Patterns of gun trafficking:

An exploratory study of the illicit markets in Mexico and the United States

A thesis presented for the degree of
Doctor of Philosophy in Security Science

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Declaration

I, David Pérez Esparza confirm that the work presented in this thesis is my own. Where information has been derived from other sources, I confirm that this has been indicated in the thesis.
Abstract

This thesis aims to explain why, against the background of a fairly global crime drop, violence and crime increased in Mexico in the mid-2000s. Since most classical hypotheses from criminological research are unable to account satisfactorily for these trends, this study tests the explanatory power of a situational hypothesis as the main independent variable (i.e. the role of opportunity). In particular, this involves testing whether the rise in violence can be explained by an increase in the availability of illegal weapons in Mexico resulting from policy changes and rises in gun production in the bordering U.S. To conduct this study, the thesis develops and implements an ad hoc analytic strategy (composed of six steps) that helps to examine each gun market (i.e. pistols, revolvers, rifles, and shotguns) both in the supply (U.S.) and in the illegal demand for firearms (Mexico). Following this market approach, the study finds that patterns of gun production in the U.S. temporally and spatially coincide with the patterns of gun confiscation (and violent crime) in Mexico. More specifically, analyses suggest that changes in illegal gun availability (across time and space) provide a better explanation for the observed difference in state-level homicide in Mexico than traditional hypotheses. The thesis presents additional analyses in favour of the situational hypothesis (through triangulation) and reports the findings of novel interviews with law enforcement officers with experience on gun trafficking in the U.S.-Mexico context. The study concludes by reviewing the key findings concerning the illicit markets between Mexico and the U.S., their theoretical and policy implications, as well as possible avenues for future research.
Impact statement

Between 2005 and 2011, more than 52,000 civilians were killed with a gun in Mexico. During the same period, around 105,000 guns were confiscated in this country. While Mexico has one of the most restrictive gun policies in the world, the availability of illegal guns has increased substantially. Gun violence has become the leading cause of death, triggering a reverse in the life expectancy of the Mexican population, for the first time in recorded history.

This thesis aims to provide a comprehensive analysis concerning gun trafficking in this country. The research presents new spatial and temporal patterns regarding the supply and demand for guns. It is estimated that these analyses can provide policymakers, health specialists, and crime prevention practitioners with a background to design and implement crime-reduction initiatives based on empirical evidence.
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## Abbreviations

<table>
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<th>Acronym</th>
<th>Full Form</th>
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<tr>
<td>ATF</td>
<td>Bureau of Alcohol, Tobacco, Firearms, and Explosives (U.S.)</td>
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<tr>
<td>AWB</td>
<td>Federal Assault Weapons Ban (U.S.)</td>
</tr>
<tr>
<td>CBP</td>
<td>Customs and Border Protection (U.S.)</td>
</tr>
<tr>
<td>CISEN</td>
<td>Centre for Investigation and National Security (Mexico)</td>
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<tr>
<td>CONACYT</td>
<td>National Council for Science and Technology (Mexico)</td>
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<td>CONAPO</td>
<td>National Council for Population (Mexico)</td>
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<tr>
<td>CPT</td>
<td>Crime Pattern Theory</td>
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<td>DEA</td>
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<tr>
<td>FBI</td>
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<tr>
<td>FFL</td>
<td>Federal Firearms Licensee (U.S.)</td>
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<tr>
<td>FOI</td>
<td>Freedom of Information Request</td>
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<tr>
<td>GDP</td>
<td>Gross Domestic Product</td>
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<tr>
<td>HDI</td>
<td>Human Development Index</td>
</tr>
<tr>
<td>ICE</td>
<td>Immigration and Customs Enforcement (U.S.)</td>
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<td>IEP</td>
<td>Institute for Economics &amp; Peace</td>
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<tr>
<td>INAI</td>
<td>National Institute for Transparency, Access to Information and Personal Data Protection (Mexico)</td>
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<td>OCG</td>
<td>Organised crime group</td>
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<td>PEMEX</td>
<td>Mexican Petroleum (Mexico)</td>
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<td>PF</td>
<td>Federal Police (Mexico)</td>
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<td>PGR</td>
<td>Attorney General of the Republic (Mexico)</td>
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Chapter 1. Introduction

The purpose of this thesis is to try to explain why, against the background of a fairly global crime drop, violence increased in Mexico in the mid-2000s. In particular, I focus on how gun trafficking from the U.S. to Mexico might explain this pattern. In contrast to the majority of the current literature concerning the increase in violence in Mexico, in the work which follows I will argue that traditional criminological approaches are unable to satisfactorily explain the rise observed. In this chapter, I aim to provide an overview of the thesis. To do this, I briefly present contextual information about the security challenge under scrutiny. Next, I discuss the critical aims of the study, the gaps in research, and then outline the chapters that follow.

1.1. Background and motivation

Violent crime in Mexico decreased over most of the twentieth century. For instance, kidnapping and robbery reached all-time lows around the mid-2000s. This downward trend was also visible for homicide, a crime that generates the most fear and social harm (CIDAC, 2013), and is the focus of this thesis. In fact, homicide rates in Mexico dropped from 40-50 cases per 100,000 inhabitants in the mid-1950s, to 17 in 1997, and to as little as 11 in 2004 (SNSP, 2015). In effect, over the twentieth century, Mexico experienced a similar pattern to that observed in the U.S, Canada, Oceania, Japan, the UK, Europe, and other industrialised countries around the world where ‘crime dropped’ (Farrell, Tseloni, Tilley, & Mailley, 2011). By 2004,
Mexico was safer and more peaceful than a number of places in both Europe and the U.S.

Nevertheless, around 2005, this downward trend abruptly stopped, and the situation changed rapidly. Rates of reported crime increased substantially. Offences that had been previously stable, such as vehicle theft and burglary, suddenly displayed considerable increases. Likewise, extortion, violent robbery, and kidnapping increased significantly, at times even doubling in rate from one year to the next. Notably, homicides also increased for the first time in a century. In 2011, Mexico reached 24 homicides per 100,000 inhabitants (SNSP, 2015), a rate that was amongst the highest in decades (Aguirre Botello, 2018). In fact, this increase in homicide was so great that life expectancy dropped for the first time in Mexico’s history (Aburto, Beltrán-Sánchez, García-Guerrero, & Canudas-Romo, 2016).

Evidence suggests that three other types of violent attacks - that previously were simply non-existent in Mexico - also began to occur during this period. For instance, assaults against frontline police officers and the armed forces appeared for the first time. Between 2008 and 2011, organised crime groups (OCGs) killed more than 2,000 police officers and almost 180 members of the Army (Molzahn, Rios, & Shirk, 2012). Second, attacks against state officials also began to occur. In effect, between 2004 and 2014, OCGs killed more than 70 Mayors, or Alcaldes (Heinle, Molzahn, & Shirk, 2015; 2018). A third new trend included criminal attacks against the civilian populace, including the media. Between 2004 and 2011, OCGs killed at least 52
These recent trends in violence and crime, and the lack of satisfactory explanations for them, motivate a number of important questions that will be addressed in the course of the thesis. For instance, why did Mexico become a violent country at this particular time after such a substantial reduction in crime recorded throughout the twentieth century? What approaches can be taken to dissect the overall crime problem into more manageable parts? Moreover, what can be done to mitigate the causal factors triggering the increase in violence and crime, still evident to date?

1.2. The limitations of existing explanations for crime increase in Mexico

Existing academic research has offered different explanations as to the possible reasons for the increase in crime in Mexico. Some have drawn on classical criminological perspectives. Roel (2015), for example, argued that the crime rise observed could be the result of increases in poverty. Enamorado et al. (2014) proposed that the rise in crime could be explained by an increase in income inequality.

Researchers have also proposed institutional factors as an explanation for the crime rise. For example, Buscaglia (2013) suggested that an institutional inability to tackle corruption facilitated the rise in crime. Other scholars have
hypothesised that police and judicial inefficiency allowed criminal activity to
flourish when the violence first erupted, leading to an escalation in the
violence (Zepeda Lecuona, 2004; Ambrogi, 2015; López-Ayllón & Fix-Fierro,
2015; Hope, 2013).

Scholars have also focused on the drug-violence nexus as an explanation.
For example, Escalante (2011), Guerrero (2011), Phillips (2015) and
Espinosa & Rubin (2015) suggested that the increase in homicide could be
attributed to the Mexican Army’s anti-drug intervention. The rationale of this
hypothesis is that, by taking down kingpins and fragmenting illegal groups,
these interventions intensified both internal and external criminal rivalry,
which in turn, led to an increase in homicide (Villalobos, 2010). Grillo (2011)
and Chabat (2015) agree, stating that the development of more violent
organisations, such as the Zetas, was an outcome of these interventions.

In this thesis, I argue that these explanations are quite problematic, as they
ignore the long-term trends reported in Mexico. To elaborate, consider three
common arguments often used to explain the increase in violence and crime
in this country as examples.

First, it has been hypothesised that Mexico became violent as a result of
declining socioeconomic conditions, which in turn, led to an increase in the
‘risk factors’ correlated with violence. However, this argument is not
consistent with the empirical record. In fact, lower unemployment, higher
income, a reduction in inequality, and a number of other socioeconomic
macro-level achievements have been reported during those periods that crime increased in the most. Because of this counterintuitive empirical observation, I argue that these simplistic approaches are unlikely to hold. A similar paradox was also reported in Europe and the U.S. after the Second World War. Back then, the economy was flourishing, and the Welfare states were expanding. Despite these two factors, crime also rose significantly, leading Cohen & Felson (1979) to argue out that theories that concern the influence of these factors were unable to provide a satisfactory explanation for the rise in crime.

Second, it has been contended that a recent deterioration in the performance of the Mexican security agencies is a key reason that explains the increase in violent crime. Again, this hypothesis contrasts with historical evidence that suggests the opposite. In effect, while it is true that room for improvement exists, Mexican security agencies are probably better equipped now than during the decades in which crime reduced (Valdés Castellanos, 2013; Astorga, 2016; Knight, 1996). The Federal Police too have made major strides over the last two decades (Alcocer Vega, 2016; Sabet, 2010). Consequently, I contend that explanations that focus exclusively on institutional challenges do not seem to be sufficient to explain what occurred in Mexico after the mid-2000s.

Third, it has been argued that Mexico became a violent country due to the existence of criminal groups participating in global drug trafficking networks. Although evidence suggesting this criminal involvement exists,
summarised by Astorga (2016), the argument disregards the critical fact that the involvement of OCGs in drug trafficking from and throughout Mexico is not new. In contrast, and as suggested by historians and analysts, OCGs have participated in the global illegal drug industry for at least one hundred years (Astorga, 2016; Valdés Castellanos, 2013). Hence, this phenomenon is not new, and as such, it seems an unlikely candidate to explain all the increases in violence reported since the mid-2000s.

1.3. Situations and opportunities

The empirical evidence examined in this thesis suggests that these ‘classical explanations’ for increase in crime ostensibly do not work, or at least, do not work for the recent patterns reported in Mexico. For this reason, instead of adopting the above perspectives, in this thesis I argue that an extension of the rational choice paradigm (which assumes that offenders are rational decision makers), may provide a more accurate explanation of the observed increase in violent crime in Mexico. This fundamental concept, which I discuss in detail in Chapter 3, concerns changes associated with situational opportunities for crime. In the course of the thesis, I postulate that what occurred in Mexico is, to a large degree, the result of an increase in opportunities for violence that has resulted from changes in the criminal setting that facilitated crime (Clarke, 1997). In this context, I define opportunities for violence as criminals’ access to guns.
As will be discussed in Chapter 3, I argue that three federal gun law reforms in the U.S., implemented during the mid-2000s considerably increased the production of guns in this country. I then hypothesise that this increase in gun production in the U.S. created new opportunities for the illicit supply of firearms to bordering Mexico. I suggest that these new opportunities for gun trafficking had three specific impacts. First, they supported the proliferation of a vast black market for weapons between the U.S. and Mexico; a concept that I will discuss in further detail in Chapters 2, 3, and 5. Second, they provided additional incentives amongst criminal groups to traffic more (and perhaps cheaper) guns into Mexico. Third, for OCGs, these opportunities reduced the costs (and risks) concerning the use of armed force against rivals, authorities, and the civilian populace, increasing overall violence.

In Chapter 3, I will discuss these three gun reforms - the Tiahrt Amendments of 2003, the expiration of the Assault Weapon Ban (AWB) of 2004, and the enactment of the Protection of Lawful Commerce in Arms Act (PLCAA) of 2005 - in detail. For the meantime, it is sufficient to say that these three laws motivate a situational hypothesis that offers an alternative explanation for the increase in violence reported in Mexico. Moreover, in contrast to more traditional arguments, it can help to explain, at least to some degree, why the observed violence began to increase (in the way it did) precisely during the years in question, and not after or before.
1.4. The trafficking of guns and the market approach

This thesis is also concerned with the study of gun markets. Specifically, it is concerned with research regarding the black markets for guns, as these are closely related with the economic principles behind gun trafficking. Using the black market approach for the study of guns has many implications, as will be discussed in more detail in Chapters 2 and 5, and in the course of the thesis, more generally. For instance, the notion of black markets suggests the existence of supply and demand (and constant interactions between these two). In a simplistic model, the concept of supply suggests there are actors (i.e. firms in the U.S.) who are willing to produce and sell guns, at a given price, at a given place/time. The demand, on the other hand, represents actors (i.e. OCGs in Mexico) who are willing to acquire these guns and pay for them in proportion to the expected utility of having access to them.

The concept of black markets offers additional insight for the framing of this thesis. For instance, it suggests the presence of rational actors (both in the supply and in the demand), who react to incentives. For gun manufacturers, the principal incentive is to increase their returns through more sales (Buss, 2001; Baum, 1987; Luce, 1994). For OCGs, the critical incentive is to acquire as many guns as possible to maximise the impact of their criminal activity (Cook P., 1983, p. 49). More generally, the idea that OCGs are rational actors follows the perspective often found across studies on OCGs known as the enterprise model (Albanese, 1985; Kleemans, 2013) whereby organised
crime ‘is viewed as economic activity that happens to be illegal’ (Liddick, 1999, p. 404). This notion is relevant since scholars have argued that, regardless of their differences, both legal and illegal actors are more similar than originally thought, as both merely aim to maximise their profits (Liddick, 1999; Bouchard, 2009; Reuter, 1983; Reuter, 1985).

The notion of markets, legal or otherwise, also provides a framework for thinking about the actors involved. These can make several decisions regarding their activity. Amongst their possible choices, actors involved in the supply side of the market, for example, will have to decide where to operate (or relocate), and when or how to specialise in what they do. In chapter 4, I will explain these and other concepts and discuss the extent to which these can inform the current research.

Likewise, as with any other market, governments can play an important role on markets, including illicit ones. In fact, decisions made (or the lack of these) by policymakers and security officers can either encourage or restrict the size of a black market, including that for guns (Braga, 2002). As discussed below, I suggest that the implementation of three federal gun laws in the U.S. in particular had a significant impact on illicit gun markets.

1.5. Structure of the thesis

This thesis includes six chapters in addition to this introduction. The aims and content of these chapters can be summarised as follows:
In Chapter 2, I present a review of the literature that frames the thesis. I divide this chapter into four main sections. In the first, I discuss important theoretical perspectives from criminological research that have been used to explain crime (and increases in it). By briefly reviewing this body of research, I aim to set the background in anticipation of Chapter 3, in which I debate the possible reasons for the increase in homicide reported in Mexico. In the second section of this chapter, I describe the phenomenon of firearms trafficking. Specifically, I debate some of the distinctive features of this crime, as well as how this offence has been studied in the broader scientific literature. In the third section, I introduce in more detail the market approach that is used to frame this thesis. Finally, in the fourth section, I briefly discuss some of the current debates concerning gun trafficking and its links with other relevant fields, such as gun violence.

In Chapter 3, I present the first empirical chapter. Specifically, I focus on testing different hypotheses that might explain the increase in homicide observed in Mexico after the mid-2000s. To do this, I evaluate some of the traditional explanations for the crime increase debated in Chapter 2. More specifically, I test the extent to which variables used in similar studies might explain the increase in homicide (e.g. income, human development, inequality, unemployment, and dark figure of crime). Since most of these classical hypotheses are unable to account satisfactorily for these trends, I test the explanatory power of a situational explanation as the main independent variable. In particular, this involves testing whether the rise in violence can be explained by an increase in the availability of illegal weapons.
in Mexico (resulting from policy changes and rises in gun production in the bordering U.S.). To do this, I use a novel dataset provided by the Mexican Army that includes all gun confiscations in Mexico (by state and year) for the period 1999-2011. Regression analyses (for the subnational federal states in Mexico) suggest that changes in illegal gun availability (across time and space) provide a better explanation for the observed difference in state-level homicide than traditional explanations. Simply put, I suggest that changes to gun policy in the U.S. during the mid-2000s had three major outcomes. First, they increased the supply of guns overall (but mainly at the U.S. southern border with Mexico). Second, they increased the opportunities for trafficking from that region to Mexico. And third, that the interplay of these two factors facilitated the increase in homicide reported in Mexico.

As it is suggested that the trafficking of guns between the U.S. and Mexico operates as a (black) market, Chapters 4 and 5 study both the supply and the demand for guns in more detail. To do this, I develop and implement an analytic strategy composed of six steps (explained below) that helps to examine each gun market (i.e. pistols, revolvers, rifles, and shotguns) in terms of both supply and demand, and how these changed over time.

In Chapter 4, I specifically study the supply-side of this (black) market; in other words, the production of guns in the U.S. In particular, I analyse how each gun market in the U.S. adapted following crucial changes to federal policy. To inform this, I first discuss the economic concepts that motivate the analyses that follow. These are the concepts of manufacturing relocation,
agglomeration economies, and specialisation. Next, I empirically assess the extent to which particular U.S. states came to specialise in the manufacturing of specific types of guns. This is accomplished by exploring how the fabrication volume for each market is concentrated at the state level using an index of subnational market share. For the purpose of this thesis, a market share will be understood as the percentage of a market (e.g. the manufacturing of pistols) that is produced by a particular state (e.g. Texas). The analysis of how market shares have changed is then used to examine whether this phenomenon is stable over time. Overall, I present evidence that suggests that after the mid-2000s, in the U.S.: (a) there were increases in overall gun production, and (b) rises particularly occurred across the southern states. In sum, I argue that the combination of these two observed patterns might have increased opportunities for trafficking more guns into Mexico.

In Chapter 5, I examine the demand-side in more detail, examining patterns of illegal gun prevalence in Mexico. As will be discussed, previous estimates of illicit gun demand for Mexico have used proxy variables as input (e.g. crime records). In this chapter, I use novel data on gun confiscations. Specifically, I use the dataset provided by the Mexican Army (described above) including all gun confiscations in Mexico. While this approach is not perfect (i.e., that confiscations do not necessarily represent all illegal guns in a given place/time), I argue that these data provide the best available estimate for studying the demand-side of this black market. As such, like the previous chapter, I follow an approach which consists of six analytic steps to
examine the patterns for each gun market (at the state level). Empirically, I present evidence that tests two key hypotheses – that after the mid-2000s, in Mexico: (a) there were increases in overall gun confiscation, and (b) rises particularly occurred across the northern states (although other key patterns will be also discussed below). While Chapter 3 examines the market for (illegal) firearms briefly, Chapters 4 and 5 provide a much more comprehensive and nuanced analysis.

In *Chapter 6*, I draw on alternative sources of data including the findings of novel interviews with law enforcement officers. The aim of the chapter is to further test the opportunity hypothesis through triangulation.

Finally, in *Chapter 7*, I conclude with a review of the main findings, a discussion of the limitations of the study, and an outline of possible routes for further research. First and foremost, this section argues that patterns previously discussed can effectively inform policy. Specifically, it shows the need for an evidence-based strategy that can reduce gun trafficking (and gun related violence) in Mexico.
Chapter 2. Literature review

In chapter 1, I provided an overview of the thesis and touched on the theoretical perspectives that inform what follows. In this chapter, I present a more detailed literature review. The chapter is divided into four sections. In the first, I discuss the key theoretical approaches from the criminological research that are used to explain crime (and crime increases). These set the background for Chapter 3. In the second section, I describe the phenomenon of firearms trafficking. Specifically, I debate some of the distinctive features of this crime, as well as how this offence has been studied in the broader scientific literature. In the third section, I introduce in more detail the market approach, which is used in later chapters presented in this thesis. Finally, in the fourth section, I briefly discuss some of the current debates concerning gun trafficking and its links with other relevant activity, such as gun violence.

2.1. Explanations for crime and crime increase

As discussed, a key aim of this thesis is to analyse why specific places or societies are (or become) violent. More specifically, why crime and violence reported in Mexico increased after a long period of decline (see Chapter 3).

What explains the factors that can lead some societies to become more violent? Several theories have been articulated to explain the causes of delinquency. Brantingham and Brantingham (1991), for example, proposed
the ‘macro-meso-micro three levels of analysis’ model to the context of crime. According their model, a *macro* analysis involves all studies that focus on the distribution of crime between countries, states, or cities. The *meso* analysis involves the study of crime within subareas of a city, such as suburbs, police districts, and neighbourhoods. The *micro* analysis, by contrast, focuses on specific sites, giving particular emphasis to building type and its placement, landscaping, and lighting (Brantingham & Brantingham, 1991). Other approaches focus upon the individual actors and offer a range of explanations based on biological, psychological, or social factors.

Rather than focusing on the unit of analysis as proposed by Brantingham and Brantingham (1991), other categorisations have focused on how human beings are perceived and consequently, how crime and violence can be understood and tackled. In the seventeenth century, European settlers in North America considered crime as a *sin*, and as a consequence criminals as *sinners* (McKenzie, 2007; Greenberg, 1982). Following this assumption, they argued that those who did not obey social rules act in this way as the result of being possessed by *evil spirits* (Friedman, 1994). The cause of crime was therefore seen as internal. To maintain social order, this perspective assumed that sinners had to be dealt with harshly, as the sole means of eliminating bad practices from society (Jones & Johnstone, 2015).

In the nineteenth century, scientific advances began to put this (untested) argument into question. Researchers such as Cesare Lombroso stated that criminality was inherited, and that someone *born criminal* could be identified
by their physical characteristics (Lombroso, 1876). Although this biological theory was largely rejected later (Wolfgang, 1961; Newburn, 2013, p. 122), Lombroso’s legacy was useful since it may have triggered the first use of observation and hypothesis-testing, key elements of the scientific method.

Following subsequent advances in the scientific method, other scholars took advantage of statistical and methodological improvements to correlate crime with various social conditions. Some of the pioneers in this line of research were Andre-Michel Guerry and Adolfe Quételet. Guerry (1833) worked with France’s first centralised national system of crime reporting, and developed the first crime maps with the aim of uncovering patterns resulting from poverty and other social factors. Quételet (1842) continued this tradition by studying the association between crime and social factors (such as age, gender, poverty and illiteracy) at the regional administrative level. Some of his findings included, for example, the fact that crimes against individuals are more likely than property crimes in the summer (while the reverse is true in the winter), that males have a greater propensity to participate in criminal activities than women, and that there is a correlation between age and crime (Quetelet, 1842).

In sum, it is evident that different approaches have been considered in the study of crime and violence. Similarly, different approaches can be considered for this thesis in particular. Undoubtedly, taking one particular approach influences the empirical work that can be conducted, which research questions can be answered, and the methodological scope of the
research project in general. That being said, the aim of section 2.1.1 is to briefly outline some general explanations for crime (including homicide). Next, in section 2.1.2 and 2.1.3, I review some specific approaches that are relevant to provide a more specific framework for this thesis.

2.1.1. Crime-related paradigms

Paradigms are considered general orientations to explain a particular phenomenon, including crime (Kuhn, 1970). By definition, paradigms combine a collection of assumptions about how knowledge is generated, subsuming both methodological and theoretical premises. Paradigms are *schools of thought*. As such, they are like *umbrellas* that incorporate different theories that have key conceptual, methodological, and instrumental similarities.

Unsurprisingly, criminological thinking is populated by multiple paradigms. Brown, Esbensen & Gilbert (2015) argue that five major paradigms dominate discussions on crime-related research: (a) positivism, (b) interactionism, (c) critical criminology, (d) theoretical integration, and (e) rational choice. Although a broad discussion of these paradigms is outside the scope of this thesis, a brief review of this categorisation is useful to frame the approaches followed throughout this thesis:

a. The *positivistic* paradigm assumes that forces beyond the control of individuals determine criminal behaviour. Crime is not seen as a
Numerous theories in this paradigm suggest that social, biological, or other pathologies are responsible for criminal’s conduct.

b. The *interactionist* paradigm focuses on analysing State definitions of crime and the operation of social control agencies, such as the police and prosecutors. This paradigm does not concentrate on explaining *why* crime happens. Instead, it asserts that acts become criminal only because others label them as such. The focus is on understanding why and by whom these labels are created for.

c. The *critical* paradigm concentrates on challenging core assumptions of conventional criminology. Often, this paradigm understands crime as a function of power and oppression against the less-advantaged groups within society. Most theories in this paradigm focus on class division, gender, and race.

d. The *integrational* paradigm proposes that optimal explanations for crime can be obtained from combining different theoretical perspectives (as opposed to the exclusive use of a single one). As such, this paradigm does not imply a particular or universal definition of crime, but a combination of different perspectives according to what is most useful for each case. Critics of the integrational paradigm argue that this lack of focus (or ‘theoretical commitment’) is unable to explain or predict crime coherently.
e. The rational choice paradigm assumes that individuals are rational actors and, as such, they are able to make decisions regarding their own behaviour. These decisions are often the result of cost-benefit considerations. This paradigm aims to both understand why and how actors commit crime. As a result of this notion, rational choice interventions often aim to design and implement efficient preventative measures (based on rational incentives) that can actually deter criminal behaviour.

Often, the distinction between these paradigms is not that straightforward. For instance, some theoretical or empirical explanations for crime can overlap. Yet, it is possible to suggest that two paradigms have seemingly dominated the discussions concerned with the explanations of crime: the positivistic and the rational choice. In the following section, I present a brief review of some examples concerning both. The aim is not to be exhaustive, but to inform the discussion on violent crime increase in Mexico that will be presented in Chapter 3.

2.1.2. Positivistic paradigm

A large body of research has been published to explore the association between poverty and violent crime (Hsieh & Pugh, 1993). Some of these studies have focused specifically on homicide (Bailey W., 1984, p. 534). The assumption is that homicide occurs as a result of the inter-personal conflicts linked with absolute deprivation or poverty. While the poverty-homicide
mechanism can be contested, some scholars have suggested that: ‘absolute
deprivation may also produce emotional situations which escalate into
violence’ (…) ‘perhaps (lethal) violence is one of the few options available to
those without the economic means to deal with problems and crises of
everyday life’ (Parker, 1989, p. 986).

The study of the association between poverty and homicide has considered
both the individual and aggregate levels (e.g. community, cities, countries,
etc.). The tradition of using empirical data to test the correlates between
homicide and poverty at aggregate spatial units (such as countries) began in
earnest in the late 1960s and early 1970s (Pridemore, 2011). The studies
that use aggregate data are the most relevant for this thesis.

Overall, these studies often use two variables to capture the role of income
or poverty. Perhaps the most common is the use of Gross Domestic Product
(GDP). While there are different ways to define GDP, it can be understood as
the monetary value of all of the goods made, and services provided, in a
given place during a specific period. Another recurrent variable is the Human
Development Index (HDI). This is a summary measure of deprivation that
includes variables such as life expectancy at birth, expected years of
schooling, amongst others.

A number of cross-national studies have shown a positive and significant
association between poverty and national homicide rates (Paré, 2006;
Pridemore, 2008; Pridemore, 2011; LaFree, 1999). This association has also
been studied using sub-national units within in the U.S., with studies often finding similar results. Reviews from Messner & Rosenfeld (1999) as well as Pratt and & Cullen (2005) explore these results in more detail.

There are, however, other perspectives that have aimed to explain homicide from a slightly different angle. Some scholars have argued that rather than poverty (understood as absolute deprivation), the focus should be placed on relative deprivation. In other words, upon inequality (Sampson & Castellano, 1982; Blau & Blau, 1982; Fajnzylber & Lederman, 2002). The argument is that ‘some individuals evaluate their socioeconomic position in relative terms, and they are bothered by the perception that others have more desired social and economic resources’ (Parker, 1989, p. 985). Following this assumption, the inability to achieve these resources creates frustration and a social tension in society (Agnew, 2016, pp. 209-229). It is hypothesised that this, in turns, plays a major role in explaining crime and homicide.

Inequality is the focus of many cross-national studies of homicide. These studies often use the Gini coefficient. This is the most widely used single-summary number to estimate the difference in income between the richest and the poorest individuals in a particular country or region. LaFree (1999, p. 141), for example, reviewed forty-seven studies around the world and found that, with the exception of Messner (1982), in all studies there was a positive significant association between inequality and homicide. Other studies also provide some evidence in favour of this association (Fajnzylber & Lederman, 2002; Wilkinson, 2004).
Nonetheless, the results for the inequality-homicide association in the U.S. literature are mixed. For instance, a number of studies such as Krohn (1976) and Messner et al. (2002) found that there is a positive relationship between homicides and income inequality. In contrast, more comprehensive reviews have been unable to conclude a homogenous effect (Messner & Rosenfeld, 1999). Pridemore (2011) has suggested this lack of agreement in the results can be explained by the fact that some studies did not include poverty and inequality in the same regression. The best models, he suggested, should include these two variables as predictors in the same model, as they essentially measure different things.

Some scholars have also suggested that there is a potential link between unemployment and homicide. In explaining this association, Brenner (1978, pp. 20-22), for example, suggested that individual or collective inability to maintain standards of living while unemployed engenders stress. This, in turn, is hypothesised to lead to criminal acts (such as homicide).

Despite the existence of a theoretical foundation to study the unemployment-homicide hypothesis directly, most empirical studies use combined data from different types of crime (e.g. burglary). This can be explained as a result of data availability and other methodological considerations (for a discussion, see Cantor & Land, 1985). The accumulated body of research literature has not produced a consistent set of findings concerning this association. Kapuscinski et al. (1998, p. 217) provided a review of relevant findings. Between American states, a number of scholars have found that those with
high unemployment tend to have more crime (Hemley & McPheters, 1974; Chiricos, 1987), but others have reported mixed effects when summarising the existing literature (Land, McCall, & Cohen, 1990). A similar contrasting pattern has been reported between cities. While some scholars have found a positive association (Danziger, 1976); others did not find evidence of this relationship (Spector, 1975, p. 401).

Similarly, there are a number of studies that have aimed to directly correlate unemployment with homicide. Again, the existing evidence is often inconsistent. While some studies in the U.S. have found a positive relationship (Brenner, 1976; Vidgerhous, 1978; Ehrlich, 1975; South & Cohen, 1985), some of these studies have been severely criticised for omitting important control variables, such as gun availability, or for assuming causality from a correlation (Cohen & Felson, 1979, p. 253; Kleck, 1979).

Analyses concerning the unemployment-homicide association between and across countries are also controversial. Krohn (1976) observed that countries with higher unemployment rates have higher homicide rates. In contrast, Archer and Gartner (1986) studied the link between homicide and unemployment for sixteen nations between 1900 and 1972, and found nine nations (including the U.S.) to have a positive association, and seven nations to have a negative one. As suggested by Land et al. (1990), these differences in results (also observed across other possible correlates described above) can be explained due to variations in ‘time periods
covered, units of analysis, samples, model specifications, and problems of statistical analysis and inference’ (p. 922).

More generally, these studies overlook variables that other scholars have offered as correlates of crime and homicide. For instance, as described by Neumayer (2003), there are a number of possible correlates for homicide considered in the conflict studies literature, such as the respect for human rights. Other alternative factors that have been articulated include political legitimacy, understood as the state’s ability to provide citizens with fair and equal rights and protection (see: Gilley, 2006). Nivette and Eisner (2012) found that indices of political legitimacy are a strong and consistent predictor of homicide rates.

It is not the aim of this thesis to review and test such explanations in depth. Nonetheless, following the positivistic explanations for crime, this research does reflect (particularly in Chapter 3) on the extent to which factors associated with state malfunctioning (and deprivation) can influence criminal behaviour. For the purposes of this research, three variables in particular are considered. First, some scholars have argued that corruption can influence levels of crime, including homicide (Trent, 2015; Van Dijk & Nevala, 2002; Zhang, 2011; Buscaglia & Van Dijk, 2003; IEP, 2015). Other researchers have focused on studying the extent to which impunity and related inefficiencies in the judicial system are associated with homicide, finding positive results (Nadanovsky, Keller, Wilson, & Daly, 2009; Montenegro & Posada, 1994; IEP, 2015). The third variable considered is the existence of
illicit drug markets. The assumption in this case is that OCGs who run this type of illegal activity can trigger homicide. This occurs as they participate in a highly competitive setting in which there is no other way to resolve disputes other than through violence (Snyder & Duran, 2009).

Given their prominence in the literature, these explanations are tested in Chapter 3 alongside the key theoretical perspective examined, which will now be discussed. The following section introduces this rational choice perspective, which is a second paradigm that can also help to explain crime. This school of thought invokes concepts of situation and opportunity, which are key to this thesis.

2.1.3. Rational choice

Becker (1968) proposed the notion that criminals are rational actors. Offenders are defined as self-interested individuals who want to maximise the utility of their actions, and who use information from their environment to make purposive decisions related to committing a crime (or not). Thus, according to his perspective, lawbreaking is the result of expected utilities: offenders commit crime if the expected benefits from illegal action outweighed the associated costs (e.g., the probability of apprehension, conviction, and punishment).

Cornish and Clarke (1975; 1986) later offered a more comprehensive argument based on Becker’s notion. They analysed the relationship between
costs and benefits of crime, and proposed that opportunities are relevant factors to explain why crime happens at a particular moment at a particular place. As such, instead of focusing on studying criminals (or their personal stories and criminal careers), these scholars suggested a focus on the specific dynamics associated with lawbreaking (or event level decision making). In other words, they argued that rather than concentrating exclusively on the offender (they did discuss the process through which offenders decide to engage in criminal careers), it is important to focus on the crime commissioning process.

