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Gun control and suicide:
The impact of state firearm regulations, 1995–2004

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Abstract:

Suicide is a major cause of preventable death. Restricting access to lethal means has been identified as an effective approach to suicide prevention, and firearms regulations are one way to reduce gun availability. This study examines the relationship between state firearms regulations and suicide among males, using negative binomial regression and state panel data for the years 1995–2004. Results suggest that firearms regulations which function to reduce overall gun availability have a significant deterrent effect on suicide, while prohibited persons categories have less of an effect. Overall, the results suggest that gun control measures such as permit and licensing requirements might have public health benefits.

Keywords: suicide; guns; state regulations; panel data.

JEL classification: I18.

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1. INTRODUCTION

1.1 Firearms and suicide

Suicide is a major cause of preventable death. In 2006, more than 32,000 suicides occurred in the United States, as compared with approximately 18,000 homicides. Suicide is the 8th leading cause of death for males, and the 19th leading cause for females in the United States. For every suicide, there were more than ten hospitalizations from non-fatal attempts. In 2006, an average of 46 Americans committed suicide daily with a firearm, accounting for approximately 50 percent of all suicides (CDC, 2009).

There is a considerable body of empirical work that has documented a positive relationship between access to firearms and suicide (Miller and Hemenway, 2008; Miller et al., 2005). In fact, much of the decline in suicide in the United States over the past decades has been linked to the reduced prevalence of firearms (Miller et al., 2005; Miller et al., 2007; Cook and Ludwig, 2006). Although the respective roles of self-selection and availability in explaining the relationship between guns and suicide have not been completely resolved, the implication in either case is that reducing access to firearms should reduce suicide (Duggan, 2003) Restricting access to firearms has been recommended as a suicide prevention strategy by national and international organizations such as the CDC and the WHO. Gun control policies can serve to reduce overall gun availability by creating barriers to firearm ownership. Additionally, firearms policies can also prevent individuals who are at a relatively higher risk of suicide from purchasing firearms.

Gun Control
Gun control is a highly contentious issue in the American political debate. Guns are common in the United States – 40 percent of Americans reported having a gun in their home in 2009 (Gallup, 2009). Calls for increased regulation are based on the belief that restrictions will reduce gun violence. Regulation is opposed by those who claim infringement on the constitutional right to bear arms, and/or argue that firearm

ownership deters crime. In the academic literature, the efficacy of gun control in reducing violence has received considerable attention, although little consensus has emerged from the empirical work (Cook and Ludwig, 2006; Lott and Whitley, 2000; Kleck and Kates, 2001; Kleck, 2004).

The current era of gun control in the United States originated with the Brady Handgun Violence Prevention Act (1993)[1], more commonly known, as the Brady Bill. The Brady Bill established a federal requirement for a waiting period of up to five days before the transfer of a handgun to a purchaser. During this period, a background check is performed, which is intended to prohibit individuals with criminal backgrounds from purchasing firearms. The transfer of the handgun is completed whether or not the background check is finalized within the five-day period. The federal waiting period was phased out in 1998 with the development of the National Instant Criminal Background Check System (NICS), administered by the Federal Bureau of Investigation (FBI). Over time, many states have passed laws which matched or surpassed the federal minimums.

There are many different types of state firearm regulations. Some seek to establish general oversight over individuals owning firearms, and mainly consist of permit, registration, and/or license requirements, and bans on the purchase of firearms by minors. These laws also facilitate the tracing of firearms used in crimes to original purchasers. Other state laws seek to prevent gun trafficking and the use of firearms in crimes. These consist of bans on the sale of certain types of firearms, and restrictions on the number of firearms that can be sold to individuals. Restrictions on carrying concealed weapons serve a similar purpose. A number of laws are designed to prevent firearm ownership by individuals considered disproportionately likely to commit gun crimes. These laws include prohibitions on gun ownership by those with criminal histories, such as conviction for a felony, misdemeanor, or domestic violence offence, as well as those with a history of mental illness, and alcohol or drug problem, and minors. The requirement of a "cooling off" period of some specified period before the purchase can be completed is a measure designed to reduce the consequences of impulsive firearm purchases.

