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Factors influencing the rate of homicides by firearms

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Introduction

RESEARCH FRAMEWORK

EVOLUTION OF THE RESEARCH FRAMEWORK

The original request of the provider of funds was to carry out a study for establishing comparisons and observations on the legal possession of firearms and the criminal use of firearms, especially in homicides.

During later meetings with the representative of the provider of funds and following the results obtained during a preliminary research, we suggested tackling the issue with two complementary angles of approach:

- On the one hand, the research will take into account a part of the original request, by attempting to explore the link between the possession of firearms and the rate of homicides by firearms.

- On the other hand, the research will evaluate the links that exist between the laws related to firearms implemented in a set of countries, and the rate of homicides by firearms in this same set of countries.

These two angles of approach constitute the basis of our primary hypotheses, as defined in CHAPTER 2, which presents our research plan.

In order to meet the requested objective, we carried out three distinct steps:

- Firstly, we reviewed the state of the scientific research on this specific topic or on related topics and subjects. *What type of research has been conducted? What methods of data collection and analysis have been used? What results have been obtained?* The reader can find the results of these investigations in our CHAPTER 1, relating to this review of scientific literature.

- Secondly, we explored the accessibility, availability and updated data that we had to collect from each of the selected countries. During this research phase, we quickly found ourselves faced with a lack of standardised data that would enable us to define our variables of interest; namely, the availability/possession of firearms by civilians and the strictness of the laws related to firearms. Concerning the first variable of interest "*availability of firearms*", we were able to measure a proxy variable through the literature review. The second variable "*strictness of the laws*" could not be studied except in relation with a related

index[1], which forced us to construct our own questionnaire in order to establish a second measurement for this variable. These different elements will be described in CHAPTER 2 of this research.

- Lastly, we attempted to establish a suitable statistical model as regards the constraints of access and availability of data, the size of the study, as well as the available resources, in order to be able to explore the aforementioned relations between the rate of homicides by firearms in a given country and our variables of interest (the availability of firearms and the strictness of the implemented laws).

In this context, the analyses conducted and the derived results can be divided into two broad parts:

- The first part relates to studying the links between our different variables on a sample of 52 countries, using the existing data and indicators that were collected.

- The second part will include the statistical analyses conducted on the countries that responded to our questionnaire. This second part will therefore allow us to use the "strictness of the laws" variable as we conceptualised it, using standardised data collected via our questionnaire.

This report consists of 4 chapters:

- CHAPTER 1 puts the addressed issue into perspective and defines the state of the scientific literature on the matter.

- CHAPTER 2 highlights our research plan and describes the precise design of our study: our different hypotheses, the methodology used, the variables studied and the analyses planned.

- CHAPTER 3 presents the results of the statistical analyses conducted on the collected data, as well as a preliminary interpretation of them.

[1] Gun Right Index

- CHAPTER 4 describes the conclusion of this study and summarises the relevant interpretative elements.

Putting things into perspective

In most countries, civilians are able to purchase and possess firearms. However, the purchase and possession of these weapons are generally restricted and regulated in various manners.

Weapons possessed by civilians represent nearly three quarters of the firearms in circulation across the globe. Paradoxically, only a fraction of civilians are the owners of all these weapons (Small Arms Survey, 2013).

For several years now, the proliferation of these firearms has been a concerning issue for multiple leaders and governments across the globe [Homicides, 2013, UNDOC].

One of the main reasons for these concerns certainly comes from the fact that the most widely used instrument for committing homicides is the firearm. The United Nations estimate that nearly four of every ten homicides are committed using a firearm (UNDOC, 2013, p.15).

Alongside this, the economic, social and moral issues linked to the issue of firearms make it a particularly sensitive subject, which is closely followed by the general public. Hence, this topic is highly valued by both, political as well as institutional players. In this context, authors such as HEMENWAY ET WINTMUTE (Hemenway, 2009, Wintmute et al., 2010), have highlighted the influence of these various issues on the quality of the researches conducted in this matter. They have determined that a certain number of studies were presented in order to highlight results that were used to justify certain political choices. Similar bias can be observed among supporters and opponents of the free circulation of firearms. It is therefore important to keep in mind that these ideologies could affect the results highlighted by the studies carried out on this topic.

It should also be noted that legislating on the access and acquisition of firearms appears to be considered, rightly or wrongly, as a means to limit the availability of firearms and, consequently, their circulation. Often, this type of policy underpins a desire to reduce the number of violent crimes and, thereby, the number of crimes committed using firearms.

However, within this law-making desire, note that there is a great diversity concerning the measures of controlling weapons, depending on the country concerned. Some governments impose a complete prohibition on the sale and possession of weapons, whereas others focus on modifying the conditions required to acquire them or even legislating on only certain categories of weapons.

Lastly, although there are measures for making these regulations more consistent, especially from an international point of view, they are generally developed and discussed at different levels of power, thus making their enforcement rather delicate.

In this context, we believe that it is vital to investigate the fact that, apart from the availability of firearms in a given country, the control measures implemented at the national level enable countering a particular form of violent crimes, namely homicides by firearms.

Chapter 1

Scientific literature review

FIREARMS, POSSESSION AND LEGISLATIONS

An analysis of the texts addressing the question of firearms in a quantitative manner has highlighted the fact that most studies attempt to answer two distinct questions:

- One category of studies focus on the possible links connecting the availability and the possession of firearms to two distinct phenomena: suicides and homicides.
- The second category of studies attempts to define the impact of a change in the laws on these same topics, i.e. the rate of homicides and/or suicides in a given region.

THE POSSESSION OF FIREARMS

The first thing to be noted when focusing on studies that investigate links between the availability of firearms and suicides or homicides, is that it is necessary to understand the concept of the availability and possession of firearms by civilians, which is a rather complicated variable.

Effectively, measuring the possession of firearms in a given country is difficult to define, as it requires significant resources (human, technical, financial) for obtaining a reliable measurement. This difficulty can be explained by the fact that the various countries do not always have a central register linking firearms to a single owner. Moreover, in countries where these systems have existed for a certain amount of time, information has not always and systematically been centralised. Lastly, the nature and type of recorded information also varies from country to country.

It should be noted that, during the past decade, two international normative instruments have helped this situation to evolve:

- The Protocol against the illicit manufacturing of and trafficking in firearms, their parts and components and ammunition, supplementing the United Nations Convention against Transnational Organized Crime (hereinafter the "Firearms protocol") (AGNU, 2001).
- The international instrument on the rapid and reliable identification and tracking of illicit small arms and light weapons (hereinafter the "ITI") (AGNU, 2005).

The Firearms Protocol, adopted in May 2001, states, in its article 7, that the

signatories undertake to set up national firearms registries and keep them up to date[2].

The ITI, adopted in December 2005, is a legally binding instrument that imposes the registration of small arms and light weapons[3]. However, it must be noted that this registration is finally defined as a national prerogative, thus limiting the comparability of certain data unless a harmonisation of national practices is imposed in the future.

The Member States of the European Union are also under obligation, as of December 2014, to maintain a firearms registry[4].

Although these developments should, in the future, facilitate the collection of relevant data during researches, access to this data remains highly restricted, nearly reserved only for the authorised authorities.

All these difficulties have created a fertile ground for carrying out studies that focus on developing and validating proxy variables[5], in order to approach the possession of firearms in an indirect manner. As we will see later, the data used to establish these proxy measures are varied and are not equally accessible in all countries.

[2] Article 7 of the Protocol contains the provisions related to the keeping of the registries. It states that "Each State Party shall ensure the maintenance, for not less than ten years, of information in relation to firearms and, where appropriate and feasible, their parts and components and ammunition that is necessary to trace and identify those firearms and, where appropriate and feasible, their parts and components and ammunition which are illicitly manufactured or trafficked and to prevent and detect such activities."

[3] Article 11 of the ITI requests the States to set up "accurate and comprehensive records for all marked small arms and light weapons within their territory and that these records are kept (...) in order to enable their competent national authorities to trace illicit small arms and light weapons in a timely and reliable manner."

[4] Article 4, $4 of Directive 2008/51/EC of the European Parliament and of the Council dated 21 May 2008 amending directive 91/477/EEC of the Council relating to the control of the acquisition and possession of weapons states that: "Member States shall, by 31 December 2014, ensure the establishment and maintenance of a computerised data-filing system, either a centralised system or a decentralised system which guarantees to authorised authorities access to the data-filing systems in which each firearm subject to this Directive shall be recorded. This filing system shall record and maintain for not less than 20 years each firearm's type, make, model, calibre and serial number, as well as the names and addresses of the supplier and the person acquiring or possessing the firearm."

[5] "proxy variables" in English.

THE LAWS RELATED TO FIREARMS

The second category of scientific studies that make up the corpus of the studied literature concerns the researches focusing on the control measures related to firearms. These studies mainly attempt to observe the manner in which modifying the laws related to firearms impacts crime.

We can consider that these studies are an extension to those of the first category, insofar as one of the postulates regularly put forward by these researches is the assertion that the laws are able to limit access to firearms (and therefore limit the possession of firearms) in a country.

MORTALITY RELATED TO FIREARMS

In the literature, the mortality related to firearms is addressed in different manners, depending on the phenomenon being considered. Thus, several studies focus on suicides by firearms, others on homicides by firearms and yet others on fatal accidents involving a firearm. (Anglemeyer A., Horvarth T., Rutherford G., 2014, Pridemore W.A., 2008, Altheimer I., 2012).

These issues and the resultant measures are analysed in various manners, sometimes individually and sometimes simultaneously (by studying the rates of homicides by firearms and the rates of suicides by firearms through various variables) and sometimes even combined (by combining several phenomena) to form new variables (e.g. mortality related to firearms).

These choices are sometimes dictated by theoretical supports, whereas others are justified by the limited accessible data.

This concept of mortality related to firearms therefore often arises from heterogeneous realities, which makes their use somewhat delicate.

The literature that we will present in this part mostly takes into account the researches related to mortality linked to homicides by firearms.

However, being aware of the lessons learned from the studies addressing aspects other than homicides, we will present a few relevant results of researches pertaining to the link between our variables of interest and the rate of suicides by firearms.

Before presenting the empirical studies and their results, we will linger for a bit on the theories developed in the domain that seek to conceptualise the relations that might exist between our variables of interest

(*availability of firearms, laws relating to firearms*) and crime in the broadest sense of the word, or more specifically those committed using firearms.

THE ASSOCIATION BETWEEN THE POSSESSION OF FIREARMS AND CRIME

The relation between firearms and crime is a subject that has been hotly debated on in the scientific world.

Globally, studying this association between the availability of firearms and crime can result in three different statistical findings, namely that these two variables might have a positive relation, or a negative relation or there might not even be any relation. These observed relations will result in different conclusions:

- There is a relation between the availability of firearms and crime:
  - This relation is positive: increasing the availability of firearms will increase the rate of crime and the rate of crime by firearms.
  - This relation is negative: increasing the availability of firearms will reduce crime in general.
- There is no relation between the availability of firearms and crime.

These conclusions respectively consider firearms as a cause of crime, as a mechanism to reduce violent crimes or as totally independent from crime.

These three types of conclusions are the basis of the theoretical hypotheses developed below.

To date, no clear consensus has emerged to unilaterally favour any one of these propositions.

FIRST HYPOTHESIS

Increasing the availability of firearms increases crime.

Theoretical perspectives have suggested that the availability of firearms do indeed increase the global crime rate as well as the rate of crimes committed using firearms. There are two separate hypotheses to explain this:

- The hypotheses of "facilitation"[6] and "triggering factor"[7] focus mainly on the effects of the availability of firearms on the global crime rate.

- The "instrumentality" hypothesis[8] focuses on replacing / substituting firearms with other weapons in the committing of a crime, and the implications that it has on the crime rates related to firearms.

Facilitation

The facilitation hypothesis suggests that increasing the availability of firearms might increase the rate of assaults and thefts.

This hypothesis argues that *the availability of a weapon can encourage an individual who plans to commit an assault to actually commit it, or can encourage an individual who normally would not have committed an assault to do so.* This encouragement can be found in the hypothetical "facilitation" that a weapon procures in the commission of a misdeed.

The possession of a firearm would increase the power of a potential assailant and would ensure the victim's submission, thereby amplifying the chances that the crime will be committed successfully by reducing the probability of an actual physical attack (beyond a threat) being necessary.

This hypothesis is particularly suited to situations where the assailant is weaker than the victim. In such situations, the possession of a firearm by the assailant can neutralise the physical advantage of his opponent (Felson, 1996, p.444).

A weapon can also facilitate the crime by increasing the courage of an assailant, who would normally have avoided coming close to the victim or who would not have used a knife or a blunt weapon to stab or bludgeon a person to death.

[6] ("facilitation hypothesis")
[7] "Triggering hypothesis" / "Weapons effect"
[8] ("Weapons Instrumentality hypothesis")

Triggering factor

Another manner in which *weapons could increase crime is by triggering an aggressive response in the potential perpetrator.* The "Weapons effect" is a phenomenon described by BERKOWITZ ET LEPAGE (1967), according to which *the presence of a firearm can lead to more aggressive behaviour, especially in persons who are already in a certain state of arousal.*

Moreover, BERKOWITZ (1983) also highlighted that the presence of a firearm is likely to intensify negative emotions such as anger. Thus, a situation where a firearm is present would result in more aggressive and violent behaviour, likely to result in offences (thus inflating the figures of general crime). This presence of firearms could also result in an increase in fatal outcomes of certain situations, thereby increasing the rate of homicides by firearms.

By applying these theoretical concepts to the observations that should result from them at a macro-analytical level, the facilitation and triggering factor hypotheses indicate that we should be able to find a positive association between the availability of firearms and the rate of violence by firearms on the one hand, and violence in general on the other hand. It is expected that the availability of firearms will be positively correlated with armed assaults and armed thefts, since expanded access to firearms would result in more citizens considering that any crime committed would be greatly facilitated if a weapon is used.

The triggering factor hypothesis suggests that the availability of firearms would be positively associated with the global levels of assaults and thefts, as this availability would trigger aggressive behaviours in citizens and would encourage individuals who would normally not commit crimes to do so.

Weapon instrumentality

The "Weapon instrumentality" hypothesis suggests that *the availability of firearms increases the probability that crimes involving firearms will be committed. A greater availability of firearms will effectively increase the probability that an assailant will use a firearm instead of another weapon (or no weapon) while committing a crime.* The final result of this substitution would therefore be an intensification of the violence of the committed act (Cook, 1991; Zimring & Hawkins, 1997).

There are three basic postulates of the "Weapon instrumentality" perspective. The use of a firearm to commit an assault or a theft:

- increases the probability of death or serious injury
- gives the assailant the opportunity to injure at greater distances
- facilitates the assault of a greater number of victims as compared to the use of other weapons normally used to commit violent crimes (e.g. a knife or a bat).

Firearms, with respect to other weapons, would increase the lethality of injuries and the fatal outcome of the acts perpetrated using this type of weapon[9].

This perspective, applied at the macro-analytical level, suggests that *the availability of firearms will be positively associated with violence by firearms.* Increasing the level of accessibility to firearms in a city would therefore result in more citizens using a firearm instead of another weapon for committing an assault. Thus, these crimes have a greater probability of causing deaths or serious injury.

Contrary to the facilitation hypothesis and the triggering factor hypothesis, *this hypothesis does not assume that increasing the availability of firearms will increase the rate of assaults or thefts in general*, but rather the rate of crimes involving a weapon, thereby increasing their lethality.

[9] It should also be noted that the lethality of a firearm may depend on the calibre used, as stated by Zimring (1972). Beyond just the weapon calibre, the probability that a victim of a bullet injury succumbs to this injury also depends on other variables such as the location of the injury, the availability of medical infrastructure nearby, the length of time in which the victim is given treatment and the treatment's effectiveness.

SECOND HYPOTHESIS

Increasing the availability of firearms reduces crime in general.

Another theoretical perspective, completely contradictory to the first, contains the possibility that the availability of firearms would reduce the level of crime (Kleck, 1997; cited by Altheimer, 2008; Cook, 1991; Lott & Mustard, 1997). This refers to the protective effect that firearms might have.

In this perspective, *increasing the level of accessibility to firearms would result in a greater capacity for the public to stop or hinder the commission of an assault* (Kleck, 1997; cited by Altheimer, 2010; Cook, 1991).

KLECK (1997; cited by Altheimer, 2010) suggests that the availability of firearms would prevent the commission of a criminal act in two manners:

- An armed victim can prevent the commission of a crime by neutralising the armed assailant or by modifying the balance of power in his/her favour on being confronted by an unarmed assailant (Kleck, 1997; Kleck & Delone, 1993; Tark & Kleck, 2004; cited by Altheimer, 2010).
- An armed victim can use a weapon to resist the assault of a perpetrator that avoid an injury (Kleck, 1997, cited by Altheimer, 2010).

Increasing the level of accessibility could also reduce crime by discouraging potential perpetrators (Kleck, 1997; Wright & Rossi, 1986; cited by Altheimer, 2010). These potential perpetrators may therefore refrain from committing a crime for fear of reprisal from the victims. This discouragement can be specific or general. For example, a criminal might refrain from committing new attacks after facing an armed victim in a previous experience, or an attacker might refrain from committing a crime if he/she believes that a large proportion of potential victims might be armed (Rengert & Wasilchick, 1985; cited by Altheimer, 2010).

Applied at the macro-analytical level, this perspective suggests that the availability of weapons should be negatively associated with crimes by firearms and crime in general. Therefore, in cities where inhabitants have greater access to firearms, the potential victims will be better equipped to discourage or prevent certain criminals from committing crimes.

THIRD HYPOTHESIS

Increasing the availability of firearms does not influence crime.

The third perspective discussed here suggests that *the availability of firearms does not have a global effect on the level of crime* (Kleck, 1997 cited by Altheimer, 2010).

This lack of effect could result from two reasons:

- The availability of firearms might simply have no influence on crime. Thus, the use of a weapon could simply reflect a greater motivation by the perpetrator to harm the victim (Wolfgang, 1958, cited by Altheimer, 2010). If this hypothesis is true, the absence of a weapon would simply lead the assailant to use another type of weapon to reach the desired goal.
- The second possibility is that the effect between the availability of firearms and crime cannot be detected owing to a defensive use of firearms. Firearms used for legitimate defence could neutralise the effects of firearms used for criminal assaults (Kleck, 1997 cited by Altheimer, 2010). Thus, the observable link could be neutralised by opposing or compensatory effects.

Applied to a macro-analytical perspective, these assertions suggest that a change in the availability of firearms would not influence or has no link with crime.

The following table shows a summary of the hypotheses described above, and summarises the expected effects of each of them on crime.

TABLE 1 - Summary of the theoretical hypotheses concerning the link between the availability of firearms and crime

	HYPOTHESES	Rel. between CRIM & AVAIL	AVAIL effects on CRIM	AVAIL effects on CRIM/FA	AVAIL effects on HOM/FA
"MORE GUNS, MORE CRIME"	FACILITATION	+	↗	↗	↗
	TRIGGERING FACTOR	+	↗	↗	↗
"MORE GUNS, MORE GUNS CRIME"	WEAPON INSTRUMENTALITY	+	No effect or ↗	↗	↗
"LESS GUNS, LESS CRIME"	PROTECTIVE EFFECT OF GUNS	-	↘	↘	↘
"GUNS DON'T KILL"	NO RELATION	None	No effect	No effect	No effect

THE ASSOCIATION BETWEEN THE LAWS RELATED TO FIREARMS AND CRIME

The hypotheses underlying the influence of the laws related to firearms on crime are not different from those expressed above.

Globally, the elements via which laws can influence the rate of mortality by firearms are as follows:

- Accessibility:
- Availability
- Dissuasion

Concerning the rate of homicides by firearms, we can summarise this influence as the fact that *the laws can indeed prevent homicides by firearms by reducing the availability and accessibility of firearms, and could also have a dissuasive effect owing to the strictness of the punishments applied to offences committed using firearms.*

Accessibility:

Limiting the accessibility aims to make it more difficult for an individual to procure a firearm at a given location and at a given time (Cuckier, 1998; cited by Blais, Gagné & Linteau, 2011).

The postulate behind this limitation is as follows: *the easier the laws make it to access firearms, "the greater the proportion of homicides by firearms will be with respect to the total number of homicides" (Ludwig & Cook, 2003, cited by Blais et al., 2011).* This type of measurement mainly focuses on the purchase of weapons, it being considered that access to firearms is normally made more difficult by regulating their purchase.

In fact, the laws regulating the purchase of firearms increase the effort and cost that an individual must invest in order to acquire a firearm. Imposing in-depth history verification procedures and requiring a weapon purchase permit are some measures to this effect.

Availability

Limiting the availability is often justified using the following assertion: *the greater the number of firearms in circulation, the greater the number of homicides by firearms will be.*

To reduce this availability, the legal response is generally a limitation, prohibition or expanding the panel of weapons to which these limitations apply.

Contrary to the previous two points, some authors (Kleck, 1993; Kates & Mauser, 2007) believe that reducing the accessibility to firearms or reducing their availability is not a globally acceptable solution. They believe that other lethal means are accessible to individuals who wish to commit a homicide. According to these authors, limiting the access and availability of firearms will only shift the problem elsewhere. We would thus observe one weapon being replaced by another, thereby increasing the number of deaths by means other than firearms. However, it should be noted that this

opinion is based on the idea that most murders are premeditated by the perpetrator and that an intention to kill is present before the act and is persistent. Yet, it is reasonable to believe that some homicides are not the result of a murderous premeditation, but are actually decided in the moment.

Dissuasion

The laws may also lay down stricter punishments to discourage potential delinquents from committing crimes using firearms. This dissuasion effect is based on the idea that the delinquent is a rational being, committing a deliberate act and balancing the potential benefits and risks that would result from this act.[10]

To conclude this brief theoretical overview, it should be noted that the hypotheses related to the influence of laws on crime systematically pertain to laws in the broadest sense of the term. In this sense, the postulates made do not refer to a specific measure that is likely to influence crime related to firearms, but laws in their entirety.

After this brief theoretical overview, we will now present the empirical studies that attempted to address these same relations between:

- the possession/availability of firearms and mortality by firearms
- the strictness of the laws related to firearms and mortality by firearms

[10] (refer to the Rational choice theory).

THE STUDY OF THE RELATION BETWEEN POSSESSION AND MORTALITY BY FIREARMS

In this section, we will present a set of researches that sought to address the relation that might exist between the possession of firearms and mortality by firearms, and more specifically when possible, the rate of homicides by firearms.

The studies will be presented based on the methodology that they use. We will address:

- individual case-control studies
- cross-sectional and longitudinal studies carried out at the national level
- cross-sectional and longitudinal studies carried out at the international level

The research framework of each study will be presented in a concise manner, as we will focus mainly on the description of the link observed between the conceptualisation of the possession of firearms and homicides. This positioning choice can be explained by the desire to link the results to the methodological specificities of the researches in question, especially with respect to the diversity of the measurements used by the researchers of the domain in order to address the concept of possession/availability of firearms.

THE CONCEPT OF AVAILABILITY OF FIREARMS

The possession of firearms is a variable that has been used in several researches, although under different names. Researchers make no distinction between firearm possession, prevalence or availability or access. We will also use these different terms to define this variable.