Six specific features are essential to this paradigm:

a. Criminal behaviour is purposive,

b. Criminal behaviour is rational,

c. Crime decision-making is crime-specific,

d. Criminal choices are decisions over type of involvement (i.e. criminals can decide either to participate ‘once in a crime’ as opposed to start a life-time criminal career),

e. Crime involvement is composed of three stages: initiation, habituation, and (sometimes) desistance, and

f. Criminal events unfold in a sequence of stages and decisions that can be summarised in a modus operandi (i.e. a distinct method or pattern in which offenders commit crime).
These six features suggest a clear shift from previous explanations of crime (i.e., from the positivistic paradigm discussed above). In sum, criminal behaviour is not understood as specific to a definable group of offenders, but to the fact that immediate circumstances can play an important role in shaping criminal behaviour. This suggests that, under specific circumstances, many people are capable of committing illegal or violent conduct (Gabor, 1994; Haney, Banks, & Zimbardo, 1973). Unsurprisingly, the proposal that ‘even good people can do bad things’ (Gash, 2016) has many theoretical and empirical consequences. For instance, it indicates that the existence of situational opportunities for crime can be as important as the presence of offenders themselves. To date, the rational choice paradigm is one of the most common approaches in the study of crime.

Following the key ideas articulated by this school of thought, a number of theories have been proposed to explain specific elements of crime. Although the list of rational choice theories is large, three theories are of particular interest to frame this thesis.

2.1.3.1. Routine activity theory (RAT)

Traditional criminology often assumes that crime is the result of deprived socioeconomic conditions (e.g. positivist school of thought). Nevertheless, during the late 1970s, scholars realised that the evidence did unequivocally support this assumption. For instance, after World War II, welfare states expanded and Western economies boomed, but crime still increased
significantly. Cohen and Felson (1979) proposed that the reason for the observed increase in crime was not a worsening in socioeconomic indicators (since it could not be), but the result of the changes to people’s *routine activities* which simply offered more *opportunities* for crime. Clearly linked to the essence of the rational choice paradigm, Cohen and Felson’s arguments led to the Routine Activity Theory (RAT).

RAT suggests that crime occurs if three conditions are met. First, three elements are required: (a) a motivated offender, (b) a place, and (c) a possible target/victim. Second, these elements need to intersect in time and space. Third, three other elements -that normally stop or deter crime- should be absent for crime to happen. RAT calls these elements *crime controllers*.

According to this theory, crime occurs when controllers are not present to stop an offender victimising a target at a particular place (and time). For the offender, the controller is the *handler* (Felson, M., 1986), normally a person who knows the potential lawbreaker, and has the aptitude and interest to encourage them to avoid engaging in criminal activity (e.g. parents or spouses). For the place, the controller is the *place manager*, usually conceptualised as the person who has responsibility for monitoring people’s behaviour in any specific location, such as a bus driver on a bus, or manager in a bar (Eck, 1994; Eck & Weisburd, 1995). For the target/victim, the controller is the *capable guardian*, usually described as someone (or something) with the capability to protect the target from the potential criminal/criminal act (Clarke & Eck, 2003). These ideas led to the concept of
the ‘crime triangle’ (Eck, 2003). Figure 2.1 illustrates the relationship between the three elements that trigger crime and the three elements that can (or should) deter it. Following this consideration, RAT is not only useful to explain crime (or crime increases), but it also helps thinking on possible alternatives for crime disruption.

![Figure 2.1. The Cohen and Felson's crime triangle](image)

The most recent iteration of this theory includes the concept of super controllers. Super controllers are ‘the people, organisations and institutions that create the incentives for controllers to prevent or facilitate crime’ (Sampson, Eck, & Dunham, 2010, p. 40). This concept is particularly relevant for this thesis as it considers that some organisations (such as governments) can indirectly influence (through policy) the behaviour of individuals who engage in specific activities, including crime.
2.1.3.2. Crime Pattern Theory (CPT)

A second theory relevant to the framing of this thesis is Crime Pattern Theory (CPT). During the early 1990s, scholars started to develop further the key arguments proposed by the rational choice perspective by explicitly incorporating a geographical component. Originally proposed by Brantingham and Brantingham (1991), CPT proposes that crime follows specific patterns that can be explained as the result of the routine activities of: (a) those who might become victims of crime, and (b) those who can commit crime (prospective offenders).

According to these scholars, crime occurs particularly in those places and times in which there is an intersection between (a) crime opportunities associated with potential victims, and (b) the awareness space of potential offenders (i.e. at places where they feel more familiar and comfortable, and where there will be less uncertainty associated with the risks of offending). As such, the theory provides a parsimonious explanation as to why places within a city that attract high amounts of people (i.e. potential victims and offenders), such as commercial areas, tend to experience higher rates of crime than do other locations (Brantingham & Brantingham, 1991).

To elaborate, Figure 2.2 shows a hypothetical city. It indicates the location of the (possible) victim’s home, friend’s apartment, work or school premises, the place where the victim engages in entertainment and shopping, as well as the routes used to get to these places. It also shows how offenders
similarly move across the city, looking for the best time/place to commit a
crime, often in their known areas where they feel more confident
(Brantingham & Brantingham, 1991; Brantingham & Brantingham, 1993).
According to the theory, crime is expected to concentrate at those places
and times where criminal opportunities (resulting from victims’ routines)
overlap with the offenders’ awareness space.

![Image of Brantingham's crime pattern theory]

Figure 2.2. Brantinghams' crime pattern theory
Figure based on Brantingham and Brantingham (1993)

2.1.3.3. Situational Crime Prevention (SCP)

A third relevant theoretical perspective concerns crime opportunity in
particular and informs what has come to be known as Situational Crime
Prevention (SCP). Since the mid-1970s, Ron Clarke (and others) has
proposed that crime can be explained as a result of the specific situational
opportunities that facilitate the occurrence of offending (Clarke, 1980). As
such, rather than focusing on aiming to change offenders, from this
perspective, the key to preventing crime was to focus on understanding crime opportunity (Clarke, 1980). Felson and Clarke (1998, p. 9) later expanded this concept of opportunity through ten key principles:

(1) ‘Opportunities play a role in triggering different types of crime’ (Felson & Clarke, 1998, p. 9). By focusing on studying the environment, it is possible to find existing opportunities in a setting. Identifying opportunities allows an anticipation of criminal decision-making, and hence, the possibility of reducing crime. To date, this approach has been useful for tackling non-violent crimes (such as burglary), and has also shown its relevance for serious and organised crime (Bullock, Clarke, & Tilley, 2010).

(2) ‘Crime opportunities are highly specific’ (Felson & Clarke, 1998, p. 13). As the modus operandi involved in offending differs from crime to crime, and the rationale and possible rewards associated with different offences also vary, opportunities should be analysed (and tackled) separately. This statement has a number of implications. For example, police officers in a city where specific opportunities for crime are abundant (e.g. assume a high affluence of tourists related to the night-time economy), would need to implement different interventions than officers in a neighbouring city where these opportunities do not exist.
(3) ‘Crime opportunities are not equally distributed but concentrated in time and space’ (Felson & Clarke, 1998, p. 14). As crime occurrence is not random, some places at particular times experience a higher probability of crime occurrence than do others (i.e. hotspots).

(4) ‘Crime opportunities depend on everyday movements of activity’ (Felson & Clarke, 1998, p. 16). Following assumptions of the RAT previously discussed, offenders exploit information from their immediate environment to take a decision as to where, when, and how to commit a crime. Therefore, crime occurrence is the interplay of the daily opportunities encountered by offenders, and the offender’s perception of risk. According to this theory, there are three types of places that increase the risk of crime: (a) Crime generators: places to which large numbers of people are attracted for reasons unrelated to criminal motivation, creating large numbers of opportunities for offenders and targets to come together (e.g. shopping centres); (b) Crime attractors: places that, by offering many deviant opportunities appeal to criminal motivation (e.g. drug hotspots or red-light districts), and (c) Crime enablers: places where there is little regulation and rules of conduct are absent or are not enforced (e.g. an unguarded parking lot).

(5) ‘One crime produces opportunities for another’ (Felson & Clarke, 1998, p. 17). Theories of crime opportunity also suggest that, having embarked upon one crime, an offender can be drawn into another. An
example occurs when burglary escalates to an unplanned violent or sexual assault.

(6) ‘Some products or criminal dynamics offer more tempting crime opportunities’ (Felson & Clarke, 1998, p. 19). This pattern is particularly common in the case of theft, and items that are concealable, removable, available, valuable, enjoyable and disposable (or CRAVED) are assumed to be the most attractive (Clarke R., 1999, p. 5). In brief, this would explain why some (for example) electronic devices such as tablets or smart phones are frequently stolen items but refrigerators (which may be more expensive) typically are not.

(7) ‘Social and technological changes produce new crime opportunities’ (Felson & Clarke, 1998, p. 22). Normally, consumer goods experience a life cycle of four stages: innovation, growth, mass market, and saturation. Generally, when new products are released inadequate attention is given to how secure they are, and hence they may be targeted by thieves. Products that are in the growth or mass market stage, but are not yet ubiquitous (the saturation stage), are assumed to be the most attractive to thieves since they can be readily acquired but there will still exist an illegal market for them.

(8) ‘Crime can be prevented by reducing opportunities’. Opportunity-based theories do not aim to change human behaviour or condition. In
contrast, they argue that crime can be actually prevented by *blocking opportunities*. One example of this approach can be seen in the Bike Off initiative in London. In this example, by changing bike parking stands from an ‘n-form’ to a ‘m-form’, the initiative allowed bike users to secure all their bikes, instead of only one wheel or parts of the frame (Arts & Humanities Research Council, 2009; Johnson, Sidebottom, & Thorpe, 2008; Sidebottom, Thorpe, & Johnson, 2009; Thorpe, Johnson, & Sidebottom, 2012). Because of the intervention, London authority reported that the project achieved a 5.4% decrease in cycle thefts during 2010-11 (UCL, 2012).

(9) ‘Reducing opportunities does not usually displace crime’ (Felson & Clarke, 1998, p. 25). A frequent criticism of interventions that aim to reduce opportunity is that they will simply displace crime (i.e. geographically, temporally, in terms of target, tactically, and in terms of crime type). Nevertheless, a review of empirical studies suggests that there is little evidence that crime prevention interventions actually lead to displacement. In the very few cases in which displacement occurs, this phenomenon is usually overshadowed by the amount of crime successfully prevented due to the crime-reduction intervention (Guerette & Bowers, 2009). Overall, this suggests that situational interventions are worthy of implementation.

(10) ‘Focused opportunity-reduction can produce wider declines in crime’ (Felson & Clarke, 1998, p. 30). Empirical evidence suggests that as a
result of an intervention, a positive effect-the reverse of displacement-can actually take place. This phenomenon, called a *diffusion of benefits* (Guerette & Bowers, 2009, p. 1333) occurs for example when CCTVs reduces crime not only in the place where these devices are located, but also in surrounding streets (Clarke & Weisburd, 1994).

During the early 1990s, Clarke (1992) offered a first taxonomy of prevention strategies based on these features associated with the concept of opportunity. The original model, however, has been modified over the years following contributions from other prominent scholars (Clarke & Homel, 1997; Wortley, 2001). As a result of these contributions, table 2.1 shows the current form of the (five-column) matrix which describes 25 specific techniques of crime prevention (Cornish & Clarke, 2003).

**Table 2.1. The situational crime prevention matrix**

<table>
<thead>
<tr>
<th>A. Increase the effort</th>
<th>B. Increase the risks</th>
<th>C. Reduce the rewards</th>
<th>D. Reduce provocations</th>
<th>E. Remove excuses</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) <strong>Target hardening</strong></td>
<td>6) Extend guardianship</td>
<td>11) Conceal targets</td>
<td>16) Reduce frustrations and stress</td>
<td>21) Set rules</td>
</tr>
<tr>
<td>2) <strong>Control access to facilities</strong></td>
<td>7) Assist natural surveillance</td>
<td>12) Remove targets</td>
<td>17) Avoid disputes</td>
<td>22) Post instructions</td>
</tr>
<tr>
<td>3) <strong>Screen exits</strong></td>
<td>8) Reduce anonymity</td>
<td>13) Identify property</td>
<td>18) Reduce emotional arousal</td>
<td>23) Alert conscience</td>
</tr>
<tr>
<td>4) <strong>Deflect offenders</strong></td>
<td>9) Utilise place managers</td>
<td>14) Disrupt markets</td>
<td>19) Neutralise peer pressure</td>
<td>24) Assist compliance</td>
</tr>
<tr>
<td>5) <strong>Control tools and weapons</strong></td>
<td>10) Strengthen formal surveillance</td>
<td>15) Deny benefits</td>
<td>20) Discourage imitation</td>
<td>25) Control drugs and alcohol</td>
</tr>
</tbody>
</table>

Table taken from Cornish and Clarke (2003)
2.1.4. A critical appraisal of opportunity theories

For some criminologists, opportunity theories are, in fact, incomplete or inaccurate explanations for crime. For completeness, in this section I present some of the most common critiques, and discuss the extent to which academics favouring opportunity theories have tried to address them.

Perhaps the most influential opportunity-based theory is the theory of rational choice. As previously discussed, this theory refers to a set of ideas about the relationship between people’s preferences and the choices they make. The theory suggests that offenders assess the possible consequences (positive and negative) of their actions before engaging in crime (Cornish & Clarke, 1986).

A first common critique concerning this theory is that it assumes that individuals’ rationality is perfect and complete. In other words, that offenders use objective and comprehensive knowledge from their environment when evaluating criminal opportunities (e.g. whether the benefit of committing a crime is higher than the risk). While some of the leading academics promoting the opportunity theories later accepted that offender rationality is actually bounded by limitations in human information processing, situational context, and emotions (Cornish & Clarke, 1986; Clarke, 2014), it has been suggested that they never fully integrated these constructs into their theory (Wortley, 2014).
This potential limitation could have important implications for the explanatory power of opportunity theories in general, and upon this theory in particular. For instance, some scholars have argued that there are many factors that influence decision makers that opportunity theories simply do not consider. More specifically, it has been claimed that emotional and affective aspects of criminal decision-making are not well integrated into these theories (De Haan & Vos, 2003; Hayward, 2007). This argument has been used to explain why, whereas opportunity theories seem to be useful for explaining acquisitive crime (e.g. theft), they may have less potential for explaining non-economic offences, such as sexual harassment (Hayward, 2007).

The exclusion of emotion is significant in a number of different ways. For instance, it has been estimated that one-third to one-half of all economic decisions represent emotional choices (Zafirovski, 2012). Similarly, other scholars have conducted empirical studies showing that, in addition to considering the perceived costs and benefits of different courses of action, individuals also incorporate the role of emotion in the criminal decision-making process (Lindegaard, Bernasco, Jacques, & Zenebergen, 2014; Bouffard, 2014). Based on these arguments, some leading scholars have suggested that there are empirical limitations to opportunity theories of crime. In an effort to address these limitations, Farrell (2010) replied to Hayward’s critique (discussed in the paragraph above), arguing that some opportunity theories, such as SCP, can be applied to explain expressive and irrational crimes. Similarly, Walters (2015) presented a model to integrate the role of
emotion, impulsivity, and affect into one key opportunity theory, the rational choice theory.

A second criticism of the so-called opportunity theories is linked to the concept of *opportunity* itself. For example, as previously discussed, rational choice theory differs from other explanations for crime as it focuses upon how people’s preferences affect their choices, rather than explaining the *source* of their preferences. As such, the rational choice explanation contrasts *vis-a-vis* those theories that argue that crime is the outcome of social disorganisation (Shaw & McKay, 1942; Burgess, 1967), strain (Merton, 1957), low self-control (Gottfredson & Hirschi, 1990), or other social forces.

In this context, Clarke (2005) suggested that scholars who criticise opportunity theories have suggested that there is a lack of methodological rigor concerning the concept of *opportunity*. For instance, Clarke (2005) noted that these critiques suggest that opportunity theories often disregard essential angles of the concept of *criminal opportunity*; particularly, when it comes to the perspective of the offender. In effect, while considering some possible limitations from the opportunity theories, it has been argued that criminal opportunity *actually varies* according to an individual’s position in the social structure of society (Charest & Tremblay, 2011). This is in line with the argument presented by Felson (1986) who noted that: ‘people make choices, but they cannot choose the choices available to them’ (p. 119). Put differently, individuals with criminal skills, available resources, criminal motivation, and experience, would not only seek out (or even create crime
opportunities), but would also see opportunities for crime that would go unnoticed by others (Letkemann, 1973; Mccarthy & Hagan, 1992).

Considering this idea, Cullen (1988) has noted that assessing variation in criminal opportunity from the offender’s perspective is rarely tackled. Often, he suggested, it is assumed to be constant, taken for granted, and simply set aside as the subject of future research. Cullen (1988) goes further by arguing that scholars have not sufficiently explored the different faces of criminal opportunity. For this reason, he argues that academics should explore in more depth how criminal opportunity operates as an intervening variable that can explain not only why people engage in crime, but also ‘why persons choose one wayward path rather than another’ (Cullen, 1988, p. 214).

Finally, opportunity theories have been criticised from a philosophical and ethical point of view (Von Hirsch, Garland, & Wakefield, 2004). As previously discussed, one prominent argument that is constant across some of these theories is that blocking opportunities for crime actually reduces crime. In effect, opportunity theories have received a fair amount of attention from scholars and policy makers as they do a fairly good job of promoting efficient and effective answers for crime, by blocking or removing opportunities (Laycock, 2005).

Nonetheless, as suggested by Wortley (2010), opportunity theories of crime have been a controversial development. For instance, Clarke (2005) noted that a common critique against the opportunity theories is that they tend to
ignore the root causes of crime. Certainly, and as acknowledged by Wortley (2010), the concerns and approaches of opportunity theories contrast in significant ways with those of traditional criminological theory. In effect, Wortley (2010) suggested that, while criminology ‘generally seeks to understand offenders and the social and psychological forces that create them’, opportunity theories are ‘concerned only with the immediate circumstances under which crime is performed’ (p. 1). Unsurprisingly, the fact that opportunity theories tend to minimise the body of research establishing that the root causes of crime lie in ‘deprivation resulting from genetic inheritance, personality and upbringing, or from social, cultural, racial and economic disparities’ (Clarke, 2005, p. 40), has been very contentious. In this context, Wortley (2010) has noted that opportunity theories promote ‘neither social reform nor offender rehabilitation, both central themes elsewhere in criminology’ (p.1). The differences between these two schools of thought could explain why opportunity theories are often treated with scepticism by traditional criminologists who, additionally argue that opportunity theories encourage a status quo that is only useful for those who are better off in material terms (Duff & Mashall, 2004).

A second philosophical and ethical argument suggests that the promotion of this status quo can be seen in the specific solutions proposed by the opportunity theories. This argument is perhaps most evident in the situational prevention approach that encourages a modification of the urban environment as a way to mitigate crime throughout target hardening (see: Clarke, 2003). Certainly, a likely origin of this argument comes from the work
developed by Oscar Newman (1972) who proposed the idea of *defensible space*. Originally, his notion suggested that apartments can be built with the aim of enabling people to keep an eye on the neighbourhood around their homes. Nonetheless, throughout the years, this approach has also raised controversy. In one of his articles, Clarke (2009) summarised and discussed some critiques concerning the opportunity theories, including those suggesting that they promote the popularisation of the gated community, the unquestionable spread of *Big Brother* surveillance systems (i.e. CCTV), and the promotion of a *fortress society* in which ‘fearful citizens barricade themselves at home’ (p. 268).

There are, of course, counter arguments to these critiques. For example, Clarke (2010) has openly opposed these critiques, offering a counter-narrative in favour of opportunity theories. For instance, when it comes to CCTV, he argues that they are collectively valuable and positive as they can protect society from dangers, particularly when data protection protocols are considered (as they should be in democratic societies). In sum, he suggests, ‘people are willing to endure inconvenience and small infringements of liberty when these protect them from crime and terrorism’ (Clarke, 2010, p. 268).

Certainly, as is the case for any other school of thought in the context of social research, opportunity theories are not perfect, universal, or unquestionable. In the context of this thesis, it is important to recognise that there are a number of ethical and social dilemmas that should be considered (Von Hirsch, Garland, & Wakefield, 2000), and that a key challenge for
academics is to promote solutions that can find a balance between effectiveness, efficiency, sustainability, completeness, inclusion, and that promote a better society for all.

In the previous sections, I presented key theoretical perspectives that help to frame this thesis. As discussed above, the concepts of opportunity and situation in particular provide new avenues for studying crime in Mexico that have not been considered to date. These notions are particularly relevant in the light of research which suggests that organised crime groups (such as those which often participate in the trafficking of firearms) are opportunistic (Bouffard, 2014, p. 9). The application of these concepts is discussed further in chapter 3. In the following sections, I will review the theoretical background on gun trafficking, as well as existing studies of this crime in the U.S.-Mexico context.

2.2. The study of firearms trafficking

At the end of 2017 there were approximately 1,013 million small arms worldwide already in circulation (Karp, 2018, p. 4). Small arms is the technical definition used for firearms that are designed for individual use, such as handguns (e.g. pistols and revolvers) and long guns (e.g. rifles and shotguns). In this thesis, I use small arms, firearms, and guns synonymously.

Despite the high levels of small arms in circulation, this global market does not appear to be saturated. In contrast, it has been estimated that at least 8
million new firearms are manufactured each year (Peters, 2009). This annual figure, however, may be much higher. For example, official reports suggest that around 11 million small arms were produced during one year in the U.S. alone (ATF, 2016). In the next section, I discuss some of the distinctive features of firearms trafficking as well as how this offence has been studied in the broader scientific literature.

2.2.1. The scope of firearms trafficking

Some of the key factors that make the movement of firearms particularly difficult to address are the fact that not all guns are illegal, and that not all movements of guns are illicit per se. In discussing this issue, Feinstein & Holden (2013, p. 2) propose that there are actually two ‘worlds’ in the context of the global trade in arms: the legal trade, on the one hand, and the shadow world of illegal transactions, on the other (see: Figure 2.3 below).

The first world includes all permitted transactions that occur between licit actors. Usually, this involves the production, sale, and distribution of firearms to governments and individual users. Although this can involve illegal activity, such as corrupt practices to secure contracts, this first category is characterised by its relative transparency. In fact, due to the way it operates, it is possible to monitor the activity of companies and countries that export and import guns in this way. As a matter of fact, the Stockholm International Peace Research Institute (SIPRI) uses these figures and estimations to produce an annual yearbook on the legal arms trade, providing insight into
such activity (SIPRI, 2018). This thesis does not focus on these legal transactions.

![Diagram showing 'First world' and 'Second world'](image)

**Figure 2.3. The two worlds in the movement of guns**

The *second world* refers to all transactions that occur either on the grey or black market. The black and grey markets share a key similarity. In both cases, transactions are not transparently recorded. Grey and black markets also differ in a number of ways. Feinstein & Holden (2013) suggest that the grey market includes all arms deals undertaken by individuals associated with (or employed by) state security and intelligence agencies. While some of these trades are not illegal per se, they are ‘undertaken in secret as exposure may have political ramifications’ (p. 3). These scholars suggest that a relevant example of this grey trade is the Iranian-Contra scandal in which U.S. officials secretly sold weapons to Iranian authorities as part of a deal to release American hostages (Feinstein & Holden, 2013, p. 3). In contrast, the black market consists of deals that are illegal in conception and execution. These are usually undertaken by arms dealers, traffickers and other types of
criminals in violation of international and national laws, monitoring, conventions, and embargoes (Feinstein & Holden, 2013). The trafficking of firearms is similarly presented in the literature as gun trafficking, gun smuggling, and the illicit trade of firearms. The black market, a subcategory of the second world, is the key focus of the thesis.

Despite the above distinction between the first and second worlds, these should not be perceived as being entirely independent. For example, Sampson (1977) presented a review of the international arms trade, describing how some legal firms use questionable connections and techniques to expand their commercial activities, often using bribery and corruption. Other studies have also found evidence in favour of this argument by exposing: (a) how some corrupt private firms decide to sell guns to actors that should not have access to these, (b) how some governments often try to obtain guns without registration, and (c) how some arms dealers can make fortunes moving guns between these two worlds (Feinstein, 2011; Farah & Braun, 2007; Gilby, 2014).

To summarise, the aim of this section was to illustrate that rather than being independent, there can be connections between the legal and illegal worlds of arms trading. In some cases, actors operating in one world may also deal in another. Rather than providing a comprehensive review of all the different types of arms trade, in the next section I concentrate on describing the firearms trafficking that is shaped by black markets. As suggested, this is the main focus of the thesis.
2.2.2. Defining firearms trafficking

Greco (1998) defines firearms trafficking as ‘the movement of guns from the legal to the illegal marketplace through an illicit method for an unlawful purpose, usually to obtain profit, power, or prestige’ (p. 1). This definition provides some initial suggestions concerning the challenges associated with conceptualising the trafficking of firearms. Greco’s (1998) definition, for instance, describes the trafficking of firearms as a result of the legality of these weapons. This consideration is important as ‘the same gun can be legal or illegal at different points in that chain of commerce, depending on who has it in their possession’ (Peters, 2009, p. sec. 3).

Accordingly, the trafficking of firearms occurs when guns are moved ‘from the legal to the illegal spheres’ (Squires, 2014, p. 6). Legal guns can become illegal when they are ‘diverted during transportation, by leakage from factories or surplus stocks, theft from stockpiles, dealers, or individual owners, or converted to illicit firearms’ (Savona & Mancuso, 2017, p. 14).

While this definition is useful inasmuch it helps to frame the problem as a result of the legality of the weapons, it also lacks a second key component. That is, the spatial dimension, which is also relevant for the trafficking of firearms. Certainly, the phenomenon of firearms trafficking also occurs when guns are moved from a (physical) space in which they are legal to a place where they are not. This spatial component has been discussed by other scholars. Feinstein & Holden (2013, p. 1), for example, provide a definition in
which they see firearms trafficking as the process that occurs when the deals undertaken violate existing rules on the movement of arms. Veen et al. (1997) expand upon this definition by suggesting that firearms trafficking can be understood as ‘the acquisition of firearms for the purpose of making them available to criminals or to other people who reside in areas where State and local laws limit the availability of firearms’ (p. 1).

From these definitions it is then possible to recognise that firearms trafficking is the outcome of (at least) two different processes. As suggested by Greco (1998), one of these processes is linked with the legal nature (or source) of the guns. Yet, as suggested by Veen et al. (1997) and Feinstein & Holden (2013), a second definition is more closely related with the physical movement of guns from one place to another. The thesis considers mainly the latter, but acknowledges the key role of the legality of the gun source as both are intrinsically related.

In fact, a key foundation for the study of firearms trafficking is the recognition that this can be framed as a crime. From the legal perspective, firearms trafficking is considered a crime if there is a violation of national or local laws. Furthermore, firearms trafficking can also have an international dimension. According to the United Nations Protocol against the Illicit Manufacturing of and Trafficking in Firearms, the illegal movement of guns can be defined as ‘the import, export, acquisition, sale, delivery, movement or transfer of firearms, their parts and components and ammunition’ (United Nations, 2001, p. 3). This definition additionally highlights the illegal movement of guns from
(or across) the territory of one country to another if ‘any of those concerned does not authorise it’ (United Nations, 2001, p. 3).

A similar definition to the one presented by the United Nations has also been incorporated by inter-governmental regional bodies. As a matter of fact, in its article 1.2, the Inter-American Convention Against the Illicit Manufacturing of and Trafficking in Firearms (applicable to the U.S. and Mexico) reproduces the definition provided by the United Nations (Organization of American States, 1977, p. 9). An alike definition was also incorporated to the European Union Directive on control of the acquisition and possession of weapons (European Union, 2017, p. 28).

The fact that firearms trafficking is considered a crime also has practical implications from a law enforcement perspective. For example, if the spatial definition of firearms trafficking is considered, one of the key components required for this offence to happen is that guns should be moved from one physical place to another. In legal terms, these places can be considered jurisdictions, or areas in which specific laws are implemented that could be different to neighbouring places (Hazard, 1965). For this reason, the movement of guns that violates a law that is applicable to one jurisdiction is an offence that can be considered a cross border crime. Porter (1996) defines these crimes as those in which ‘an offender crosses a police force boundary to perpetrate a crime or commit an offence in such a way as to require the police to cross boundaries to investigate it’ (Porter, 1996, p. iii).
Unsurprisingly, for police officers it is often impossible to cross the border and investigate crime. This is especially challenging for the case of firearms trafficking where guns may cross international borders (UNODC, 2015). This feature also explains why collaboration between different agencies around the world is required, and why tackling this crime is often very challenging for law enforcement personnel (Seniora & Poitevin, 2010).

In addition to the characteristics previously discussed, there are a number of other key features that make the trafficking of guns different to other offences. The inclusion of these in this literature review is important since they can help to frame this offence following the crime-specificity used in criminological explanation (Clarke R., 1992; Cornish & Clarke, 1986). In the following section, I summarise some of these features. Next, I describe the market approach that is used to motivate empirical chapters 4 and 5.

2.2.3. Distinctive features of firearms trafficking

2.2.3.1. Firearms trafficking as the sum of multiple crimes

Instead of defining gun trafficking as a crime that occurs in one moment, at one given location, Feinstein & Holden (2013) conceptualise gun trafficking as a complex multifaceted crime often involving a series of offences. As such, firearms trafficking is not only the outcome of an illegal act, but also the basis or trigger for others. One example of this multi-faceted feature can be seen in the U.S. when a convicted felon (who does not have the right to
possess a gun) buys one firearm using a false identification (ID), commits an assault using the gun, and then provides the weapon to a criminal network for smuggling.

Feinstein & Holden (2013) also distinguish between offences that are required to obtain guns for trafficking, and offences that can occur once an illicit firearm has been obtained. The first category consists of offences that occur as pre-conditions of the illegal possession of a weapon for trafficking. Some examples are the theft of guns from legal sources (such police premises or established gun shops), or the illegal acquisition of weapons by falsifying permits or licenses to divert these into illegitimate markets. The second category includes crimes that occur after a gun has been obtained (for the purpose of trafficking). These offences can happen when traffickers bribe or intimidate officials when trying to cross a border with illegal weapons, or when criminals exchange guns for another illegal product, such as illicit drugs (Feinstein & Holden, 2013). There are other crimes that can occur after the (trafficked) gun has been obtained. In fact, this explains why the situational crime prevention (SCP) approach (previously discussed) often considers that guns are facilitators of further offences, since they make crime easier (Clarke & Homel, 1997; Wortley, 2001; Cornish & Clarke, 2003). Examples in which guns can facilitate crime include kidnapping and extortion, but evidently also armed robbery and gun homicide.
2.2.3.2. Firearms trafficking and guns as durable goods

Economic theory distinguishes between two types of goods: soft and durable. Tobacco, alcohol, and drugs can be immediately consumed and are examples of nondurable, consumable, or soft goods. In contrast, guns are durable goods (Kalaiselvi, 2017). Durable goods are defined as those that yield utility over time, having a lifespan of at least three years, such as furniture or machinery (Cooper, 1994). Since guns often work for decades (or longer), they are durable goods.

This notion has many implications for security. For instance, as opposed to smuggled alcohol or drugs (that are normally consumed as soon as they are bought by the consumer), guns can be accumulated infinitely. This accumulation can generate large stocks of weapons, which may have a long-term impact on the health and security of citizens. As a result of their durability, guns can have different owners across their lifespan, and can be associated with ‘good’ and ‘bad’ people, a factor that complicates criminal investigations (Grillot, 2011).

The durability of firearms can be appreciated empirically. Regions that experience substantial trafficking (linked to armed conflicts) later face the costs associated with circulating guns, as has occurred in Central America or Africa. In these regions, guns originally introduced by a contending group as instruments for the armed conflict (i.e. war), are then diverted to criminals who used them for committing crimes (such as extortion or kidnapping), even
decades after war hostilities have concluded (Human Rights Watch, 2004). Challenges that emerge from gun durability can be also observed in mature democracies. Since 1997, the UK has enforced a very restrictive gun law that aims to reduce prevalence. Nonetheless, authorities still confiscate antique firearms that are used in crime, some dating back as far as the American Civil War (Milmo, 2014; Willgress, 2017).

**2.2.3.3. Firearms trafficking as a victimless crime**

Unlike crimes against individuals (e.g. rape) or against businesses (e.g. commercial burglary), firearms trafficking does not have a *direct* or *immediate* victim. As such, this phenomenon is similar to other offences categorised as ‘victimless crime’, such as corruption, prostitution, and others that involve illegal contraband (e.g. drugs). In general, assuming a typical scenario in which trafficked guns are not stolen, this crime is victimless as: (a) all parties consent, (b) there is a lack of a visible/complaining participant, and (c) the crime could have a negative social outcome, but not immediately against a particular person or organisation (Schur, 1965).

Unsurprisingly, these conditions may influence the security sector authorities in a number of different ways. For instance, firearms trafficking usually ranks low in reporting, a condition that naturally raises concerns when aiming to effectively measure the phenomenon. The usual approach for measuring firearms trafficking is through the number of confiscations, which offers the possibility of having comparable data across time and space (Savona &
Mancuso, 2017). Nevertheless, as these data are not always available or sufficient, other proxy approaches have been also considered, including: (a) gun use in different crimes, such as the amount of injured individuals or the proportion of murders with guns (UK NCA, 2016), (b) cases of gun threats, bullying, and intimidation (Hemenway & Azrael, 2000), (c) gun use by gangs (Cook, Luwding, Venkatesh, & Braga, 2006), and (d) reports of domestic abuse involving guns (Parsons, Speigel, & Zwicker, 2014; Gerney & Parsons, 2014).

Low reporting, however, has many other additional consequences. From an operational point of view, it can reduce the intelligence that security officers have about a crime, and as such, the chances of efficiently tackling this offence. From a public perception angle, the fact that there are no immediate victims also reduces the pressure to disrupt this crime/network, and the police are perhaps more likely to prioritise crimes with high visible victims. For these and other reasons, gun trafficking is often understudied and underestimated. Yet, evidence suggests this should not be the case as reducing illegal gun prevalence and trafficking is perhaps one of the more direct ways to potentially reduce incentives (or facilitators) for violence (Clarke, 1997; Wortley, 2001).

2.2.3.4. Firearms trafficking as a complex network

Gun trafficking can be seen as the result of a ‘complex and innovative network’ (Stohl, 2004, p. 24). This network can involve a number of
interconnected actors or nodes (e.g. individuals, OCGs, etc.) and relationships, or ties (Wasserman & Faust, 1994; Campana, 2016).

