Does regulation matter? A cross-national analysis of the impact of gun policies on homicide and suicide rates

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ABSTRACT

In this contribution, we evaluate the effectiveness of firearm regulations in curbing the number of homicides and suicides committed both with and without firearms. We develop a gun control index that enables us to compare the restrictiveness of firearm regulations across time and space. We model the effects of gun control on figures of (gun) homicide and (gun) suicide gained from public health records in 16 West European countries between 1980 and 2010. We thus shift the analytical focus away from the United States, which can be considered an extreme case in many ways and analyze the effects of gun control in a least likely setting: a world region in which gun control is comparably strict to begin with. Our analysis demonstrates that stricter gun control entails a strong and robust negative effect not only on homicides and suicides committed with firearms, but also on overall homicide and suicide rates.

KEYWORDS

firearm regulation, gun control, homicide, policy evaluation, suicide

The publisher's version of the article is available at
https://onlinelibrary.wiley.com/doi/10.1111/rego.12235

CITATION

Hurka, S. & Knill, C. (2020). Does regulation matter? A cross-national analysis of the impact of gun policies on homicide and suicide rates. *Regulation & Governance* 14 (4): 787-803.

1. Introduction

One of the major challenges for modern states is to resolve the tension between citizens' individual freedoms and public intervention in order to reach policy objectives. To what extent should individual liberties be limited for the sake of the public good? To what extent should society be protected from governmental intervention? The tension between individual freedoms and the collective good is particularly evident in the context of regulatory policies, that is, policies that define behavioral constraints (Lowi 1972). Such constraints emerge not only from the extent to which governments decide to interfere with individual freedoms, but also how actively public bodies engage in rule enforcement and the sanctioning of rule violations (Knill et al. 2015). The concrete constellation of these constraints can be conceived of as regulatory restrictiveness that delineates how governments balance the tension between individual liberties and collective goal attainment in a given policy sector.

The regulation of gun control perfectly illustrates this tension. On the one hand, governments must ensure the safety of their citizens and prevent deadly weapons from falling into the wrong hands. On the other hand, individual self-determination is a guiding principle of democratic states, which implies that infringements on personal liberties must be proportional. Thus, in order to arrive at a policy that reconciles these two conflicting goals, policymakers are forced to take a stance between the poles of "collective security" and "individual freedom."

Yet the question of exactly how governments strike the balance between restricting individual freedoms and collective security considerations is subject to remarkable spatial and temporal variation (Knill et al. 2015). Comparative studies have revealed that gun policies not only vary remarkably across countries (Hurka 2015), but also have been subject to more or less far-reaching regulatory changes over the last decades; for instance, governments have adjusted gun policies in response to new safety challenges, such as rampage shootings (Hurka & Nebel 2013; Hurka 2017).

This general assessment leaves us with a striking puzzle: We know quite a lot about differences in national gun policies and probably also quite a lot about the drivers of policy change in some countries, but we are far less informed about whether different levels of regulatory restrictiveness make a difference to the prevalence of violence and crime in societies. In short: Does gun regulation matter; and if so, to what extent?

At first glance, this claim of lacking evidence on the link between policy outputs (gun regulation) and policy impacts (collective safety) seems to be an extremely bold one. There is a sizeable body of literature dealing with the prevalence of guns and their impact on crime and violence. Yet this booming research industry suffers from some important shortcomings.

First, the boom is basically driven by studies focusing on the United States (US). The reasons for the pronounced academic interest on the US are obvious. Contrary to other Western democracies, gun violence constitutes an almost ubiquitous fact of life in the US, notwithstanding certain variation across states (Smith & Spiegler 2017). As a result, however, academic interest has concentrated on an extreme case, largely neglecting empirical variation in gun regulation in the rest of the world. Gun violence also occurs in other countries, leading to similar debates on gun regulation and various demands to redraw the balance between individual freedom and collective safety. In 1997, a shooting in a kindergarten in the United Kingdom (UK) fuelled an intense debate over gun control and eventually led to a comprehensive handgun ban (Karp 2003). Likewise, Germany repeatedly revised its gun control framework in the 2000s in the wake of two school shootings (Hurka 2015). Second, existing approaches often do not compare the impact of different policy outputs directly, but instead investigate the influence of gun availability on crime rates. However, apart from the fact that measuring gun availability or gun prevalence in a valid and reliable manner has proven to be an extremely challenging task, such approaches cannot bring us closer to an answer to the most central question, namely whether gun regulation, and hence policy output, actually matters.

In view of these considerations, our study makes a range of contributions that advance our knowledge of the relationship between gun regulation and the prevalence of societal crime and violence. First, we provide a systematic and comparative assessment of the impact of gun policy restrictiveness in 16 European countries over a period of three decades (1980–2010). In so doing, we rely on an innovative and original data set on national firearm regulations that captures not only the dominant regulatory paradigm, but also the personal requirements (age thresholds, mental health certificates, theoretical or practical exams), as well as procedural regulations with regard to safe storage. We thus systematically capture the most central factors that have been identified as predominant causes of gun-related deaths (Smith & Spiegler 2017).

Second, we add to the literature by explicitly concentrating on countries that – compared to the outstandingly permissive regimes in many of the US states – are characterized by relatively restrictive gun regulations. By focusing on the impact of regulatory differences between these countries that are relatively small in relation to the US case, it is our intention to obtain a more detailed understanding on the impact of gun regulation on societal crime and violence. More specifically, our country selection reflects a least likely case design. If we can already observe that minor variations in gun policy restrictiveness have a significant impact on the prevalence of violence and crime across the countries in our sample, we have a very strong case to argue that such impacts should be even more pronounced in constellations of higher variation in regulatory arrangements. In other words, if small differences in regulatory outputs already matter, we can safely conclude that this should even more so be the case in countries with large regulatory differences.

Finally, by investigating both homicides and suicides committed with and without firearms, we analyze whether the effects of gun control are restricted to gun violence only or whether they also reduce violence more generally. We show that stricter gun control is not only associated with lower rates of gun homicides and gun suicides, but also impacts general homicide and suicide rates. This suggests that means substitution is not likely to offset the crime reducing effects of stricter gun laws. However, while our findings point in that direction, the aggregate nature of our study does not allow us to draw any final conclusions on the causal mechanisms affecting behavior at the individual level and underline the necessity to invest more into individual level research.

The paper is structured as follows: First, we summarize the state-of-the-art in research on the nexus between gun regulation and societal homicide and suicide rates; thereby identifying the research void we seek to fill. Second, we introduce our theoretical framework. Third, we present our dataset and our methodological approach. Finally, we present our findings and conclusion.

2. Gun control and gun violence

Although there is a growing body of research on homicide and suicide in various academic disciplines, such as criminology, sociology, psychology, and public health (Kivivuori et al. 2014), public administration and public policy scholars have largely neglected the area. In this

section, we summarize the main lessons that can be drawn from the extant literature and identify the remaining research challenges we address in our paper.

2.1. Gun regulation and (gun) homicides

Taking a closer look at the literature dealing with the relationship between gun regulation and homicide rates reveals the above-mentioned research deficits. First, almost all of the existing literature is based on studies of individual countries, in particular the US. There is a lack of systematic and up-to-date comparison involving multiple nations and time periods. As a result, the empirical picture we find in the literature is strongly dominated by evidence from the US and it is unclear to what extent these findings can actually be transferred to other world regions where gun violence is less widespread.

