Guns in America:

What Do The Data Tell Us?

by

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Get your facts first. Then you can distort them.
Mark Twain

Facts never trump interpretations.
Anonymous

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This is a work-in-progress and subject to revision

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What role do guns play in the American drama? Are guns a motivator of violence or is violence a driver of gun ownership? What are the merits and demerits of the now-all-too rhetorical and angry "debate" about guns and gun use? *What do the data tell us?* This study addresses these and other questions about guns in America.

We begin in section 1 ("The Scope of the Problem") with a general view of gun deaths in America: the horror of mass shootings, the prominence of guns as the mode of death in homicides and (particularly) suicides, the motives behind "unnatural" deaths, the roles of suicides, gangs, race, urbanization, age and gender in gun deaths, and the identification of the murder capitals in America—the cities and towns where murders are most common. *You* might live in one.

Section 2 ("Guns and Gun Use") assesses the link between guns, murders, and violence. We discuss how the number of guns in America is measured, the phenomenon of the American "super-gunner," the demographics of gun ownership, and the consequences of lost and stolen guns. We also construct estimates of the American stock of guns from the federal BATFE (Bureau of Alcohol, Firearms, Tobacco and Explosives) data on annual flows of new guns into America, and we compare gun numbers estimated from BATFE sources with estimates obtained by survey methods.

Section 3 ("Guns as Predictors of Death") contains the meat of the study—a statistical analysis of state-level data related to the role of guns in American deaths, both homicides and suicides. Here we demonstrate that the fundament gun-related source of homicides *and* suicides is not the number of guns, it is the number of *stolen* guns.

Section 4 ("Gun Control Policies") discusses the implications of these results for gun regulations that might target the core of the role guns play in homicides and suicides.

In Section 5 we briefly summarize some of the key information obtained; in addition we construct a list of "take-aways" summarizing key points in the study.

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1. The Scope of the Problem

Motivation

I am not a gun libertarian—I recognize that anything that can cause harm to others is a strong candidate for regulation: that is why we have product liability laws, why we regulate the right to drive, and why access to the ownership and use of deadly weapons is not just a private matter. But I am a gun owner, so I do have biases; I've tried to keep them out of the study as much as possible, but that's a hard row to hoe.

Each of us has a responsibility to learn as much as possible about both what we oppose *and* what we support. Opinions on important matters are too often formed by others (friends, newspapers and television, popular reading, and rumor) rather than hard evidence, and rejection of opposing views is often expressed in sound bites or adolescent vituperation; each is a bar to intelligent discussion. Developing an *informed* view of the world is hard work, but that is the only route to progress on any public policy problem. There is rarely a right or wrong on matters of proper balance between private rights and public interests, but a judgement of this balance is essential in a democracy.

Answers will not be found in "facts." Facts have never been dispositive on any important issue; they are only meaningful when they are interpreted, and that's precisely why they lose their clarity because opposing points of view are often consistent with the same facts. Consider the following fact, often cited by the *New York Times* writer Nicholas Kristol: the number of civilian firearm deaths in the U. S. since 1970 equals to the number of deaths in U. S. wars in the nation's entire history (1.4 million). Now ask whether you would consider this fact useful if you know that military deaths include deaths from *all* causes, including disease which was the source of two-thirds of Civil War deaths—our most deadly war; that would take away between 335,000 and 500,000 of *all* wartime deaths and make the "fact" a squishy proposition. What if you learned that the civilian side of that fact included firearm deaths from accidents and suicides? You see the point: a "fact" that compares apples to oranges will not be a universally accepted act. It can simply be both true and extremely misleading!

Still, without some understanding of facts and of their contexts, our interpretations have no anchor. This is my effort to look at the facts and find an anchor.

Mass Shootings in the U.S.

The current intense public attention given to guns in America is undoubtedly due to the emergence of the phenomenon of mass shootings. The Congressional Research Service defines a mass shooting as "a multiple homicide event in which four or more victims, excluding the killer, are murdered *with firearms* within one event and in one or more locations in close proximity." This definition has been adopted in the official records of the FBI and other government agencies.[1]

[1] Recently the FBI became schizophrenic when it decided that a "mass killing" requires four of more deaths, while a "mass murderer" is one who kills three or more victims.

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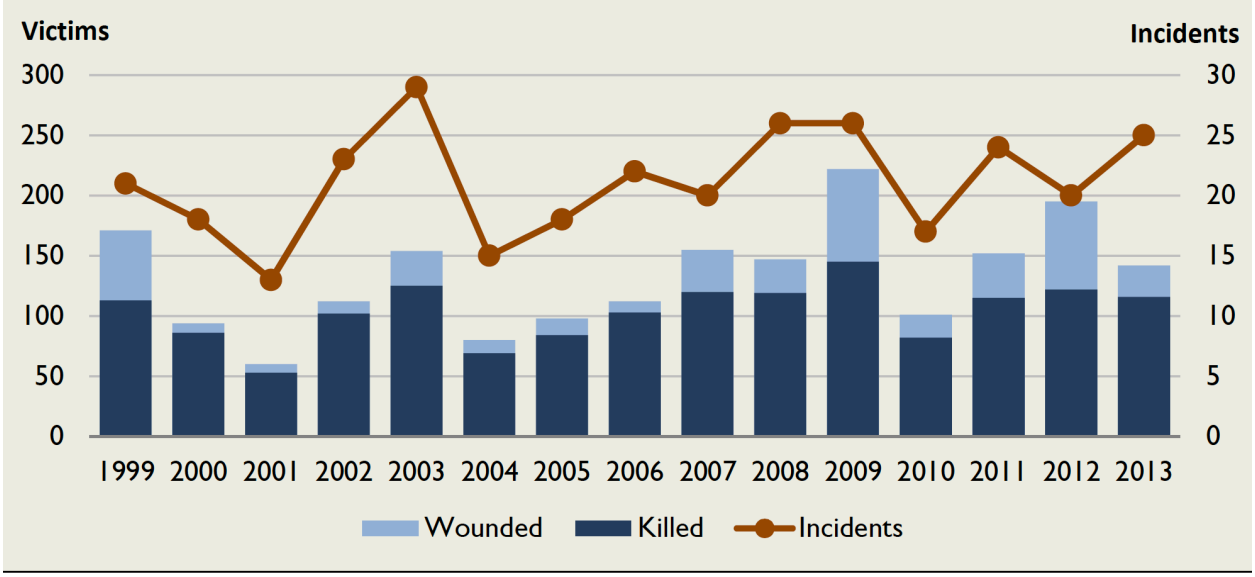
Mass murders are not a modern event; they are almost an American tradition with a long history. Nor are they confined to guns as a tool. In 1911 six were in murdered by axe handle in Colorado Springs, Colorado (mass murder by axe); In 1919 237 black sharecroppers in Phillips County, Arkansas, were lynched after attempting to create a union (mass murder by rope); in 1949 veteran Howard Unruh strolled the streets of Camden NJ with a gun and killed 13 while wounding three; in 1998 Timothy McVeigh murdered 283 Oklahomans with a truck bomb (mass murder by explosives); in 2001 the Twin Towers destruction (mass murder by airplane); in 2017 the killing of 58 and injuring of 442 with firearms from a Las Vegas hotel window (mass murder by gun).[2] The list goes on . . . and on.

The chart below shows the firearm murder rate and the number of victims in mass shooting incidents from 1999 to 2013 [Crouse and Richardson, 2015]. This is consistent with the longer-term data showing no trend in the *number* of incidents. However, after 2013 the mass shooting picture changed. Sadly, the frequency of events has risen in 2018 to its highest yet and pundits project that growth into the future.

Chart 1A
Mass Shootings in America
1999-2013



Source: CRS analysis of FBI Supplementary Homicide Reports, press accounts, agency press releases, and other compilations by mass media and advocacy groups.

The modern era of mass public shootings began in 1966 at the University of Texas, when Charles Whitman, a 25-year old former Marine, murdered his mother and sister, then climbed to the top of the tower of the administration building at the University of Texas in Austin. From there he killed 15 people and injured another 31 before being shot to death by a policeman and, yes, an armed civilian. This was a just cause for national alarm in itself, and it initiated the modern age of mass shootings with firearms.

[2] Another 409 were injured in the crowd panic that ensued.

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Table 1
Major Mass Shootings in the U. S. 2005-2018

Year and Place	Location	Dead	Injured	Shooter's Age	Weapons
2018					
Bar	Thousand Oaks, CA	13	10	28	H
T&T Trucking	Bakersfield, CA	6	0	46	H
Newspaper	Annapolis, MD	5	2	38	S
Restaurant	Antioch, TN	4	4	29	R
High School	Parkland, FL	17	17	19	**R**
High School	Santa Fe, TX	10	10	17	H
Ed's Car Wash	Melcroft, PA	5	11	28	H
Synagogue	Pittsburgh, PA	11	6	46	H
2017					
Flamma Office	Orlando, FL	6	0	45	H
Savings Bank	Rothschild, WI	5	0	45	H, R
Club 66	Yazoo City, MS	4	0	27	H
Hotel	Las Vegas, NV	58	422	64	**R**
Church	Sutherland Springs, TX	27	20	26	H
Airport	Ft. Lauderdale, FL	5	6	26	H
School	Rancho Tehama, CA	6	10	44	H
Store	Abiquiu, NM	5	0	21	H
2016					
Pulse Nightclub	Orlando, FL	50	53	29	H,R
Macy's	Birmingham, WA	5	0	20	R
Protest March	Dallas, TX	6	9	25	H, R
Cookout	Wilkinsburg, PA	6	3	29/27F	H
Cracker Barrel	Kalamazoo, MI	6	2	45	H
Campsite	Anderson County, TX	6	0	33	H
2015					
State Office	San Bernardino, CA	16	21	27/28	H
Community College	Roseburg, OR	10	7	26	H
Church	Charleston, SC	9	1	21	H
Military Facility	Chattanooga, TN	6	1	24	H
2014					
High School	Marysville, WA	4	0	15	H
Military Facility	Fort Hood, TX	4	14	34	H
County Office	Isla Vista, CA	7	13	22	H
Tribal Office	Alturas, CA	5	2	44F	H
2013					
Apartment	Federal Way, WA	5	0	27	H
Navy Yard	Washington, DC	13	8	34	H, S
Apartment	Hialeah, FL	7	0	42	H
College	Santa Monica, CA	6	3	23	H
Car Wash	Herkimer, NY	5	2	64	H
2012					
Elementary School	Sandy Hook, NJ	26	2	20	H
Theater	Aurora, CO	12	70	25	H
Sikh Temple	Oak Creek, WI	6	4	40	H
Signage Company	Minneapolis, MN	7	1	36	H
Restaurant	Seattle, WA	6	1	40	H
College	Oakland, CA	7	3	43	H
Spa	Norcross, GA	5	0	59	H

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Table 1B above lists the major mass shootings since 2005. Following FBI definitions, these are public shootings with four or more deaths other than the killer.

Table 1 (continued)
Major Mass Shootings in the U. S., 2005-2018

Year and Place	Location	Dead	Injured	Shooter's Age	Weapons
2011					
Hair Salon	Seal Beach, CA	8	11	42	H
Restaurant	Carson City, NV	5	7	32	R
Roller Rink	Grand Prairie, TX	6	4	35	H
Grocery	Tucson, AZ	6	13	22	H
2010					
Restaurant	Buffalo, NY	4	4	23	H
Office	Manchester, CT	9	2	34	H
Restaurant	Hialeah, FL	5	3	38	H
Restaurant	Los Angeles, CA	4	2	28	H
2009					
State Office	Binghamton, NY	13	4	41	H
Spree/Family	Geneva County, AL	10	6	28	H, R
Military Facility	Fort Hood, TX	13	30	41	H
Restaurant	Parkland, WA	4	0	37	H
Health Center	Carthage, NC	8	0	45	H
2008					
Community College	Roseburg, OR	9	8	26	H, S
Office	Henderson, KY	5	0	25	H
College	DeKalb, IL	5	0	27	H
Govt Office	Alger, WA	6	0	28	H
Salvage Yard	Santa Maria, CA	4	0	31	H
City Hall	Kirkwood, MO	6	1	52	H?
2007					
College	Blacksburg, VA	33	23	23	H
Church	Colorado Springs, CO	4	0	24	H
Mall	Salt Lake City, UT	6	4	18	H
Party	Crandon, WI	6	1	20	H
Mall	Omaha, NE	8	0	19	H
2006					
Amish School	Nickel Mines, PA	5	0	32	R
City Hall	St. Louis, MO	5	1	32	H
Postal	Goleta, CA	7	0	44F	H
Church	Baton Rouge, LA	5	0	25	H
Party	Seattle, WA	6	0	28	H/S
2005					
Family/High School	Red Lake, MN	10	5	16	H
Church	Sash, TX	4	0	54	H
Courthouse	Atlanta, GA	4	0	33	H
Church	Brookfield, WI	7	0	44	H
Totals		**667**	**887**		

Weapons: H = Handgun; R = Rifle; S = Shotgun
Sources: Wikipedia, "Mass Shootings in the United States," Washington Post, November 9, 2018
(https://www.washingtonpost.com/graphics/2018/national/mass-shootings-in-america/?utm_term=.072d5e768ff1)

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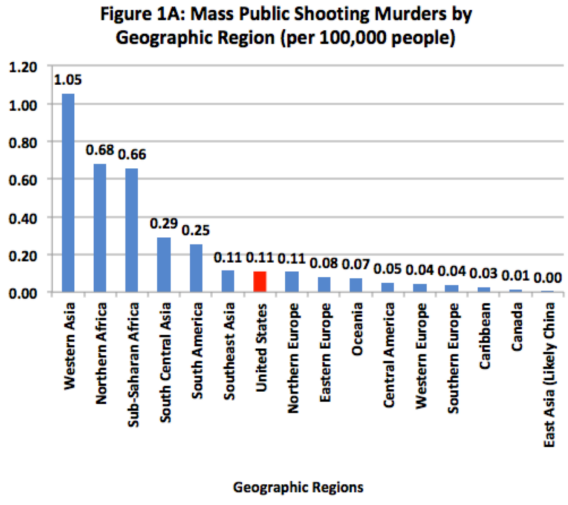
There were 75-five mass murder events in those fourteen years with 667 deaths and 887 gunshot injuries (half of the injuries in one event).[3] The deadliest of these mass murder events was the 2017 Las Vegas event when 64-year old Stephen Paddock transported an arsenal of 24 rifles and one handgun into his rooms at the Mandalay Bay Hotel and shot into a crowd of 22,000 people gathered outside for a music concert. The Las Vegas event had four particularly notable characteristics. The first was the scale of the carnage—58 deaths and 422 injuries from gunshots plus 437 injuries from the crowd panic that followed. This exceeded the runner-up, 2016's Pulse Nightclub, by eight deaths and 369 gunshot injuries. The second characteristic was the age of the shooter: mass shooting is generally a province of the young, and the victims are typically in the same age group; but at 64 the Las Vegas shooter was far older than both his victims and the typical mass murderer. The third characteristic was his use of an arsenal of rifles; mass murder by rifle is a rare event. Finally, the rifles were modified with a "bump stock," a commercial device to convert his weapon from its legal semi-automatic fire into an illegal automatic weapon.

There are, of course, other public shooting events that don't quite meet the four-death minimum, as well as many private shooting incidents that don't make the list. You can find a more exhaustive list at *GunViolence.com*.

How do mass murders in the U. S. stack up against the rest of the world? The economist John Lott reports [Lott, John. 2018] that we are not, as commonly believed, in the lead; in fact, as Chart 1C shows, we are in the middle of the pack when mass shootings are grouped by region. The impression of leadership in mass murders comes from cherry-picking the data—the U. S. is above European, Caribbean, and Chinese numbers, but well below South American, African, and many Asian countries. President Obama said in 2015, that "This just doesn't happen in other countries," a statement far from true.

Chart 1C



Source: Lott, John. August 30, 2018.

[3] For the statisticians among us, there were an average of 5.4 events per year, 8.9 deaths per event, and 11.8 gunshot injuries per event.

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Weapons of Choice: the AR-15?

The well-justified outrage over school shootings has been particularly intense and appears to be at the center of current anti-gun rhetoric. A common method of rousing support is to personalize an issue; we see this when a TV ad for donations to aid children in a war zone (say Afghanistan) show the photo of one child: personalization works. So publics anger is generated by directing attention at specific firearms, not just at "guns." In that spirit, the AR-15 semiautomatic rifle receives most of the burden. Critics often mistakenly misinterpret the "AR" as a reference to an "assault rifle." In fact, the AR refers to the manufacturer—the Armalite Corporation—and the AR-15 is a simply model 15 of an "Armalite Rifle." This is a minor nit to pick, but it is an example of the ignorance about firearms common among gun critics.