In a basic scheme, a single actor controls the entire illicit process, from gun acquisition, to its delivery at the final destination point. However, due to logistical challenges (e.g. long distances, corruption capacity at border controls, and the required knowledge of local routes), two or more actors are often involved (Savona & Mancuso, 2017). Normally, these are the supplier, who knows how to get the weapon, and the purchaser, who requests to acquire it. As occurs in other commercial transactions, there is often a third party involved, the broker, who, knowing that the supplier and purchaser are willing to trade, works as the link between the two (Goodman & Marizco, 2010).

Often, the actors who participate in the trafficking of firearms are ‘quick to exploit legitimate international channels, systems, and infrastructures where they already exist – and are equally quick to create new ones where they do not’ (Stohl, 2004, p. 21). Nonetheless, as suggested by the research conducted for other trafficking crimes, such as drug (Calderoni, 2012; Bright, Hughes, & Chalmers, 2012) and human trafficking (Mancuso, 2014), it is possible to assume that not all criminal actors who participate have the same level of prominence.

While it is not known, it is possible that a range of small and medium groups participate in cases of gun trafficking (UNODC, 2015; Braga, Cook, Kennedy,
& Moore, 2002; Wellford, Pepper, & Petrie, 2004). If true, the existence of more than a few actors might also indicate the presence of numerous ties in trafficking networks, making them complex and possibly resilient to disruption.

The complexity of a network that smuggles guns is also likely to increase if each actor or node follows a different (and constantly evolving) *modus operandi*. In contrast to other crimes, for which offences might be committed following a similar *modus operandi* (e.g. in burglary most offenders break in through a window or a door), as discussed below firearms trafficking is subject to substantial variation. This variation is the outcome of different sources, routes, and schemes employed by traffickers and other criminals who are involved in this offence.

For instance, trafficked guns can be obtained from different sources. These can include illicit importation, diversion from legal markets by corrupt firearm dealers, the illicit theft of legally possessed firearms, and the reactivation of antique guns (Bricknell, 2012). Braga et. al. (2002) defined two key sources of supply: point sources and diffuse sources. *Point sources* represent the more organised spectrum of illegal firearms trafficking, and are best typified by the ongoing diversion of weapons from corrupt firearm dealers, or illegal importation. *Diffuse sources*, on the other hand, are defined as less routine acquisitions, and include weapons acquired from theft or informal clandestine sales.
Firearms can also be trafficked using different schemes and transportation means. This diversity can also influence how the relationships or *ties* within the network are formed. For instance, it is believed that the most common method employed is known as the *ant trade*. This method can be understood as the cross-border smuggling of small amounts of firearms (Goodman & Marizco, 2010; UNODC, 2015). There are, however, other cases in which traffickers move the guns in larger amounts, and over more extended distances (UNODC, 2015). Taking advantage of the fact that most customs agencies cannot inspect all trade containers or all border crossings, traffickers often conceal guns (or their parts) inside cars, buses, or rail wagons that pass through *terrestrial border crossings* (Seniora & Poitevin, 2010). Other mechanisms include the camouflaging of weapons inside post parcels, checked baggage in air transportation, or among sealed shipping containers that claim to carry legitimate items (Griffiths & Jenks, 2012).

Traffickers also use several routes. In Brazil, for example, the Russian mafia introduces most illegal guns at the Paraguayan border and through the ports in São Paulo (UNAFEI, 2002). In Western Europe, most illegal weapons are trafficked from the Balkans (Savona & Mancuso, 2017). In Paraguay, illegal guns come from the U.S., Bolivia and Argentina (Bargent, 2016). In Papua New Guinea, firearms enter from Australia, Indonesia, and the Solomon Islands (UNAFEI, 2002). Each route possesses different operational challenges. In terms of the network, this could be explained as a result of the variety of the *nodes* and *ties* (Wasserman & Faust, 1994; Campana, 2016) that characterise each local setting.
The purpose of this section was to provide the reader with a general background about gun trafficking - as this is a key concept used in the course of this research. Three observations discussed above are particularly relevant. For instance, firearms trafficking includes the movement of guns from the legal to the illegal domain, but also the movement from a (physical) space in which they are legal to a place where they are not. This dual definition sets the context for Chapter 3, in which I explore the movement of guns from a setting such as the U.S. (where guns are legal) to another one, such as bordering Mexico (where guns are highly restricted, and illegal in most cases). A second relevant consideration discussed in this review of literature is that firearms trafficking can also be considered a durable good. This specific feature is significant inasmuch as it reveals the complexity of estimating illegal gun availability (i.e. prevalence), as discussed in Chapter 5 for the case of Mexico. Finally, the third consideration from this review is that firearms trafficking is often the sum of multiple crimes, and the result of a complex network. Overall, these two factors are relevant to inform why tackling this crime is particularly challenging for law enforcement officers, as discussed in more detail in Chapter 6. That being said, in the following section I introduce in more detail the market approach that is used in subsequent chapters in the course of this thesis.

2.3. Firearms trafficking: the market approach

Economists have long discussed two key elements that shape any market: supply and demand. The supply is the quantity of a good (or service) that
manufacturers are willing to produce and offer to the market, at a given price, at a given time. The demand is the quantity of a good (or service) that consumers are willing and able to buy at a given price, at a given time (O'Sullivan & Sheffrin, 2003; Samuelson & Marks, 2003).

Theoretically speaking, markets are real or virtual places, formal or informal, where buyers and sellers - suppliers and demanders - interact directly or through intermediaries to trade these goods (Krugman & Wells, 2012). Guns, like any other item, are economic goods or commodities ‘subject to the forces of demand and supply’ (Killicoat, 2007, p. 2). For this reason, it is possible to suggest that there are ‘gun markets’ (Koper & Reuter, 1996; Cook, Molliconi, & Cole, 1995; Savona & Mancuso, 2017; Bice & Hemley, 2002). These markets ‘may be viewed as a function of the incentives and constraints faced by buyers, suppliers and regulators’ (Killicoat, 2007, p. 2).

The existence of gun markets suggests the presence of two key elements. On the one hand, there are actors interested in producing, offering, selling, retailing, or transferring the goods to a potential buyer or customer. They form the supply of guns. On the other hand, there are individuals or organisations who need, want, and have the ability and willingness to pay for the guns. They constitute the demand for guns (Samuelson & Marks, 2003; Savona & Mancuso, 2017).
Conceptually, supply is determined by four basic factors of production: land, labour, capital, and human capital or entrepreneurship (Samuelson & Nordhaus, 2010; O'Sullivan & Sheffrin, 2003). In this way, economic theory would suggest that the availability of raw materials, the existence of skilled human resources, the accessibility of technology and machinery to be efficient and compete successfully, and the expected demand and profits, can all influence levels of gun production (Johnston, 1961; Parkin & Esquivel, 2007). Specifically, it has also been argued that the supply side of the small arms market is determined by the price, existing laws and regulations concerning these guns, and the supply costs (Killicoat, 2007).

The demand is traditionally seen as the outcome of income, prices and preferences amongst specific countries, societies, or individuals (Krugman & Wells, 2012; Varian, 1992). Empirical studies suggest this also applies to the demand for guns (Killicoat, 2007, p. 7). In effect, scholars in the field of security have proposed an ad hoc ‘general theory of demand for small arms’ (Brauer & Muggah, 2006). This theory suggests that the demand for guns consists of two key concepts often used by economists: motivations and means.

Motivations can be understood as the desire (or ‘taste’) for a good (i.e. the gun), which determines the willingness to buy that good at a specific price. The means can be defined as the existence of sufficient wealth or income, and the ability and willingness to buy that good at specific price using that income (Krugman & Wells, 2012; Varian, 1992). In a basic model,
motivations and means can serve as stimulators of the demand (if they are present), or as inhibitors (if they are absent). Economic theory also suggests that these two factors depend on the market price. When the market price for a product is high, demand will be low. When price is low, demand will be high (Low, 1974; Whelan & Msefer, 1996).

Concerning motivation, Brauer and Muggah (2006), who developed this theory, suggest that there is an interplay between individual and collective decisions when demanding a gun. ‘While small arms demand is ultimately expressed at the individual level’ -they argue-, ‘the motivation for acquisition is at least partly socially constructed and embedded in various social practices and cultural forms’ (Brauer and Muggah, p. 139). Overall, this suggests that the demand for firearms is not only an individual decision, but also the result of the cultural and historical environment existing in the society within which an individual lives. This notion informs the discussions presented in Chapter 3 and Chapter 5. Specifically, it can help to explain why some specific societies (i.e. states) are driven into what can be seen as a collective decision in which the demand for gun increases.

Brauer and Muggah (2006) also discussed the role of means as the second factor that explains the demand for guns. Although the economic literature often concentrates on the resources required to pay for goods (or services), these scholars also suggest that non-monetary resources are relevant. Some examples of these types of resources include the ‘person or group’s drive, inventiveness, organisational and social capacity’, as well as ‘the networks
that make arms acquisition possible or impossible’ (p. 140).

While Brauer and Muggah’s (2006) study is very useful to frame the discussion concerning the demand for guns, they did not focus on the complexities associated with studying a market that is part of an ‘underground economy’. That is, one that is hidden from official view (Frey & Schneider, 2000). Nevertheless, this consideration is important for a number of reasons. As opposed to other more regular markets (in which supply and demand assume a perfectly competitive market, rational consumers, and free market entry/exit), the supply and demand for guns in illegal settings (as studied in this thesis) operate under the radar.

While the concept of the underground economy (also known as ‘black market’) is often simply defined as the economy that is hidden from official view (Frey & Schneider, 2000), economic literature suggests that, in effect, there are four different types of black markets. Importantly, each type of black market has different theoretical and practical implications (Feige, 2016; Feige, 1990; Lippert & Walker, 1997). As will be discussed, some are relevant for this thesis.

The first category of black market is called the unrecorded economy. This consists of those economic activities that are not monetised or reported to government statistical agencies. As example, consider the crops used by farmers for own consumption (Goldschmidt-Clermont & Pagnossin-Aligisakis, 1995). A second category is called unreported economy. This concept is
similar to the first, but it focuses on the fact that the economic activities are outside the reports of tax authorities. As an example consider unrecorded income (Feige, 2016). A third category has been called the informal economy. This includes activities that avoid the costs and are excluded from the benefits and rights covered by laws and administrative rules, such as informal jobs (Feige, 2016; Feige, 1990; Lippert & Walker, 1997). The fourth category, is the illegal economy, or more often, illegal black market, and seems to be the most appropriate to frame this thesis. In short, this fourth category of illegal black market consists of activities often conducted by individuals or groups who engage in the production and/or distribution of prohibited goods and services, in open violation of legal statutes (Feige, 2016).

In this context, economic theory also suggests that there are many incentives to explain why firearms' trafficking is an illegal black market (that operates under the radar). For offenders, firearms associated with illegal trafficking have two different roles. Gagliardi (2012), for example, suggests that guns can be ‘(a) the primary commodity of the market itself, or (b) the instruments that are relied upon by the criminal groups to exert the physical force required to direct and sustain their illicit markets’ (p. 88). The latter case occurs when criminals demand guns to advance their criminal enterprises through the use of deadly force (i.e. homicide), or when they aim to intimidate for the purposes of committing other crimes, such as extortion. Regardless, if the goal is to participate as traders, or to directly benefit from gun use, the key logistical requirement for criminals is to obtain the guns. Since this process in
which guns are obtained is illegal, it is rational for traffickers to effectively respond to existing incentives, hiding and reducing its visibility as much as possible.

The fact that the trafficking of guns is a hidden activity requires us to reflect upon methodological and research considerations. For instance, available sources of data on illegal black markets (resulting from trafficking) rarely exist. Even in the few cases they do, these are often not available to the public. In the absence of a better approach, scholars have studied different illicit black markets using available proxy-data, noting that caveats should be taken into account. Data on confiscations have formed the basis for analyses in a number of studies concerned with cigarette smuggling (Von Lampe, 2006; Beken, Janssens, Verpoest, Balcaen, & Laenen, 2008), illegal wildlife trade (Zimmerman, 2003; Rosen & Smith, 2010), and drugs and arms trafficking (Feige, 2016; Feige, 1990; Braga & Pierce, 2005).

A number of studies concerned with gun trafficking have combined the use of confiscation data with the market approach discussed above. The UNODC Study on Firearms Trafficking, for example, used data on confiscations as the primary source of data, and analysed the global demand for and supply of firearms as a market (UNODC, 2015). Furthermore, some countries, such as Australia, have typically considered confiscation data as a way to inform the demand for guns, and have implemented a gun market analysis as a useful framework to design and implement ad hoc policies (Australian Criminal Intelligence Commission, 2016; Bricknell, 2012). Recently, the
European Union mandated the think-tank *Transcrime* to complete a report on firearms trafficking focusing on the supply and demand for guns (Savona & Mancuso, 2017). A similar approach has been considered in the U.S., in which interventions concerning gun markets have been officially divided between demand-side and supply-side (National Institute of Justice, 2013). Likewise, other academic studies have used this dual framework to inform policy (Brauer, 2013; Bice & Hemley, 2002).

The use of the market approach that follows the key principles developed by economists offers additional advantages. While an exhaustive review of these is outside the scope of this thesis, two are relevant and deserve consideration here. First, the market approximation (that sees the black market like any other) provides a parsimonious explanation for why black markets operate in specific ways. This has several implications for the case study analysed in this thesis, as it provides a first insight into the sources and destination in trafficking. One of the key foundations is the classical theory of consumer demand, which suggests that scarcity is fundamental to understand how any market operates (Hicks, 1959). From this theory, it is possible to suggest that if one place has surplus of guns (i.e. a relative excess of production or supply) it is likely that it will become a source of guns to meet a demand elsewhere. In contrast, if a place has a gun shortage (i.e. buyers want to purchase more than existing guns), it is likely that this place will trigger the demand for these goods.
Second, dissimilarities in scarcity also create differences in the prices for the guns, which can influence the existence of trafficking and the profitability of doing it. This notion has been suggested by the commodity theory of Brock (1968). The main premise of Brock’s theory is that any commodity will be valued to the extent that it is unavailable. In other words, ‘the more restricted and less available a good is, the more it will be valued’ (Verhallen, 1982, p. 301). The relative difference in the price of a gun between the place of source (supply) and the place of destination (demand) is what creates the initial incentives for trafficking. In fact, according to this economic notion, the higher the gap in laws, availability, taxes, and prices between the source and destination, the higher the incentives for trafficking (Merriman, 2001). In this context, economic theory predicts that, if the (potential) benefits are worth it, actors (e.g. individuals, criminal organisations, etc.) who can tolerate the risk would decide to smuggle guns between these places. As will be shown in subsequent chapters, there are stark differences in the availability of guns in the U.S. and Mexico, which (arguably) create ideal conditions for the trafficking of weapons between them.

2.4. More guns, more crime? A background to existing debates

There have been numerous approaches to the study of guns. The aim of this section is not to present an exhaustive review, but to provide the reader with the necessary background to frame this thesis. An important note to consider is that most of these approaches have focused on the U.S. There are a number of reasons for this. One is the large number of guns that exist in the
U.S. estimations conducted by the Small Arms Survey (2018), the UNODC (2015), and other academic experts (Hemenway, 2004) suggest that while the U.S. accounts for five percent of the world’s population, it accounts for around half of the world’s gun production and ownership. An additional factor that explains why most studies (as those discussed below) come from the U.S. is the existing need in this country to reduce social costs associated with these guns. Gun crime in the U.S. costs around $100 billion per year (Ludwig & Cook, 2003). Firearm violence causes more than 38,000 U.S. deaths annually, from which 14,000 are homicides (U.S. Centers for Disease Control and Prevention, 2016). In fact, the firearm homicide rate in the U.S. is almost 20 times higher than those across other high-income countries (Grinshteyn & Hemenway, 2016; Richardson & Hemenway, 2011, p. 238).

That being said, in the following lines I present the key approaches found in the U.S. literature on guns that are useful for framing this thesis.

One approach found in literature is the study of gun production. Cook (1993) described U.S. domestic firearm production by gun type between 1965 and 1990. Three years later, Wintemute (1996) reported the key changes observed in the calibre of pistols manufactured during the period 1985-1994. Later, this scholar extended his analyses by including trends in gun production (by weapon type) between 1976 and 1999 (Wintemute, 2002). More recent studies have followed a similar approach. Braga et al. (2012) analysed the key trends in handgun manufacturing during the period 1979-1998. Brauer (2013) documented that about 98 million guns were manufactured in the U.S. between 1986 and 2010. Smith et al. (2017) also
studied trends in gun production, but, following a slightly different focus, concluded that this was concentrated ‘as the top 20 manufacturers hold a combined 87.2% market share’ (p. 588). Importantly, they also observed that since 2005, firearm production has moved towards products ‘that are of higher calibre and greater lethality’ (p. 589).

A second approach often found in literature focuses on studying the association between estimated firearm ownership (using proxy-variables, such as survey data, the fraction of crimes committed with a gun, etc.) and specific types of crime. This is important since two contrasting arguments are often debated. Apropos of these, Cook and Ludwig (1997) suggested that, on the one hand, ‘widespread gun ownership in a community could provide a general deterrent to criminal predation, lowering the risk to owners and non-owners alike’ (p. 379). On the other hand, they also indicated that ‘widespread gun ownership could also lead to increased risks of various sorts, including the possibility that guns will be misused by the owners or transferred to dangerous people through theft or unregulated sale’ (p. 380). Aiming to contribute to this debate, most studies concentrate upon reviewing the link between gun ownership and the homicide rate, often finding positive and statistically significant associations (Hepburn & Hemenway, 2004; Duggan, 2001). One study from Siegel et al. (2013), for example, found that gun ownership was a significant predictor of firearm homicide rates for the period between 1981 and 2010. In fact, they indicated that ‘for each percentage point increase in gun ownership, the firearm homicide rate increased by 0.9%’ (p. 2098). Researchers have also studied this link for
other crimes. Moore and Bergner (2016) found that an increased prevalence of firearms was associated with increased violent crime, such as rape, robbery, and assault. Other scholars have found a similar positive association for property crime (e.g. burglary, larceny, and theft), but to a lesser extent (Duggan, 2001).

A third approach found in the literature focuses instead on studying the change in crime as a result of the implementation of a specific gun law. As opposed to the previous approach, in which the focus is on correlating estimations of gun ownership with levels of crime, in this case the idea is to observe the extent to which specific gun laws are associated with increases or decreases in crime. This is relevant considering the different types of gun laws that can be implemented, often at the local level. McClenathan et al. (2017) identified 133 possible gun laws in the U.S., which can be grouped within fourteen categories. Some of these categories include laws regarding dealer and buyer regulations, laws concerning prohibitions for high-risk gun possession, and laws about background checks. There is probably no better example of this type of research than the numerous studies concerning the so-called Right to Carry (RTC) laws, which make it easier for individuals to carry loaded, concealed firearms in public spaces. Lott (2010) suggested that the RTC laws had reduced violent crime. Based on this research, a number of states implemented RTC laws, even though subsequent studies later refuted Lott’s findings (Ayres & Donohue III, 2003; Wellford, Pepper, & Petrie, 2004; Aneja, Donohue, & Zhang, 2014). Studies that have adopted this approach have also considered other gun policies. For example,
scholars have studied the impact of *Stand your ground* (SYG) laws. These laws provide citizens with expanded protections for the use of deadly force in a response to a perceived threat with no duty to retreat. Research has found that SYG laws are associated with increases in rates of state-level firearm homicide (Cheng & Hoekstra, 2013; Humphreys, Gasparrini, & Wiebe, 2017).

The aim of this Chapter was to provide the reader with a general review of the literature concerning the phenomenon under scrutiny. More specifically, I included four sections: (1) the theoretical explanations for crime and violence, (2) the distinctive features of firearms trafficking, (3) the conceptualisation of the *market approach*, and (4) some of the current debates concerning the study of guns. The concepts reviewed in this chapter are valuable to set the background for the thesis; for example, the observation that guns can be studied like markets, and the remark that firearms trafficking has distinctive features that makes this offence different from others. Likewise, the concepts discussed in this chapter are also essential to articulate the central hypothesis tested in this thesis: that (situational) opportunities can influence the patterns of violence and crime. Some of these concepts are particularly relevant for the following Chapter 3, in which I test whether increases in gun production in the U.S. are correlated with increases in gun confiscation (and violent crime) in Mexico.
Chapter 3. The security challenge

In chapter two, I presented the literature review that informs this thesis. I introduced some of the different theories from criminological research that have been articulated to explain crime, and presented key relevant features that define the phenomenon of firearms trafficking. In chapter three, I test whether the increase in violence observed in Mexico after the mid-2000s is consistent with theories of crime opportunity. In particular, I explore whether the rise in homicide can be explained by an increase in the availability of illegal weapons (a situational explanation) that resulted from policy changes in the bordering U.S. Evidence suggests that changes to gun policy in the U.S. increased both the supply of guns at the Mexican border and the opportunities for the trafficking of weapons into Mexico. Analyses suggest that variation (across space and time) in illegal gun availability in Mexico provide a parsimonious explanation for the observed variation in state-level homicide rates, even after accounting for factors associated with traditional explanations of violence. Some ideas and analyses presented in Chapters 1 and 3 were submitted for publication with Prof Shane D. Johnson and Dr Paul Gill.

3.1. Introduction

An important body of literature suggests that opportunities play an important role in crime occurrence (Clarke & Felson, 1998; Clarke R. , 2012). According to this perspective, opportunities can be equal in importance to
those personal and social variables that are usually thought of as causes of crime. As opposed to most classical criminological approaches (discussed above) that ‘try to remove the criminal dispositions that offenders have’, these theories ‘aim to remove the crime opportunities that offenders have’ (Gok, 2011, p. 98).

This paradigmatic change is relevant for a number of reasons. For instance, opportunity theories seek to explain the occurrence of crime rather than simply the existence of criminal dispositions (Natarajan, 2011). As such, instead of studying offenders and their criminal propensities, these theories aim to understand the crime event as a result of the opportunities that offenders have (Clarke R., 2012; Wilcox & Cullen, 2018; Felson & Clarke, 1998).

Advocates of opportunity theories of crime have remained largely silent with respect to the increase in homicide in Mexico. This absence is surprising as such theories have been invoked to explain the opposite effect –the crime drop- elsewhere. Farrell et al. (2011), for example, have compellingly argued that theories of opportunity, and not alternative explanations (such as those discussed above) might best explain the crime drop observed across industrialised countries during the final decades of the twentieth century.

A notable exception of an opportunity-based approach in the case of Mexico is reported in Dube et al. (2013). These scholars proposed that the expiration of the federal Assault Weapons Ban in 2004 increased the supply of guns in
the U.S., and as a consequence, opportunities for trafficking them into bordering Mexico. To test this gun trafficking argument, they examined both the changes in illegal weapon availability (estimated using data on gun confiscations), and variations in the rates of homicide in Mexican cities (municipios) for the two-year periods before and after the policy change (i.e. 2002-2004 and 2004-2006). Focusing on the Mexican cities within 100 miles of the U.S.-Mexico border, they contrasted changes for those cities in close proximity to Texas, Arizona, and New Mexico (where gun policy became more lenient as the federal ban on the production of ‘assault weapons’ was removed), and those Mexican cities that share a border with California, where a state-level ban on the production of these firearms was retained. Dube et al. (2013) found that, relative to cities situated along the Californian border, those lying along the non-California segment of the border experienced a 38% increase in homicides following the changes to this gun policy (p. 407). In other words, they found that Mexican states that border the U.S. states with more permissive gun laws had, on average, more homicides than those bordering states with strict gun law.

This chapter builds upon and extends the work of Dube et al. (2013). First, I consider a number of different theoretical and empirical perspectives that they do not. For instance, I explicitly frame the analysis in terms of opportunity theories of crime (which they did not). Second, I consider the possible influence of two other federal regulatory changes (implemented during the mid-2000s) that could have impacted upon the production and supply of guns in the U.S.-Mexico context. Third, I examine patterns over a
greater period of time (1999-2011). Fourth, I analyse these trends for the entire Mexican territory rather than focusing exclusively on the Mexican municipios within 100 miles of the U.S. border (which account for less than 5% of Mexican territory), as they did. This approach allows for an examination of hypotheses about how the effects of changes to gun policy might have diffused geographically. In other words, in addition to examining overall trends, I test the theoretical expectation that any trend of gun trafficking observed would exhibit a pattern of distance-decay from the U.S.-Mexican border. Finally, taking a criminological perspective, I test and control for alternative explanations not considered by these scholars.

The chapter is organised as follows. First, I briefly examine existing patterns concerning homicide in Mexico (i.e. the dependent variable). Second, I introduce the idea that an increase in illegal gun prevalence (due to trafficking) might be a key variable to explain violence increase in Mexico (i.e. the independent variable). To elaborate this argument, I discuss the three federal gun reforms that might have impacted upon gun production in the U.S. and then review the stability and stringency in Mexico’s federal gun policy (noting that studies that inform our understanding of gun trafficking between the U.S. and Mexico are reviewed in Chapter 5). Next, I describe the methodology and analytic strategy employed to test hypotheses before presenting the results. In the final section, I conclude with a discussion of the findings and their implications for the subsequent chapters presented in this thesis.
3.2. Patterns of homicide in Mexico

As previously commented, homicide patterns in Mexico have exhibited two contrasting trends over the last sixty years. I briefly review these here. Between 1950 and the early 2000s, the murder rate substantially decreased, falling from 48 to 17 homicides per 100,000 of the population (Heinle, Molzahn, & Shirk, 2015; Sistema Nacional de Seguridad Pública, 2017; Aguirre Botello, 2018). By the mid-2000s, homicide was at its lowest ever recorded level across most places in the country (around 9,000 homicide cases nationwide). Nonetheless, in subsequent years, this picture rapidly changed as homicide figures substantially increased. In 2011, more than 27,000 people were killed in Mexico. Figure 3.1 shows the pattern of all (national) homicide for 1999-2011 - the years under scrutiny in this thesis.

![Figure 3.1. Homicide in Mexico (totals) 1999-20011](image)

Generated by the author based on INEGI (2014)
Figure 3.1 indicates that homicide was reducing during most of the studied period. The figure also shows a substantial increase after the mid-2000s. This pattern, by its own, is important as there are no documented cases of large and populated countries experiencing such an anomalous trend in such short a period of time.

Of course, patterns observed at the national level can mask the trends experienced across different regions of the country. To observe the extent to which variation is present at the regional level, in Figure 3.2 I show the four regions in which Mexico can be studied. They represent the regions often used by the Mexico’s National Institute of Statistics and Geography (INEGI), the National Commission for Security (CNS), and other authorities. For the interested reader, in Table 3.1 I present the number of states included in each region and other spatial variables of importance for the thesis.
Table 3.1. Summary of the spatial zones used in the analysis

<table>
<thead>
<tr>
<th>Region</th>
<th>Location</th>
<th>Number of states included</th>
<th>Distance to closest border with the U.S. by land</th>
<th>Regional average distance to U.S. border</th>
<th>States included</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>North</td>
<td>6</td>
<td>From 0± km to the border</td>
<td>244 km</td>
<td>Baja California, Chihuahua, Sonora, Coahuila, Nuevo León, Tamaulipas</td>
</tr>
<tr>
<td></td>
<td>(border with the U.S.)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B</td>
<td>Central-North</td>
<td>11</td>
<td>From 600± km to the border</td>
<td>873 km</td>
<td>Baja California Sur, Sinaloa, Durango, Zacatecas, San Luis Potosí, Nayarit, Jalisco, Aguascalientes, Guanajuato, Querétaro, Hidalgo</td>
</tr>
<tr>
<td>C</td>
<td>Central-South</td>
<td>8</td>
<td>From 900± km to the border</td>
<td>1024 km</td>
<td>Colima, Michoacán, Estado de Mexico, Mexico City, Morelos, Tlaxcala, Puebla, Veracruz</td>
</tr>
<tr>
<td>D</td>
<td>South</td>
<td>7</td>
<td>From 1,200± km to the border</td>
<td>1609 km</td>
<td>Guerrero, Oaxaca, Chiapas, Tabasco, Campeche, Yucatán, Quintana Roo</td>
</tr>
</tbody>
</table>
As expected, homicide is not homogenously distributed: some regions in Mexico are (or became) more violent than others. In effect, the general trends over time are not consistent across the four regions (see Figure 3.3). In particular, it is apparent that the north of Mexico which immediately borders the U.S (Region A) experienced the largest increase in murder after the mid-2000s.

![Figure 3.3. Homicide in Mexico (by region)](image)

*Generated by the author based on INEGI (2014)*

In Table 3.2, I present the regional share of homicide in Mexico as a proportion for the nation for each year. This table also suggests that homicide increased disproportionally in the north of the country over time. While Region A accounted for 17% of all homicide in 1999, it accounted for 36% during 2011. The opposite pattern is observed for Regions C (centre) and D (south).
Table 3.2. Percentage of regional count of homicide in Mexico by year

<table>
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<tr>
<td>Region A</td>
<td>17</td>
<td>16</td>
<td>17</td>
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<td>18</td>
<td>19</td>
<td>19</td>
<td>20</td>
<td>34</td>
<td>34</td>
<td>43</td>
<td>36</td>
</tr>
<tr>
<td>Region B</td>
<td>19</td>
<td>19</td>
<td>20</td>
<td>19</td>
<td>19</td>
<td>18</td>
<td>19</td>
<td>18</td>
<td>20</td>
<td>20</td>
<td>23</td>
<td>25</td>
<td>25</td>
</tr>
<tr>
<td>Region C</td>
<td>42</td>
<td>44</td>
<td>46</td>
<td>44</td>
<td>44</td>
<td>45</td>
<td>45</td>
<td>43</td>
<td>40</td>
<td>30</td>
<td>26</td>
<td>21</td>
<td>25</td>
</tr>
<tr>
<td>Region D</td>
<td>22</td>
<td>21</td>
<td>17</td>
<td>20</td>
<td>20</td>
<td>19</td>
<td>17</td>
<td>20</td>
<td>20</td>
<td>16</td>
<td>17</td>
<td>11</td>
<td>14</td>
</tr>
</tbody>
</table>

Generated by the author based on INEGI (2014)

To examine this variation more explicitly, Figure 3.4 and Figure 3.5 show how the frequency of homicide changed at the regional level before and after the mid-2000s. As will be discussed in further detail below, I specifically analyse this for the two six-year periods 1999-2004 and 2006-2011 as they are particularly relevant for testing the hypothesis of interest in this chapter. Figure 3.4 shows that between 1999 and 2004 there was a substantial reduction in homicide across all four regions, with Region A experiencing a reduction in homicide of -3.9%, Region B of -5.6%, Region C of -4.1% and Region D of -7.3%. Figure 3.5 shows the trend for the interval 2006-2011, revealing a clearly contrasting pattern. In Region A homicide increased by 49.8%, in Region B by 33.2%, in Region C by 9.9% and in Region D by 15%.

Overall, the pattern of change identified across regions suggests that what occurred post 2004-2005 cannot be explained by a general trend (for Mexico as a whole) and deserves further explanation. In the following section, I discuss the opportunity hypothesis regarding gun trafficking that is at the heart of this thesis.
Figure 3.4. Homicide drop 1999-2004
Generated by the author based on INEGI Fuente especificada no válida.

Figure 3.5. Homicide increase 2006-2011
Generated by the author based on INEGI Fuente especificada no válida.
3.3. Gun trafficking as explanatory variable for homicide increase

As noted earlier, a number of traditional criminological theories have previously been invoked to explain the rise in homicide observed in Mexico. Nevertheless, with the exception of Dube et al. (2013), existing studies have not examined how situational factors - and the role of opportunity - might explain the increase in violence. Moreover, Dube et al. (2013) do not frame their analysis in these terms.

In line with opportunity theories of crime (Clarke & Felson, 1998), previous research on the crime drop by Farrel et al. (2011), and Dube et al.’s study, I propose that a change in opportunity structure can explain the rise in violence in Mexico. In particular, I argue that the three changes to federal gun policy that occurred in the U.S. during the mid-2000s (described below) created new opportunities for the illicit supply of firearms to Mexico. The argument is that these increased the availability (and accessibility) of illegal firearms, which in turn facilitated homicide in Mexico. In the sections that follow I review these policies.

3.3.1. Changes in U.S. federal gun policy

On September 13, 1994, U.S. President Bill Clinton signed into law the Public Safety and Recreational Firearms Use Protection Act, commonly known as the Federal Assault Weapons Ban (AWB). This federal law included a ten-year prohibition on the manufacture and import of semi-
automatic firearms for civilian use, defined therein as ‘assault weapons’ (U.S. Congress, 1994).

The aim of restricting military-style gun availability was to re-empower police forces and reduce the social costs (i.e., morbidity and mortality) associated with public shootings, accidents and murders that had been occurring across the U.S. at the time. Although no absolute consensus exists regarding the success of the AWB, on balance most studies suggest positive effects (Roth & Koper, 1999; Koper, Woods, & Roth, 2004).

Nonetheless, on September 13, 2004 both President George W. Bush and the U.S. Congress decided to terminate the AWB. As a consequence, restrictions previously placed on private contractors regarding the manufacture, importation and trade of all semi-automatic weapons (that had been prohibited for a decade) were removed. Not surprisingly, as a result of the expiration of the ban, the manufacture of long guns increased, as discussed in Chapter 4.

The expiration of the AWB in 2004 is, however, not the only gun law change during these years that merits attention. Another important reform occurred in 2003, just a few weeks before the expiration of the AWB. Named after its sponsor, U.S. Representative Todd Tiahrt (R-KS), the Tiahrt Amendments were explicitly designed to prohibit the U.S. Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) from disclosing any type of data that could be used to trace firearms. It was argued that if authorities were allowed to
continue sharing such data for the purposes of addressing gun violence, this would ‘criminalise’ gun owners, and effectively violate the ‘right to keep and bear firearms’, which has been guaranteed by the U.S. Second Amendment since 1791. One consequence of these 2003 Amendments was to impede attempts by law enforcement agencies across the U.S. to identify gun traffickers and corrupt gun dealers. Despite changes to these Amendments in 2008 and 2010 that removed some of the restrictions that originally blocked law enforcement agencies to exchange trace data, the remaining regulatory framework continued to prohibit data disclosure to members of the public (including researchers) and litigants. In so doing, I argue that the Tiahrt Amendments would have reduced the ‘perceived risk’ to offenders involved in gun-related offences which, from a rational choice perspective (Cornish & Clarke, 2003) would do little to deter them from such activity. In this way, I suggest that Tiahrt Amendments would have created additional incentives for criminals to traffic more guns, not only within the U.S. but also to Mexico.