In addition to these empirical research gaps, the state-of-the-art literature suffers from a second problem that is more conceptual in nature. Instead of focusing on gun regulations, existing research often investigates the effect of gun availability on homicide (e.g. Killias 1993; Hemenway & Miller 2000; Miller et al. 2002; Siegel et al. 2014; Monuteaux et al. 2015).[1] Yet apart from the challenges associated with valid and reliable measurement, studies investigating the impact of gun availability cannot address the challenge of evaluating the effectiveness of gun regulations, because they do not take into account varying policy outputs. Although stricter gun regulations might reduce the availability of guns, it is hardly possible to draw precise conclusions about gun policy restrictiveness from gun availability data. Gun availability can thus hardly be considered a valid proxy for the substance and setting of regulatory outputs. This problem is reinforced by the fact that in some of these studies, gun availability is not assessed directly, but is measured by questionable proxy variables. While some use the share of suicides committed with guns to approximate gun ownership levels (e.g. Siegel et al. 2014), others estimate gun availability through subscription rates to gun magazines (e.g. Duggan 2001), and still others have even used the percentage of robberies committed with a gun in order to predict gun homicides (McDowall 1991). Only in some instances have researchers been able to rely on survey data in order to measure gun availability (Killias 1993; Monuteaux et al. 2015). Given the use of problematic and varying proxies for gun availability, it is hardly surprising that the

[1] For a review of these studies, see Hepburn and Hemenway (2004). A critical methodological review was also recently published by Kleck (2015).

corresponding studies provide a rather inconclusive picture. Some studies have found a significant relationship between gun availability and homicide (Hoskin 2001; Killias et al. 2001; Cook & Ludwig 2006) while others have not (Kleck & Patterson 1993; Kates & Mauser 2007). A more balanced view is taken by the recent comparative study of Altheimer and Boswell (2012), concluding that the relationship between gun availability, homicide, and gun homicide is not stable across nations but contingent upon cultural and sociohistorical factors.

Third, even the few studies analyzing gun regulations rather than gun availability hardly provide a systematic and consistent picture on the link between gun policy outputs and societal impacts. This can be traced to the fact that these studies typically concentrate on the effects of singular and very specific policy measures rather than providing a more encompassing assessment of gun policy restrictiveness in a given country. Moreover, the dependent variable, (gun) homicide, is conceptualized and measured in different ways, which additionally complicates the accumulation of knowledge. Consequently, the evidence provided by this research is quite inconclusive. In a recent study focusing on the US, Smith and Spiegler (2017) compared the strictness of gun control across different states and found that stricter laws are associated with lower numbers of gun deaths. By contrast, Rosengart et al. (2005) argued that while the introduction of permissive shall-issue provisions (permitting an individual to carry a concealed weapon unless restricted by another statute) is potentially associated with an increase in gun homicides, policy measures that restrict gun availability fail to reduce these homicide rates. Focusing on the supply side, some authors claim that more stringent regulation of gun dealers is an effective means to reduce gun-related harm (Irvin et al. 2014), while still others argue that policy measures such as assault weapon bans and concealed weapons laws even boost gun-related homicide rates (Lott & Mustard 1997; Gius 2014). Yet the existing empirical evidence is not only mixed with regard to the US. Case studies from other countries do not allow us to draw any final conclusions. In a study of the Canadian case, Langmann (2012) did not find any effect of gun legislation on Canadian homicide rates. Chapman et al. (2006, 2016) showed, however, that the Australian move to introduce tighter gun regulations has been effective in reducing all sorts of gun-related harm.

2.2. Gun regulation and (gun) suicides

Although there is also an extensive literature on the relationship between gun regulation and suicide rates, it suffers from research gaps rather similar to those discussed for studies on

homicides. First, existing research is again heavily US-centered and it is highly questionable whether findings from this extreme case can be generalized to countries where the availability of firearms is much lower in general. While some studies have focused on single policy interventions in other countries,[2] few comparative studies have examined the effect of firearms on suicide rates both cross-nationally and cross-temporally. One notable exception to this rule is Ajdacic-Gross et al. (2006). This analysis of trends between firearm availability and suicide in 13 Western European countries between 1983 and 2000 confirmed that fewer firearms in the population lead to fewer firearm suicides.

Second, although this study is methodologically advanced, it cannot establish a link to overall suicide rates and is based on survey proxies for gun availability. This problem also applies to most other investigations in this field of inquiry. In some cases, proxies for firearm availability were even derived from other impact measures, such as firearm accidents or homicides. This has sometimes led to the curious situation that the number of gun suicides was "explained" by the number of gun accidents (Lester 1987).

Third, while studies on the individual level have generally suggested that a substitution of methods is rather unlikely, as suicidal people tend to have a rather strong preference for their own method, substitution effects were hardly subjected to empirical testing in population studies so far and if so, the results were ambiguous (Daigle 2005). Thus, in order to control for possible substitution effects, it is necessary to investigate both gun and non-gun suicides simultaneously. Yet even if different impact measures are compared, the capacity of ecological studies to make inferences at the individual level is naturally limited. In order to draw robust conclusions at the individual level, more individual level data would be required.

2.3. Remaining research challenges

In this paper, we systematically analyze the impact of gun policy restrictiveness on both homicide and suicide rates. The previous discussion has shown that any attempt to systematically analyze the impact of gun regulation on the prevalence of homicide and suicide

[2] For example, a range of contributions examined the effects of policy interventions in Australia (e.g. Chapman et al. 2006; Klieve et al. 2009; Leigh & Neill 2010), Austria (Kapusta et al. 2007; Niederkrotenthaler et al. 2009), Canada (e.g. Lester & Leenaars 1993; Leenaars et al. 2003; Bridges & Kunselman 2004; Gagné et al. 2010), Israel (e.g. Lubin et al. 2010), New Zealand (Beautrais et al. 2006), Switzerland (e.g. Ajdacic-Gross et al. 2010), and, of course, the United States (e.g. Ludwig & Cook 2000; Rosengart et al. 2005; Rodríguez Andrés & Hempstead 2011).

has to overcome three major challenges. The first challenge refers to empirical data collection: there is a strong need for comparative assessments of the impact of regulatory outputs across countries and over time in order to overcome the dominant focus on individual countries.

The second challenge is conceptual: on the one hand, we need to address the "independent variable problem" prevalent in most studies of the impact of gun policy availability rather than gun policy regulation. On the other hand, we have to overcome the "dependent variable problem," that emerges from the non-consideration of violence not committed with firearms.

The third challenge is methodological: so far, studies focusing on gun policy restrictiveness have concentrated on the effects of singular instruments rather than providing an encompassing assessment of the policy mix in this area. As emphasized by Miller and Hemenway (1999, p. 66) research has not found a satisfactory way to conceptualize and measure the restrictiveness of gun laws. We hence need to develop a systematic measurement approach in order to systematically assess and compare levels of gun policy restrictiveness across countries and over time.

3. Analytical framework and hypotheses

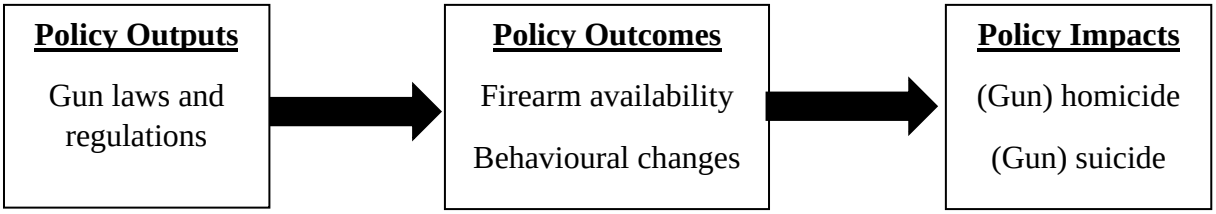
Our analytical interest is to study the extent to which gun regulation matters in order to address the problem of homicide and suicide. The independent variable of interest is thus policy outputs. Policy outputs refer to the relevant regulations governing national gun control regimes. Policy impacts – the dependent variable under study – relate to changes in the problem under study. In our context, policy impacts refer to changes in societal homicide and suicide rates. For both phenomena, we assess gun-related as well as overall rates.

Both policy outputs and policy impacts constitute macro-level phenomena, implying that causal effects of outputs on impacts emerge from the aggregation of behavioral changes of the policy addressees (in particular people interested in purchasing guns, gun owners, and implementation authorities in charge of gun control) in response to changes in policy outputs. These behavioral changes can be conceived as policy outcomes (Sager et al. 2010; Knill & Tosun 2012).

Based on these considerations, the presumed causal mechanism between changes in gun policy restrictiveness and changes in (gun) homicides and (gun) suicides is presumed to operate as follows: Changes in policy outputs (gun laws and regulations), lead to changes in policy

outcomes. Outcome changes might first refer to changes in gun availability. Depending on the extent to which gun policy changes make it more or less difficult to purchase guns, the availability of guns in a society will increase or decrease. As argued above, several studies have focused on this link between outcomes and impacts (i.e. firearm availability and violence), without paying much attention to the underlying policy outputs. Second, outcome changes can result in behavioral changes of the implementation authorities in charge of controlling the gun dealers and gun owners. This might result not only in changes to gun availability, but also in behavioral changes of people who already own a gun. The aggregation of outcome changes in turn is expected to result in changes to societal homicide and suicide rates (see Fig. 1).