Perhaps it would be useful to define the characteristics of this eponymous and ominous weapon. The AR-15 is a semi-automatic civilian version of the fully automatic military M-16, but with the M-16's automatic-fire capability removed and its normal 30-round magazine reduced by law (but not always in practice) to a civilian limit of 10 rounds. It is no more an "assault rifle" than is my 80-year old semi-automatic M1 Garand, a .30-06 rifle used in WWII, a far more powerful weapon with a clip of 8 rounds as opposed to the ten rounds of a legal AR-15. The primary difference between the two rifles is that the AR-15 has faster reload capability (it uses a magazine rather than a clip), less recoil, lighter weight, and, most important of all, Darth Vader looks. It looks ferocious, and in the wrong hands it obviously can be ferocious, but it is essentially a .22-caliber rifle with a more powerful cartridge than the run-of-the-mill .22-caliber rifle used by teenagers around the world.

The AR-15 is a modern favorite of many hunters because it is light and accurate at short ranges. But to demonstrate its power, some states prohibit the use of the AR-15 for hunting because it is not sufficiently powerful—it is more likely to wound an animal than kill it, leaving it to a slow and grueling death. But in a crowded room filled with disco dancers or theater and concert goers it can be devastating, as can semi-automatic handguns or revolvers.

That the AR-15 is the public's image of a weapon for mass killings is, I suspect, the result of that weapon's use in action movies, of the copycat behavior common to the usually-adolescent minds that choose to do mass murders, and of its promotion by mass media. That it is popular among rifle owners is, perhaps, because they became accustomed to it during the Viet Nam war years (some 45 percent of gun owners are veterans), and because it is, by all reports, a sweet gun to shoot: highly maneuverable in close quarters, with high accuracy and short-to intermediate ranges, low maintenance, and low recoil. But it and its ilk are not really the prime weapons for mass murders—those are handguns.

As we can see in Table 1 (and later) very few homicides (including mass shootings) are with long guns of any kind; the handgun is the common weapon of choice. Yet, strangely, it's the AR-15 that is the face of evil.

The near hysteria in the political debate about guns has an interesting backdrop. Chart 2 shows the number of violent crimes and murders *by any means* in the period 1980- 2016. One thing is clear: the sharply rising trend in violence and homicides reversed in 1990. By 2015 the murder-manslaughter rate had returned to its 1960 level. Thus, the population-adjusted

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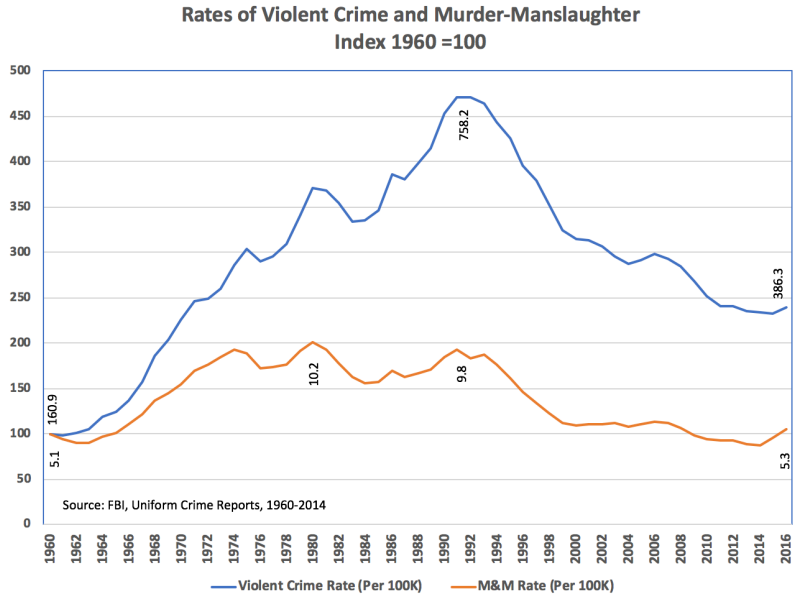
rates of both violent crime and murder-manslaughter has declined even as the stock of guns has risen.

Chart 2



Unnatural Deaths in America

Beyond the question of mass shootings, which have accounted for at least 700 deaths and 900 injuries thus far in the 2000s, there is the larger matter of the role of guns in all "unnatural deaths," defined as deaths from accidents, suicides, substance abuse, and assaults. Evidence on this for 2015 shown in Table 2.

Of the 296,531" unnatural" deaths reported in 2015 by the National Vital Statistics Survey, 17,793 (6%) were homicides from "assaults" and 12,707 (4.3%) were homicides by firearms. Almost 30 percent of deaths by assault were from hanging, poisoning, asphyxiation, pushing from high places, and other causes (possible axe handles). If accidents and substance abuse—the two major killers—are set aside, there were 61,986 unnatural deaths from suicide and homicide, of which 34,725 (56%) were firearm-related. But any way you cut it, firearms are used in the majority of unnatural deaths from events other than accident and substance abuse.

While the deaths in Table 2 might be attributed to single causes, there are interactions among the categories. For example, substance abuse is common among those who commit suicide. How many suicides by gun should really be counted as "premature" suicides by drug abuse? It's a rhetorical question, but it reveals a weakness in the data for deaths-by-gun: Attribution of deaths by method masks the underlying reasons.

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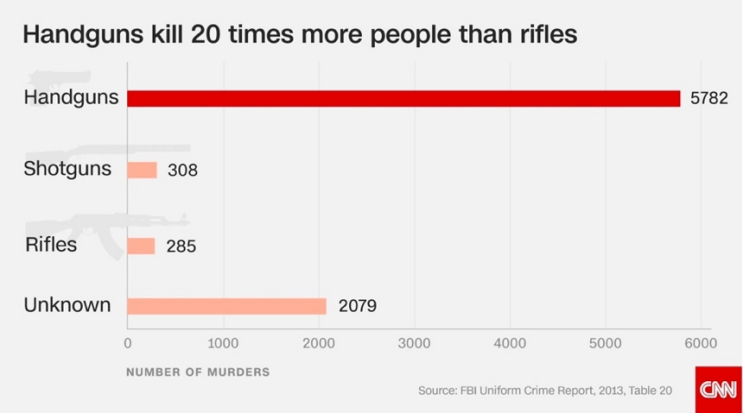
Table 2
2015 Causes of Unnatural Deaths in the United State

Cause of Death	Number	Percent
Accidents	**146,571**	**49.43**
By Firearms	489	.33
By Other Means	146,082	99.67
Suicides	**44,193**	**14.90**
By Firearms	22,018	49.82
By Other Means	22,175	50.18
Drugs and Alcohol	**88,574**	**29.87**
By Firearms	0	0
By Other Means	88,574	100.00
Assaults (Homicides)	**17,793**	**16.67**
By Firearms	12,707	71.42
By Other Means	5,086	28.58
TOTAL NON-NATURAL DEATHs	**296,531**	**100.00**
By Firearms	35,214	11.88
By Other Means	261,917	88.12

Source: National Vital Statistics Survey, Vol. 66, Number 6, September 2017.

What type of firearm is used most frequently? Chart 3 shows a firm answer for 2013 that has been confirmed in more recent studies.

Chart 3



Of the 6,375 firearm deaths in 2013 for which the type of gun was known, "long guns" accounted for 9.3% of firearm deaths: 285 (4.5%) of those were rifles like the AR-15, and 308 (4.8%) were deaths by shotgun. The remaining 90.7% were handguns (revolvers and pistols). By the numbers, handguns are the most lethal firearm in the American arsenal even though they only represent 40 percent of the stock of guns in America, a proportion that has increased over

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time and continues to rise. The American handgun is a minority weapon in the arsenal but a majority weapon in firearm deaths.

Homicide and Suicide

In 2015 there were 35,214 deaths from firearms; of these 22,018 (62.5%) were suicides. It's said that men *commit* suicide while women *attempt* suicide. Table 3 shows that for each completed female suicide in 2016 there were 3.4 completed male suicides. Male success at suicide is undoubtedly because men use a fail-safe method—guns–while females typically use less messy and less successful methods.

Chart 4

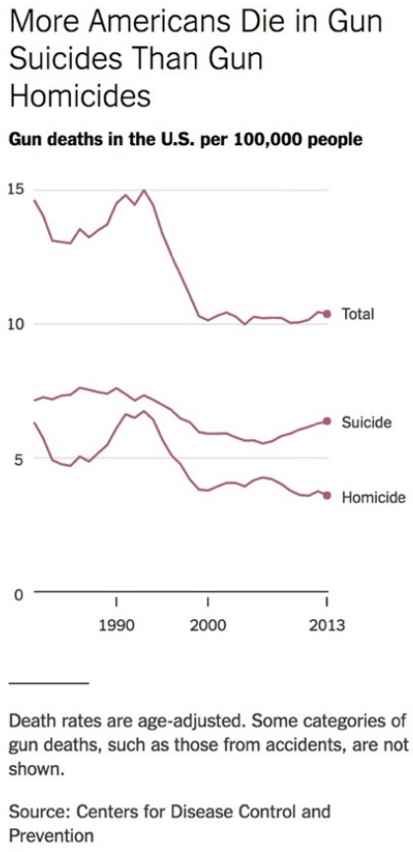

Chart 4 above shows the national gun death rates in 1980-2013 for both suicides and homicides. Table 3 reports the demographic profile of suicides in 2016. The good news from Chart 4 is that the homicide-by-gun rate has fallen significantly, from about 6 per 100,000 population to about 4 per 100,000. The bad news is that while the suicide-by-gun rate has declined, its decline is far less than the fall in homicides.

Table 3 shows that for both males and females, suicide is concentrated in the 15-64 age group, with middle age a prominent time. After age 64 the number of suicides drops sharply

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for both men and women; it drops again at age 75, but only for women—perhaps because in the over-75 group their men are gone and women find life worth living again. (joke!)

Table 3

Number of suicides by age group and sex: USA, 2016.[1]

Age (years)	10 – 14	15 – 24	25 – 34	35 – 44	45 – 54	55 – 64	65 – 74	75+	Unknown	All
Males	265	4575	5887	5294	6198	5745	3463	3291	2	34727
Females	171	1148	1479	1736	2239	2014	940	510	1	10238
Male/Female Ratio	1.5	4.0	4.0	3.0	2.8	2.9	3.7	6.5	1.0	3.4
Total	436	5723	7366	7030	8437	7759	4403	3801	3	44965

Source: Wikipedia, "Suicide by Age"

Weighing Homicides and Suicides

This brings us to a thorny issue. Should suicides and homicides (deaths at the hands of others) be equally weighted in the debate about guns in America? Both are deaths, whether by firearm or other means, and doesn't every life count equally? Or is the weight given to suicides simply a rhetorical choice, with suicides fully weighted in the gun-death debate by anti-gun folks and not weighted by pro-gun folks?

I understand the anguish that a suicide's family and friends experience: it has touched my family too. Still, I side with those who think that suicide is a horse of a very different color when it comes to firearms and the public interest. It is difficult to compare a death whose timing and method is chosen with one in which neither is chosen. A gun might be involved in both cases, death is the result in both cases, and the pain experienced by family and friends is the same in both cases, but the harm to society of a murder is significantly greater than the harm from suicide. Death by homicide is a social event that affects the national fabric: it spreads fear and distrust, it affects our sense of safety and of community, and it contributes to protective isolation and, perhaps, to increases the chances of homicides as copycats emerge. A suicide is a sad but self-selected act that has minimal peripheral harm beyond the survivors.

This study is directed primarily at homicides unless otherwise indicated. If suicides are left out, the number of 2015 deaths which we count in the gun debate is not the 35, 214 deaths by firearms, it is the 12,701 deaths by homicides. But suicides will be considered in our statistical analysis, where we find some interesting connections.

Motives for Homicide

What prompts people—primarily males—to murder? Table 4 summarizes the FBI's analysis of the motives for murders in 2010. Of the 12,996 homicides in 2010, 1,923 (14.7%) were attributed to the usual suspects—felonies like rapes, thefts, vice, sex, gambling, arson, and narcotics. The remaining 85.3 percent of motives were primarily either "friends and family" murders or of unknown motive.

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Murder is rarely a cold-blooded event: it is typically an act done in the heat of anger between folks who know each other.

Table 4
Motives for Homicides—2010

Felony-Total	1,923	Other - Total	11,073	
Rape	41	Romance	90	
Robbery	780	Baby Sitter	36	
Burglary	80	Brawl	179	
Larceny	20	Argument	3,396	
MV Theft	37	Gang	849	
Arson	35	Institutional	17	
Vice	5	Sniper	3	
Other Sex	14	Other	1,781	
Narcotics	463	Unknown	4,656	
Gambling	7	Suspected Felony	66	
Other	441	**Grand Total**	**12,996**	

Source: https://ucr.fbi.gov/crime-in-the-u.s/2010/crime-in-the-u.s.-2010/table...

Homicide and Urbanization

American murder is all around us. By and large, murder is thought to be concentrated in large urban areas like Chicago, Detroit, Baltimore, and Washington D. C. Overall, about 53.6 percent of murders do happen in areas considered urban. But is it true that the largest cities are the most dangerous?

In fact, the cities we think of as the deadliest often are not even close to the scale of death in small or smaller cities. For example, in 2014 Chicago led the national hit list with 478 murders, earning its sobriquet as "America's Murder Capital." But as Table 5A shows, when adjusted for population size Chicago's 15.09 murder *rate* (murders per 100,000 residents) wasn't enough to put it into the top 10 murder rates among large cities. St. Louis, Missouri won those honors with triple Chicago's murder rate. Surprisingly, our largest cities—New York and Los Angeles—are relative havens of safety.

Among medium-size cities, Jackson, Mississippi was most murderous; it would have ranked fourth in the nation among large cities. All ten of the most murderous small cities (10,000-99,999) were more dangerous than any medium-size city (100,000-250,000).

But if you want to settle in a town with the highest probability of being murdered, check out Table 5B. In the tiny town of Darby, PA there are 311 murders per 100,000 population, an astronomical murder rate giving you a .3% probability that you'll become a police statistic.

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Table 5A
2014 Murder Capitals by City Size

250,000+		100,000-250,000		10,000-99,999	
City	**Per 100K**	**City**	**Per 100K**	**City**	**Per 100K**
St. Louis, MO	49.91	Jackson, MS	35.33	East St. Louis, IL	101.8
Detroit	43.52	Birmingham	24.52	Chester, PA	88.09
New Orleans, LA	38.75	Baton Rouge, LA	23.11	Muskegon Hgts, MI	73.9
Baltimore, MS	33.84	N. Charleston, SC	23.78	Helena, AR	61.34
Newark, NJ	33.32	Little Rock, AR	21.69	College Park, GA	60.89
Buffalo, NY	23.22	San Bernardino, CA	20.04	Lumperto, NC	50.28
Pittsburgh, PA	22.43	Richmond, VA	18.92	Gary, IN	47.43
Memphis, TN	21.38	Dayton, OH	18.85	Riviera Beach, FL	38.87
Atlanta, GA	20.47	Inglewood, CA	17.86	Eunice, IL	37.95
Cincinnati, OH	20.16	Montgomery, AL	17.48	Trenton, NJ	37.95
Appended					
Chicago, IL	*15.09*				
Los Angeles, CA	*6.66*				
New York, NY	*3.93*				

Source: https://chicago.cbslocal.com/2015/10/22/violent-crime-statistics-for-every-city-in-america

Table 5B
2014 Murder Rates in the Leading Tiny Cities
1,000-10,000

Weldon, NC	311.72
Weisston, MO	256.72
Mangonia Park, GA	153.77
Alturas, CA	152.96
Hawkins, TX	149.93
Arcola, TX	122.17
Lockland, OH	116.48
Cairo, IL	116.28
Lake City, GA	113.90
Quitman, TX	110.44

Source: See Table 5A

Homicide and Gangs

Pro-gun advocates often claim that gangs are responsible for the vast majority of murders. Perhaps this comes from the observation that it's in the big cities that organized gangs (and drug trade) are most common and where there are the largest *number* of murders. The conclusion drawn is that since homicides are a gang thing, and criminals will always have easy access to guns no matter what the laws say, gun control will only deprive the lawful citizen of protection from the lawless.