A third relevant policy shift not discussed by Dube et.al. (2013) occurred a few months after the federal AWB expired. On 26 October 2005 the then U.S. President George W. Bush signed into law the Protection of Lawful Commerce in Arms Act (PLCAA). This new regulation was designed to protect firearms manufacturers and dealers from being held liable for crimes committed using their products. As a result of the PLCAA, the American gun industry received a legal protection that is not available to any other industry in the U.S. (Brady Center, 2015). I argue that the PLCAA created additional
incentives that also reduced the ‘perceived risk’ to offenders involved in gun-related offences.

These three legal changes had significant implications for the market for guns in the U.S. This is particularly relevant considering the size of the U.S. industry, which is the world’s largest producer, exporter and importer of firearms. With at least 88 guns per 100 inhabitants, there is no other country in the world with more weapons per capita (Small Arms Survey, 2012; Azrael, Hepburn, Hemenway, & Miller, 2017, p. 39; Karp, Global Firearms Holdings: the US, 2018). Due to its size and global role, the consequences for such a large market, however, extend beyond American domestic issues. For instance, the U.S. is the largest legal exporter of weapons to developing countries (Grimmett & Kerr, 2012). Its proximity to Mexico also provided a potential opportunity for gun traffickers to supply a conveniently located illegal market for which there was little internal supply (see below).

3.3.2. Stability and stringency in Mexico’s federal gun policy

In contrast to the U.S., Mexico has had some of the most restrictive gun laws in the world. Mexico has a tradition of restrictive gun policy and some of the most stringent gun control laws in the world (UNODC, 2010; U.S. LOC, 2013; Hummer, 2016). This tradition began in 1931 when the Mexican Congress passed the Federal Penal Code (Mexican Congress, 1931). Articles 160-163 of this Code stated for the first time that (in Mexico): (a) licenses were required to carry pistols or revolvers, (b) individuals were requested to prove
their need to carry these weapons, and (c) only mercantile establishments - as opposed to individuals - were allowed to participate in gun sales (Mexican Congress, 1931, pp. Art. 160-163). This Penal Code imposed strict sanctions (i.e., three years of imprisonment) for violations of these specific provisions (Mexican Congress, 1931) and was probably amongst the world’s most stringent laws at the time (Green, 1987; Carbonell, 2006).

Even so, the federal gun policy became stricter a few decades later (U.S. LOC, 2013). In 1972, the Mexican Congress enacted the Federal Law of Firearms and Explosives. This federal law explicitly aimed to reduce the possession, ownership, circulation, sale, and use of firearms in the country (Art. 5). In addition to imposing new restrictions for gun ownership and possession, this law mandated all firearms to be registered at the Federal Arms Registry controlled by the Mexican Army (Kopel, 2013, p. 31). The 1972 law also imposed up to 10 years of prison for violations of this Law (Mexican Congress, 1972).

Henceforth, the restrictiveness of the federal gun law has been constant in Mexico (Hummer, 2016). Existing limitations for gun owners are evident throughout the entire supply chain, from production to possession. For instance, ‘Mexico does not produce weapons domestically for the civilian market’ (Cook, Cukier, & Krause, 2009, p. 271).

Furthermore, there are no private gun shops across the country (Mexican Congress, 1972). In effect, weapons in the country can only be purchased
from one single gun shop (run by the Army) located on a heavily guarded military base on the outskirts of Mexico City (Burton & Stewart, 2007; Cook, Cukier, & Krause, The illicit firearms trade in North America, 2009).

Moreover, the process to purchase a firearm in the Army-run gun shop is far from easy or accessible. For instance, finding the gun shop can be a difficult task as the federal law prohibits the Mexican Army both from advertising the existence of the gun shop as well as the guns on sale there (Mexican Congress, 1972). Access to the gun shop is also restricted. Before being allowed into the store, potential customers must present valid identification, pass through a metal detector, and surrender their mobile phones, tablets, and cameras to the soldiers who run the store (Booth, 2010). This gun shop is only open five hours per day (SEDENA-DECAM, 2018), a factor that can effectively restrict the number of prospective buyers.

If all these limitations were not sufficient to restrict gun sales, to be able to purchase a gun, the potential buyers are also fingerprinted and photographed. Furthermore, they should complete a form in which they have to justify their need to carry a weapon. Likewise, they should also present a copy of their birth certificate, proof of current residence (i.e. utility bill), and the official report of no criminal record issued by the State Attorney Office of the place where they live. Prospective gun buyers also need to demonstrate the legitimacy of their income by presenting a bank statement and an official letter from the current employer, including the amount of time they have been employed, their specific job title and salary, and the observed behaviour at
the workplace. Prospective gun buyers also need to submit a psychological, a medical and a toxicology test, and must undergo two months of background checks (SIPSE-AP, 2016; SEDENA-DECAM, 2018; SEDENA-RFAFCE, 2018).

Unsurprisingly, the civilian ownership of firearms for security purposes has also been restricted, both in terms of firepower and the number of guns that a civilian can acquire (Sánchez, 2007; Cook, Cukier, & Krause, 2009). Citizens in Mexico who pass the background checks conducted by the Army receive a one-year permit (Mexican Congress, 1972). This permit only allows citizens the right to keep one hand gun, and they are restricted to keeping this gun in their households only (Krantz, 2013; Mexican Congress, 1972). In other words, Mexican law does not permit citizens to carry guns in public places, either openly or concealed (UNODC, 2013; Mexico’s Official Journal of the Federation, 2015). The Mexican Army systematically and rigorously enforces this policy, seizing all guns where no license/permit has been granted.

Generally speaking, permit holders are also limited to buying and possessing small calibre weapons (Cook, Cukier, & Krause, 2009). Overall, the Mexican regulatory framework is so restrictive that, by 2013, only 3,140 private citizens in Mexico (2.6 per 100,000 population) held a valid legal gun license (Gutiérrez, 2014).
As described by the 1972 Federal Law, the Mexican gun policy has aimed to reduce the availability of circulating guns in the country (Mexican Congress, 1972). In effect, the considerations presented by the 1972 Federal Law show that Mexican lawmakers assumed that fewer guns would help to decrease homicide and other security concerns, such as violent crime. Kopel (2012; 2013) argue there were additional explanations for the gun control measures implemented, particularly those enacted during the late 1960s and 1970s. In brief, he suggests that anti-government student movements that took place in 1968 alarmed many governments around the world, including that in Mexico. According to Kopel (2012), this explains why policies that aimed to restrict the guns in circulation (or that mandated citizens to register their weapons) were implemented, as Mexico did with the 1972 Federal law (Kopel, 2012, p. 31).

Did the Federal Law achieve its aim? Data indicates that homicides and violent crime substantially reduced through the twentieth century, as discussed in Chapter 3. Nonetheless, also as discussed in Chapter 3, official data suggests that most types of crime in Mexico began to follow the opposite trend after the mid-2000s. Specifically, the most relevant increases are reported for gun-related offences, such as homicide, extortion, kidnapping, and robbery (SNSP, 2015).

3.3.3. Testing gun trafficking between the U.S. and Mexico

This asymmetry in gun policy between these two bordering countries has created several incentives for gun trafficking from the U.S. into Mexico,
incentives that may be responsible for many of the illegal guns found in Mexico. While research on gun trafficking from the U.S. into Mexico is not extensive, a number of studies provide valuable insight into the extent to which trafficking occurs, and some of the associated patterns. These are reviewed in detail in Chapter 5.

To test the opportunity hypothesis (linked to gun trafficking), three sets of analyses are conducted sequentially to examine each stage in the process. These are presented in the form of input-output-outcome model. The first stage considers the extent to which the key federal regulatory changes (e.g. Tiahrt Amendments, AWB expiration and PLCAA enactment) were associated with increases in gun production in the U.S. (input). The second stage considers the extent to which variation in gun production in the U.S. over time was associated with the availability of illegal firearms in Mexico (output). In addressing this question, I explore how such patterns varied geographically and how any geographic patterns shifted after changes to U.S. gun policy discussed above. After providing evidence to show that the illegal availability of weapons did increase in Mexico, in the third stage I discuss the extent to which changes in illegal gun availability in Mexico were associated with variations in the homicide rate over time, and if and how this varied spatially (outcome).
Motivated by the observation that there is typically an inverse relation between supply and distance in retail and other sectors (Reilly, 1929; Stewart, 1948), I also expect opportunities for trafficking to be the most acute in northern Mexico (which shares a border with the U.S.), where illegal firearms would be most readily available and trafficking would require the least effort (Zipf, 1949). While I anticipate gun availability and rates of murder to be most evident at the border between Mexico and the U.S., I also anticipate to observe the association to diffuse spatially, exhibiting a pattern of distance decay, so that the effects are also observed in states further from the border, albeit to a lesser extent. In the current study, I use time series data to test these arguments and to examine how patterns varied spatially.

In addition to testing these ideas articulated above, which are the focus of this paper, I control for additional variables associated with other criminological explanations. These explanations are related with the discussion presented concerning the positivistic paradigm in the literature review (Chapter 2). In Table 3.3, I provide a summary of each of the potential

Figure 3.6. More guns, more crime? Analyses conducted
Generated by the author
explanations considered for Chapter 3, and offer citations to the related literature.
### Table 3.3. Summary of potential explanations

<table>
<thead>
<tr>
<th>Explanation</th>
<th>Rationale</th>
<th>Studies in which this explanation was proposed</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Opportunity explanations for homicide in Mexico:</strong></td>
<td></td>
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</tr>
<tr>
<td>1</td>
<td>An increase in the availability of illegal firearms led to a rise in homicide in Mexico</td>
<td>Current</td>
</tr>
<tr>
<td>2</td>
<td>The association between firearm availability and homicide is expected to be more acute at the U.S-Mexico border and nearby</td>
<td>Current</td>
</tr>
<tr>
<td>3</td>
<td>The association between firearm availability and homicide is expected to show a pattern of distance decay</td>
<td>Current</td>
</tr>
<tr>
<td><strong>Traditional explanations for homicide in Mexico (control variables):</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>An increase in the population in Mexico led to a rise in opportunities for and hence the count of homicides</td>
<td>Braithwaite (1975); Nolan (2004)</td>
</tr>
<tr>
<td>5</td>
<td>An increase in poverty led to a rise in homicide in Mexico</td>
<td>Ludwig et. al. (2001); Webster and Kingston (2014)</td>
</tr>
<tr>
<td>6</td>
<td>A reduction in human development, as measured by the Human Development Index (HDI), led to an increase in homicide</td>
<td>LaFree (1999); Nivette (2011)</td>
</tr>
<tr>
<td>7</td>
<td>An increase in inequality led to a rise in homicide</td>
<td>Blau and Blau (1982); Elgar and Attken (2010)</td>
</tr>
<tr>
<td>8</td>
<td>An increase in unemployment led to a rise in homicide</td>
<td>Chircos (1987); Paternoster &amp; Bushway (2001)</td>
</tr>
<tr>
<td>9</td>
<td>An increase in the dark figure of crime, which would suggest a decrease in public trust in the ability of the authorities to address crime problems, led to a rise in homicide</td>
<td>Skogan (1977); MacDonald (2001)</td>
</tr>
<tr>
<td>10</td>
<td>An increase in judicial inefficiency led to a rise in homicide</td>
<td>Montenegro &amp; Posada (1994); Levitt and Miles (2006)</td>
</tr>
<tr>
<td>11</td>
<td>An increase in corruption led to a rise in homicide</td>
<td>Buscaglia and Van Dijk (2003); Daday, Broidy &amp;Willits (2007)</td>
</tr>
<tr>
<td>12</td>
<td>An increase in all drug crimes led to an rise in homicide</td>
<td>Fœron (2011); Mejia and Restrepo (2013) Goldstein (1985); McBride et. al. (2003)</td>
</tr>
<tr>
<td>13</td>
<td>An increase in military action (enforcement) to reduce drug crime led to an increase in homicide, either by exacerbating conflict or displacing criminal activity</td>
<td>Resignato (2000); Werb (2011)</td>
</tr>
</tbody>
</table>
3.4. Method and Results

3.4.1. Data

Annual data on the dependent variable (i.e. homicide), independent variable (i.e. gun confiscation) and covariates were collected for each of all the 31 Mexican states for which data was provided (i.e. due to its special status, data for Mexico City that is often considered the 32nd state was not reported). I specifically study the thirteen-year interval 1999-2011 to explore the impact resulting from the changes in U.S. federal gun law. Data were collected for inter-period comparisons and for an econometric model. While conducting inter-period comparisons, I consider two equal intervals of six years, and exclude data for 2005 when the AWB really expired and the PLCAA came into effect. While conducting the econometric model (explained below), I include data for the 13 years. In this case, the unit of analysis is the state measured each year. Thus, the dataset has a times-series cross-sectional structure with 403 observations (31 states x 13 years).

Table 3.4 provides a summary of the variables used, how they were constructed, and their provenance.
Table 3.4. Dependent variables, covariates and data sources used

<table>
<thead>
<tr>
<th>Variable(s)</th>
<th>Variable construction</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DV</strong></td>
<td>Homicide or gun homicide</td>
<td>Homicide (and gun homicide) as a natural Logarithm</td>
</tr>
<tr>
<td><strong>IV</strong></td>
<td>Firearms illegal prevalence by spatial zone</td>
<td>Interaction of the count of all illegal guns seized by the Mexican Army by state (as a natural Logarithm), according to the region (A, B, C, or D) of each Mexican state</td>
</tr>
<tr>
<td>C</td>
<td>Population</td>
<td>State population expressed as a natural Logarithm</td>
</tr>
<tr>
<td>C</td>
<td>Poverty</td>
<td>State gross domestic product (GDP) expressed as a natural Logarithm</td>
</tr>
<tr>
<td>C</td>
<td>Social development</td>
<td>State human development index (HDI)</td>
</tr>
<tr>
<td>C</td>
<td>Inequality</td>
<td>State Gini index</td>
</tr>
<tr>
<td>C</td>
<td>Unemployment</td>
<td>State unemployed population (percentage)</td>
</tr>
<tr>
<td>C</td>
<td>Dark figure of crime</td>
<td>State dark figure of crime based on victimization survey data</td>
</tr>
<tr>
<td>C</td>
<td>Judicial inefficiency</td>
<td>State percentage of reported crimes satisfactorily solved by the authorities (proxy of no impunity)</td>
</tr>
<tr>
<td>C</td>
<td>Corruption</td>
<td>State level of corruption based on perception survey</td>
</tr>
<tr>
<td>C</td>
<td>All drug crimes</td>
<td>State count of all reported drug-related crimes (production, possession, trafficking, and others) as a natural Logarithm</td>
</tr>
<tr>
<td>C</td>
<td>Military use of force</td>
<td>State sum of all soldiers deployed by the Mexican Army during Felipe Calderón term (2006-2012)</td>
</tr>
</tbody>
</table>

DV = dependent variable  IV = key independent variable  C = covariate
As with any research, it is necessary to explicitly recognise the limitations of the data and possible biases. For the purpose of this chapter, three points are particularly worthy of consideration.

First, data on gun confiscation were obtained through a Freedom of Information Act (FOI) request. The process included an official request to the Mexican Army, the institution in charge of managing all illegal guns that are confiscated in the country. While these FOI processes are often quite straightforward, it is perhaps worth noting that in this case the Army initially refused to disclose the data arguing that it was a matter of “national security”. Ultimately, the data were provided but only after a number of appeals were made over a period of more than two years.

Second, it should be recognised that the data on “confiscations” have a methodological drawback: these data only capture the “visible cases”. That is, as with all academic studies that focus on black markets (see Chapter 2), the data on confiscations (or seizures) provided by the Army only include data on those guns that were detected by the authorities. These data will not include all guns that were trafficked as it will exclude those that were not identified and reported by government officials. While this is not ideal, this characteristic of the data (which is discussed in further detail below in the Conclusion section) is a common limitation for studies such as the one presented in this Chapter.
Due to this limitation, the data on confiscated guns were assessed for bias. To do this, a random sample of 500 cases were contrasted with open source material (online newspapers) to see if cases reported in the database were also reported by the media. This comparison focused upon three key features: (a) the day of confiscation, (b) the place of confiscation, and (c) the number of guns seized. The data matched entirely, both in time and space, (i.e. state and year of confiscation), as well as in the number of guns seized. Hence, the database received by the Mexican Army was considered fit for purpose.

To examine spatial variation in estimates of firearm availability in Mexico, it was necessary to collect and aggregate data for these variables for discrete spatial regions. A variety of approaches could be taken, but here I assembled data for each of the 31 states in Mexico and then allocated each state to one of the four spatial regions shown in Figure 3.2 and Table 3.1. As discussed, the first region (A) represents all northern states that share a direct border with the U.S. The remaining states were allocated to regions B, C, and D based on contiguity and how far their capital city was located from the U.S. border.

To provide a broad overview of historical trends, I first provide basic descriptive statistics related to the three key areas under examination: (a) Firearm production in the U.S., (b) Illegal firearm availability in Mexico, and (c) Homicide counts in Mexico.
3.4.2. Data on firearm production in the U.S

Figure 3.7 shows yearly estimates of gun production (prod.) in the U.S. compiled by the ATF. This figure indicates that the manufacturing of guns remained stable until the mid-2000s, but subsequently increased rapidly, approximately doubling over a period of five-years (2004-2009).

![Graph showing yearly estimates of gun production in the U.S.](image)

**Figure 3.7. National prod. of guns in the U.S.**
Generated by the author based on ATF (2015)

To examine changes in the spatial variation of gun production in the U.S., I also analyse ATF data on state-level gun manufacturing. As shown in Figure 3.8, gun production was not uniformly distributed. In fact, for the six-year period prior to the ban (1999-2004), more than 70% of all guns were produced in just four states (Connecticut, New York, New Hampshire, and Massachusetts), all of which are located on the Northeast coast of the U.S. After the ban, these four states still accounted for a substantial market share
of the national figure, but this reduced to 54%. In contrast, the national market share at the four U.S. states bordering Mexico show two opposing effects. While California and New Mexico decreased from 3.22% in the period prior to the ban (1999-2004) to 0.57% after it (2006-2011), production in Arizona and Texas substantially increased from 6.2% to almost 14%.

Figure 3.8 shows the average change in gun production, but masks the yearly trend. A more detailed analysis of annual gun production in Arizona and Texas, shown in Figure 3.9 indicates that the proportion of guns produced in these two states increased more dramatically than Figure 3.8 might suggest. This increase in gun production is particularly noteworthy for

![Figure 3.8. State gun production (%) / national](image)

*Generated by the author based on ATF (2015)*
three reasons. First, Arizona and Texas account for almost one-fifth of all gun production in the U.S. at the end of the time series (a level that is 2-4 times higher than it was at the start of the period shown). Second, these two states collectively account for 80% of all border-crossing points between the U.S. and Mexico, and 84% of the geographical border between the two countries (U.S. Department of Transportation, 2000).

![Figure 3.9. Percentage of guns prod. in TX and AZ / national production](image)

Overall, these trends clearly indicate that the geography of gun production in the U.S. changed after the mid-2000s, with a larger share of all guns being produced closer to the U.S.-Mexico border. This, coupled with the fact that gun production in the U.S. increased dramatically over this period, is thus consistent with the suggestion that the change in gun production observed following the three gun reforms implemented during the mid-2000s would
have increased opportunities for trafficking weapons into Mexico. These patterns will be explored in more detail in Chapter 4.

3.4.3. Data on illegal firearm availability in Mexico

Due to its nature, there is logically no record of illegal firearm possession in Mexico. Consequently, it was necessary to estimate the availability of illegal firearm possession using the best available data. For three reasons, I use the frequency of illegal firearms confiscations as an estimate of illegal firearm availability. First, seizures or confiscations are often used to estimate the availability of illegal goods, such as drugs (Keefer & Loayza, 2010; Werb, et al., 2011). Second, other studies such as Nowak (2016) and Dube et al. (2013) have also used gun confiscations as a proxy of illegal gun availability. Third, the confiscation of illegal firearms is rigorously enforced in Mexico. As this policy has been consistently applied across the country over time (UNODC, 2013), this suggests that counts of confiscations will provide a good estimate of illegal firearm availability.

Figure 3.10 shows the count of firearms seized across the whole of Mexico and by region. Two observations are particularly noteworthy. First, estimates of firearm availability remained stable or declined during the initial period (1999-2005), but increased dramatically after 2006, much like the pattern of gun production in the U.S. It is important to note that Dube et al.’s analysis was limited to the period 2002-2006 and hence did not include this period of rapid change. Second, while the availability of illegal weapons appears to have increased across the country, the increases seem to be most acute in
the regions closest to the U.S. border, where (as described in the Texas/Arizona example) gun production increased notably during this period. Again, it is important to note that Dube et al.’s analysis did not contrast changes at the border to those observed elsewhere in the country.

![Illegal gun availability in Mexico (by region) and gun prod. in TX-AZ](image)

**Figure 3.10. Illegal gun availability in Mexico (by region) and gun prod. in TX-AZ**

Generated by the author based on INAI (2014) for guns confiscated in Mexico and ATF (2015) for guns manufactured in the U.S.

### 3.4.4. Data on homicide in Mexico

Annual counts of recorded homicides in Mexico were obtained from INEGI (2014) and are shown in Figure 3.11 for both the whole of Mexico and for each spatial region. For Mexico in general, this figure suggests three phases across the time-series considered. During the first (up to 2003), the data show a decline in annual counts of homicide, similar to those observed in
developed countries (see: Farrell et al., 2011). During the second stage (2004-2007) the homicide rate appears to stabilise. Post-2007 however, homicide escalated substantially, exceeding the levels observed in previous years by a factor of up to four. As previously discussed, the largest increase was reported in Region A, which corresponds to the north of Mexico. As a matter of fact, a comparison between the homicides that occurred in this region during 2004 (the lowest year recorded) with those reported during 2010 (the highest recorded) suggest an increase of 565%. For comparative purposes, national data concerning gun confiscations in Mexico are also shown, and can be seen to exhibit a similar trend.

![Figure 3.11. Homicide by region & illegal gun availability](image)

Generated by the author based on INEGI (2014) for homicide, and INAI (2014) for gun confiscations
Three points deserve particular attention. First is the uniqueness of the Mexican case. There is no record of any other large and populated country exhibiting such a dramatic change in crime trends in such a short period. Second is the fact that this interval of time has been understudied. Instead, most of the research focusing on Mexico has concentrated on the changes in the crime rate that followed 2008, ignoring the transition that occurred before it. Finally, it is evident that trends in the homicide rate (per unit time) varied across the country. As with homicide, firearms seizures in northern Mexico (Region A) increased at a much higher rate than in the other three regions (B, C, and D). This is particularly notable since region C initially had the highest annual counts of homicides.

3.5. Inferential Analyses

3.5.1. Were changes in gun law associated with gun production in the U.S.?

I first examine whether the changes to gun policy in the U.S. (discussed above) were associated (in statistical terms) with increases in the production of guns. To do this, I correlate the time elapsed (in years) since these key regulatory changes with the natural logarithm of annual counts of gun production in the U.S. (to reduce issues with data skewness). I create a variable to capture the former, and code this as zero for all years prior to 2004, and using incremental values for subsequent years (+1 for 2005, +2 for 2006, etc.). The correlation coefficient of $r(12)=0.90$ ($p<.001$) was clearly strong, positive and statistically significant, indicating that regulatory changes
in the U.S. during the mid-2000s were associated with the production of guns in that country.

3.5.2. Was the illegal availability of firearms in Mexico associated with gun production in the U.S.?

I next examine whether variation in gun production in the U.S. was associated with (illegal) gun availability in Mexico. To do this, I correlate data on the production of all guns in the U.S. and all confiscations in Mexico (13 observations, years 1999-2011). Results from this analysis indicate a strong, statistically significant and positive correlation of $r(12)=0.94$ ($p<.001$). In other words, gun production in the U.S. was associated with gun confiscations in Mexico.

I also study this phenomenon at the regional level. In particular, I test whether the association between gun production and gun confiscations differs between those U.S. states or Mexican regions that are in close proximity to, or further from, the border. As discussed, relative to U.S. states that do not share a border with Mexico, I expect that increases in gun production in bordering (southern) U.S. states would have a higher impact on confiscations in Mexico. Likewise, I anticipate that gun production in the south of the U.S. would have a higher impact on gun availability in the north of Mexico (i.e. Region A) than other regions (e.g. Region D).

To do this, I first correlate annual gun production in the U.S. states of Texas and Arizona with annual confiscations for the four regions of Mexico (i.e. A,
B, C and D). I report the results for Texas and Arizona, rather than all bordering U.S. states, for two reasons. First, as discussed above, more than half of all guns confiscated in Mexico during the period 2006-2009 came from these two states (Mayors Against Illegal Guns, 2010). Second, gun production in the two other bordering states - California and New Mexico - was relatively low and decreased over time. However, it is worth noting that the same pattern of results is obtained if I include the data from these two U.S. states. To examine the effect of proximity, I then correlate annual gun production reported in the non-bordering U.S. states with confiscations across the four Mexican regions.

In both cases, I test whether there was a change in the associations following the observed changes to gun policy, since I would expect a clearer association for the latter than the former. To do this, I report separate correlations for the periods before (1999-2004) and after 2005 (2006-2011). Table 3.5 shows the results of these correlations. For all correlations, I work with the natural logarithm of the two variables. The table presents the correlation coefficients between gun production in the U.S. (logged) and gun confiscations (logged) in Mexico, by period.
Table 3.5. U.S. gun prod. & gun confiscations in Mexico

<table>
<thead>
<tr>
<th>Gun confiscations in Mexico's regions (logged)</th>
<th>Region A (U.S. border)</th>
<th>Region B (north-center)</th>
<th>Region C (south-center)</th>
<th>Region D (south)</th>
<th>Mexico (all national data)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Texas (TX) and Arizona (AZ)</td>
<td>0.41</td>
<td>0.95**</td>
<td>0.71</td>
<td>0.96**</td>
<td>0.88*</td>
</tr>
<tr>
<td>All U.S. non-border states</td>
<td>0.38</td>
<td>0.86*</td>
<td>0.82*</td>
<td>0.86*</td>
<td>0.77</td>
</tr>
</tbody>
</table>

*p < .05; ** p < .01; *** p < .001

In line with expectation, in all cases, the correlation coefficients were positive. For the U.S bordering states, the values were consistently statistically significant for the period after 2005, and were stronger for this period than the first. Similar results were observed for the non-bordering states, but the findings were less clear cut, as expected.

In sum, the findings reported above are consistent with the argument that the availability of illegal guns in Mexico was associated with gun production in the U.S. after the mid-2000s, particularly for those U.S. states at the U.S.-Mexico border. In what follows, I examine whether illegal gun availability in Mexico was associated with homicide.
3.5.3. Was illegal gun availability in Mexico associated with the increase in homicide?

I use an econometric model to estimate the association between changes in illegal firearm availability and the rise in violence in Mexico, focusing particularly on how this varied \textit{spatially} and \textit{over time}. In this regression model, the dependent variable is the annual count of homicide (and gun homicide) reported by the National Institute of Statistics (INEGI), expressed as a natural logarithm. The unit of analysis is the state-year. Hence the dataset has a times-series cross-sectional structure with 403 observations.

As explained above, two types of independent variables are included in this model. The first test the ‘gun availability’ argument. To do this, I model annual gun availability for each state. The second set of variables are used to test the alternative explanations summarised in Table 3.1 (e.g. that a change in inequality can explain the changes in Homicides observed).

To test the idea that the association between firearm availability and homicide was most pronounced at the Mexico-U.S. border, I employ \textit{interaction terms} to estimate the average association for each of the four geographic regions. According to the expectation, these terms should be strongest for the regions closest to the border (i.e. regions A and B).

As the aim is to explain yearly counts of homicide across states, I use a \textit{fixed effects} (state level) panel data model. One advantage of using multiple observations per state and a fixed effect model is that it removes the
pernicious effect of omitted variable bias that other model specifications would be susceptible to. As shown in the following Equation (3.1) below, I formalise the model as:

\[ Y_{ijt} = \alpha_j + (\sum \beta_j X_{ij} \cdot \text{Firearms}_{ijt}) + \text{Pop}_{it} + \text{GDP}_{it} + \text{HDI}_{it} + \text{Gini}_{it} + \text{Un}_{it} + \text{Df}_{it} + \text{Erc}_{it} + \text{Corr}_{it} + \text{Drug}_{it} + \text{Calderon}_{it} + E_i \]

where:

- \( i \) indexes the states,
- \( j \) indexes the geographical regions, and
- \( t \) indexes the year

\( Y_{it} \) is the dependent variable (homicide/gun homicide, expressed as a natural logarithm) observed for State \( i \) in region \( j \) in year \( t \)

\( \alpha_j \) is the intercept (the average value of the fixed effects in region \( j \))

\( \text{Firearms}_{ijt} \) is the count of firearms in state \( i \), located in region \( j \) in year \( t \)

\( \beta_j \) is used to estimate the average association between the availability of weapons and homicide for states in region \( j \) in year \( t \)

\( X_{ij} \) represents a matrix of dummy variables, one for each region \( j \)

\( \text{Pop}_{it} \) is the population (expressed as a natural logarithm) in state \( i \) in year \( t \)

\( \text{GDP}_{it} \) is gross domestic product (expressed as a natural logarithm) in state \( i \) in year \( t \)

\( \text{HDI}_{it} \) is the human development index in state \( i \) in year \( t \)

\( \text{Gini}_{it} \) is the Gini index in state \( i \) in year \( t \)

\( \text{Un}_{it} \) is unemployment rate in state \( i \) in year \( t \)

\( \text{Df}_{it} \) is dark figure of crime (unreported crime) in state \( i \) in year \( t \)
**ERc** is the judicial system efficiency in punishing reported crimes in state \( i \) in year \( t \)

**Corr** is the perception of corruption in state \( i \) in year \( t \)

**Drug** is all drug crimes (expressed as a natural logarithm) in state \( i \) in year \( t \)

**Calderon** is all soldiers deployed in anti-drug trafficking efforts in state \( i \) in year \( t \)

**E** is the error term

As the effects of firearm availability can be expected to influence homicides that involve firearms more than those that do not, I run the analyses for all homicides and for homicides that only involve firearms separately. All analyses were conducted in STATA 14.

Table 3.6 provides a summary of the main results. Models 1 and 2 focus on all homicides in Mexico. Model 1 presents the findings for just those variables of central interest (opportunity explanations) while Model 2 shows the findings for all variables (opportunity explanations and the traditional explanations as control variables). Models 3 and 4 do the same but for incidents of gun homicide in Mexico.
Table 3.6. Econometric models of homicide / gun homicide

<table>
<thead>
<tr>
<th>E</th>
<th>Tested argument</th>
<th>All homicide</th>
<th>Gun homicide</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Model 1</td>
<td>Model 2</td>
</tr>
<tr>
<td>1</td>
<td>Firearms in Region A (log)</td>
<td>.1963***</td>
<td>.1236***</td>
</tr>
<tr>
<td>2</td>
<td>Firearms in Region B (log)</td>
<td>.0893***</td>
<td>.0370**</td>
</tr>
<tr>
<td>3</td>
<td>Firearms in Region C (log)</td>
<td>.0514*</td>
<td>-.0048</td>
</tr>
<tr>
<td>4</td>
<td>Firearms in Region D (log)</td>
<td>.0413</td>
<td>.0144</td>
</tr>
<tr>
<td>6</td>
<td>Population (log)</td>
<td>N/A</td>
<td>-.2668</td>
</tr>
<tr>
<td>7</td>
<td>Gross domestic product (GDP, log)</td>
<td>N/A</td>
<td>15.41</td>
</tr>
<tr>
<td>8</td>
<td>Human development index (HDI)</td>
<td>N/A</td>
<td>5.594</td>
</tr>
<tr>
<td>9</td>
<td>Gini index</td>
<td>N/A</td>
<td>1.966*</td>
</tr>
<tr>
<td>10</td>
<td>Unemployment</td>
<td>N/A</td>
<td>.1623***</td>
</tr>
<tr>
<td>11</td>
<td>Dark figure of crime</td>
<td>N/A</td>
<td>-.0047</td>
</tr>
<tr>
<td>12</td>
<td>Judicial efficiency in reported crimes (crimes satisfactorily solved)</td>
<td>N/A</td>
<td>.0497**</td>
</tr>
<tr>
<td>13</td>
<td>Corruption</td>
<td>N/A</td>
<td>-.0110</td>
</tr>
<tr>
<td>15</td>
<td>Drug-related crimes (log)</td>
<td>N/A</td>
<td>-.0270</td>
</tr>
<tr>
<td>16</td>
<td>Soldiers deployed in anti-drug operations (“Calderón effect”)</td>
<td>N/A</td>
<td>.00001</td>
</tr>
<tr>
<td></td>
<td>N [observations]</td>
<td>403</td>
<td>403</td>
</tr>
<tr>
<td></td>
<td>Constant</td>
<td>4.992***</td>
<td>1.85</td>
</tr>
<tr>
<td></td>
<td>$R^2$ (within)</td>
<td>0.2423</td>
<td>.4958</td>
</tr>
<tr>
<td></td>
<td>$R^2$ (between)</td>
<td>0.2132</td>
<td>.0408</td>
</tr>
<tr>
<td></td>
<td>$R^2$ (overall)</td>
<td>0.2116</td>
<td>0.0002</td>
</tr>
</tbody>
</table>

*p < .05; ** p < .01; *** p < .001 / Homicide expressed as natural log.
In general, the results indicate that for those states that border the U.S. (Region A), firearm availability is positively and significantly associated with annual counts of homicide. This is the case for all models but stronger for homicides involving weapons than for all homicides.

The coefficients are also positive and significant for states located in region B. However, as expected, the coefficients and levels of significance are lower than for Region A. For regions C and D, the associations are weaker and non-significant for those models that include other explanatory factors (models 2 and 4). These findings are consistent with a pattern of distance-decay.

As discussed above, the aim of this chapter was not test each of the alternative explanations shown in Table 3.1. However, a few comments are necessary. First, I note that the majority of the associated coefficients (shown for transparency) were either non-significant or in line with expectation. Second, I find that changes in the number of soldiers deployed in anti-drug operations, was not associated with the number of homicides/gun homicides. This is important because increases in the number of recorded seizures could plausibly be associated with increases in the number of soldiers tasked with policing cartels, and hence those who might be involved in the confiscation of weapons. In this case, rather than reflecting an increase in the availability of weapons, changes in the confiscation of weapons might simply reflect an increase in activity of this kind. Further, as this type of activity would involve engagement with cartels it
might also lead to direct increases in violence, including homicide. If this were the case here, rather than reflecting the role of opportunity, the observed association between confiscations and homicides might instead be a by-product of changes in the intensity of military activity. We can rule out these alternative explanations for these findings.