Figure 1. *The relationship between outputs, outcomes and impacts*



Yet the public policy literature acknowledges that policy outputs rarely constitute the only source that triggers changes to relevant impact measures. Rather there are additional variables that might independently affect these measures. In our context, such control variables include, in particular, socioeconomic factors, such as rates of unemployment, urbanization, and alcohol consumption. Based on these general considerations, in the following sections we develop hypotheses on the relationship between gun policy restrictiveness and societal homicide and suicide rates.

3.1. Gun policy restrictiveness and (gun) homicides

The extent to which more restrictive gun laws will actually lead to more or less homicides is intensely debated in the literature. Many authors argue that stricter regulations reduce gun accessibility and availability, which reduces the likelihood of violent crimes and accidental shootings (Braman & Kahan 2006; Cook & Goss 2014). By contrast, others emphasize that easy accessibility increases public safety, as guns might produce a deterrence effect that reduces violence (Kleck 2015). Moreover, these authors argue that stricter laws will not affect the number of guns already available (Lott 2010).

Yet there are many reasons to expect that stricter gun regulations will contribute to a decrease rather than increase of homicides. First, guns need not necessarily deter crime and the number of times guns are used in self-defense is much lower than the number of times guns are used to commit a crime (Mercy et al. 1993; Spitzer 2016). Second, although stricter laws might not immediately reduce gun prevalence, we should expect a direct effect with regard to gun accessibility; that is, those who do not own a gun will find it more difficult to get one (Smith & Spiegler 2017).

Based on these considerations and the theoretical framework introduced above, we derive two hypotheses:

Hypothesis 1*: Higher degrees of gun policy restrictiveness (policy output) lead to lower numbers of gun homicides (policy impact).*

As stricter gun regulations restrict access to guns, violent people find it more difficult to obtain a gun (policy outcome). Consequently, the number of gun homicides should decline with higher access restrictions (Cook & Goss 2014).

Hypothesis 2: *Higher degrees of gun policy restrictiveness lead to a lower overall number of homicides.*

Because not all violent attacks are driven by the intent to murder, the deadliness of the weapon in use will have a crucial effect on the extent to which an attack results in death rather than just injury (Zimring 1968, 2004; Smith & Spiegler 2017). As a result of this "instrumentality effect" (Gabor 2016, p. 56), stricter gun regulations will reduce violence intensity and hence the overall number of homicides. While lower gun accessibility need not mean that the number of crimes decreases, crimes will result in lower instances of death the more guns are substituted by weapons with less lethal effects (Cook & Goss 2014).

3.2. Gun policy restrictiveness and (gun) suicides

The explanation of suicide rates is a well-established area of inquiry in the social sciences. Building on the seminal work by Durkheim (1897), a rich body of literature has developed over the past decades. Scientific debates in particular concentrate on the factors that affect suicide rates. In this regard, a large body of literature refers to the question of suicide prevention,

including preventive and proactive measures within the realms of medicine and mental health, as well as public health. However, the literature also acknowledges that suicide should not solely be viewed as a medical or mental health issue, but that it is affected by environmental risk factors at the same time – in particular, the access to lethal means. The basic theoretical expectation is that restricted availability of lethal means can help reduce suicide rates by delaying action until suicidal thoughts pass. Particular attention has been paid to the availability of guns. Because guns are quick and more lethal than other suicidal means, they are considered a major driver of suicide rates.

We formulate two further hypotheses in light of these arguments:

Hypothesis 3: *Higher levels of gun policy restrictiveness (policy output) lead to lower rates of gun-related suicides (policy impact).*

If guns are increasingly difficult to access (policy outcome), we should observe fewer suicides committed by the use of guns.

Hypothesis 4: *More restrictive gun laws not only reduce gun-related suicides, but also suicide rates in general.*

This can be traced to the instrumentality effect mentioned above. Compared to other means, guns have more lethal effects. This implies that the likelihood of suicides should decline, the more people willing to commit suicide resort to other, less effective means (Spitzer 2016).

4. Data and measurement

We rely on a sample of 16 West European countries, which we analyze over a time period of three decades (1980–2010). Specifically, the country sample includes Austria, Belgium, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, and the United Kingdom. Accordingly, the total number of country-years is $31 \times 16 = 496$. We lack information on gun homicides and gun suicides for the year 1980 in Spain and some country-years are not used in the analysis because gun control was regulated at the subnational level (Switzerland 1980–1996). Accordingly, we run our

models with 479 country-years for overall homicide and suicide rates and 478 country-years for gun homicide and gun suicide rates.

The sample we analyze thus allows for conclusions on the effectiveness of gun control in Western Europe. The main rationale for selecting these countries is that their gun control laws have been quite strict for the most part when compared to the US (with the exceptions of Switzerland and Finland). Thus, we can consider most West European countries least likely candidates for a strong policy impact of gun law reform. Eastern European countries are not included, not only because we lack comparable data both on the independent and the dependent variables, but also because our focus on Western Europe allows us to hold some important scope conditions constant, most importantly the rule of law.

4.1. The independent variable: Gun policy restrictiveness

As pointed out in the theoretical section, our major analytical interest is on the causal link between policy outputs (gun policy restrictiveness) and their impacts (homicide and suicide rates). Rather than adopting an isolated focus on singular regulatory measures (which has been the dominant approach in existing research), our goal is to rely on a more encompassing assessment of policy outputs, capturing the most relevant regulations that – taken together – determine the amount and level of regulatory restrictions for gun ownership. Our conception of gun policy restrictiveness thus constitutes an aggregate measure of policy outputs. In this context, our aggregate assessment focuses on a specific dimension, namely restrictiveness. We do not consider other potential dimensions that might be used for aggregating policy outputs, such as merely accounting for the number of regulations (policy density) (Knill et al. 2012) or certain instrument mixes (Howlett & Rayner 2007). Our assessment is rather based on the combination of two measures, namely the presence of relevant regulations and their restrictiveness. We are thus not only concerned with policy density, but also with the intensity of the adopted policies (Knill et al. 2012).

The gun control index, which we use in order to measure gun policy restrictiveness, is composed of several indicators that are ordered hierarchically according to their relative impact on the gun owner, namely the dominant regulatory paradigm, personal qualification requirements for purchasing a gun, and gun storage requirements. Our index thus focuses on the restrictiveness of a country's gun policy instruments, not the way in which they are

implemented. While we are aware that implementation is important, we lack data on the implementation stage and also consider such a focus beyond the scope of this article. We do think, however, that looking into implementation patterns is a promising avenue for future research. At the same time, it should be emphasized that our countries under study can generally be assumed to reflect cases in which legal rules are generally observed and controlled. While this does not mean that implementation is always effective, there are good reasons to assume that rules are not systematically ignored.

The first and most fundamental distinction in the gun control index is made between the paradigms of permission, privilege, and prohibition. States' shifts between these categories may be considered large-scale policy changes, as they affect central features of a country's overall gun policy approach.

In the permissive paradigm, there is no need for the customer to prove a specific purpose for which they intend to possess the gun. Either there is no need at all to demonstrate a good reason, or simply citing a reason upon application without further proof is sufficient. Thus, in order to prevent a certain person from acquiring a gun, the licensing authority must prove that the person does not fulfill the standards prescribed by the national policy framework.

In the privilege paradigm, by contrast, this logic is reversed, and a regular citizen may not own a gun unless she is able to prove a genuine need for it. In most countries, hunting or sporting purposes are the primary reasons that can justify a citizen's application for a gun license (Parker 2011, pp. 38–47). The extent to which personal protection is recognized as a valid reason to own a firearm varies across countries. Many gun laws list personal protection as a possible justification for gun possession, but require customers to demonstrate an extraordinary threat to their lives. Unless such a rare situation can be proven, personal protection is hardly ever recognized as a genuine reason to own a gun in the privilege paradigm.

Finally, the most restrictive system is represented by the prohibitive paradigm. States pursuing this approach explicitly prohibit by law the possession of certain firearms, in particular handguns, for the civilian population. By definition, no valid reasons exist for firearm possession in these countries, and therefore all other lower-level rules (personal and procedural) are theoretically redundant.