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[1] The Gun Control Act (1968) was the first firearm act in the USA.

There is considerable variation in the comprehensiveness of firearm regulation across U.S. states. Some states have almost no firearm regulation of their own. Forty-four states have a provision in their state constitutions similar to the Second Amendment of the Bill of Rights (the exceptions are California, Iowa, Maryland, Minnesota, New Jersey, and New York). Firearm license holders are subject to the firearm laws of the state in which they are carrying and not the laws of the state in which the permit was issued. Reciprocity between states may exist for certain licenses such as concealed carry permits. These are recognized on a state-by-state basis.

Some firearms regulations are more relevant to suicide prevention than others. Restrictions banning the purchase of guns by convicted felons, or laws banning the sale of "Saturday Night Specials", for example, have little obvious applicability to suicide. Yet other categories of restriction are potentially more salient, particularly those that reduce overall firearm availability. Permit requirements create barriers to gun ownership and may also serve to prevent impulsive purchases. The prohibition of purchases by minors serves a similar function. Some of the "prohibited persons" categories, such as those related to mental illness, a drug or alcohol problem, or history of domestic violence problems may theoretically be relevant to suicide prevention, but in all likelihood are not.[2] Mental illness is the single most important risk factor for suicide, and substance abuse and domestic violence are also risk factors. However, while the criteria for "prohibited persons" categories varies by state, they are generally based on fairly serious incidents, such as hospitalization against one's will or conviction records. Such bans are likely to identify only a fraction of the population with mental health, substance abuse, or domestic violence problems.

At the state level, the comprehensiveness of gun control laws tends to be correlated with firearm prevalence. The causality most likely runs in both directions, since restrictive gun control regimes reduce gun ownership, yet these laws are more likely to be passed in states where overall gun ownership rates are relatively low and the

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[2] In some states, the alcohol regulation means that sale of firearms are prohibited to people who are intoxicated at the time they are trying to buy them, while in other states it refers to people with a documented alcohol problem. Indeed, in some states it covers both situations.

population of gun rights advocates is relatively small. In general, Western and more rural states have fewer gun control restrictions and higher rates of gun ownership as compared with more urbanized states in the Northeast. These states also have significantly higher rates of suicide, particularly firearm suicide.

1.2 Gun Control and Suicide

The literature on gun control and suicide has in general found a negative relationship between firearm restrictions and suicide. However, most of these studies lack a strong design and are essentially pre- and post- comparisons (Killias et al., 2001). Lambert and Silva (1998) perform a literature review of studies in the United States and Canada and conclude that available information generally supports the notion that gun control can reduce suicide rates, particularly among males. Another review of gun control in the United States, framed within the context of historical and rational choice theory, covers attempts to curb firearm violence in that country and the success of such measures (Cook et al., 2001). A recently published analysis suggests that states where background checks are conducted locally have lower rates of firearm suicide and homicide (Sumner et al., 2008)

Several other studies find no empirical evidence in favor of a relationship between firearms regulations and suicide. However, one study has a weak design, while the other does not capture the most relevant types of firearms regulations. Price et al. (2004) use cross-sectional state data for 1999 to perform a simple partial correlation analysis between several types of gun control laws and suicide rates. Their results suggest that gun control laws were not significantly related to suicide in 1999, even after controlling for firearm prevalence. Rosengart et al. (2005) conduct a study of the relation between firearm regulations and homicides and suicides using state panel data over 1979–1998. They fail to uncover a statistically robust link between suicide rates and firearm regulations. However, most of the regulations they examined- such as bans on carrying concealed weapons, "junk gun" bans, and quantity sales restrictions are not particularly relevant to suicide.

Several studies in other countries where regulations restricted general access to firearms have found evidence of an effect on suicide. Cheung and Dewa (2005) examine the relationship between suicide and the implementation of new restrictions on firearms (Bill C-17), using time series data from Canada. They concluded that there was a relationship between means used by young people and the imposition of the restrictions. In the case of New Zealand, Beautrais et al. (2006) find that after the introduction of legislation restricting ownership and access to firearms, firearm suicides significantly decreased, particularly among the young. Ozanne-Smith et al. (2004) conclude that the implementation of a strong reform in New Zealand lowered firearms deaths, particularly suicides. An evaluation of the 1996 National Firearms Agreement (NFA) in Australia documents a decline in firearm suicides after the implementation of the agreement (Klieve et al., 2009). However, these findings may be confounded with an overall decline in gun ownership that preceded the NFA. Additionally, there was some evidence of increased suicides by hanging.