All models were tested for evidence of multicollinearity by examining variance inflation factors (VIFs). Models 1 and 3 (those that only assessed the ‘opportunity explanations’) had acceptable VIF values according to common practice (Neter, Kutner, Wasserman, & Nachtsheim, 1996; O’Brien, 2007). Models 2 and 4 (those that assessed all variables), had higher than acceptable Mean VIF values. In this case, the individual VIFs reported for two variables (i.e., the log of population and log of GDP) were above 10. Centering the data with no intercepts (and excluding the log of population) addressed this issue. Doing so had little effect on the estimated coefficients and consequently these findings are discussed no further. Finally, to control for potential omitted variable bias, I ran the same models as above but added a time-lagged dependent variable on the right hand side of the equation. The inclusion of this variable made no material difference to the results and so these findings are discussed no further. All results obtained followed the expectation.
3.6. Conclusion

In contrast to the majority of previous research on crime in Mexico, in this chapter I tested alternative explanations motivated by opportunity theories of crime. Overall, findings are consistent with those of Dube et al. (2013) and suggest that the availability of illegal firearms trafficked from the U.S. changed the opportunity structure for violent crime. The findings presented here also extend those of Dube et al. (2013) in at least three different ways. For instance, I explicitly examined how the patterns evolved spatially. Second, I also examined the patterns over a longer period of time, during which more dramatic changes in gun production occurred in the U.S. Third, I control for the effects of other factors that criminological theory would predict might account for the rise in violence.

The aim of this chapter was to test a crime opportunity postulate regarding the rise in violence observed in Mexico. In terms of causality, I test three specific arguments: (a) that policy changes in the U.S. led to increases in gun production in the U.S.; (b) that increases in the production of guns in the U.S. increased the opportunities for the trafficking of guns into Mexico; and (c) that an increase in the availability of guns in Mexico increased opportunities for violence (i.e. homicide).

The discrete timing of changes to U.S. gun policy, and the selective geographic effects that they apparently had on gun production within the U.S. provide a unique opportunity to test such assumptions. These analyses
support the expectations, and (in line with Dube et al., 2013) suggest that the rise in violence in Mexico can be explained (at least in part) by changes in opportunity. Furthermore, these effects were selective, suggesting geographical diffusion, as expected. The findings thus provide further support for the role of opportunity in crime.

As with most studies of criminological phenomena, there are strengths and weaknesses to the approach I present here. The most important limitation is that while the results obtained from the statistical analyses reported in this chapter offer evidence in favor of the key argument presented through this chapter, it is important to note that the aim of this study is not to suggest that changes in gun law in the U.S. are the only reason for (an increase in) illegal gun circulation in Mexico. Similarly, the study does not aim to suggest that the increase in homicide and violence in Mexico can only be explained due to gun production in the U.S. In fact, I assume that other factors could have also contributed.

There are additional warnings that should be considered more specifically. As already mentioned, one important caveat is that illegal gun prevalence in Mexico is estimated using data on confiscations of illegal firearms. These data are imperfect but represent the best available data, and have been used in previous studies of this kind. A second important caveat to consider is that while I employ a type of quasi-experimental design, correlation does not imply causality. Yet, the findings are thus consistent with expectation but they are certainly not unequivocal. True ‘experiments’ are difficult to
implement for issues such as that examined here, and arguably would be unethical. Of course, there are other methodological approaches that can provide additional evidence to the arguments presented in this thesis. While such research is beyond the scope of the current chapter, other data and approaches are discussed in Chapter 6 which are used as a form of triangulation.

While a considerable research agenda remains to fully explain crime and violence in Mexico, the results that I present here have clear implications for both policy and criminological understanding. In particular, they provide further support for opportunity explanations of the crime drop (or in this case, increase), and suggest that strategies intended to block the flow of illegal weapons into Mexico might help reduce the violence in that country.
Chapter 4. Understanding the supply: gun production in the U.S.

In chapter three, I suggested that an increase in U.S. gun production can be a key factor for explaining why violent crime increased in Mexico. In chapter four, I expand upon this argument by examining the geographic evolution of gun markets in the U.S. In particular, I study how gun markets adapt following key changes to U.S. policy and whether geographical relocation of production occurred after the mid-2000s. This analysis is motivated by the idea that gun markets in the U.S. represent the supply-side of gun trafficking networks that might empower organised criminals in Mexico. To this end, in this chapter I will examine how the volume and geographical distribution of production changed at the state level. Empirically, I present evidence that tests two key hypotheses – that after the mid-2000s, in the U.S.: (a) there were increases in overall gun production, and (b) rises particularly occurred across the southern states. Overall, I argue that the combination of these two observed patterns might have increased opportunities for trafficking more guns into Mexico.

4.1. Introduction

As with any other market, gun production is the outcome of different factors that influence the supply, and the manufacturers’ decision to produce. Conceptually, supply is determined by four basic factors of production: land, labour, capital, and human capital or entrepreneurship (Samuelson &
Nordhaus, 2010; O’Sullivan & Sheffrin, 2003). In this way, economic theory would suggest that the availability of raw materials, the existence of skilled human resources, the availability of technology and machinery to be efficient and compete successfully, and the expected demand and profits, can all influence levels of gun production (Johnston, 1961; Parkin & Esquivel, 2007).

Likewise, as with any other economic good, governments play an important role as market regulators (Eisinger, 1988; Taylor, 1994). With their decisions, policymakers can promote or restrict incentives for gun production by implementing subsidies, taxes, and regulations. Gun manufacturers react to these as they seek to maximise profits (Buss, 2001; Baum, 1987; Luce, 1994).

As there have been relevant changes to U.S. gun policy since the mid-2000s, I study whether spatial patterns of gun production changed as a possible outcome. In particular, as a result of the mechanisms that I will explain below, I study whether geographical relocation of production occurred over time.

Similarly, as occurs with any other market, the production of guns is likely to be spatially concentrated, following a phenomenon of agglomeration (Weber, 1909), which is discussed in more detail below. For this reason, this chapter also aims to study whether agglomeration (i.e., the spatial clustering of production) exists, and if so, the extent to which it has changed over time. If manufacturing relocation and policy changes occurred, it could be expected
that the clustering of production may have changed over time in response to changes in incentives (see below).

The chapter also investigates if, and the extent to which, U.S. states have come to specialise in the production of specific types of guns. This is accomplished by exploring how the fabrication volume for each market is concentrated at the state level using an index of subnational *market share*. For the purpose of this thesis, a market share will be understood as the percentage of a market (e.g. the manufacturing of pistols) that is controlled by a particular state (e.g. Arizona). The analysis of how market shares have changed over time is then used to examine whether this phenomenon is stable over time.

The chapter is organised as follows. In the next section, I discuss the literature on manufacturing relocation, as well as other concepts that are relevant for the studied patterns in this chapter (i.e., gun reform, agglomeration economies, and specialisation). Second, I discuss the method, data sources, and analytic strategy. Then, I present the analyses for all guns and for each type of weapon (i.e. pistol, revolver, rifle, shotguns) at the subnational level. Finally, I discuss the key findings and the implications for this case study.
4.2. Manufacturing relocation

All private firms are, by definition, profit maximising. The ultimate goal of any firm, including gun manufacturers, is to generate a sustainable advantage with a yield greater than competitors (Amit & Schoemaker, 1993; Hoopes, Madsen, & Walker, 2003). To this end, firms make many decisions influenced by their environment, both in the short and long-term (Lewin, Weigelt, & Emery, 2004; Ginter & Duncan, 1990; Narayanan & Fahey, 2001). The most basic decisions include determining the price and level of output that returns the greatest profit, with the lowest possible risk (Johnston, 1961; Porter, 2008). A long-term strategy also includes the key decision of where to produce (Flores & Aguilera, 2007; Johanson & Vahlne, 2002; Pellenbarg & Wever, 2008).

Weber (1909) developed the first general theory of industrial location. His model suggested the significance of production costs in firms’ choices of places to operate. Weber proposed that, according to their costs, some firms would install their facilities near inputs used in their production processes (such as labour and raw materials), while others would locate near to their customer base. In general, Weber’s theory took into account several spatial factors. He concluded the firm’s optimal location was the result of availability of materials and human resources required for production levels that allow firms to maintain a competitive advantage (Weber, 1909).
Prior to the 1970s, most economists agreed with this perspective that location and relocation decision were a transportation cost-minimisation problem (Blair & Premus, 1987). Recent research has expanded this argument. For instance, the business literature suggests the *embeddedness of firms* within existing places is a key factor that might (or not) pose barriers to relocation (Hess, 2004; Romo & Schwartz, 1995; Uzzi, 1996; Moulaert & Sekia, 2003). While economic embeddedness can be beneficial for firms' performance, it is also known that too much dependency on a geographical space produces a *spatial lock-in* that impedes relocation (Stam, 2003; Knoben & Oerlemans, 2008).

A second group of factors that explain relocation include a firm's age and size. Research indicates that firms that serve larger markets relocate more often since they can mitigate the *sunk costs* - that have already been incurred and cannot be recovered - that often restrict relocation (Brouwer A., 2004). Research also suggests that younger firms are more likely to relocate as they expect to have higher growth rates. By contrast, older firms are possibly too large and too embedded in the spatial environment to move (Brouwer A., 2003; Brouwer A., 2010; Hayter, 1997).

Several factors therefore influence relocation decisions and some of these can have contradictory effects. Overall, however, empirical research on firm relocation suggests there are two key influencing factors for most firms. The first is the real estate market, as buying or leasing an industrial site represents a major cost for firms (Mazzarol, 2003; Lindholm, Gibler, &
Leväinen, 2006). The second is government policy, which can facilitate or complicate the operation of a private company (Pellenbarg, 2002).

To elaborate on the second reason, firms react to decisions taken by government, particularly those involving subsidies, taxes, and laws (Eisinger, 1988; Taylor, 1994; Carroll & Wasylenko, 1994). Unsurprisingly, these policies can be favourable (or not) to firms, and companies react to these incentives.

In effect, theories of industrial relocation suggest that, as profit-maximising actors, gun manufacturers would be expected to react rationally to both pull and push factors existing in their environment (Carlton, 1983; Kolesar, 1995; Milward & Newman, 1989; Carroll & Wasylenko, 1994). In this context, pull factors, including subsidies, low wages, and abundant resources would be expected to encourage businesses to relocate to a particular location. By contrast, push factors, such as stricter gun policies, increases in taxes, and higher risks of reputational damage would be expected to encourage gun manufacturers to relocate from a particular location. When such push factors are substantial in magnitude, firms debate as to whether a geographical relocation would be a convenient strategy to maintain profits (Pellenbarg, 2002).

Overall, these theories provide a rationale to explain why some gun producers might close (or scale down their activities) at the locations where they have traditionally manufactured. Likewise, they provide a potential
explanation for why firms move their production to places where investment is safer, or manufacturing is more convenient (Marques & Puig, 2011; Györffy & Oren, 2006; Smith D., 1966; Christensen & Drejer, 2005; Mccann & Sheppard, 2010). In the next subsection, I discuss the extent to which gun policy variations could have influenced the level of gun production in the U.S.

4.2.1. Gun reforms as a contributing factor for relocation

As discussed in previous chapters, three major U.S. federal gun reforms implemented during the mid-2000s -Tiahrt Amendments, AWB expiration, and PLCAA enactment- may have substantially impacted upon national gun production levels. Nevertheless, individual U.S. states can also introduce their own local laws, and these can have an impact on production and relocation. This pattern has become particularly relevant in recent years. In fact, whilst federal gun laws have not changed since 2007, when U.S. Congress enacted a bill that required federal agencies to keep up-to-date records of the National Instant Criminal Background Check System (NICS), a number of states have busily enacted their own local laws since the mid-2000s. Not all local laws have the same objective. While some may have intended a stricter gun regulation, others could have had the opposite objective. For example, while some states have repealed their background check requirements on handguns, such as Missouri (Webster, Kercher, & Vernick, 2014), others have implemented new restrictions for anyone purchasing this type of gun, such as Maryland (Maryland General Assembly, 2013). In a similar way, whereas five states have introduced legislation to
prohibit concealed carry weapons at colleges and universities (NSCL, 2017), others have implemented laws to allow exactly the opposite, such as Texas (Texas Legislature, 2016),

A number of different factors can explain why some states introduce stricter (or more permissive) gun laws. Economic theory suggests that a key element to explain changes in the regulatory framework that affects the firms is the reputation of their industry (Fombrun & Shanley, 1990; Hall, 1992).

Following this argument, gun manufacturers have incentives to project a positive image to their stakeholders and to the communities where they work. For firms, local support reduces potential conflicts, consolidates a long-term network of potential customers, and assures the basic environment to operate successfully (Dorobantu, Henisz, & Nartey, 2017). Maintaining a good local reputation is rational and profitable, and this is always good for business (Flemming & Dorobantu, 2017).

Nonetheless, gun manufacturers do not always achieve the goal of maintaining a local positive reputation. For instance, increases in gun crime (and particularly, high-profile mass shootings) can have impact upon how the gun industry is perceived by communities, and how governments react to this perception. Recently, scholars have started to investigate the influence of mass shootings on gun reform, finding this relationship is mediated by collective perception and political factors (Azari, 2017). An empirical study found that a mass shooting increases by 75% the number of enacted laws
that *loosen* gun restrictions in Republican-majority legislatures, and no effect if the congress is controlled by Democrats (Luca, Malhotra, & Poliquin, 2016).

In turn, variation in local gun laws can impact the commercial decisions of gun manufacturers regarding where, when, and how many guns to produce. A number of cases exemplify these patterns. A few months after the 2013 Newtown school shooting in Connecticut, local Congress enacted a restrictive gun law. Consequently, *O.F. Mossberg & Sons, Inc.*, America’s largest shotgun manufacturer, cancelled its expansion plans in that state (Schwartz, 2013; Miniter, 2014). Similarly, after this shooting, the neighbouring state of New York banned the retail sale of *assault weapons*. Shortly after, *Remington Outdoor Co.*, the producer of the Bushmaster assault rifle -used by the Newton’s attacker- announced the closure of its New York plant (Harkinsson, 2016).

Unsurprisingly, firearms’ manufacturers have not perceived these policies as *gun-friendly*. In effect, firms often blame members of Congress for any negative impact upon the local economy -including job losses- if a restrictive gun law is enacted. In some cases, gun manufacturers have cancelled expansion plans, and have eliminated job positions once restrictive gun laws were passed (NRA-ILA, 2013).
4.2.2. A case for relocation

Notwithstanding previous cases, the closure of manufacturing sites in gun unfriendly states does not necessarily mean that there will be a drop in gun production. In fact, overall firearms manufacture may even increase following the relocation of production to alternative locations. This can occur as manufacturers faced with regulatory challenges in one state have learnt to negotiate relocations to gun-friendly states, who, eager for job creation, can offer financial and economic incentives to gun producers in return.

There are various examples. Days after Remington closed its New York plant, the company announced a relocation to Alabama, which had offered $69 million in incentives (Harkinsson, 2016). Similarly, when Colorado’s Governor Hickenlooper signed a ban on AR-15 rifles, Magpul Industries announced a relocation to Texas, which offered legal, tax, and logistical incentives (NRA-ILA, 2013). In response to a set of new restrictive gun laws in Connecticut, Stag Arms’ announced that it also considered to relocate to Texas (NRA-ILA, 2013), while PTR moved its production to South Carolina (Schwartz, 2013). Likewise, when Maryland implemented a new gun law, Beretta U.S.A. announced its relocation to southern Tennessee, where this firm also received tax incentives and free land (Dresser, 2014).

Relocations have not occurred by chance. In fact, southern Governors have offered packages to welcome northern gun manufacturers facing stricter laws in other states. In June 2014, Texas Governor Rick Perry, and South Dakota Governor Dennis Daugaard, tried to convince Connecticut manufacturers of
the virtues of their states for a possible relocation. These are not isolated cases. Brian Ruttenbur, an analyst with CRT Capital Group, noted that most firearms’ manufacturers with a traditional base in the northeast have relocated (or are planning to move) to the gun-friendly south. Ruttenbur suggested these relocations are the result of better taxes, political support, reduced labour costs, subsidies, and particularly, much more permissive gun laws (McLeod, 2014).

Certainly, economic theory predicts that, as profit-maximising rational actors, gun producers are expected to respond to their policy environment. In this context, it is not a surprise that manufacturing companies faced with restrictions would move to friendlier states. Nevertheless, what it is remarkable, is the lack of research focusing on the link between gun laws and gun production. An exception is a study by Brauer, Montolio, & Trujillo-Baute (2017). These scholars examined the association between U.S. state firearms laws (but not federal ones) from 1986 to 2010, with the geographical location of more than 2,700 federally licensed firearms manufacturers. They found that states with relatively permissive, end-user friendly laws tend to host more gun manufacturing establishments. This paper, however, did not focus on studying gun production as this chapter does. This gap is relevant as, to the best of my knowledge, no study has compared the evolution of gun production in the U.S. before and after the mid-2000s – a period when significant federal and local gun laws were implemented. In this chapter, I aim to fill this gap by studying how gun production has evolved over these periods. Overall, I hypothesise that gun production has increased, but that
changes have not been homogenous neither across states nor across gun markets. Considering the relocation cases previously discussed, I anticipate that increases in gun production were more pronounced in the south. I argue this can occur taking into account that, while some northern states implemented stricter gun policies (which conceivably affected production), southern states were interested in attracting gun manufacturers. In line with the hypothesis that gun production moved closer to Mexico (see Chapter 3), I also expect relocations from east to west.

To test this idea, I conduct statistical and geographical analyses to examine state-level variation in gun production. The key aim of this chapter is not to explore the effect of local gun laws explicitly, but to analyse changes in gun production. In the subsection below, I review further economic concepts observed across different industries. I argue these are useful for the analyses on gun production that I conduct through this chapter.

### 4.2.3. Agglomeration economies and specialisation

Businesses of a particular type often cluster spatially. The clustering of similar businesses may seem counter-intuitive since there will only be a finite number of customers in a given area. Nevertheless, scholars have found that firms effectively follow the principle of *agglomeration economies*, as many benefits occur when firms ‘locate near one another’ (Glaesner, 2010, p. 1).
Agglomeration economies are those external factors from which a firm can benefit ‘by being located at the same place as one or more other firms’ (Malmberg, Malmberg, & Lundequist, 2000, p. 305). A number of mechanisms explain why the agglomeration of similar firms occurs. For instance, the possibility of sharing resources, such as specific types of infrastructure needed by similar firms (as occurs at industrial parks), can reduce production costs and enhance agglomeration (Goldstein & Gronberg, 1984). Second, the existence of better networks -that often result when suppliers and customers work routinely- can also reduce transportation and transaction expenses (Malmberg, Malmberg, & Lundequist, 2000). Similarly, firms’ performance (and revenues) can improve by sharing intangible assets at the local level, mainly through knowledge spill-overs. Spill-overs occur when proximity of similar firms facilitates the exchange of ideas, promotes innovation, triggers healthy competition, and allows companies to learn from one another (Hanna, 2017; Jacobs, 1961; Porter, 1990). An additional advantage of agglomeration is that it attracts -and maintains- specialised labour. This explains why, despite fierce competition, directors, producers, and scriptwriters agglomerate at the film-industry cluster in Los Angeles; and why microchip producers locate in Silicon Valley (Carlino, 2001).

There are good reasons to expect the spatial clustering of firearms manufacturers to have changed since the mid-2000s. In the context of this chapter, one possible reason is that some laws implemented in specific states could have attracted similar manufacturers to these places.
Unsurprisingly, the fact that related companies move to specific states could have provoked *agglomeration economies* there, as previously discussed.

Nevertheless, a second phenomenon can also occur. Economic theory suggests that rational actors -such as individuals, companies, states, or societies- tend to specialise in the activities they perform, following rational incentives (Romer, 1987). In this context, the *law of comparative advantage* first suggested by David Ricardo (1817) explains why some firms (or states) produce specific goods or services. Since not all actors experience the same costs when producing a good, this law suggests that those with the lower *opportunity cost* would eventually focus on producing it, as a result of the advantages they possess (Deardorff, 1980).

The law of comparative advantage has many implications for the study of gun markets. For instance, it provides potential explanation for why specialisation might occur. Within a firm, this concept could explain why it is rational that each worker specialises in separate tasks according to preferences and abilities (Hill, 2004). Within an industry, specialisation could explain why particular firms decide to specialise in the production of a certain good considering the advantages they possess in the production of that good or service (Manning, Johnson, Tilley, Wong, & Vorsina, 2016, p. 53). Theoretically, this *division of labour* is normal, expected, and even useful, as resources are ‘allocated more efficiently’ (p. 53).
In the context of this chapter, specialisation occurs (and it is influenced by) opportunity costs. Opportunity costs, at the same time, are influenced by variations in gun law. These two arguments favour the assumption that, as a result of gun law variations implemented during recent years, some states (and the manufacturing firms operating there) would have reacted to (new) opportunity costs and possibly became specialists in the production of specific gun types (e.g. rifles) when this was possible.

In this way, as a result of changes to state-level policies, specialisation could impact upon the spatial distribution of manufactured guns. There are different ways to observe whether this occurred. One alternative is to analyse changes in the market share accounted for by each state. Conceptually, each state in the U.S. accounts for a specific market share of manufactured guns. This share is expected to be relatively constant over the years as firms (within a state) tend to produce more or less stable volumes (from one year to the next) in the absence of external shocks in the industry (Gort, 1963; Jacoby, 1964). Nonetheless, if substantial fluctuations in the market share occur, this might be indicative that relative changes in gun production are present.

In this chapter, I focus on studying the extent to which gun production changed before and after the mid-2000s. To this end, I explore how concentration, relocation, spatial clustering, and market share progressed over time. In the next section, I describe data analysed and the analytic strategy adopted.
4.3. Data and methods

4.3.1. Data

Gun production data were obtained from the Annual Firearms Manufacturing and Exportation Reports (AFMER), which are published yearly by the U.S. Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF). Information includes annual production of guns by type (i.e. pistols, revolvers, rifles, and shotguns) and by state.

4.3.2. Analytic Strategy

Before proceeding it is necessary to define the periods of time and geographical areas considered. As previously stated, two major regulatory changes (AWB expiration and PLCAA enactment) occurred in late 2004 and 2005. Most local laws were also implemented after the mid-2000s. As such, with respect to the time periods considered, I divide the years under study into the two six-year intervals before (1999-2004) and after 2005 (2006-2011). Data for 2005 are omitted as the federal policy changes discussed occurred part way through that year.

A key aim of the research is to examine the extent to which manufacturing was concentrated within U.S. states, and the extent to which production moved following key changes to federal and state gun policy. Therefore, in terms of geographical scope, I focus on the 48 contiguous (continental)
states. I exclude data for Washington D.C. (since this is not a state) and production is non-existent. Likewise, I omit data for the states of Alaska and Hawaii, as they have no other U.S. states as neighbours and are located around 2,300 and 3,900 km (respectively) from the nearest U.S. border. I additionally exclude the overseas unincorporated U.S. territories (e.g. Puerto Rico, Guam, Virgin Islands, etc.) as they are not states, gun production is non-existent, and they do not share a geographical border with any other U.S. state.

**4.3.2.1. National (aggregate) analyses**

As a first step I analyse whether there was a systematic change in levels of production overall (*for the whole* of the U.S.), before variation is examined at the state level. Three analytic steps are employed to do this.

First, I examine changes in the volume of manufacturing for each gun type across the thirteen studied years. For this purpose, I build a stacked bar graph in Excel. Each bar represents a year (from 1999-2011), and the segments in each bar denote the totals for each type of gun produced during that year (see: Figure 4.1).

Second, I estimate the percentages of growth (or decline) for the production of firearms *for each state*, including analyses for all guns and for each of the four gun types across the two studied periods (see: Figure 4.2 and Figure 4.3) Then, I test the statistical significance of these variations. There were (at
least) three different alternatives to do this. The first was to conduct paired-t-tests. In this test, an entity (i.e. state) is measured twice (resulting in a pair of observations) to determine whether the mean difference between two sets of observations (i.e., gun production before and after the mid-2000s) is zero. Nevertheless, this parametric test often assumes: (a) a large sample, (b) no outliers, and (c) that the difference between the pairs (in this case, the differences between the guns produced in 1999-2004 and 2006-2011) follow a Gaussian/normal distribution). As these conditions were not fully met, I considered two nonparametric alternatives for dependent/paired samples. One option was to conduct Wilcoxon signed-rank tests, which were not possible as the distribution of the differences between the two related groups needs to be symmetrical in shape (i.e. differences are distributed symmetrically around their median). Consequently, I preferred to conduct Sign Tests as they can effectively handle distribution of differences (between paired observations) that are neither normal nor symmetrical. In this way, I run five Sign Tests (one for each type of weapon, and one for all guns) using SPSS V.22 to observe whether the median increases (or decreases) in gun production were statistically significant.

Third, I study whether the proportion of the different types of gun produced changed significantly over time. To do this, I collapse the data to a 4 (weapon type) x 2 (before vs after) contingency table (see: Table 4.1). To test for statistical variation over the two periods, I use a Chi-Square test. I also perform a Cramer's V statistic to estimate the strength of any pattern observed.
4.3.2.2. State/market analyses

Analyses are then presented to examine variation across states (rather than for the U.S. as a whole). To do this, I employ a methodological approach composed of six steps to analyse the sum of all guns, and for each type of weapon individually. I discuss these steps below.

First, I examine overall patterns of gun production. As previously discussed, one of the key arguments of this research is that some U.S. states may have increased their production during the second period (2006-2011), while others may have reduced it. To explore this argument, I first present the number of states (out of the 48 states) in which production increased. Next, I conduct analyses to see if there is a significant change in state rankings for the production of weapons from the first period to the second. A number of approaches could be taken to examine this. In this case, I conduct a Spearman's rank-order correlation analysis in STATA 14 to see whether the rankings for state production significantly changed over time. The Spearman rank-order correlation is a nonparametric test that assesses the strength and direction of association between two ranked variables that are measured on an ordinal or continuous scale. By analysing data for counts of production for all 48 U.S. states, the Spearman's test provides a general overview of how stable levels of production were across states over time. A strong, positive, and statistically significant correlation coefficient (p =<.001) would suggest the rank ordering is relatively stable over time. Although changes in state level production are anticipated, it is likely that substantial changes will only
be observed for some states. As such, the rankings for many states may remain relatively stable over time. Given this, it is not unreasonable to expect that the Spearman's correlation coefficients will be positive and high, masking variations observed for particular states. For this reason, more in-depth analyses are conducted.

Second, I study the geographical distribution of production. To do this, counts of gun production are mapped using a geographical information system (GIS), in this case ArcMap/ArcGIS version 10.3.1. Specifically, I produce thematic (polygon) maps for both periods to facilitate the comparison of gun production by state over time. These maps are colour coded to show variation across states using an equal interval distribution function. This divides the distribution into ten identical thematic classes – in this case, a zero for non-production and nine other numerical classes which divide the distribution into equal intervals. I use this type of thematic classification as it emphasises the amount of an attribute value relative to others, as recommended by the Data Classification Methods Guidelines (ArcGIS, 2018) for comparison between periods. In addition to producing maps for each period, I create a third thematic map to display the absolute change in production observed in each state (percentage change, cannot be performed as some of the count figures in the first period had a value of 0). As before, ten thematic classes are used to display the data. Nonetheless, in this case I use the Jenks optimisation method function, as suggested for this type of data by the Data Classification Methods Guidelines (ArcGIS, 2018). The Jenks method is a data clustering algorithm designed to estimate the
best arrangement of values into different classes based on natural groupings inherent in the data. To do this, the Jenks method identifies categories that minimise each class’s average deviation (from the class mean), while maximising each class’s deviation (from the means of the other groups) (ArcGIS, 2018). Due to its nature, Jenks offers data-specific classifications. Therefore, they are not useful for comparing multiple maps built from different underlying information. This explains why I use an equal interval distribution for the two maps concerning the periods, and the Jenks method for the third of absolute change. Since some states experienced an inter-period increase in gun production but others experience a decrease, this third map includes negative and positive values, to show decreases and increases, respectively.

Third, I study the market share (i.e., the proportion of guns produced in each state vis-à-vis the national production) that each state accounts for, over the two periods. To do this, I sum the production of guns across the years that make up the two periods (for each state) and divide this by the overall production reported during the corresponding period. This allows us to observe the number of states in which the market share increased (out of the 48 states in total). Next, I study the changes in market share focusing on the states with the highest levels of production. To do this, I rank the states according to their overall production reported in the first period. I then focus on the 15 states with highest levels of gun production during the first period, and I include the corresponding values for the same states observed in the second (regardless of the order in the second period is different to the first).
To ease this comparison, I then graph the data for these top-15 states (following the order observed during the first period), aiming to detect whether variation is observed for the states that had the largest production volumes for the first period. As opposed to studying absolute levels of production (as previously implemented), in this step I use the market share as a relative measure. One of the advantages of using this approach is that it allows one to explicitly observe whether the role of leading states changed vis-à-vis the national figure. Likewise, this approach allows us to examine whether the same states account for a similar proportion of manufacturing over time, or whether these proportions changed (possibly as a result of specialisation/gun law variation), as proposed throughout this chapter. To complement this analysis, I compute a Chi-Square and a Cramer’s V on the production of these top-15 states (on the raw numbers) to observe whether these observed differences were significant.

Fourth, I analyse the extent to which there is evidence of geographical concentration of gun production over time. To do this, I compute a variant of a Lorenz curve for each period. Developed by Max Lorenz (1905) the typical Lorenz curve is a graphical representation of inequality in a distribution. It is produced by plotting the cumulative percentage of actors (e.g. states) that account for a cumulative percentage of goods (e.g. guns). Traditionally, Lorenz curves are computed by ordering observations from the lowest level of concentration to the highest. In this case, I ordered the data from highest to lowest as this provides an easier to follow visual representation of the data, as conducted by Johnson and Bowers (2010). The two approaches are
equivalent, and in both cases a curve which resembles a 45-degree line represents perfect equality.

I produce two of these curves (one for each period), and compare these by displaying both in a single graph. To create each curve, I generate two arrays (one for each period) that enumerates the number of guns produced by each state, and rank-order these 48 figures from highest to lowest. Then, for each period, I calculate and plot the cumulative percentage of states (on the X-axis) against the cumulative production of guns (on the Y-axis). This procedure generates two different curves (which, as suggested, are variations of the classical Lorenz) that indicate the concentration of each gun market (i.e., how much a percentage of states accounts for a given percentage of gun production). One characteristic of this approach is that it does not display whether the same states account for the same levels of production over time, but whether production is concentrated to the same extent across the two periods.

To provide additional information on how equally distributed the production of guns was across the states, I also calculate the Gini index for each of these two distributions (i.e. the two adaptations of the Lorenz curves) in Excel. Named after Corrado Gini, this index represents the ratio of inequality between actors (e.g. the states) that are part of a given distribution (e.g. gun production). Mathematically, this coefficient is the area that lies between the line of equality and the Lorenz curve, over the total area under the line of equality. As such, the Gini index ranges from zero to one. A value of 0
corresponds to perfect equality (i.e. every state produces the same amount of guns), while 1 corresponds to perfect inequality (i.e. one state produces all the guns, while every other state produces zero). If Gini index value increases from the first period to the second, this provides evidence to suggest that gun production became more concentrated (and vice versa). Normally, when values are ordered from lowest to highest, the numerator is the area between the Lorenz curve of the distribution and the uniform distribution line (45 degrees), and the denominator is the area under this uniform distribution line. As I ordered the data from highest to lowest, I invert these to calculate the size of areas accordingly.

Fifth, I examine the extent to which there is evidence of geographical relocation of gun production over time. To do this, I compute a weighted mean centre (WMC) of production for each period. The WMC is a measure of the geographic centre of a set of observations; in this case, the average coordinates for the states in which guns were produced. Following the approach suggested by Burt and Barber (1986), the WMC is obtained by multiplying the geographical position of each state’s capital city (defined by the location in decimal degrees of the state Capitol building in latitude \( X \) and longitude \( Y \) obtained from GeoHack (2018) by the gun production \( w \) in each period, as follows:

\[
\bar{X}_w = \frac{\sum_{i=1}^{n} w_i X_i}{\sum_{i=1}^{n} w_i} \quad \bar{Y}_w = \frac{\sum_{i=1}^{n} w_i Y_i}{\sum_{i=1}^{n} w_i} \quad [1]
\]
To see the extent to which WMCs might have changed between periods, I map these against the U.S. states. Then, I calculate the distances and trajectories between these WMCs in ArcGIS. Lastly, I compare the distance between these two WMCs (observed in each period) and Mexico City. This approach is useful for this study inasmuch as it helps to assess the possible relocation of gun markets.

Finally, in what follows I study the spatial agglomeration of production to evaluate the existence of clusters. To this end, I use two indicators of spatial association using ArcGIS. The first statistic calculated is the Global Moran’s I (GMI). GMI measures the overall (or global) level of spatial autocorrelation based on both feature locations and feature values simultaneously. GMI tests the null hypothesis that the attribute being analysed -gun production- is randomly distributed across spatial units -states. In other words, it tests whether there is a complete spatial randomness (CSR). This tool calculates a z-score and p-value to indicate whether or not it is possible to reject the null hypothesis. When p and z indicate statistical significance, a positive Moran's I index value suggests that the overall pattern of gun production is clustered; a negative indicates dispersion. Importantly, GMI only shows the similarity of nearby features through the GMI’s value, but does not indicate if the clustering is for high or low values. GMI (or I) is defined as:

\[ I = \frac{N}{W} \sum_{i} \sum_{j} W_{ij} (x_i - \bar{x})(x_j - \bar{x}) \frac{1}{\sum_{i} (x_i - \bar{x})^2} \]  

[2]

Where:
$N$ is the number of spatial units indexed by unit $i$ and $j$, 
$x$ is the variable of interest and $\bar{x}$ its mean,
$W_{ij}$ is the matrix of weights (with zeroes on the diagonal), and
$W$ is the sum of all $W_{ij}$

The second spatial statistic used is the Anselin Local Moran’s I. As opposed to the GMI that studies the global (overall) pattern, this approach aims to find clusters at the local level. To do this, the tool uses the gun production data for each state to calculate a local Moran’s I value, a z-score, a pseudo p-value, and a code representing the cluster type for each statistically significant feature identified. A positive value indicates that a feature (in this case a state) has neighbouring features (i.e., other states) with similarly high or low attribute values, so it is part of a cluster. In contrast, a negative value suggests the state has neighbouring states with dissimilar values, so it is an outlier. In this manner, this approach is able to identify significant clusters of high (HH) and low values (LL), as well as outliers in which a high value is surrounded primarily by low values (HL), or a low value is surrounded primarily by high values (LH).

