet, many Southern and Midwestern states remain at the bottom of the scale.

Figure 1 and Figure 2 show the heat map of state firearm legislation strictness scores in 2014 and 2024, respectively.

Red represents a low score, light beige represents the 50th percentile, while green represents a high score. Table 5 shows numerical scores of states' firearm legislation in 2014 and 2024, where the same color scale applies: red represents a low score, light beige represents the 50th percentile. Scores from Table 5 correspond to the heat map as shown in Figures 1 and 2. When looking at the states holistically in the context of the entire United States, it is clear that from 2014 to 2024, the strictness score of states has been increasing, with the average strictness score increasing from 12.44 to 16.02. However, this change is not uniform, as some states, such as in the Midwest and South, remain with single-digit scores across the decade. Some states have even regressed, such as North Dakota, which went from five out of 72 laws to just two.

Table 5: State firearm legislation strictness score in 2014 and 2024. The average strictness scores for states increased from an average of 12.44 in 2014 to 16.02, a nearly 4-law increase, reinforcing the rhetoric that the nation as a whole is moving toward stronger firearm policies. However, some states have seen regressions as 25 states went up in their strictness score, 23 went down, while two stayed the same, demonstrating the clear polarization between restrictive and permissive states.

State	score2014	score2024
Alabama (AL)	2	3
Alaska (AK)	1	1
Arizona (AZ)	3	3
Arkansas (AR)	3	1
California (CA)	48	62
Colorado (CO)	20	35
Connecticut (CT)	41	47
Delaware (DE)	21	36
Florida (FL)	11	15
Georgia (GA)	2	0
Hawaii (HI)	38	48
Idaho (ID)	2	0
Illinois (IL)	31	41
Indiana (IN)	6	4
Iowa (IA)	14	9
Kansas (KS)	1	2
Kentucky (KY)	1	0
Louisiana (LA)	6	7
Maine (ME)	5	9
Maryland (MD)	31	40
Massachusetts (MA)	46	51
Michigan (MI)	6	14
Minnesota (MN)	14	20
Mississippi (MS)	2	1
Missouri (MO)	2	0
Montana (MT)	3	1
Nebraska (NE)	11	10
Nevada (NV)	2	13
New Hampshire (NH)	4	3
New Jersey (NJ)	34	48
New Mexico (NM)	5	17
New York (NY)	42	47
North Carolina (NC)	11	8
North Dakota (ND)	5	2
Ohio (OH)	6	4
Oklahoma (OK)	5	3
Oregon (OR)	9	22
Pennsylvania (PA)	18	20
Rhode Island (RI)	24	39
South Carolina (SC)	6	4
South Dakota (SD)	3	2
Tennessee (TN)	11	5
Texas (TX)	9	5
Utah (UT)	4	3
Vermont (VT)	1	19
Virginia (VA)	3	16
Washington (WA)	23	40
West Virginia (WV)	11	9
Wisconsin (WI)	9	8
Wyoming (WY)	6	4
Average	12.44	16.02

Table 6 shows the regression results for the change in strictness for state gun laws, measured by the number of laws each state had in place in 2024 (out of a total of 72), subtracting the number of laws each state had in place in 2014. Results indicate that most of the factors, such as income (real median household income of states), poverty (poverty rate), unemployment (unemployment rate), and gun ownership rate (percent of population who own guns), are not statistically significant predictors of the overall strictness of states' gun policies. These twelve factors explained 74% of the variance, with an R^2 value

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of 0.740 (adjusted R^2 = 0.656). For all the subcategory data, please refer to Appendix A.

However, three factors stand out. First, gun mortality per capita was positively associated with stricter gun policies; it is statistically significant (β = 3.579, p = 0.040), though this association should be interpreted cautiously. Because the average strictness score increased overall nationally during this period, states with higher baseline mortality, thus having more room to adopt new laws, may appear to be more responsive, which may inflate this coefficient. Political factors are also strong predictors. Both *presvotingmargin* (percent of Republican votes minus percent of Democrat votes) and legislature (state legislature control) are statistically significant (β = -4.618 and -2.950, respectively, p = 0.003 and 0.005, respectively), and show that Republican majority voter bases and Republican legislatures were negatively correlated with more restrictive gun policies.

Table 6: Predictors of change in overall gun policy strictness. Most socioeconomic factors do not play a big role in predicting a state's restrictiveness of its firearm policy. However, higher death rates correlate with a more restrictive policy, while a Republican voting margin and a majority Republican voting margin correlate with more lenient policies.