A recurring critique on the use of this indicator of possession and availability is based on the fact that no consensus appears to exist on the measurement that would best enable addressing the reality of firearm possession, seeing as the number of citizens possessing one or more firearms is not available, accessible or is presented in different manners in different regions and countries.

This finding has given rise to attempts to create a new index that reflects the actual possession of firearms in given regions[11]. While these attempts regularly materialise via surveys conducted on a representative sample of the population, it should be noted that this type of survey, aside from the limitations specific to the methodology that it uses[12], also poses problems at the implementation level and regarding the logistical and financial resources that it requires.

Researches studying the possession of firearms must therefore regularly use indirect measures, which are believed to reflect this actual possession.

Out of the studies investigating the link between the availability of weapons and crime, we can highlight a part of these different "alternative" measurements:

- The number of official firearm licences issued in a country (Kapusta, Etzersdorfer, Krall & Sonneck, 2007[13]).
- The number of purchase permits for handguns (Bordura, 1986; Fisher, 1976; Newton & Zimring, 1969; cited by Hepburn & Hemenway, 2004).
- The rate of firearm sellers per 100,000 inhabitants (Price, Thompson & Dake, 2004).
- The number of subscriptions to a review on firearms (Duggan, 2001).
- The rate of accidental mortality involving a firearm (Lester, 1988; cited by Hepburn & Hemenway, 2004).
- The rate of use of firearms in the committing of violent crimes (Kleck, 1984; Mc Dow Cook, 1982; cited by Hepburn & Hemenway, 2004; Lester, 2000).
- Cook's index (Sloan et al., 1988; cited by Hepburn & Hemenway, 2004; Hemenway & Miller, 2000; Miller, Azrael & Hemenway, 2002) which uses the mean of the percentages of homicides and suicides committed using firearms.
- The percentage of suicides on the rate of homicides by firearms (Lester, 2000).
- The number of suicides by firearms out of the total number of suicides (Hemenway & Miller, 2002; Siegel, Ross & King, 2013).

In a 2004 study, GARY KLECK lists more than twenty measurements used in local, regional, national and international studies. *This great diversity is undoubtedly one of the*

[11] Among these are the International Crimes Victims Survey, the Behavioural Risk Factor Surveillance System and General Social Survey. All these surveys especially contain questions related to the possession of firearms.

[12] For example, Representativeness of the studied sample; generalisation from a sample of the population; dependence on the persons who compose the sample understanding and completing the questionnaire; social desirability bias,

[13] Refer to the author's publication for a critique on this measurement.

components that explains the inconsistency of certain results of research in this domain.

Apart from the diversity of measurements used, it is also interesting to take into account the fact that it is unanimously recognised that a limited number of civilians possess firearms. When they possess firearms, they normally own several of them. *The rate of possession per inhabitant could therefore be a biased measurement of the possession of firearms, and does not reflect reality.*

During the evaluation of a series of proxy variables of the possession of firearms, AZRAEL & HEMENWAY (2001) highlighted that the indicator measuring the ration between the number of suicides by firearms on the total number of suicides was the one that produced the most consistent results when compared with firearm possession measurements taken from surveys of households.

GARY KLECK (2004) confirmed these results and estimated that out of the 25 proxy measurements of the possession of firearms that he listed from literature, the ratio between the number of suicides by firearms and the total number of suicides was the best estimator for international studies. He came to this finding by correlating these different measurements with those obtained during self-reported surveys.

In light of these results, the proxy variable that we will use is the ratio between the number of suicides by firearms on the total number of suicides, in order to conceptualise the availability of firearms in the countries that make up our sample.

INDIVIDUAL STUDIES

Case-control studies

Individual empirical studies use methodologies that take into account comparisons between a target population and a control population. In this category, there are case-control studies that were originally used in medicine, which are regularly used to highlight risk factors that could contribute to the appearance of a given phenomenon.

In the case of mortality by firearms, the idea is to compare the characteristics of a population of subjects, whose death was caused by a firearm, to a population of subjects who are still alive. These two populations should also share a certain number of common characteristics that enable "pairing" them (age, sex, place of residence, etc.).

In 1993, KELLERMANN ET AL. conducted a case-control study on 388 homicides that occurred in the homes of the victims. They studied a database containing all homicides in Tennessee, Washington and Ohio over a period of five years. Their results highlighted that half of these homicides were carried out using a firearm and that most of the perpetrators were friends of members of the family. By using a control case for each studied homicide, they observed that *people living in a house with a firearm present were at a three times greater risk of being the victims of a homicide than those who did not possess a firearm.*

CUMMINGS, KOEPSELL, GROSSMAN, SAVARINO ET AL. (1997) conducted a case-control study in a major private healthcare centre (HMO- Health Maintenance Organization). They compared a group of employees who were victims of homicides by firearms with a control group of employees, still alive, comparable on the basis of characteristics such as age, sex and place of residence. Their results showed that *the risks of being a homicide victim for individuals possessing a handgun in their house are two times greater than households that do not own such a weapon.* The risk of being a victim of a homicide committed using a firearm also increases based on these same conditions.

WIEBE ET AL. (2003, cited by Humeau et al., 2007) also conducted a case-control study using data of an American national survey of 1993, the "National Mortality Followback Survey". For each case that corresponded to their research criteria, they also collected information related to the possession of one or more firearms by the victim, by questioning the entourage of the said victim. Their study also used a control group of subjects, still alive, who they compared with the selected cases based on their sex and age. Their analysis showed that *the possession of a firearm is linked to a risk of suicide that is three times greater* (3.44). Moreover, the comparison between individuals possessing a firearm at home with those not owning one, shows that *the risk of being a homicide victim is significantly higher among the former.*

In a 2004 study, DAHLBERG, IKEDA & KRESNOW proved that *people possessing a firearm are at a higher risk of being victims of homicide in their homes*. However, they noted that this increased risk is only present for people who live with others in their house. For those who live alone, the association could not be proven. This finding reinforces the idea that many homicides by firearms are the tragic outcome of interpersonal quarrels and domestic violence.

These different results appear to show that at the individual level, the possession of a firearm in the house significantly increases the risk of being a homicide victim.

However, it should be noted that one of the major limitations of this type of study is *the comparability of the target and control populations*, which can be determined from the quality with which they have been paired. Moreover, these studies are limited as they examine the risks and benefits of the possession of firearms only at an *individual level*. They therefore cannot be used to evaluate whether the possession of firearms in the population has an influence on the mortality related to weapons in a given country.

Without denying the interest of the results obtained by individual studies regarding the understanding of the links connecting the availability of firearms and mortality by firearms, we will not focus on this type of methodology in this research, mainly owing to its inability to be applied to a macroscopic level. The next section will address the ecological studies that attempt to overcome this main limitation of case-control studies.

MACROSCOPIC STUDIES

National studies

PRICE, THOMPSON & DAKE, in their 2004 study, investigated the relations that might exist between the rate of homicides, suicides and accidental deaths by firearms, by taking a series of 16 variables into account.

Their statistical tests used the data specific to these variables, collected in the fifty American states for the year 1999, by the "Centres for Disease Control and Prevention".

In order to conceptualise the variable concerning the possession of firearms, they used the proportion of the number of suicides by firearms on the total number of suicides. The results of their bi-variable correlation analyses showed that *the prevalence of firearms measured in this manner is significantly correlated to the rate of homicides by firearms* (r = 0.422; $p<0.001$). This relation becomes even stronger when they integrate socio-economic variables in their model (r = 0.516; $p<0.001$). In the latter model, 27% of the variance of the rate of homicides by firearms between states can be explained by the prevalence of firearms.

The conclusion of their study is that the rate of homicides varies significantly according to the prevalence of firearms and the proportion of African Americans in this same country. They also highlight that the national laws related to firearms only have a limited effect on the rate of homicides by firearms.

DUGGAN (2001), in his research evaluating the link between the possession of firearms and the evolution in trends related to the committing of violent crimes across fifty American states, used the subscription rates to the Guns & Ammo magazine[14] as the proxy measure. He validated the use of this measurement by proving that *the rate of subscription to this magazine is highly correlated with the estimate of firearms possession obtained through the "General Social Survey"*[15] (GSS). The results of his study showed that this measurement is associated with changes in the rates of homicides. He also demonstrated that *an increase in the possession of firearms by 10% is linked to an increase of 2.14% in the rate of homicides during the following year.*

[14] The Guns & Ammo magazine is one of the highest-selling magazines on firearms in the United States of America.

[15] The "General Social Survey" is a sociological survey conducted by the National Opinion Research Centre (NORC) of the University of Chicago. This national survey is conducted through face-to-face interviews and has been conducted every year since 1994. Some surveys of this centre can be directly viewed on their website: http://www3.norc.org/GSS+Website

We think that it is important to mention that the question raised with respect to possession is as follows: "Do you happen to have in your home (or garage) any guns or revolvers?". Hence, this is not a measurement that takes personal possession as such into account, but rather the possession or accessibility of a firearm in a household.

BRIDGES & KUNSELMAN (2004) used "Cook's Index" to study the relation between the availability of firearms and the rate of homicides in Canada between 1974 and 1999. These authors used the homicide data taken from two different databases: the "Canadian Mortality Database" developed by Statistics Canada (2002) and the "Homicide Survey" of DAUVERGNE (2002). At the end of their study, they found a *particularly important and significant correlation between the availability of firearms and homicides committed using a firearm for both data sets* (Canadian Mortality Database : r = 0.94; p<0.001 and Homicide Survey: r = 0.87; p<0.001).

MILLER, HEMENWAY & AZRAEL (2007), also demonstrated a *link between the prevalence of weapons and the homicide rate*. The measurement of the prevalence of weapons was taken from the results of the "Behavioural Risk Factor Surveillance System" survey[16] dated 2001. The data related to homicides were incorporated from 2001 to 2003. Their analysis showed that *the States with higher possession of weapons have higher rates of victimisation and homicides by firearms.* This relation persists when variables such as thefts or unemployment are controlled.

LESTER (2000) conducted a longitudinal study using data on homicides and suicides from 1970 to 1996 in Canada. His results showed that *the availability of firearms is positively associated with the rate of homicides by firearms and negatively associated with the rate of homicides by any other method.*

SIEGEL, ROSS & KING (2013) recently conducted a study with a particularly developed statistical design that took several confounding variables into account, in addition to the data on the availability of firearms and homicides by firearms. In their studies on 50 American states, they collected data from the period of 1981 to 2010. At the end of their research, they concluded that *the availability of firearms is a significant predictor of the rate of homicides by firearms.*

The most recent longitudinal study on the link between mortality related to firearms and the possession of firearms is the 2013 study of SIEGEL, ROSS & KING. They also used the proportion of suicides by firearms out of the total number of suicides for conceptualising the prevalence of firearms. The statistical model used is particularly well developed, as it controls a set of variables that are regularly shown as being linked to the rate of homicides.

The results obtained showed a significant correlation between the prevalence of firearms and the rate of

[16] The "Behavioural Risk Factor Surveillance System" is a telephonic survey service controlled by the "Centres for Disease Control and Prevention" of Atlanta. Originally created to supplement the American National Bureau of Statistics, which did not collect State-wise data. With its 500,000 interviews conducted in 2011, it is now the largest telephonic survey service in the world.

homicides by firearms. The authors conclude by stating at countries with higher rates of firearm possession were characterised by disproportionally elevated rates of mortality related to firearms.

Alongside these studies whose results appear to constantly prove the positive relation between the prevalence of firearms and the global rate of homicides, or more particularly the rate of homicides by firearms, other researches have shown more nuanced results.

This is especially the case for the study of KAPLAN & GELING (1998). In their research, they used mortality data taken from the "National Centre for Health Statistics" (NCHS) covering a period of 3 years (1988-1991). For measuring the prevalence of firearms, they used data of the GSS (see above) from 1989 to 1991.

At the end of their analysis, the interpretation of the Spearman's correlation coefficient showed that *the association between the possession of firearms and the rate of homicides is only significant for women* ($r_s = 0.78$; $p = 0.01$).

In 2009, GIUS used data of the 2001, 2002 and 2004 surveys of the "Behavioural Risk Factor Surveillance System" in order to conceptualise the prevalence of firearms among the population. In order to link this variable with the rate of homicides, he collected data from the "Statistical Abstract of the United States and Uniform Crime Reports" produced by the U.S. Federal Bureau of Investigation (FBI) for the same years, for the 50 American states. To control the influence of confounding variables, he integrated a certain number of socioeconomic data in his regression model.

The interpretation of his model enabled observing *a significant relation between homicides and the prevalence of firearms. However, this relation is only significant at a significance threshold of 10%.* This means that there is one chance out of 10 that this relation was due to random chance.

Other studies have also shown contradictory results on the relation that might exist between the availability of firearms and the rate of homicides by firearms.

MOODY & MARVELL (2005) used GSS data to estimate the possession of firearms in the 50 American states. They studied this measurement using an econometric model and linked the availability with the crime rates taken from the FBI reports, the "Statistical Abstract of the United States and Uniform Crime Reports" on data dated from 1977 to 1998. Contrary to the previous studies, *their model did not show any relation between the prevalence of firearms and the rate of homicides. The effect of firearms on the rate of homicides is null according to their conclusion.*

STOLZENBERG & D'ALESSIO (2000; cited by Altheimer, 2008) studied this same relation in 46 counties of the state of South Carolina using data from 1991

to 1994 of the "National Incident-Based Reporting System" (NIBRS). This database contains information on the number of firearms stolen per year, as well as the number of licences granted to citizens per county. The authors used this data to distinguish between the prevalence of legal firearms and illegal firearms.

At the end of their study, the authors proved that *the prevalence of illegal firearms is correlated with the rates of crimes involving firearms, while the prevalence of legal firearms is not correlated.*

International studies

In his study covering 11 European countries, Australia, Canada and the United States of America, KILLIAS (1993) examined data collected during a telephonic survey conducted as part of the "International Crime Survey" in 1989. He particularly examined the data related to the possession of weapons and compared them with the national rates of homicides and suicides conducted using a firearm. His study showed *positive correlations between the percentage of households possessing firearms and the number of homicides and suicides by firearms.*

In 2001, KILLIAS, VAN KESTEREN & RINDLISBACHER made comparisons by taking data from international studies on victimisation (dated 1989, 1992 and 1996) and WHO statistics on homicides and suicides in 21 countries. Studying the correlations they established showed that there is a *significant correlation between the presence of firearms in houses and the rates of suicides by firearms as well as homicides by firearms whose victim is female.*

In their 2002 study, HEMENWAY & MILLER studied 26 countries classified as being high-income countries according to the classification established by the World Bank. To conceptualise the possession of firearms, they used two proxy variables: the proportion of suicides by firearms and "Cook's Index".

They showed that these two measurements are highly correlated with the rate of homicides. However, once the United States of America are removed from the equation, only the relations between Cook's Index and the rate of homicides by firearms remain significant.

ALTHEIMER AND BOSWELL (2012) also studied the link between the availability of weapons and homicides in 43 countries. Their model takes a certain number of demographic and economic variables into account (GINI coefficient, proportion of young men in the population, urbanisation). The variable chosen to conceptualise the availability of firearms is the rate of suicides by firearms per 100,000 inhabitants. Contrary to the previous international studies, *the accessibility to firearms here is negatively correlated with the global rate of homicides.*

These results are contrary to the theoretical expectations that are

normally put forward, probably due to the proxy variable used.

In their transnational study on 25 high-income countries, HEMENWAY & MILLER (2002) collected data on the victimisation of women for the period from 1994 to 1999 and compared it with a measurement of the availability of firearms in each country. They concluded that in *countries where the availability of firearms is greater, women were at greater risk of being victims of homicide, and even more significantly, victims of homicide by firearms.*

Meta-analyses

Although it does not pertain to homicides by firearms, we have deemed it important to note the 2007 meta-analysis conducted by HUMEAU ET AL. They used cross-sectional studies on the availability of firearms and its impact on the suicide rates.

As reported earlier, we observed an over-representation of American studies in this domain.

12 out of the 19 studies that these authors listed concerned the United States of America (see the Table below).[17]

Out of the 19 studies that they list, they observed that 18 among them showed a positive correlation between the availability of a firearm and the rate of suicides by firearms.

They concluded that a large majority of studies that they examined showed that the accessibility to firearms significantly increases the risk of suicide by firearms.

In 2004, HEPBURN & HEMENWAY conducted a literature review of peer-reviewed studies that focused on the link between the availability of firearms and homicides. The objective of this review was to exclude a set of studies whose validity was uncertain or whose neutrality was not proven.

At the end of their research, they asserted that the few case-control studies conducted and published in this respect, showed that households having firearms were at a greater risk of being victims of a homicide, and especially a homicide by firearms.

Among the international cross-sectional studies that they examined, they found that in countries where there is a high prevalence of firearms, both men and women were at a greater risk of being victims of homicide and homicide by firearms. However, the authors noted that when the United States of America were excluded from some researches, the results are no longer significant, although most of the relations between availability and homicide remain positive. They explained these results by the fact that the United States of America have a much higher rate of firearms

Table 1
Studies pertaining to the availability of firearms (FA) and its impact on suicide rates

Study	Country	FA availability measurement	Impact on the rate of suicides by FA	Impact on the global suicide rate
Farmer & Rohde (1980) [14]	Multiple countries concerned	None	Yes	Yes
Boor (1981) [1]	USA	Number of FAs imported and manufactured	Yes	Yes
Boyd (1983) [3]	USA	FA sales	Yes	Yes
Markush & Bartolucci (1984) [31]	USA	Survey	Yes	Yes
Boyd & Mowcicki (1986) [15]	USA	Manufacturing of FAs	Yes	Yes
Lester (1988) [27]	USA	Survey	Yes	NO
Wintemute (1988) [41]	USA	FAs for sale	Yes	NO
Lester (1989) [28]	USA	Rate of accidental deaths by FAs	Yes	?
Clarke & Jones (1989) [9]	USA	Survey	Yes	NO
Cantor & Lewin (1990) [7]	Australia	Survey	Yes	NO
Lester (1990) [28]	USA	Percentage of homicides by FAs	Yes	NO
Sloan (1990) [35]	USA	No. of FA purchases	Yes	NO
Kleck (1991) [22]	USA	Multiple indices	NO	NO
Moyer & Carrington (1992) [15]	Canada	Survey	Yes	Yes
Dudley (1992) [13]	Australia	Previously conducted researches	Yes	Yes
Killias (1993) [21]	Multiple countries concerned	Survey	Yes	Yes
Hawton (1998) [18]	United Kingdom	Survey	Yes	NO
Hemenway & Miller (2002) [19]	USA	Survey	Yes	Yes
Bridges (2004) [5, 6]	Canada	Average of the percentage of suicides + homicides by FAs Rate of accidents/FA Avg. S + H/AAF	Yes	Yes

[17] by Humeau, Papetb, Jaafarib, Gotzamanisa, Lafayb and Senonc (2007) and published in the review *Annales Médico Psychologiques*.

possession and that the regulation of firearms in the other countries that were studies is often more comprehensive that in the United States of America.

STUDY OF THE RELATION BETWEEN THE LAWS RELATED TO FAS AND MORTALITY BY FAS

A certain number of studies focused on evaluating the association between the laws related to firearms and the reduction of mortality related to firearms.

It should be noted that, in this field of study, the authors obtained extremely varied results with extremely varied methodologies. Moreover, the researches were also different with respect to the scope of the laws that they studied; some taking into account only a specific aspect of the laws related to firearms while others consider them in their entirety. The following two sections will address the results obtained by distinguishing between the studies conducted based on the manner (specific or global) in which they approach the laws.

SPECIFIC LEGISLATION

A review of the studies conducted showed that in the United States of America, most of the studies focus on the link between crime and certain specific laws.

These studies investigated different aspects of the laws on firearms:

- The prohibition of certain firearms or ammunition (Kleck & Patterson, 1993; Vernick, Webster & Hepburn, 1999; Weil & Knox, 1997; Loftin, McDowall, Wiersema & Cottey, 1991; Roth & Koper, 1999; Britt, Bordua & Kleck, 1996; McDowall, Loftin & Wiersema, 1996),
- The restriction of the acquisition of firearms (Kleck & Patterson, 1993; Wintemute, Wright & Beaumont, 1999),
- The waiting periods for acquiring a firearm (Kleck & Patterson, 1993; Ludwig & Cook, 2000);
- The registration of the weapon and the owner (Kleck & Patterson, 1993; Webster, Vernick & Hepburn, 2001);
- The right to bear arms (Kleck & Patterson, 1993; Ludwig, 1998; Duggan, 2001; Mustard, 2001; Dezhbakhsh & Rubin, 2008; McDowall, Loftin & Wiersema, 1995; Plassmann & Tideman, 2001)

These studies were evaluated by the "Task Force on Community Preventive services" (Hahn et al.,2005), during a systematic review of the researches having the greatest methodological

validity out of all the studies available when this evaluation was carried out.

At the end of their review and evaluation, HAHN ET AL. estimated that no definitive correlation can be found from these studies. They showcased a certain number of points that should be improved in the scientific research in order to be able to draw definitive conclusions, especially vis-à-vis the recording of and access to data or, vis-à-vis the lack of details on the information collected by the databanks (e.g. in case of a crime committed using a firearm, provide the type of weapon). They also highlighted shortcomings in terms of statistical design, as well as the lack of consideration of certain effects that could be provoked by the introduction of particular laws (e.g. effect of substituting one weapon for another following a particular restriction). Lastly, they insisted on the need to continue to conduct new researches on this topic.

Among the other researchers who focused on studying the effect of laws on homicides and suicides by firearms, RUDDELL & MAYS (2005) studied the effects of laws that required an inspection of the history of firearm purchasers in the various American states. They compared this element with the rate of homicides by firearms. The data that they used for their statistical study covered a period of three years (1999-2001). Their results showcased that *states having the most comprehensive laws concerning the verification of history showed negative relations with the rates of homicides by firearms.*

In another vein, some studies also show that storage practices can affect the rate of suicides by firearms, particularly among adolescents. In their study, GROSSMAN ET AL (2005; cited by Humeau, 2007), showed that *firearms used in suicidal behaviour are less often stored unloaded, secured or its ammunition is less frequently stored separately, as compared to a control group*. This study showed that *practices of the secure storage of weapons, which can be imposed by the laws of a state, are associated with a reduction in the risk of suicide among adolescents and accidental injuries by firearms.*

STUDIES THAT TAKE MULTIPLE COMPONENTS OF LAWS INTO ACCOUNT

As noted by HAHN ET AL, very few studies take into account all the laws related to firearms. Among those studies that do so, most often focus on the association between the laws and suicide (Cantor 1995; cited by Fleegler, 2013; Conner & Zhong, 2003).

ROSENGART, CUMMINGS, NATHENS, HEAGERTY, MAIER, RIVARA (2005) studied the relation between the rates of suicides and homicides by firearms and a series of laws regulating weapons in 50 American states, using statistics derived from econometrics. *These authors could not find a link between the studied laws and the rates of suicides and homicides by firearms.*

PRICE, THOMPSON ET DAKE (2004) studied the relations between the rate of suicides and homicides by firearms, the prevalence of firearms and the laws related to firearms. Their results showcased *a strong correlation between suicides by firearms and the prevalence of firearms, as well as with the laws related to weapons that they examined.* As regards homicides by FAs, by integrating a series of confounding variables, they showcased *a positive relation with the restrictive nature of laws on firearms ($r = 0.311$; $p < 0.05$) and the prevalence of firearms ($r = 0.516$; $p < 0.001$).*

The recent study of FLEEGLER ET AL. (2013) examined the link between the laws related to weapons present in the American States and mortality related to firearms in these states. They explored this relation using a particularly sophisticated cross-sectional and ecological methodology.