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Consider the blog *GunFacts.org,* an organization that describes itself as unbiased and fact-oriented; its goal is laudable—to separate fact from fiction. The blog makes the following claims:

> ***Fact:*** **Two-thirds of the people who die each year from gunfire are criminals being shot by other criminals.**
> ***Fact:*** **Gangs are responsible for between 48% and 90% of all violent crimes.**
> ***Fact:*** **Most gun crimes are gang related, and as such are big-city issues.**
> (source,http://www.gunfacts.info/gun-control-myths/crime-and-guns/)

Gunfacts.org attributes these "facts" to the Federal Bureau of Investigation's annual Uniform Crime Reports (but an issue dated long ago, in 1994). If I jigger the 2015 numbers in Table 4 to get an estimate of murders attributable to gang activity, the best I can do is add "vice," "sex," "narcotics" and "gambling" from the left-hand column to the "gang" entry on the right. The result is a recorded 1,338 "gang-related" murders in 2010, about 10 percent of total homicides. A source a bit more favorable to *GunFacts.org* is the National Gang Violence Center, which reported 2,236 gang-related homicides in 2011; this is still only 17.2 percent of 2010 homicides.

The National Gang Center estimates that in 2011 there were about 30,000 youth gangs in the U.S., with total membership of 850,000. Over 40 percent of these gangs were in large urban areas, leaving the remainder to threaten suburban areas, small cities and rural areas. While gang-related activity is undoubtedly important, and while the *GunFacts.org* blog is correct in noting that large urban area are centers for both the larger gangs and the absolute number of homicides, there is no evidence that gang murders account for anything near a majority of homicides in the United States. It could be true—there are lots of murders with motives in the "Unknown" category that might be gang-related—but the evidence at hand says that homicide, by gun or other means, is not essentially a gang phenomenon. It appears that is largely a felony and "friends and family" activity.

Homicide and Race

Murder also has a clear racial face. Chart 5A gives an ethnic breakdown of 2015's "unnatural" deaths. For each method of death the totals are allocated among Non-Hispanic Whites, Non-Hispanic blacks, Hispanics, and Other; the last group is primarily U. S. citizens in island territories.

This chart should be carefully interpreted. The chart does *not* say that in 2015 55% of all blacks died in accidents; rather, it says that 55% of all *unnatural* black deaths were from accidents, 48 percent of Non-Hispanic white deaths in 2015 were attributed to accidents, 29 percent to substance abuse, 15 percent to suicide, and about 4 percent to assaults. Clearly, accidents were the main killer in each group, with substance abuse a clear second and suicides placing third. Assaults ranked last for each ethnic group; death by assault (homicide) is the most frequent cause of unnatural deaths among non-Hispanic whites.

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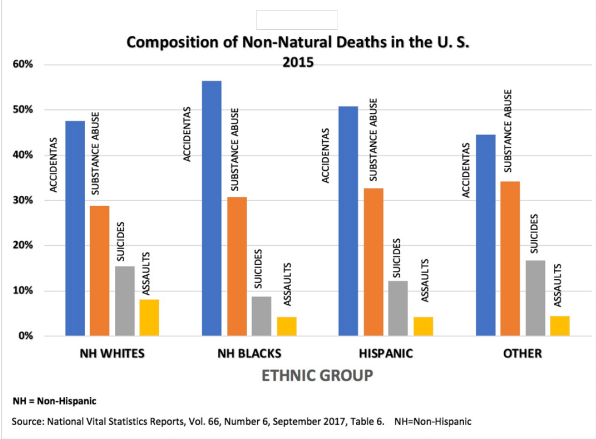
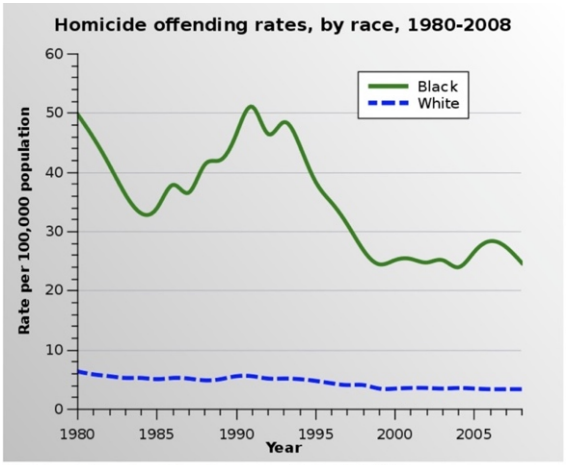
Chart 5A



Charts 5B and 5C below provide more information on the ethnicity of assault deaths. The left-hand chart shows the murder rate per 100,000 population by race of the *convicted* murderer. The right-hand chart shows the murder rate by the victim's race.

Chart 5B

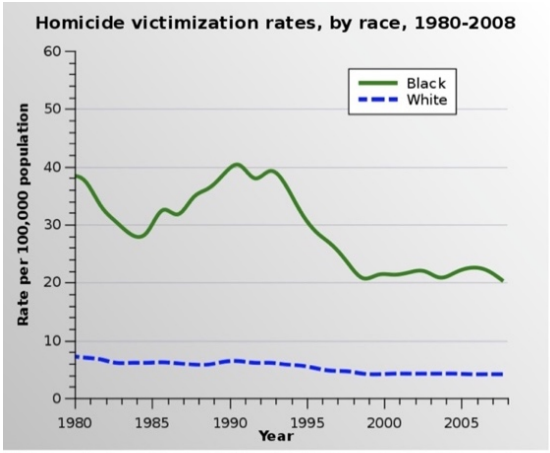
Murder Rate by Offender's Race
1980 - 2008



US homicide convictions by race, 1980–2008[29]

Chart 5C

Murder Rate by Victim's Race
1980 - 2008



This graph shows the homicide victimization rate for whites and blacks, according to the US Bureau of Justice Statistics.[29]

Source: Cooper, Alexia and E.L. Smith, Homicide Trends in the U.S., Bureau of Justice Statistics, Report 11/16/2011.

In 2008 blacks were murdered at a rate of 20 per 100,000 while whites were murdered at roughly 5 per 100,000. Among convicted murderers, blacks accounted for about 25 murders per 100,000 and white killers were responsible for about 3 percent per 100,000. Perhaps Charts 5B and 5C are the source of the *GunFacts.org* claim that 80 percent of murders are gang-on-gang—the charts do suggest that about 80 percent of murders are black-on-black, and blacks

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(non-whites) are prominent among gang members; but blacks are not necessarily gang members.

The impression that these two charts give is that homicide is racially segregated—blacks murder blacks, whites murder whites—and that most convicted murderers are black. This fits well with the popular view of murder in our still-segregated modern-day America.

Demographic studies reveal a relationship between homicides and standard demographic characteristics like age, income, income inequality, and gender. According to the FBI's Uniform Crime Report, in 2010 there were many more white female victims than black, with that relationship reversed for blacks: the male-to female ratio of murders was 2.6 among whites and 5.7 among blacks. Thus, homicide among blacks is a male-on-male thing, while among whites it is more gender-balanced. Black males kill other black males; while males kill their women.

Homicides and Economic Inequality

Income inequality is often cited as a cause of homicides: as income inequality widens, it's argued, the poor increasingly turn to predation of the rich. This appears to get support from Chart 6.

Chart 6
International Cross-Section
Homicides and Inequality

This theme is at the center of Martin Daly's book *Killing the Competition* (2016). Daly, an animal behaviorist turned homicide researcher, argues that homicide is largely the result of two related animal traits: first is the competition between the "poor" and the "rich" for resources like food, shelter, and security; second is the competition for social position which rests not only on resource acquisition but also on trust and respect. As for the competition over resources, the role of the poor as predator and the rich as prey has been established among a variety of species: few species are sharers like the Bonobo ape, and even Bonobo groups will fight each other for necessities. When one hears that a murder occurred because

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someone was "dissed," it's easy to believe that trust and respect also play a role. But is homicide really a product of inequality in resources and respect?

In 1999 Stephen Leavitt, an economics professor at the University of Chicago, examined homicide data by neighborhood in in Chicago. He found that prior to 1990 income inequality across neighborhoods increased and black victimization declined while white victimization increased—there was a narrowing of what he called the "homicide gap." After 1990 income inequality decreased and the homicide gap widened as black victimization increased and white victimization fell. Leavitt's study supports Daly—when inequality increases, members of poorer neighborhoods shift their predation to members of richer neighborhoods because there is more to be gained; when inequality decreases, the poorer communities return to preying on their own members and the homicide gap widens.

Daly's hypothesis is supported by other psychological research addressing the relationship between inequality and homicide. Much of the analysis is through across-country comparisons in which income inequality is highly correlated with trust among citizens and between citizens and their government. An survey [Elgar and Aitkin, 2010] questioned over 48,000 individuals from different countries on the level of trust they felt existed in their country of origin. The data were then correlated with homicide rates in those countries.[4] The result was a consistent negative correlation between income inequality and trust: when inequality is high, trust is low.

Income inequality has increased in the U. S. over the last two decades. From this we'd predict that if we looked at the relative homicide rates among white (richer) victims and black (poorer) victims, the white-black homicide gap would be narrowing. Chart 5B above shows just this result: as income inequality after 1990 increased black victimization rate fell sharply (though the white victimization rate barely budged).

Levitt's work focused on the difference between victimization rates among white and black communities. It says nothing about the *aggregate* homicide rate, though Chart 5B tells us that the sharp decline in the black homicide victimization rate should show up as a decline in the overall homicide rate. This is borne out by Chart 2 above, showing a significant decline in violent crime rates and murder rates.

Recall that national *time series* data (Chart 2) suggests that income inequality and the rates of violent crimes and murders are inversely correlated over time. However, the *cross-section data* in Chart 6 below suggest the opposite: in a comparison across countries at the same point in time, countries with higher income inequality (measured by the Gini Coefficient) experience higher homicide rates.[5] This inconsistency between time series correlations and cross-section correlations is a common finding in many social science fields, and an unending

[4] Wisely, they focused on *correlations* between homicide and trust, thus avoiding the causation quandary (do homicides cause mistrust, or does mistrust cause homicides?).

[5] The positive relationship in Chart 6 between inequality and homicides across countries is only an *apparent* relationship that should be taken with doses of salt. Bivariate relationships ignore important intermediate variables that can change the result. Also, homicide is defined differently in many countries: in some it includes attempted homicide on the grounds that the intent is what matters, not the result.

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source of confusion because the data seem to support every position. But occasionally some clever academic discovers a way to make the inconsistencies disappear.[6]

[6] In my field—Macroeconomics—the apparent inconsistency between time series and cross-section evidence on personal income and spending on consumers' goods was a "paradox" resolved by Milton Friedman's Permanent Income Hypothesis.

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2. Gun Numbers and Gun Owners

Much has been made of the fact that the U.S. has an unusually high rate of gun ownership: some polls suggest that approximately one-third of households have guns and that another 10 percent would consider owning a gun. This suggests that actual or would-be gun owners are a large minority among adults.

How Many Guns in America? Survey Results

How many guns are there in America? Well, beyond "a whole lot," *we really don't know*. Conventional wisdom is that there is now at least one gun per person—with a 2017 population of 325.7 million this would suggest about 325 million guns.

The 2004 National Firearm Survey [Hepburn et al., 2007] reported that there were 218 million guns when *households* were used as the unit of analysis. But when the *adult population* is used as the unit of analysis, there were 283 million guns: adults are report more guns than households. This is a range of 65 million guns based just on the choice of unit of analysis.[7]

The 2015 National Firearm Survey [Azrael et al., 2017] estimated 265 million guns of all types, of which 53 percent were long guns (rifles and shotguns), 42 percent were handguns (revolvers, pistols and other), and 5 percent were musket loaders and other antiques. The 265 million firearms were owned by 54.7 million adults in 42 million households. In 2014 the U. S. population was 319 million and the a*dult* population was 245 million; this translates to .83 guns *per capita*, 1.1 guns *per adult*, and 6.3 guns *per household*.

What is most surprising in the 2015 NFS report is the extreme concentration of guns: *fourteen percent (7.6 million) of the 54.7 million gun-owning adults held half (132.5 million) of all the guns*; one "super-gunner" respondent reported 140 guns![8] This translates to an average of 17.4 guns per "super-gunner," leaving only 2.8 guns for each of the other 47.1 million gun owners; one super-gunner reorted 140 firearms.. This firearm concentration has interesting implications for the gun debate.

First, as mentioned above, according to conventional logic that *more guns = more homicides*, these super-gunners should be *Masters of Massacre*—they hold, on average, more than 6.3 times the number of guns of "normal" gun- owning adult, and if it is the number of guns that matters, we would expect the super-gunners to show up on the homicide radar. But, with the exception of Richard Paddock in Las Vegas, there is no indication that super-gunners are more responsible for firearm deaths than their less well-armed citizens. We call this the *super-gunner paradox*. Perhaps the notion that more guns means more murders needs more careful thought.

Second, if 50 percent of guns are in non-homicidal super-gunner hands (museums, collectors, avid gun lovers, survivalist camps, etc.), those guns are basically out of the death-gun

[7] Each estimate had a 95% confidence interval attached. For the household data it was 206-235 million guns; for the adult unit it was 260-305 million guns. So the effective estimation range is 206 million to 305 million, a vast chasm.

[8] Private dealers in stolen guns hold many more, as demonstrated by a recent arrest and confiscation of over 3,000 firearms from one person.

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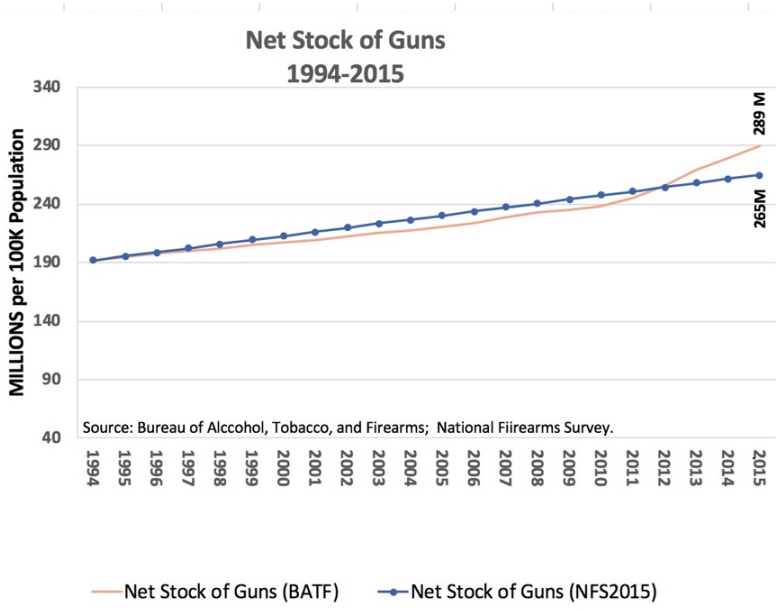
loop. That means that only the remaining 132.5 million guns are in the "dangerous" category, cutting in half the number of guns that might kill. The number of "bad" guns falls from roughly one gun per capita to about ½ gun per capita, not far above Switzerland. This throws the conventional cross-country comparisons of homicides and firearms—a recent cottage industry in the media—into the category false or, at best, misleading. And that's only one flaw in the international comparisons of guns and deaths.

How Many Guns in America? Direct Estimates

Surveys are particularly useful for information on the distribution of guns and the attitudes of gun owners. But we see later in Table 6 that they can generate a wide range of answers about how many guns actually exist.

Fortunately there are also non-survey methods of estimating total guns in America. Annual reports by the Bureau of Alcohol, Transportation, and Firearms (BATF) record the number of guns manufactured in America, the number of guns imported into America, and the number of guns exported to other countries. From these reports the annual *flow* of guns into America's arsenal can be constructed. These BATF data give us the net *additions* of guns in the U.S., not the stock of guns held in each year.

Chart 7



To obtain estimates of the stock of guns we borrow an estimate that in 1994 the total stock of useable guns was 192 million [Cook and Ludwig, 1994]. Adding the BATF flows to the Cook and Ludwig estimate of the gun stock in 1994 gives an estimate of the stock of guns for the period 1995-2015. When calculating the gun stock we should recognize that though guns are highly durable, there is attrition as guns are lost or become damaged beyond repair. Cook and Ludwig use a 1 percent annual attrition rate, implying a 100-year lifetime for the average gun. We follow their lead.

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The net gun stock derived from BATFE annual data is shown in Chart 7 (red line); we also show in blue a straight line drawn between the NFS 1994 and 2015 survey estimates. The two track each other closely unto post-2010, when the BATFE numbers begin to increase at a faster rate.[9] In 2015 the BATFE net gun stock stood at 289 million guns, or .90 guns *per capita*, while the NFS number is 265 million guns, or .83 guns per capita.[10] These results fit with the commonly held view that there is one gun per man, woman and child in America, though the value of that information is reduced by the knowledge that gun ownership in America is highly concentrated.