Predictors	Coefficient	StdErr	t_value	p_value
const	3.580	0.568	6.307	0.000
income	-1.820	1.490	-1.221	0.230
poverty	-1.856	1.390	-1.335	0.190
gini	-0.396	0.977	-0.406	0.687
BA+	0.650	1.547	0.420	0.677
unemployment	-0.236	1.141	-0.207	0.837
density	0.635	1.119	0.568	0.574
gunpercent	-0.925	1.876	-0.493	0.625
massshootingrate	-0.075	0.771	-0.098	0.923
gundeathrate	3.579	1.680	2.130	0.040
presvotingmargin	-4.618	1.478	-3.123	0.003
legislature	-2.950	0.978	-3.015	0.005
governor	-0.139	0.786	-0.177	0.861

Regression Results for Subcategories:

Table 7 shows the OLS regression model results for the eleven subcategories, only including factors that were statistically significant at the standard p < 0.05. For the ammunition regulation subcategory, legislation that places regulation on the buying and selling of ammunition, two predictors reached this benchmark, *BA+* (percent of population with bachelor's degree and above) and *gunpercent* (percent of population that owns a firearm), with β = -0.333 and -0.514, respectively, and p = 0.018 and 0.003, respectively. Both were negatively associated with the adoption of ammunition regulation laws. The regression model produced an R^2 value of 0.680, meaning that the 12 factors combined explained 68% of the variation. (Adjusted R^2 = 0.576)

Table 7: Statistically significant predictors of change in subcategories of gun policy strictness.

Category	Predictor	Coefficient	StdErr	t_value	p_value
ammoreg	***BA+***	-0.333	0.135	-2.471	0.018
ammoreg	***gunpercent***	-0.514	0.163	-3.147	0.003
asweaplgcapmag	***income***	-1.079	0.487	-2.216	0.033
bgchecks	***presvotingmargin***	-1.491	0.720	-2.070	0.045
bgchecks	***legislature***	-0.967	0.476	-2.030	0.050
buyerreg	***income***	-1.185	0.438	-2.702	0.010
buyerreg	***presvotingmargin***	-1.211	0.435	-2.784	0.008
concarry	***unemployment***	0.257	0.100	2.578	0.014
dealerreg	***gunpercent***	-0.382	0.176	-2.167	0.037
possreg	***presvotingmargin***	-0.863	0.415	-2.079	0.045
prohighrisk	***BA+***	0.395	0.177	2.226	0.032
nosyg	***poverty***	0.241	0.110	2.194	0.035
nosyg	***BA+***	0.296	0.123	2.414	0.021

Given the number of tests conducted for subcategories, individual significant results at the subcategory level should be considered exploratory and may reflect a Type I error (The null hypothesis is true, but is incorrectly rejected).

For the assault weapons and large-capacity magazines subcategory, restrictions placed on the sale, transfer, and possession of large-capacity magazines and assault weapons, only one predictor stood out, *income* (real median household income), with β = -1.079 and p = 0.033. This predictor was negatively associated with the adoption of assault weapons and large-capacity ammunition magazine bans. The regression model produced an R^2 value of 0.350, meaning that the 12 factors explained 35% of the variation. (Adjusted R^2 = 0.139)

Presvotingmargin (percent of Republican votes minus percent of Democrat votes) and *legislature* (party control of state legislature) were statistically significant and marginally significant predicators apiece of the adoption of the background check subcategory, legislation that requires background checks to be performed on consumers at the point of purchasing a firearm, with β = -1.491 and -0.967 and p = 0.045 and 0.050, respectively. Both political factors show that Republican majority voter bases and Republican legislatures are negatively correlated with the background checks subcategory of laws. The regression model produced an R^2 value of only 0.340, meaning that the 12 factors explained 34% of the variation. (Adjusted R^2 = 0.126)

For the concealed carry subcategory, legislation that requires individuals to have a permit to carry a concealed firearm, *unemployment* (unemployment rate) were the only statistically significant predictors, with a β = 0.257 and p = 0.014, correlating with a higher adoption of laws in this subcategory. The regression model produced an R^2 value of 0.64, meaning that the 12 factors explained 64% of the variation. (Adjusted R^2 = 0.523)