In Europe, a study of the E.U. countries as a group and the U.K. in particular has found that changes in firearm legislation have led to fewer firearm suicides (Kapusta et al., 2007; Hawton et al., 1998; Haw et al., 2004). An analysis of firearm legislation reforms enacted in 1997 in Austria also found a statistically strong effect on suicide rates (Wahlbeck and Mäkinen, 2008).

2. EMPIRICAL MODEL AND DATA

2.1 Empirical model

The basic model that motivates the empirical analysis is that firearm availability affects suicide rates, and that gun control affects firearm availability. Our hypothesis is that regulations such as permit requirements, which create overall barriers to gun ownership, are the most important way in which gun control may affect suicide. While it is possible that "prohibited persons" categories can affect the likelihood that certain persons at above average risk of suicide will obtain firearms, we believe that the actual measurement and enforcement of those categories will result in the

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prohibition of a relatively small proportion of people at risk. Firearms regulations designed to prevent gun trafficking or other criminal activity involving guns are not expected to influence suicide rates.

There are several potential complications to this simple model. The first is that of state variation in views towards guns is likely to affect both firearm prevalence and the comprehensiveness of gun control regulation. Additionally, views toward gun ownership evolve over time. Finally, there is the problem of the mismeasurement of gun ownership.

The basic model can be expressed with two equations:

1. $S = \alpha + \beta G + \mu$

2. $G = \delta - \Delta R + \Phi$

Where S is suicide, G is firearm prevalence, and R is firearms regulation. The reduced form is:

3. $S = \alpha + \beta\delta - \beta\Delta R + \beta\Phi + \mu$

The potential endogeneity of firearm prevalence with respect to gun control is reflected in the identifying equation,

4. $R = \omega + \eta G + \varphi$

However, G is not measured annually. For our main specification we estimate the reduced form equation (3), thereby assuming that η is zero. In an alternative specification, we instrument for G with the number of hunting licenses per capita, a statistic which is collected annually for all states.

For the main specification, the estimating equation is:

5.
$$S_{ijt} = f(Z_{jt}, X_{it}, \alpha_i, \lambda_t, \varepsilon_{it})$$

where the subscript i indexes each age group with $i = 15\text{–}24,\ 25\text{–}44,\ 45\text{–}64,$ and $65+$, j indexes each state with $j = 1,\ldots,50$ and t indexes time period with $t = 1995,\ldots,\ 2004$. Equation (5) specifies that the number of male suicides for age group i in state j during the year t is a function of laws regulating the possession of firearms (Z_{it}), other socioeconomic characteristics (X_{it}), state effects (α_i), year effects (λ_t), and ε_{it} the classical error term. The sample contains 500 state-year observations. The sample period (1995-2004) was chosen because gun data before and after 1995 is not readily

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comparable, and there are in fact relatively few state firearms regulations prior to 1995.

The dependent variable— male suicides by state, year and age group— violates the Poisson assumption that the conditional mean is equal to the conditional variance. Instead, the suicide data are overdispersed: the variance exceeds the mean. The over-dispersion can cause a downward bias in the standard errors resulting from Poisson regression. To avoid such bias, we estimate a negative binomial model via maximum likelihood. The variance of the distribution is modeled as a quadratic function of the mean, $E[Y_i] = \mu$, so that $\sigma 2 = \mu + \alpha\mu 2$, where α is the dispersion parameter (Cameron and Trivedi, 1998). In our case, the negative binomial model has a significantly better goodness of fit than the Poisson model. A likelihood ratio test of the negative binomial dispersion parameter leads to the conclusion that the Poisson distribution is inappropriate for the data. We do not use zero-inflated specifications since there is no excess of zeros in the dependent variable.