They used data from the "Web-based Injury Statistics Query and Reporting System" for the years 2007 to 2010. To examine the effect of the laws, *they created a score of the "strictness of the law" that they compared with the mortality rate in the State.* Several results were drawn from their research. *Firstly, a larger number of laws related to firearms in a state is associated with a lower rate of mortality by firearms.* This relation is still valid when socioeconomic factors (age, sex, ethnicity, poverty, unemployment, education, population density, firearm possession) are controlled. Next, *higher scores were associated with a lower rate of firearm possession. The possession of firearms was positively related with the global rate of mortality caused by firearms.* However, it should be noted that the index that they developed has not been validated.

LONGITUDINAL STUDIES OUTSIDE THE US

KAPUSTA, ETZERSDORFER, KRALL & SONNECK (2007) studied the effect of the reform of Austrian law on firearms following the directive of the European Council of 1991 on firearms, homicides and suicides by firearms. The data used was collected from the Austrian Bureau of Statistics, and covered the years 1985 to 2005. At the end of their analysis, KAPUSTA ET AL. estimated that *following the introduction of a stricter law, the rates of homicides by firearms reduced significantly.*

MOUZOS & RUSHFORH (2003) examined mortality related to firearms between the period from 1991 to 2001 in Australia. They found that *5 years after the application of the new weapons control law of 1996, the rate of homicides by firearms with female victims fell by 57%*. They also showed that during the studied period, *suicides and homicides by firearms reduced by half* whereas deaths caused by bladed weapons remained practically unchanged (Mouzos & Rushforh, 2003, p.2).

CONCLUSION RELATED TO THE SCIENTIFIC LITERATURE

As we have attempted to showcase in this first chapter, several authors have focused on the global topic of "firearms". This interest has generated a large number of researches, using varied methodologies, seeking to approach a phenomenon related to this topic at different levels - local, regional, national or even international.

These studies also focused on analytical levels ranging from individual to macroscopic, particularly by using case-control analyses, or by using a set of measurements reflecting variables that could be related to the availability of firearms, to the legal framework surrounding this availability, as well as to specific phenomena such as violent crimes committed using a firearm, the rate of general suicides or homicides, or those involving a firearm.

Lastly, some of these researches used a longitudinal method that seeks to detect evolutions and changes over time, whereas others focused on a limited period of time.

Nevertheless, what must be highlighted in this set of researches, other than the wealth of its different teachings, is that on the one hand, very few studies have focused on the link between the possession of firearms or even between the laws related to firearms and crime related to firearms outside the United States of America.

This reduced number could be explained by the fact that currently, there is no standardised method of measuring this possession or of evaluating a particular law or its strictness, as well as by the fact that it is difficult to obtain comparable data from country to country. It should also be noted that this difficulty is accentuated when we attempt to study the different types of laws in different countries, written in different languages - which is not much of a problem when we study the American states.

On the other hand, it is necessary to emphasise that none of the results presented in these studies show any causal relation between the possession of weapons or the laws related to firearms and the rate of homicides by firearms. In fact, the statistical tests used do not allow concluding on cause-and-effect findings, but rather on the manner in which the studied variables co-vary, or they only enable explaining variations of one on another. The possibility that the relations observed in certain researches

are caused by excluded variables cannot be ruled out. This is why, in light of these different considerations, the variety of methodologies, measurements and regions used, it is necessary to take the interpretations of the aforementioned studies with care.

Chapter 2

Research plan

PURPOSE AND HYPOTHESES OF RESEARCH

DOUBLE OBJECTIVE

This study falls under an international context. It aims to give an overview of the link that might exist between homicides by firearms and other variables of interest such as the availability of firearms or the strictness of the laws implemented in a given country.

There are therefore two objectives, since on the one hand, it involves observing the relation between the laws related to firearms and the rate of homicides by firearms, and on the other hand, verifying the relation between the latter and the possession (or availability) of firearms. This double objective must be achieved using the most up-to-date data available.

Moreover, as we mentioned in our literature review, a certain number of studies conducted on this topic fall short owing to the lack of consideration of economic, social, demographic or criminogenic factors, the influence of which on crime in general or particularly on crimes committed using firearms has been proven. These different factors are called confounding factors, or confounding variables.[18]

The statistical model that we propose for our study takes these variables into consideration, and takes into account the possible contribution of each of them in the possible relation that might exist between our dependent variable and our variables of interest.

[18] A confounding variable refers to a variable, linked with the subject of the research, which should be controlled or eliminated so that it does not affect the analysis of the association made in the subject of the research and, consequently, the validity of the study. The term "confound" comes from the fact that the variable is likely to confound or mix certain detected effects between the studied variables.

The conventional example is that of the study of cardiovascular diseases, which shows a positive association with the variable "coffee consumption". In fact, it is the confounding variable "smoking", associated with several coffee drinkers, which has an influence on cardiovascular diseases. In this case, the variable "smoking" is the confounding variable.

MAIN HYPOTHESES

With respect to our double objective, we can put forward two main research hypotheses.

- There is a link between the availability of firearms and the number of homicides by firearms. (H1)
- There is a link between the laws related to firearms and the number of homicides by firearms. (H2)

The counterpart to these hypotheses is that this relation will persist even when all confounding variables are taken into consideration.

These main research hypotheses will be addressed using a series of inferential statistical processing operations.

SECONDARY HYPOTHESIS

We will also address the research hypothesis underlying the traditionally used theories regarding the possible link between the possession of firearms and the rate of homicides by firearms, as we developed in CHAPTER 1. This secondary hypothesis is related to the alleged link between the possession of firearms and the global rate of homicides (i.e. all types of homicides combined):

- The possession of firearms in a country is significantly linked to the global number of homicides (H3).

This last hypothesis refers directly to the postulate of facilitation and triggering factor, according to which the availability of firearms is significantly correlated to the rate of homicides by firearms as well as to the global homicide rate.

Even in the negative, this hypothesis would allow verifying the theories specific to the "weapon instrumentality" hypothesis, which postulates that the availability of firearms is significantly correlated with homicides by firearms, but not with the global homicide rate. Or even the "More Guns, Less Crime" hypothesis that states that the availability of firearms is negatively associated with homicides by firearms and the global homicide rate, as we described in the literature review in CHAPTER 1.

METHODOLOGY

In order to verify the different hypotheses mentioned, we have developed a cross-sectional ecological[19] statistic study.

This choice was made based on the limited accessibility of data, which made it impossible to use the longitudinal approach.

THE STUDY SAMPLE

The countries to be studied in this research were selected using comments and critiques issued on the subject of researches having similar designs.

These critiques mainly pertain to the consideration of components related to:

- The population size of the countries studied
- The political regime of the countries studied
- The conflict zones in the countries studied

In the following paragraphs, we will describe each of these components and will explain the adjustments that they make in the selection of our sample.

Population

The first selection criterion is mathematical in nature. In fact, since the main dependent variable of our study is the rate of homicides by firearms for one-hundred thousand inhabitants in a given country, the data specific to these variables will depend directly on the size of the population of the country in question. Thus, an isolated event will have a higher significance for a country having a low population.

In order to counter this possible bias, we chose, similarly to HEMENWAY, SHINODA-TAGAWA & MILLER (2002), to select countries having a sufficient population to carry out the type of analyses chosen in our study design.

[19] This qualifies as an ecological study as we reference studies that seek to detect the variations of a phenomenon over time or space, "to connect these variations to environmental or social (more often) factors". This type of study does not use individual data, but instead data taken from a particular geographical region (a region, a country, a group of countries, etc.). This type of approach allows us, in this research, to address a macroscopic level. Definition taken from the website of the French Health Monitoring Institute: http://www.invs.sante.fr/publications/pol_atmo1/page3.html

We therefore chose to consider countries having at least one million inhabitants, so that isolated events have lesser impact on the collected data.

Unlike other studies, we did not find it appropriate to group smaller countries together, as the analysis would have included an additional data computation step, thereby making the data less reliable.

Democracy

The second selection criterion concerns the political regime of the countries to be considered. We decided to rule out countries having a proven autocracy, since they regularly face more or less significant problems of corruption and/or criminalisation of the law enforcement forces.

This choice was dictated by the simple reason that these components are highly significant in the manner in which laws are applied (Soares, 2004).

Moreover, authoritarian regimes are less inclined to provide complete data and to collaborate with international institutions during surveys on criminal phenomena (Van Dijk, 2008).

In order to make our selection, we therefore used the "Global Democracy Ranking" classification (Campbell, Pölzlbauer, Barth & Pölzlbauer, 2013) and the "Democracy index" (Intelligence Unit, 2012).

The first classification is defined annually by "The Democracy Ranking Association". It is obtained using the methodology developed by DAVID CAMPBELL in 2008, integrating different indicators in order to determine the quality of democracies across the globe.

The main indicator used is the political regime of the countries concerned.

We also took into account the classification developed by the research and analysis division of the newspaper "The Economist", i.e. the "Economist Intelligence Unit".

This classification divides the studied countries into four types of regimes:

- democracies
- flawed democracies
- hybrid regimes
- authoritarian regimes

Our choices were made from the first three categories, while the last one was completely excluded in order to avoid the various kinds of bias described above.

Conflict zones

Literature has also recognised the difficulty of handling countries characterised by the presence of conflict zones. On the one hand, the trafficking of firearms is particularly high in these countries (Small Arms Survey, 2013). On the other hand, the data related to mortality by firearms and to homicides in general is not always recorded in the same manner in conflict zones (Geneva declaration on armed violence and development, 2008).

We therefore excluded from our sample all countries that are or were beset by significant armed conflicts during the past ten years.

For every selected country, we then carried out a verification based on a review of the international press, as well as on a verification of this information using the websites of the foreign affairs ministry of the chosen country.

United States of America and Australia

Lastly, the United States of America and Australia were deliberately excluded from our sample.

The diversity of laws in the different states and territories of these countries would result in considering each component entity as an independent observation. Under these conditions, the entities that make up these countries would no longer comply with the criterion of the minimum number of inhabitants.

Moreover, the research contract sought to expand the scope of the study to countries other than the United States of America, seeing as most literature has already been largely focused there.

COLLECTION OF DATA

LEGISLATIVE ASPECTS

Keep in mind that while certain *international norms* exist, only some of them are binding for Member States.

Some of these *binding* instruments are:

- Directive 2008/51/EC of the European Parliament and of the Council dated 21 May 2008 amending directive 91/477/EEC of the Council relating to the control of the acquisition and possession of weapons (w.e.f. 28 July 2008)
- the Nairobi Protocol for the prevention, control and reduction of small arms and light weapons in the Great Lakes Region and the Horn of Africa (w.e.f. 5 May 2006)
- the SADC Protocol on the control of firearms, ammunition and other related material (w.e.f. 8 November 2004)
- The ECOWAS convention on small arms and light weapons, their ammunition and other related materials (w.e.f. 29 September 2009)

These binding norms provide the country with the option of adopting *a minimum required norm or one that is stricter on certain aspects* defined by the given directive, protocol or convention.

Thus, a certain leeway is granted to the signatory as regards the transposition of the norms. For example, Directive 2008/51/EC of the European Parliament and of the Council dated 21 May 2008 amending directive 91/477/EEC of the Council relating to the control of the acquisition and possession of weapons, imposes on Member States that in case of a violation of the national norms, "the penalties provided must be effective, proportionate and dissuasive".

This provision, selected among others, illustrates the *leeway* granted to the countries that are subjected to the same regime of binding norms, derived from regional instruments, thus resulting in the implementation of laws with significantly different levels of strictness.

This brief overview of the legislative norms in force enables us to affirm that the *national level appears to be the most pertinent angle of approach* for addressing the law(s) related to firearms in a given group of countries.

The rarity of recent analyses of comparative law in this matter, as well as the significant limitation as regards the accessibility of translations of a large number of national laws on firearms, forced us to search for an existing index that would offer us, for each of the selected countries, a

measurement of the strictness of the laws implemented at the national level.

Moreover, the difficulty is even greater owing to the fact that laws remain a "global" concept that is difficult to quantify. A law will pertain to a large number of components, ranging from the possibility of purchasing a weapon, all the way to the conditions for possessing them or even to a general restriction on the possibility for a civilian to possess a firearm.

Our investigations revealed only one index that is likely to reflect most of these components, with attributed scores. However, the validity of this index, the Gun Right Index, is difficult to control as although it has been used in various studies, it has not been scientifically validated.

In order to compensate for this possible lack of validity, we attempted to construct our own index using a questionnaire intended for each country of our sample. The following paragraphs describe the steps dedicated to this construction.

THE CONSTRUCTION AND WEIGHTING OF THE QUESTIONNAIRE

The first step of our work was dedicated to developing a specific questionnaire, intended for each of the selected countries, in order to obtain an overview of the different laws, especially through various components related to the possession, purchase and public bearing of firearms by civilians, to existing licences, defined punishments, etc.

This method has the advantage of allowing us to obtain comparable data on specific points of the laws and also, consequently, to use this standardised data for creating a legislation index for each of the responding countries.

For the various reasons described above, we therefore firstly selected a set of relevant legislative components.

In order to obtain a global overview of each national law, we divided a standard law into a series of concrete and potentially measurable components (existence of a licence, minimum age, punishments, etc.), in order to allow us to establish a score for each component present in the said law.

Legislative overview

The portrait that we wished to draw using our questionnaire focuses on three distinct parts, based directly on the components highlighted by the "small arms survey 2011"[20].

A part of this survey (e.g. Chapter 9, regulating the firearm and regulating the user), effectively pertains to the review, across a sample of countries, of different national laws implemented to

[20] Small arms survey 2011, Graduate institute of International and Development Studies, Geneva

regulate and control the access and possession of firearms by civilians.

We therefore used the indicators used in this study, which we believe to be relevant, in order to create the base of our own survey. While the small arms survey plays an essentially descriptive role, seeking to inform the general public about the laws in force across the globe, our research attempts to quantify this information.

Hence, these indicators will be enriched or detailed on certain points.

The created questionnaire consists of different sections:

The first section of the questionnaire investigates the restriction and prohibition concerning the possession of certain types of firearms, as well as the practices for recording information related to firearms.

The second section concerns the regulations related to the firearm user. This section mainly contains information related to the minimum age for possessing a firearm, the components verified during the control of the firearm purchaser, the competency tests required as well as the reasons for acquiring a weapon that are laid down by the law.

The third section focuses on the conditions related to the licence, the storage and the public bearing of firearms. In this part, the following points are investigated: the existence of a permit for purchasing and possessing firearms as well as their time limits; the punishments laid down in case of the illegal possession of firearms; the measures for reporting thefts; the measures for storing weapons; the regulations on bearing weapons in public.

For each investigated aspect, a score was attributed based on the answers provided to the questions.

The sum of these scores on the different aspects forms the indicator of the strictness of the law.

The scoring instrument was created using an analysis of a certain number of laws for which access in English or French was assured. This analysis enabled listing all possible responses to each question and assigning a weight to each response. The total score itself is the weighted sum of the different aspects of the law. This weighting was developed using components of literature and various adjustments made during the creation of the questionnaire and its scoring grid.

STATISTICAL PLAN

This research seeks to prove the existence of a link between, on the one hand, the availability of firearms and the number of homicides by firearms (H1) and on the other hand, between the laws related to firearms and the number of homicides by firearms (H2).

Moreover, this research also aims to understand the links between the possession of firearms in a country and the global number of homicides (H3).

In order to verify the existence and pertinence of these relations, several authors have highlighted the importance of taking into account a certain number of confounding variables (economic, social, demographic, criminogenic), which are also likely to influence the rate of homicides by firearms.

The variables that the authors believe should be controlled, and which are most frequently integrated in the statistical models as confounding variables, shall be comprehended during this research.

In the first part of our analyses, we will attempt to showcase the effects that they could have on the number of homicides by firearms so that, once these effects are quantified and controlled, it will be possible to statistically show the link that could exist between the availability of firearms and the number of homicides by firearms (H1), and between the laws and the number of homicides by firearms (H2).

In order to achieve these objectives, the statistical analyses of this research will be carried out twice in three sets.

The first series will pertain to our sample of 52 countries, whereas the second will be conducted on the countries that replied to our questionnaire and for which we therefore were able to attribute a score for the strictness of the law.

Each of the steps described below will therefore be carried out separately on these two samples of countries.

CORRELATIONS

Firstly, we will describe the different variables that were studied and their contents.

We will carry out correlation analyses that will be used to verify which variables, out of our studied variables, are the ones having a significant link with the rate of homicides by firearms in the studied countries.

The correlation analysis will enable highlighting any significant association between two variables, as well as the manner in which these two variables co-vary together, i.e. the direction of the relation that exists between them.

To do this, we will use parametric tests (Pearson correlation) and non-parametric tests (Spearman's correlation) in order to be certain that no effect has been ignored.

In fact, the parametric tests can be considered to be more "meticulous" and "stronger" than non-parametric tests. To be applied however, they must comply with a series of constraints (normality, equality of variances, etc.). The use of non-parametric tests is justified when the application constraints of parametric tests are not met, especially when the size of the sample being studied is small.

PARTIAL CORRELATIONS

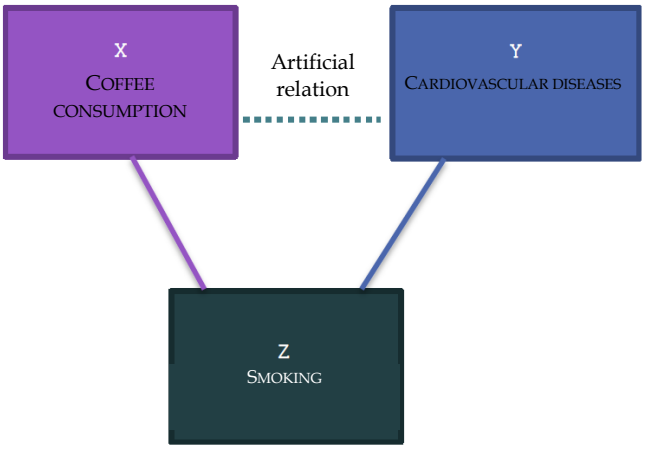
Secondly, these correlation analyses will be supplemented by partial correlation analyses.

Partial correlation enables studying the influence of one variable on another by controlling the influence of a third variable. The partial correlation thus indicates the relation between a variable X and a variable Y when their variance with a variable Z is controlled.

Effectively, it is possible that behind a link between X and Y, there is a hidden relation between X and Z and between Z and Y. In this hypothetical case, there will therefore be an artificial relation between variables X and Y, which comes from their respective link with variable Z.

The following diagram illustrates the explanation of an artificial relation between variables X and Y.

Illustration of an artificial relation



The delicate point here is to know which variable Z should be used in the partial correlations. We can find an answer to this question in literature.

In fact, most studies on homicides across the globe have shown a higher rate of homicides in economically less developed countries. *The wealth of the country would therefore have a large influence on the rate of homicides and will therefore be the most important confounding variable to be taken into consideration.*

The controlled variable that we will use to calculate these partial correlations is therefore the wealth of the country, modelled by the gross domestic product per capita. Note that this step is essential given the theoretical relations that exist between the wealth of a country and a certain number of other variables studied. It is necessary to keep in mind that certain data that is deemed to reflect a specific reality (e.g. consumption of a type of drug), may actually reflect another reality (e.g. the wealth of the population, by which it has the financial resources to procure the said type of drug). Partial correlations will thus enable estimating whether a given variable retains a significant relation with the number of homicides by firearms when the wealth of the country is controlled (through the GDP variable). In this sense, if an independent variable remains significantly linked to the rate of homicides by firearms after the wealth of the country is controlled, the relation between the variables may then be considered to be distinctly more reliable and, consequently, will have greater validity.

MULTIPLE REGRESSIONS

The last step of analysis will consist of carrying out multiple-regression analyses in order to try and showcase *the relative impact of each of the variables when the others are controlled.*

This type of analysis will therefore allow us to study the relation between our dependent variable (X) and multiple variables (Y1, Y2, Y3, etc.). Here, we refer to the dependent variable (the rate of homicides by firearms) as a predictive variable, whereas the other variables (the infant mortality rate, unemployment rate, GDP, etc.) are used as "explanatory" variables. These variables are integrated in a model that is tested to answer the question: "What is the best indicator for predicting the significance of the rate of homicides by firearms?"

We will propose different multiple-regression models (integrating different variables) in order to determine the variables that enable taking as many dimensions as possible into account.

The choice to multiply the tested models complies with the applicability constraints of this type of statistical test, which enables studying only a limited number of variables based on the number of observations. In fact, it is recommended to have 10 to 20 times more observations (here, the countries that make up our sample) than variables. Given the size of our sample (53N), we will process several models containing 4 to 5 variables (economic, socio-demographic, criminogenic). The last planned model (M4) will frame the variables with the highest explanatory nature revealed in the previous models (M1, M2, M3).

THE STUDIED VARIABLES

In the following paragraphs, we will present the different indices used to reflect the dependent variables, variables of interest and confounding variables of our study.

We will describe each index with a brief definition, following by some information showcasing the manner in which these variables can influence the rate of homicides by firearms.

THE DEPENDENT VARIABLE

The dependent variable used in our statistical modelling is the *rate of suicides by firearms per 100,000 inhabitants.*

This is the measurement that is the most frequently used in international studies on homicides by firearms.

In this research, we used the most recent accessible data possible. Most of the data is taken from international databases and has been verified using national statistical reports where possible.

Mostly, the data was taken from the World Health Organisation (WHO), the United Nations Office on Drugs and Crime (UNDOC) and the Organization of American States (OAS). Nearly three quarters of the data concern the years 2011 and 2012. Six countries have data earlier to 2010. The oldest data is from 2008.

In case any data was missing from the database used, we used other databases, national or international reports or other ways, the collection method of which was as close as possible to the one used by the original database[21].

For some countries, we were forced to calculate the rate per one hundred thousand inhabitants[22]. We had access to reports issued by the same authority providing, on the one hand, the absolute number of homicides with all weapon types combined, and the percentage of homicides committed using a firearm.

[21] (Bosnia and Herzegovina; New Zealand; United Kingdom).
[22] (Bosnia and Herzegovina)

In order to ensure the validity of the obtained results, we compared them with the previous years, for which the rates for 100,000 inhabitants were accessible in order to verify that we did not obtain any atypical data, which was not the case for any country of our sample.

THE VARIABLES OF INTEREST

The Indices of the strictness of laws

We attempted to comprehend the "*strictness of the laws*" variable through two distinct indices:

- the value established by the *Gun Right Index (GRI)*[23]. This index mainly takes into account the registration of firearms, the necessity of training for possessing a weapon, the storage restrictions, the bearing of arms and the presence of more restrictive regional laws within the country.

  The GRI index takes a value between 0 and 10. We took the opposite value of the GRI, since originally, the GRI measures the ease of access to firearms.

  Although this index has not been scientifically validated, it is, to our understanding, the only index that can compare the legislative measures implemented regarding firearms.