On a second level, we distinguish countries according to the personal requirements necessary to qualify for a gun purchase. It is important to note here that such personal requirements are relevant not only within the privilege paradigm, but also within the permissive paradigm. Even when customers do not have to provide a reason for their gun purchases, they are nevertheless obliged to conform to certain rules. The second measurement level consists of three items that capture the qualification hurdles a prospective handgun owner must overcome before acquiring a weapon: age, health, and technical capability. We measure an applicant's required age with an ordinal item consisting of three categories (0: under 18 years, 1: exactly 18 years, and 2: over 18 years). The second (binary) item indicates the mandatory requirement to produce a medical certificate upon application for a firearm. Finally, another binary item captures whether the applicant must pass any safety training classes or other technical exams in order to be eligible to possess a gun. Accordingly, the second measurement level consists of an additive index that ranges from 0 to 4 and captures the intensity of personal requirements for gun ownership (no requirements to very demanding requirements).

Finally, we distinguish between three different ordinal categories of safe storage requirements: none, basic, and detailed. While the first two measurement levels should primarily affect the availability of firearms within a country, this procedural level affects their accessibility, in particular for people in the immediate environment of the gun owner. Both availability and accessibility should affect the extent to which suicidal people can translate their suicide ideation into practice and the extent to which homicides can be perpetrated in affect. Table 1 summarizes the components of the gun control index. The index ranges from a theoretical minimum of 1 (complete permission without any personal or procedural requirements) to a theoretical maximum of 3 (complete prohibition).

Thus, we assume a hierarchical order between the three major components of our index. While the elevated importance of the policy paradigm is straightforward, we also consider personal requirements more fundamental interventions than procedural requirements. This is because procedural requirements (in our case safe storage) only become relevant once personal requirements have been cleared. In other words, procedural requirements are downstream to personal requirements and are therefore assigned a lower weight in the gun control index.

Table 1. *The gun control index*

General rules paradigm	Personal requirements *Additive index incl. age, health and technical capability*	Procedural rules *Safe storage requirements*	Index value
Prohibition	Not relevant	Not relevant	3.00
Privilege	Very demanding	Detailed	2.93
		Basic	2.87
		None	2.80
	Demanding	Detailed	2.73
		Basic	2.67
		None	2.60
	Medium	Detailed	2.53
		Basic	2.47
		None	2.40
	Few	Detailed	2.33
		Basic	2.27
		None	2.20
	None	Detailed	2.13
		Basic	2.07
		None	2.00
Permission	Very demanding	Detailed	1.93
		Basic	1.87
		None	1.80
	Demanding	Detailed	1.73
		Basic	1.67
		None	1.60
	Medium	Detailed	1.53
		Basic	1.47
		None	1.40
	Few	Detailed	1.33
		Basic	1.27
		None	1.20
	None	Detailed	1.13
		Basic	1.07
		None	1.00

As shown in Table 1, the hierarchical ordering of our three index components allows us to identify specific policy configurations that consist of a general policy approach, and personal and procedural requirements. The values attributed to each component ensure that all other things being equal, a shift on the first level is more consequential than a shift on the second level, which is in turn more consequential than a shift on the third level. If, for example, a country moves from the the permission paradigm with very demanding personal requirements and detailed procedural rules to the privilege paradigm (with similarly demanding and detailed rules), its value changes from 1.93 to 2.93. If, however, the country remains within the permission paradigm and only increases its personal hurdles from few to demanding (assuming basic procedural rules in both constellations), the value only changes from 1.27 to 1.67. If the

country decides to tighten procedural rules in addition (moving from basic to detailed requirements), the value changes to 1.73. Thus, fundamental policy shifts on level 1 are mirrored more strongly in the index value than changes on secondary or tertiary levels.

The index we use in order to capture the restrictiveness of a country's overall firearm regime pertains to handguns, which can be easily concealed and fired with one hand. However, it should be mentioned that many of the policy measures that enter our index are also relevant for other firearms (e.g. storage requirements, safety training etc.). The focus on handguns is only consequential for the assessment of the policy paradigm and the personal requirement "age threshold," which tends to be higher for handguns than for other firearms.

We assembled the data for our independent variable gun policy restrictiveness in the context of a largescale research project on morality policy called MORAPOL (Knill et al. 2015). The data collection entailed the analysis and coding of laws and regulations in the field of gun policies in all countries under investigation. Moreover, we complemented the assessment with a questionnaire completed by contracted national policy experts.

4.2. The dependent variables: (gun) homicides and (gun) suicides

The dependent variables are based on the International Classification of Diseases (ICD) and were retrieved from the World Health Organization's (WHO) Mortality Database (World Health Organization 2018) and from national statistical offices for the earlier years under investigation. For each country year, we list the precise data source in Tables S1 and S2. All data on homicides and suicides are thus based on public health records, not on crime statistics. Our analysis thus complements previous research, which used figures from victimization surveys as their dependent variables or only analyzed a few selected country years (Killias 1993; Killias et al. 2001; Killias & Markwalder 2012). Table 2 lists the detailed ICD codes used for the analysis. For the most part, the countries under study used ICD-9 and ICD-10 codes during the time period under observation. Only Denmark, Finland, Norway, Sweden, and Switzerland used ICD-8 codes for some early years. ICD-8 codes do not distinguish between homicides and suicides committed by firearms and explosives, which is why we present robustness checks without ICD-8 years in the Tables S3 and S4. In order to account for potential differences in coding practices over time, we include a control for the applied ICD codes in our statistical models. Based on the absolute death figures from WHO and the national statistical offices, we calculated the rates of (gun) homicide and (gun) suicide per 100,000 people with

annual population data we retrieved from the World Bank (2018). These rates constitute the dependent variables for our analysis.

Table 2. *ICD codes used for the data analysis*

Concept	ICD-8	ICD-9	ICD-10
Suicide	A147 ("Suicide and self-inflicted injury")	E950-E959 ("Suicide and self-inflicted injury")	X60-X84 ("Intentional self-harm")
Homicide	A148 ("Homicide and injury purposely inflicted by other persons")	E960-E969 ("Homicide and injury purposely inflicted by other persons")	X92-Y09 ("Assault")
Gun Suicide	E955 ("Suicide and self-inflicted injury by firearms and explosives")	E955.0 ("Suicide and self-inflicted injury by handgun"), E955.1 ("Suicide and self-inflicted injury by shotgun"), E955.2 ("Suicide and self-inflicted injury by hunting rifle"), E955.3 ("Suicide and self-inflicted injury by military firearms"), E955.4 (Suicide and self-inflicted injury by other and unspecified firearm")	X72 ("Intentional self-harm by handgun discharge"), X73 ("Intentional self-harm by rifle, shotgun and larger firearm discharge"), X74 (Intentional self-harm by other and unspecified firearm and gun discharge")
Gun Homicide	E965 ("Assault by firearms and explosives")	E965.0 ("Assault by handgun"), E965.1 ("Assault by shotgun"), E965.2 ("Assault by hunting rifle"), E965.3 ("Assault by military firearms"), E965.4 ("Assault by other and unspecified firearm")	X93 ("Assault by handgun discharge"), X94 ("Assault by rifle, shotgun and larger firearm discharge"), X95 "Assault by other and unspecified firearm and gun discharge")

4.3. Control variables

In our statistical models, we control for some confounding factors that potentially affect the relationship between gun policy restrictiveness and gun violence. Next to the controls regarding different ICD classification schemes mentioned in the previous subsection, we control for rates of unemployment, urbanization, and alcohol consumption. Figures for the former two indicators were retrieved from the World Bank (2015a,b), while figures for alcohol consumption were retrieved from the WHO Global Information System on Alcohol and Health (2015). We include the same set of control variables in all our models because we found them represented in

different combinations in previous studies both on suicide (e.g. Ludwig & Cook 2000; Rodríguez Andrés & Hempstead 2011) and homicide (e.g. Ludwig & Cook 2000; Miller et al. 2002).