Each model includes the relevant population as a right hand side control variable to normalize by exposure. The specification includes fixed effects that account for unobserved heterogeneity across states. The fixed effects model is appropriate in this case given the almost complete population coverage by the sample (Kennedy, 1998, pp. 227) and it is likely that the omitted variables captured by the α_i are correlated with some of the included covariates. Since nearly ninety percent of firearm suicides are committed by males, we have excluded females from the analysis (CDC, 2009). We estimate separate models for males of all ages and in four different age groups: 15–24, 25–44, 45–64, and 65 years and older.

We face several identification challenges. The first is that gun control regulations by state tend to change slowly, so there tends to be relatively little within-state year–on-year change. Further, once states adopt particular gun control regulations, they never remove them. For these reasons, it is not possible to analyze leads and lags, which would be a desirable robustness check. To maximize variation, we have created several indices of categories of gun control regulations, which are additive measures of individual measures.

a. Dependent variable

Data on the number of suicides in states over the period 1995–2004 come from the Centers for Disease Control (CDC). Deaths included in the study are those categorized as suicides according to the International Classification of Diseases (ICD). In 1999, there was a change in the classification system from ICD–9 to ICD–10. In the case of suicide, this change in ICD version is thought to have a negligible effect on the classification of suicides. For 1995–98, suicide deaths were coded as E950–E959. Starting in 1999 and later, suicide deaths were coded as X60–X84, Y87.0, and U03.

Table 1 displays the age adjusted male suicide rates across US states for the year 2004.[3] Reported suicide rates in the US vary considerably across states. The suicide rate in Nevada (30.2), for example, is nearly thrice that in New York (10.4). The District of Columbia is excluded, since it has essentially banned the possession of handguns.

Table 1. Age-adjusted male suicide rates, by state, 2004

State	Deaths	Population	Rate
Alabama	444	2180516	20.6
Alaska	118	341960	33.8
Arizona	694	2875320	24.9
Arkansas	291	1340696	22.0
California	2546	17781851	15.2
Colorado	611	2319950	26.6
Connecticut	230	1690101	13.5
Delaware	70	400799	17.2
District of Columbia*	27	273235	9.3
Florida	1800	8483460	20.3
Georgia	773	4386229	19.0
Hawaii	90	627760	14.0
Idaho	191	699441	28.9
Illinois	819	6225442	13.4

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[3] We do not show average suicide rates over 1995-2004 because of the relative position of the states is basically unchanged during the study period.

Indiana	563	3054027	18.9
Iowa	287	1448679	19.7
Kansas	291	1351179	21.8
Kentucky	464	2024358	22.9
Louisiana	437	2176259	20.8
Maine	137	637824	21.0
Maryland	403	2675138	15.3
Massachusetts	343	3114101	10.9
Michigan	875	4960895	17.8
Minnesota	427	2523241	16.8
Mississippi	295	1395815	21.8
Missouri	562	2799494	20.4
Montana	142	462398	30.6
Nebraska	132	861390	15.4
Nevada	342	1181165	30.2
New Hampshire	104	636504	16.4
New Jersey	482	4202733	11.4
New Mexico	291	931748	31.5
New York	972	9335736	10.4
North Carolina	796	4170787	19.5
North Dakota	63	318958	19.0
Ohio	1036	5570983	18.7
Oklahoma	395	1731819	23.3
Oregon	415	1775505	23.3
Pennsylvania	1130	5981910	18.5
Rhode Island	70	517179	13.1
South Carolina	391	2041647	19.4
South Dakota	94	385163	24.7
Tennessee	627	2880226	22.0
Texas	1803	11163013	17.4
Utah	310	1227347	28.4
Vermont	77	303996	24.7
Virginia	657	3651909	18.6
Washington	639	3073759	21.4
West Virginia	236	880805	26.4
Wisconsin	507	2732268	18.4
Wyoming	67	253954	27.5
United States	25,566	144,060,672	18.0

Note: *The District of Columbia is excluded from the remainder of the analysis because it
had virtually outlawed the possession of guns during the study period*.

b. Independent variables

Firearms regulations

In order to maximize variation across states and over time in the measure of gun
control, we created three additive indices that reflect different intensities of firearms
regulations. The first index —arguably is the most important in terms of suicide

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prevention— measures general prohibitions. It is the sum of two indicator variables reflecting the presence of permit requirements and on firearm, purchases by minors. This index thus varies between 0 and 2.