At this point it is important to note that, in contrast to spatial outliers, the locations shown as significant clusters are not the actual clusters, but the cores of a cluster. This suggests, for example, that while there may be only one state shown as significant, to be a cluster of high-high value (HH) there must be a state with a high value and a neighbouring state also with a high value.
More specifically, Local Moran is defined as:

\[ I_i = \frac{Z_i}{m_2} \sum_j W_{ij} Z_j \quad [3] \]

Where:

- \( Z_i \) and \( Z_j \) are deviations from the mean of \( i \) and \( j \),
- \( W_{ij} \) is the matrix of weights where \( i \) is a neighbour of \( j \), and zero otherwise,
- \( m_2 = \frac{\sum_i Z_i^2}{N} \),
- \( I = \sum_i \frac{I_i}{N} \),
- and \( N \) is the number of analysis units in the map.

There are three methodological notes that are relevant for this chapter (and the following). First, it is important to note that I also considered the Getis-Ord General G and Getis-Ord Gi* (local) statistics. Nonetheless, as results obtained were similar to Moran and Local Moran, these are discussed no further.

Second, I used the function of *contiguity of edges and corners* for the spatial agglomeration analyses. When computing the ‘conceptualisation of spatial relationships’ in ArcGIS, this specific choice taken defined the type of neighbourhood considered for these analyses as the polygons that touch one another. In this case, neighbours were defined as those that share either an edge, understood as the ‘line between two points that forms a boundary’ (ArcGIS, 2018) or a corner/node, which is ‘the point representing the beginning or ending point of an edge’ (ArcGIS, 2018). This type of
neighbourhood used for the analyses follows the recommendation for polygon features suggested by scholars such as Luna (2014) and by the ArcGIS itself.

Third, I also used the function of *row standardisation*. This standardisation aims to reduce the risks of potential bias ‘due to sampling design or an imposed aggregation scheme’ (ArcGIS, 2017). In this case, the standardisation is useful to avoid, for example, that the number of neighbours of each state influence (more than it should) the spatial agglomeration statistic. I present the results in the following section.
4.4. Results

4.4.1 National (aggregate) trends

Figure 4.1 shows the trends of production for all guns. Overall, two key patterns can be observed. First, there was a phase during the first six-years of the studied period in which gun manufacturing decreased. In effect, annual production of all guns reduced by one million between 1999 and 2004. Second, after 2005, the production of guns increased. In fact, the volume of manufactured guns doubled between 2005 and 2011.

Figure 4.1. National gun production in the U.S. (by type of weapon)
Figure 4.2 shows the same data by period rather than year. Information on all guns suggests that 8 million units more were produced in the second period than the first. This represents a substantial increase of 39%. In this case, the median level of all guns produced at the state level by year increased from 18,341 in the first period, to 77,299 in the second. The median level for all the 48 paired differences was 20,996 (i.e., not the difference between 18,341 guns produced in the first period and 77,299 in the second). A Sign-test (N=48) showed that the increase in the production of all guns was statistically significant across states (z=-3.792, p<.001).

![Figure 4.2. National gun production by period](image-url)
Next, I explore the key trends by type of weapon. As Figure 4.3 shows, there were clear increases in three markets (left bar corresponds to first period). The a-priori expectation was that there were increases in all types of weapons, mainly considering that the three studied gun laws are likely to have influenced all markets (and not only long guns as would be expected if only AWB expiration is studied). Evidence indicates this was the case for most types of guns.

Data suggests that around 4.7 million more pistols were manufactured in the second period (84.0% increase) than the first. Specifically, the median level of pistol production at the state level by year increased from 2,785 in the first period to 6,065 in the second. The median of the paired differences between the two periods was 1,002 and a Sign-test (N=48) showed that the increase in the production of pistols was statistically significant across states (z= -3.501, p<.001).

![Figure 4.3. National gun production by gun type/period](image-url)
There was also a rise in the production of revolvers of around 958,000 (a 49.7% increase). The median level of revolver production at the state level by year increased from a value of zero in the first period, to 3 in the second, which indicates that a substantial amount of states manufactured zero revolvers in both periods. The median of the paired differences equals zero. A Sign-test (N=48) suggested that the increase in the production of revolvers was not statistically significant across states (z= -1.886, ns).

For rifles, there was a rise in production of around 3.0 million units (36.8% increase). The median level of rifle production at the state level by year increased from 4,985 in the first period to 21,740 in the second. The median of the paired differences between the two periods was 11,195. A Sign-test (N=48) showed that the increase in the production of rifles was statistically significant across states (z= -4.474, p<.001).

The only market in which overall production decreased was shotguns. Here, an 11% reduction was observed. Despite this decline, the median level of shotgun production at the state level by year increased from 7 in the first period, to 89 in the second, a pattern that could indicate the emergence of new actors (i.e. states) with higher levels of production after the mid-2000s. The median of the paired differences between the two periods was 2 and a Sign-test (N=48) showed that the reduction in the manufacturing of shotguns was not statistically significant across states (z= -1.080, ns).
For the final analysis of national trends, I perform a Chi-square test to determine whether the changes in the distribution over time by type of gun were significantly different to chance expectation (see Table 4.1). They were ($\chi^2(3) = 780468.85, p<.001$). However, the Cramer's V statistic showed that this association was weak (V=.1256).

**Table 4.1. National gun production by type of weapon/period**

<table>
<thead>
<tr>
<th></th>
<th>Period A 1999-2004</th>
<th>Period B 2006-2011</th>
<th>Total</th>
<th>% change</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Pistols</strong></td>
<td>5,625,623</td>
<td>10,353,023</td>
<td>15,978,646</td>
<td>84%</td>
</tr>
<tr>
<td><strong>Revolvers</strong></td>
<td>1,925,820</td>
<td>2,884,135</td>
<td>4,809,955</td>
<td>49%</td>
</tr>
<tr>
<td><strong>Rifles</strong></td>
<td>8,223,970</td>
<td>11,250,585</td>
<td>19,474,555</td>
<td>36%</td>
</tr>
<tr>
<td><strong>Shotguns</strong></td>
<td>4,884,415</td>
<td>4,304,037</td>
<td>9,188,452</td>
<td>-11%</td>
</tr>
<tr>
<td><strong>All guns</strong></td>
<td>20,659,828</td>
<td>28,791,780</td>
<td>49,451,608</td>
<td>39%</td>
</tr>
</tbody>
</table>

In what follows, patterns of gun production are examined at the state level. To this end, I first analyse the case of all guns, and then follow the same procedure for each type of weapon.
4.4.2 Production of all guns

Gun production increased in 38 states during the second period (39% increase overall). I also compare whether the state level ranking for the volume of guns produced across states (N=48) was stable over time. That is, I test if states with the largest (smallest) volume of production during the first period also report, on average, high (small) values in the second. In this case, a Spearman’s rank-order correlation computed for the production of all guns (for the two periods) shows a strong, positive, and statistically significant correlation ($r_s(46) = .86, p = .001$). This suggests that, albeit not perfect, the rank ordering was relatively stable over time.

The geographical patterns in the production of all guns show key regional dynamics more explicitly. Figure 4.4 shows that, during the 1999-2004 period, for most states the production of all guns was around one million units (or less). Figure 4.5 on the other hand, suggests that during the 2006-2011 period, levels of production for all guns increased in some states, particularly the southern states of Texas and Arizona. Figure 4.6 provides a more direct comparison of the changes observed by showing the absolute difference in production per state. While some states in the north and northeast of the U.S. experienced a clear decrease in all guns manufactured (e.g. Connecticut), as expected Texas and Arizona were amongst those states for which overall gun production increased the most.
Figure 4.4. Production of all guns 1999-2004
(Count, equal intervals thematic classification)

Figure 4.5. Production of all guns 2006-2011
(Count, equal intervals thematic classification)

Figure 4.6. Absolute change in the production of all guns
(Natural breaks thematic classification)
I also found that the market share increased in 30 states. A comparison of the market share for the top-15 states that manufactured most guns (during first period) is presented in Figure 4.7.

![Figure 4.7. All guns - market share evolution (1999-2004 vs. 2006-2011)](image)

A key argument explored throughout this chapter is that the production of guns (relatively) reduced in the northeast and increased in the south of the U.S. (in closer proximity to Mexico). Figure 4.7 provides initial support for this. For instance, the three states that produced most guns in the first period (Connecticut, New York, and New Hampshire) are located in the northeast. Each of these states experienced a substantial reduction in their market shares during the second period. In contrast, in addition to report the top-2 and top-4 largest absolute increase (see Figure 4.6), the market shares in Texas and Arizona (both located in the south) substantially increased. In
effect, the relative importance of these two states more than doubled during the second period, as their combined market share reached the 14% of all production after the mid-2000s. Results from the Chi-square test suggest that the changes for these 15 states were significantly different to chance expectation ($X^2 (14) =3426892, p<.001, V= 0.2731$).

Next, I analysed the extent to which there was evidence of concentration in the production of all guns over time. If high concentration exists, a low percentage of states would account for a high percentage of gun production (and vice versa). To test this, I computed two Lorenz curves (see above for details), one for each period and show them in Figure 4.8.

![Lorenz curve graph](image)

**Figure 4.8. Production concentration of all guns (1999-2004 vs. 2006-2011)**

Gun production is clearly concentrated for both periods, but somewhat less so in the second period. For example, while 75% of the production of all
guns occurred in just five states for the period 1999-2004, a similar level of production (73%) was distributed across seven states during the second period (2006-2011). This change can also be seen in the differences between the Gini indices computed for the two periods. While this was equal to 0.83 for the first period, it was 0.77 for the second (note: distribution close to 1 it is very unequal/concentrated). Although small, this change in the distribution suggests that production of all guns became less concentrated.

In addition to study concentration, I also analysed the extent to which there was evidence of production relocation over time. To do this, I calculated the weighted mean centre (WMC) of production for the two periods. In line with expectation, I find that the WMC moved approximately 236 kilometres/146 miles southwest, from Brookville, Pennsylvania in the first period (1999-2004), to Summerfield, Ohio in the second (2006-2011). The distances between the WMCs and Mexico City also reduced from 3,076 kilometres/1,912 miles during the first period, to 2,835 kilometres/1,762 miles during the second. As hypothesised, both patterns suggest that the WMC of gun production moved towards Mexico (see Figure 4.5 to observe this visually).

<table>
<thead>
<tr>
<th></th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1999-2004</strong></td>
<td>41.04</td>
<td>79.06</td>
</tr>
<tr>
<td><strong>2006-2011</strong></td>
<td>39.82</td>
<td>81.35</td>
</tr>
<tr>
<td><strong>Effect</strong></td>
<td>north to south</td>
<td>east to west</td>
</tr>
</tbody>
</table>
Finally, I study the level of *agglomeration* in the production of all guns. Results from the GMI suggest that production of all guns was clustered for both periods (see: Figure 4.9 and Figure 4.10). This suggests evidence of agglomeration economies, but the figures also indicate that this marginally reduced over time. For both periods, results from the Anselin Local Moran's I indicate a high-high cluster and a low-high outlier, both located in the northeast (see: Figure 4.11, Figure 4.12). While a more noticeable effect was expected for the states in the south (during the second period), this Figure illustrates that agglomeration was most noticeable in the northeast region when the production of all guns is studied. Likewise, it also draws attention to the states of Vermont and Rhode Island, which essentially produced very few guns despite being surrounded by states for which levels of production were high.
Figure 4.9. GMI 1999-2004 (all guns)

Figure 4.10. GMI 2006-2011 (all guns)
Figure 4.11. Anselin Local Moran’s I (1999-2004)

Figure 4.12. Anselin Local Moran’s I (2006-2011)
4.4.3 Pistol production

As noted above, the same analytic steps were repeated for each type of weapon considered. Summary information is provided in the table 4.7 at end of this chapter.

The production of pistol increased in 37 states (84% increase overall). As with all guns, a Spearman’s rank-order correlation was computed for the production of pistols. Results suggest that, although it was not perfect, the rank ordering was relatively stable over time considering a strong, positive, and statistically significant correlation ($r_s(46)=.81, p<.001$).

With respect to spatial patterns, Figure 4.13 shows that, during the first period, not all states manufactured this type of gun. In fact, those states that did, produced relatively low figures of around 200,000 pistols (or less). By contrast, during the second period, most states reported production and overall levels that were evidently higher (Figure 4.14). Additionally, it is notable that increases were particularly substantial for the two southern states of Florida and Arizona. Of specific interest is the case of Arizona, which borders Mexico, and which was amongst the states for which there was the greatest increase in pistol production after the mid-2000s.
Figure 4.13. Pistols’ production 1999-2004
(Count, equal intervals thematic classification)

Figure 4.14. Pistols’ production 2006-2011
(Count, equal intervals thematic classification)

Figure 4.15. Absolute change in the prod. of pistols
(Natural breaks thematic classification)
The previous maps show the states with the highest levels of pistol production. From a comparative perspective, it is noteworthy that market shares increased in 30 states. In Figure 4.16, I show the specific change in the market share for the top-15 leading states. Results from the Chi-square test suggest that the changes were significant ($X^2 (14) = 1286778, p<.001, V= 0.2898$).

![Figure 4.16. Pistols’ market share evolution (1999-2004 vs. 2006-2011)](image)

Figure 4.16 indicates a number of key patterns in pistols’ market share. For instance, with the exception of Massachusetts (which experienced a substantial inter-period increase), most northern states experienced a substantial decrease after 2005. By contrast, the southern states of Arizona, Texas and Florida, as well as Utah and Nevada, displayed increases. The case of California follows an opposite pattern in the south. It should be noted that, as a result of number of shootings during the late 1980s/1990s, California implemented more restrictive gun laws over the years. Although
further research is required, this could provide a potential explanation for why pistol production decreased.

Figure 4.17 shows the Lorenz curves (one for each period) computed for pistols. It shows that pistol production was concentrated in a few states, and that the profile of concentration changed little over time. In fact, the Gini values of 0.81 and 0.82, for the first and second period (respectively), were practically identical.

![Lorenz curves for pistol production](image)

**Figure 4.17. Production concentration of pistols (1999-2004 vs. 2006-2011)**

While there was no evidence that levels of pistol production changed across all states, it was clear that it changed substantially in some (e.g. Arizona). This is reflected in the change in the WMC for the two periods (See Table 4.3), which moved approximately 333 kilometres/206 miles south/southeast,
from Staunton, Illinois to Salem, Indiana (see Figure 4.14 to observe this visually). In this case, however, the distance between the WMCs and Mexico City (in each period) marginally increased from 2,358 kilometres/1,465 miles in the first period to 2,477 kilometres/1,539 miles in the second. As such, while the market of pistols relocated from the north to the south (as hypothesised), the shift to the east was not in line with expectation.

<table>
<thead>
<tr>
<th></th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999-2004</td>
<td>38.97</td>
<td>89.80</td>
</tr>
<tr>
<td>2006-2011</td>
<td>38.59</td>
<td>85.99</td>
</tr>
<tr>
<td>Effect</td>
<td>north to south</td>
<td>west to east</td>
</tr>
</tbody>
</table>

Considering the *agglomeration* analyses, results from the GMI indicate that patterns of pistols manufacturing did not differ significantly from a random distribution for either period (see: Figure 4.18 and Figure 4.19). Results from the Anselin Local Moran’s I suggest that, while there were two clusters of high-high states in the first period, there was only one after 2005 as production in California decreased (see: Figure 4.20 and Figure 4.21).
Figure 4.18. GMI 1999-2004 (pistols)

Figure 4.19. GMI 2006-2011 (pistols)
Figure 4.20. Anselin Local Moran’s I (1999-2004)

Figure 4.21. Anselin Local Moran’s I (2006-2011)
4.4.4 Revolver production

37 states saw an increase in revolver production (49% increase overall). In terms of the position of the states over time, a Spearman’s rank-order test (N=48) found only a moderate, positive, and statistically significant correlation ($r_s(46)=.56, p=<.001$). In short, this suggests that, although there were some similarities in the rankings, the association over time was much more unstable than for the analyses presented above. However, this finding must be considered in light of one caveat. Some states did not manufacture revolvers in either period (i.e. there were zeros), and this could affect the correlation observed. The analyses that follow look at the association in more detail.

The geographical patterns of production also show trends that are unique for this gun market. As discussed, Figure 4.22 shows that during the first period not all states reported production of revolvers. In effect, those states that manufactured (19) can be divided into two groups: states that produced around 9,000 units (or less) and states for which levels of production reached between 90,000 and 760,000 units. In contrast, as shown in Figure 4.23, most states (28 out of 48) manufactured at least some revolvers after 2005. Importantly, the levels of state production during the second period were much higher, reaching 2.8 million units overall. The increases observed in Utah and Florida are particularly notable, as is that observed in Arizona, which shares a border with Mexico (see: Figure 4.24).
Figure 4.22. Revolvers’ production 1999-2004 (Count, equal intervals thematic classification)

Figure 4.23. Revolvers’ production 2006-2011 (Count, equal intervals thematic classification)

Figure 4.24. Absolute change in the prod. of revolvers (Natural breaks thematic classification)
Previous figures show that some states had notable increases relative to their previous levels of production. In Utah, for example, revolver manufacturing increased by 50%, while in Arizona it did by 397%. Despite this, a market share analysis shows that only Utah was amongst the largest producers nationally.

Figure 4.25 highlights that only five states concentrate most of the market share. In this way the share reported for states in the 6\textsuperscript{th} place onwards is very low. As such, the finding suggesting that market share increased in 35 states would confirm that most of these were marginal. Results from the Chi-square test suggest that the changes were significant ($\chi^2 (14) = 57248$, $p<.001$, $V=0.1093$).

![Figure 4.25. Revolvers’ market share evolution (1999-2004 vs. 2006-2011)](image-url)
As expected from previous analyses, evidence for this market shows high levels of concentration (see Figure 4.26). In fact, only five states accounted for 98% of all production during both periods. The Gini indices were 0.93 in both cases.

![Graph showing production concentration](image)

**Figure 4.26. Production concentration of revolvers (1999-2004 vs. 2006-2011)**

To explicitly analyse whether the manufacturing of revolvers relocated spatially, I also calculate the WMCs for the periods before and after the key changes in gun law (see: Table 4.4). Due to the small magnitude of the changes observed, I did not find any substantial evidence of spatial variation for this gun market. For instance, results indicate that the WMC moved approximately 29 kilometres/18 miles southwest, from Harveys Lake, Pennsylvania to Berwick, Pennsylvania (also see Figure 4.25), which is far less than the effect reported for pistols. Likewise, the distance from the WMCs (in each period) to Mexico City only reduced marginally, from 3,277 kilometres/2,036 miles to 3,242 kilometres/2,014 miles.
Table 4.4. Change in WMCs (revolvers)

<table>
<thead>
<tr>
<th></th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999-2004</td>
<td>41.35</td>
<td>76.10</td>
</tr>
<tr>
<td>2006-2011</td>
<td>41.09</td>
<td>76.19</td>
</tr>
<tr>
<td>Effect</td>
<td>north to south</td>
<td>east to west</td>
</tr>
</tbody>
</table>

With respect to the analysis of *agglomeration*, results from the GMI indicate that patterns of revolver manufacturing were clustered in both periods (see: Figure 4.27 and Figure 4.28). On the other hand, results from the Anselin Local Moran’s I indicate that a similar high-high cluster (in the northeast) was identified in both periods. While it can be noted that production increased in the neighbouring states of Arizona and Utah, their manufacturing levels were not high enough to generate a high-high cluster.
Figure 4.27. GMI 1999-2004 (revolvers)

Figure 4.28. GMI 2006-2011 (revolvers)
Figure 4.29. Anselin Local Moran’s I (1999-2004)

Figure 4.30. Anselin Local Moran’s I (2006-2011)
4.4.5 Rifle production

The manufacturing of rifles increased in 40 states (36% increase overall). Furthermore, a comparison between the rankings across the states (for each period) suggests that this market was relatively stable over time. This can be confirmed by the results of the Spearman’s rank-order test, which shows a strong, positive, and statistically significant correlation ($r_s(46)=.81, p<.001$).

The geographical patterns of rifles’ production provide some initial evidence to suggest that most states manufactured this gun type. In contrast to the other gun markets, for which the production was concentrated within twenty or fewer states, the manufacturing of rifles was distributed across most states in both time periods (Delaware being the exception). Overall, Figure 4.33 suggests that, a number of states in the north and northeast experienced an increase in their levels of rifles’ production, as did Texas. Of particular interest for this research is the increase reported in Texas, since it shares a long and porous border with Mexico. This state produced 236,000 more rifles in the second period and was amongst the states for which there was the greatest increase in production.
Figure 4.31. Rifles' production 1999-2004
(Count, by equal intervals)

Figure 4.32. Rifles' production 2006-2011
(Count, by equal intervals)

WMC:
- 1st period (1999-2004)
- 2nd period (2006-2011)

Figure 4.33. Absolute change in the production of rifles
(Natural breaks thematic classification)
An analysis of the market share for the states that manufactured most rifles also highlights relevant patterns. For instance, Figure 4.34 confirms that a few states account for most of the rifles’ market share. Additionally, changes observed also had spatial implications. The top-three leading states during the first period (i.e. Connecticut, New Hampshire, and New York) are all located in the northeast. These same three states showed a proportional reduction during the second period. This contrasts with the trend observed in almost all other states for which a relative increase was observed. This applies to those states not listed in Figure 4.34, such as Texas. Results from the Chi-square test for the top-15 states suggest that the changes were significant ($\chi^2 (14) = 1220714$, $p<.001$, $V= 0.2597$).

Despite the fact that most states manufactured rifles, a large proportion of production was concentrated in a few states (see: Figure 4.35). Nonetheless,
evidence also suggests this concentration decreased over time. While only five states accounted for 85% of all rifles manufactured in the U.S. during the period 1999-2004, the same number of states accounted for only 69% of production during the second period. This pattern is also detected by comparing the Gini index across periods. That is, the Gini index of 0.87 for the first period, was quite a bit larger than that for the second (0.79), suggesting a lower concentration of production in the second period.

I calculate the WMC to analyse the extent to which volumes of production changed spatially (see: Table 4.5). In line with expectation, these results suggest that WMC moved considerably, approximately 213 kilometres/132 miles southwest, from Hancock, New York -where it was located during the first period-, to Cross Fork, Pennsylvania, where it was located for the
second (see Figure 4.32 to see this visually). This relocation also reduced the distance between the WMCs (in each period) and Mexico City, from 3,367 kilometres/2,092 miles to 3,177 kilometres/1,974 miles. As such, the combined effects provide some evidence in favour of the expected overall spatial pattern. In other words, that the market of rifles moved closer to Mexico after the mid-2000s.

### Table 4.5. Change in WMCs (rifles)

<table>
<thead>
<tr>
<th></th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999-2004</td>
<td>42.04</td>
<td>75.28</td>
</tr>
<tr>
<td>2006-2011</td>
<td>41.47</td>
<td>77.73</td>
</tr>
<tr>
<td>Effect</td>
<td>north to south</td>
<td>east to west</td>
</tr>
</tbody>
</table>

Noticeably, agglomeration analyses for the market of rifles were similar to those previously found for revolvers. Results from the GMI show that patterns of rifle manufacturing were also clustered for both periods, although, in this case, there was a small increase for this value over time (see: Figure 4.36 and Figure 4.37). Results from the Anselin Local Moran’s I suggest that one high-high cluster was identified in the northeast in both periods. Specifically, this result suggests that, despite some states -such as Texas- exhibited a substantial increase in rifle production over time, the spatial contiguity of high production states in the northeast was statistically very significant (Figure 4.38 and Figure 4.39).
Figure 4.36. GMI 1999-2004 (rifles)

Figure 4.37. GMI 2006-2011 (rifles)
Figure 4.38. Anselin Local Moran’s I (1999-2004)

Figure 4.39. Anselin Local Moran’s I (2006-2011)
4.4.6 Shotgun production

Analyses suggest that production of shotguns increased in 31 states (11% decrease overall). Results from the Spearman’s test indicate that the rank ordering was relatively stable over time ($r_s(46)=.73$, $p=<.001$). Overall, this suggests that the states with the largest (smallest) volume of production during the first period also report, on average, high (small) values in the second.

The geographical patterns in shotgun production also indicate that a large number of states manufactured this gun type during the second period. As shown in Figure 4.40, twelve states did not manufacture this gun type during 1999-2004. Nonetheless, as it was reported for other markets, the number of states that manufactured shotguns increased after 2005 (see: Figure 4.41). These maps also reveal additional north-south patterns that are noteworthy. During the first period, New York, Connecticut, and Massachusetts were the leading states nationally. During the second period, Texas emerged as a leader in the south. In effect, with 1.4 million shotguns more produced in the second period (compared to the first), this was the largest increase observed across all the U.S.
Figure 4.40. Shotguns’ production 1999-2004
(Count, equal intervals thematic classification)

Figure 4.41. Shotguns’ production 2006-2011
(Count, equal intervals thematic classification)

WMC:
Θ 1st period (1999-2004)
★ 2nd period (2006-2011)

Figure 4.42. Absolute change in the production of shotguns
(Natural breaks thematic classification)
An analysis of the market share shows additional patterns concerning the distribution of production. For instance, market share increased in 34 states across periods. Nonetheless, as Figure 4.43 shows, only four states (New York, Connecticut, Massachusetts, and Texas) accounted for most shotguns’ market share. Evidence also indicates that, with the exception of New York (which experienced an inter-period increase), the other two states located in the north had a substantial reduction in their shares. Of particular relevance is the case of Connecticut, in which production reduced by 1.3 million shotguns and market share reduced by 24%. In contrast, it is worth noting the case of Texas, in which market share increased by more than seven-fold. Remarkably, the reduction in Connecticut is equivalent to the increase in Texas, which could provide some initial insight concerning the relocation effect that I will analyse in a subsequent subsection. Results from the Chi-square test suggest that the changes across the top15 states were significant ($X^2 (14) = 2247910, p<.001, V= 0.4952$).

**Figure 4.43.** Shotguns’ market share evolution (1999-2004 vs. 2006-2011)
Figure 4.43 suggests that a few states accounted for most of the shotguns’ market share. As expected from this pattern, analyses also indicate that shotgun production was very concentrated in a few states (Figure 4.44). Likewise, evidence also shows that the level of concentration was very stable over the studied years. In fact, only five states accounted for 98% of all shotgun production during both periods. Unsurprisingly, the Gini indices were virtually the same. While a value of 0.93 was calculated for the first period, a similar index of 0.94 was estimated for the second.

![Graph showing production concentration of shotguns](image)

**Figure 4.44. Production concentration of shotguns (1999-2004 vs. 2006-2011)**

In line with expectation, I find that the WMC of shotgun production moved approximately 877 kilometres/544 miles southwest, from Wallkill, New York, to Jackson, Kentucky (see Figure 4.41 to observe this effect). This spatial relocation also reduced the distance between the WMCs and Mexico City (in each period) from 3,413 kilometres/2,120 miles in the first period, to 2,530 kilometres/2,058 miles in the second. Table 4.6 shows the WMC values for
each period. Noticeably, this is the most substantial relocation of all those observed across the different gun markets, providing support to the key argument discussed throughout this chapter.

**Table 4.6. Change in WMCs (shotguns)**

<table>
<thead>
<tr>
<th>Period</th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999-2004</td>
<td>41.62</td>
<td>74.23</td>
</tr>
<tr>
<td>2006-2011</td>
<td>37.65</td>
<td>83.08</td>
</tr>
<tr>
<td>Effect</td>
<td>north to south</td>
<td>east to west</td>
</tr>
</tbody>
</table>

Finally, I present the results of the two spatial tools used to estimate the level of *agglomeration* in shotgun production. Results from the GMI show that patterns of shotgun manufacturing were clustered in the first period, but random in the second (see: Figure 4.45 and Figure 4.46). This difference in existing patterns could be explained, at least to some degree, by the substantial increase in production reported in a number of states that modified the previous overall distribution (e.g. Idaho, Nevada, and Texas). Results from the Anselin Local Moran’s I suggest that one high-high cluster was identified in the northeast during the first period, and that a high-low outlier was found in the case of Texas during the second.

More generally, in terms of this research, the fact that the production of shotguns increased in the magnitude (and location) it did, provides some initial evidence to the key argument discussed in this chapter. Specifically, that the market of guns moved closer to Mexico.
Figure 4.45. GMI 1999-2004 (shotguns)

Figure 4.46. GMI 2006-2011 (shotguns)
Figure 4.47. Anselin Local Moran’s I (1999-2004)

Figure 4.48. Anselin Local Moran’s I (2006-2011)

Clusters
- Not Significant
- High-High Cluster
- High-Low Outlier
- Low-High Outlier
- Low-Low Cluster
4.5 Discussion

In this chapter I examined the spatial and temporal patterns of gun production in the U.S. and how this evolved following key changes in federal and state gun policy implemented during the mid-2000s. Specifically, I investigated the following for each gun market. First, whether the rankings in the volume produced across all the states were stable over time. Second, I examined the geographical distribution of gun production. Third, I studied whether the market share reported for the top-15 states changed over time. Fourth, I assessed whether the production of guns was concentrated in few states. Fifth, I studied whether geographical relocation of gun production occurred. Finally, I explored whether spatial clustering effects were present. Overall, I hypothesised that gun production had increased, but that changes were not homogenous neither across states nor across gun markets. I anticipated that increases in gun production were more pronounced in the south, and that gun production moved closer to Mexico, potentially increasing opportunities for trafficking.

Table 4.7 summarises some key findings (step 2 on geographical distribution is excluded as the maps better visualise these patterns). Considering the overall results, with the exception of shotguns, production increased substantially across all markets.

However, production did not increase across all states. As a matter of fact, even in those markets that experienced a substantial overall increase, there
were some states that reported reductions. It is noteworthy that some of these reductions appeared in the northeast (i.e. Connecticut and New York). By contrast, some of the most notable increases were often found in the southern states. The increases reported for different markets in Arizona and Texas deserve particular consideration as they provide some evidence to the key hypothesis explored in this chapter (i.e. that changes in the spatial distribution of production increased opportunities for trafficking).

The third column of Table 4.7 also shows the changes in the (subnational) market share. As mentioned earlier, in this particular step I focused on the 15 states that were leading producers during the first period, and then assessed the extent to which their market share changed during the second. There are three relevant observations from these analyses. First, the market share increased for 30 to 35 (out of the 48) states across all gun types (between periods). Second, while northern states tended to experience a relative decrease in productions, the southern states tended to experience a proportional increase. Of particular interest are the cases of Arizona (AZ) and Texas (TX), which often appeared as the states with the largest proportional increases.

The changes in the patterns of concentration also offer some interesting insights. For instance, when the production of all guns is considered, evidence suggests that the concentration of production reduced after the mid-2000s (conceivably as a result of the patterns observed for rifles). This indicates that manufacturing became more dispersed across states.
Results discussed in this chapter also suggest that each market operates differently. The manufacturing of revolvers and shotguns, for example, were highly concentrated in a few states, while in the case of pistols and rifles, the patterns of concentration were also present but, on average, to a lesser extent. These differences in concentration between gun types are interesting and they have not been discussed elsewhere. Further research might focus on exploring the reasons for these differences.
### Table 4.7. Inter-period summary of effects (step 2 is excluded)

<table>
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<tbody>
<tr>
<td>All guns</td>
<td>Increase of 8.1 million guns (39%) overall. Prod. increased in 38 states. +/Sig/Strong rank correlation (0.86, stable).</td>
<td>MS increased in 30 states. TX and AZ appeared in the ranking, and both increased their MS.</td>
<td>Before (0.83) Top-5: 75.5% Top-10: 89.3% Top-15: 97.0% After (0.77) Top-5: 61.7% Top-10: 83.1% Top-15: 92.6%</td>
<td>North to South* East to West* Combined: 236km SW</td>
<td>Before Clusted One HH (NE) After Clusted One HH (NE)</td>
</tr>
<tr>
<td>Pistols</td>
<td>Increase of 4.7 million pistols (84%) overall. Prod. increased in 37 states. +/Sig/Strong rank correlation (0.81, stable)</td>
<td>MS increased in 30 states. TX and AZ appeared in the ranking, and both increased their MS.</td>
<td>Before (0.81) Top-5: 65.3% Top-10: 92.1% Top-15: 98.3% After (0.82) Top-5: 69.3% Top-10: 90.2% Top-15: 97.3%</td>
<td>North to South* West to East Combined: 333km S</td>
<td>Before Random Two HH (SW and NE) After Random One HH (NE)</td>
</tr>
<tr>
<td>Revolvers</td>
<td>Increase of 958k revolvers (49%) overall. Prod. increased in 37 states. +/Sig/Moderate rank correlation (0.56)</td>
<td>MS increased in 35 states. AZ appeared in the ranking, and increased its MS.</td>
<td>Before (0.93) Top-5: 98.5% Top-10: 99.8% Top-15: 99.9% After (0.93) Top-5: 98.6% Top-10: 99.9% Top-15: 99.9%</td>
<td>North to South* East to West* Combined: 29km SW</td>
<td>Before Clusted One HH (NE) After Clusted One HH (NE)</td>
</tr>
<tr>
<td>Rifles</td>
<td>Increase of 3 million rifles (36%) overall. Prod. increased in 40 states. +/Sig/Strong rank correlation (0.81, stable)</td>
<td>MS increased in 32 states. AZ appeared in the ranking, and (marginally) increased its MS.</td>
<td>Before (0.87) Top-5: 85.2% Top-10: 95.1% Top-15: 98.1% After (0.79) Top-5: 69.6% Top-10: 86.7% Top-15: 94.6%</td>
<td>North to South* East to West* Combined: 213km SW</td>
<td>Before Clusted One HH (NE) After Clusted One HH (NE)</td>
</tr>
<tr>
<td>Shotguns</td>
<td>Decrease of 580k shotguns (-11%) overall. Prod. increased in 31 states. +/Sig/ Strong rank correlation (0.73, stable)</td>
<td>MS increased in 34 states. TX appeared in the ranking, and (substantially) increased its MS.</td>
<td>Before (0.93) Top-5: 98.9% Top-10: 99.9% Top-15: 99.9% After (0.94) Top-5: 98.8% Top-10: 99.8% Top-15: 99.9%</td>
<td>North to South* East to West* Combined: 877km SW</td>
<td>Before Clusted One HH (NE) After Random One HL (TX)</td>
</tr>
</tbody>
</table>

+=Positive, Sig=statistically significant /Coefficients in ( ) / Prod = production / CT=Connecticut, TX=Texas, AZ=Arizona, CA=California, MA=Massachusetts, FL=Florida, NH=New Hampshire. NE=Northeast, NW=Northwest, SE=Souteast, SW=Southwest. HH= High/high value. HL= High/low value. (*) = In line with expectation.
This chapter also tested for evidence of patterns of relocation in the production of guns. Specifically, the WMC assessed the spatial distribution of production considering the average latitude and longitude for each period, as well as the difference between these. To do this, the WMC weights the gun production by the latitude and longitude of each state (for each period). This provides a simple analysis of the extent to which the WMC change between periods.