During our analyses, this index will be compared with a second index of the strictness of the laws, which is itself derived from the questionnaire that we developed.

- The SEV_LEG index represents the score established on the basis of the responses collected on our questionnaire. This index covers certain dimensions that are similar to the GRI index, but goes more into detail for certain information. Moreover, it allows us, as mentioned previously, to manage the "counting" of the scores obtained by the different countries and thereby control the validity of the thus obtained data in a standardised manner.

[23] Developed by Fries in 2009, the index has been updated annually using documentation collected by the authors. We took this variable with the data entered at the most recent update (2014) of this index.

The firearm availability index

The last variable of interest is the availability of firearms.

As we mentioned in the previous chapter, there is no actual valid index representing the availability of firearms in a given country.

However, different authors have showcased a set of proxy measures that are deemed to reflect the possession of firearms in a country. Among these measures is the relation between the number of suicides by firearms and the total number of suicides, which appears to be identified as the most appropriate conceptualisation of the availability of firearms in a given country.

The index is therefore calculated by dividing the number of suicides committed by firearms by the total number of suicides.

THE CONFOUNDING VARIABLES

The confounding variables will be integrated as independent variables in the different statistical models. These variables have been grouped into four separate categories:

- economic variables
- demographic variables
- social variables
- criminogenic variables

Economic variables

These variables seek to comprehend the dimension of the poverty and wealth of a country.

We chose to integrate in this set of variables:

- the gross domestic product (GDP) per capita
- the Gini coefficient
- the unemployment rate
- the infant mortality rate for every thousand births

The gross domestic product per capita

In general, the gross domestic product (GDP) is a measurement that is regularly used to estimate *the standard of living of the inhabitants of a given country*. This economic indicator measures the wealth created in a country and corresponds to the sum of household consumption, investment, government spending, stock variations and total exports (minus imports).

The *GDP per capita* is the gross domestic product divided by the population in the middle of the year. One of the major advantages of this indicator is that it is regularly and

accurately measured in a standardised manner by the World Bank, which is where we obtained our data concerning the GDP per capita. The latest available data concerned 2013.

Different international researches have shown that the GDP was significantly linked to the homicide rate (Agha, 2009 ; Altheimer, 2008; Cochran & Bjerregaard, 2011; Lin, 2007). It should be noted that in these researches, the association that was found was systematically negative. Thus, *the higher the GDP of a country, the lower is the homicide rate.*

The GINI coefficient

The GINI coefficient is a measurement of the inequality of income within a given country. This measurement, also called the "Gini index", varies between a score of 0 and 100. A coefficient equal to 0 signifies that there is no income disparity in a given country. The higher the index, the greater the inequality will be.

This is one of the most frequently used indices in international studies that seek to understand how poverty can be linked to crime.

Several studies have shown a positive association between the number of homicides and the inequality of income (Cochran & Bjerregaard, 2011; Cole & Gramajo, 2009; Chamlin & Cochran, 2006; Fajnzylber, Lederman & Loayza, 2002; Stamatel, 2009; Pridemore, 2008; Messner, Raffalovich & Shrock al., 2002; Wilsem, 2003). Thus, *the greater the inequality in income within a population, the greater the homicide rate will be.*

The data concerning the GINI coefficient was taken from the latest publications of the United Nations Development Programme (UNDP)[24], which constitutes the most complete and most uniform data for the selected countries.

The unemployment rate

The unemployment rate shows the percentage of unemployed people in a given country. Unemployed persons, as defined by the International Labour Organisation, are *members of the labour force without a job but available for work.*

The relation between unemployment and crime has been studied several times. Of course, while not all the obtained results are conclusive, a certain number of studies show a positive association between these two variables (Jongman, 1983; Raphael & Winter-Ebmer, 2001). In this sense, *the greater the unemployment rate in a given country, the greater the homicide rate will be in the same country.*

The data related to the unemployment rate has been taken from the British weekly "the Economist". It was compared with that of the World Bank and revealed to be similar, although

[24] The data and publications of the United Nations Development Programme are directly available online at their website: http://www.undp.org/content/undp/fr/home.html

more complete, for the years in question.

The infant mortality rate for every thousand births

The infant mortality rate is defined as *the ratio between the number of children deceased in less than one year and all live births.*

For PRIDEMORE (2008), this is an interesting proxy variable for measuring poverty, for various reasons:

- Firstly, it has been shown multiple times that this rate is correlated with other measurements of poverty (Antonovsky and Bernstein, 1977; cited by Pridemore, 2008; Firebaugh and Beck, 1994; Frey and Field, 2000).
- Moreover, there is a consensus on the measurement of this concept and no definition problem has altered the collection of this data.
- This measurement is regularly used in studies on domains other than criminology as an indicator of the poverty of a country.
- Lastly, certain authors such as PARE (2006) estimate that the infant mortality rate as a measurement of poverty is the best predictor of violent crime.

The data concerning the infant mortality rate has been taken from the database of the Global Health Observatory. Since the reduction of infant mortality is one of the Millennium Development Goals, the collection of data by the 189 States pursuing this goal is carried out homogeneously and regularly.

Demographic variables

Out of the demographic variables, we chose:

- the degree of urbanisation
- the proportion of young men in the population

The choice was based directly on these variables, since their influence has been demonstrated numerous times in different researches on homicides.

The degree of urbanisation

The urban population is the percentage of the total population living in urban areas, as defined by each country. This index therefore reflects the degree of urbanisation of a given country.

A certain number of international studies have shown that *a higher degree of urbanisation is associated with a higher number of homicides and a greater prevalence of social issues in a country* (Jacobs & Richardson, 2008; Pratt & Godsey, 2002).

This finding has also been highlighted in researches focussing specifically on homicides carried out using firearms. For example, the study of BRANAS, RICHMOND & SCHWAB (2004) showed that a majority of homicides

by firearms occurred in more densely populated areas.

There is also the study of HU, WEBSTER & BAKER (2008), which studied the changes in the number of homicides by firearms, between 1999 and 2005, in 3141 cities in the United States of America. The results showed that homicides by firearms increased more drastically in large agglomerations than in the cities located outside large agglomerations.

The urban population rate for each country has been codified using the database of the United Nations. The United Nations Department of Economic and Social Affairs has a "population" division that drafts a report every two years on the urban and rural populations across the globe. This database is frequently used by international organisations and research centres.

The proportion of young men in the population

The indicator that is generally used to evaluate the proportion of young men in the population is *the percentage of men between 15 and 34 years of age out of the total population of the country.*

Indeed, researches on crimes tend to conclude that men are more frequently registered as the perpetrators in crime statistics. Moreover, higher crime rates are often found among the young population.

These two findings have led several authors to conclude that the number of young men in the general population is a variable that should be controlled in studies on homicides.

The international study of JACOBS & RICHARDSON (2008) showed an association between homicides and the proportion of young men (15-29 years) in the population. In this sense, *the greater the proportion of young men in the population, the greater the homicide rate will be.*

Similarly to the data related to the urban population rate, the percentage of young men between the ages of 15-34 years in the population was collected from the database of the "population" division of the United Nations Department of Economic and Social Affairs[25].

Social variables

The social variables that were studied focus on data related to the education of the population:

Education

Some authors have demonstrated that informal social control could explain the variations in the violence rate within a population. The major social institutions such as family, school, workplace, etc. that are present from infancy till adulthood enforce a certain social control on individuals.

In this sense, *a lower level of education would be linked to lesser social control and hypothetically to a higher proportion of victimisation.*

The study of PRIDEMORE & SHKOLNIKOV (2004; cited by Pridemore, 2008) concluded that a lower level of education was linked to a higher risk of victimisation.

In this sense, a large number of studies use the literacy rate of a population to conceptualise the level of education of a given country.

However, since the countries that we selected already have a high literacy rate, we chose to use other measures that allow better discriminating between the countries of our sample, in which the education system is globally effective.

The two chosen indicators of the education level are:

- *The average number of years of schooling*
- *The proportion of the population above 25 years of age that attained a level equivalent to higher education in a country.*

As defined by the UNESCO Institute for Statistics, *the average number of years of schooling measures the average value of the years of study completed by the adult population (persons aged above 25 years), minus the years spent in repeating grades.*

The education level considered by this variable is the completion of at least one cycle of higher education. Hence, we are seeking to comprehend the proportion of the population aged more than 25 years that completed higher studies or university studies (corresponding to level 5 of the ISCED) as well as higher education programmes of the 3rd cycle that lead

[25] The United Nations Department of Economic and Social Affairs (DESA) publishes demographic and economic analyses for the Member States of the United Nations. The DESA is also known for its high-quality data, such as the population estimates and statistics, which have long been considered to be the global reference for reliable information. The publications can be viewed at their website: http://www.un.org/en/development/desa/publications/category/statistics/index.html

to obtaining a doctorate (doctorate corresponding to level 6 of the ISCED).

The indicator on *the proportion of the population above 25 years of age that attained a level equivalent to higher education* is based on the International Standard Classification of Education (ISCED) developed by the United Nations Educational, Scientific and Cultural Organisation (UNESCO). This classification makes it easier to compare statistics and indicators related to education between countries, on the basis of standardised definitions at the international level.

The data concerning these two indicators was collected from the database of the UNESCO Institute for Statistics[26].

Criminogenic variables

The average per capita consumption of alcohol

The measurement used to take the alcohol consumption in a given country into account is the total consumption of alcohol per individual aged more than 15 years over a period of one year, in litres of pure alcohol.

Studies across the globe have constantly highlighted the association between alcohol and violent crime. According to ADLER, MUELLER & LAUFER (1998; cited by Van Dijk, 2012), in the United States of America, nearly half of the persons sentenced for violent crimes were under the influence of alcohol during the event.

More specifically, the association between alcohol consumption and homicides was also showcased by literature. ADLER & AL. (1998; cited by Van Dijk, 2012) also showed that in the case of homicides, the consumption of alcohol by both the perpetrator and the victim was more prevalent than in less "serious" forms of crime.

[26] The data and publications used are available directly online at the website of the UNESCO at: http://www.uis.unesco.org/Pages/default.aspx

The quarterly report of Alcohol Concern (2001, cited by Measham & South, 2012), supports this finding. The figures of the "British medical association" that they used showed that in 65% of homicide cases, the victim or the perpetrator had consumed alcohol.

Several other studies using various methods, both cross-sectional and longitudinal, have shown the significant role that alcohol might have in homicides (Graham et al, 1998; Room & Rossow, 2001).

This association between alcohol and violent crimes is also found at a macroscopic level. LENKE, in 1990 (cited by Van Dijk, 2012) and ROSSOW, in 2001, showed obvious and constant relations between the consumption of alcohol and the homicide rate in Scandinavian and Central European countries. This relation also exists in Southern European countries, but tends to be less significant.

With the consumption of alcohol per gram per person per day, the per capita alcohol consumption is the most frequently used indicator for presenting alcohol consumption.

The data collected in order take this variable into account is that of the report of the World Health Organisation titled "Global Status report on alcohol and health 2014"[27].

Till date, this data is the most complete and available, collected in the most uniform manner.

The consumption of drugs

ROBERT (2003) believes that a consensus exists on the association between drugs and crime, although this relation is not causal. Generally, the individual-level explanation of this relation between crime and drugs is polarised between two alternatives:

- "A criminal lifestyle facilitates drug use"
- "Drug dependency leads to the committing of crimes for the purpose of obtaining drugs" (Bennet & Holloyway, 2005; cited by Measham & South, 2012).

At the macroscopic level too, we can find this relation between drugs and homicides.

The figures of the Department of Justice of the FBI from 2009 (cited by the UNDOC, 2010, p.81) showed that in the United States of America, the use of cocaine in the general population reduced by 56% between 1988 and 2002.

[27] The WHO drafted this Global Status Report on Alcohol and Health (2014), which presents the profile of alcohol consumption in 194 Member States of the WHO. This report can be directly accessed online at: http://www.who.int/substance_abuse/publications/global_alcohol_report/en/

In the same time period, the number of reported crimes reduced by 29% and the number of murder victims reduced by 34%.

Drug consumption was also used as a control variable in a series of researches studying the number of deaths linked to firearms.

We chose 3 variables for evaluating the effect of drug consumption on homicides by firearms. These variables reflect the drugs that are most often used across the globe, namely:

- The consumption of cannabis,
- The consumption of ecstasy,
- The consumption of cocaine.

The data for these variables reflect *the percentage of persons between 15 and 64 years of age that consumed the drug at least once in the past year.* The data for these variables was taken from the United Nations reports on drugs across the globe[28].

The following page has a summary table showing the different variables studied.

[28] The different publications and the global report on drugs drafted by the United Nations Office on Drugs and Crime are available on their website: https://www.unodc.org/unodc/en/publications-by-date.html

Table 2: Overview of the variables taken into account in the research design	
CODES	VARIABLES
Dependent variable	
Tx_HOM/AAF	Rate of homicides by firearms
Variables of interest	
POSS	Availability of firearms
GunRi	Strictness of the laws
Economic variables	
GDP	Gross domestic product per capita
GINI	Income inequality in the population
CHO	Unemployment rate
MORT	Infant mortality rate
Demographic variables	
POPURB	Degree of urbanisation of a country
JHPOP	Proportion of young men in the population
Social variables	
EDUY	Average number of years of schooling
EDU25	Proportion of the population that attained a higher education level
Criminogenic variables	
ALC	Alcohol consumption
DGCAN	Cannabis consumption
DGCOC	Cocaine consumption
DGXTA	Ecstasy consumption

LIMITATIONS INHERENT TO THIS TYPE OF METHOD

The main limit of this study, as in every international analysis, lies in the fact that the national level analysis hides differences that might exist within the studied countries. This is one of the usual problems of this type of analysis.

In general, the homicide rate can vary greatly within the same country. This finding should also be made as regards the rates of homicides by firearms. The ecological and cross-sectional design of our study therefore does not allow us to take these variations into account.

Moreover, as we have noted several times, the variables under study are conceptualised using different measurements. While some of them are unequivocal for representing a given variable and therefore, a given reality (e.g. the rate of homicides by firearms), others require more interpretation despite the fact that they have been used in several researches (such as our variable of interest "availability of firearms").

Moreover, although most of the indicators have been collected in a standardised manner by global organisations, it is still possible that certain variables are not, from the outset, recorded adequately or meticulously at the local or national levels, thus generating data losses or approximations of the figures produced.

Lastly, once the analyses are complete, the interpretation of an indicator, and consequently the link that it might have with another, may sometimes be vague. Vigilance and undertones remain essential during our approach that seeks to quantify, for interpretation purposes, the links binding the social, educational, cultural or economic realities.

To conclude, keep in mind that the showcased links that might bind two variables are not always linear relations, i.e. the rise or fall of one generating that of the other. While this type of relation does not call for interpretation as regards the conclusions to be drawn therefrom, this does not apply to the use of non-parametric tests that may uncover other forms of associations, with much more delicate interpretations.

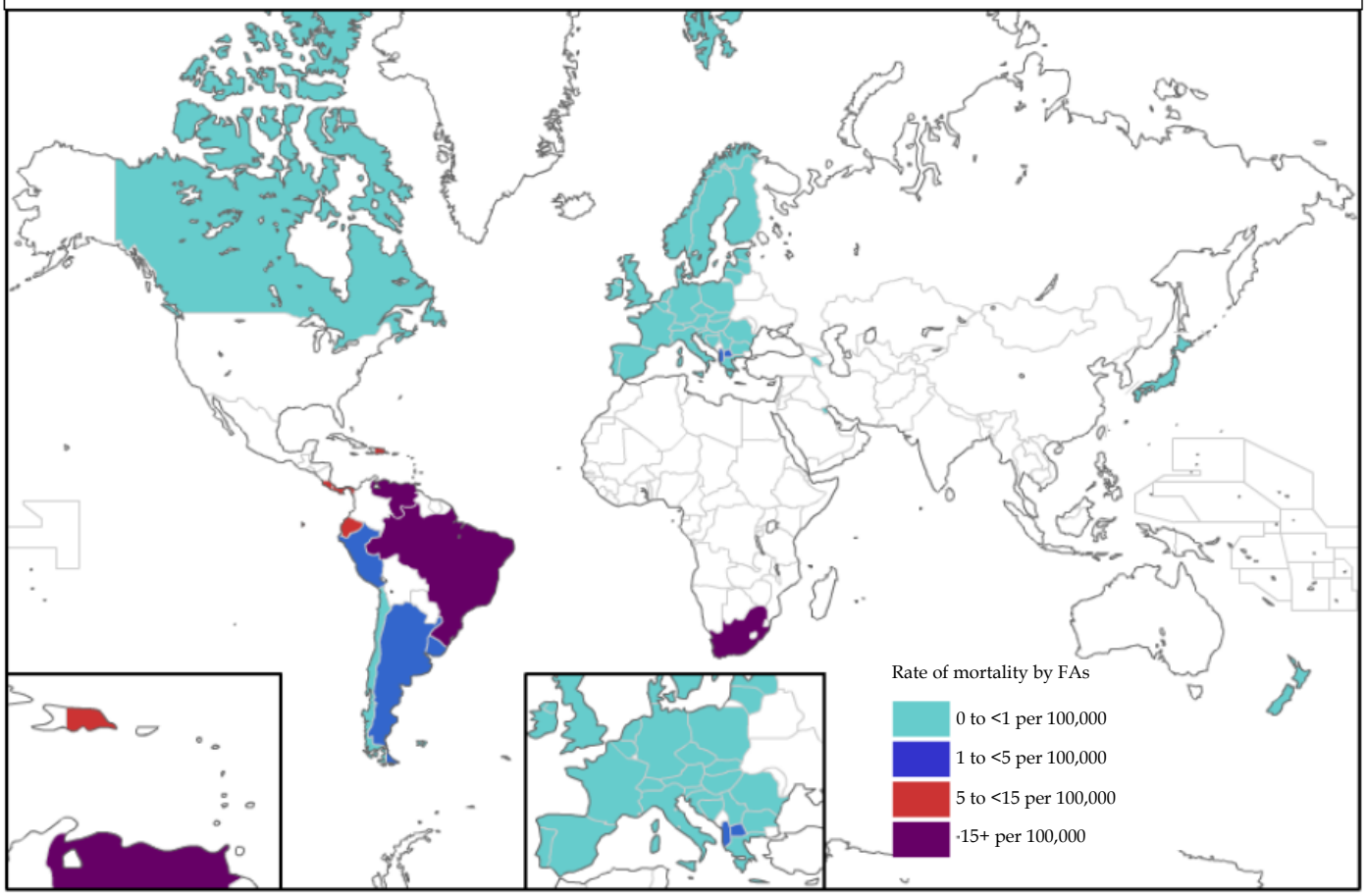
Chapter 3

Statistical analyses

ANALYSES OF THE STATISTICAL DATA COLLECTED FROM 52 COUNTRIES

RATE OF HOMICIDES BY FIREARMS IN THE STUDIED COUNTRIES

Figure 1: Illustration of the different rates of homicides by firearms per 100,000 inhabitants in the countries of our sample.



CORRELATIONS BETWEEN THE DIFFERENT SELECTED VARIABLES

This part tends to meet a double objective:

- On the one hand, establishing significant relations between our dependent variable and the confounding variables that could influence it, selected from our literature review (SEE CHAPTER 2)
- On the other hand, investigating the significant relations between our dependent variable and our variables of interest, in order to respond to our two main hypotheses as presented in our research plan (CHAPTER 2)

To reiterate, our dependent variable used corresponds to the rate of homicides by firearms per 100,000 inhabitants.

The confounding variables are of 4 types:

- Economic
- Social
- Demographic
- Criminogenic

Our variables of interest are represented by the availability of firearms and the strictness of the laws related to firearms within a given country.

DESCRIPTION OF THE DEPENDENT VARIABLE AND THE VARIABLES OF INTEREST

Dependent variable: rate of homicides by FAs

The map shown above gives an overview of the rate of homicides by firearms in the different countries studied.

We have data related to this variable for 52 of the countries chosen by our selection. Our sample is characterised by an average of 3.67 homicides by firearms per 100,000 inhabitants.

The standard deviation is 8.08, which characterises a rather significant dispersion of the different rates observed.

The records as regards the lowest rates of homicides by firearms are held by the Republic of Hong Kong, Japan, Kuwait and Mauritius Island. In fact, these countries have rates of less than 1 homicide by firearm per 1,000,000 inhabitants. Also note that for the first three countries, these are also countries having the lowest global homicide rates (Japan 0.3 / Kuwait 0.4 / Hong-Kong 0.4), whereas Mauritius Island is at the 35th place in the classification related to the global homicide rate,

with 3.2 homicides per 100,000 inhabitants.

As shown in GRAPH A and the world map shown above, a large number of countries that constitute our sample are characterised by a low rate of homicides by firearms. Out of the 52 countries that our sample is made up of, 73% (N=38) have a rate of less than 1 homicide by firearms per 100,000 inhabitants.

To the contrary, 5 countries have rates of more than 15 homicides by firearms per 100,000 inhabitants. Among these countries, Venezuela has the ignoble first place with a rate of 39 homicides by firearms per 100,000 inhabitants, followed by Jamaica (28.4), Trinidad and Tobago (21.77), Brazil (18.5) and South Africa (17). Note that the top four are all countries belonging to the American continent. These 5 countries also have the highest global homicide rates in our sample.

We also calculated[29] the percentage of homicides by firearms on the total number of homicides in the studied countries. Here too, there is a significant dispersion in the percentages obtained. In fact, as shown in GRAPH B below, the sample of the selected countries has percentages of homicides by firearms ranging from 1.7% (Japan) to 83.55% (Venezuela), with the average percentage being 30.05%.

Nearly 1 country out of 4 (N=11) from our sample has a percentage of homicides by firearms exceeding 60% with respect to the total number of homicides. Here too, the countries with the highest percentages are located in South America and Central America. Only two European countries, Macedonia and Albania, fall under this classification with percentages of 63.33% and 60.56% respectively.

In contrast, 1 country out of 4 (N=12)[30] is characterised by rather or even very low percentages of homicides by firearms, not exceeding 10%. The ranking of the first 5 places, having the lowest percentages in our sample, consists of Japan (1.7%), Romania (3.28%), Poland (3.56%), Lithuania (3.65%), and Latvia (5.15%).

Note that Western European countries fall in the middle of the ranking, except for United Kingdom (5.82%) and Germany (8.84%), and unlike Greece, Netherlands, Italy and Switzerland, which are characterised by percentages higher than the average (32.61%, 34.24%, 39.51% and 47.83% respectively).

Given below is GRAPH A showing the different rates of homicides and homicides by FAs for each of the

[29] This calculation was carried out on the basis of the total homicides in a given country and the total homicides by FAs in the same country, for the same year. The thus available data corresponds to the years 2009 to 2012. Note that 3 countries could not be taken into account as up-to-date data was not available. These countries are Hong Kong, Kuwait and Mauritius Island. Owing to their rates of homicides and homicides by FAs per 100,000 inhabitants, these countries should have similar percentages to those of Japan.

[30] It is highly probable that this ratio would actually be 1 country out of 3 if the missing countries (Hong Kong, Kuwait, Mauritius Island) were integrated.

countries in our sample, followed by GRAPH B showing the percentages of homicides by firearms.