The second index measures prohibitions based on behavioral problems, some of which have been identified as risk factors for suicide, but which are not likely to actually affect suicide. This index is the sum of five indicators variables reflecting the presence of bans on persons with mental health, alcohol, or drug problems, as well as prohibitions on those with prior convictions for misdemeanors and domestic violence offenses.

Our third and last index captures four types of prohibitions reflecting criminal concerns. We include this variable primarily as a robustness check, since the prohibitions captured are least likely to affect suicide. The index, varying between 0 and 4, is the sum of indicator variables measuring the presence of prohibitions against "aliens"[4], convicted felons, fugitives from justice, and those who committed serious offenses as juveniles.

Gun ownership
Given the relationship between firearm regulations and firearm prevalence, as well as that between firearm prevalence and suicide, it is necessary to control for gun ownership in the alternative specification. Gun ownership is available every several years from the CDC's Behavioral Risk Factor Surveillance System, but there is no annual data at the state level, and the available data only dates back to 2001. The most commonly used proxies for gun ownership are the proportion of homicides and the proportion of suicides committed with firearms (see, Lester, 1987; Lester, 1989; Hemenway et al., 2001; Miller et al., 2002; Shenassa et al., 2006; Azrael et al., 2004). These variables are combined to create an index called Cook's index. However, given that the dependent variable for this analysis is the total number of suicides, it was felt that this proxy was inappropriate. As an alternative, the number of hunting licenses per capita from the Fish and Wild Life Service[5] was used as a control for gun

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[4] In some states, this prohibition refers to undocumented immigrants, while in others to individuals who have "forsaken their allegiance to the United States."
[5] www.fws.gov

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ownership[6]. Hunting licenses per capita and firearm suicides as a proportion of suicides were highly correlated ($r = 0.74$, p-value $<.05$). Data on state gun regulations was obtained from the Bureau of Justice Statistics.[7]

Data on state personal income (*income*) were obtained from the Bureau of Economic Analysis and deflated by the consumer price index (CPI) extracted from the Bureau of Labor Statistics (BLS). Unemployment rates (*unemployment*) also come from the BLS. Data on per capita ethanol consumption of beer (*beer*), an estimate for the amount of pure ethanol consumption per capita, was extracted from the NIIA Surveillance Reports. Alcohol consumption and economic conditions have been linked to suicide in a number of population level studies (Yang, 1992; Markowitz et al., 2003) The percentage of people over 65 (*psh65*) years of age and the proportion of the population which is non-Hispanic white (*white*) were obtained from the US Census Bureau (2007). Table 2 reports summary statistics for the variables used in regressions.

Table 2. Summary statistics

Variables	N	Mean	Std. Dev.	Min	Max
Dependent variables:					
Male suicides, total	500	484.09	476.87	49	2939
Male suicide, ages 15-24	500	70.95	62.67	3	421
Male suicide, ages 25-44	500	191.06	181.23	18	1191
Male suicide, ages 45-64	500	134.20	134.80	7	831
Male suicide, ages > 65	500	93.36	102.79	1	575
Socioeconomic variables:					
Percent with bachelor's degree	500	24.65	4.67	12.70	38.70
Real per capita income (log)	500	10.20	0.15	9.82	10.65
Unemployment rate	500	4.81	1.17	2.20	8.20
Beer consumption per capita	500	1.27	0.20	0.73	1.91
Percent non white	500	0.78	0.15	0.26	0.99
Percent 65 years or older	500	0.14	0.11	0.05	1.34
Gun supply:					
Hunting licenses per capita	500	0.087	0.071	0.007	0.340
Firearm regulation:					
General prohibitions(1)					
Permit requirements	500	0.22	0.41	0	1
Ban on purchase by minors	500	0.68	0.47	0	1
General prohibitions index	500	0.90	0.63	0	2