Analyses concerning the WMC offered particularly interesting results. In fact, in line with the key arguments explored through the chapter, in most cases the WMC values indicate a relocation from the north to the south, and from the east to the west. Combined, these two spatial patterns indicate a relocation towards the southwest (i.e. in closer proximity to Mexico). However, the magnitude of these variations were not homogenous. In the case of revolvers, the inter-period change reported suggests a WMC change of only 29km. Nevertheless in the other markets, the variations reported are higher, ranging from 213 to 877 kilometres. Particularly notable was the case of shotguns. For instance, as discussed, data on this type of weapon indicates that this is the only market for which there was a small reduction in production between the two periods observed (11%). Although the variation observed was not statistically significant overall (from 4.8 to 4.3 million units) according to the Sign-test (N=48, z= -1.080, ns), some substantial changes were observed at the state level. In particular, shotgun production in Connecticut reduced from 1.7 million to half a million shotguns, while the production in Texas increased six-fold from 257,000 to almost 1.7 million
units. Combined, these patterns would suggest that production in one state probably substituted the other. More generally, the substantial relocation effect found for this market (of around 877 km south, closer to Mexico) supports the idea that the spatial distribution of production can change considerably.

Table 4.7 also presents analyses on spatial agglomeration. In the case of all guns, evidence suggests that production was clustered in both periods. It also indicates that there was a cluster of high-high states located in the northeast. When studied individually, results from each market suggest a similar pattern, with two exceptions. In the case of pistols, the spatial distribution was found to be random in both periods. This pattern is likely to be explained by the case of California and Florida, which had large volumes of production but are located far away from the other leading states. In the case of shotguns, the spatial distribution was found to be random during the second but not first period. This pattern is likely to be explained, at least to some degree, by the substantial increase in production reported in Texas, a state that is spatially distant from the traditional hotspot of production in the northeast.

The spatial analyses conducted in this chapter were motivated by the fact that there have been changes to federal and state gun laws since the mid-2000s, which may have led to variations in the spatial distribution of gun production in the U.S. As evidence shows, there are a number reasons to believe that relocation (in some cases) has occurred. Perhaps one of the
best examples of this pattern comes from the *Mossberg & Sons, Inc.* case discussed in the introduction of this chapter. When this company decided to decrease its operations in northern Connecticut, it increased production in its new facility (with the name of *Maverick Arms*) in Eagle Pass, Texas a city that is literally meters away from the border with Mexico.

As discussed, cases of relocation do not occur by chance. In this case, in addition to providing special subsidies and tax deductions, the Governor of Texas initially granted Mossberg’s with $75,000 USD paid by taxpayers from the *Texas Enterprise Fund* (TEF) to convince this firm to establish operations in that state (TEF, 2018). As a result of this agreement, the new facility in Eagle Pass comprised 116,000 square-feet of factory space. Shortly after opening, it produced 423,000 shotguns and 51,000 rifles (AMFER, 2011), and more than 90% of all Mossberg’s production, becoming one of the largest gun manufacturing facilities in the world (Miniter, 2014). This pattern is relevant as the increase in the number of rifles and shotguns confiscated by the Mexican Army in northern Mexico (INAI, 2014), and the increase in gun homicide here (INEGI, 2015) spatially and temporally coincides with the expansion of Mossberg plant in bordering Eagle Pass (which began after the mid-2000s).

In line with the *least effort principle* (Zipf, 1949) relocations in close proximity to Mexico would make the trafficking of guns to this country easier and more attractive. In this context, by reducing the distance and effort over which guns need to be transported, the Mossberg case illustrates how relocation
could substantially modify possible opportunities for the trafficking of guns as an immediate outcome of geographic proximity. Although further research is required, cases such as Mossberg’s would help to explicate whether the correlation between production-confiscation-violence applies to this trafficking context. If this association were found to be causal, then data on changes to gun production in U.S. states might offer additional insights into illegal gun trafficking to Mexico.

Overall, this chapter aimed to provide insight into how the availability of guns changed throughout the U.S. before and after changes to key federal and state laws. This was accomplished by analysing data regarding gun production. Data, however, can have limitations. One example is the Modifiable Areal Unit Problem (MAUP). MAUP is a source of statistical bias that can occur ‘when the interpretation of a geographical phenomenon within a map depends on the scale and partitioning of the areal units that are imposed on the map’ (Hayward & Parent, 2009, p. 120). Although a discussion on this effect is outside the scope of this chapter, at this point it might be sufficient to recognise that some possible limitations (such as this) or other could be present. Further research can consider the suggestions from Openshaw (1984), Altaweel (2018) and Holt et.al. (1996) to minimise this potential limitation, for example.

Of course, alternative approaches exist that could be pursued in future research. For example, in addition to examining the production of guns, prospective studies could be conducted to examine changes in the spatial
distribution of sales. This could be achieved through an analysis of background checks, which are theoretically conducted before any legal sale.

Originally the intention was to use these data in the current thesis. However, after substantial analysis of these data, I concluded that there are four structural weaknesses that impede their use. First, by definition, each background check only covers a single transaction. However, as suggested by FBI data, a single transaction can involve the purchase of multiple guns (WSJ, 2016). Second, not all states have the same level of involvement in the application of background checks. In 31 states, the FBI is responsible for conducting both handgun and long gun checks. In 7 states there is a shared responsibility (i.e. local authorities focus on handguns while the FBI focuses on long guns). In the other 13 states, local authorities use the NICS to perform all background checks themselves (FBI-NICS, 2014). This suggests that data is potentially not comparable. Third, not all states demand background checks for every sale, as prospective buyers can also apply to have a permit that is valid to buy guns for a period of time. In effect, federal law allows individuals who hold certain firearms-related permits, issued by 26 local governments (such as concealed weapons permits), to bypass the federally required background checks (LCTPGV, 2017). The diversity between local laws complicates the analyses, as (a) there are different types of permits (e.g. to purchase, to possess, to carry), (b) a background check is usually a pre-condition required to receive most permits, and (c) permits can last from 30 days in the case of Michigan, to 5 years in Texas, to 7 in Florida (Csere, 2013). As a result, it is likely that these differences in the way
background checks are implemented would bias any comparisons of the number of guns purchased across states.

Additionally, it is possible that background checks do not represent all the gun sales. Theoretically, all gun sales in the U.S. require a background check, so restricted individuals -such as convicted felons- cannot access guns. Nevertheless, in practice, this only applies to prospective purchasers aiming to buy a weapon in any of the 65,000 federally licensed dealers (also known as gun-shops) in the U.S. As previously discussed, the main regulatory challenge here is that not all individuals obtain guns from such sources, as they can also get them from unregulated bazars, also known as gun shows. This is relevant for a number of reasons. For instance, and at least by definition, typical transactions occurring at gun shows are private (i.e. between regular citizens that are not officially full-time dealers). As a consequence, background checks do not occur (they are not everywhere required by law).

Naturally, this means that many private transactions will not be registered and there is substantial evidence to suggest that, in addition to the new guns bought, there is an unknown proportion of guns that are acquired from unlicensed sellers without a background check. For example, in 1994, a survey found that 40% of all firearms transferred in the U.S. were acquired from sellers without background checks (Cook & Ludwig, 1997). More recently, a survey found that 78% of current gun owners who acquired a firearm within the past two years (2015 and 2016) did so without a
background check (Miller, Hepburn, & Azrael, 2017). Taken together, figures such as these suggest that background checks do not capture all sales. This situation is complicated by the fact that the proportion of guns that are acquired from unlicensed sellers without a background check can be higher in some states. For these reasons, data on background checks are used no more in this thesis.

4.6. Conclusion

The U.S. is the world’s largest manufacturer and consumer of guns. As a result of the Tiahrt Amendment in 2003, the expiration of the Assault Weapon Ban (AWB) in 2004, the enactment of the Protection of Lawful Commerce in Arms Act (PLCAA) in 2005, and substantial changes in states’ gun laws since, the U.S. has experienced the most significant gun-related policy shifts in recent history. Although I do not demonstrate causality here, and do not explicitly examine changes in state gun laws, I take this opportunity to see whether the spatial distribution of gun markets in the U.S. changed during this time. By and large, four main conclusions can be drawn from the analyses presented.

First, gun production in the U.S. increased after the mid-2000s. With the exception of one market (shotguns), evidence clearly suggests that more guns have been produced in the U.S. after the mid-2000s. Noticeably, the increases between the two periods (1999-2004 and 2006-2011) are substantial, increasing from around 20 to 28 million guns. When each type of
gun is studied individually, these increases can range from 36% up to an 84% increase between periods (at the national level).

Second, as hypothesised, *not all changes (or increases) reported were homogenous* across states. Despite almost all markets showed an increase in production, some states had larger increases than others. Interestingly, each single market and each state reacts differently. As such, it is possible to observe that some states became (relative) specialists in some types of guns, either because they increased their production or because other states reduced their own manufacturing levels. In this context, for example, whereas the increase in the production of shotguns is relevant for Texas, the rise in the manufacturing of pistols and revolvers is for Arizona.

Third, the *production of guns is concentrated, but not all types of weapons are concentrated to the same extent*. In particular, production for two of the markets (i.e. revolvers and shotguns) was highly concentrated across very few states.

Fourth, *changes in the distribution of gun production in some gun markets might have produced an overall geographical relocation*. Although most markets were relatively stable between the two periods (i.e. similar leading states), there are clear cases for which gun production in particular states reduced or increased substantially. Take, for example, the cases of Connecticut (where reductions in production were observed for rifles and shotguns), and those of Texas and Arizona (where increases were observed
for a number of types of weapons). This pattern was particularly evident for some specific markets, such as the production of shotguns for which a possible substitution effect is observed between Connecticut and Texas.

Considering patterns of relocation more generally, the findings reported in this chapter suggests that the production of all types of weapons tended to relocate south, and tended to move towards Mexico, although the changes observed were smaller for some types of guns (e.g. revolvers). Similarly, in almost all cases, the markets also relocated from east to the west, although again, some changes were small. While the findings of this chapter cannot establish causality, they are consistent with the idea that there was an increase in the overall production of guns in the U.S., and an increase of production nearer to the border, which in turn might explain why there has been an increase in the trafficking of guns into Mexico since the mid-2000s.
Chapter 5. Understanding the demand: gun confiscation in Mexico

In chapter four, I analysed state-level changes in the production of guns in the U.S. (the supply-side in this case study) over time and found (some) evidence consistent with the suggestion that post-2005 there were increased opportunities for trafficking (more) guns into Mexico. In this chapter, I examine the demand-side, in other words, patterns of illegal gun prevalence in Mexico. As opposed to previous estimations of gun demand conducted for this country that used proxy variables as input (e.g. crime records), as those discussed below, in this chapter I use data on gun confiscations. Specifically, I use a novel dataset provided by the Mexican Army, which includes all confiscations in Mexico by type of gun, time, and location (1999-2011). Similar to the previous chapter, I examine how the volume and geographical distribution of gun markets changed at the state level. Empirically, I present evidence that tests two key hypotheses – that after the mid-2000s, in Mexico: (a) there were increases in overall gun confiscation, and (b) rises particularly occurred across the northern states that border the U.S.

5.1. Introduction

The observation suggested in Chapter 3 that an increasing number of crimes have been committed with guns in Mexico since the mid-2000s -but that purchasing a gun legally in the country remains difficult- suggests an increase in the illegal availability of weapons. This also indicates a possible increase in the number of trafficked guns. To examine this pattern based on
empirical evidence, two different analyses would be required.

On the one hand, it would be necessary to examine the existing evidence regarding the magnitude or scale of *gun trafficking flows*. In other words, the estimates concerning the number of guns that are smuggled, at any given time, between the U.S. and Mexico. On the other hand, it would be also essential to consider available estimates regarding how large the *prevalence* of illegal guns in Mexico is. Put differently, the number of illegal guns already in circulation in this country. Exploring the hypothesis of increasing gun availability in Mexico would require an assessment of the existing research on these two dynamics and the extent to which they have spatially and temporally changed, before and after the mid-2000s (when key gun policies in the U.S. changed, as well as patterns of gun crime in Mexico).

Despite the relevance of these issues, there is an apparent gap in the literature. In fact, very little information is known about the demand-side of the U.S.-Mexico illegal gun market. The lack of evidence could be explained, to some degree, by the fact that in this region most academic research on illegal markets has focused instead on illicit drugs. That is, flows which move from the south (i.e. Mexico or Colombia) to the U.S., often ignoring the illegal flows in the opposite direction. I aim to fill this gap by offering a comprehensive analysis of the demand-side in the trafficking of firearms between the U.S. and Mexico. Using a novel dataset provided by the Mexican Army that includes all confiscations reported between 1999 and 2011, I present what, to the best of my knowledge, is the first spatiotemporal
analysis of the illegal prevalence of guns in Mexico based on confiscations.

As I will discuss in further detail in the following sections, this approach offers a number of advantages compared to the very few existing studies. For instance, since the data provided by the Mexican Army is disaggregated at the state level, it is possible to observe the extent to which confiscation levels vary across the thirty-one Mexican states. Second, as the data include annual confiscation figures for a period that extends up to thirteen years, it is also possible to observe key longitudinal trends. As such, instead of providing only one estimation of the availability of firearms (as previous reports have done it), this approach allows an analysis of changes in confiscation levels over time. Third, since the data differentiate each confiscation by the type of weapon (i.e., pistol, revolver, rifle, shotgun, and other guns), it is also possible to observe whether each gun market exhibited a different pattern of concentration across time and space. Fourth, since the data differentiate each confiscation by the type of weapon, it is also possible to study whether these patterns match those for production in the U.S.

In chapter 4, I argued that gun production relocated from the north to south of the U.S. after the mid-2000s. In this chapter, I test two key hypotheses – that after the mid-2000s, in Mexico: (a) there were increases in overall gun confiscation, and (b) due to a spillover effect, rises in confiscation were particularly acute across the northern states that border the U.S.
This chapter is organised as follows. In the next section, I review the very few studies that have aimed to estimate the illegal demand for guns in Mexico. To do this, I review existing research that has focused on estimating the flows, as well as studies that have projected the illegal prevalence of firearms already in circulation in Mexico. Next, I discuss the data and the methods used in this chapter in more detail. I then implement the six-steps approach (also used in the previous chapter 4) to analyse the extent to which gun confiscations (overall), as well as for pistols, revolvers, rifles, shotguns, and other guns, changed over time. Finally, I discuss the implications of the study for gun trafficking in this particular context. By and large, I argue that these empirical analyses are relevant inasmuch as they help to understand the patterns of gun trafficking to Mexico that have been not studied to date.

5.2. Estimating the illegal market of guns in Mexico

As discussed in Chapter 2, this thesis focuses on studying the black market for guns. By definition, this is an illegal market in which rational incentives for suppliers, traffickers and buyers require them to operate under the radar. This makes studying this market challenging as transactions are naturally not recorded.

In the absence of official data, researchers studying illegal gun markets often use a number of alternative sources. Nowak (2016) summarised seven possible alternatives for estimating gun demand. These include: (a) hospitalisation records on gun-related injuries, (b) the proportion of homicide
and suicide committed with guns, (c) court cases of gun-related crimes, (d) black-market intelligence reports, (e) interviews with informants or security sector officers, (f) surveys of victimisation and gun ownership, and (g) government data on gun confiscations or seizures. Despite the existence of these different alternatives, very little research has been conducted about illegal gun demand in Mexico, both regarding (a) trafficking flows as well as (b) the current prevalence of guns already circulation.

A few studies have examined the trafficking flows between the U.S. and Mexico which provide some insights concerning gun demand in Mexico. For example, using ATF tracing data, U.S. government official reports showed that, of all guns confiscated and traced in Mexico, between 70 and 90% were illegally introduced from the U.S. (GAO, 2009; GAO, 2016). Second, it is estimated that around 2,000 guns illegally enter into Mexico from the U.S. on a daily basis. (Brookings Institution, 2008). However, the methodology used to generate this figure is not public. Third, a United Nations study suggested that 20,000 U.S. firearms are illegally introduced into Mexico every year. This study also estimated the value of this illicit trade to be around US$20 million per year and no less than 10% of the annual global illegal gun market (UNODC, 2013). Fourth, a study by McDougal et al. (2014) projected that the amount of guns trafficked from the U.S. to Mexico has increased during the twentieth-first century. By comparing the figures and locations of U.S. gun shops near to Mexico between 1997 and 1999, with those between 2010 and 2012, these scholars concluded that gun shops near to Mexico were overrepresented; that is, there were more shops than would be necessary to
service local state demand in the U.S. According to their estimates, McDougal et al. (2014) suggested that there has been a rise in the illegal flows, which increased from 88,000 guns that were smuggled between 1997 and 1999 to 253,000 guns between 2010 and 2012. As a result of this increase in the trafficking flows (associated with more gun shops), McDougal et al. (2014) suggested that the illicit revenue linked to this flow of guns between the U.S. and Mexico increased four-fold, up to 127 USD million per year.

With respect to the prevalence of illegal guns already in circulation in Mexico, only a few studies have examined this. First, the Gun Policy organisation utilised a rule of thumb from the United Nations Office on Drugs and Crime (in which illegal guns are assumed to be proportional to the probable number of licit guns), to suggest that illicit firearms in Mexico increased from around 300,000 in 2004 to more than 600,000 in 2012 (Gun Policy, 2016). Second, the Small Arms Survey used an approach including proxy indicators (e.g. firearm suicide) and expert estimates based on an analogous comparison (i.e. extrapolating information from two similar countries when available data is only existing for one of these) to estimate that 15.5 million firearms were in circulation in Mexico. As a result of these estimates, Mexico ranked sixth worldwide in terms of numbers of guns and 42nd when per capita figures were considered (Small Arms Survey, 2011). Third, Weigend and Guevara (2015) estimated the number of guns trafficked into Mexico across the years. Using the Brooking’s estimated flow of 2,000 guns illegally entering into Mexico daily, they noted this figure represented around 10% of all guns produced in
the U.S. (during 2008, when this study was conducted). Then, they extrapolated this rate to overall gun production in the U.S. between 1990 and 2013 and calibrated the model using the number of homicides in Mexico. Using this approach, they estimated that Mexico had accumulated a stock of 24.6 million illegal firearms between 1990 and 2013.

Although these three studies provide initial estimates of the size of the illegal market in firearms, they each have significant flaws. On the one hand, these studies heavily relied on estimations that follow, either a rule of thumb approximation (i.e. an estimate based on global patterns) or an analogous comparison approximation (i.e. an estimate based on a similar country). While these two alternative approximations could be useful when data do not exist, they also have substantial limitations and can lead to fallacious conclusions. For example, these estimates did not take into account the specificities of the local context under study. On the other hand, these estimations did not always consider the number of guns as the base for the calculations. In other words, as they measured the illegal availability based on extrapolations by proxy, they actually estimated another phenomenon (e.g. gun injuries) but not directly the number of guns that have been trafficked. As with any other study using proxy variables, this flaw is relevant as it may have potentially biased the estimations for the gun demand.

Other studies have sought to estimate gun demand more directly. Pérez Esparza and Hemenway (2017) conducted a household survey in nine cities across Mexico. They found that 3% of urban households in Mexico reported
gun ownership, which would equate to around one million guns in the country. Respondents also suggested that most of these guns were acquired recently (i.e. in a period of five years or less) for self-defence. Although this study is significant inasmuch as it also described key features of illegal gun demand in Mexico (i.e. price paid, mechanism and time of acquisition, etc.), it is also likely that it underestimated the number of guns circulating in the country. For example, there may have been potential biases in the study, as respondents may have denied the existence of guns in their households since illegal ownership is a crime. Also, it seems reasonable to expect that guns owned by criminal organisations would not be captured in such an exercise. As such, the number of illegal guns in Mexico may well be much higher.

Most readers will have noticed that each of these estimates of gun demand vary substantially. These differences may be the result of the diverse sources and approaches used in each study. More generally, the differences are likely explained by the fact that they concern a black market, in which information is incomplete and extrapolations are required. This limitation is particularly challenging for those studies for which the authors did not have access to data on the guns themselves, but instead estimated the illegal demand for guns based on (distant) proxy variables such as gun injuries, the number of licit guns, or overall homicides (as most discussed beforehand).

In contrast to these existing studies, in this chapter, I use data on gun confiscations. As a result of the characteristics of these data, it is possible to
implement the six-step approach (also used in chapter 4) to study not only the number of confiscated guns but also the spatial and temporal patterns that other researchers have been unable to analyse before. The availability of these data enable an assessment of the extent to which gun confiscations were concentrated in a few states, and whether this changed over time. As discussed above, the key hypotheses tested in what follows are that after the mid-2000s, in Mexico: (a) there were increases in gun confiscations overall, and (b) due to a spillover effect, rises in confiscations were particularly observed at the northern states that border the U.S. As with Chapter 4, these hypotheses are tested for all guns and for each type of weapon individually.

5.3. Data and methods

5.3.1. Data

Gun confiscation data were obtained using a Freedom of Information (FOI) request to the Mexican Army, through Mexico’s National Institute for Transparency, Access to Information and Personal Data Protection (INAI). Information received included all confiscations that occurred across the 31 subnational states (excluding Mexico City, the capital) during the 1999-2011 period (as such, it is comparable to analyses previously reported). In a previous chapter, I analysed the production for pistols, revolvers, rifles and shotguns in the U.S. In addition to studying the confiscations of these types of firearms, in this chapter I also study confiscations for other guns. This category includes all weapons that were not explicitly classified as pistols,
revolvers, rifles or shotguns by the Mexican Army.

5.3.2. Analytic Strategy

Overall, I employ the same procedure used to analyse the production of guns in the U.S. (presented in detail in chapter 4), but for confiscations in Mexico. The analytic strategy presented here is summarised to avoid repetition (see Section 4.3.2 for more detail).

5.3.2.1. National (aggregate) analyses

As a general overview, I first analyse patterns of gun confiscation for the whole of Mexico. Three analytic steps are employed to do this. First, I examine changes in the volume of confiscation for each gun type across the thirteen studied years (1999-2011) by simply presenting a stacked bar graph. Second, I run a two-sided Sign Test for all guns and for each gun type, to observe whether the median increases (or decreases) in confiscation for each state before and after 2005 (i.e., 1999-2004 and 2006-2011) were statistically significant. Third, I run a Chi-Square (and a Cramer’s V) to detect whether the proportion of the different types of gun confiscated changed significantly over these periods.
5.3.2.2. State/market analyses

Analyses are then presented to examine variation across the 31 Mexican states (rather than for Mexico as a whole). To do this, I employ a methodological approach composed of six steps to analyse the sum of all guns, and to analyse each type of weapon individually. I briefly discuss these steps below (note: a more detailed description of these six steps was presented in Chapter 4).

First, I test the extent to which overall patterns of gun confiscation were stable over time. To do this, I conduct a Spearman's rank-order correlation analysis using data for counts of confiscation for all Mexican states, over the two periods.

Second, I study the geographical distribution of gun confiscation. To do this, counts of gun confiscation are mapped (for both periods), using an equal interval distribution function. The absolute change between these is presented in another map using the Jenks optimisation method.

Third, I study whether the proportions of gun confiscation for by each state are alike over the two periods. Particularly, I focus on the 15 states in which confiscations were highest during the first period, and analyse the rankings (of their ratios) subsequently (note: a ratio emulates the rationale of the market share used in the previous Chapter 4, and is obtained by dividing state confiscation by national confiscation, multiplied by 100). As discussed
in chapter 4, the key advantage of using a proportional measure (i.e. the ratio of each state vis-à-vis the national confiscation) is that it allows us to examine the relative prominence for each subnational unit (i.e. state) over time. I also include a Chi-square test to observe whether variations for these 15 states were significant.

Fourth, I analyse the evidence regarding the *geographical concentration* of gun confiscation over the studied periods. To do this, I compute a variant of a Lorenz curve for each period, and compare these by displaying both in a single graph. I then calculate the Gini index for each of these two distributions and contrast these indices as a way to observe changes in concentration.

Fifth, I examine the evidence concerning the *geographical relocation* of gun confiscation over time. To do this, I compute the *weighted mean centre* (WMC) of confiscation for each period. As discussed in Chapter 4, an estimate of the differences between the WMC (for each period) is valuable for this research inasmuch as it indicates whether the average location of confiscation (i.e. latitude and longitude) changed over the studied periods.

Finally, I examine the *agglomeration* patterns for gun confiscations in Mexico. Specifically, I use the Global Moran’s I (or GMI) to explore overall spatial autocorrelation. Then, I use the Anselin Local Moran’s I to find clusters or outliers at the local level. In what follows I present the results.
5.4. Results

5.4.1. Aggregate/national trends

Figure 5.1 shows the national trends of confiscation for all guns. Overall, as in the previous chapter, two key patterns can be observed. First, there was a phase during the early years in which gun confiscations decreased. Actually, between 1999 and 2004, annual confiscation reduced by almost one-half. Second, after 2005, gun confiscation increased. In fact, the volume of confiscated guns increased by almost twenty times between 2005 and 2011.

![Figure 5.1. National gun confiscation in Mexico (by type of weapon)
Figure 5.2 illustrates the same data by period instead of by year. Analyses for all guns suggest that 94,490 weapons more were confiscated in the second period than the first. This represents an increase of 702%. Furthermore, the median level of all guns confiscated at the state level each year increased from 142 in the first period to 1,050 in the second. The median level for all the 31 paired differences (for all the states) was 736. A Sign-test (N=31) showed that the increase in the gun confiscation was statistically significant across states (z= -5.029, p < .001).
Next, I explore the key trends by type of weapon (see Figure 5.3). Following the findings from the previous chapter, the a-priori expectation is that after the mid-2000s there would be increases across all types of guns confiscated in Mexico, except for shotguns (for which production in the U.S. marginally decreased during the second period). Evidence found was partly in line with this expectation, as I will discuss below.

For instance, data suggests that around 29,605 more pistols were confiscated in the second period (636% increase) than the first. The median level of pistol confiscation at the state level by year increased from 73 in the first period to 354 in the second. The median level of the paired differences between the two periods was 275, and a Sign-test (N=31) showed that the increase in the confiscation of pistols was statistically significant across states (z= -5.388, p<.001).

![Figure 5.3. National gun confiscation by gun type/period](image)
There was also a rise in the confiscation of revolvers of around 8,192 (954% increase). The median level of revolver confiscation at the state level by year increased from 19 in the first period to 116 in the second. The median level of the paired differences between the two periods was 80, and a Sign-test (N=31) showed that the increase in the confiscation of revolvers was statistically significant across states (z= -4.564, p<.001).

For rifles, there was a rise in confiscation of around 19,127 (489% increase). The median level of rifle confiscation at the state level by year increased from 40 in the first period to 179 in the second. The median level of the paired differences between the two periods was 173. A Sign-test (N=31) showed that the increase in the confiscation of rifles was statistically significant across states (z= -4.199, p<.001).

For shotguns, there was an increase in confiscation of 8,738 (438% increase). The median level of shotgun confiscation at the state level by year increased from 27 in the first period to 134 in the second. The median level of the paired differences between the two periods was 90, and a Sign-test (N=31) showed that the increase in the confiscation of shotguns was statistically significant across states (z= -3.233, p<.01).

For other guns, there was also a rise in confiscation of 28,828 (1,420% increase). In this case, the median level of confiscation at the state level by year increased from 16 in the first period to 355 in the second. The median level of the paired differences between the two periods was 338. A Sign-test
(N=31) showed that this increase was statistically significant across states (z=-5.029, p<.001).

Table 5.1 summarises these results. Before proceeding, two observations are noteworthy. On the one hand, these findings suggest that confiscations of other guns had the greatest increase (between periods) amongst all types of weapons. On the other hand, the increase reported in the case of shotguns is the only that does not follow the a-priori expectation. As discussed in Chapter 4, overall manufacturing of shotguns in the U.S. marginally decreased between 2006 and 2011. For this reason, it was expected that shotgun confiscation would also reduce in Mexico between 2006 and 2011, but this did not occur. There are some spatial factors that may explain this unexpected increase reported for the confiscations of shotguns in Mexico. I will elaborate further on these in Section 5.4.6. below.

**Table 5.1. National gun confiscation by type of weapon/period**

<table>
<thead>
<tr>
<th></th>
<th>Period A 1999-2004</th>
<th>Period B 2006-2011</th>
<th>Total</th>
<th>% change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pistols</td>
<td>4,653</td>
<td>34,258</td>
<td>38,911</td>
<td>636%</td>
</tr>
<tr>
<td>Revolvers</td>
<td>859</td>
<td>9,051</td>
<td>9,910</td>
<td>954%</td>
</tr>
<tr>
<td>Rifles</td>
<td>3,910</td>
<td>23,037</td>
<td>26,947</td>
<td>489%</td>
</tr>
<tr>
<td>Shotguns</td>
<td>1,995</td>
<td>10,733</td>
<td>12,728</td>
<td>438%</td>
</tr>
<tr>
<td>Other guns</td>
<td>2,029</td>
<td>30,857</td>
<td>32,886</td>
<td>1,420%</td>
</tr>
<tr>
<td>All guns</td>
<td>13,447</td>
<td>107,936</td>
<td>121,383</td>
<td>702%</td>
</tr>
</tbody>
</table>
For the final analysis of national trends, I perform a Chi-square to determine whether the changes in the distribution of confiscations over time by type of gun were significantly different to chance expectation (data used from Table 5.1). They were $X^2 (4) = 1488.47$, $p<.001$. However, the Cramer's V statistic showed that this association was weak ($V=.1107$).

In what follows, patterns of gun confiscation are examined at the state level.
5.4.2. Gun confiscation (totals)

Confiscation of all guns increased 702% between periods. With the only exception of Yucatan (Yuc.), there was an increase in confiscation across all Mexican states (30 out of 31). The Spearman’s rank-order test for the state level rankings (N=31) showed a strong, positive, and statistically significant correlation ($r_s(29)=0.77$, $p<.001$). As such, the rank ordering was relatively stable between periods.

Figure 5.4 shows that during 1999-2004 gun confiscation levels were around 1,700 units (or less) across all states. In contrast, Figure 5.5 suggests that during 2006-2011 gun confiscation levels substantially increased. In particular, the northern states of Sinaloa (Sin.), Durango (Dgo.), Chihuahua (Chih.), Nuevo León (NL), and Tamaulipas (Tamps.), as well as Michoacán (Mich.), had the largest increases in their levels of gun confiscation. Figure 5.6 provides a more direct comparison of the changes reported by showing the absolute difference in confiscation per state. While some states in the south experienced a small increase -or even a decrease in confiscated guns-, northern states were amongst those for which overall confiscation increased the most. To some degree, and while more analyses are required, this provides preliminary evidence in favour of one the key hypothesis explored throughout this chapter. In effect, I study the extent to which this pattern is observed across all types of guns.
Figure 5.4. Gun confiscation 1999-2004
(Count, equal intervals thematic classification)

Figure 5.5. Gun confiscation 2006-2011
(Count, equal intervals thematic classification)

Figure 5.6. Absolute change in the confiscation of all guns
(Natural breaks thematic classification)
In addition to identifying the states with the largest levels of confiscations, I also study the ratio or proportion accounted for by each state in relation to the national figure. Overall, the ratio of confiscations increased in 11 states. Figure 5.7 focuses on the 15 states that confiscated the most guns during the first period. On the one hand, this figure suggests that nearly all states that confiscated the most guns during 1999-2004 experienced a proportional (relative) reduction in their levels of confiscation during 2006-2011 (e.g. Guerrero, Durango, Chihuahua, Oaxaca). On the other hand, this figure also shows that four states experienced a considerable proportional increase: Michoacán (west), Sinaloa (northwest), as well as Nuevo León and Tamaulipas (northeast). Results from the Chi-square test suggest that the changes for these 15 states were significantly different to chance expectation ($X^2 (14) = 7048, p<.001, V=0.2557$).

![Figure 5.7. Ratio of all guns confiscated by state (1999-2004 vs. 2006-2011)](chart-5-7.png)
As reported in this figure, the proportional increase in Tamaulipas is the largest across all observed. This case is relevant considering that -similarly to Nuevo León-, these two states border Texas, which, as previously discussed in Chapter 4, had the second largest absolute increase in overall gun production and became the top-4 gun manufacturer across all U.S. states.

The confiscation of all types of guns was concentrated for both periods. Nonetheless, concentration was slightly higher during the second period (see: Figure 5.8). For example, while 50% of confiscations occurred in just five states during 1999-2004, 63% of guns were confiscated across five states during 2006-2011. This variation can also be seen in the differences of the Gini indices calculated for the two periods. While this was equal to 0.56 for 1999-2004, it was 0.67 for 2006-2011. As suggested by both curves and the Gini indices, this change in the distribution indicates that confiscation of all guns became more concentrated.
A key aim of this research was to evaluate whether confiscations relocated spatially. To do this, I compute the weighted mean centre (WMC) for each period (see: Table 5.2). Results show that the WMC of gun confiscation moved approximately 56 km / 35 miles north-east, from San José de Abajo, Zacatecas (Zac.) in the first period to Fresnillo, Zacatecas, in the second (see also Figure 5.5). While this overall relocation is of smaller magnitude than most of those observed in the previous chapter (for the U.S.), this finding still provides some moderate evidence that the spatial mean of confiscation in Mexico (for all guns) moved slightly closer to the northern border with the U.S. In the next subsections, I will discuss why this pattern is not as strong as expected.