As with all observational empirical research, also our study is not immune from potential problems arising from omitted variable bias. While we cannot account for all possible alternative explanations in our models, which is at least in part the result of missing data,[3] we report robustness checks including country fixed effects and temporal fixed effects in order to account for unobserved factors at the country level and for particular years in the Supporting Information tables. While we are aware that these checks are not a perfect cure, they at least show that the findings we present in the following section hold if we change relevant aspects of the model specification within reasonable bounds.

5. Results

In this section, we first present some descriptive empirical evidence on the evolution of (gun) homicide and (gun) suicide in Western Europe from 1980 to 2010. We then proceed to the statistical analysis and investigate the relationship between gun policy restrictiveness and these policy impacts.

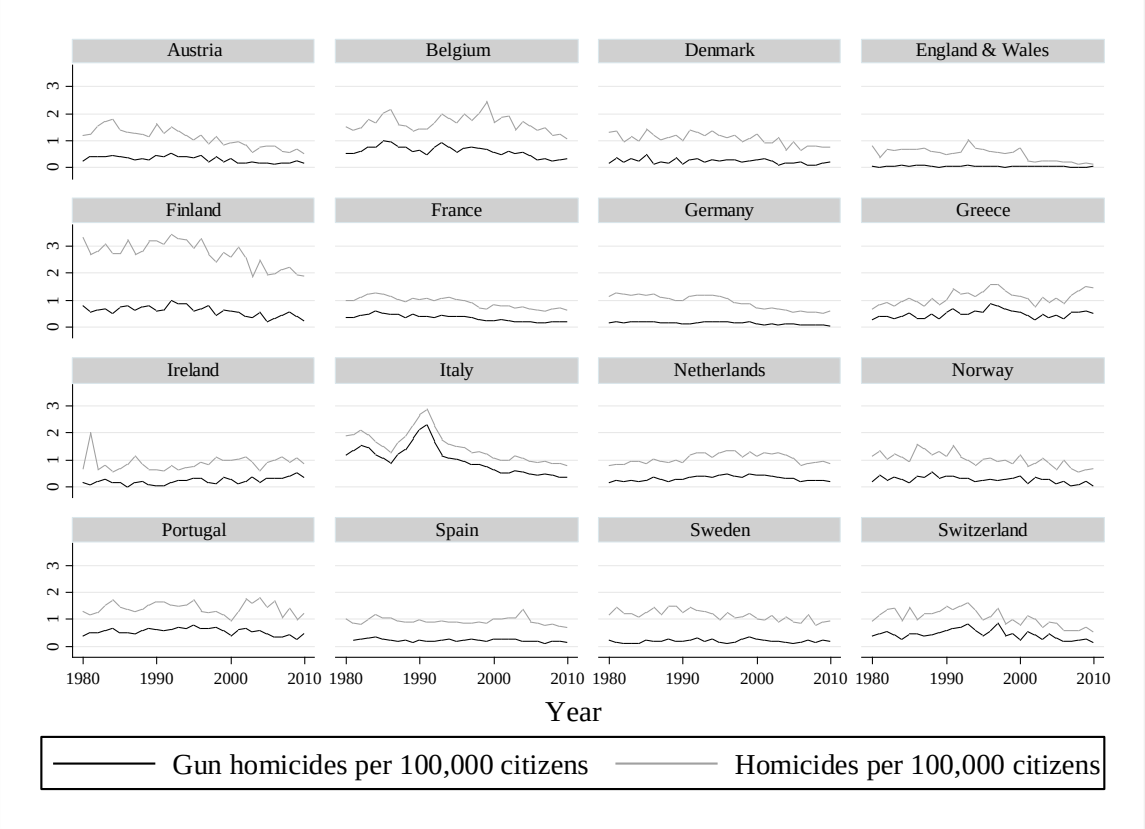
5.1. Descriptive analysis

Before we get to the statistical analysis, we would like to highlight some descriptive observations. First, as the line plots in Figure 2 illustrate, the relative number of gun homicides vary cross-nationally. While England & Wales and Germany in particular report very low incidents of gun homicide, other countries like Belgium, Finland, and Italy have experienced higher numbers. Nonetheless, the figures also indicate that there is some variance within individual countries over time. More specifically, the number of gun homicide incidents does not follow a clear trend. In several countries, the figures have decreased in the long run, but there are also many years for which we observe an increase in gun homicides. In Greece, for example, we observe an increase in homicide rates between 1980 and 2010, while gun homicide rates remain more or less constant. In Finland, we observe a different pattern with decreasing homicide rates and constant gun homicide rates. In Italy, both homicide and gun homicide

[3] For example, we are unable to control for access to mental health services, as Smith and Spiegler (2017) did in their study on gun control and gun deaths in the US.

increased around 1990 before falling significantly until 2010. The plots also show that the number of gun homicides is not always directly related to the total number of homicides. This suggests that these indicators should be analyzed separately.

Figure 1. *Homicide and gun homicide rates in Western Europe, 1980-2010*



A similar picture emerges if we compare suicide and gun suicide rates over time (Fig. 3). Some countries display a remarkably clear trend of decreasing suicide rates over time (e.g., Austria, Denmark, and Germany). In other countries, suicide rates increase during some time periods and fall again thereafter (e.g., Finland and Portugal). We can also see differences between countries regarding their gun suicide rates, whereas variance over time is limited. Austria, Finland, France and Switzerland display comparably high gun suicide rates, whereas gun suicide is very rare in England & Wales and the Netherlands.

Figure 3. *Suicide and gun suicide rates in Western Europe, 1980-2010*

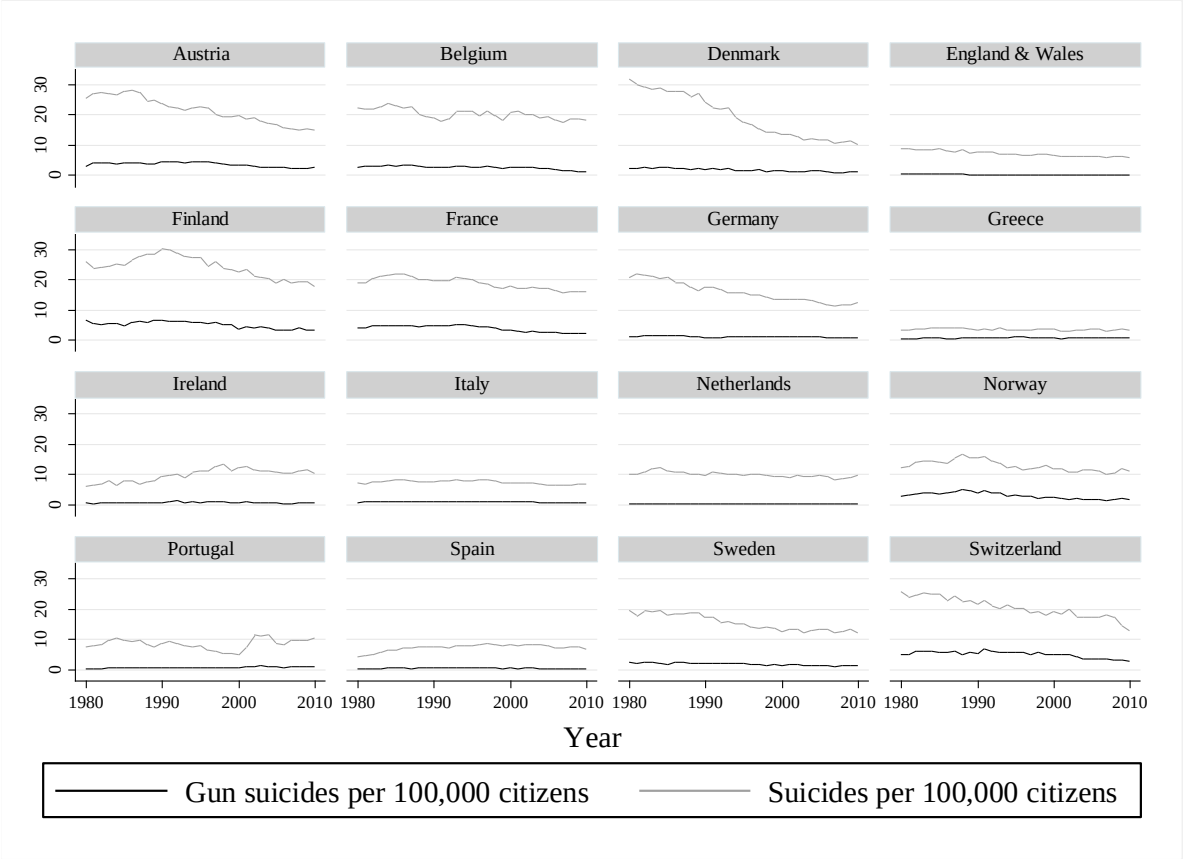


Table 3 displays country rankings comparing the average rates of gun homicide and gun suicide over the entire time period under observation. We see that Finland features both high rates of gun homicide and gun suicide, whereas England & Wales experienced the fewest homicides and suicides committed with firearms in relation to their overall population. The figures give a good sense of the variance across Europe. The average gun homicide rate in Italy from 1980 to 2010 was about 20 times the rate in England & Wales. Similarly, Finland's average gun suicide rate was about 19 times the gun suicide rate of England & Wales.