Con formato: Italiano (Italia)

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[6] The model was also estimated using the firearm suicide proxy, and results were very similar. We do not report them here for brevity.
[7] http://www.ojp.usdoj.gov/bjs/

Behavioral prohibitions(2)						
Mental health problem	500	0.47	0.50	0	1	
Alcohol problem	500	0.34	0.47	0	1	
Drug problem	500	0.41	0.49	0	1	
Misdemeanor conviction	500	0.36	0.48	0	1	
Domestic violence conviction	500	0.29	0.45	0	1	
Behavioral prohibitions index	500	1.87	1.70	0	5	
Criminal prohibitions(3)						
Alien	500	0.15	0.36	0	1	
Felony	500	0.73	0.45	0	1	
Juvenile offense	500	0.41	0.49	0	1	
Fugitive	500	0.17	0.38	0	1	
Criminal prohibitions index	500	1.46	1.11	0	4	

3. RESULTS

The regression results are reported in Table 3. The estimations include year and individual state specific effects which are statistically significant in all regression models. All coefficients have been put on an exponential scale; thus the parameters (β) obtained from the negative binomial regression should be interpreted as incidence rate ratios (henceforth, IRR). The IRR are obtained by exponentiation of the regression coefficients, that is, exp (β). The expression $100*(\exp(\beta)-1)$ is the percentage change in the incidence or risk of suicide mortality for each unit increase in the independent variable.

Table 3: Results of Negative Binomial Regression, all males, 1995-2004 (N=500).

Dependent variable is number of male suicides, exposure variable is male population

	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
	Fixed effects only	Socio-economic variables	General Prohibitions	General prohibitions and hunting licenses per capita	Behavioral prohibitions	Criminal prohibitions
State Fixed Effects	X	X	X	X	X	X
Year Fixed Effects	X	X	X	X	X	X
High School graduates (%)		0.9985	0.9991	0.9991	0.9986	0.9984
		[0.0017]	[0.0017]	[0.0017]	[0.0016]	[0.0017]
Beer consumption		1.1067	1.1022	1.1021	1.1184	1.0988
.		[0.1062]	[0.1039]	[0.1037]	[0.1012]	[0.1011]
Unemployment rate		1.0181 **	1.0185 **	1.0185 **	1.0165 **	1.0179
		[0.0075]	[0.0076]	[0.0075]	[0.0074]	[0.0073]

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Log of median HH income		0.6394 **	0.6433 **	0.6428 **	0.6376 **	0.637
		[0.1424]	[0.1418]	[0.1429]	[0.1338]	[0.1435
Percent White		3.5333 ***	3.5115 ***	3.5152 ***	3.3638 ***	3.525
		[1.5326]	[1.5247]	[1.5171]	[0.0145]	[1.5327
Percent > 65 years		1.1245 ***	1.1232 ***	1.1232 ***	1.1166 ***	1.126
		[0.0147]	[0.0153]	[0.0153]	[0.0145]	[0.0157
General prohibitions (1)			0.9440 ***	0.9438 ***		
			[0.0093]	[0.0099]		
Behavioral prohibitions index (2)					0.9946 *	
					[0.0030]	
Criminal prohibitions index (3)						1.003
						[0.0068
Hunting Licenses Per Capita				0.9692		
				[0.4548]		
Log likelihood	-2228.3	-2199.2		-2199.1	-2199.1	-2200.
Ln alpha	**-7.0532**	**-7.6410**	**-7.6475**	**-7.6477**	**-7.6692**	**-7.659**

Notes:
(1) General prohibitions index: permit requirement, ban on purchase by minor.
Range 0-2
(2) Behavioral prohibitions index: mental health, alcohol problems (or intoxication), drug problems, domestic violence conviction, misdemeanor conviction.
Range: 0-5
(3) Criminal prohibitions index: alien, prior felony conviction, fugitive from justice, serious offense as a juvenile. Range:0-4
District of Columbia is excluded.
(4) Standard errors in brackets. Constant term included but not reported.