Similarly, for dealer regulations, laws that place regulations on how and where dealers sell firearms, a single factor was statistically significant: *gunpercent* (percent of population that owns a firearm) with a β = -0.382 and p = 0.037, which was negatively associated with the adoption of dealer regula-

tion laws. The regression model produced an R^2 value of 0.44, meaning that the 12 factors explained 44% of the variation. (Adjusted R^2 = 0.258)

For possession regulations, legislation regulating who, where, and how they can carry a firearm, only a single factor was statistically significant: *presvotingmargin* (percent of Republican votes minus percent of Democrat votes) with a β = -0.863 and p = 0.045, showing that a Republican majority voting population negatively correlated with adoption of laws in the possession regulation subcategory. The regression model produced an R^2 value of 0.73, meaning that the 12 factors explained 73% of the variation. (Adjusted R^2 = 0.642)

For the prohibition of high-risk gun possession, restrictions on how individuals who have committed violent crimes can possess firearms, only one factor was significant, with a β = 0.395 and p = 0.032: *BA+* (percent of population with bachelor's degree and above), which was positively correlated with the adoption of prohibitions on high-risk gun possession. The regression model produced an R^2 value of only 0.35, meaning that the 12 factors covered 35% of the variation. (Adjusted R^2 = 0.139)

Finally, for the no stand your ground laws, which refers to how an individual is allowed to use deadly force, two factors were significant with β = 0.241, 0.296 respectively and p = 0.035, 0.021 respectively: *Poverty* (poverty rate) and *BA+* (percent of population with bachelor's degree and above), both positively associated with the absence of adoption of stand your ground laws. The regression model produced an R^2 value of only 0.379, meaning that the 12 factors covered 37.9% of the variation. (Adjusted R^2 = 0.178)

Regression Results for Individual Laws:

Table 8 shows the sample sizes and ridge penalty parameters for each of the eight individual law models. The ridge penalty parameter λ was selected via cross-validation, with the number of folds set to five or the size of the minority class, whichever was smaller. States that previously had adopted a given law in 2014 for adoption models or did not have a law in 2014 for repeal models were not included.

Table 8: Sample sizes for ridge-penalized logistic regression models of individual law adoption or repeal, 2014 to 2024.

Law	Direction	Eligible States	Changed	CV folds	λ
permitconcealed	***Repeal***	46	25	5	1.624
gvrolawenforcement	***Adoption***	48	19	5	0.013
universalpermit	***Adoption***	39	7	5	0.089
nosyg	***Repeal***	28	5	5	0.616
permit	***Adoption***	44	2	2	10,000
permithandgun	***Adoption***	37	2	2	10,000
collegeconcealed	***Adoption***	37	1	2	10,000
age21handgunposs	***Adoption***	42	0	—	—

Of the eight laws, *age21handgunposs* could not be modeled because no state adopted it between 2014 and 2024. For *collegeconcealed* and *permithandgun*, both pieces of legislation had only one or two states changing their status during the study period. With 12 predictors and only one to two events, this caused the ridge penalty to be driven to an extremely high value (λ=10,000). Coefficients were shrunk to near zero.

The four laws with five or more states changing their status during the study period that produced interpretable coefficients are reported in Table 9. For the two adoption models, presidential voting margin had the largest coefficient with *gvrolawenforcement* (β = -6.22) and *universalpermit* (β = -4.13). Partisan control of the governor's office was the second largest for *gvrolawenforcement* (β = -5.47). For the two repeal models, presidential voting margin remained as the largest coefficient with *permitconcealed* (β = +1.21) and *nosyg* (β = +0.90). None of the twelve predictors reached statistical significance at p<0.05 for any of the eight pieces of legislation.

Table 9: Ridge logistic regression coefficients for key predictors across individual law models with adequate sample sizes.

Law	Direction	presvotingmargin	legislature	governor	gundeathrate
gvrolawenforcement	***Adoption***	-6.22	-1.68	-5.47	-1.71
universalpermit	***Adoption***	-4.13	+0.05	-1.14	+1.11
permitconcealed	***Repeal***	+1.21	+0.33	+0.12	+0.19
nosyg	***Repeal***	+0.90	+0.08	-0.41	+0.43

For adoption models, negative political coefficients indicate Republican-leaning states were less likely to adopt restrictive laws. For repeal models, positive political coefficients indicate Republican-leaning states were more likely to repeal restrictive laws. Both directions are consistent with the OLS results.