How do the BATFE and survey estimates of guns compare? The 2004 NFS [Hepburn and Azrael et. al., 2007] and the 2015 NFS [Azrael and Hepburn et. al., 2017] calculated civilian guns at 218 million in 2004 and 265 million in 2015. The Small Arms Survey reported civilian guns at a (very high) 270 million in 2007. A comparison between these surveys and the BATF data is shown in Table 6.

Table 6
Comparison of BATF and Survey Estimates of Net Gun Stock

Year	Surveys	BATF	BATF less Survey
2004	218M (NFS)	218	+ 0M (+ 0.0%)
2007	270M (SAS)	228	- 42M (- 15.6%)
2015	265M (NFS)	289	+ 24M (+ 9.1%)

As expected, the survey and BATF numbers differ, but the greatest difference is between the surveys: BATF and NFS have differences of 10 percent or less, but the SAS survey for 2007 gives a very high estimate: 15.6% more guns than the BATF estimate for that year.

Stolen Guns

Many gun thefts are never reported, and official records of stolen guns are sparse on the subject. As a result, data for lost and stolen guns will understate the numbers. However, the results of periodic surveys—our most common method of obtaining information on the gun world—sheds some light on the issue. The surveys available suggest an alarming number of stolen guns.

Cook and Goss report that in 2005-2010 an average of 232,000 guns were stolen *annually*. Another source places the annual number of guns stolen in 2015 at 500,000 [Azrael et. al., 2015]; that is about 0.2 percent of their estimated national stock of guns Under the assumption that stolen guns remain indefinitely in the illegal gun stock, that rate of gun theft applied to the stock of guns in each year since 1994 amounts to an accumulated 1.7 to 3.4

[9] Some observers attribute this to increased political action threatening the availability of guns during the Obama era inspiring new gun owners or existing gun owners to stock up. Another reason might be increased fear resulting from the widely reported rising frequency of mass murders. A third factor might be the replacement of stolen guns, a matter we turn to soon.

[10] The 2015 population was 321 million.

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million guns stolen between 2005 and 2015; this does not include the legacy stock of stolen guns accumulated prior to 2005.[11]

In the statistical analysis reported later in this paper we find that stolen guns are a strong predictor of both gun homicides and suicides. in fact, stolen guns are the only robust gun-related driver of both homicides and suicides. We will argue that the reason that gun ownership (or any other measure of the stock of guns) appears to explain gun deaths is that the number of guns and the number of stolen guns are highly correlated. As a result, any statistical method that ignores stolen guns will erroneously indicate that the number of guns is the driver of gun deaths. This should come as no surprise when one learns that (at least in Philadelphia) about 80 percent of murderers used a gun they didn't legally own [Fabio, 2016].

Table 7 reports evidence of this misleading correlation. In a state-level cross-section regression of stolen guns on a variety of demographic and socioeconomic variables we see that stolen guns are more common in states with higher income, younger populations, greater black representation, and fewer males per female.

Table 7
OLS Test of Gun-Stolen Gun Linkage
Dependent Variable: Stolen Guns per 100 Adults

Independent Variable	Coefficient	t-Statistic
intercept	+ 4.1963	+ 4.45
Personal Income ($, per capita)	**+ 0.000+**	**+ 7.22**
Median Age (yrs.)	**- 0.0561**	**- 4.66**
Race (% Black))	**+ 0.7579**	**+ 3.05**
Gender (male per female)	**- 0.0352**	**- 4.43**
Guns Owned (per 100 adults)	**+ 0.0090**	**+ 5.05**
F		53.45 (p=0000+)
adjusted R^2		0. 84

Bold-font indicates statistical significance at 5%
Note: Stolen guns are from BATFE reports of firearms stolen annually from FFLs; Guns Owned is the gun ownership rate, a measure of the minimum number of guns per 100 adults

The primary thing to note in Table 7 is that guns-owned are a statistically significant explanatory variable for stolen guns, and that the coefficient on guns-owned indicates a one percent annual theft rate. In 2015, with the national gun stock between 265 and 289 million, the guns-owned coefficient implies 239,000 and 260,000 gun thefts, according well with independent information on the annual rate of gun thefts.

Why Do Americans Own So Many Guns?

International data tell us that Americans hold almost one gun per capita, an extremely high ownership rate. The 2007 Small Arms Survey reported *global* population and civilian guns at 7,130 million and 644 million, respectively, and a world-wide average 9.03 guns per 100

[11] When used in a crime an illegal gun might be disposed of either by the criminal or by law enforcement, moving it out of both the gun stock and the stolen gun stock.

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people. In the U. S. there were a reported 88.8 civilian-owned guns per 100 people. America is a gun-owning society! Why?

It's worth noting that growth in the gun stock is not out of line with growth in real income. Over the 21-year period 1994 - 2015 the BATF estimate of the firearm stock grew at 1.97 percent per year while population grew at a 1.05 percent annual rate; thus, firearms per capita grew at 0.92 percent annually during a period when real per capita GDP grew at 1.59 percent per year. Economists would describe firearms as a "normal good," a product for which the quantity demanded increases with real income. One reason for our increasing gun stock is that we started with a lot of guns and have had increasing real incomes that encourage additions to the gun stock.

But recognition of guns as normal goods only moves the question back one step: Why do Americans see guns as normal goods? Why do they buy more guns as real income increases? The fundamental reasons America has so many guns is, I believe, not economics or theft. It is rooted in history and culture—and it is unique to America. "Culture" is extremely difficult to measure and to pin down as a causal factor, but unlike many other countries with whom we are compared, America has a long and historic connection with citizen-owned guns.

Our gun culture is born of our frontier history during which guns were an essential tool for both survival and conquest, and from our origin in rebellion against a monarchy that exploited its colonies. From the frontier we inherited an affinity for guns as well as, I suspect, a tendency to violence. From the American Revolution we inherited a distaste for monarchy and for the oppression it can bring.

We are not alone in our frontier history. For example, Canada also has a frontier history, but Canada has far fewer guns per capita and its citizens are more willing to accept gun controls. But Canadian and American gun culture was born of different parents. Canada was a frontier for British and French expatriates who remained faithful to their European origins and to the European way of life. Their loyalty to the home countries and to their monarchy brought a European willingness to accept restrictions on weapons.

Europe was forged in a feudal system of fixed social obligations: Lords ruled their areas with impunity, their only obligations were to the King. Those obligations were to pay taxes and to provide troops if the King required them. Those troops were from two social classes: an aristocracy that owed allegiance to the lords and fulfilled their military obligations by maintaining a body of well-armed troops, and hoi polloi, the peasants who worked the Lord's land and, if needed, could be called to battle. The system engendered a fear of revolution from below, a fear that generated division of the right to arms: The King and the lords held the tools of war (swords, war horses, armor, and so on) while the lords owed fealty to the monarch. This included obligations to provide soldiers when the monarch required.

The fear of revolution from below created a social division of arms; it was designed not to reduce violence or to save lives. Rather, controls on the distribution of weapons maximized the nation's ability to engage in military conflicts with competing nations while at the same time minimizing the threat of armed rebellion from within. In short, weapon restrictions by class were a power-preserving strategy. One did not hold weapons that were "above one's station."

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The aristocracy had access to the full range of weapons (armor, war horses, swords, and firearms) while lower classes were restricted in access by both economic factors (weapons were expensive) and by social controls. At the bottom it was pitchforks and other non-military items.

Gun restrictions are a part of European history and embedded in its culture; that Europeans shrug them off and point the finger at America is largely because they had a different path. In sharp contrast, America was born in rebellion against a "tyrannical" European monarchy. It was created by British subjects who rejected the home country in favor of self-determination, who wanted power placed in the hands of "the people," and who were keenly aware that the social control of weapons in Europe reduced the ability to achieve and to maintain self-determination. The process of the American Revolution left behind a solid core of American belief that government—whether monarchy or democracy—should *not* be empowered to disarm the people, that the people *should* be empowered to oppose their government. This was the origin of the Second Amendment and, while many reject that concept, for many others it is bred into the American bone. It is this constitutional protection that our Supreme Court reaffirmed in *District of Columbia v. Heller* (2008), though the court did, quite sensibly, allow for "reasonable" regulation of gun ownership and use.

In short, America has an entirely different history in its approach to weapons. Those who push against that history by declaiming the merits of the European approach to weapons simply ignore the simple fact that history is not something in a book, to be changed when a new edition is issued; it is something in the blood. In these days with the notion of national uniqueness well out of fashion, there seem to be many Americans who want to have "Europe envy."

It seems odd that in these days, when there is so much popular anger against the current president and the quotidian warnings of an emerging Fascist dictatorship are increasing, there are so many Americans who want to sacrifice the right to own guns. Yes, guns are misused—as are automobiles, alcohol, soft drinks, knives, and fists—but guns have become the *cause célèbre* of the unfortunate rush to ban anything we don't want, whether it's supersized soft drinks or AR-15s. This ignores the clear fact that most Americans do not acquire firearms to shed blood as either a murderer or victim; they buy guns as collectors, as aficionados, as gun club members who gather for target and skeet shooting, as hunters, and as residents of remote areas both for protection from large animals and for varmint mitigation.

I have a friend who is an emergency room doctor. He's encountered many motorcyclists who have had fatal accidents. As someone unaware of the pleasures of motorcycles he roundly condemned them. Then I discovered that he had bought a Harley. "Why?" I asked. His answer, "I finally rode one!" Those who detest something that others get pleasure from sometimes overcome their ignorance. [Yes, that was bias!]

Guns and Violence

Chart 8 repeats Chart 2 but with the net gun stock added and with an *index* of each variable replacing the absolute value. In 2015 there were 373.7 violent crimes and 4.9 murders per 100K population. Information that might surprise us is that while the net stock of guns has risen by 34 percent over these 27 years, the population-adjusted rates of both violent crimes

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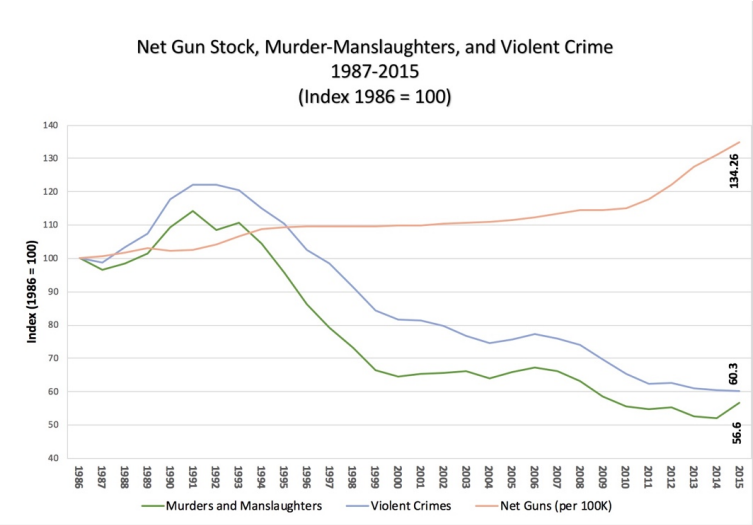
and murders have fallen since 1991 to roughly 60 percent of the 1987 level for both murders and violent crimes.

The decline in violent crimes and murders in the face of increasing numbers of guns is an anomaly for gun critics to address. If more guns cause more violence and murder, why have the rates of violence and murder fallen while the stock of guns has steadily risen. We'll call this the *guns-violence paradox* and add it to the *super-gunner paradox* for later consideration.

Chart 8



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Surveys as an Information Source: Caveats

Data on the number and type of guns in America are typically derived from periodic surveys like the Small Arms Survey and the biennial National Firearms Survey; these are supplemented by surveys conducted by academic researchers and other interested parties. Before we get into gun ownership, let's touch on the good, the bad, and the ugly regarding surveys.

A successful survey uses a random sample and generates randomly selected answers: it fails in this when, even if the sample is random, the respondents willing to answer are not. For example, women tend to be reticent about discussing their guns, and women as a group tend to under-report gun ownership; men tend to brag about their use of guns for self-defense, overstating the survey results for self-defense events. Adults surveyed tend to report more guns owned than the numbers derived from household surveys.

Every survey, even the best designed, involves respondents who give "false positive" or "false negative" answers. If, for example, the question "Do you own a gun" is asked, there will be those who answer "yes" even though they don't, perhaps because they want to support the

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right to own guns; and there will be those who answer "no" even if they do own a gun, perhaps because the gun is not legally owned or simply because it is a contentious question in modern America, or because they don't trust the confidentiality of their answer. We will see that a significant bone of contention between researchers on guns is the balance of false and negatives and positives.

Perhaps a more serious matter is that survey responses are delicately sensitive to precisely how a question is phrased. Here is an example of that sensitivity. Years ago a pair of academic psychologists[12] became interested in the biases that drive individual decisions. They pursued this through the creation of simple experiments that would reveal those biases. In one simple experiment survey respondents were told that a new pharmaceutical for a specific type of terminal cancer has been developed; they were also told the national cost of public provision of the drug to patients with that cancer. Then they were each asked one of two questions:

- Would you support public provision if 20 percent of patients would be saved?
- Would you support public provision if 80 percent of patients would die?

These are obviously exactly identical questions, so respondents would be expected to give identical answers: a "yes" for one question implies a "yes" for the other. But a majority of those asked the first question responded "Yes, I would support paying for the drug because it saves lives," and a majority of those asked the second question responded , "No, I would not support public provision of the drug because so many still die." Tversky and Kahneman called this "framing bias," and it has become a widely accepted anomaly in surveys.[13] The "frame" in the first question is that the drug would save lives, something we all want. The frame in the second question is that the drug would not save lives, something we all *don't* want. 80 percent deaths is bad, 20 percent survival is good! Thus, we respond not to the information given, but to the feelings we attach to that information.

The framing problem has shown up in the gun debate. In the mid-1990s there was a survey about concealed carry of guns. Respondents were asked one of two different questions, each phrased slightly differently. According to my source [Cook and Goss, 2014] those questions were,

- Should ordinary Americans, after proper training, be able to carry a gun on their person? (65% NO)
- Should average Americans, such as yourself, be allowed to get a concealed-carry license for self-protection? (60% YES)

Note that respondents reversed their answers when the question was personalized to be about *them* and when it mentioned self-defense. People felt very differently when they question was phrased in personal terms, not in general impersonal language.

[12] Amos Tversky and Daniel Kahneman won the Nobel Prize in Economics for their work on the intersection between psychology and economics.

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Who Owns Guns, and Why?

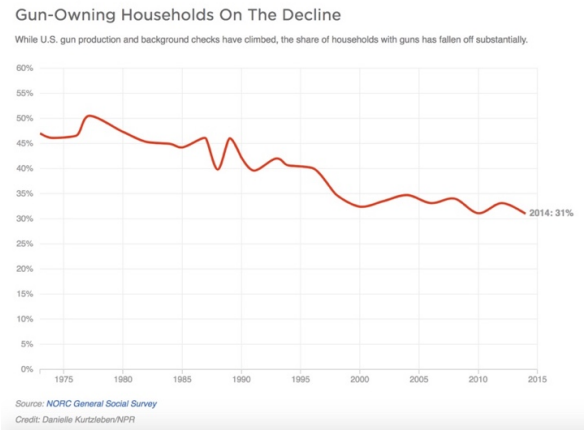
Armed with suspicions about survey results, let's look at what surveys tell us about guns in America. The NFS for 2015 [Azrael et. al., 2017] estimated that 22 percent of adults (31 percent of households) owned a gun.

In 2016 the Pew Research Center, a well-respected survey research organization, produced the following map of gun ownership by region (Chart 9). The unique region of the U.S. is the northeast, with only 27 percent of *households* having at least one firearm. The other three regions have household ownership rates in the mid to high 30 percent range; as expected, the South has the highest rate of gun ownership.

Chart 9

In 2016 the Pew Research Center, a well-respected survey research organization, produced the following map of gun ownership by region (Chart 9). The unique region of the U.S. is the northeast, with only 27 percent of *households* having at least one firearm. The other three regions have household ownership rates in the mid to high 30 percent range; as expected, the South has the highest rate of gun ownership.