Table 3. *Average number of gun homicides and suicides per 100,000 citizens (1980-2010)*

Gun Homicides		Gun Suicides	
1. Italy	1.00	1. Finland	5.07
2. Belgium	0.61	2. Switzerland	4.98
3. Finland	0.60	3. France	3.86
4. Portugal	0.54	4. Austria	3.64
5. Greece	0.49	5. Norway	3.02
6. Switzerland	0.44	6. Belgium	2.64
7. France	0.34	7. Sweden	1.84
8. Austria	0.31	8. Denmark	1.81
9. Netherlands	0.31	9. Germany	1.12
10. Norway	0.27	10. Italy	1.02
11. Denmark	0.24	11. Greece	0.77
12. Spain	0.22	12. Ireland	0.76
13. Ireland	0.22	13. Portugal	0.71
14. Sweden	0.19	14. Spain	0.46
15. Germany	0.15	15. Netherlands	0.28
16. England & Wales	0.05	16. England & Wales	0.27

5.2. Analysis I: Gun policy restrictiveness and (gun) homicides

We estimate pooled regressions with a Prais–Winsten AR(1) correction and panel-corrected standard errors (Plümper et al. 2005). This approach allows us to cope with the most common problems associated with timeseries cross-sectional analyses, namely heteroscedasticity and autocorrelation. Please note that we report several robustness checks in the Supporting Information tables, including the omission of ICD-8 country-years (Tables S3 and S4), the inclusion of fixed country effects (Tables S5 and S6), or the inclusion of fixed time effects (Tables S7 and S8). None of these checks casts doubt on the validity of the findings we present in this article.

As Table 4 shows, more restrictive gun policies are associated with both significantly lower rates of homicide and gun homicide. These effects are both highly significant and robust to the inclusion of control variables. If the means to put homicidal thoughts into practice are lacking or are hard to come by, these homicide intentions are apparently not simply realized through other means or the weapons employed are not as deadly as firearms. The results thus support Zimring's (1968) classic study on the comparable deadliness of different weapons. Zimring showed that if firearms were more difficult to obtain, the most likely substitute weapons would be knives; as the deadliness of knives is significantly lower than of firearms, this leads to a reduced overall homicide rate. This is precisely what our findings indicate. Moreover, our results resonate with more recent studies carried out in the US context on intimate partner

violence (Richardson Vigdor & Mercy 2006) and suggest that the findings can even be extended to areas with much lower overall crime rates than those of the US. Apparently, tighter gun laws even exert their influence in a context in which crime is already at a comparably low level.

Table 4. *Time Series Cross Sectional Analysis: Gun policy restrictiveness and (gun) homicides*

Variables	Model I Homicides	Model II Homicides	Model III Gun Homicides	Model IV Gun Homicides
Gun policy restrictiveness	-0.49***	-0.49***	-0.17***	-0.20***
	(0.10)	(0.10)	(0.04)	(0.04)
Alcohol per capita consumption (15+)		-0.00		0.01
		(0.01)		(0.01)
Unemployment (percent of civilian labor force)		0.01		0.01**
		(0.01)		(0.00)
Urban population (percent of total)		0.00		-0.00**
		(0.00)		(0.00)
ICD version 9		-0.16		0.05
		(0.10)		(0.05)
ICD version 10		-0.20**		0.02
		(0.09)		(0.06)
R^2	0.21	0.22	0.08	0.11
N	479	479	478	478

*p<0.1; ** *p*<0.05; *** *p*<0.01; panel-corrected standard errors in parentheses. Dependent variable: (Gun) homicides per 100,000 citizens.

On average, we estimate that a one-unit increase in our gun control index entails roughly 0.5 fewer homicide fatalities and 0.2 fewer gun homicide fatalities per 100,000 citizens. If we recall that that the European average of gun homicides per 100,000 citizens in the years 1980-2010 varied from 1.0 in Italy to 0.05 in England & Wales (Table 3), a potential reduction of 0.2 fatalities per 100,000 citizens in this range through stricter gun legislation (e.g., by moving from the permissive to the privilege paradigm) seems quite remarkable.

These findings remain robust to the inclusion of several control variables. While alcohol consumption rates are unrelated both to overall homicide and gun homicide, we find that higher unemployment is associated with higher levels of gun homicide and a more urban population tends to go hand in hand with fewer gun homicides.

5.3. Analysis II: Gun policy restrictiveness and (gun) suicides

Can we find a similarly consistent effect of stricter gun legislation on suicide and gun suicide rates? Employing the same estimation strategy as in the previous section, the results of our analysis suggest that the relationship between gun control and (gun) suicide is just as strong as the one between gun control and (gun) homicide (Table 5). We estimate that increasing the

restrictiveness of gun laws by one unit reduces the number of suicides per 100,000 citizens on average by 3. The number of gun suicides is reduced on average by 0.89 per 100,000 citizens. These findings are robust to the omission of ICD-8 years and the inclusion of country and time fixed effects (Tables S3–S8). Along with these substantive findings on our key variable of interest, we also find that the number of suicides and gun suicides tends to increase in more urban environments, while the number of suicides is increased by alcohol consumption. We did not find any effects of unemployment.

Table 5. *Time Series Cross Sectional Analysis: Gun policy restrictiveness and (gun) suicides*

Variables	Model I Suicides	Model II Suicides	Model III Gun Suicides	Model IV Gun Suicides
Gun policy restrictiveness	-1.92***	-3.00***	-0.71***	-0.89***
	(0.46)	(0.50)	(0.17)	(0.16)
Alcohol per capita consumption (15+)		0.23**		-0.00
		(0.09)		(0.02)
Unemployment (percent of civilian labor force)		-0.08		-0.01
		(0.05)		(0.01)
Urban population (percent of total)		0.27***		0.03***
		(0.03)		(0.01)
ICD version 9		-0.74		-0.03
		(0.50)		(0.15)
ICD version 10		-0.95**		-0.13
		(0.47)		(0.12)
R^2	0.39	0.52	0.19	0.25
N	479	479	479	479

*p<0.1; ** *p*<0.05; *** *p*<0.01; panel-corrected standard errors in parentheses. Dependent variable: (Gun) suicides per 100,000 citizens.

Suicidal people do not seem to switch to other methods of suicide if their preferred method is unavailable or more difficult to obtain. These findings underline the validity of many previous studies carried out primarily in the North American context (Daigle 2005; Rodríguez Andrés & Hempstead 2011) and show that stricter gun control also contributes to lower suicide rates in other parts of the world where the access to firearms is significantly more restricted to begin with. Firearms are a highly effective and deadly suicide method and easy access to a loaded firearm makes it easy to put suicidal ideations into practice (Lubin et al. 2010, p. 422 f.). This stands in stark contrast to other methods of suicide, which require much more planning and preparation (e.g. railway suicide, self-poisoning, or jumping from heights). Thus, regulation indeed makes a crucial difference. This should encourage policymakers around the world to consider means restriction more strongly as a method to reduce violence in general, and gun violence in particular.