Discussion:

Three factors consistently emerged to be associated with the overall level of gun policy strictness with *gundeathrate* (β= 3.579, p = 0.040), *presvotingmargin* (β = -4.618, p = 0.003), and legislative control (β = -2.950, p = 0.005), explaining 74% of the variance seen. At the subcategory level, political factors emerged as the most consistent, while socioeconomic factors emerged as significant in only certain policy areas. No significant predictor emerged in individual law models. Predictors varied dramatically across different categories, with political affiliations, education, and income emerging as consistent predictors. Many subcategories send mixed signals with no one explanation, which accentuates how different parts of gun legislation respond to a wide range of political, social, and economic pressures from different areas.

It is important to note the dominant role that political factors played in nearly all of the models, although gubernatorial control was not significant when state legislatures were taken into consideration. This may be due to the fundamental difference between these two branches of government. By design, the legislature's primary function is to create laws, while the governor's office's main role is to enforce those laws. In addition, the legislature and the governor's office often come in pairs, either both Republican or both Democrat, reflecting a broader pattern of increasing polarization in U.S. politics.[23] Republican presidential voting margins and Republican legislative control were consistently negatively associated with strict state gun legislation and the adoption of strict gun legislation,

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even after considering other socioeconomic and violence-related variables. This suggests that partisan control over state politics is strongly associated with the outcome of firearm legislation. Moreover, the state's gun policy is more strongly associated with deep ideological divides than mass shootings.[19] Simply put, gun policy is primarily a product of the deeply entrenched existing culture and attitude around guns.

Texas, where firearms have played a key role in its culture and history, serves as an illustrative example. Texas has some of the least restrictive firearm laws in the country, having only 5 of the 72 laws in 2024.[24] Even after mass shootings such as the Santa Fe high school shooting which killed 10 people and wounded another 10 in 2018 or the shooting at Robb Elementary School which killed 19 students and two teachers and injured at least 17 others in 2022, Texas's gun legislation has actually weakened from 2014 to 2024, going from 9 laws to just 5.[25,26] This remains consistent with the philosophy of many gun advocates that the only way to prevent these tragedies from happening again is to allow more law abiding citizens to own guns and to use them in situations to stop shooters.[27] Texas's political atmosphere has also been dominated by Republicans, with a +5.6 and +9.0 percentage point margins in favor of the Republican party in the 2016 and 2020 Presidential races, respectively.[28,29] On the state level, the governorship and both chambers of Texas's legislature have been controlled by the Republican Party from 2014 to today.[30] These further support the findings that Republican controlled governments and voting margins were associated with more lenient policies. Notably, the gun ownership rate, a proxy for the entrenchment of gun culture, was not a significant predictor, yet political factors and partisan lean were. This may reflect an increasing extremism where support for stricter gun policy is more deeply associated with partisan lean rather than grassroots gun culture.

This brings us to the second point on the asymmetry between violence-related factors and overall change. This paper has shown that higher firearm death rates are correlated with overall stricter laws. This may be due to the state's gun legislation, which, on average, slowly changed toward more restrictive policies during this paper's timeframe (Figures 1, 2, and Table 5), a shift associated with lower gun death rates.[11] Moreover, states with more permissive gun policies and higher baseline gun mortalities can expand their gun legislation.[11] Compare this to restrictive states that don't have that ability, making high baseline gun mortality appear to be more correlated with strict gun policies. Although higher firearm mortality rates are partially correlated with stricter gun policies, the mass shooting variable did not reach statistical significance. Despite this, these results should not be interpreted as evidence that mass shootings do not affect legislation, as this could have been a problem of insufficient statistical power to detect an effect. Other research has found that an increase in the leniency of state gun laws was associated with a higher rate of mass shootings, though this may point in the direction that violence is an agenda setter.[31]. These horrific acts of gun violence draw attention from the media, the public, and lawmakers. Often, the public is outraged and calls for change; however, this manuscript's interpretation is that it depends on the political establishment to decide what laws will actually be enacted. Many Republican-controlled states have actually loosened their laws after a mass shooting. At the same time, there were no significant changes in states with Democrat-controlled legislatures.[32] On the federal level, the U.S. seems to be stuck in an endless cycle where a major gun violence event occurs, there is a major push for change and stricter gun laws, and then inaction.[31] An additional consideration is that state legislatures may respond to high-profile shootings in other parts of the country, and the effects of the reactions may also vary between states, with some relaxing restrictions while others tighten them.[31] To summarize, the mass shooting rate was not significantly associated with changes in gun legislation in this manuscript, which may be because of a lack of sufficient power to detect such an effect. Overall, firearm mortality was associated with changes in gun legislation; the political environment is the key factor influencing the adoption of stronger legislation.