*=p<.10

** p<.05

***p<.01

The first two models show the effects of fixed state and year effects (Model 1), and the fixed effects in addition to a set of socio-demographic variables namely education, income, alcohol consumption, the proportion of the population over age 65, and the proportion of non-Hispanic white population (Model 2).

Model 3 introduces the index of general prohibitions – namely gun control regulations which affect the largest number of people and which create general barriers to entry. We find the general prohibition index to be statistically significant, both individually and when we include our proxy for gun prevalence, hunting licenses per capita, which enters insignificantly (Model 4).

The next model includes the second index of gun control measures, which aims to capture firearm restrictions based on, behavioral issues such as a history of mental

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health or alcohol/drug problems. While significant, the IRR is 0.9946 in this model compared to 0.9440 in Model 3 that includes the general prohibition index; and the coefficient is only significant at the 10 percent level. Model 6 includes our last index, which captures gun control measures that are least unlikely to affect suicide. They are designed rather to prevent criminal behavior. As expected, this variable does not enter with a statistically significant coefficient.

Table 4 shows the effects of individual state level firearm restrictions on the phenomenon of the suicide for particular age groups. In all models, we control for gun prevalence with the number of hunting licenses per capita, and include the standard covariates. We find that gun control measures do not affect all age groups identically. For instance, a ban on firearm purchases by minors affects suicides particularly among younger males, while restrictions on permits and waiting period requirements have a more deterrent effect on for older males. Among behavior related prohibitions that based on a history of mental illness prohibition is only significant for males aged 25-44 years, and that against alcohol abusers only matters for 65 + males. The drug and misdemeanor conviction bans do not enter significantly for any of the age groups, and the prohibition linked to a history of domestic violence only affects suicides among the middle aged. None of the criminal prohibitions enter significantly for specific age groups, and are therefore omitted.

Table 4: Selected gun control measures, males by age, 1995-2004 (N=500).

Dependent variable is number of male suicides, exposure variable is male population, within age groups

	Model 1		Model 2		Model 3		Model 4	
	Males 15-24 years		Males 25-44 years		Males 45-64 years		Males 65+	
General prohibitions								
Permit requirement	1.2043	***	0.9741		0.8601	***	0.8518	***
.	[0.0343]		[0.0188]		[0.0208]		[0.0222]	
Ban on minor purchase	0.8715	*	0.8647	***	0.9867		1.0304	
.	[0.0679]		[0.0183]		[0.0817]		[0.0756]	
Behavioral prohibitions								
Mental health	0.9949		0.9657	***	0.9948		1.0435	
.	[0.0245]		[0.0111]		[0.0212]		[0.0246]	
Alcohol	1.0015		1.0085		0.9916		0.9437	***
.	[0.0199]		[0.0168]		[0.0196]		[0.0166]	

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Drugs	0.9723	0.9972	1.0017	1.0086
.	[0.0229]	[0.0167]	[0.0220]	[0.0241]
Misdemeanor conviction	1.0169	0.9848	0.9758	1.0062
	[0.0216]	[0.0159]	[0.0160]	[0.0293]
Domestic violence conviction	0.9812	1.0048	0.9630 **	0.9700
	[0.0261]	[0.0190]	[0.0167]	[0.0185]

Note: All models include state and year fixed effects, as well as control variables for the level of education, unemployment rate, income per capita, and the percent of Non-Hispanic white population. A proxy for gun prevalence (hunting licenses per capita) is also included. District of Columbia is excluded. Standard errors in brackets. Constant term included but not reported.

*=p<.10

** p<.05

***p<.01

4. DISCUSSION

Access to lethal weapons is an important risk factor for suicide. Our study suggests that general barriers to firearm access created through state regulation can have a significant deterrent effect on male suicide rates in the United States. Permit requirements and bans on sales to minors were the most effective of the regulations analyzed. These findings have important implications for U.S. gun control policy, which remains exceptionally heterogeneous across states. While all states except Wyoming have banned sales of handguns to minors, twelve states still allow the sale of *long guns* to minors. Furthermore, only twelve states currently require purchase permits for firearms. While gun control remains a controversial issue both at the state and federal level in the U.S., this analysis suggests that there are clear public health benefits to restricting access to firearms through regulation.

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