6. Conclusion

The question of whether restricted access to firearms should be considered an effective means to curb firearm-related violence is regularly subject to heated political debates. Are higher hurdles to legally obtain firearms associated with fewer or more homicides and suicides? Are the numbers of homicides and suicides affected by regulation? Or do people simply switch their homicide and suicide method if firearms are more difficult to obtain? To the best of our knowledge, our study is the first to evaluate these questions in a time-series cross-sectional research design, focusing on 16 countries of Western Europe. We thus deliberately shift the analytical focus away from the US, which has been the focus of much research in the past for obvious reasons. However, we claim that any findings on this extreme case are difficult to generalize to a broader population of countries. In particular, we consider it analytically more promising to analyze least likely cases for the effectiveness of gun control; that is, cases in which gun control is generally stronger to begin with. If we can detect meaningful regulatory effects in these least likely cases, it can be considered rather likely that regulation actually makes a difference.

We make several important contributions. First, we introduce a novel measurement concept for the restrictiveness of gun control regimes, enabling the literature to move past proxies for gun availability and model the effects of regulation directly. Second, we investigate the old question of whether gun control matters with new data that expands the rather narrow empirical contexts of previous studies considerably to a total of 16 West European countries and a time period of three decades. Third, instead of just focusing on one particular impact measure, we model the relationship between gun control and four different impact measures (suicide, gun suicide, homicide, gun homicide), while taking into account a set of potentially confounding factors. Fourth, we show that stricter gun control has a strong and robust negative effect on all four impact measures, which implies that means substitution apparently is not likely to offset the crime-reducing effect of stricter gun control. In order to test this claim convincingly, however, more research at the individual level is needed. Given the empirical scope of our analysis, we suspect that if we can find such strong effects in a highly regulated environment like Western Europe, it is quite likely that stricter gun control would exert even more substantive effects in countries like the US, where the overall regulatory approach has been quite permissive.

In this contribution, we only looked at the aggregate effects of gun policy mixes and did not attempt to isolate the effects of individual policy measures (e.g., age thresholds or safe storage requirements). The growing complexity of contemporary policy mixes makes the evaluation of individual policy measures increasingly challenging and often times virtually impossible (Adam et al. 2019). For instance, we can hardly evaluate the effects of increasing age thresholds without considering the configuration of mental health requirements or the existence of mandatory safety training. In many instances, gun law reforms address several policy measures at once, rendering the comparative evaluation of their relative effects exceedingly difficult. In these regulatory environments characterized by high policy complexity, the analysis of interaction effects becomes not only difficult to perform, but also difficult to communicate. Thus, we base our conclusions on an aggregate measure for the restrictiveness of a country's regulatory approach concerning firearms. Our research design therefore does not allow us to draw conclusions about individual policy measures (a problem we share with all other previous studies), but we can show that movements toward stricter gun control entail significant reductions in gun-related violence.

Acknowledgments

This work was supported by the European Research Council (Grant no. 249388) (MORAPOL). Moreover, the authors would like to thank the Center for Advanced Studies at LMU Munich for hosting them during the preparation of this article as fellows in the "Senior Researcher in Residence" Program.

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Supporting information

Table S1. *Data sources: homicide and suicide*

Country	Years	Source[i]
Austria	1980-2001	WHO Mortality Database (ICD-9)
	2002-2010	WHO Mortality Database (ICD-10)
Belgium	1980-1997	WHO Mortality Database (ICD-9)
	1998-2010	WHO Mortality Database (ICD-10)
Denmark	1980-1993	WHO Mortality Database (ICD-8)
	1994-2010	WHO Mortality Database (ICD-10)
Finland	1980-1986	WHO Mortality Database (ICD-8)
	1987-1995	WHO Mortality Database (ICD-9)
	1996-2010	WHO Mortality Database (ICD-10)
France	1980-1999	WHO Mortality Database (ICD-9)
	2000-2010	WHO Mortality Database (ICD-10)
Germany	1980-1997	WHO Mortality Database (ICD-9)
	1998-2010	WHO Mortality Database (ICD-10)
England &Wales	1980-2000	WHO Mortality Database (ICD-9)
	2001-2010	WHO Mortality Database (ICD-10)
Greece	1980-2010	WHO Mortality Database (ICD-9)
Ireland	1980-2006	WHO Mortality Database (ICD-9)
	2007-2010	WHO Mortality Database (ICD-10)
Italy	1980-2002	WHO Mortality Database (ICD-9)
	2003	WHO Mortality Database (ICD-10)
	2004-2005	Istituto nazionale di statistica (ISTAT): Suicide[ii]; Homicide[iii]
	2006-2010	WHO Mortality Database (ICD-10)
Netherlands	1980-1995	WHO Mortality Database (ICD-9)
	1996-2010	WHO Mortality Database (ICD-10)
Norway	1980-1985	WHO Mortality Database (ICD-8)
	1986-1995	WHO Mortality Database (ICD-9)
	1996-2010	WHO Mortality Database (ICD-10)
Portugal	1980-2001	WHO Mortality Database (ICD-9)
	2002-2003	WHO Mortality Database (ICD-10)
	2007-2010	WHO Mortality Database (ICD-10)
Spain	1980-1998	WHO Mortality Database (ICD-9)
	1999-2010	WHO Mortality Database (ICD-10)
Sweden	1980-1986	WHO Mortality Database (ICD-8)
	1987-1996	WHO Mortality Database (ICD-9)
	1997-2010	WHO Mortality Database (ICD-10)
Switzerland	1980-1994	WHO Mortality Database (ICD-8)
	1995-2010	WHO Mortality Database (ICD-10)

Table S2. *Data sources: gun homicide and gun suicide*

Country	Years	Source[iv]
Austria	1980-1998	STATISTIK AUSTRIA (ICD-9)
	1999-2001	WHO Mortality Database (ICD-9)
	2002-2010	WHO Mortality Database (ICD-10)
Belgium	1980-1992	Statistics Belgium (ICD-9)
	1993-1997	WHO Mortality Database (ICD-9)
	1998-2010	WHO Mortality Database (ICD-10)
Denmark	1980-1993	Sundhedsdatastyrelsen (ICD-8)
	1994-2010	WHO Mortality Database (ICD-10)
Finland	1980-1986	Statistics Finland (ICD-8)
	1987-1995	Statistics Finland (ICD-9)
	1996-2010	WHO Mortality Database (ICD-10)
France	1980-1996	GUN SUICIDE: Pequinot et al. (2004: 42) (ICD-9)[v]
	1980-1996	GUN HOMICIDE: INSERM-CépiDc (ICD-9)
	1997-1999	WHO Mortality Database (ICD-9)
	2000-2010	WHO Mortality Database (ICD-10)
Germany	1980-1997	DESTATIS – Statistisches Bundesamt (ICD-9)
	1998-2010	WHO Mortality Database (ICD-10)
England & Wales	1980-1997	Office for National Statistics (ONS) (ICD-9)
	1998-2000	WHO Mortality Database (ICD-9)
	2001-2010	WHO Mortality Database (ICD-10)
Greece	1980-1997	Hellenic Statistical Authority (ELSTAT) (ICD-9)
	1998-2010	WHO Mortality Database (ICD-9)
Ireland	1980-2006	Central Statistics Office (ICD-9)
	2007-2010	WHO Mortality Database (ICD-10)
Italy	1980-1995	ISTAT
	1996-2002	WHO Mortality Database (ICD-9)
	2003	WHO Mortality Database (ICD-10)
	2004-2005	ISTAT
	2006-2010	WHO Mortality Database (ICD-10)
Netherlands	1980-1995	Centraal Bureau voor de Statistiek (ICD-9)
	1996-2010	WHO Mortality Database (ICD-10)
Norway	1980-1995	Folkehelseinstituttet (ICD-9)
	1996-2010	WHO Mortality Database (ICD-10)
Portugal	1980-1997	Instituto Nacional de Estatística (ICD-9)
	1998-2001	WHO Mortality Database (ICD-9)
	2002-2010	WHO Mortality Database (ICD-10)
Spain	1980	Missing
	1981-1996	Portal Estadístico, Ministerio de Sanidad, Servicios Sociales E Igualidad (ICD-9)
	1997-1998	WHO Mortality Database (ICD-9)
	1999-2010	WHO Mortality Database (ICD-10)
Sweden	1980-1986	Swedish National Board of Health and Welfare (ICD-8)
	1987-1995	Swedish National Board of Health and Welfare (ICD-9)
	1996-2010	WHO Mortality Database (ICD-10)
Switzerland	1980-1994	Swiss Federal Statistical Office (ICD-8)
	1995-2010	WHO Mortality Database (ICD-10)

Table S3. *Time Series Cross Sectional Analysis: Gun policy restrictiveness and (gun) homicides (excluding ICD-8)*

Variables	Model I Homicides	Model II Homicides	Model III Gun Homicides	Model IV Gun Homicides
Gun policy restrictiveness	-0.40***	-0.41***	-0.16***	-0.18***
	(0.10)	(0.10)	(0.05)	(0.04)
Alcohol per capita consumption (15+)		-0.00		0.01
		(0.01)		(0.01)
Unemployment (percent of civilian labor force)		0.01		0.01*
		(0.01)		(0.00)
Urban population (percent of total)		0.00		-0.00
		(0.00)		(0.00)
ICD version 10		-0.08		-0.01
		(0.05)		(0.03)
R^2	0.20	0.21	0.08	0.11
N	445	445	444	444

*p<0.1; ** *p*<0.05; *** *p*<0.01; panel-corrected standard errors in parentheses. Dependent variable: (Gun) homicides per 100,000 citizens. Analysis excludes country years for which ICD-8 codes were used: Denmark (1980-1993), Finland (1980-1986), Norway (1980-1985), Sweden (1980-1986), Switzerland (1980-1994).