Third, there was major heterogeneity between different types of laws for the same predictor, such as education (BA+), which correlated with a higher adoption of high-risk prohibitions but lower adoption of ammunition laws. Real median household income was negatively associated with assault-weapon and buyer regulations. Higher gun ownership consistently predicted lower adoption of ammunition regulations and dealer regulations, suggesting that states with higher household ownership of guns are resistant to the adoption of ammunition or dealer regulation laws.

Taken together, these results demonstrate that these socioeconomic factors do not associate with the adoption of different types of gun laws equally. Gun policy is not uniform; different policy categories are predicted by differing socioeconomic, political, and violence-related predictors. The heat map reveals the increasing polarization around guns during this decade, where strict states become stricter while permissive states remain stagnant or regress.[23]

The null results presented by the individual legislation models are informative despite the lack of statistical significance ($p<0.05$). The null findings for *permit*, *permithandgun*, *college-concealed*, and *age21handgunposs* are attributed to the lack of statistical power within this study rather than the absence of any potential underlying associations. With one or two events, no model can accurately determine or detect meaningful effects.

The four models with adequate sample sizes are more telling and provide a clearer story. Although ridge shrinkage changed the magnitude of individual coefficients relative to the OLS models used in the other two parts of this study, the direction of the political coefficients was consistent throughout for all four. Republican-leaning voting majorities and Republican legislatures were associated with a higher probability of repealing restrictive laws and a lower probability of implementing new ones. This is consistent with the OLS finding that says that partisan composition and control are the dominant factors, and this extends to individual laws. Across the three levels of legislation analyzed, all provided the same conclusion: political factors have the strongest association with the leniency of state policy.

The *permitconcealed* model was particularly notable. 25 states changed their status by repealing their concealed carry permit requirement during the study period, with nearly all of them having Republican controlled legislatures and presidential voting margins in favor of the Republican party. This aligns with the broader constitutional carry movement that accelerated after 2015. This remains the clearest case in this study where partisan control translated into a specific legislative action on firearms.

These results suggest that it may be more productive to analyze changes as packages of reforms rather than individual laws, as meaningful patterns emerge at the subcategory and overall levels where statistical power is sufficient. Future research should consider expanding the timeframe or using pooled cross-state panel data to increase the effective sample size for individual law models.

This study does have limitations. The paper only covers a ten-year time frame, which might miss some longer-term reactions to shootings. Likewise, this ten-year time frame doesn't explore how these factors have changed gun laws over a longer period of time. Moreover, the 10-year lag from baseline predictors in 2014 to outcomes in 2024 may obscure the effects. Future studies should evaluate the associations in a shorter timeframe. One of the two violence-related variables, firearm mortality per 100k, mixes both suicides and homicides, which have differing root causes. Future research should separate these two components, as legislators may respond differently to each. The study also had low power to detect factors that predicted the adoption of specific laws because individual law changes were uncommon. Future research should expand the timeframe and thus the number of state observations, and consider additional predictors such as lobbying activities.[33] The ratio of predictors to observations (12:50) is below the conventional thresholds for regression estimation.[34] This may inflate R^2 values and produce unstable coefficient estimates. Future studies should consider looking at a larger sample for a more stable regression estimation. Likewise, given the number of tests conducted, some significant findings at the subcategory level reflect Type I error, as no correction for multiple comparisons was applied. These results should be interpreted as exploratory.[35]

Conclusion

This study found that the associations of political factors heavily outweighed those of socioeconomic and violence-related factors. Republican presidential voting margins and GOP-controlled legislatures consistently correlated with more lenient gun policy and negatively correlated with the adoption of new restrictive legislation. Mass shootings were not positively or negatively linked with gun policy. However, the study did find that firearm mortalities per capita were positively associated with stricter legislation and adoption of new restrictive legislation; however, it may be an effect of gun policies getting stronger in general across America, and may be partially due to the ability of lenient states to strengthen their policies, lowering gun deaths per capita. Socioeconomic factors such as income and poverty did have some association with specific categories of gun legislation. Still, these associations were not uniform and did not relate to the same degree to gun policy as the political factors.