Chart 10A



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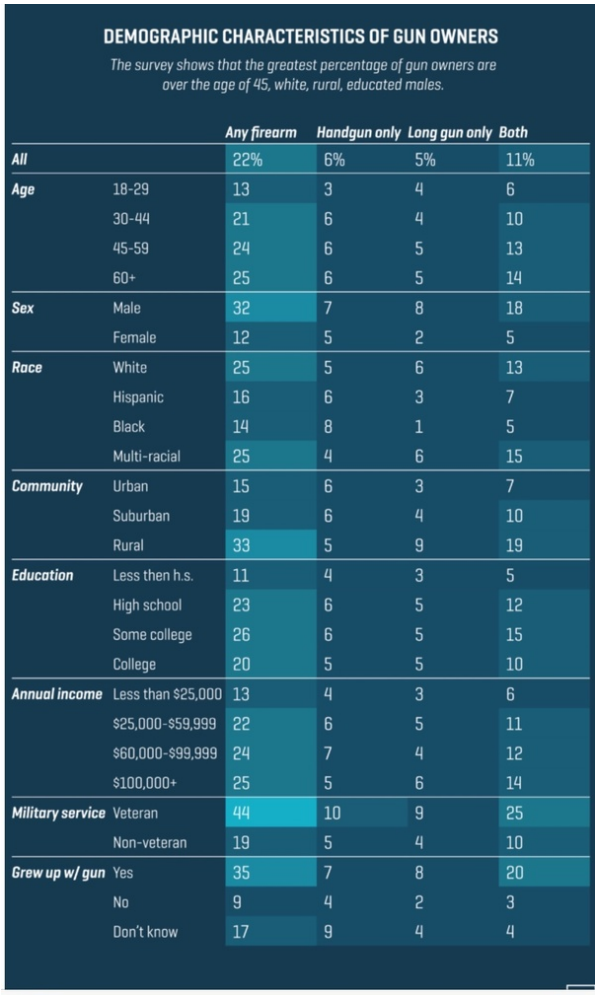
The proportion of households holding guns has been part of the University of Chicago's *General Social Survey* since 1973. Chart 10A above shows a declining trend in the percentage of *households* owning guns from 47 percent in 1973 to 31 percent in 2014. So the picture we get is of an increasing concentration of guns: a rising gun stock is held by a smaller number of households.

Chart 10B



DEMOGRAPHIC CHARACTERISTICS OF GUN OWNERS

The survey shows that the greatest percentage of gun owners are over the age of 45, white, rural, educated males.

		Any firearm	Handgun only	Long gun only	Both
All		22%	6%	5%	11%
Age	18-29	13	3	4	6
	30-44	21	6	4	10
	45-59	24	6	5	13
	60+	25	6	5	14
Sex	Male	32	7	8	18
	Female	12	5	2	5
Race	White	25	5	6	13
	Hispanic	16	6	3	7
	Black	14	8	1	5
	Multi-racial	25	4	6	15
Community	Urban	15	6	3	7
	Suburban	19	6	4	10
	Rural	33	5	9	19
Education	Less then h.s.	11	4	3	5
	High school	23	6	5	12
	Some college	26	6	5	15
	College	20	5	5	10
Annual income	Less than $25,000	13	4	3	6
	$25,000-$59,999	22	6	5	11
	$60,000-$99,999	24	7	4	12
	$100,000+	25	5	6	14
Military service	Veteran	44	10	9	25
	Non-veteran	19	5	4	10
Grew up w/ gun	Yes	35	7	8	20
	No	9	4	2	3
	Don't know	17	9	4	4

Source: Pew Foundation

Women are a small but increasing share of gun owners;[14] the black ownership rate is only half of the white rate, but blacks account for the bulk of homicides by gun; southerners and military veterans are more likely to own guns. The high proportion of military veterans and of men who grew up with guns certainly resonates—those who have used and know guns in youth are the poster children for gun owners.

Surveys also suggest that about 10 percent of respondents who don't already own a firearm would consider buying one, so a safe estimate is that 33-45 percent of American

[14] There is a widely-held view that women underreport gun ownership.

households are either gun owners or fellow-travelers. At this date that seems to put a repeal of the Second Amendment proposed by retired Supreme Court Justice John Paul Stevens, a minority dissenter in the 2008 Supreme Court decision *District of Columbia vs. Heller*, in the group called "non-starter." [15]

Defensive Gun Use (DGU)

Surveys of gun ownership typically ask why a gunowner has guns. The overwhelming majority of gun owners list self-defense as a priority. Those who don't appreciate that the absence of evidence is *not* evidence of absence scoff at this, asking "And when did you ever know someone who *needed* a gun for self-defense?"

While gun advocates say they hold guns for self-defense, gun critics object to self-defense as a reason for holding guns on two grounds. First, it is argued that a self-defense event is extremely rare, a questionable belief given the range of estimates we'll encounter below. Second, it's said that use of a gun for self-protection will often lead to the gun owner's death or injury, so it's in society's interest to protect the gun owner from himself.

We'll first look at the question, "Is Defensive Gun Use (DGU) really so rare?" Serious researchers have looked into the frequency of DGUs. The only recorded sources of DGU information are police reports and victimization surveys like the National Criminal Victimization Survey (NCVS), conducted by the Justice Department. Police records rely on self-reporting and, depending on the severity of the event, there is a strong tendency to not report—a DGU with a dead offender will be more likely to be reported because the deed will become evident; a DGU in which a gun was simply shown to the offender who then peacefully left the scene is less likely to be reported, particularly if it occurs on the street and not in the victim's home: street display of a gun requires a concealed-carry license. So one might expect substantial false negatives that weigh against the false positives and bias NCVS-reported DGUs downward.

The political stakes in the debate are high. If DGUs are rare, the NRA-style argument that guns are required for self-defense can be heavily discounted and the road to stricter gun controls is wider; if guns are a meaningful tool for self-defense, the road to a gun ban will be narrower. The most intense participants in the debate on DGUs are Gary Kleck, a criminologist at Florida State University, and David Hemenway, an economist and faculty member at Harvard's School of Public Health. Hemenway is a strong advocate of counting DGUs via victimization reports, a position that yields a low DGU count. Kleck, on the other hand, is in a survey-oriented field and relies on surveys as the method of research. This difference in training and orientation may be at the heart of the vituperation in the debate.

The controversy began in 1995 when Kleck and a colleague published the results of the National Self-Defense Survey [Kleck and Gertz, 1995], in which 5,000 respondents were contacted at randomly selected phone numbers and questioned about DGUs. Kleck's survey, blown up to national size, reported an annual 2.5 million DGU events. This is wildly above—33

[15] Repeal of a Constitutional Amendment requires a two-thirds approval in each House of Congress and a majority approval by three-quarters (38 states) in a constitutional convention called by two-thirds (34) of the fifty state legislatures. Each state has one vote.

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times higher—than the 65,000 annual DGUs reported by the NCVS, and it brought Hemenway out of his corner to become Kleck's leading critic. Indeed, the "debate" between them became a mirror image of the entire gun debate, with charges of incompetence flying back and forth, yielding much heat but little light. Both have notable supporters and notable critics.

Hemenway charges that Kleck's survey did not attempt to address the problem of "false positives." For example, a braggart's exaggerated report of a DGU was treated as a real DGU. He also claims that the NCVS reports are *ipso facto* superior to Kleck's surveys because of the false positive problem.[16] This theme has been picked up by other respected researchers like Phillip Cook at Duke University and John Lott at Yale University.

Kleck responds that there are false positives in any survey, but there are also false negatives—respondents who don't report a self-defense event, perhaps because the DGU was resolved successfully without injury and the victim feared legal complications from reporting the event. He notes that nobody can know what the balance of false negatives and positives is, so criticism on that grounds is not constructive until additional information is found.

Until very recently there was a stalemate, allowing each side to choose its own estimates of DGUs. But in June of 2018 that stalemate was upset when Kleck reported that he had, by accident, uncovered unpublished surveys done in the late 1990s by the Center for Disease Control (CDC). For the first time, explicit questions about DGUs were included as part of a new Behavioral Risk Factor Surveillance System.[17]

It was a shock to the gun research community that the federal government had been doing Kleck-style research after Kleck's 1995 paper, but the earthquake came when the results of those CDC surveys were announced—they supported Kleck's estimates of DGUs! It's unclear why the CDC didn't report the findings, but the answer might lie in Congressional restrictions on federal gun research.[18]

Table 8
Evidence on Injuries in Self-Defense Events

Victim Action	Number [1]	% [1]	Victim Injury [2]
No Resistance	6,375,500	38.7 %	
Resisted with Firearm	175,500	1.1 %	2.4 %
Resisted with Other Weapon	304,800	1.8 %	1.7%
Resisted with No Weapon	4,005,500	24.3 %	3.6%
Passive Resistance (argue, etc.)	4,887,400	29.6 %	---
Other	743,700	4.5 %	---
Total	*16,492,600*		

Source: 1 Tark and Kleck, 2004, Table 7, col. 4.

[16] Hemenway also criticized Kleck's survey for some statements made that Hemenway felt were wildly inconsistent with the records. For example, Kleck reported that 50 percent of respondents said they had made a police report, but police records show nothing near that level of DGU reporting.

[17] The NCVS does not directly ask about DGUs. Only after a respondent brings it up does the NCVS protocol allow the questioner to pursue the nature of a DGU.

[18] In 1996 the Dickey Amendment was attached to the federal spending bill approved by Congress. That amendment prohibited the use of federal funds for advocating gun control. It's effect might have been to chill any interest in gun control-related research. In 2018 the Dickey Amendment was clarified to bar any research for gun advocacy but not to bar research into gun violence.

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As noted above, the second reason gun critics object to using guns for self-defense is that even if DGUs are not rare, a gun owner is likely to be injured or killed when he shows a gun. Once again, Kleck was point man on this issue. In a paper published in 2004 he and a graduate student used a decade of NCVS reports to investigate the frequency of injury to victims who resist an offender.[19] Table 8 is the result.

There were a total of 16.5 million victimizations counted, of which over 9.4 million involved some form of resistance ranging from firing a gun to passive resistance like arguing and cajoling. There were 175,500 reports of a DGU—an average of 17,000 per year, very close to a popular estimate [Cook and Goss, 2007] that the odds of a gun owner actually using a gun for self-defense are 1-in-3,500: with 55 million adult gun owners, that means about 16,000 self-defense uses per year. Of course, the Cook and Goss number might be taken from the same NCVS data discussed earlier, in which case it's no surprise that the annual DGU numbers would be almost identical.

What is interesting is that *victim* injuries were *more* likely when weaponless resistance was used (3.6%) than when a weapon was used; also, if a weapon was used the chance of injury was about the same whether it was a firearm (2.4%) or some other weapon (1.7%).

So where does the DGU debate stand? Kleck does not capitulate on his estimate that 2.5 million DGUs occur every year, and after dredging up the hidden CDC surveys he has little reason to recant. He still maintains that the NCVS estimates seriously under-report actual defensive gun use—he puts NCVS estimates of DGUs at about 64,000 per year while his review of 19 survey-based studies of DGUs yields estimates ranging from 760,000 to 3.6 million DGUs annually, a very wide range that includes Kleck's original number. It appears that there are a substantial number of DGUs each year—far more than reported by the NCVS—but the range of estimates is very wide.

[19] What was careful about this study was that it was based on victimization reports and it coded events twice, first as a victim injury *before* self-defense was used, and second as victim injury *after* self-defense was initiated. This was done in an attempt to distinguish between events in which the victim was harmed before offering resistance and events occurring after resistance; only the latter can be called harmful as a result of self-defense. They found that many injuries had already occurred *before* any resistance was made—the offender came in ready to put the victim down and out.

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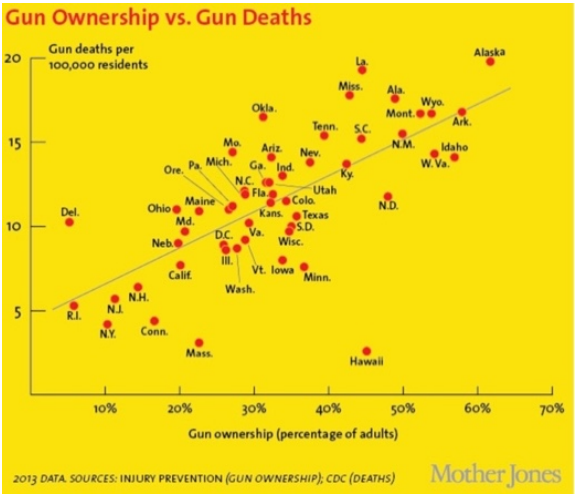
3. Statistical Analysis: Guns and Deaths

The evidence on the connection between the number of guns and the homicide rate is murky, at best. Some believe that the plethora of guns in America is a significant predictor of gun-related deaths. Consider Chart 11, taken from *Mother Jones Magazine*. Mother Jones is hardly unique in its approach to gun deaths and guns: it is simply one example of a cottage industry of statistics-abuse in the gun debate, an example of the thinking behind the popular linkage of gun deaths and guns.

Chart 11



Source: Mother Jones

The chart tells us that those states with greater gun ownership experience greater gun deaths. As we'll see, this is a questionable conclusion even on its face, and especially in light of other factors excluded by *Mother Jones* that affect gun deaths.

Parsing Mother Jones

A contention of this study is that the primary culprit in American homicides is not the number of guns, it is the number of *stolen* guns. The reason that the number of guns gets the honors is that stolen guns and gun ownership are highly correlated. When Mother Jones and its readers follow the herd and use simple correlation to attribute gun deaths to gun numbers, they are, inadvertently or not, shifting attention from the true problem of stolen guns to a correlated proxy.

Table 9 supports this correlation using state cross-sectional data in a multivariate regression of the number of stolen guns per 100 adults on state demographic and socioeconomic variables and on the gun ownership rate per 100 adults. Variables listed in bold font are statistically significant at the 5% level. We find that stolen guns are more common in

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states with higher personal income, younger median age, a larger black population, fewer males, *and greater gun ownership*. The coefficient on "guns owned" implies a one percent *annual* gun theft rate: for every 100 guns in the national gun stock, one gun is stolen *each year*. In 2015 there were an estimated 265 million guns so Table 9 implies 265,000 stolen guns. This fits well with the estimate of 232,000 guns annually in [Cook and Goss, 2014].

Table 9
OLS Test of Gun-Stolen Gun Linkage
Dependent Variable: Stolen Guns per 100 Adults

Independent Variable	Coefficient	t-Statistic
intercept	+ 2.1941	+ 1.39
Guns Owned (per 100 adults)	**+ 0.0103**	**+ 5.09**
Personal Income ($, per capita)	**+ 0.0002**	**+ 5.08**
Median Age (yrs.)	**- 0.0445**	**- 3.81**
Black Population (%)	**+ 1.0454**	**+ 3.29**
Gender (male per female)	**- 0.0232**	**- 2.19**
Urbanization (% of population)	+ 0.3433	+ 1.68
Inequality (Gini Coefficient)	+ 0.7130	+ 0.63
adjusted R^2		0. 85

Bold-font indicates statistical significance at 5%
Note: Stolen guns are from BATFE reports of firearms stolen annually from FFLs.

Mother Jones errs in several other ways. First, Chart 1 connects total gun deaths with the number of guns, but gun deaths consist of both homicides and suicides. When separated, the effect of guns is very different for each, as is seen in Chart 12A and 12B; in particular, homicides do not appear to be correlated with the number of guns but suicides are. This suggests that each type of gun death has a different set of causes.

Chart 12A

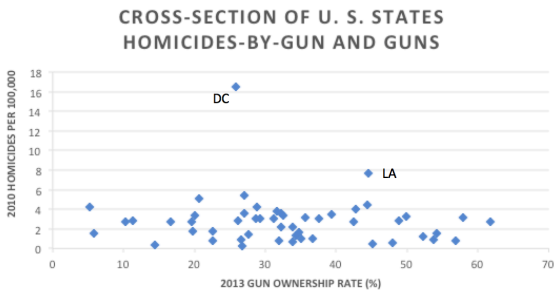
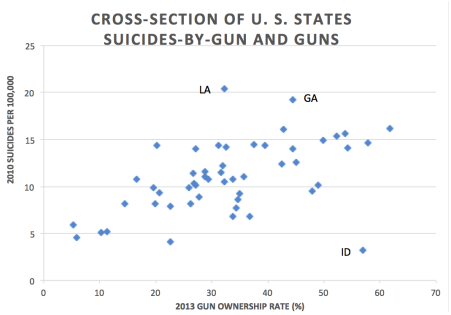


Chart 12B



Source: Author's Calculations.