Table 3

Mortality rate per 100,000 inhabitants

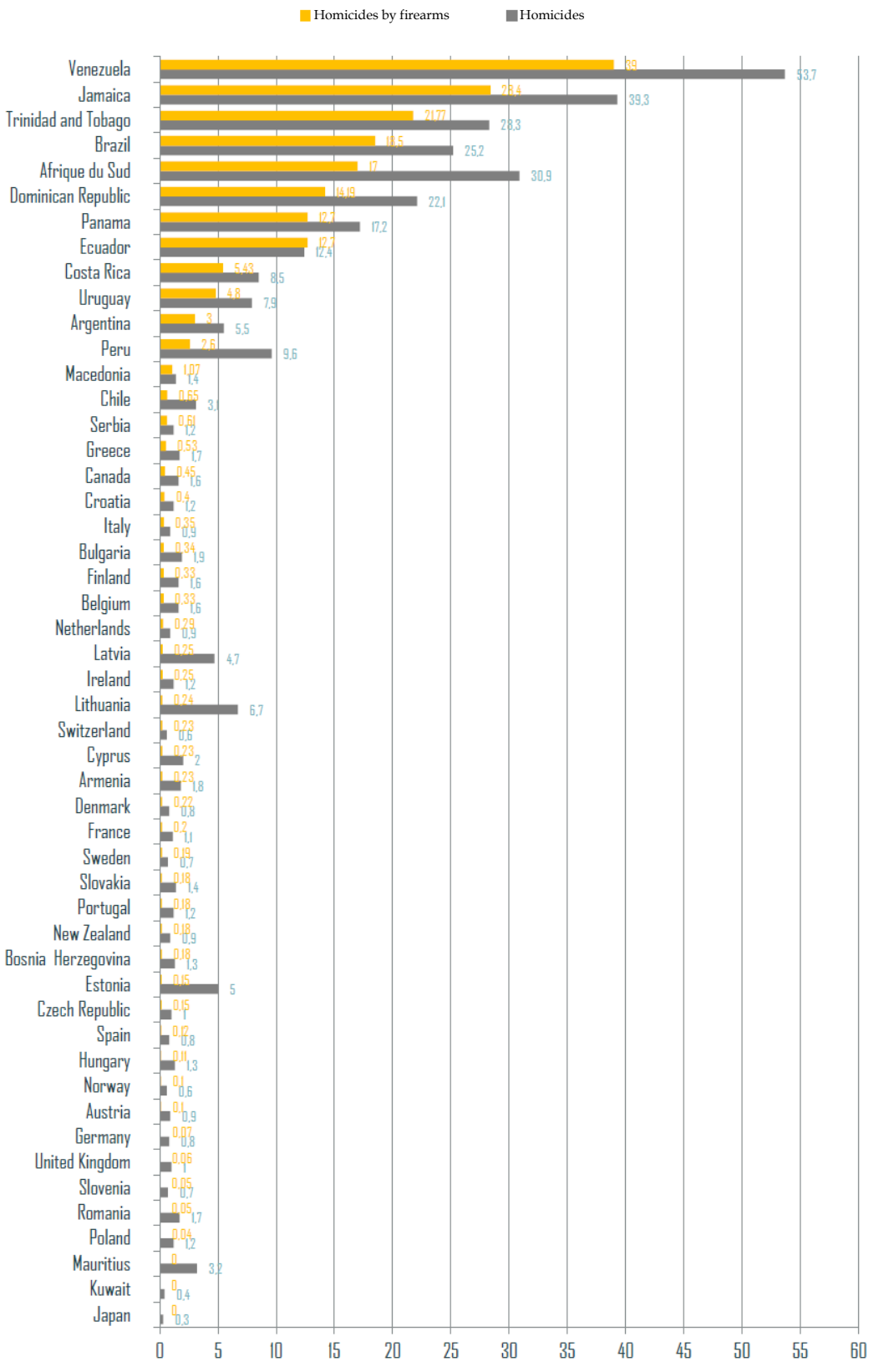
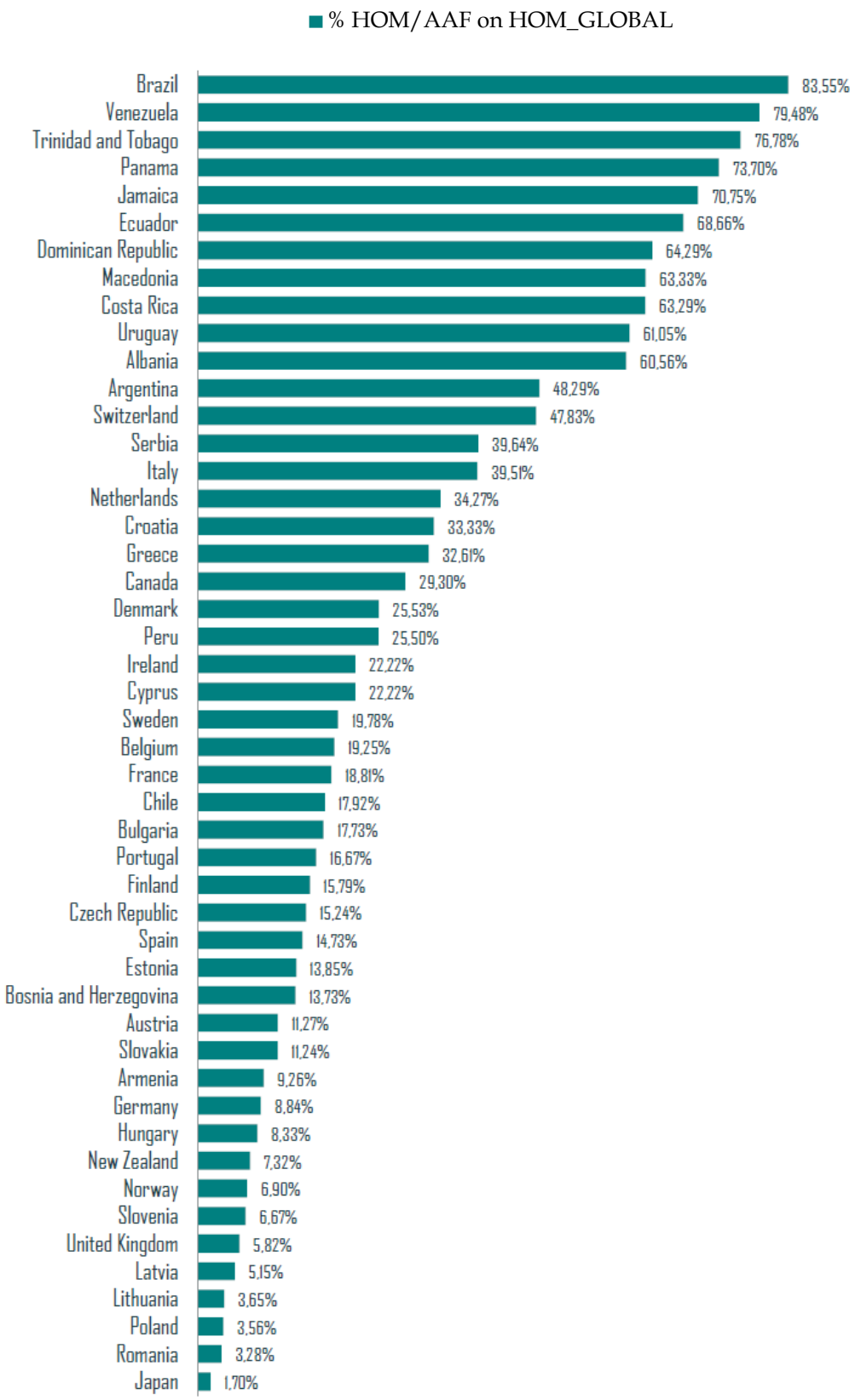


Table 4

Percentage of the number of homicides by FA on the total number of homicides in a country



Variable of interest #1: the availability of firearms

As we mentioned several times in the previous chapters, our first variable of interest corresponds to the prevalence of firearms in a given country.

This variable, which is difficult to measure, has been the subject of a large number of researches, during which the researchers attempted to evaluate proxy measurements that would provide the best way to approach the actual quantity of firearms in circulation within a given population.

The measurement chosen in this study is the proportion of the number of suicides by firearms out of the total number of suicides in a country.

Globally, the first finding lies in the observable dispersion of this variable. The calculated proportions range between 0 (Hong Kong, Kuwait, Singapore, Costa Rica, Jamaica, Bosnia) and 20.34 (Greece). It is quite remarkable that one out of ten countries in our sample show a score of zero (N=6).

The average score obtained is 6.65 with a standard deviation of 6. The countries having unusual values are characterised by high scores. These are two European countries, namely Switzerland (20.31) and Greece (20.34).

TABLE X below shows the scores obtained for each of the countries in our sample.

At the same time, you can view the GRAPH following the comparison between this index and the proportions of homicides by firearms obtained previously for these same countries.

As we have already observed on this graph, the curves observed between the countries having higher proportions of homicides by firearms out of the total number of homicides do not appear to be specifically characterised by higher proportions of possession.

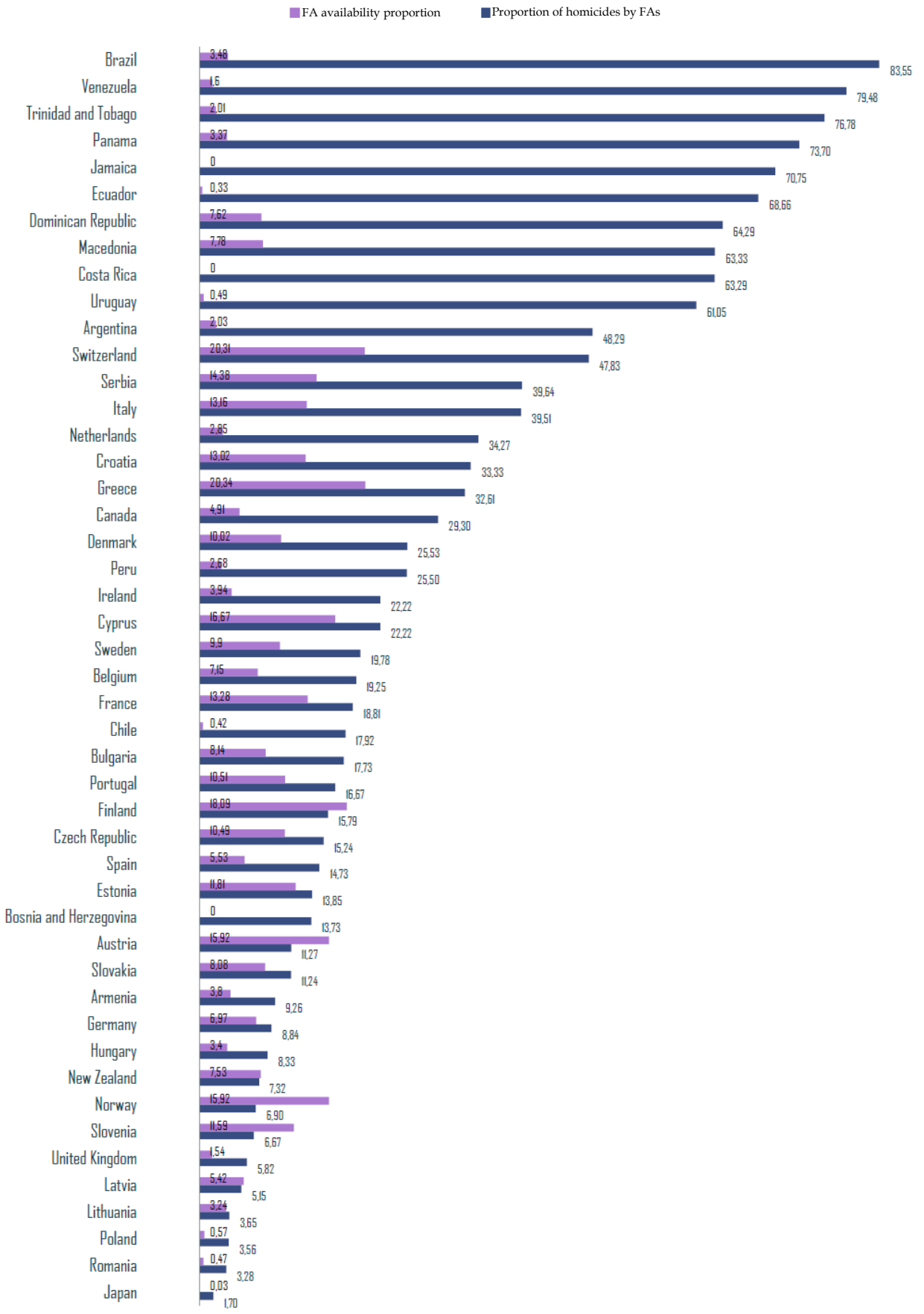
Table 5: Country-wise firearm availability index

COUNTRY	AVAILABILITY
BOSNIA HERZEGOVINA	0,00
COSTA RICA	0,00
HONG KONG	0,00
JAMAICA	0,00
KUWAIT	0,00
SINGAPORE	0,00
JAPAN	0,03
ECUADOR	0,33
CHILE	0,42
ROMANIA	0,47
URUGUAY	0,49
POLAND	0,57
UNITED KINGDOM	1,54
VENEZUELA	1,60
MAURITIUS	1,69
TRINIDAD AND TOBAGO	2,01
ARGENTINA	2,03
PERU	2,68
NETHERLANDS	2,85
LITHUANIA	3,24
PANAMA	3,37
HUNGARY	3,40
BRAZIL	3,48
ARMENIA	3,80
IRELAND	3,94
CANADA	4,91
LATVIA	5,42
SPAIN	5,53

COUNTRY	AVAILABILITY
GERMANY	6,97
BELGIUM	7,15
NEW ZEALAND	7,53
DOMINICAN REPUBLIC	7,62
MACEDONIA	7,78
SLOVAKIA	8,08
BULGARIA	8,14
SWEDEN	9,90
DENMARK	10,02
CZECH REPUBLIC	10,49
PORTUGAL	10,51
SLOVENIA	11,59
ESTONIA	11,81
CROATIA	13,02
ITALY	13,16
FRANCE	13,28
SOUTH AFRICA	13,50
SERBIA	14,38
AUSTRIA	15,92
NORWAY	15,92
CYPRUS	16,67
FINLAND	18,09
SWITZERLAND	20,31
GREECE	20,34

Table 6

Proportion of homicides by FAs and FA availability



Variable of interest #2: Gun Right Index

The index of the strictness of laws was measured using the reversed Gun Right index. TABLE 7 below shows the scores obtained for each of the countries in our sample. This score is calculated on a total of 10 points ranging from 0 (low) to 10 (high).

The average score obtained in the studied countries is 6.439, with a standard deviation of 1.351 representing a low dispersion.

Only one country has a slightly unusual higher value, Kuwait with 9.25 (limit at 9.141). Whereas Bulgaria and the Czech Republic have lower values that are lower than those of the sample (3 and 3.6 respectively).

One out of every 10 countries (N=6) has laws that are less strict according to the index used, with a score of less than 5/10: Bulgaria (3), Czech Republic (3.6), Peru (4), Switzerland (4), South Africa (4) and Lithuania (4.8).

38.5% of our sample of countries are characterised by high scores, greater than or equal to 7/10. Out of these countries, 6 score more than 8/10. These are New Zealand (8), the Republic of Hong Kong (8.5), Japan (8.5), United Kingdom (8.5), Venezuela (8.9) and Kuwait (9.25).

Table 7: Index of the strictness of laws measured using the reversed Gun Right index

COUNTRY	SEV. INDEX
BULGARIA	3
CZECH REPUBLIC	3,6
PERU	4
SWITZERLAND	4
SOUTH AFRICA	4
LITHUANIA	4,8
BOSNIA HERZEGOVINA	5
PANAMA	5
ESTONIA	5,2
GREECE	5,2
CHILE	5,3
DOMINICAN REPUBLIC	5,5
LATVIA	5,5
ECUADOR	5,8
JAMAICA	5,8
URUGUAY	5,8
FINLAND	6
FRANCE	6
SLOVAKIA	6,2
SERBIA	6,3
SLOVENIA	6,3
COSTA RICA	6,4
CYPRUS	6,4
ITALY	6,4
ALBANIA	6,5
BRAZIL	6,5
ROMANIA	6,6

COUNTRY	SEV. INDEX
GERMANY	6,8
IRELAND	6,8
POLAND	6,8
SWEDEN	6,8
BELGIUM	6,9
CANADA	7
MAURITIUS	7
NORWAY	7
PORTUGAL	7
TRINIDAD AND TOBAGO	7
ARMENIA	7,2
CROATIA	7,4
SPAIN	7,4
ARGENTINA	7,5
AUSTRIA	7,5
DENMARK	7,5
HUNGARY	7,5
MACEDONIA	7,5
NETHERLANDS	7,5
NEW ZEALAND	8
HONG KONG	8,5
JAPAN	8,5
UNITED KINGDOM	8,5
VENEZUELA	8,9
KUWAIT	9,25

STATISTICAL ANALYSES

Given the restrictions that we set for defining the population to be studied (countries having more than one million inhabitants and having a democratic regime), we have a sample that is close to the total population.

Moreover, the large number of observations that we have[31] allows us to invoke the central limit theorem, which stipulates that the sum of random variables with the same mean and standard deviation tend towards normal distribution. We can therefore accept *de facto* the normality condition required for carrying out parametric tests. However, it should be noted that we will also verify our hypotheses using non-parametric tests.

Indeed, although our variables comply with the conditions for them to be applied to parametric tests, it is also possible to analyse them via non-parametric tests. These are not as effective as the former and require less demanding methods, but they allow us to verify that there is no non-linear[32] relation between two variables that would not have been detected by a Pearson correlation.

In the following paragraphs, we will present the results of the correlations made between our dependent variable and the different selected variables, as we have presented.

Using different correlation tables, we will attempt to observe whether the findings from literature are also present in our sample. When appropriate, we will also comment on the results of these tables using the applied correlations, not just on the rate of homicides by firearms but also on the global rate of homicides[33] in order to offer a new perspective to our results.

The analysis of the link between our dependent variable and the other variables will be carried out using 3 distinct statistical tests. In some ways, this could be considered as a three-step analysis. In this sense, we will attempt to obtain the highest possible significance by enhancing the severity of each test used. These 3 types of correlation are:

- A Spearman's correlation
- A Pearson correlation
- A partial correlation

The last test (partial correlation) will allow us to control the economic influence that could be hidden behind

[31] The central limit theorem can be invoked once 30 observations are collected (Ricco Rakotomalala, 2013).

[32] Note that if the Spearman's correlation is the non-parametric equivalent of the Pearson correlation, the link that the rs estimates is difficult to interpret as it is not linear.

[33] See Annexe XXX

these selected variables, as explained below.

The results will be presented according to this approach in three steps. Thus, if the first correlation gives a significant result, along with the second and the third, we will consider that the correlation obtained is relevant and robust vis-à-vis the power of the tests that it was subjected to.

However, if all these correlations are not found to be significant, we will conclude on an inconsistency of results.

THE LINK BETWEEN CRIME AND THE WEALTH OF A COUNTRY

The research conducted to study the variations in the rate of homicides for a set of countries have highlighted that economic variables are likely to influence this rate. In this sense, the wealth of a country appears to possess an undeniable explanatory character in comprehending crime in general, or more specifically in the variations observed in the homicide rates from country to country.

Several studies, by working on different economic variables, have showcased the link between the GDP per capita and crime in a country.

The other economic (the unemployment rate), demographic (urban population) or social variables (education level) that we use in our models can also be linked to the wealth of a given country. We therefore found it essential to control this "wealth" variable by making, in addition to the correlations with our dependent variable, additional partial correlations that take into account this wealth of the studied territories, via the GDP variable.

Owing to this processing step, we were able to determine, once the partial correlation was made, that the variables that continued to have a significant correlation with the rate of homicides by firearms could therefore be considered as having a very high relation with our main dependent variable.

In the following sections, we will observe the relation between the variables of the different categories and our dependent variable.

THE LINK BETWEEN CRIME AND THE WEALTH OF A COUNTRY

The economic variables that were investigated are:

- Gross domestic product,
- GINI coefficient,
- Unemployment rate,
- Infant mortality rate.

Dependent variable X Eco variables				
Code	(S)	(P)	(PIB)	(N)
PIB	- 0.311**	-0.431***		50
GINI	0.564 ***	0.683***	0.494***	51
CHO	- 0.002	0.164	-0.178	51
MORT	0.611***	0.585***	0.552***	52
* p<0.10 **p<0.05 ***p<0.01				

The sample size for which we have data related to these variables is given in column (N) of the table.

The correlations made are, respectively:

- (S) Spearman's rank-order correlation coefficient.
- (P) Pearson correlation
- (GDP) Partial correlation, control of the GDP

The correlations shown in this table have helped us draw numerous reflections.

- Firstly, the "unemployment" variable does not appear to be associated with the rate of homicides by firearms. Although unemployment has generally been associated with crime, it is possible that it is not associated with certain forms of it.

Moreover, we carried out the same statistical processing, referring not only to the rate of homicides by firearms, but also to the general homicide rate. The results are similar: the unemployment variable does not have any significant link with the general homicide rate[34].

[34] The correlation calculated with the rate of homicides per 100,000 inhabitants is r = -0.009. The partial correlation with the controlled gross domestic product is rgdp = -0.129.

- Contrary to this, the other two economic variables, infant mortality and the Gini coefficient show a highly significant correlation ($p<0.01$), which can be qualified as significant. This relation is positive in both cases. Thus, *the greater the income inequality, the greater the rate of homicides by firearms will be, and the same applies to infant mortality.*

  Also note that these correlations persist after the GDP is controlled. This latter finding demonstrates that the GINI coefficient as well as infant mortality are measurements that are different from the GDP or that they act differently on the rate of homicides by firearms.

- The GDP is negatively related with the rate of homicides by firearms, which tends to show that the lower the per capita income, the greater the expected rate of homicides will be. The significance of this correlation is nevertheless lower than the one obtained for the GINI coefficient and the infant mortality rate.

Lastly, it should be noted that the conclusions made here were also confirmed during the use of non-parametric tests (Spearman's coefficient).

At the end of these tests, we can therefore conclude that the economic variables were associated with the rate of homicides by firearms, and we also characterised the direction of the relation binding them. Given below is a table containing the different studied variables, divided according to the relation that they have with the rate of homicides by firearms from our sample.

NO RELATION with the rate of homicides by firearms (Tx_HOM/FA)	
Unemployment rate	
POSITIVE RELATION with the Tx_HOM/FA: The greater the X variable, the higher the rate of homicides by firearms will be When X is ⇧, the Tx_HOM/FA is ⇧	
GINI coefficient	The greater the inequality of wealth in a country, the greater the rate of homicides by firearms will be.
Infant mortality rate	The greater the infant mortality rate in a country, the greater the rate of homicides by firearms will be.
NEGATIVE RELATION with the Tx_HOM/FA The greater the X variable, the lower the rate of homicides by firearms will be When X is ⇧, the Tx_HOM/FA is ⇩	
Gross domestic product per capita	The greater the income of the inhabitants in a country, the lower the rate of homicides by firearms will be.