Table S4. *Time Series Cross Sectional Analysis: Gun policy restrictiveness and (gun) suicides (excluding ICD-8)*

Variables	Model I Suicides	Model II Suicides	Model III Gun Suicides	Model IV Gun Suicides
Gun policy restrictiveness	-1.99***	-2.37***	-0.68***	-0.81***
	(0.47)	(0.49)	(0.16)	(0.16)
Alcohol per capita consumption (15+)		0.18*		0.01
		(0.09)		(0.02)
Unemployment (percent of civilian labor force)		-0.04		-0.01
		(0.05)		(0.01)
Urban population (percent of total)		0.23***		0.03***
		(0.04)		(0.01)
ICD version 10		-0.06		-0.08
		(0.25)		(0.07)
R^2	0.42	0.51	0.21	0.26
N	445	445	445	445

*p<0.1; ** *p*<0.05; *** *p*<0.01; panel-corrected standard errors in parentheses. Dependent variable: (Gun) suicides per 100,000 citizens. Analysis excludes country years for which ICD-8 codes were used: Denmark (1980-1993), Finland (1980-1986), Norway (1980-1985), Sweden (1980-1986), Switzerland (1980-1994).

Table S5. *Time Series Cross Sectional Analysis: Gun policy restrictiveness and (gun) homicides (country fixed effects)*

Variables	Model I Homicides	Model II Homicides	Model III Gun Homicides	Model IV Gun Homicides
Gun policy restrictiveness	-0.47***	-0.40***	-0.19***	-0.15***
	(0.08)	(0.07)	(0.03)	(0.03)
Alcohol per capita consumption (15+)		0.03**		0.03***
		(0.01)		(0.01)
Unemployment (percent of civilian labor force)		0.00		0.01*
		(0.01)		(0.00)
Urban population (percent of total)		0.01		0.00
		(0.01)		(0.00)
ICD version 9		-0.05		0.04
		(0.08)		(0.05)
ICD version 10		-0.17**		0.01
		(0.08)		(0.05)
Country fixed effects	Yes	Yes	Yes	Yes
R^2	0.61	0.67	0.51	0.53
N	479	479	478	478

*p<0.1; ** *p*<0.05; *** *p*<0.01; panel-corrected standard errors in parentheses. *p<0.1; ** *p*<0.05; *** *p*<0.01; Dependent variable: (Gun) homicides per 100,000 citizens. Analysis includes fixed effects for all 16 countries in the sample.

Table S6. *Time Series Cross Sectional Analysis: Gun policy restrictiveness and (gun) suicides (country fixed effects)*

Variables	Model I Suicides	Model II Suicides	Model III Gun Suicides	Model IV Gun Suicides
Gun policy restrictiveness	-2.52***	-2.66***	-0.67***	-0.57***
	(0.49)	(0.46)	(0.15)	(0.13)
Alcohol per capita consumption (15+)		0.10		-0.01
		(0.08)		(0.02)
Unemployment (percent of civilian labor force)		-0.02		0.01
		(0.04)		(0.01)
Urban population (percent of total)		0.00		-0.03**
		(0.06)		(0.01)
ICD version 9		-0.81		-0.01
		(0.50)		(0.14)
ICD version 10		-1.51***		-0.25**
		(0.52)		(0.12)
Country fixed effects	Yes	Yes	Yes	Yes
R^2	0.76	0.80	0.72	0.80
N	479	479	479	479

*p<0.1; ** *p*<0.05; *** *p*<0.01; panel-corrected standard errors in parentheses. *p<0.1; ** *p*<0.05; *** *p*<0.01; Dependent variable: (Gun) suicides per 100,000 citizens. Analysis includes fixed effects for all 16 countries in the sample.

Table S7. *Time Series Cross Sectional Analysis: Gun policy restrictiveness and (gun) homicides (time fixed effects)*

Variables	Model I Homicides	Model II Homicides	Model III Gun Homicides	Model IV Gun Homicides
Gun policy restrictiveness	-0.47***	-0.44***	-0.16***	-0.19***
	(0.10)	(0.10)	(0.05)	(0.04)
Year	-0.01***	-0.01***	-0.00*	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Alcohol per capita consumption (15+)		-0.01		0.00
		(0.01)		(0.01)
Unemployment (percent of civilian labor force)		0.01*		0.01**
		(0.01)		(0.00)
Urban population (percent of total)		0.00		-0.00*
		(0.00)		(0.00)
ICD version 9		-0.14		0.05
		(0.10)		(0.05)
ICD version 10		-0.12		0.04
		(0.09)		(0.06)
R^2	0.23	0.23	0.09	0.12
N	479	479	478	478

*p<0.1; ** *p*<0.05; *** *p*<0.01; panel-corrected standard errors in parentheses. *p<0.1; ** *p*<0.05; *** *p*<0.01; Dependent variable: (Gun) homicides per 100,000 citizens. Analysis includes fixed effects each year in the analysis (*Year*).

Table S8. *Time Series Cross Sectional Analysis: Gun policy restrictiveness and (gun) suicides (time fixed effects)*

Variables	Model I Suicides	Model II Suicides	Model III Gun Suicides	Model IV Gun Suicides
Gun policy restrictiveness	-1.73***	-2.53***	-0.66***	-0.82***
	(0.45)	(0.48)	(0.17)	(0.17)
Year	-0.11***	-0.15***	-0.01	-0.02**
	(0.03)	(0.03)	(0.01)	(0.01)
Alcohol per capita consumption (15+)		0.11		-0.02
		(0.10)		(0.02)
Unemployment (percent of civilian labor force)		-0.05		-0.01
		(0.04)		(0.01)
Urban population (percent of total)		0.29***		0.03***
		(0.03)		(0.01)
ICD version 9		-0.64		-0.01
		(0.46)		(0.15)
ICD version 10		-0.50		-0.07
		(0.44)		(0.11)
R^2	0.41	0.55	0.19	0.25
N	479	479	479	479

*p<0.1; ** *p*<0.05; *** *p*<0.01; panel-corrected standard errors in parentheses. *p<0.1; ** *p*<0.05; *** *p*<0.01; Dependent variable: (Gun) suicides per 100,000 citizens. Analysis includes fixed effects each year in the analysis (*Year*).

[i] The WHO mortality database can be accessed online at http://apps.who.int/healthinfo/statistics/mortality/causeofdeath_query/start.php (last access: 26 February 2018).
[ii] https://www.istat.it/it/archivio/14562
[iii] http://dati.istat.it/Index.aspx?DataSetCode=DCIS_CMORTE1_EV
[iv] The WHO mortality database can be accessed online at http://apps.who.int/healthinfo/statistics/mortality/causeofdeath_query/start.php (last access: 26 February 2018).
[v] Péquignot, F., Le Toullec, A., Bovet, M., Mellah, M., & Jougla, E. (2004). Données sur la mortalité par arme à feu en France (statistique nationale des causes médicales de décès 1979 – 1999) Suicides, accidents, homicides, causes indéterminées quant à l'intention. Retrieved on 26 February 2018 from http://www.cepidc.inserm.fr/inserm/html/pdf/feufin.pdf.