Using charts like those above to "demonstrate" the effect of guns on deaths reflects a confusion between correlation and causation. Even if we find that guns and gun deaths are highly correlated we still have no information on the essential element in the linkage: causation: does gun ownership *cause* gun deaths or is it *caused by* gun deaths (as when citizens

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in high- death rate states buy guns for protection).[20] There are statistical methods to address the causation problem but even those can never settle the debate with certainty; still, ignoring the causality problem is not an answer.

Yet another problem with Mother Jones-like analysis is the assumption that any linkage between guns and deaths is bivariate. Both guns and deaths will have multiple drivers, and ignoring the multivariate nature of the linkages can lead to very significant errors in analysis. For example, we will see later that stolen guns have a number of drivers other than gun ownership: income, age, race and gender all affect the number of stolen guns. With multivariate methods we are able to hold those other drivers constant and isolate the *partial* correlation between stolen guns and gun ownership; and partial correlation, not total correlation, is what matters.

Teasing Out the Independent Effect of Guns

If simple associations (correlations) between variables don't allow us to determine the independent effect of guns, how can one go about establishing causation? The answer is, generally, it can be done *under certain circumstances* with statistical methods like multivariate regression or similar correlation-based techniques; we will explore that soon. But correlations are a characteristic of numbers, of statistics, while causality is meta-statistical concept embedded in the way the world works. Causality is about the subterranean linkages between variables that might show up as correlations but not as overtly causal.

The most effective way to extract information about causality from data is through the observation of a "natural experiment" in which one variable changes by design or by chance and we follow the subsequent effects. For example, if one city suddenly bans guns and another city makes them mandatory, you have a natural experiment to tell you what happens when gun availability is independently changed.

And yes, that precise experiment is available, well, sort of, in a way. . . And it has received great attention because of its implications for causation. In the early 1980s two small towns—Kennesaw, Georgia (an Atlanta suburb) and Morton Grove, Illinois (a Chicago suburb)—changed their ordinances regarding gun ownership.[21] In 1981, a Morton Grove ordinance banned all handguns in its jurisdiction; in 1982, in reaction to Morton Grove, the Kennesaw city council passed an ordinance mandating that every head of household own a gun.[22] The Morton Grove ordinance was heavily litigated but stayed in effect until 2008.[23] The Kennesaw ordinance was never contested and is still in effect.

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[20] Long ago an apocryphal study found a surprisingly strong positive correlation between the price of rum and the salaries of preachers. Were highly-paid preachers buying too much rum and driving the rum price up? Or were preachers getting better compensation when rum prices rose? Obviously, neither—the answer was that a third variable, general inflation, was driving both rum prices and salaries upward.

[21] Kennesaw's population was 5,400 in 1982; it is now over 30,000. Morton Grove had about 23,000 residents in 1982; it is now slightly smaller.

[22] Much later, in 2013, the town of Nelson, Georgia—near Kennesaw—adopted a Kennesaw-type rule but this was quickly contested and rescinded within the same year.

[23] The Morton Grove ordinance was heavily litigated. It was immediately contested and upheld in 1982 by a U.S. District judge; on appeal it was upheld in 1984 by the Illinois Supreme Court; it remained in effect until the U. S. Supreme Court 2008 decision in *District of Columbia v. Heller*.

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Early predictions were that Morton Grove would experience a drastic increase in crime rates while Kennesaw's crime rates would plummet. As a side note, Art Buchwald—the Al Franken of his day—predicted that Kennesaw would experience a blood bath as its citizens murdered each other. So what happened?

Regrettably, neither of these actions were the controlled experiment of a statistician's dreams: both were intended as symbolic acts of sentiment rather than ordinances to be enforced. In Kennesaw an estimated 70 percent of households already had a gun, so the ordinance was *de jure* recognition of the *status quo*; the town did not force residents to buy guns and the ordinance had no impact on gun ownership. in Morton Grove there was no effort do remove guns from those who already owned them. In fact, neither Georgia nor Illinois require gun registration so there was nothing to define gun-owning residents.

Because neither changed the status quo, the only basis for expecting any change in crime rates was the possibility of an *announcement effect*: as news of the ordinance spread, evildoers would be less active in well-defended Kennesaw and more active in helpless Morton Grove.[24] But this "announcement effect" would operate only if criminals were ignorant of the fact that nothing had really changed in either town. While this is a distinct possibility—we've seen that in surveys people don't even know when exactly the same question is asked twice but in different "frames"—basing a test on the stupidity of the participants is questionable.

All we know for sure is that Buchwald was wrong. There are no known crime records for that period in Morton Grove, but the mayor has been quoted as saying there was no change in crime and none had been expected—it was a symbolic gesture. For Kennesaw the results are murky. The available FBI Uniform Crime Reports go back only to 1985 and can tell us nothing about the immediate effects of the Kennesaw ordinance. However, *Snopes.com*—the internet's arbiter of fact and fiction—reports that in 1981 there was a burglary rate of 10.14 per thousand residents (55 incidents). This fell to 4.79 (26 incidents) in 1982 and to 2.0 (11 incidents) in 1985. This 80 percent drop in the burglary rate was far greater than the 13 percent drop for the state from 1981 to 1985.[25]

No good fact goes uncontested. A study completed in the late 1980s [MacDowell, David, 1989], when data might have been fresh and available, argued that the 1981 Kennesaw burglary rate was unusually high in 1981 and that the decline in burglaries afterward was an artifact of the unusually high starting number. Examining data over a longer period around the 1982 change, McDowell found no change in Kennesaw's burglary rate. We are back where we started, with no "experimental" evidence on guns and crime.

Cross-Section Data by State

The data and their sources are summarized in the Statistical Appendix at the end of the text. There is a single cross-section of state-level data for the years 2010 to 2013; comparable

[24] In 2013 the town of Nelson, Georgia—near Kennesaw—adopted a Kennesaw rule but this was quickly contested and rescinded within the same year.

[25] The Kennesaw burglary numbers are plagued by the "small numbers" problem: in a small town like Kennesaw the annual burglary rate is likely to be highly variable.

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data could not always be found for the same year, but the use of different years for different data should make little difference because the rankings state level data do not change dramatically within a year or two.

It will come as some surprise that *while important matters rest on the number of guns in America, and while we have reasonably good estimate of the national stock of guns, we have no direct data on the distribution of the national stock of guns across states.* Surveys give us information on gun ownership—the percentage of adults in a state that own at least one gun—but without data on the average number of guns held by a state's gun-owners we can't compute the state-level *number* of guns.

Why don't we have a better understanding of the state-level distribution of guns? An important reason is that federal law bars registration of guns at the federal level if it would record owners' names and addresses, which is, of course, the essential purpose of registration. However, individual states do have the power to require registration, and a variety of postures have been adopted: eight states specifically prohibit registration (DE, FL, ID, PA, RI, SD, VT), two states require it (HI, DC), and one state requires it but only for handguns (NY). The remaining forty states have no form of gun registration.

As a result of this gap, *all* studies that report a connection between the number of guns in a state and gun deaths are using some *proxy* for the number of guns. The gun ownership rate—gun owners per 100 adults— is a common proxy for the number of guns but it falls short of gun spread by ignoring the variation in adult population across states. But what proxies are available for gun density?

In what follows we refer to the gun ownership rate—the proportion of adults in the state that own at least one gun—as *Gun Spread* because it measures the minimum number of guns in the state (it is guns per 100 adults, so if each gun-owning adult has just one gun it also measures the number of guns); it also measures the spread of guns across the state's population.

Gun Spread does not measure the number of guns in the state because it doesn't capture multiple gun ownership—most gun owners have more than one gun. This second aspect of guns is called *Gun Density*—it is the average number of guns per gun owner. For example, we've seen that in 2015 there were an estimated 265 million guns and 54.7 million gun owners in U.S. Thus, U. S. gun density was 4.8 guns per owner.

But we have no precise measures of gun density at the state level. We know that gun density across owners is highly variable (remember the super-gunners?), and we suspect that it is highly variable across states as well. We have adopted a proxy for gun density: the number of License-to-Carry (LTC) permits issued in a state; the underlying assumption is that owners with a LTC are more likely to hold multiple guns.[26] So when we refer to gun density we really mean LTC permits.

[26] We experimented with another proxy: guns registered at the BATFE. It seems obvious that anyone holding a BATFE-registered gun (an automatic firearm like a machine gun or machine pistol, a short-barrel shotgun or rifle) is likely to hold multiple guns. The results were similar to the LTC proxy but fell afoul of outlier problems. For example, the proxy value for Wyoming was very high (25 guns per 100 adults, about ten times the national average) giving Wyoming—a high suicide state) a high weight in explaining suicides.

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Multivariate Analysis of Guns and Gun Deaths

Table 10A reports a simple Ordinary Least Squares (OLS) regression of homicides-by-gun and suicides-by-gun on *Stolen Gun*s (measured by firearms reported to the BATFE by Federally Licensed Gun Dealers, or FFLs), on *Guns Spread*, and on *Gun Density*. Homicides are driven only by stolen guns; neither gun spread nor gun density matter. Suicides are more complex: both stolen guns *and* gun density are statistically significant.[27] plays no role in homicides. or suicides by gun (though it comes close for suicides).

The results in Table 10A provide a benchmark measure of the effects of gun-related variables on homicides and guns: homicides are driven only by stolen guns; suicides are driven by stolen guns and gun density; as with suicides, gun spread plays no significant role.

The remainder of this section is devoted to pursuing avenues that might *un*settle those results. Essentially, we are asking "Why might those results be incorrect?" If we can find no basis for rejecting Table 10A, it will stand as our evidence on gun-related variables and gun deaths.

Table 10A
Ordinary Least Squares Regressions

	Dependent Variables			
Independent Variable	**GUN HOMICIDES per 100K**		**GUN SUICIDES per 100K**	
	Coefficient	***t-Statistic***	***Coefficient***	***t-Statistic***
Intercept	**+ 2.3739**	**+ 4.11**	**+ 5.6368**	**+ 1.12**
Stolen Guns (per 100 adults)	**+ 8.0909**	**+ 5.95**	**+ 1.5644**	**+ 2.64**
Gun Spread (per 100 adults)	+ 0.0042	+ 0.23	+ 0.0607	+ 1.74
Gun Density (per 100 adults)	- 0.0480	- 1.15	**+ 0.2086**	***+2.58***
F (p-value)		*13.11 (p=0.0000+*		*3.20 (p=0.035)*
Adjusted R^2		*0.32*		*0.12*

Bold face text shows statistically significant variables (5%).
Variables: Stolen guns are from BATFE reports of firearms stolen annually from FFLs; Gun Spread is gun ownership per 100 adults, Gun Density is LTC permits issued.

The exclusion of exogenous demographic and socioeconomic variables from Table 10A might have affected the results. If the gun-related variables are correlated with the exogenous variables, the exclusion might give the gun-related variables statistical significance because they are stand-ins for the exogenous variables

Table 10B adds seven socioeconomic and demographic variables. While some of these exogenous variables are statistically significant suicide-drivers, none are significant for homicides. More importantly, the significant gun-related variables in Table 10B are the same as those that are statistically significant in Table 10A: the presence or absence of exogenous variables does not alter the effect of our gun-related variables. to the gun-related drivers.

[27] The reason that stolen guns affect suicides is not clear. Perhaps stolen guns reflect the laxity of gun management at home and the ease with which impulsive and disturbed residents can obtain guns.

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Table 10B
Ordinary Least Squares Regressions

Independent Variable	Dependent Variables: GUN HOMICIDES per 100K *Coefficient*	GUN HOMICIDES per 100K *t-Statistic*	GUN SUICIDES per 100K *Coefficient*	GUN SUICIDES per 100K *t-Statistic*
Intercept	-17.8834	-0.46	+ 93.7323	+1.40
Personal Income (per capita)	-0.0001	-0.83	**- 0.0006**	**-2.21**
Income Inequality (Gini)	+17.1784	+0.61	**-119.1820**	**-2.46**
Median Age (Years)	+ 0.2247	+0.71	- 0.1700	-0.31
Race (% Black)	+0.7339	+0.09	- 14.3557	-0.99
Urbanization (percent)	- 4.4866	-0.90	- 4.6847	-0.54
Gender (Males per 100 Females)	+ 0.1113	+0.42	+ 0.0163	+0.03
Unemployment (%)	+ 0.2812	+ 1.78	- 0.2251	-0.82
Stolen Guns (per 100 adults)	**+ 9.2983**	**+2.57**	**+ 18.6830**	**+2.98**
Gun Spread (per 100 adults)	- 0.0522	-0.85	- 0.1196	-1.12
Gun Density (per 100 adults)	- 0.0502	-1.11	**+ 0.2045**	**+2.62**
F-Statistic (p-value)		*5.08 (p=.0000+)*		*3.44 (p=0.0025)*
Adjusted R^2				*0.33*

See notes for Table 10A

The inclusion of demographic and socioeconomic variables does not alter the results of Table 10A, though it does add some additional information: the additional variables are not statistically significant drivers of gun homicides: only stolen guns matter. Suicides, on the other hand, do appear to have socioeconomic drivers: high personal income and high income inequality appear to reduce the suicide rate.

Endogeneity, Exogeneity, and Simultaneity Bias

A second statistical issue that might affect the results in Tables 10A and 10B is the possibility of "simultaneous equation bias" in the OLS estimates. The method of Ordinary Least Squares assumes that all variables on the right-hand side (RHS) of an equation are exogenous—their values are determined independently of the value of the endogenous variable on the LHS. Stated differently, no feedback mechanism exists so that, say, a random change in homicides or suicides (with the RHS variables unchanged) affects gun deaths. This is the essence of the caveat that "correlation does causation."

Do homicides or suicides affect gun-related variables as well as be affected by them? Is causality a two-way street? To address this we must specify an explicit dynamic model that relates the endogenous variables to exogenous variables and to each other. Our model is shown in Box 1. There is one *definitely endogenous* variable, y_1 (gun deaths, either homicides or suicides), there is also a set of *definitely exogenous* variables denoted by the matrices marked **X**.

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Box 1

A Simple Dynamic Model

Simultaneous Equations Model

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Gun Deaths (y_1): $y_1 = \mathbf{X_1}\beta_1 + \gamma_{12}z_2 + \gamma_{13}z_3 + \gamma_{14}z_4 + u_1$

Stolen Guns (z_1): $z_1 = \mathbf{X_2}\beta_2 + \gamma_{21}y_1 + \gamma_{23}z_3 + \gamma_{24}z_4 + u_2$

Gun Spread (z_3): $z_3 = \mathbf{X_3}\beta_3 + \gamma_{31}y_1 + \gamma_{32}z_2 + \gamma_{34}z_4 + u_3$

Gun Density (z_4): $z_4 = \mathbf{X_4}\beta_4 + \gamma_{41}y_1 + \gamma_{42}z_2 + \gamma_{43}z_3 + u_4$

Note that the exogenous variables in the matrices $\mathbf{X_1}$ ... $\mathbf{X_4}$ will be different, hence the difference in subscripts. In fact, if you plan to estimate all the equations in the model this difference is necessary because of the *identification problem*: a necessary condition for identification of the parameters in any of the equations is that the number of exogenous variables *excluded* from an equation is at least as great as the number of endogenous RHS variables that are included in the equation. We have three potentially endogenous RHS variables, so estimation of the gun deaths equation requires that there must be at least three exogenous variables available that are *not* included in $\mathbf{X_1}$. Our estimation of the gun-deaths equations satisfies the identification requirement.

In the model we have three *potentially endogenous* variables; z_1 (stolen guns), z_2 (gun spread), and z_3 (gun density); each of this might be either exogenous (an *x*) or endogenous (a *y*). If these potentially endogenous variables are in fact exogenous (can be classifies as *x*'s) then the OLS equations for gun deaths in Tables 10A and 10B are the end of the story. But if any of those potentially endogenous variables is endogenous (can be classified as a *y*), OLS of the gun deaths equation will generate biased estimates.

So the first task is to determine whether any of the three potentially endogenous variables are actually endogenous. One often-used exogeneity test is the Hausman Test, outlined in the statistical appendix. Its implementation is straightforward. First, separately regress each of the three gun-related variables (the z's) on all definitely exogenous variables, being mindful of the identification requirement; save the fitted values and the residuals from each of these "first-stage" Hausman-test regressions.

Second, estimate the gun deaths equations by regressing y_1 (gun deaths, homicides or suicides) on all of the variables in the gun deaths equation including the gun-related variables *plus* the residuals from the three gun-related equations estimated in the first stage.[28] Any statistical significance of these residuals in this "second stage" regression indicates a sufficiently high probability that endogeneity is present to cause rejection OLS results and pursue further corrective action. The t-statistics will be a guide to which of the gun-related variables are endogenous.