CORRELATIONS BETWEEN THE DEMOGRAPHIC VARIABLES AND THE RATE OF HOMICIDES BY FA

In this section, we have used the following as demographic variables:

- the proportion of men aged between 15 and 24 years
- the size of the urban population

Dependent variable X Demo variables				
Code	(S)	(P)	(PIB)	(N)
JHPOP	0.488***	0,591***	0,540***	51
POPURB	-0.02	-0,136	0,001	52
* p<0.10 **p<0.05 ***p<0.01				

- The first finding that we can address concerns the absence of any significant correlation between the "urban population" variable and our dependent variable, contrary to the postulate of the modernisation theory.
- However, the proportion of young men in the population is correlated very significantly ($p<0.01$) to the rate of homicides by firearms. This positive correlation can be qualified as significant ($r = 0.591$), even after controlling the GDP ($rgdp = 0.540$).

  This result is in line with what has been reported in literature. Thus, *the greater the number of young men in the population, the greater the rate of homicides by firearms will be.*

This conclusion is also applicable with our dependent variable is replaced with the global homicide rate. The correlation observed in this case is even stronger than the one observed with the rate of homicides by firearms ($r = 0.704$), but falls to similar values when the GDP is controlled ($rgdp = 0.544$).

These results are also meaningful when non-parametric tests are used.

To summarise, the relations observed between the demographic variables and the rate of homicides by firearms in our sample are as follows:

NO RELATION with the rate of homicides by firearms (Tx_HOM/FA)	
Percentage of urban population	
POSITIVE RELATION with the Tx_HOM/FA: The greater the X variable, the higher the rate of homicides by firearms will be When X is ⇧, the Tx_HOM/FA is ⇧	
Proportion of young men in the population	The greater the proportion of young men in a country, the greater the rate of homicides by firearms will be.

CORRELATIONS BETWEEN THE SOCIAL VARIABLES AND THE RATE OF HOMICIDES BY FA

Here, we will use the variables representing:

- the proportion of persons above 25 years of age that attained ISCED level 5 or 6
- the average number of years of schooling

Dependent variable X Socio variables				
Code	(S)	(P)	(PIB)	(N)
EDU25	-0.297**	-0,369***	-0,236*	51
EDUY	-0.480***	-0,428***	-0,326**	51
* p<0.10 **p<0.05 ***p<0.01				

- We observed that both the studied variables showed significant correlations with our dependent variable. This correlation is negative in both cases, which leads to the assumption that higher education is linked to lower rates of homicides by firearms. These results lean towards the protective effect, described in literature, that education could have on crime in general.
- However, it should be noted that these relations weaken when the wealth of the country is controlled. Indeed, the first variable "proportion of persons above 25 years of age that attained ISCED level 5 or 6" loses its significance with only $p<0.10$, which means that it is possible that this significance is valid in only 1 out of every 10 cases. The second variable "average number of years of schooling" remains strongly significant ($p<0.05$).

The correlations made with the general homicide rates lead us to the same finding.

These conclusions made here are also meaningful when non-parametric tests are used.

To summarise, the relations observed between the social variables and the rate of homicides by firearms in our sample are as follows:

NEGATIVE RELATION with the Tx_HOM/FA The greater the X variable, the lower the rate of homicides by firearms will be When X is ⇧, the Tx_HOM/FA is ⇩	
Average number of years of schooling	The greater the average number of years of schooling in a country, the lower the rate of homicides by firearms will be
Proportion of the population that attained a higher education level	The greater the proportion of the population that attained a higher education level, the lower the rate of homicides by firearms will be

CORRELATIONS BETWEEN THE CRIMINOGENIC VARIABLES AND THE RATE OF HOMICIDES BY FA

The criminogenic variables that were selected are:

- the per capita consumption of alcohol
- the consumption of cannabis
- the consumption of cocaine
- the consumption of ecstasy

- Globally, only the Pearson's correlations given a significant result to each type of analysis concerning the consumption of alcohol and ecstasy.

Dependent variable X Crimino variables				
Code	(S)	(P)	(PIB)	(N)
ALC	-0.345**	-0,292**	-0,310**	51
DGCAN	0.058	-0,041	0,061	51
DGCOC	0.299**	0,155	0,184	48
DGXTA	-0.242*	-0,244*	-0,216	49
* p<0.10 **p<0.05 ***p<0.01				

- Note that while the Spearman's correlations appear to indicate that drug consumption, especially ecstasy and cocaine, is linked to the rate of homicides by firearms, these correlations do not appear to persist when more meticulous tests are carried out. The consumption of cocaine does not show any significance, whereas that of ecstasy is observed to be $p<0.10$ and negative, which would mean that the greater the consumption of ecstasy in a country, the lesser the rate of homicides by firearms will be. Apart from the fact that the correlation between the rate of homicides by firearms and the consumption of ecstasy has a significance of only $p<0.10$, we also observed that it does not remain significant once the GDP is controlled.

The same results are obtained when these "drug" variables are crossed with the general homicide rate. No drug-related variable is significant.

These contradictory results between our parametric and non-parametric tests mean that we are not able to rule on the absence or presence of a link between these variables and the rate of homicides by firearms. Indeed, it is possible that these variables have a non-linear relation, which makes any interpretation rather difficult.

- As regards the consumption of alcohol, all the correlations tested showcase a link between it and the rate of homicides by firearms. Moreover, all the correlations are negative. This rather surprising finding contradicts what is normally stated in literature. It supposes that, *the higher the number of inhabitants in a given country having a high consumption of alcohol, the lesser the rate of homicides by firearms will be.*

  Even when the GDP is controlled, this finding remains applicable.

Similar values and a similar result can be found for the general homicide rate.

We sought to verify this conclusion using other data that could be an indicator of alcohol consumption (number of deaths caused by cirrhosis of the liver per 100,000 inhabitants; registered consumption of alcohol per capita). The results of the parametric and non-parametric correlations led to similar conclusions.

The conclusions as regards alcohol are similar to those of the Spearman's rank-order correlation coefficients. However, we have no explanation that would suffice to interpret this result.

To summarise, the relations observed between the criminogenic variables and the rate of homicides by firearms in our sample are as follows:

NO RELATION with the rate of homicides by firearms (Tx_HOM/FA)	
Cannabis consumption	
Ecstasy consumption	
Cocaine consumption	
NEGATIVE RELATION with the Tx_HOM/FA The greater the X variable, the lower the rate of homicides by firearms will be When X is ⇧, the Tx_HOM/FA is ⇩	
Alcohol consumption	The greater the alcohol consumption in a country, the lesser the rate of homicides by firearms will be.

CORRELATIONS BETWEEN THE VARIABLES OF INTEREST AND THE RATE OF HOMICIDES BY FA

In this section, we will analyse the correlations between our dependent variable and our variables of interest:

- The possession of firearms
- The strictness of the laws

The purpose of these analyses is to answer our two main hypotheses of research:

- There is a link between the availability of firearms and the number of homicides by firearms. (H1)
- There is a link between the laws related to firearms and the number of homicides by firearms. (H2)

The index related to the strictness of the laws corresponds to the Gun Right index, as mentioned in CHAPTER 2.

Dependent variable X Variables of interest				
Code	(S)	(P)	(PIB)	(N)
POSS	-0.012	-0,257*	-0,167	51
GunRi	-0.342**	0,004	0,112	52
* p<0.10 **p<0.05 ***p<0.01				

- The first finding is that none of the variables related to our hypotheses has any link that persists through successive tests. This could mean that none of the legislative components studied in the selected index clearly influences the rate of homicides by firearms.
- While the strictness of the laws, as measured by the Gun Right index, shows a significant negative correlation when Spearman's test is used, it does not persist when more meticulous tests are applied. Again, it is possible that there is a relation between these two variables, but that this relation may not be linear, which would explain the discordant results produced by the different tests.
- On the other hand, the index corresponding to the availability of firearms shows a significant correlation with the rate of homicides by firearms. This correlation is negative, which leads to the supposition that *the greater the availability of firearms, the lesser the rate of homicides by firearms will be.*

This finding is in line with the one put forward by LOTT & MUSTARD, postulating the protective effect that a firearm might have. However, this relation is not very significant ($p<0.10$), and is even less so when the wealth of the countries of our sample is controlled. Moreover, Spearman's test also does not show any significant result.

To summarise, the relations observed between the variables of interest and the rate of homicides by firearms in our sample are as follows:

NO RELATION with the rate of homicides by firearms (Tx_HOM/FA)	
Availability of firearms	
Strictness of the laws	

In this sense, similarly for the link between drug consumption and the rate of homicides by firearms, we must compare these results with those taken from the multiple regression carried out hereinafter, in order to refine our conclusions concerning their interpretation.

Before this, we attempted to go a bit further to search for a link that could bind our variables of interest to our dependent variable by carrying out a series of ANOVA[35].

Kruskal-Wallis ANOVA by Ranks

Using this series of tests, we attempted to determine whether, by dividing our sample into multiple groups (qualitative variable) using a selected criterion, we would be able to find a link between our variables of interest (the availability of firearms and the strictness of the laws related to firearms) and our dependent variable (the rate of homicides by firearms).

We therefore sought to find out if there is a link between variable X and variable Y, and to what extend Y depends on the fact that it belongs to a subgroup characterised by variable X.

We sought to group the countries of our sample according to different categories. In the following two sections, the countries of our sample will be grouped according to our two variables of interest and our dependent variable:

- the strictness of the laws
- the availability of firearms
- the rate of homicides by firearms

The tests categorise our sample of countries one by one according to each of these variables in order to determine whether the strictness of the laws and/or the availability of FAs influence the variability of the rate of homicides by FAs in these same countries.

When there is no difference, it means that Y globally gives the same measurements in all the subgroups.

[35] Analysis of variance

This does not mean that X and Y are independent, but that factor X does not have a global effect on Y.

The strictness of the laws

Independent variable (classification): Gun Right Group

Kruskal-Wallis test: H (2, N= 52) = 3.875142 p =.144

We carried out an ANOVA by grouping the countries according to the strictness of the respective laws (using the metric variable of the index of the strictness of the laws (GunRI)). The obtained results do not allow rejecting the equality of medians[36].

This therefore signifies that the strictness of the laws does not influence the measurement of our dependent variable, namely the rate of HOM/FA.

In this sense, a group characterised by a low score, i.e. a strictness of laws considered to be "low", will not have a homicide rate that varies significantly with respect to a group whose legislative strictness is considered to be "high".

Similarly to the previous statistical tests conducted, this finding implies that the strictness of the laws does not allow explaining the variance of the rate of homicides by firearms.

The availability of firearms

By using the same analysis process, this time with the "availability of firearms" variable for categorising the different countries of our sample, we obtain the following table.

Code	(N)	Sum - Ranks	Mean - Rank
1	11	254,0000	23,09091
2	16	478,0000	29,87500
3	13	286,5000	22,03846
4	11	307,5000	27,95455

[36] The results of the Kruskal-Wallis test (H (2, N= 52) = 3.875142 p = 0.144) lead to considering that the medians between the three subgroups are equivalent.

Kruskal-Wallis test: H (3, N= 51) = 2.625206 p = .453

The non-parametric tests conducted on the rate of homicides by firearms and the availability of firearms also appear to confirm the finding obtained using multiple regressions.

When the countries of our sample are categorised with respect to the possession of weapons[37], the probability of exceeding statistic H of Kruskal-Wallis does not allow rejecting the null hypothesis of the equality of medians.

Similarly to the strictness of the laws, the separation of the groups according to the "availability of firearms" variable does not allow determining a significant difference between the groups.

A group characterised by a low score, i.e. a firearm availability considered to be "low", will not have a homicide rate that varies significantly with respect to a group whose firearm availability is considered to be "high".

[37] The categorisation was carried out using standardised scores of the possession variable. The standard deviation of the standardised scores was used as the unit for creating the different groups. This allows creating homogeneous groups based on their deviation with respect to the mean of the sample.

The rate of homicides by FA

We also conducted the Kruskal Wallis test by grouping countries not only according to one of our variables of interest, but also directly according to their rate of homicides by firearms.

Code	(N)	Sum - Ranks	Mean - Rank
1	6	185,5000	30,91667
2	26	766,5000	29,48077
3	20	426,0000	21,30000

Every confounding variable was then tested to observe whether the created groups differed on any of these variables.

Although the size of groups was small, it is interesting to observe the variables on which these groups differ.

The countries of our sample were categorised into two groups:

- more than 10 homicides per 100,000 inhabitants
- less than 10 homicides per 100,000 inhabitants

The variables that significantly differ between the two groups are:

- The per capita consumption of alcohol
- the consumption of ecstasy
- the proportion of young men in the population
- the average number of years of schooling

- ✪ the proportion of the population that completed higher education,
- ✪ the inequality of income (GINI)
- ✪ the infant mortality.

We can therefore observe the similarity between these indices and the correlations obtained in the first part of this section (3.1. Correlations).

In order to check whether certain countries showed unusual values, i.e. deviating greatly from the mean of the rate of homicides by FA of our sample, we carried out the same tests by excluding these countries showing "extreme" data[38].

The results showed that certain variables remained stable, which thus allowed differentiating the two groups:

- ✪ The per capita consumption of alcohol
- ✪ the proportion of young men in the population
- ✪ the average number of years of schooling
- ✪ the proportion of the population that completed higher education,
- ✪ the inequality of income (GINI)
- ✪ the infant mortality

These are the same variables as those highlighted earlier, except for the "ecstasy consumption" variable. These variables remain significantly different between the two groups of countries of our sample.

We can therefore conclude that these variables can also differentiate the countries having a lesser number of homicides, and are therefore good predictors of homicides by firearms.

[38] groups having less than 1.07 homicides per 100,000 inhabitants (n=39) and those up to 5.3 homicides per 100,000 inhabitants (n=5),

TO CONCLUDE

This section helped to showcase certain variables that had significant links with the rate of homicides by firearms. To reiterate, the observed correlations do not imply causal links between the variables in play, but rather show the influence that these variables might have on each other.

We will therefore close this part by reiterating the significant correlations that we found during the different tests that were conducted. The correlations that we will mention below are those that were confirmed by the three types of tests carried out.

VARIABLE CATEGORY	NO RELATION with the rate of homicides by firearms (Tx_HOM/FA)		Corr with GDP control
ECONOMIC VARIABLES	Unemployment rate		-0.178
DEMOGRAPHIC VARIABLES	Percentage of urban population		0.001
CRIMINOGENIC VARIABLES	Cannabis consumption		0.061
	Ecstasy consumption		-0.216
	Cocaine consumption		0.184
VARIABLES OF INTEREST	Availability of firearms		-0.167
	Strictness of the laws		0.112
	POSITIVE RELATION with the Tx_HOM/FA: The greater the X variable, the higher the rate of homicides by firearms will be When X is ⇧, the Tx_HOM/FA is ⇧		
ECONOMIC VARIABLES	GINI coefficient	The greater the inequality of wealth in a country, the greater the rate of homicides by firearms will be.	0.494***
	Infant mortality rate	The greater the infant mortality rate in a country, the greater the rate of homicides by firearms will be.	0.552***
DEMOGRAPHIC VARIABLES	Proportion of young men in the population	The greater the proportion of young men in a country, the greater the rate of homicides by firearms will be.	0.540***
	NEGATIVE RELATION with the Tx_HOM/FA The greater the X variable, the lower the rate of homicides by firearms will be When X is ⇧, the Tx_HOM/FA is ⇩		
ECONOMIC VARIABLES	Gross domestic product per capita	The greater the income of the inhabitants in a country, the lower the rate of homicides by firearms will be.	
SOCIAL VARIABLES	Average number of years of schooling	The greater the average number of years of schooling in a country, the lower the rate of homicides by firearms will be	-0.326**
	Prop. of the population that attained a higher education level	The greater the proportion of the population that attained a higher education level, the lower the rate of homicides by firearms will be	-0.236*
CRIMINOGENIC VARIABLES	Alcohol consumption	The greater the alcohol consumption in a country, the lesser the rate of homicides by firearms will be.	-0.310**

* p<0.10 **p<0.05 ***p<0.01

MULTIPLE REGRESSIONS BETWEEN THE DIFFERENT SIGNIFICANT VARIABLES

In order to supplement our statistical analyses of correlations between the different variables studied, we carried out a series of multiple regressions.

These regression analyses take 4 different models into account:

- The first will take the economic variables into account
- The second will integrate the social and demographic variables
- The third model will integrate the criminogenic variables
- Lastly, the final model will group the significant variables with the greatest part of the explanations in the previous models.

These models will integrate our two variables of interest, namely the availability of firearms and the strictness of the laws with respect to the rate of homicides by firearms.

Indeed, despite the fact that only marginal relations could be found during the bivariate analyses between our variables of interest and the rate of homicides by firearms, it might be interesting to include them in the multiple regression models. In fact, it is possible that these variables play a role in explaining the rate of homicides by firearms when we control other variables, such as is the case during a multiple regression.

Each of the models therefore have 4 to 5 indices, which complies with the requirements set by our N (~50), given that it is considered that the regression can integrate one additional variable per section of 10 units of the total sample size.

Before focusing on the obtained results, it is important to also specify that the observation of the tolerance enabled rejecting the hypothesis of the existence of a problem of multicollinearity. This means that the studied indices do not have too much of a similarity. Indeed, the tolerance for all these indices is greater than 0.10, and we can therefore conclude that there is not too much inter-correlation between the explanatory variables of the models.

The table shows the results of the multiple regression for the 4 models considered.

GLOBAL MULTIPLE REGRESSION ANALYSIS WITH THE INSERTION OF THE "AVAILABILITY OF FIREARMS" VARIABLE

Global multiple regression analysis with the insertion of the availability of firearms variable				
Code	M1	M2	M3	M4
POSS Availability of FA	-0.873	-0.003	-0.228	-0.059
GINI GINI coefficient	0.226			
CHO Unemployment rate	-0.112			
MORT Infant mortality rate	0.470***			0.394**
JHPOP Proportion of young men aged between 15 and 24 years in the population		0.414**		0.298
POPURB Urban population		0.015		
EDU25 Proportion of people aged above 25 years with ISCED level 5 or 6		-0.109		
EDUY Average number of years of schooling		-0.128		
ALC Per capita consumption of alcohol			-0.338**	0.0158
DGCAN Cannabis consumption			0.0767	
DGCOC Cocaine consumption			-0.004	
DGXTA Ecstasy consumption			-0.201	
R^2	45%	33%	27%	43%

First model: Economic variables

The first model integrating the economic variables enables us to demonstrate that only the infant mortality rate is significantly related to the rate of homicides by firearms.

The relation between our dependent variable and the infant mortality rate is therefore the only relation that persists when the variables are integrated in the regression model.

Code	M1
POSS Availability of FA	-0.873
GINI GINI coefficient	0.226
CHO Unemployment rate	-0.112
MORT Infant mortality rate	0.470***

This relation is positive and with a high significance threshold ($p<0.01$). The other economic variables, as well as our variable of interest related to the availability of firearms, do not reveal any significant result.

In this sense, when all the economic variables studied are controlled, infant mortality is the only one having significant power in explaining the variation of the rate of homicides by firearms in the countries of our sample.

Second model: Socio-demographic variables

The second model that takes the social and demographic variables into account shows that only the proportion of young men in the population appears to be a good predictor of the rate of homicides by firearms when all demographic and social variables are taken into account.

As shown in the following table, only one variable has a significant association ($p<0.5$) with our dependent variable.

Code	M2
POSS Availability of FA	-0.003
JHPOP Proportion of young men aged between 15 and 24 years in the population	0.414**
POPURB Urban population	0.015
EDU25 Proportion of people aged above 25 years with ISCED level 5 or 6	-0.109
EDUY Average number of years of schooling	-0.128

In our socio-demographic model, it appears that the variable representing the proportion of young men in the population has the highest explanatory value for the variations in the different homicide rates observed in our sample.

Third model: Criminogenic variables

In this third model, only the consumption of alcohol remains linked to the rate of homicides by firearms when the other criminogenic variables are taken into account, with a significance threshold of $p<0.5$.

It should be noted that here too, the standardised regression coefficient is negative, confirming the correlations made previously. Alcohol consumption is therefore still negatively linked to the rate of homicides by firearms.

Code	M3
POSS Availability of FA	-0.228
ALC Per capita consumption of alcohol	-0.338**
DGCAN Cannabis consumption	0.0767
DGCOC Cocaine consumption	-0.004
DGXTA Ecstasy consumption	-0.201

When all the criminogenic variables studied are taken into account, only the alcohol consumption variable appears to significantly explain the differences that can be observed between the rates of homicides by firearms in our sample.

Fourth model: Explanatory variables

As explained earlier, the fourth model integrates that variables with the highest explanatory power concerning the variation in the rate of homicides by firearms. This mode is therefore made up of the significant variables derived from the previous models, to which we have added, like in each of the previous models, our variable of interest "availability of firearms".

In the previous models, the best explanatory indices were:

- the infant mortality rate,
- the proportion of young men in the population,
- the consumption of alcohol.

Code	M4
POSS Availability of FA	-0.059
MORT Infant mortality rate	0.394**
JHPOP Proportion of young men aged between 15 and 24 years in the population	0.298
ALC Per capita consumption of alcohol	0.0158

As shown in the previous table, on bringing together the different variables having significant explanatory power within the same model, only one explanatory variable appears to still be significantly linked with the rate of homicides by firearms, which is infant mortality.

This result implies that in this series of regressions that integrate our variable of interest "availability of firearms", infant mortality is the indicator with the highest explanatory power as regards the variations observed between the different rates of homicides by firearms in our sample.

This is therefore the variable that best predicts the significance of the rate of homicides by firearms in a given country.

This result should be supplemented by the analysis of the coefficients of determination of each of the created models, in order to be able to determine the strength of the explanatory power of these variables.

This analysis is based on the percentage of variance of our dependent variable that can be explained using the models that we presented.

COEFFICIENTS OF DETERMINATION

By examining the coefficients of determination produced by our multiple regression, we can observe the percentages of variance of the rates of homicides by firearms that can be explained by each of our models.

By comparing the variance of the first and last model (R^2) (45% and 43%), we can note that more than 40% of the variance of the rates of homicides by firearms in our sample can be explained by the variables specific to each of them.

As these models focus on the economic variables and the most significant explanatory variables respectively, it might be acceptable to consider that it is the variable that is common to both these models, i.e. the infant mortality rate, which plays the most explanatory role.

	M1	M2	M3	M4
R^2	45%	33%	27%	43%

Lastly, regardless of the model taken into account, the availability of firearms does not play a significant role in explaining the variance of the rate of homicides by firearms in our sample.

This latter finding therefore allows us to reject our starting hypothesis (H1) that postulates a link between the availability of firearms and the rate of homicides by firearms.

We did not find any significant link between these two variables in our sample of countries studied.

As explained earlier, by taking into account a set of economic,

demographic, social and criminogenic variables, the multiple regressions carried out indicated that only one economic variable, infant mortality, appears to possess significant explanatory power for explaining the observable variations between the rates of homicides by firearms.

Although the economic, socio-demographic and criminogenic models have been shown to be relevant, with coefficients of determination rising up to 45%, once all the significant "explanatory" variables are controlled in the same model, only infant mortality continues to have a highly significant relation with our variable of interest.