These findings suggest that US state gun policies are more strongly associated with partisan philosophies, not a direct response to violence. The results suggest that targeted risk-based laws saw more success with adoption and broader political support across political leanings than broad supply-side restrictions. If partisan control is a dominant predictor of the strength of gun laws and the adoption of further legislation, then this may point to electoral and political engagement being as important as public health advocacy in reducing gun violence.

Appendix A: Tables for Full Regression

Table 10: Ammunition Regulation Subcategory Results.

Predictor	Coefficient	StdErr	t_value	p_value
income	0.147	0.130	1.131	0.266
poverty	0.053	0.121	0.434	0.667
gini	0.048	0.085	0.569	0.573
BA+	-0.333	0.135	-2.471	0.018
unemployment	-0.065	0.099	-0.651	0.519
density	0.091	0.097	0.932	0.357
gunpercent	-0.514	0.163	-3.147	0.003
massshootingrate	0.013	0.067	0.189	0.851
gundeathrate	0.143	0.146	0.977	0.335
presvotingmargin	-0.118	0.129	-0.919	0.364
legislature	0.046	0.085	0.542	0.591
governor	-0.090	0.068	-1.310	0.198

Table 11: Assault Weapon Large-Capacity Magazine Subcategory Results.

Predictor	Coefficient	StdErr	t_value	p_value
income	-1.079	0.487	-2.216	0.033
poverty	-0.908	0.454	-2.000	0.053
gini	-0.249	0.319	-0.781	0.440
BA+	-0.087	0.506	-0.172	0.865
unemployment	-0.083	0.373	-0.221	0.826
density	0.289	0.366	0.790	0.435
gunpercent	0.016	0.613	0.026	0.980
massshootingrate	0.314	0.252	1.244	0.221
gundeathrate	0.225	0.549	0.411	0.684
presvotingmargin	-0.587	0.483	-1.214	0.232
legislature	-0.374	0.320	-1.169	0.250
governor	-0.301	0.257	-1.170	0.250

Table 12: Background Checks Subcategory Results.

Predictor	Coefficient	StdErr	t_value	p_value
income	0.048	0.726	0.067	0.947
poverty	-0.427	0.677	-0.631	0.532
gini	-0.016	0.476	-0.035	0.973
BA+	-0.258	0.754	-0.343	0.734
unemployment	-0.433	0.556	-0.779	0.441
density	0.450	0.545	0.825	0.414
gunpercent	1.194	0.914	1.307	0.199
massshootingrate	0.072	0.376	0.191	0.849
gundeathrate	0.641	0.819	0.783	0.439
presvotingmargin	-1.491	0.720	-2.070	0.045
legislature	-0.967	0.476	-2.030	0.050
governor	0.323	0.383	0.844	0.404

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Table 13: Buyer Regulation Subcategory Results.

Predictor	Coefficient	StdErr	t_value	p_value
income	-1.185	0.438	-2.702	0.010
poverty	-0.301	0.409	-0.737	0.466
gini	-0.151	0.288	-0.526	0.602
BA+	0.686	0.455	1.507	0.140
unemployment	-0.503	0.336	-1.497	0.143
density	0.073	0.329	0.222	0.826
gunpercent	0.100	0.552	0.180	0.858
massshootingrate	-0.078	0.227	-0.344	0.733
gundeathrate	0.794	0.495	1.607	0.117
presvotingmargin	-1.211	0.435	-2.784	0.008
legislature	-0.395	0.288	-1.373	0.178
governor	-0.149	0.231	-0.644	0.524

Table 14: Child Access Prevention Subcategory Results.

Predictors	Coefficient	StdErr	t_value	p_value
income	0.073	0.083	0.880	0.384
poverty	-0.091	0.078	-1.167	0.251
gini	0.075	0.055	1.378	0.176
BA+	-0.073	0.087	-0.844	0.404
unemployment	0.121	0.064	1.889	0.067
density	0.010	0.063	0.162	0.873
gunpercent	0.002	0.105	0.020	0.984
massshootingrate	-0.033	0.043	-0.769	0.447
gundeathrate	-0.040	0.094	-0.431	0.669
presvotingmargin	0.076	0.083	0.915	0.366
legislature	-0.035	0.055	-0.646	0.522
governor	-0.024	0.044	-0.536	0.595

Table 15: Concealed Carry Subcategory Results.