[28] In this second-stage regression you can use *either* the fitted values \r the residuals from the first-stage regressions.

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Table 11A
First Stage, Hausman Exogeneity Test

List of Known Exogenous Variables	Dependent Variables: Stolen Guns Coefficient (t-stat)	Gun Spread Coefficient (t-stat)	Gun Density Coefficient (t-stat)
intercept	+ 1.12 (+0.57)	- 104.2 (-0.89)	+59.95 (+0.76)
Personal Income ($, per capita)	**+ 0.00+ (+3.21)**	- 0.00+ (-1.58)	+ 0.00 (+0.32)
Inequality (Gini Coefficient)	+ 1.70 (+1.22)	+96.04 (+1.15)	- 7.22 (-0.13)
Median Age (yrs.)	**+ 0.05 (-3.77)**	- 0.95 (-1.10)	- 0.59 (-1.01)
Race (% Black)	**+ 1.14 (+2.87)**	+ 8.80 (+0.37)	- 1.14 (-0.07)
Urbanization (% of population)	- 0.12 (-0.55)	**-45.69 (-3.35)**	- 0.88 (-0.10)
Gender (male per female)	-0.00+ (-0.32)	**+ 1.86 (+2.53)**	- 0.36 (-0.71)
F(6,44)	26.72 (p=00+)	46.60 (p=.00+)	0.60 (p=0.73)
adjusted R^2	0.75	0.85	-0.05

Bold-font indicates statistical significance at 5%
Variables: Stolen guns are from BATFE reports of firearms stolen annually from FFLs; Gun Spread is gun ownership per 100 adults, Gun Density is LTC permits issued.

Table 11B
Second Stage, Hausman Exogeneity Test

	Dependent Variables: Homicide Rate Coefficient (t-stat)	Suicide Rate Coefficient (t-stat)
intercept	-2.3059 (-1.33)	**+ 84.3600 (+3.57)**
Personal Income	**----**	- 0.0004 (-1.55)
Income Inequality	**----**	**-140.1755 (-2.80)**
Unemployment	**+0.4481 (+2.88)**	**----**
Stolen Guns	**+9.2983 (+2.66)**	+ 18.6830 (+3.01)
Gun Spread	*- 0.0522 (-0.87)*	- 0.1200 (-1.12)
Gun Density	- 0.0502 (-1.15)	**+0.2045 (+2.64)**
Stolen Guns (Stage 1 Residual)	- 1.0583 (-0.28)	-5.3147 (-0.66)
Gun Spread (Stage 1 Residual)	+ 0.0621 (+0.99)	+0.0788 (-0.68)
Gun Density (Stage 1 Residual)	+ 0.1767 (+1.53)	+ 0.6577 (+0.23)
F(6,45)	7.65 (p=0.0000+)	4.19 (p=0.001)
adjusted R^2	0.48	0.34

Bold-font indicates statistical significance at 5%
Variables: Stolen guns are from BATFE reports of firearms stolen annually from FFLs; Gun Spread is gun ownership per 100 adults, Gun Density is LTC permits issued.

Table 11A reports OLS regressions of the three potentially endogenous gun-related variables on the six exogenous variables characterizing demographic and socioeconomic conditions; these are the Hausman first stage regressions. The residuals from each of those equations were saved and are among the explanatory variables in the second stage regressions reported in Table 11B.

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Table 11B reports the second stage of the Hausman test. Homicides are regressed on gun-related variables and their associated first-stage equation residuals.[29] The results labelled "First Stage Residual" show no statistical significance, indicating that all three gun-related variables pass the exogeneity test.

The Hausman Tests indicate no statistical evidence for feedback from gun deaths to gun-related variables, a feedback that would taint the OKS regressions reported and require further analysis. In the case of guns and gun deaths, correlation ***is*** causality.

[29] Table 4B shows no significant effect of any exogenous variables, i.e. $\beta_1 = 0$, so they can be excluded from the homicide equation in Table 5B. Note that because no X-variables affected gun density (see equation 5A), actual gun density and the gun density error from Table 5A cannot both be included in Table 5B. Still, gun density appears to be exogenous,

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4. Gun Controls

The statistical analysis in the previous section of this study concludes that after adjusting for several demographic and socioeconomics variables that might affect gun deaths, the security of our national stock of guns is of primary importance: an estimated 230,000 to 500,000 gun thefts each year is a constant source of guns for illegal activities. It is through this back door that the illusion of "more guns mean more deaths" is formed. Gun owners who leave guns loose in their homes or cars are feeding both gun theft and homicides.

There is little to be done about the legal gun owner who commits an unjustifiable homicide or commits suicide with a firearm. Each is outside the limits of law, and laws haven't proven to be a successful deterrent. However, many misuses of guns among normally law-abiding gun owners, and many thefts, might be prevented if firearms are properly secured. Perhaps public policies can thwart the gun thief, the purchaser of a gun in an illegal transaction, the family member who takes an unsecured gun and uses it for homicide or suicide, or the family member who allows others access to guns without direct supervision.

Some Gun Control History

Washington D. C. has had among the most restrictive gun laws in the U. S. Implemented in 1975, the D. C. law prohibited ownership of handguns acquired in 1976 or later. The law also required that all rifles and handguns be stored unloaded and either disassembled or have the trigger locked. In addition, certain types of ammunition were restricted.

In 2003 the law was contested in the courts and in the Supreme Court's 2008 decision the Chicago ban was overturned; in 2010 the restrictions on ammunition were also overturned; the city then prohibited any ammunition purchases by unlicensed gun owners. Other gun policies like microstamping of bullet casings and maintenance of ballistics records for every firearm have been proposed but never adopted.

Chart 13A reports the homicide rate in D. C. and in the U. S. from 1960-2014. It seems clear that during the period of enforced gun controls there was no lack of homicides. The peak homicide rate (80 per 100K population) was reached in 1991 after a long period of gang warfare and drug-related murders. The rate plunged thereafter in company with a much milder sag in the national homicide rate. The failure to contain the murder rate during a period of strict gun controls is an indication of the prevalence of illegal guns during the gang wars.

In 1982 Chicago instituted a handgun ban that grandfathered handguns registered before the ban; those handguns were initially required to reregister every two years; the reregistration requirement soon became annual. The Chicago handgun ban continued even after *District of Columbia vs. Heller*, but it was removed with the 2010 Supreme Court decision on *McDonald vs. Chicago*. Chicago then allowed handgun ownership if the owner was licensed and had completed a firearms training course including live fire; however, it refused to approve any firing ranges within the city limits.

Chart 13B shows the Chicago homicide rate in 1960-2013. The handgun ban appeared to have little, if any, effect after it was adopted, and in 1991 a homicide spike like that in D. C. occurred; that spike quickly moderated and the moderation continued after the handgun law was struck down.

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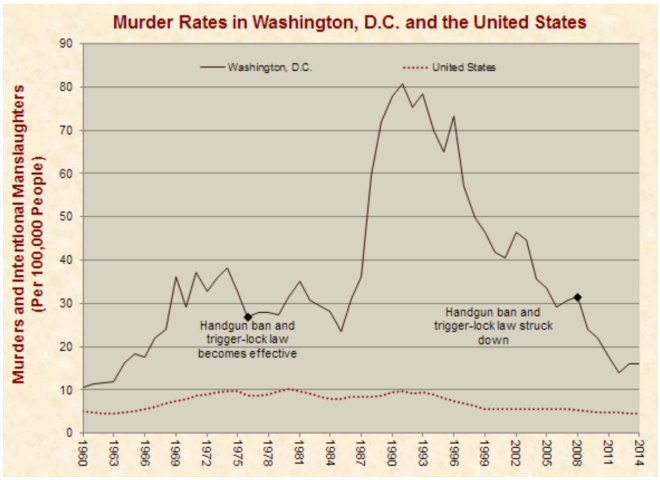
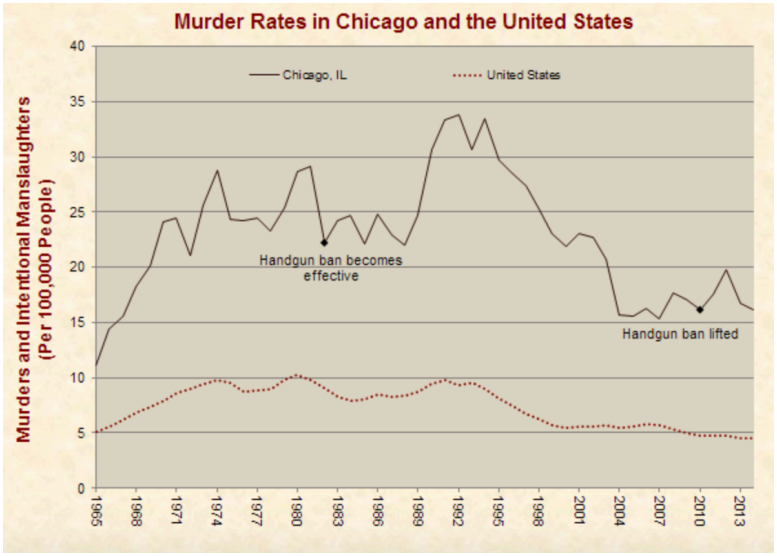
Chart 13A



Source: JustFacts.com

Chart 13B



Source: JustFacts.com

Potential Gun Control Reforms

Table 12 shows both popular and expert support for 29 gun control proposals: "expert" support is rated on a 0 - 10 scale, "popular" support is on a 0 - 100 scale. The authors obtained the "popular" ratings via a telephone survey of almost 2,000 citizens asking their position ("support" or "don't support") on each of the gun control proposals; the results were recorded as the percentage of supporting respondents. They also interviewed 32 gun control experts about their support on a scale of 1 to 10, reporting the average response. Respondents were told to set aside any judgements about feasibility or legality of each proposal.

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Table 12
Expert and Popular Support for 29 Gun Control Proposals
Ranked by Expert Approval Score

	Expert	Popular
Universal Background Checks for Firearms	7.3	86
Prohibit Sales to Convicted Violent Offenders	7.1	83
Prohibit Sales to Stalkers	6.5	85
Require Permits for Firearms	6.4	78
Universal Background Checks for Ammunition	6.4	72
Ban Sales of Automatic and Semi-Automatic Firearms	6.1	63
Prohibit Sales to Those Reported by Mental Health Providers	6.0	87
Require Reporting of Lost and Stolen Firearms	6.0	88
Ban High-Capacity Magazines (>10)	5.8	63
Create National Registry of Firearms	5.7	70
Expand screening and treatment of mentally ill	5.6	86
Require demonstration of "genuine need" for firearm purchase	5.6	49
Match guns with bullets through microstamping	5.5	65
Increase penalties for possession of illegal guns	5.4	80
Require gun dealers to keep and report records of gun sales	5.4	80
Ban ownership of assault weapons and similar firearms	5.0	67
Require gun owners to register fingerprints	5.0	72
Ban gun sales to "known or suspected terrorists" at FBI	4.9	89
Mandatory Three-Day Waiting Period	4.8	77
Limit Firearms Purchased within a Time Period	4.8	67
Limit Ammunition Purchased within a Time Period	4.4	64
Require Safe Gun Storage	4.4	76
Ban Firearms in All Workplaces	4.3	60
Require Safety Training and Tests	4.1	79
National Buy-Back Program for Prohibited Weapons	3.9	74
Ban Firearms from School and College Campuses	3.8	68
Require Child-Proof Locks on Firearms	3.5	82
Honor Out-of-State Firearms Permits	1.7	73
Require National Stand-Your Ground Gun Laws	1.7	71

Quoctrung Bui and M. Sanger-Katz, "How to Prevent Gun Deaths? Where Experts and the Public Agree," New York Times, January 10, 2017. Policies marked in green are already very common.

The policies highlighted in green are policies are already used in many states but are not a federal requirement; all five are standard state policies but on only two (background checks and prohibiting sales to violent offenders) is there strong popular *and* expert support (they are rated very high). The areas of greatest disconnect are banning acquisition by terrorists, and requiring trigger locks. Banning automatic and semi-automatic firearms is ranked high but not highest by both groups; if anything the popular rating is more lukewarm than the expert rating.

Five of the policies on the list address the matter of gun theft. These (along with expert and popular ratings) are: ***a*** require reporting of lost guns (5.8, 63); ***b*** adopt a national registry (5.7, 70); ***c*** require gun dealers to keep sales records and report sales (5.4, 80), ***d*** require safe gun storage (4.4, 76), and ***e*** require safety training and tests (4.1, 7.9). The experts rank these policies lower than the public; for the experts, prohibitions like banning semiautomatic

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weapons are favored. It's interesting that most of the policies favored by experts are already in effect, in part or in whole—universal background checks already exist, automatic weapons are already banned unless a BATFE license is obtained, high-capacity magazines are already banned.

This section focuses on some steps that already are in place but need reinforcing.

Gun-Management Education

Most states require no basic gun education to purchase a gun, though many states do require a basic gun safety course to obtain a concealed carry permit. The introduction of effective gun education at the time of first purchase might better acquaint gun buyers with their risks and responsibilities. So might alteration of the content of concealed-carry permit courses.

I have a concealed-carry license in two states—Florida and Massachusetts. I have taken the required basic course in each state, and with some hindsight I've found them deficient in educating people about how to *own* a gun: the focus is on how to *use* a gun—basic information about how to carry a gun safely, about the laws gun owners must adhere to within the state, and a little bit of actual gun operation (perhaps 10 rounds at a target a few feet away): one learns to keep the trigger finger off the trigger, to be aware of what is behind an offender if a gun is needed for protection, and not to point a gun—loaded or unloaded—at anyone.

Good to know! But neither of the courses I took course even touched on the many pitfalls associated with managing gun security or gave tips about establishing a safer environment to keep guns away from unintended users. The assumption was that the owner would be in control of the gun at all times. That is a weak reed for the public's safety to lean on. These courses are a tragically missed opportunity to create a culture of secure gun ownership. If we are serious about reducing gun deaths we need to step up to the plate and give gun owners the information they really need to keep innocent people safe, and to hold them accountable if their guns are used badly by third parties.

Gun-Owner Accountability

I am not personally in favor of mandated registration of guns. Though I see the merits from law enforcement being able to trace guns back to their source, I'm concerned about all the hullabaloo regarding outright bans of all firearms: registration would tell the authorities where to go to collect the guns, and I have little doubt that in some jurisdictions, if not nation-wide, the collections would begin. However, if the possibility of gun confiscation could be prevented I would happily reconsider gun registration.

At present only eleven states require reporting of a lost or stolen gun, and some of those have lax enforcement and low penalties—less than the price of a gun—for first offenses.[30] What I suggest is the adoption of national *mandated reporting* of a stolen gun with significant penalties when an *unreported* stolen gun is traced back to its original owner, and with additional liability for the original owner if the gun has harmed anyone. Gun owners

[30] The Trace, https://thetrace.org/2017/11/stolen-guns-reporting-requirements/

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should be incentivized to manage their firearms responsibly, meaning that they should adopt appropriate practices to keep the weapons out of the hands of thieves or of family and friends who would be otherwise banned from buying a gun. In this case, the gun owner would have a personal responsibility do his own "background check" regarding use of his gun.

The remarkably lackadaisical behavior of some gun owners is appalling: guns left loose in cars or at home, parents buying guns for use by under-age or unqualified family members, gun owners who ignore their responsibility to be present when their weapons are used. These should be treated as serious offenses, just as we would treat reckless driving. Fines should be large and permits cancelled when guns go astray.

One way to get parental attention is to levy a significant gun tax at the time of purchase; say, 100 percent of the weapon's price. This would be placed in a state-managed escrow account for a period of, say, five years. If the gun develops a tragic history in that time–it is stolen and not reported, or it is used in a crime and traced back—the gun owner would forfeit the escrowed amount and be subject to additional liability for actual harm done with the gun. If the gun is sold before the redemption date, the seller would redeem that amount but the buyer would have to replace it and the time clock would restart. If the probationary period passes without incident, the money is returned to the gun buyer with interest.

I can hear the objection that these penalties won't work—after all, the abundant gun laws we have don't work, and why would a few dollars lost on a gun be missed. But gun owners are people, and people pay remarkable attention to even small financial penalties; paying a price for careless actions will induce more care.

Universal Waiting Periods

Waiting periods, ranging from two to seven days, are adopted to give time for gun buyers to "cool down" before taking delivery. They are applied to each gun purchase, not just to an initial purchase.