GLOBAL MULTIPLE REGRESSION ANALYSIS WITH THE INSERTION OF THE "STRICTNESS OF THE LAWS RELATED TO FIREARMS" VARIABLE

Global multiple regression analysis with the insertion of the strictness of the laws related to firearms variable				
Code	M1	M2	M3	M4
GUNRi Strictness of the laws	0.250**	0.094	0.228	0.229
GINI GINI coefficient	0.343**			0.285
CHO Unemployment rate	-0.101			
MORT Infant mortality rate	0.470***			0.382**
JHPOP Proportion of young men aged between 15 and 24 years in the population		0.405**		0.151
POPURB Urban population		0.01		
EDU25 Proportion of people aged above 25 years with ISCED level 5 or 6		-0.100		
EDUY Average number of years of schooling		-0.140		
ALC Per capita consumption of alcohol			-0.381**	0.01
DGCAN Cannabis consumption			0.053	
DGCOC Cocaine consumption			0.073	
DGXTA Ecstasy consumption			-0.228	
R^2	49%	32%	22%	49%

The above table shows the results of our second multiple regression analysis.

This analysis uses the same models as the previous one (eco, socio-demo, crimino models) with the same variables as those used previously, except for the explanatory model, which integrates the variables that are revealed to be significant in this second series of multiple regressions.

We integrated our second variable of interest "strictness of the laws" in these 4 models in place of the "availability of firearms" variable.

This "strictness of the laws" variable represents the GUN Right index, as for the correlations.

First model: Economic variables

Code	M1
GUNRi Strictness of the laws	0.250**
GINI GINI coefficient	0.343**
CHO Unemployment rate	-0.101
MORT Infant mortality rate	0.470***

In this first model, out of the economic variables taken into account with the strictness of the laws, we can observe that 3 variables are significant. The Gini coefficient, infant mortality and the strictness of the laws.

The Gini variable and infant mortality were already linked to the rates of homicides by firearms during the bivariate analyses and they are linked here as well, with a positive relation and with high significance thresholds ($p<0.5$ and $p<0.01$ respectively).

By contrast, the index showing the strictness of the laws is positively linked to the rate of homicides by firearms. While the non-parametric tests also showed a significant relation between these two variables, here, and contrary to the first result, the relation is positive. This could mean that in this economic model, stricter laws are associated with a high rate of homicides by firearms.

We can therefore conclude that in this economic model, three of the planned variables are significant predictors of variations observable between the different rates of homicides by firearms in our sample.

Second model: Socio-demographic variables

The second model, focusing on demographic and social variables, shows only one explanatory variable.

In this model, only the proportion of young men in the population appears to be a good predictor of the rate of homicides by firearms when all the variables are taken into account.

Code	M2
GUNRi Strictness of the laws	0.094
JHPOP Proportion of young men aged between 15 and 24 years in the population	0.405**
POPURB Urban population	0.01
EDU25 Proportion of people aged above 25 years with ISCED level 5 or 6	-0.100
EDUY Average number of years of schooling	-0.140

We can therefore state, similarly to the previous regression model focusing on the socio-demographic variables, that here too, only the variable representing the proportion of young men in the population has a significant positive relation ($p<0.5$) with our dependent variable.

Third model: Criminogenic variables

In this model, only the consumption of alcohol remains linked to the rate of homicides by firearms when the other criminogenic variables are taken into account.

Code	M3
POSS Availability of FA	-0.228
ALC Per capita consumption of alcohol	-0.338**
DGCAN Cannabis consumption	0.0767
DGCOC Cocaine consumption	-0.004
DGXTA Ecstasy consumption	-0.201

Almost identically to what we observed in the previous criminogenic model, alcohol consumption is the only relevant significant variable in explaining the variations in the rates of homicides by firearms. In this model, the significance threshold of this variable is even greater than in the previous model ($p<0.01$).

Similarly to all the other analyses conducted, the standardised regression coefficient indicates a negative relation with our dependent variable here as well.

Fourth model: Explanatory variables

The fourth model integrates the best explanatory variables of the rate of homicides by firearms derived from the previous models, and the index of strictness on firearms.

In the previous models, the best explanatory indices were:

- the strictness of the laws
- the GINI coefficient
- the infant mortality rate
- the proportion of young men in the population
- the consumption of alcohol

Only one explanatory variable appears to still be significantly linked with the rate of homicides by firearms when it is integrated in the regression model, which is infant mortality.

Code	M4
GUNRi Strictness of the laws	0.229
GINI GINI coefficient	0.285
MORT Infant mortality rate	0.382**
JHPOP Proportion of young men aged between 15 and 24 years in the population	0.151
ALC Per capita consumption of alcohol	0.01

Similarly to the previously conducted regression series, it therefore appears that the variable representing infant mortality has the most explanatory power.

This result implies that in this series of regressions that integrate our variable of interest "strictness of the laws", infant mortality is the indicator with the highest explanatory power as regards the variations observed between the different rates of homicides by firearms in our sample.

This is therefore the variable that best predicts the significance of the rate of homicides by firearms in a given country.

Here too, this finding should be supplemented by the analysis of the coefficients of determination of each of the created models, in order to be able to determine the strength of the explanatory power of these variables.

COEFFICIENTS OF DETERMINATION

Here as well, we can note that the coefficients of determination of the first and last models are identical (49%). In this sense, nearly 50% of the variance of the rate of homicides by firearms in our sample can be explained by the variables of these models. In view of these two models, it appears acceptable to consider that the mortality rate variable plays an important role in this explanation.

	M1	M2	M3	M4
R^2	49%	32%	22%	49%

In this global model, the index of the strictness of laws is no longer significant. Moreover, as stated earlier, it is probable that the entire explanation for the variance of the rate of homicides by firearms is due to the infant mortality variable.

By replacing our dependent variable with the global homicide rate and by carrying out multiple regressions on the same models, the results are similar (see the annexe).

Here too, the variables related to the infant mortality rate, the proportion of young men in the population, alcohol consumption remain the best predictors of the global homicide rate.

Similarly to the previous analyses, the index of the strictness of laws is only associated in the model focusing on economic variables. This associated disappears when all the variables are controlled.

These results therefore allow us to reject our second research hypothesis: we were able to find that there is no significant link between the strictness of the laws in a given country and the rate of homicides by firearms.

Here too, the variable with the greatest impact on the rate of homicides by firearms is the economic variable representing the infant mortality rate.

SPEARMAN'S BIVARIATE CORRELATIONS

In the last section of this statistics part, we studied the influence that the availability of firearms could have on the type of homicides taken into account. This focus also allowed us to answer our third secondary hypothesis, according to which "there is a significant link between the availability of firearms and the global homicide rate".

In this sense, we distinguished:

- the global homicide rate
- the rate of homicides by firearms
- the rate of homicides by means other than firearms

Results of the Spearman's rank-order correlation for the availability of FA.		
	(S)	(N)
Homicide rate	-0.175	51
Rate of homicides by firearms	-0.012	52
Rate of homicides by other methods	-0.2355*	51

We carried out bivariate correlation analyses using Spearman's non-parametric statistics, since this test is less sensitive to data that strongly deviates from the mean.

The only significant result obtained is the negative association between the availability of firearms and the percentage of homicides by means other than firearms per 100,000 inhabitants (r_s=- 0.2355, p<0.1).

This finding implies that in our sample, the countries that tend to have a greater availability of firearms also have the tendency to face lesser homicides by other weapons out of the total homicides committed in the country. Note that this correlation is not causal and therefore does not mean that the rate of homicides by firearms will consequently be greater. Moreover, no correlation was observed between the general homicide rate or the rate of homicides by firearms and the availability of firearms.

Keep in mind that this detected relation does not exceed the significance threshold of p<0.1 and remains modest (r_s = -0.2355), which means that it could just be an artefact of the Spearman's rank-order test.

These results have led us to conclude that the availability of firearms, as we had conceptualised, is not associated with the global homicide rate in our sample, and therefore to reject our third hypothesis postulating the existence of this link.

PART 2 - ANALYSES OF THE DATA ON THE SAMPLE OF RESPONDING COUNTRIES

DESCRIPTIONS OF THE RESPONDERS

As explained in the previous chapters, one of the stages of the study consisted of developing a questionnaire for measuring different indicators, identified as relevant in the literature, in order to grant an overview of the laws implemented by each country with respect to the possession and purchase of firearms by civilians.

However, collecting data via the questionnaire was laborious and did not enable obtaining the desired number of responses[39].

After verifying the returned questionnaires, we were only able to consider 10 questionnaires as completed in a sufficiently thorough manner that would enable establishing an index on the laws on firearms in the selected countries. Out of the completed questionnaires, one of them had to be excluded owing to a lack of clarity and accuracy with respect to the given answers (Austria).

The responding countries are Cyprus, Czech Republic, Germany, Hungary, Lithuania, Netherlands, Spain, Sweden, United Kingdom and New Zealand. Ten of these countries are European, and New Zealand is the only representative of another continent.

[39] This can be explained by various reasons: such as the availability of responders, the timeframe for the research, the unwillingness of certain responders to answer our questions, the partial completion of questionnaires, etc.

DESCRIPTION OF THE CONTROL VARIABLES

All these countries are also classified as high-income countries except for Lithuania, which the World Bank considers as a country in the upper section of medium-income countries.

The mean population of these countries is 24,674,984 with population sizes ranging from 1,141,166 inhabitants (Cyprus) to 80,621,788 inhabitants (Germany).

The countries of our sample had a certain similarity as regards a series of variables. There was no significant deviation in the values for the variables conceptualising:

- the inequality of income[40],
- the gross domestic product per capita[41],
- the infant mortality[42],
- the percentage of population living in urban areas[43],
- the proportion of the population above 25 years of age that attained a diploma of a level equivalent to at least ISCED-5[44],
- the prevalence of the consumption of cannabis[45]
- the average of the total litres of pure alcohol consumed per inhabitant[46].

However, certain countries deviate significantly on other variables that were studied.

[40] The inequality of income calculated by the World Bank for these ten countries was between 0.25 and 0.376 with a mean of 0.32. The standard deviation for this variable is 0.04. No country significantly deviates from the mean of the sample.

[41] The mean income per capita is $US 33,376.4 per inhabitant, with a minimum of $US 13,134 and a maximum of $US 58,269 and a standard deviation of 15219.91. No country significantly deviates from the mean of the sample.

[42] The infant mortality for 100,000 births in our sample was between 2 (Sweden) and 5 deaths (New Zealand, Hungary). The standard deviation of 0.97 and the mean of 3.6 implies that no country shows an unusual value with respect to our sample.

[43] The proportion of population living in urban areas appears to be quite similar in the countries of our sample. The mean is 77.59% with a minimum of 66.52% (Lithuania) and a maximum of 89.91% (Netherlands). The standard deviation is 8.33. No country seems to have an aberrant value with respect to the other observations of the sample.

[44] The proportion of the population above 25 years of age that attained a diploma of a level equivalent to at least ISCED-5 is between 17.34% (Czech Republic) and 34.76% (New Zealand) of the population in our sample. The mean is 28.05% with a standard deviation of 5.6%. No country seems to have aberrant values with respect to the other observations of the sample.

[45] The proportion of the population that consumed cannabis at least once in the past year ranges from 2.2% to 14.6% of the population of the countries in our sample. The mean of 6.11 and the standard deviation of 4.33 implies that no country shows values that are completely different from the other countries. These figures are calculated only for 9 countries, since the data used to conceptualise this prevalence of cannabis consumption was not available for the United Kingdom. This comment also applies to the consumption of cocaine and ecstasy.

[46] The average of the total litres of pure alcohol consumed per inhabitant in our sample is 11.55 with a minimum of 9.2 (Cyprus) and a maximum of 15.4 (Lithuania). The standard deviation of 1.95 does not enable showcasing that a country of our sample has aberrant values on this variable.

For instance, Spain shows values that deviate from the mean of the sample for two variables:

- Firstly, the unemployment rate of these ten countries is between 5.2% (Netherlands) and 21.7%. The mean of the sample is 9.6%. With an unemployment rate of more than 19.2%[47], Spain shows a value much higher than the other countries of the sample (21.7%).

- The second variable in which Spain deviates is the consumption of cocaine. The proportion of the population that consumed cocaine at least once in the past year is higher is Spain. Indeed, with a prevalence of 2.3% (above the limit value of 2.161), Spain significantly deviates from the mean of the consumption in other countries (0.78%).

Similarly to Spain, New Zealand also has values that deviate from other countries in two variables.

- The first concerns one of the variables on education. The average number of years of schooling in the different countries of our sample varies from 14 to 20 years. The standard deviation is 1.51 and the mean is 16.28. Exceeding the limit value of 19.03, shows that the average number of years of schooling is unusual and higher than normal in New Zealand (20.20).

- The second variable is the variable conceptualising the consumption of ecstasy. The proportion of the population that consumed ecstasy at least once in the past year ranges from 0.1% to 2.6% of the population of the countries in our sample. The mean of 0.75% and the standard deviation of 0.78 appear to indicate that New Zealand has a value of this variable that deviates slightly from the mean of the sample (Limit value: 2.33<2.6%).

[47] This value corresponds to the limit value above which we can consider that the value deviates significantly from the mean of the sample. This is calculated from the mean and the standard deviation. We consider that data that deviates by more than two times the standard deviation from the mean of the sample is an unusual value. The complete calculation can be formulated as follows: $\bar{X} \pm (2^{*}\sigma)$. In this case, 9.6 + (2*5.15)= 19.2 for the value of the upper limit.

Lastly, it should be noted that Cyprus has data that is clearly different from our sample as regards the variable conceptualising the proportion of young men in the population. The proportion of young men in the population in our sample has a mean of 16.32%, ranging from 13.5% (Germany) to 22.2% (Cyprus). The standard deviation of 2.3% enables reporting that with a proportion of more than 20.92%, Cyprus has an unusually large proportion of young men in the population as regards the countries in the sample.

DESCRIPTION OF THE DEPENDENT VARIABLE

The rate of homicides by firearms per 100,000 inhabitants shown by the sample varies between 0.06 and 0.29. The mean is 0.164, i.e. slightly more than one murder per one million inhabitants. The standard deviation is 0.076. No country seems to have a value that deviates too much from the mean of the sample.

On the contrary, when focusing on the global number of homicides in the countries of our sample, one unusual value was highlighted. With a value of more than 5.26[48], Lithuania had a homicide rate that deviated significantly from the mean (Lithuania: 6.7; $\bar{X}$=1.61; σ = 1.83).

When we observe the proportion of homicides by firearms with respect to the total number of homicides in each country, we can also observe that there is a difference for Cyprus, where nearly 52% of homicides are committed using a firearm. Whereas in Lithuania, only 3.96% of homicides are committed using a firearm.

[48] This value represents $\bar{X} + (2x\sigma)$

DESCRIPTION OF THE VARIABLES OF INTEREST

Similarly to our first series of analyses, our variables of interest seek to measure:

- The availability of firearms
- The strictness of the laws related to firearms

The first variable of interest is based on a proxy measurement corresponding to the proportion of suicides by firearms as compared to the total number of suicides in a given country.

The availability of firearms

The following table shows a summary of the different proportions calculated in this way for each responding country.

The mean of the availability of firearms is 6.81 (X=6.81; σ=4.6). We can therefore state that within our sample, only one country deviates significantly from the other values. With an availability index of 16.67, Cyprus shows a slightly unusual value (the limit is 16.01).

The strictness of the laws

The scores obtained by the countries that responded to our questionnaire are shown in the table below.

The scores of the laws for our sample of responding countries vary between 49 (Czech Republic) and 84 (Netherlands).

The mean of the score is 65.45% with a standard deviation of 10.69% indicating a low dispersion in the values obtained. No country has an unusual value (<44.067 or >86.832).

Four countries have a score that can be qualified as high, with a score of more than 70 points out of 100. These are the Netherlands (84), Sweden (75.5), the United Kingdom (73) and Germany (71).

The countries with the lowest scores are Czech Republic (49) and Cyprus (52).

The rest of the sample (N=4) obtained values that were slightly less than the mean (between 61 and 65).

Table 8: Overview of the data related to the responding countries

	Per 100,000 inhabitants			
Country	Tx_HOM/AAF	TxGL_HOM	DISP. AAF	Law score
United Kingdom	0,06	1	1,54	72
Germany	0,07	0,8	6,97	71
Hungary	0,11	1,3	3,40	62,5
Spain	0,12	0,8	5,53	65
Czech Republic	0,15	1	10,49	49
New Zealand	0,18	0,9	7,53	61,5
Sweden	0,19	0,7	9,90	75,5
Cyprus	0,23	2	16,67	52
Lithuania	0,24	6,7	3,24	61
Netherlands	0,29	0,9	2,85	84

CORRELATION BETWEEN THE RATE OF HOMICIDES BY FA AND OTHER VARIABLES

By using the same approach as our first series of analyses (on the sample of 52N), we carried out a series of bivariate correlations, using the Spearman's rank-order correlation test, between our dependent variable, the rate of homicides by firearms and our confounding variables, the economic, demographic, social and criminogenic variables.

The choice of this non-parametric test complies with the size constraints of our sample.

As shown in the table of results, none of the correlation coefficients calculated using Spearman's index demonstrates any significant relation between the rate of homicides by firearms in a country and the control variables chosen initially[49] in our sample.

This lack of result can mostly be explained by the small size of our sample, as well as the fact that it is almost exclusively made up of European countries having a great number of similarities as regards the studied variables.

Links between the rate of homicides by firearms and the other explanatory variables:		
	(N)	(S)
Economic variables		
Gross domestic product	10	
Income inequality	10	0.091
Unemployment rate	10	-0.212
Infant mortality	10	-0.311
Demographic variables		
Urban population rate	10	0.03
Proportion of young men in the population	10	0.188
Social variables		
Average number of years of schooling	10	0.018
Proportion of persons that attained a minimum level of ISCED-5	10	0.285
Criminogenic variables		
Alcohol consumption	10	-0.353
Cannabis consumption	9	-0.218
Cocaine consumption	8	-0.381
Ecstasy consumption	9	-0.100
* p<0.10 **p<0.05 ***p<0.01		

[49] This lack of result forced us to apply a partial correlation controlling the GDP.

CORRELATIONS BETWEEN THE GLOBAL HOMICIDE RATE AND THE CONFOUNDING VARIABLES

In order to add more details to our analysis, we compared these results with those obtained by replacing our dependent variable with the total homicide rate, as we did in the first series of analysis.

Contrary to the previous results, the analyses conducted on the global homicide rate and the confounding variables of our research showcased five significant relations:

- Gross domestic product (r_s=-0.801; p<0.01);
- Urban population (r_s=-0.710; p<0.05);
- Proportion of young men in the population (r_s=0.697; p<0.05);
- Income inequality (r_s=0.581; p<0.10);
- Cocaine consumption (r_s=-0.698; p<0.10).

Among these significant relations, three of them stand out by reaching a high significance threshold (0.05 or 0.01):

- Gross domestic product (r_s=-0.801; p<0.01);
- Urban population (r_s=-0.710; p<0.05);
- Proportion of young men in the population (r_s=0.697; p<0.05);

In fact, the first relation that was showcased, between the GDP and the global homicide rate, has a high significance (p<0.01), as well as very high power (r_s =-0.801).

Note that this relation is in perfect harmony with the findings derived from literature, as it signifies that *the greater the GDP of a country, the lower the global homicide rate will be.*

The other two relations also have a good significance level, and can also be qualified as high. Once again, these relations highlight the importance of factors that can greatly influence the study of crime, confirming the choice of these control variables.

Lastly, the relations showcased for the GINI coefficient and the cocaine consumption[50] are also interesting, although it should be kept in mind that they have a significance threshold of only $p<0.10$, thereby limiting the interpretations that might be made in this respect.

The summary of the results obtained is given in the following table.

VARIABLE TYPE	POSITIVE RELATION with the Tx_HOM: The greater the X variable, the higher the global homicide rate will be When X is ⇧, the Tx_HOM is ⇧	
ECONOMIC VARIABLES	GINI coefficient	The greater the inequality of wealth in a country, the greater the homicide rate will be.
DEMOGRAPHIC VARIABLES	Proportion of young men in the population	The greater the proportion of young men in a country, the greater the homicide rate will be.
	NEGATIVE RELATION with the Tx_HOM: The greater the X variable, the lower the global homicide rate will be When X is ⇧, the Tx_HOM is ⇩	
ECONOMIC VARIABLES	Gross domestic product per capita	The greater the income of the inhabitants in a country, the lower the homicide rate will be.
DEMOGRAPHIC VARIABLES	Urban population	The greater the urban population in a country, the lower the homicide rate will be.
CRIMINOGENIC VARIABLES	Cocaine consumption	The greater the cocaine consumption in a country, the lower the homicide rate will be.

[50] Concerning the consumption of cocaine, several authors have highlighted that it is actually an indicator of the wealth of the population (since this drug's accessibility is much lower in terms of price than the other drugs that were studied).

CORRELATION BETWEEN THE HOMICIDE RATES AND THE VARIABLES OF INTEREST

In this section, we have firstly calculated a correlation between the legislation index that we developed using our questionnaires and the reverse Gun Right index.

The results of this correlation indicate that these two variables are significantly and positively correlated (r=0.573; p=0.083), which appears to support the existence of a link between the index that we created and the Gun Right index.

Variables related to the strictness of the laws	Spearman's correlation coefficient value	
	Rev. GUN_R	Ind_LEG
TX_HOM FA	-0.360	-0.079
TXGL_HOM	-0.234	-0.630*
TX_HOM without FA	-0.079	-0.624*
Prop. HOM FA	-0.238	0.164

Although this link could be qualified as "strong", it is not total, which could be explained by the fact that these variables measure a part of the same reality, but not its entirety. This seems to be completely logical, as the components measured by the Gun Right index are much more limited than those taken into account by the legislation index that we developed through our questionnaires.

Moreover, note that the significance threshold is low, not exceeding <0.1.

When we correlate these two variables (legislation index that we created and the reverse Gun Right index) with the different homicide rates of the responding countries, we observed that although the Gun Right index is linked with the one that we developed, it does not allow highlighting the same links as our legislation index.

- The strictness of the laws conceptualised by the reverse value of the Gun Right Index does not give any significant relation, regardless of the variable linked to the homicides.
- The strictness of the laws as conceptualised by our legislation index, on the other hand, does reveal two significant results. In fact, while no relation could be shown with the rate of homicides by firearms or even with the proportion of homicides by firearms out of the total number of homicides, we found:

- a correlation with the global homicide rate
- a correlation with the rate of homicides without firearms

These two relations are negative and can be considered to be strong, although the exceedance probability is just $p<0.1$.

Therefore, it should be kept in mind that there is one chance out of ten that this relation is random. The relation observed with the global homicide rate shows that the homicide rate is lower in countries where the laws are stricter. The same finding was made with the rate of homicides committed using means other than firearms.

CORRELATION BETWEEN AVAILABILITY AND THE HOMICIDE RATE

In order to verify in the new sample whether the measurement of the availability of firearms is linked with crime, we carried out bivariate correlation analyses using Spearman's rank-order correlation test.

Other than the rate of homicides by FA, the different variables used were extended to the global homicide rate, the rate of homicides without FA, and even to the proportion of homicides by FA / total homicides.

As indicated by the results shown in the table above, no significant link appears to exist between the studied variables and the availability of firearms in our sample.