Predictor	Coefficient	StdErr	t_value	p_value
income	0.087	0.130	0.671	0.506
poverty	-0.037	0.121	-0.302	0.765
gini	-0.037	0.085	-0.435	0.666
BA+	0.158	0.135	1.173	0.248
unemployment	0.257	0.100	2.578	0.014
density	-0.097	0.098	-0.991	0.328
gunpercent	-0.189	0.164	-1.154	0.256
massshootingrate	-0.122	0.067	-1.816	0.077
gundeathrate	0.183	0.147	1.245	0.221
presvotingmargin	-0.142	0.129	-1.101	0.278
legislature	-0.045	0.085	-0.525	0.603
governor	0.057	0.069	0.829	0.413

Table 16: Dealer Regulation Subcategory Results.

Predictor	Coefficient	StdErr	t_value	p_value
income	-0.123	0.140	-0.876	0.387
poverty	-0.086	0.131	-0.659	0.514
gini	0.034	0.092	0.372	0.712
BA+	0.122	0.145	0.840	0.406
unemployment	0.004	0.107	0.036	0.971
density	-0.158	0.105	-1.507	0.140
gunpercent	-0.382	0.176	-2.167	0.037
massshootingrate	0.102	0.072	1.409	0.167
gundeathrate	0.201	0.158	1.272	0.211
presvotingmargin	0.008	0.139	0.060	0.953
legislature	-0.130	0.092	-1.413	0.166
governor	-0.032	0.074	-0.438	0.664

Table 17: Domestic Violence Subcategory Results.

Predictor	Coefficient	StdErr	t_value	p_value
income	-0.131	0.495	-0.264	0.793
poverty	-0.304	0.462	-0.658	0.514
gini	0.063	0.325	0.193	0.848
BA+	0.363	0.514	0.706	0.485
unemployment	0.150	0.379	0.394	0.696
density	0.077	0.372	0.207	0.837
gunpercent	-0.272	0.623	-0.437	0.665
massshootingrate	-0.103	0.256	-0.402	0.690
gundeathrate	0.802	0.559	1.435	0.160
presvotingmargin	-0.301	0.491	-0.613	0.543
legislature	-0.562	0.325	-1.729	0.092
governor	0.291	0.261	1.113	0.273

Table 18: Possession Regulation Subcategory Results.

Predictor	Coefficient	StdErr	t_value	p_value
income	0.493	0.418	1.179	0.246
poverty	-0.072	0.390	-0.184	0.855
gini	0.059	0.274	0.216	0.830
BA+	-0.620	0.434	-1.426	0.162
unemployment	0.251	0.321	0.785	0.438
density	0.050	0.314	0.160	0.874
gunpercent	-0.801	0.527	-1.520	0.137
massshootingrate	-0.301	0.217	-1.392	0.172
gundeathrate	0.463	0.472	0.980	0.333
presvotingmargin	-0.863	0.415	-2.079	0.045
legislature	-0.281	0.275	-1.022	0.313
governor	-0.242	0.221	-1.096	0.280

Table 19: Prohibitions for High-Risk Gun Possession Subcategory Results.

Predictor	Coefficient	StdErr	t_value	p_value
income	-0.082	0.171	-0.479	0.635
poverty	0.076	0.159	0.480	0.634
gini	-0.085	0.112	-0.756	0.454
BA+	0.395	0.177	2.226	0.032
unemployment	0.030	0.131	0.231	0.818
density	-0.138	0.128	-1.080	0.287
gunpercent	-0.100	0.215	-0.464	0.645
massshootingrate	0.000	0.088	-0.003	0.998
gundeathrate	0.241	0.193	1.254	0.218
presvotingmargin	0.027	0.169	0.161	0.873
legislature	-0.183	0.112	-1.634	0.111
governor	0.013	0.090	0.147	0.884

Table 20: Stand Your Ground Subcategory Results.

Predictor	Coefficient	StdErr	t_value	p_value
income	-0.070	0.118	-0.590	0.559
poverty	0.241	0.110	2.194	0.035
gini	-0.137	0.077	-1.774	0.084
BA+	0.296	0.123	2.414	0.021
unemployment	0.034	0.090	0.375	0.710
density	-0.011	0.089	-0.126	0.901
gunpercent	0.021	0.149	0.141	0.889
massshootingrate	0.063	0.061	1.028	0.310
gundeathrate	-0.073	0.133	-0.552	0.585
presvotingmargin	-0.016	0.117	-0.134	0.894
legislature	-0.023	0.077	-0.299	0.767
governor	0.014	0.062	0.219	0.828

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