Both background checks and waiting periods were state-level policies prior to the 1994 Brady Act. The status of these policies since 1970 is shown below. In 1970 background checks were used in 13 states and waiting periods had been adopted in 19 states. The use of both controls increased to about 23 states by 1993.

In 1994 the Brady Act brought required background checks in all states and instituted a national five-day waiting period to allow time to develop a national background check system: perform those checks. After the 1998 adoption of the National Instant Criminal Background Check System (NICS), gun purchases in all states were subject to background checks and the federal waiting period requirement was dropped; the use of waiting periods fell back to the pre-1994 levels.

The effectiveness of waiting periods as inhibitors of gun deaths was recently addressed by three Harvard University researchers [Luca et. al., 2017]. They used two methods. First, for 1970-2014 they analyzed the relationship between state differences in death rates and in waiting period requirements. Second, they used the "natural experiment" created by the 1994 Brady Act to assess the change in death rates in those states with newly required waiting periods. Their study used a variety of measures of death rates: all homicides and suicides,

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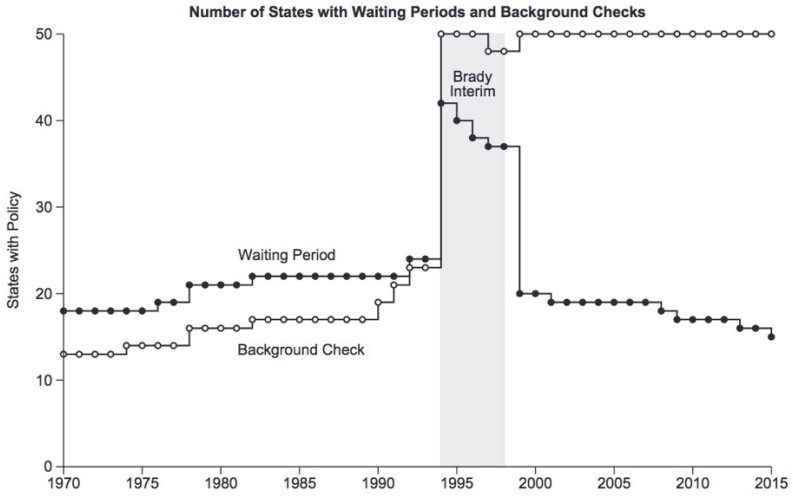
homicides by gun and suicides by gun, and all non-gun homicides and non-gun suicides. Chart 14 is from that study.

Their conclusion was that waiting periods had a statistically significant inhibiting effect on homicides by gun; for suicides by gun the effect of waiting periods was less certain. Both the state differences and natural experiment methods agreed that the effect of adopting waiting periods was a 17 percent decline in gun deaths, amounting to about 900 fewer gun deaths nationwide.

Another interesting result was that national background checks via NCIS had no statistically significant effect on gun deaths, whether by homicide or by suicide. This suggests that American gun policy is riding the wrong horse: we rely on background checks, which appear to have little or no effect on gun deaths, while the method we use least—waiting periods—shows the most promise. The message seems clear!

Chart 14



Source: Luca et. al., 2017

Universal Background Checks

The federal government operates the National Instant Criminal Background Check System (NICS) to provide background checks to firearm dealers with an FFL (Federal Firearms License). Unfortunately, NICS is not available to private dealers, many of whom attend gun shows to sell guns. Private arms dealers are held to a low standard—they are not required to keep records of guns they sell and the only "background check" is that they are not allowed to sell weapons to buyers they "know" to be prohibited. It is a super run-around for private transactions: a felon doesn't even have to steal a gun or track one down.

This loophole should be closed: both the NICS and waiting periods should be required of all gun sellers, and private sellers should be required to maintain records and, if possible, to obtain a license.

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Even with universal access to NICS our background check system can't work without receiving reports of the behavior and actions of persons who should be prohibited from owning a gun. It should come as no surprise that with perfect hindsight we can see a long list of red flags about disturbed minds that shouldn't control a firearm, but before the event the individual does not rise to the level of an obvious risk. "Clerical errors" are all too common and when added to the impediments to reporting high risk individuals—the difficulty in predicting a person's behavior, and the privacy laws that sometimes inhibit reporting—these errors reduce the effectiveness of NICS.

According to the New York Times [Buchanan, Larry et. al., 2018], mass murderers typically bought their firearms legally, though it's not clear what that means with the private sale loophole. Buchanan's list of nine missed opportunities is disturbing. A number of mass murders were clearly assisted by the poor execution of gun safety laws; these were obvious failures to report people who had problems that would raise a red flag on their guns. For examples, Stephen Paddock, the Las Vegas shooter who bought 33 guns within a short period without a report to the FBI—there is no mechanism for reporting multiple purchases; Syed Farouk and Tasheen Malik, a radicalized couple who killed 14 and injured 24 coworkers in San Bernardino, California with guns purchased from private sellers; Dylan Roof, who killed nine churchgoers in 2015 in Charleston, South Carolina after the FBI failed to bar him in NCIS as a substance abuser; Antonio Lopez, the 2014 killer at Fort Hood who was under psychiatric care in the Army but not on the banned list; Aaron Alexis, a 2014 killer who was refused purchase of a handgun and bought a shotgun instead; Devin Kelley, the shooter dishonorably discharged from the Air Force who killed parishioners in Sutherland Springs, Texas.

Some states have over-ridden federal law allowing the private-sale loophole. Fifteen states require that private transactions be processed through an FFL so that the NICS can be used for background checks. Of these, twelve states require FFL participation for all firearms purchased and three states require it only for handguns.

It's clear that we have to find a way to have effective, universally available background checks that ensure that the record of a potential gun buyer is accurate and complete so we can achieve a better balance between public safety and private interests. There will always be errors, but our current laxness borders on negligence.

Personalizing Guns

One approach to the problem of stolen guns is to make them obey only the owner, like a good hound dog. There is a movement afoot to require biometric locks on guns, devices that will unlock a gun to make it operable only if it senses the correct fingerprint or if it is given the proper code. A commercially-available example is the Identilock, produced by Sentinl.

Biometric locks like the Identilock will be of little assistance with gun thefts. Hackers will design bypasses that allow reprogramming of stolen guns. The supply of stolen guns finding its way into homicidal hands will be affected very little. But impulsive suicides might well be reduced, perhaps not those of the gun owner who can quickly get access to his Identilocked weapon, but those of family members. And since many homicides arise from family arguments, even homicides might be reduced.

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Micro-stamping of bullet casings with a gun's serial number has also been proposed. This would have little effect on the use of stolen guns, other than to allow law enforcement to identify the gun used and, perhaps, trace it to the legal owner (assuming that there are records of ownership available).

Of the approaches listed in Table 12, the most fruitful seem to be adoption of a national waiting period requirement in conjunction with *effective* background checks and supplemented by enforceable methods of holding gun owners accountable for the use of their firearms..

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5. Summary

This paper reports the results of personal research into the murky territory of guns in America in an effort to disentangle fact and fiction in the debate about guns and gun controls. The emphasis has been on use of guns in homicides; evidence on suicides suggests that it is driven by very different causes than are homicides, individual factors less connected to the socioeconomic and demographic factors underlying homicides.

Perhaps the most prominent observation coming from this overview is the importance of stolen guns as a factor in both homicides and suicides. Once the deaths from mass shootings and from family arguments are separated out (these are typically deaths largely from legally-owned guns), the bulk of gun-related homicides seems to be from stolen guns.

Some sources claim that gun homicides are primarily gang related, and there are certainly episodes when that seems clear—the drug-related homicide binges in Chicago, Detroit, St. Louis and other major cities, But homicides attributed to gangs by official sources like the FBI do not appear to corroborate this. However, there is a strong connection between race and homicides—roughly 85 percent of convicted murderers are black, and about the same portion of victims are black. Thus, homicide is largely a black-on-black phenomenon. It also appears that legal gun ownership by blacks is lower than that for whites, suggesting that illegally held guns are more common in black communities. In short, the effects of race and of stolen guns are intermixed.

We find that homicide *rates* (per 100,000 population) in American cities and towns are not directly related to population, though the *number* of homicides is higher in large cities simply because of population size. The homicide rate is quite low in New York and Los Angeles, our largest cities, and it is very high in some of our smallest cities (Weldon, NC is the winner). In 2014 even Chicago, the reputed murder capital of America, was not among the top ten in large cities (note: since then Chicago's homicide rate has increased significantly).

The most common reason reported for owning a gun is self-defense. This has been criticized by many on two grounds: first, defensive uses of guns (DGUs) are extremely rare; and second, when someone is injured in a DGU it is commonly the gun owner, not the criminal. Both of these positions are controversial, and there is considerable evidence that neither is correct. Those who argue that DGUs are rare typically rely on official records like the FBI's National Criminal Victimization Study (NVCS) indicating fewer than 100,000 annual DGUs. But it's likely that many DGUs go unreported. Those who argue that DGUs are not rare typically rely on survey responses which might overstate DGUs. The reasonable range of DGUs seems to be 1 to 3 million annually. It was recently discovered that CDC estimates, kept hidden for years, placed annual DGUs at around 2 million!

The gun owner injury rate in DGUs also appears to be far lower than is commonly thought. One study in the mid-1990s used NCVS victimization reports and concluded that the injury rate from resisting theft was about 1.7 percent when a gun was used to resist and 2.4 percent when any other weapon was used. The highest injury rate (3.6 percent) occurred when there was "passive resistance," like arguing. The implication is that words are more dangerous to the user than guns.

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Take-Aways

¶ The notion that homicides are causally related to the number of guns is inconsistent with two "paradoxes."

- The *super-gunner paradox*: in 2015 roughly fourteen percent (7.6 million) of America's 54.7 million gun owners held fifty percent of the guns (132.5 million). The logic of the "gun numbers-cause- death" argument predicts that these "super- gunners" should be at the center of gun deaths; they are not.
- *The violence-deaths paradox*: Since 1991 the per capita number of guns in America has grown steadily, yet violent crime rates and homicide-suicide rates have declined. This suggests that there is a more complex substructure to the homicide and suicide rates in the U. S.

¶ *There is no evidence of a statistically significant link between either homicides or suicides and the sheer number of guns in America.* The strong visual impression that gun deaths are directly and causally related to the number of guns or to the number of gun owners (see Chart 11A) is spurious, arising from a strong correlation between gun ownership (a measure of *gun spread*) and annual gun thefts.

¶ Both h*omicides and suicides* are *strongly related to stolen guns, not to the number of guns. In addition,* suicides (but not homicides) are related to the number of concealed-carry permits to carry, a measure of *gun density*. There might well be a common cause for the link between stolen guns and both homicides and suicides—in each it is laxness of gun security that is the heart of the problem, but the route to death might be different: for homicides stolen guns are a direct too; for suicides, stolen guns are a sign of lax security and easy access.

¶ The number of guns in America is related to demographic variables:

- The number of *stolen* guns is greater in states with a greater black population and younger median age, fewer males, and higher income.
- Gun Spread (i.e. ownership) is more common is less urbanized (more rural) states and in states with a greater male-to-female ratio.

¶ The debate over gun control policies is directed at the wrong target—the number of guns or gun owners—and largely overlooks the fundamental issue: gun deaths are primarily determined by stolen guns and lax gun security. Among policies that should be given more attention are policies that reduce the rate of gun theft, such as

- Improved gun education programs to educate owners about gun management and security as well as gun use
- Policies that allow law enforcement to trace stolen guns back to legal owners
- Policies that place financial and legal liabilities on legal gun owners whose guns have been stolen because of lax security.

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Statistical Appendix

Data Sources

The data and their sources are summarized below.

Data Definitions and Sources

Variable Name	Units	Source
Black	% of population	https://www.kff.org/other/state-indicator/distribution-by-raceethnicity/
Inequality	Gini Coefficient	https://en.m.wikipedia.org/wiki/List_of_U.S._states_by_Gini_coefficient
Gender	Males per Female	https://www.states101.com/gender-ratios
Guns, Stolen	per 100 population	http://www.governing.com/gov-data/stolen-guns-lost-firearms-by-state
Gun Spread	% of adults with guns	https://en.wikipedia.org/wiki/Gun_violence_in_the_United_States_by_state
Gun Density	BATFE registered guns	https://www.atf.gov/firearms/docs/report/firearms-commerce-us-annual-statistical-update-2013/
Homicides	per 100,000	https://en.wikipedia.org/wiki/Firearm_death_rates_in_the_United_States
Median Age	Years	https://www.statista.com/statistics/208048/median-age-of-population by state
Personal Income	$ per capita	https://ssti.org/blog/useful-stats-capita-personal-income-state-2010-2015
Population	Number	https://en.wikipedia.org/wiki/List_of_U.S._states_and_territories_by_population
Suicides	per 100,000	https://en.wikipedia.org/wiki/Firearm_death_rates_in_the_United_States
Urbanization	% in urban areas	https://en.wikipedia.org/wiki/Urbanization_in_the_United_States
Concealed Carry	# of permits	https://www.gunstocarry.com/concealed-carry-statistics/
State Permit Laws	Shall issue/Must Issue	http://www.usacarry.com/concealed_carry_permit_information.html

These data used are state-level data for the years 2010 to 2013; comparable data could not always be found for the same year, but the use of different years for different data should make little difference because the rankings state level data do not change dramatically within a year or two.

Exogeneity Testing

Consider the following auxiliary equation in a simultaneous equations model.

$$(1) \quad y = X_1\beta + X_2\theta + \varepsilon$$

where y is an *n* x *1* vector of observations on a *naturally endogenous* variable, X_1 is an *n* x *p* matrix of *potentially exogenous* variables, X_2 is an *n* x q matrix of *naturally exogenous* variables, and ϵ is an *n* x *1* vector of random errors. The distinction between naturally and potentially exogenous variables in X_1 is determined by the covariance between the variable and the equation error, that is

- Potentially Exogenous $\Rightarrow |\mathrm{Cov}(X_1, \epsilon)| \neq 0$ Potentially Exogenous ($|\ |$ denotes absolute value)
- Naturally Exogenous $\Rightarrow \mathrm{Cov}(X_1, \epsilon) = 0$

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An important concept in simultaneous equations analysis is *identification*: In order to interpret the estimated coefficients in the auxiliary equation as "structural parameters," that is, as parameters measuring the direct effect of the associated variables. If the equation is not identified, the coefficients are a combination of the coefficients in all of the structural equations, hence not subject to interpretation.

Identification Requirement

$$\boldsymbol{r \geq p}$$

The number of exogenous variables not included in X_2 (r) must be equal to or greater than the number of potentially exogenous variables (p) in the auxiliary equation.

r = p Exactly Identified
r > p Overidentified

The goal of an exogeneity test is to determine whether the *potentially exogenous* variables are exogenous or endogenous. If exogenous, you have confidence that Ordinary Least Squares (OLS) is an appropriate method of estimating equation (1); if, however, some variable in X_1 is endogenous then OLS is not appropriate and other methods need to be applied. It's important to note that a statistical test for exogeneity does not determine the status of a variable—it only establishes that the variable is or is not exogenous within the pre-selected boundaries of chance (the significance level adopted, normally a 5 percent chance of erroneously rejecting the null hypothesis of exogeneity).

Our exogeneity test, called the Hausman Test, is implemented as follows. First, form a matrix of *instrumental variables, Z,* that are *all* naturally exogenous

$$(2) \quad Z = [V \; X_2]$$

in which V is an *n* x *r* matrix of *r naturally exogenous* variables that are ***not*** *included* in the *n* x *q* matrix X_2. This, of course, requires that the number of naturally exogenous variables available in your data set exceeds the number used in X_2 by at least r variables. Then

- Estimate an OLS regression of the *p* potentially exogenous variables in X_1 on the (q+r) instrumental variables in Z.
- Save the fitted values of the *p* potentially exogenous variables. The *n* x *p* matrix of fitted values is denoted here as $\hat{X}_1$.
- Estimate an OLS regression of auxiliary equation (1) with the matrix $\hat{X}_1$ included, that is:

$$(1') \quad y = X_1\beta + X_2\theta + \hat{X}_1\delta + \epsilon$$

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- Use the **t**-test for each element of δ to determine whether the associated variable passes or fails the exogeneity test. Thus

  if $\mathbf{t} \geq t_c \Rightarrow$ Reject Exogeneity in Favor of Endogeneity
  if $\mathbf{t} < t_c \Rightarrow$ Accept Exogeneity

If the test rejects exogeneity for any of the coefficients, OLS fails and the model must be estimated with methods that allow RHS endogeneity for the newly-found endogenous variable(s). That typically requires a form of *Instrumental Variable Estimation*, of which *Two Stage Least Squares* is the commonly used method.

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