Availability of FA	Spearman
TX_HOM FA	0.151
TX GL_HOM	-0.116
TX_HOM without FA	-0.139
Prop. HOM FA	0.491

The extremely low rate of responses given to our questionnaire as well as the absence of any determining link between our dependent variable and our variables of interest and control variables do not enable carrying out a partial correlation or a multiple regression model. In order to enhance the search for an association between our variables as much as possible, we carried out an ANOVA here too, classifying the countries of our sample according to their obtained legislation score.

KRUSKAL-WALLIS ANOVA

The comparisons between the groups made in this section were executed on the basis of the groups formed using their legislation index score that we developed.

To do this, we created three groups using the data distribution histogram. The limit values of the different groups are as follows:

- Low: 45-55 (N=2);
- Medium (N=4): 55-70;
- High (N=4): 70-85.

We compared the groups on all the variables (economic, demographic, social, criminogenic and interest) of our model.

Only two Kruskal-Wallis ANOVAs were significant. The test results led to rejecting the hypothesis of the equality of medians between the subgroups for two variables:

- the gross domestic product ($H = 5.509$; $p=0.063$; $p<0.1$)
- infant mortality ($H=6.060$; $p=0.048$; $p<0.05$).

The Mann–Whitney U test showed that differences are seen in the medium and high groups.

In this sense, when the "strictness of the laws" variable is used to classify our sample of countries into different groups (from low to high), the fact of belonging to a medium or high group as regards the laws related to firearms influences only two variables in their distribution. These variables are the infant mortality rate and the GDP.

These two variables are therefore linked to our variable of interest "strictness of the laws" for countries with medium and high scores.

Chapter 4

Conclusion & discussion

VERIFICATION OF THE MAIN HYPOTHESES

At the end of our analysis, we were able to return to our main research hypotheses that focused on the link between the rate of homicides by firearms and the availability of firearms (hypothesis 1), as well as the link between the rate of homicides by firearms and the laws related to firearms (hypothesis 2).

None of the tests conducted on our data, on either the first (N=52) or second (N=10) samples of countries, consistently indicate that our two variables of interest effectively maintain a significant relation with the rate of homicides by firearms or generally with the global homicide rate. Although certain correlations did imply the presence of a link between some of these variables, these links did not stand up to a battery of more rigorous tests.

This finding therefore led us to rejecting both our hypotheses. Neither the strictness of the laws nor the availability, as we conceptualised them, appear to be significantly linked to the rate of homicides by firearms.

In the following paragraphs, we will give more details on each of the relations observed between our studied variables.

LINK BETWEEN AVAILABILITY, HOMICIDES AND HOMICIDES BY FIREARMS

When this proxy measurement was correlated with the rate of homicides by firearms using a Pearson correlation, we obtained a negative and significant correlation with a probability level of 0.10 ($r=-0.257$, $p<0.10$).

This correlation implies that a greater availability may slightly reduce the rate of homicides by firearms and the general homicide rate ($r=-0.284$),

However, this correlation, whose significance threshold does not exceed 0.1, is not very strong, which increases the risk that this result is random.

Moreover, once the GDP is controlled, the relation is no longer significant; neither with homicides by firearms nor with homicides in general. This finding reaffirms the influence of economic variables on crime at the macro-analytical level, and the importance of taking them into account while studying related phenomena.

Moreover, it is interesting to note that the availability variable was not significant in any multiple regression

model that was tested. This could imply that the effect detected in the previously mentioned correlations could be due to variables that were controlled in the multiple regressions.

Our hypothesis H1 (postulating a link between homicides by firearms and the availability of firearms) as well as the secondary hypothesis H3 (postulating a link between the global homicide rate and the availability of firearms) were therefore rejected owing to a lack of a consistent significant result during the different test phases.

As regards the studies related to the link between the availability of firearms and mortality by firearms, we were able to showcase, similarly to KLECK, the general inconsistency of the results given by literature, undoubtedly caused by the great diversity of measurements used to conceptualise the availability of firearms in a given country.

As regards the theoretical hypotheses put forward by literature regarding the possible link binding the availability of firearms and crime, our results force us to reject the hypothesis according to which the possession of firearms increases the rate of homicides and especially homicides by firearms (facilitation or triggering factor hypothesis). No result brought to light during our series of analyses on the selected sample of countries allows us to draw this conclusion.

As we highlighted, the only correlation obtained vis-à-vis the rate of homicides or the rate of homicides by firearms is negative. This finding returns us to the two remaining theoretical hypotheses, one postulating the protective effect of a greater availability of firearms and the other postulating the lack of effect between it and crime in general or, in particular, crime related to firearms.

While the negative correlation obtained could have led us to lean towards the first hypothesis, the low significance of this result, as well as the absence of any significant link detected between the availability variable and the rate of homicides by firearms in our different multiple regression models, each time controlling a set of confounding variables (social, economic, demographic, criminogenic), forced us to support the last postulate, according to which there is no link of a linear relation between the availability of firearms and the global homicide rate or the rate of homicides by firearms. Therefore, it is not possible to conclude that

increasing or decreasing one of these variables would match an increase or decrease in the other.

To reiterate, the explanation given by the supporters of this approach could be, according to them, the result of two components:

- The availability of firearms might simply have no influence on crime. Thus, the use of a weapon could reflect a greater motivation by the perpetrator to harm the victim (Wolfgang, 1958, cited by Altheimer, 2010). If this hypothesis is true, the absence of a weapon would lead the assailant to use another type of weapon to reach the desired goal.
- The second possibility is that the effect between the availability of firearms and crime cannot be detected owing to a defensive use of firearms. Firearms used for legitimate defence could neutralise the effects of firearms used for criminal assaults (Kleck, 1997 cited by Altheimer, 2010). Thus, the observable link could be neutralised by opposing or compensatory effects.

Applied to a macro-analytical perspective, these assertions suggest that a change in the availability of firearms would not influence or has no link with crime.

While it is not possible to rule on the veracity of these two explanations, it is however possible to state that in light of our results, no concrete and quantifiable link was found between this variable of interest and our dependent variable, nor more generally between the availability of firearms and the global homicide rate.

Lastly, keep in mind that our analyses are developed using a proxy measurement that, although known to be one that best reflects the reality of the availability of firearms in a country, may not be appropriate for all the selected countries.

Indeed, we can state that some countries have extremely low rates as regards this availability. Therefore, this indicator may only be effective vis-à-vis certain countries having one or more specific characteristics that have not yet been brought to light by the researches on this subject.

Moreover, this variable takes into account all the firearms available in a country. No distinction is made between the illegal possession and legal possession of these weapons in circulation. Yet, it would certainly be interesting to compare the results obtained in this study with those that might be obtained by only considering the prevalence of illegal firearms.

Indeed, it is necessary to showcase, similarly to STOLZENBERG & D'ALESSIO (2000), the importance of the use of illegal weapons in criminal activities.

In this sense, as Cook demonstrated (1979, cited by Stolzenberg & d'Alessio 2000), it is possible that the possession of illegal weapons increases the

number of violent crimes whereas the possession of legal weapons reduces this type of crime.

These statements suggest that the possession of both legal and illegal weapons influence the rate of homicides by firearms, but in opposite ways, which would be in line with the explanation given by KLECK (1997) concerning the absence of an observable effect between the availability of firearms and the rate of homicides by firearms.

In order to verify this supposition, STOLZENBERG & D'ALESSION carried out a study on South Carolina between 1991 and 1994, using the number of licences sold (legal possession) and the number of stolen weapons (illegal possession). Their research attempted to showcase the existence of a negative association between the legal possession of firearms and the rate of violent crimes, and a positive association between the possession of illegal firearms and the rate of violent crimes.

Their results showed that:

1. there is no link between legal possession and violent crimes.

2. a positive association exists between the possession of illegal weapons and violent crime.

While their basic hypotheses were only partially verified (legal possession was not significantly linked to the rate of violent crimes), the association between illegal possession and violent crime was the only significant association, that too positive, that they were able to demonstrate, thereby showing the interest of this type of study.

Of course, the major problem of this approach lies in the difficulty of quantifying, or more simply evaluating this illegal possession in a more or less high number of countries. Nevertheless, we did find that certain researchers have recently focused on this problem by proposing measurements that could relate to this difficult to investigate part of reality (MORSELLI, 2013), thereby encouraging future researches in this domain.

LINK BETWEEN LAWS AND HOMICIDES BY FIREARMS

The "strictness of laws" was conceptualised using two different indices. On the one hand, the Gun Right Index (reversed) and on the other hand, the index that we created through our questionnaire.

GUN RIGHT

Only the non-parametric analysis showed a significant and negative link between the strictness of the laws as measured by the Gun Right index and the rate of homicides by firearms.

While this result may imply that the stricter the laws related to firearms, the lower the rate of homicides by firearms will be, the relation does not persist when subjected to more rigorous statistical tests (Pearson correlation and partial correlation).

Moreover, we found that the relations determined by the parametric tests, even if they are not significant, indicated a change of sign and therefore the direction of the relation.

This finding is all the more conclusive as, when the "strictness of the laws" variable is integrated in our regression models, it is systematically positive and is significant in the regression model that takes the economic variables into account in connection with the rate of homicides by firearms.

Since the direction of the relation is positive, it implies that the stricter the laws, the higher the rate of homicides by firearms will be. Here too, and integrated in the model integrating the most explanatory of the variables, the relation between the strictness of the laws and the rate of homicides by firearms loses all significance, in favour of other variables whose explanatory power appears to be much higher.

INDEX SPECIFIC TO THE STRICTNESS OF THE LAWS

The legislation index that we developed could be created for only 10 countries. This low number and the high homogeneity of the data of the responding countries made it impossible to carry out elaborate statistical tests, and especially blocked us from conducting any kind of parametric analysis.

Since the particularity of this index is its innovative and original nature, we carried out a series of tests between it and our variables of interest previously used on our sample of 52 countries.

Legislation index X Gun Right Index

The analyses showed that this index is linked with the reverse Gun Right Index, but with a very low level of significance (r_s= 0.573; p=0.083<0.1).

This result means that these two indices could partially measure certain identical aspects. We did not expect this relation to be completely correlated, since the index that we created investigates more dimensions than the Gun Right Index. The low significance threshold indicates that a larger quantity of data will be necessary to validate this significance.

Legislation index X Availability of FA

By correlating our legislation index with the "availability of firearms" index, we do not obtain a significant relation (N=10; $r_{spearman}$=- 0.54; p= 0.107). However, the observed link is not far from the significance threshold, with a margin of error of 10%. Here too, we need more observations for verifying whether this link exists between these two measurements. The relation would then be negative and significant, which would imply that in countries where the laws are stricter, the availability would be lesser.

Legislation index X Homicides

Our legislation index is linked with the global homicide rate and the rate of homicides without firearms in our sample. However, it is not linked with the rate of homicides by firearms. The significant links observed show an inverse relation.

Thus, the countries with stricter laws on firearms also have lower rates of global homicides and homicides without firearms.

However, our analysis did not enable us to showcase a causal relation and the impossibility of taking into account the trends of criminal phenomena and the changes in laws over time greatly limit the conclusions that we can draw from these observations.

We also showcased that significant differences existed between the groups formed using our legislation index.

These significant differences were found in variables related to the wealth of the countries (GDP and infant mortality). It is therefore possible that the observations made between the legislation index and the global homicide rate and the rate of homicides without firearms are directly linked to these differences in these variables. This is also what the models built using the 52 countries tend to show.

As regards the literature, it should be noted that the obtained results both converge with and diverge from literature, given the lack of scientific consensus on the matter. In fact, while certain studies related to the link between laws and the rate of homicides by firearms demonstrate a

link between certain specific laws and crime by firearms, the evaluation of these studies by the Task Force on Community Preventive services (Hahn et al., 2005) reports that no definitive conclusion can be drawn from these studies, mostly owing to certain significant methodological bias.

Also note that as regards studies on the link between laws and homicides by firearms as well as on the one binding the latter with the availability of firearms, very few researches have focused on countries apart from the United States of America.

Moreover, concerning the measurement of the "laws", no standardised index is available. The studies focus either on a specific law, or on a specific country, thereby making national as well as international comparisons complicated or even ridiculous.

Note that while our study attempts to measure the strictness of the laws of each country studied, there is a variable that is part of this strictness that could not be taken into account in the attributed scores (both in the reverse Gun Right Index and in our legislation score). This variable relates to the effective application of the controls and punishments implemented via the laws related to firearms.

In fact, while the Gun Right Index or our legislative index attempts to measure, in a more or less in-depth manner, the way in which the States have legislated on the availability of firearms, both through punishments as well as controls, issuances of licences, storage rules and others, it is obvious that the strictness of these regulations could be wholly fictitious.

Different rules, laws and measures are enacted at the national and international levels, but they are not always applied or are applied in a lax or random manner. Thus, it is obvious that the effective strictness of the law will be reduced more or less significantly. Indeed, there is still a persistent gap between the drafted laws and their application.

While it may be possible to imagine a research design capable of measuring or at least attempting to approach this part of reality, the study of this effectiveness at the international level appears to suffer from significant human and financial limitations, and would require combining a group of research centres, departments, universities and more that are each capable of collecting standardised data at their own level.

This conclusion is also applicable to the collection of other measurements related to the availability of firearms or more specifically, to the illegal possession of firearms.

In conclusion and in light of the observations made through our tests, our data does not allow us to conclude on a significant effect of the availability of firearms or of the laws related to firearms on the rate of homicides by firearms.

We wish to state, with respect to our basic hypotheses and therefore the objective of this research that the greatest difficulty posed by our hypotheses lies in the appropriate conceptualisation of the variables of interest.

While the variable related to availability has already been subjected to a large number of studies and debates evaluating the relevance and validity of the proxy measurements, such as the one that we used (the number of suicides by firearms out of the total number of suicides), the variable related to the "strictness of the laws" has unfortunately not been subjected to the same scientific interest.

It should also be noted that there is a general lack of interest in this problem in the European scientific domain, which leaves a vast gap in the literature dedicated to it.

Although we have attempted to bypass these difficulties, especially by creating our own strictness index, other researches, other adjustments and other tests are necessary in order to judge its actual interest and its intrinsic validity.

However, it should be noted that the analyses that were conducted enabled us to constantly determine that a certain number of our confounding variables, i.e. economic, social, demographic and criminogenic variables, were validly linked to the rate of homicides by firearms in a given country, regardless of the test used.

Apart from the interest of these results, they also highlight the importance that should be given to comprehending these different variables while carrying out studies on our topic. As we revealed in our literature review, these variables are often ignored, resulting in bias in the interpretation of results and quite certainly, a large number of "artificial" relations between the studied variables.

THE CONFOUNDING VARIABLES

All the tests conducted appear to constantly indicate that a certain number of confounding variables taken into consideration are linked, both through non-parametric and parametric statistical models, to the rate of homicides by firearms.

The most significantly linked variables are:

- the infant mortality
- the inequality of income
- the proportion of young men in the population
- the consumption of alcohol

We found two variables linked to an economic aspect (infant mortality and inequality of income), one demographic variable (proportion of young men in the population) and one criminogenic variable (alcohol consumption).

Our results are therefore in line with those of the studies showcasing the association between the economic variables and homicides, and more specifically for homicides by firearms, although our results were also verified for the global homicide rate. Similarly to researchers such as COCHRAN & BJERREGAARD (2011), COLE ET GRAMAJO (2009), or even CHAMLIN & COCHRAN (2006), we were also able to demonstrate a significant positive association between the inequality of income and homicides. Our results showed a partial correlation of 0.494 ($p<0.01$) with the GDP controlled, whereas our second economic multiple regression model indicated a beta coefficient of 0.343 when a set of economic variables are controlled.

As regards the proportion of young men in the population, our findings are also in line with those revealed by the research conducted on this subject, positively associating this variable to homicides, and here to homicides by firearms. Our correlations revealed a r_{GDP} of 0.540 ($p<0.01$), whereas our two socio-demographic multiple regression models revealed beta coefficients of 0.414 and 0.405, each with a significance threshold of 0.05.

As regards the consumption of alcohol, the detected results are quite surprising as, notwithstanding the type of analysis, they continuously indicated a negative association between alcohol consumption and homicides or homicides by firearms. Even after changing the indicator for this variable, the direction of this correlation remained the same. Our analyses therefore enabled us to show correlations of $r_{GPD} = -0.310$ ($p<0.05$), and our multiple regression models showcased coefficients of -0.338 and -0.381 ($p<0.05$). These results completely contradict the research studying the link between alcohol

consumption and homicides that we detected in our literature review (Adler et al. 1998, Rossow, 2001, cited by Van Dijk in 2012). To the best of our knowledge, no other study has shown similar results.

Lastly, we also revealed the relation of the global homicide rate and the rate of homicides by firearms with infant mortality. The partial correlation obtained after controlling the GDP is 0.552 ($p<0.01$) and the ones obtained in our economic multiple regression models are 0.157 for one and 0.470 for the other ($p<0.01$). The particularity here comes from the fact that when this variable is integrated in the most explanatory regression models, it remains the only significant one with coefficients of 0.394 and 0.382 ($p<0.05$) when we control the other most explanatory variables.

In other terms, this means that among the different variables taken into account in our study, the indicator that appears to have the greatest explanatory power is the infant mortality rate. The link of this variable with our dependent variable, the rate of homicides by firearms, persists regardless of the tests used (bivariate, multivariate, parametric, non-parametric), with a high significance threshold.

This finding implies that even more than the availability of firearms or the strictness of the laws, it is the significance of the infant mortality rate in a given country that best predicts the significance of the rate of homicides by firearms.

As surprising as this may seem, it should be kept in mind that this type of variable could in fact reflect a completely different reality. Indeed, following these results, we sought to identify other studies that focused on the link that could bind "infant mortality" with crime, and more particularly homicides.

As PRIDEMORE (2008) stated, very few non-US international studies have taken into consideration the influence that economic variables could have on the homicide rates of a given country, especially owing to a lack of access or availability of comparable data between countries.

In order to overcome this pitfall, he encouraged researchers to use the measurement related to the infant mortality rate as a proxy variable.

His researches (Pridemore 2008), led to detecting a positive and significant correlation between this "proxy" variable and the homicide rate in a sample of 46 countries.

Following these results, PRIDEMORE added that infant mortality was in fact a superior indicator, in terms of measurement and validity, to other the conventional economic variables that were normally used (e.g. GDP per capita), owing to the quality of the definition, the collection and therefore the standardisation of this data across the globe. He therefore suggested that infant mortality appears to better

capture the significance of "poverty" than conventional measurements. (Messner et al. 2011) Other researchers studying poverty have also concluded that infant mortality was able to reflect a set of components that are difficult to measure across different countries, such as access to drinking water, air quality, quality of the diet, etc. (Ross 2006, cited by Messner et al. 2011).

Behind these conclusions, as stated by MESSNER ET AL., there lies the distinction that can be made between "absolute" poverty and "relative" poverty of a population.

It is actually possible to differentiate between these two concepts and the variables related to them. The "absolute" poverty of a person can be defined as the fact that "the level of resources available to him is insufficient for meeting the basic needs of life". (Messner 1999, cited by Messner 2011). This "absolute" poverty can be conceptualised by, for example, the GDP per capita.

However, this approach to poverty does not include one essential component: "what people judge as being poor, varies over time and space" (Messner 2011). This finding reflects the "relative" aspect of poverty. As also highlighted by MESSNER, the well-being of a person is always related to the conditions of well-being of the others in his vicinity.

Using these different findings, MESSNER ET AL (2011), decided to investigate the link that might associate infant mortality, relative poverty, absolute poverty and the rate of homicides in a sample of countries.

Apart from the significance and robustness of the link between homicides and infant mortality, this study also showcased the association between infant mortality and "relative" poverty (conceptualised by the GINI coefficient). In fact, the results showed through different regression models that while absolute poverty does not appear to be a good predictor of variations in the homicide rates in the selected countries, relative poverty and infant mortality are good predictors.

Moreover, the study showed a predominant influence of infant mortality on the homicide rate, even after controlling the variable related to the "relative" poverty of the countries. This result implies, as in the case of our research, that infant mortality appears to be the best predictor of the homicide rate.

To explain these results, MESSNER ET AL. suggest that this latter variable is more sensitive to the institutional context of a country. They go one step further by concluding that infant mortality appears to best capture the relevant social conditions linked with the homicide rate, and goes beyond strict material conditions.

"Especially in Europe, researchers have been interested in poverty, and have expanded the concept of "underprivileged [population]" more and more by including not only the restricted access [of the population] to

material resources, but also its significant participation in society in general". This disadvantage is often called "social exclusion".

"It is possible to propose that the infant mortality rate has an explanatory power that is independent from our selection of countries, as it captures the aspects of underprivileged social conditions related to excluded persons and marginalised populations that are not fully reflected in other poverty measurements, such as those based on income"[51].

For Messner, the fact that in the United States of America, the homicide rate can be reasonably predicted by absolute poverty unlike other countries such as the European countries, can be explained by the fact that the latter possess State-sponsored social security systems that are much more developed and generous than the United States of America. In these countries, we observed that even relative poverty (conceptualised by the GINI index) does not take into account all the social conditions of the "theoretical" population, especially a part of the excluded, marginalised population, whereas the infant mortality index appears to do so.

[51] Loose translation

AVENUES WORTH EXPLORING

To close our research, we will once again return to the variables of interest that guided our study.

Firstly, note that the legislation index that we created is the only one to show significant relations between the different homicide rates. However, as we demonstrated, these relations are weak, which can particularly be explained by the small sample size that responded to the survey, as well as by the homogeneity of the data related to this same sample (all the countries, except one, were European countries, sharing a large number of characteristics whose measurements did not differ greatly - unemployment rate, GINI coefficient, GDP, etc.).

Hence, it might be interesting to investigate this index more in-depth (readjusting the questionnaire, expanding the number of participants, consideration of the effectiveness of the application, etc.) in order to check whether it is possible to demonstrate a more significant relation between the normative framework regulating the ownership of firearms in a given country and its possible protective effect on crime related to firearms.

Next, regarding our variable related to the availability of firearms, it is possible that it is not actually the possession of firearms in general that is linked to crime, or more specifically to the rate of homicides by firearms, but rather the illegal possession of firearms.

Here too, this hypothesis is quite certainly linked to the normative and repressive frameworks implemented in a given country for controlling the possession of firearms. Indeed, as demonstrated by a large number of criminal phenomena, the impact of a suitable normative system is sometimes not seen directly in the reduction of the phenomenon, but instead in the means that it provides for managing and controlling the said phenomenon.

Yet, as stated by Messner et al. (2013) in the conclusions of their research, while it is definitely the illegal possession of weapons that seems to be the most explanatory variable of the rate of violent crimes, this result implies a significant change in perspective, both for future researches as well as for the political responses to be given to these facts, namely a reorientation of the actions to be implemented.

Indeed, as the illegal possession of weapons (in this case, stolen weapons) is actually constantly linked to crime by firearms, it would therefore be appropriate to concentrate efforts in matters of laws and regulations not on restricting purchases, but rather on enhancing secure storage rules, enhancing safeties, or the fight against

the theft of firearms as possible actions for reducing violent crimes.

To conclude, it is important to highlight that if we go a bit further with this reasoning, promoting regulations that expand yet supervise the access to firearms might reveal what is, in case of prohibition, generally concealed in illegal and hidden markets, which are by definition difficult or even impossible to control.

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