Figure 5.8. Concentration of gun confiscation (1999-2004 vs. 2006-2011)
Table 5.2. Change in WMC (all guns)

<table>
<thead>
<tr>
<th></th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999-2004</td>
<td>22.59</td>
<td>102.88</td>
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<tr>
<td>2006-2011</td>
<td>23.08</td>
<td>102.76</td>
</tr>
<tr>
<td>Effect</td>
<td>south to north</td>
<td>west to east</td>
</tr>
</tbody>
</table>

I also study the levels of agglomeration for the confiscations of all guns. This is essential as confiscations can be clustered in some specific regions of the country. Results from the GMI show that patterns of confiscations for all guns were clustered in the first period, but random in the second (see: Figure 5.9 and Figure 5.10). Results from the Local Moran's I, for the first period, indicate that there were two clusters of high-high states: one across three states in the north of Mexico, and another in Guerrero (Gro.). For the second period, this local statistic identifies Michoacán as a high-low outlier. This latter finding can be explained by the high levels of confiscations in this state compared to those across its neighbours, such as Colima (Col.).
Figure 5.9. GMI 1999-2004 (all guns, Mexico)

Figure 5.10. GMI 2006-2011 (all guns, Mexico)
Figure 5.11. Anselin Local Moran’s I 1999-2004 (all guns, Mexico)

Figure 5.12. Anselin Local Moran’s I 2006-2011 (all guns, Mexico)
5.4.3. Pistol confiscation

As noted above, the same analytic steps were repeated for each type of gun considered. Summary information is provided in the table 5.8 at end of this chapter.

Overall, pistol confiscation increased by 636%. An important observation is that confiscations increased across all the 31 states. Results from the Spearman’s rank-order test (N=31) suggest a strong, positive, and statistically significant correlation ($r_s(29)=.82$, $p<.001$). This suggests that the rank ordering reported was stable over time.

The geographical patterns of pistol confiscation also provide some key insights regarding how this increase occurred. Figure 5.13 shows that during the first period, confiscations for this type of gun were relatively low. In effect, all states confiscated less than 600 pistols. In contrast, as shown in Figure 5.14, pistol confiscation substantially increased during the second period. For example, there were more than 8,000 pistols confiscated between 2006 and 2011 in Michoacán only. Likewise, other states (mostly in the north) also reported very high levels of confiscation after the mid-2000s. By comparing the absolute change between these two periods, Figure 5.15 shows that, while most states in the south reported a relative small increase in confiscation, most western and northern states reported a large increase.
Figure 5.13. Pistols’ confiscation 1999-2004
(Count, equal intervals thematic classification)

Figure 5.14. Pistols’ confiscation 2006-2011
(Count, equal intervals thematic classification)

Figure 5.15. Absolute change in the confiscation of pistols
(Natural breaks thematic classification)
In only 7 states the subnational ratio of confiscations (that is, the figures accounted for by each state in relation to the nationals’) increased between periods. A more specific analysis of the 15 states with the largest volume of confiscations reveals two other additional patterns (Figure 5.16). For instance, most states that had high relatively levels of confiscations during the first period experienced a reduction during the second. This pattern applies, for example, to Guerrero and Durango. Nonetheless, it is also noteworthy that three states showed the opposite effect exhibiting substantial (relative) increases. In addition to Michoacán, Figure 5.16 indicates that relevant proportional increases in pistol confiscation also occurred in the northern states of Sinaloa and Tamaulipas (as hypothesised). Results from the Chi-square test suggest that the changes for these 15 states were significant ($X^2 (14) = 2093$, $p<.001$, $V=0.2478$).

Figure 5.16. Ratio of pistols confiscated by state (1999-2004 vs. 2006-2011)
Evidence found also suggests that the levels of concentration in pistol confiscation at the state level increased over time (Figure 5.17). In fact, while five states accounted for 52% of all pistol confiscation during 1999-2004, the same number of states accounted for 63% of confiscations during 2006-2011. This increase in concentration can also be seen in the Gini indices calculated for both periods. While this concentration index was 0.55 for the first period, it was 0.66 for the second.

![Figure 5.17. Concentration of pistol confiscation (1999-2004 vs. 2006-2011)](image)

Table 5.3 shows the specific WMC values for each period concerning geographical relocation. These analyses indicate that the WMC moved approximately 52 kilometres/32 miles northwest, from Las Rosas, Aguascalientes, to Villanueva, Zacatecas (see also Figure 5.14). This finding
also suggests that the WMC of pistol confiscation moved slightly closer to the border with the U.S., although this effect is essentially marginal.

**Table 5.3. Change in WMC (pistols)**

<table>
<thead>
<tr>
<th></th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999-2004</td>
<td>22.27</td>
<td>102.40</td>
</tr>
<tr>
<td>2006-2011</td>
<td>22.65</td>
<td>102.70</td>
</tr>
<tr>
<td>Effect</td>
<td>south to north</td>
<td>east to west</td>
</tr>
</tbody>
</table>

Analyses of agglomeration for pistol confiscation find relatively similar outcomes to those previously discussed for all guns. For instance, results from the GMI suggest that patterns of pistol confiscation were clustered during the first period, but random during the second (see: Figure 5.18 and Figure 5.19). Results from the Anselin Local Moran’s I indicate that, during the first period, there were two clusters of high-high states. One of these clusters was detected in Guerrero (Gro.), a pattern that is likely to be explained by its spatial contiguity to Michoacán, where a large number of pistols were confiscated. A second cluster was identified across three states in the country’s northwest. This local spatial statistic also suggests that during the second period, a low-high outlier was present in Colima (Col.). Specifically, this can be explained by the low levels of confiscation in this state, and the fact that it is surrounded by others (i.e. Jalisco -Jal.- and Michoacán) which reported high figures of pistol confiscation (see: Figure 5.20 and Figure 5.21).
Figure 5.18. GMI 1999-2004 (pistols, Mexico)

Given the z-score of 2.05535304072, there is a less than 1% likelihood that this clustered pattern could be the result of random chance.

Figure 5.19. GMI 2006-2011 (pistols, Mexico)

Given the z-score of 0.544472844503, the pattern does not appear to be significantly different than random.
Figure 5.20. Anselin Local Moran’s I 1999-2004 (pistols, Mexico)

Figure 5.21. Anselin Local Moran’s I 2006-2011 (pistols, Mexico)
5.4.4. Revolver confiscation

Overall revolver confiscation increased by 954%. In effect, confiscation levels increased in 29 out of the 31 Mexican states. Although there were some similarities in the ranks of confiscation, the order between the states was not always the same. In fact, the Spearman’s rank-order test found a moderate, positive, and statistically significant correlation ($r_s(29)=.61, p=<.001$).

Apropos of the geographical patterns, Figure 5.22 shows that most states had very low levels of confiscation during the first period. As a matter of fact, most states reported few dozens of confiscated revolvers (or less). By contrast, as shown in Figure 5.23, confiscations increased after 2005, specifically in three regions. One of these was the northwest, including the states of Chihuahua (Chih.), Sinaloa (Sin), and Durango (Dgo.). A second region with major increases can be seen in the northeast, predominantly in the states of Nuevo León (NL) and Tamaulipas (Tamps). A third significant region includes the states of Michoacán (Mich.) and Guanajuato (Gto.) in the centre-west. Figure 5.24 provides a more direct observation of the detected changes by showing the absolute change in confiscation per state. Notably, as previously reported for the case of pistols, while most states in the south experienced a minor increase -and at times, a reduction in their confiscation levels- much more substantial increases were often reported in the north and in the west.
Figure 5.22. Revolvers’ confiscation 1999-2004
(Count, equal intervals thematic classification)

Figure 5.23. Revolvers’ confiscation 2006-2011
(Count, equal intervals thematic classification)

Figure 5.24. Absolute change in the confiscation of revolvers
(Natural breaks thematic classification)
Despite these relevant overall increases from one period to the other, only six states saw a proportional increase in their levels of revolver confiscation. In fact, as suggested in Figure 5.25, one of these exceptions was Chihuahua, in the north of Mexico, for which the ratio increased from 6.7% to 8.1%. Other states with greater (proportional) increases were Michoacán, Tamaulipas, and Sinaloa. It is noteworthy that these three states with the largest proportional increases in revolver confiscation were the same that also had the largest increases in the confiscation of pistols. Results from the Chi-square test suggest that the changes for these 15 states were significant ($X^2 (14) = 1157, p<.001, V= 0.3853$).

![Figure 5.25. Ratio of revolvers confiscated by state (1999-2004 vs. 2006-2011)](image-url)
Revolver confiscation was also concentrated during the first period, but certainly, to a lesser extent than pistols. However, in a similar way to the pattern reported for pistols, revolver concentration also increased over time (see: Figure 5.26). This notable change in concentration can also be seen when studying the states with the most confiscations. While five states accounted for 38% of all confiscations during the first period, these accounted for 65% during the second. As expected, this change in concentration is echoed by the increase in the value of the Gini indices calculated for both periods. Throughout the first period this index was equal to 0.44, but during the second it was 0.67.

![Figure 5.26. Concentration of revolver confiscation (1999-2004 vs. 2006-2011)](image)

Analysis regarding the WMC of revolver confiscation found an important change over time (see: Table 5.4). In line with expectation, the WMC moved
approximately 124 kilometres/77 miles northwest, from Noria de Angeles, Zacatecas, to El Yerbanis, Zacatecas (see also Figure 5.23). As would be expected, given the above results, this pattern suggests that the mean of revolver confiscation moved closer to the border with the U.S.

Table 5.4. Change in WMC (revolvers)

<table>
<thead>
<tr>
<th></th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999-2004</td>
<td>22.37</td>
<td>101.83</td>
</tr>
<tr>
<td>2006-2011</td>
<td>23.15</td>
<td>102.69</td>
</tr>
<tr>
<td>Effect</td>
<td>south to north</td>
<td>east to west</td>
</tr>
</tbody>
</table>

The patterns of revolver confiscation also differed from those found for pistols in terms of its agglomeration. For instance, results from the GMI show that patterns of revolver confiscation did not differ significantly from a random distribution for either period (see: Figure 5.27 and Figure 5.28). Results from the Anselin Local Moran’s I suggest the existence of two clusters of high-high states during the first period. One cluster was identified in the northern state of Sonora (Son.), a pattern that can be explained by the fact that its contiguous states, Baja California (BC), Sinaloa (Sin), and Chihuahua (Chih.), also had relative high levels of confiscations. A second cluster was identified in the state of Oaxaca (Oax.), a finding that can be explained by the relative high levels of confiscations in its neighbour, Guerrero (Figure 5.29). Neither significant clusters nor outliers were identified during the second period by this local statistic (Figure 5.30).
Figure 5.27. GMI 1999-2004 (revolvers, Mexico)

Figure 5.28. GMI 2006-2011 (revolvers, Mexico)
Figure 5.29. Anselin Local Moran’s I 1999-2004 (revolvers, Mexico)

Figure 5.30. Anselin Local Moran’s I 2006-2011 (revolvers, Mexico)
Overall rifle confiscation increased by 489%. With the exception of Nayarit (Nay.), Campeche (Camp.) and Yucatán (Yuc.), rifle confiscation increased across the other 28 states. When the rankings across the states for both periods are compared, a Spearman’s rank-order test (N=31) found a strong, positive, and statistically significant correlation ($r_s(29)=.71$, $p<.001$). This suggests that, although the association was not perfect, the rank ordering was constant throughout the studied years.

As reported for other guns, rifle confiscation also increased substantially after the mid-2000s. For instance, during the first period, confiscation levels were low. In fact, across most states, only a few dozen rifles (or less) were confiscated. Only ten states confiscated more than 100 rifles, Oaxaca being the one which reported the most with 465 units (Figure 5.31). Nevertheless, these volumes increased substantively during the second period. As was found for pistols and revolvers, there were three areas where confiscations increased most significantly. One area was the northwest, including the states of Chihuahua, Sinaloa, and Durango. A second area was the northeast, particularly in the states of Nuevo León and Tamaulipas (which border Texas). A third key area includes Michoacán-Guanajuato-Guerrero in the centre-west (see: Figure 5.32). The comparison between periods also confirms some patterns in line with expectation. While rifle confiscations reduced (or marginally increased) in the south, the largest increases
occurred across Mexico’s northern -but also western- states (see: Figure 5.33).
Figure 5.31. Rifles' confiscation 1999-2004
(Count, equal intervals thematic classification)

Figure 5.32. Rifles' confiscation 2006-2011
(Count, equal intervals thematic classification)

Figure 5.33. Absolute change in the confiscation of rifles
(Natural breaks thematic classification)
The analysis reported above suggested that Oaxaca had the highest levels of rifle confiscation during the first period. Data also suggests that, in this state, confiscations increased by 181 units (39%) during the second period. Nonetheless, from a comparative perspective, the proportional levels of confiscation in this state actually decreased as other states saw much larger changes. Figure 5.34 suggests a similar pattern (i.e. reduction) for most of the 15 states with the largest volumes of confiscations reported during the first period. More generally, analyses suggest that 20 states did not see any increase in their proportional levels of confiscations. Nonetheless, from those which did, Sinaloa, Michoacán, and Tamaulipas were the three states that had the highest relative increases. Remarkably, this pattern reported across these three states was also found for the analyses on pistols and revolvers. The Chi-square test suggests that the changes for these 15 states were significant ($X^2 (14) = 2611, p<.001, V= 0.3329$).
Figure 5.35 shows that rifle confiscation was also concentrated in a few states, and this concentration increased over time. While five states accounted for 53% of all rifles confiscated in Mexico during the first period, the same number of states accounted for 67% during the second. This increase in concentration is also evident from a comparison of the Gini indices across periods. That is, the Gini index of 0.63 for the first period was quite a bit smaller than that for the second (0.71), suggesting a higher concentration of rifle confiscation over time. It is also perhaps noteworthy that, during the second period, the concentration of rifle confiscation was close to reaching the 80/20 Pareto principle. In other words, the notion that suggests that 20% of the states accounted for 80% of all confiscations reported.

Figure 5.35. Concentration of rifle confiscation (1999-2004 vs. 2006-2011)
Analyses on spatial *relocation* over time were also conducted for the case of rifles. Results presented in Table 5.5 suggest that the WMC moved approximately 71 kilometres / 44 miles east/northeast, from Jiménez del Teul, Zacatecas, to El Ahijadero Zacatecas (see also Figure 5.32).

**Table 5.5. Change in WMC (rifles)**

<table>
<thead>
<tr>
<th></th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999-2004</td>
<td>23.21</td>
<td>103.86</td>
</tr>
<tr>
<td>2006-2011</td>
<td>23.32</td>
<td>103.17</td>
</tr>
<tr>
<td>Effect</td>
<td>south to north</td>
<td>west to east</td>
</tr>
</tbody>
</table>

Results from the spatial agglomeration analyses for rifles are, to some degree, similar to those found for pistols (particularly, at the *global* level). For instance, results from the GMI suggest that patterns of rifle confiscation were clustered during the first period, and random during the second (Figure 5.36 and Figure 5.37). Results from the Anselin Local Moran's I also offer important insights. During the first period, a cluster of high-high states was identified across three states in the northwest of Mexico (Figure 5.38). Results from the second period provide special focus to Michoacán, which was identified as a high-low outlier. Specifically, this latter pattern can be explained by the high levels of confiscation reported there, and the low levels in its contiguous states, such as Colima (see: Figure 5.39).
Figure 5.36. GMI 1999-2004 (rifles, Mexico)

Figure 5.37. GMI 2006-2011 (rifles, Mexico)
Figure 5.38. Anselin Local Moran’s I 1999-2004 (rifles, Mexico)

Figure 5.39. Anselin Local Moran’s I 2006-2011 (rifles, Mexico)
5.4.6. Shotgun confiscation

Overall shotgun confiscation increased by 438% between periods. In fact, 28 out of the 31 Mexican states saw an increase in their volumes of confiscation. The corresponding Spearman’s rank-order test (N=31) for this illicit market showed only a moderate, positive, and statistically significant correlation ($r_s(29)=.46$, $p=<.01$). In short, there was a (relative) stability in the rankings over time.

The spatial distribution of shotgun confiscation displays additional insights. For instance, Figure 5.40 suggests that most states reported low levels of confiscation during 1999-2004. In fact, only six states had more than 100 confiscations, while the top-3 states reported between 250 and 460. As it was estimated for other guns, shotgun confiscations also increased after the mid-2000s, although these increases were not evenly distributed either (see: Figure 5.41). Similar to pistol, revolver and rifle confiscation, there were three states in which increases were particularly considerable during the second period (i.e. Sinaloa, Tamaulipas, and Michoacán). Figure 5.42 shows these increases and other key additional patterns. For example, it reveals that, with the exception of Sonora (Son), all other northern states which border the U.S. had increases. This figure also shows that there were states in the centre of the country (and particularly in the south) where reductions in confiscations were observed. At first, these provide some evidence to suggest that significant increases in confiscations occurred mostly across Mexico’s northern states. Nonetheless, the importance of many confiscations
across western states -in contradiction of the hypothesis- should not be disregarded.
Figure 5.40. Shotguns’ confiscation 1999-2004
(Count, equal intervals thematic classification)

Figure 5.41. Shotguns’ confiscation 2006-2011
(Count, equal intervals thematic classification)

Figure 5.42. Absolute change in the confiscation of shotguns
(Natural breaks thematic classification)
Like the patterns found for other gun markets, most states (21) saw a reduction in their proportional levels of shotgun confiscation during the second period. Nonetheless, as suggested in Figure 5.43, there were two relevant exceptions in which substantial relative increases were reported: Michoacán and Sinaloa. Likewise, there was a third notable increase observed for other states (which accounted for 12% of confiscations during the first period and for 31% during the second). Interestingly, when this latter is decomposed by states, it is possible to see that Tamaulipas in effect accounted for 17% out of 31% reported (for this category) during the second period. As such, the fact that Tamaulipas did not appear explicitly in the figure is explained by the fact that this state was not amongst the top-15 states during the first period. The observation that Tamaulipas was present (although masked) suggests that the three states previously reported were key to explain the confiscation of this gun type too. Results from the Chi-square were significant ($X^2 (14) = 805, p<.001, V= 0.2981$).

**Figure 5.43. Ratio of shotguns confiscated by state (1999-2004 vs. 2006-2011)**
Analyses on the concentration for shotguns suggest this was high, and that it marginally increased over time (Figure 5.44). During the first period, five states accounted for 61% of confiscations; by the second, this number of states already accounted for 68%. In a similar way, this increase can be confirmed by the variation in the Gini indices computed for both periods (0.61 for the first and 0.70 for the second), which suggests a slightly higher concentration of confiscations over time. On top of this, this Figure also shows that the concentration during the second period was also close to the Pareto level, and in effect, to greater extent than previously reported for rifles.

![Graph showing concentration of shotgun confiscation](image)

**Figure 5.44. Concentration of shotgun confiscation (1999-2004 vs. 2006-2011)**

As previously examined, important changes in the confiscations across some states can have a substantial effect upon the WMC. In line with this expectation, I found that shotgun confiscation relocated spatially (Table 5.6)
as the WMC moved approximately 167 kilometres / 104 miles northwest, from Los Gomez, Guanajuato (Gto), to Morenitos, Jalisco (Jal). In light of this finding, it can be suggested that the spatial mean of confiscation for shotguns also moved closer to the U.S. border.

Table 5.6. Change in WMC (shotguns)

<table>
<thead>
<tr>
<th></th>
<th>Latitude</th>
<th>Longitude</th>
</tr>
</thead>
<tbody>
<tr>
<td>1999-2004</td>
<td>20.78</td>
<td>100.89</td>
</tr>
<tr>
<td>2006-2011</td>
<td>22.00</td>
<td>101.84</td>
</tr>
<tr>
<td>Effect</td>
<td>south to north</td>
<td>east to west</td>
</tr>
</tbody>
</table>

Considering the agglomeration analyses, results from the GMI indicate that patterns of shotgun confiscation did not vary significantly from a random distribution for either period (see: Figure 5.45 and Figure 5.46). Results from the Anselin Local Moran’s I suggest the existence of a cluster of high-high states during the first period. This pattern might be because of the high levels of confiscation both in Michoacán and in its neighbour, Guerrero, which reported high levels of shotgun confiscation (Figure 5.47). Neither clusters nor outliers were identified by this local statistic during the second period (Figure 5.48).
Figure 5.45. GMI 1999-2004 (shotguns, Mexico)

Figure 5.46. GMI 2006-2011 (shotguns, Mexico)
Figure 5.47. Anselin Local Moran’s I 1999-2004 (shotguns, Mexico)

Figure 5.48. Anselin Local Moran’s I 2006-2011 (shotguns, Mexico)
5.4.7. Confiscation of other guns

The confiscation of other guns increased by 1,420%. In fact, Yucatán was the only state for which confiscations did not increase. The Spearman’s test computed for the volume confiscated across all the states (N=31) shows a strong, positive, and statistically significant correlation ($r_s(29)=.75$, $p=<.001$). Put differently, although the association was not perfect, it was fairly steady over time.

Similar to other gun markets, confiscation levels reported for other guns substantially increased after the mid-2000s. Apropos of the first period, analyses indicate that confiscations across all states were 333 weapons (or less), and that in 23 states figures were lower than one hundred (Figure 5.49). After 2005, the growth in the levels of these weapons confiscated were so high that they exceeded those reported across all other gun types. As expected, these rises were not evenly distributed across the states. As with the patterns described for other types of weapons, the west, the northeast, and the northwest were the areas for which confiscations increased most extensively (Figure 5.50). The geographical distribution of the absolute difference per state suggests a number of key patterns. For instance, it shows that all northern states which border the U.S had large increases in their levels of confiscation. Unsurprisingly, Tamaulipas -which borders Texas- and Sinaloa in the northwest of the country were amongst these states. Large absolute increases were also seen in Michoacán and Guerrero. By contrast, reductions were observed mainly in the centre and the south of Mexico (Figure 5.51).
Figure 5.49. Confiscation of other guns 1999-2004
(Count, equal intervals thematic classification)

Figure 5.50. Confiscation of other guns 2006-2011
(Count, equal intervals thematic classification)

Figure 5.51. Absolute change in the confiscation of other guns
(Natural breaks thematic classification)
As in previous analyses, the state ratio of confiscations offers additional insights about the spatial and temporal patterns for the confiscation of other guns. For instance, it is important to notice that the ratio reduced across 21 states along the two periods. This pattern is also echoed in Figure 5.52 which suggests that, for most relevant states, proportional levels of confiscation decreased during the second period (and a Chi-square test found that this differences were significant \(X^2(14) = 1089, p<.001, V=0.1881\)).

An additional remark with spatial implications is that, with the exception of Michoacán, all other states for which (proportional) confiscation increased are located in the Northeast, and all border Texas (i.e. Tamaulipas, Nuevo León, and Coahuila). Of particular relevance is the case of Tamaulipas, for which confiscations increased by more than 7,000 weapons. With such levels of confiscation, it may not be wholly surprising that this border state netted 25% of all confiscations for this gun category during the 2006-2011 period.
Figure 5.52. Ratio of other guns conf. by state (1999-2004 vs. 2006-2011)

Figure 5.53 shows the evidence of concentration in the confiscation of other guns over time. In short, the curves presented here suggest that the level of concentration was very stable. In effect, five states accounted for 63% of all other guns confiscated for either period. Unsurprisingly, the Gini indices computed were very similar for these two distributions. While the Gini index was equal to 0.68 for the first period, it was 0.70 for the second.
I also studied overall *relocation* over time. Results from the WMC analysis suggest that confiscations of other guns moved 165 kilometres/102 miles east/southeast, from Villa MonteMorelos, Durango, to Tetillas, Zacatecas (see Table 5.7 and Figure 5.50). Remarkably, it should be also noted that this type of gun is the only one for which there is evidence of relocation from the north to the south (as opposed to from the south to the north, as reported across all other gun types in this chapter). A possible explanation for this effect could be the substantial increases in confiscations reported both in Guerrero and Michoacán, which certainly challenge the hypothesis that confiscations would only have increased in the north of Mexico. More generally, this pattern can also be a key contributing factors to explain why overall relocation -that is, for all guns- occurred, but that it was not as high as expected (note: this pattern was anticipated in section 5.4.2).
Finally, I present the results of the two spatial tools used to estimate the level of *agglomeration* in the confiscation of other guns in Mexico. Results from the GMI show that patterns were clustered during the first period, but random during the second (Figure 5.54 and Figure 5.55). Results from the Anselin Local Moran’s I suggest a cluster of high-high states during the first period, specifically in the northwest (Figure 5.56). This cluster could be explained by the fact that Sinaloa, Durango, Chihuahua and Sonora were all amongst the top-5 states with the most confiscations during that time. Interestingly, neither clusters nor outliers were identified by this local statistic during the second period (Figure 5.57).
**Figure 5.54. GMi 1999-2004 (other guns, Mexico)**

<table>
<thead>
<tr>
<th>Significance level (p-value)</th>
<th>Critical value (z-score)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.01</td>
<td>&lt; -2.58</td>
</tr>
<tr>
<td>0.05</td>
<td>-2.58 to -1.96</td>
</tr>
<tr>
<td>0.10</td>
<td>-1.96 to -1.65</td>
</tr>
<tr>
<td>0.10</td>
<td>-1.65 to 1.65</td>
</tr>
<tr>
<td>0.10</td>
<td>1.65 to 1.96</td>
</tr>
<tr>
<td>0.05</td>
<td>1.96 to 2.58</td>
</tr>
<tr>
<td>0.01</td>
<td>&gt; 2.58</td>
</tr>
</tbody>
</table>

Moran’s Index: 0.416587  
z-score: 3.678836  
p-value: 0.000234

Given the z-score of 3.67883611193, there is a less than 1% likelihood that this clustered pattern could be the result of random chance.

---

**Figure 5.55. GMi 2006-2011 (other guns, Mexico)**

<table>
<thead>
<tr>
<th>Significance level (p-value)</th>
<th>Critical value (z-score)</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.01</td>
<td>&lt; -2.58</td>
</tr>
<tr>
<td>0.05</td>
<td>-2.58 to -1.96</td>
</tr>
<tr>
<td>0.10</td>
<td>-1.96 to -1.65</td>
</tr>
<tr>
<td>0.10</td>
<td>-1.65 to 1.65</td>
</tr>
<tr>
<td>0.10</td>
<td>1.65 to 1.96</td>
</tr>
<tr>
<td>0.05</td>
<td>1.96 to 2.58</td>
</tr>
<tr>
<td>0.01</td>
<td>&gt; 2.58</td>
</tr>
</tbody>
</table>

Moran’s Index: 0.116516  
z-score: 1.406114  
p-value: 0.159690

Given the z-score of 1.40611436036, the pattern does not appear to be significantly different than random.
Figure 5.56. Anselin Local Moran’s I 1999-2004 (other guns, Mexico)

Figure 5.57. Anselin Local Moran’s I 2006-2011 (other guns, Mexico)
5.5. Discussion

In this chapter, I examined spatial and temporal *patterns* of gun confiscation in Mexico. Specifically, I investigated the following for each gun market. First, whether the rankings in the volume of confiscation across all the states were stable over time. Second, I examined the geographical distribution of gun confiscation. Third, I studied whether the subnational ratio of confiscation reported for the top-15 states changed over time. Fourth, I assessed whether the confiscation of guns was concentrated in few states, and if this changed over time. Fifth, I studied whether geographical relocation of gun confiscation occurred. Finally, I explored whether spatial clustering effects were present. Overall, I hypothesised that gun confiscation in Mexico has increased, and that rises were more pronounced in the north of Mexico. As will be discussed in more detail, I found partial evidence in favour of these hypotheses.

Table 5.8 summarises some key findings (step 2 on geographical distribution is excluded as the maps better visualise these patterns). Considering the overall results, evidence suggests that confiscations increased substantially across all markets. The rises are quite noteworthy. In some cases, the increases were greater than one thousand percent, as was the case of *other guns*. Additionally, it is notable that the lowest increase in confiscation reported in Mexico was for shotguns, which, as discussed in the previous chapter (that studies the U.S. gun production), coincides with the only market of guns in the U.S. that had a reduction in production after the mid-2000s.
The changes in the patterns of concentration also offer some relevant insights. For instance, as estimated by the Gini indices for both periods, confiscations across all markets became more concentrated over time (i.e. fewer states explain higher concentration of guns). This finding may be crucial for the market analyses presented in this thesis as it shows that patterns for confiscations in Mexico did not necessarily follow the patterns of concentration reported for gun production in the U.S. (for which concentrations either reduced or were stable).

This chapter also explored the extent to which the states that proportionally confiscated the most guns during the first period were the same during the second. Remarkably, most states that led the ranking of subnational ratio before the mid-2000s experienced a substantial decrease in their (proportional) levels of confiscation after 2005. In addition to some exceptions reported across a number of northern states that maintained (or increased) their proportional levels of confiscation, it is evident that there were three other states that increased their ratio across all different types of guns: Sinaloa, Michoacán, and Tamaulipas. I discuss these in more detail below.

In this chapter I also studied the percentage of firearms accounted for by the states that confiscated the largest volumes (for each period). Specifically, I analysed the approximate level of confiscation accounted for by the Top-5, Top-10 and Top-15 states. I found that not all markets are equally concentrated. Additionally, not all markets had the same baselines, and not
all experienced the same levels of increase (between periods). The top-5 states for pistols and rifles, for example, accounted for around 50% of all confiscations during the first period, and increased to levels of around 60% during the second. Meanwhile, the top-5 for shotguns and other guns accounted for 60% during the first period, and their concentration only increased marginally afterwards. The top-5 for revolvers, on the other hand, substantially increased their concentration from 38% to 65%. These differences in the concentration (of confiscated guns), as well as the increases reported are important as they have not been discussed elsewhere. Further research might focus on exploring the reasons for these differences specifically.

The chapter also examined the extent to which there is evidence of geographical relocation over time. The analyses concerning the WMC also offer some key findings. In fact, in line with one of the hypothesis tested through the chapter, I found that, in all but one of the types of gun, the WMC values indicated a relocation of the average latitude/longitude of confiscations from the south to the north of Mexico (i.e. in closer proximity to the border with the U.S.). Essentially, this pattern reported in Mexico is the opposite of the one found in the U.S., in which the production of guns relocated from the north to the south. These two patterns indicate that the spatial centres of the supply of, and the demand for, guns effectively moved closer to each other and to the U.S.-Mexico border. However, it should be acknowledged that while this is in line with the hypotheses tested, some of the changes were relatively modest.
Table 5.8. Inter-period summary of effects (step 2 is excluded)

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>All guns</td>
<td>Ratio increased in 11 states. Michoacán, Sinaloa and Tamaulipas showing the largest prop. increases</td>
<td>Before (0.56)</td>
<td>After (0.67)</td>
<td>South to North West to East</td>
<td>Clustered</td>
</tr>
<tr>
<td></td>
<td>Increase of 94,490 (702%) overall. Conf. inc. in 30 states.</td>
<td>Top-5: 50.5%</td>
<td>Top-10: 78.7%</td>
<td>Top-15: 88.9%</td>
<td>Combined: 56km NE</td>
</tr>
<tr>
<td>Pistols</td>
<td>Ratio increased in 7 states. Michoacán, Sinaloa and Tamaulipas showing the largest prop. increases</td>
<td>Before (0.55)</td>
<td>After (0.66)</td>
<td>South to North East to West</td>
<td>Clustered</td>
</tr>
<tr>
<td></td>
<td>Increase of 29,605 (638%) overall. Conf. inc. in all states.</td>
<td>Top-5: 51.8%</td>
<td>Top-10: 75.2%</td>
<td>Top-15: 87.3%</td>
<td>Combined: 52km NW</td>
</tr>
<tr>
<td>Revolvers</td>
<td>Ratio increased in 6 states. Michoacán, Sinaloa and Tamaulipas showing the largest prop. increases</td>
<td>Before (0.44)</td>
<td>After (0.67)</td>
<td>South to North East to West</td>
<td>Random</td>
</tr>
<tr>
<td></td>
<td>Increase of 8,192 (854%) overall. Conf. inc. in 29 states.</td>
<td>Top-5: 38.1%</td>
<td>Top-10: 84.6%</td>
<td>Top-15: 91.3%</td>
<td>Combined: 124km NW</td>
</tr>
<tr>
<td>Rifles</td>
<td>Ratio increased in 11 states. Michoacán, Sinaloa and Tamaulipas showing the largest prop. increases</td>
<td>Before (0.53)</td>
<td>After (0.71)</td>
<td>South to North West to East</td>
<td>Clustered</td>
</tr>
<tr>
<td></td>
<td>Increase of 19,127 (489%) overall. Conf. inc. in 28 states.</td>
<td>Top-5: 53.9%</td>
<td>Top-10: 86.1%</td>
<td>Top-15: 96.5%</td>
<td>Combined: 71km E/NE</td>
</tr>
<tr>
<td>Shotguns</td>
<td>Ratio increased in 10 states. Michoacán, Sinaloa and Tamaulipas showing the largest prop. increases</td>
<td>Before (0.51)</td>
<td>After (0.70)</td>
<td>South to North East to West</td>
<td>Random</td>
</tr>
<tr>
<td></td>
<td>Increase of 8,738 (438%) overall. Conf. inc. in 28 states.</td>
<td>Top-5: 61.6%</td>
<td>Top-10: 78.4%</td>
<td>Top-15: 93.4%</td>
<td>Combined: 167km NW</td>
</tr>
<tr>
<td>Other guns</td>
<td>Ratio increased in 10 states. Michoacán, Sinaloa and Tamaulipas showing the largest prop. increases</td>
<td>Before (0.68)</td>
<td>After (0.70)</td>
<td>North to South West to East</td>
<td>Clustered</td>
</tr>
<tr>
<td></td>
<td>Increase of 28,828 (1,420%) overall. Conf. inc. in 30 states.</td>
<td>Top-5: 63.5%</td>
<td>Top-10: 89.0%</td>
<td>Top-15: 95.2%</td>
<td>Combined: 165km E/SE</td>
</tr>
</tbody>
</table>

++Positive, Sig=statistically significant / Conf. inc. = confiscations increased / Prop. = proportional / NE=Northeast, NW=Northwest, SE=Southeast, SW=Southwest, E= East / HH= High/high value (cluster), HL= High/low value (outlier), etc. Coefficients for the tests and the Gini indices in brackets. Step 6 focuses on relevant states.
Nonetheless, it is also important to note that the magnitude of these WMC variations were not homogenous for all the different types of guns. In the case of pistols, for example, the inter-period change reported suggests a WMC relocation of only 52 km. For other markets, the variations reported are higher, ranging from 71 to 167 kilometres. Particularly interesting was the case of shotguns for which there was the largest spatial change in WMC between periods (167kms.). This substantial relocation might be relevant taking account of the fact that the production of shotguns in the U.S. was the one that relocated the most towards Mexico, exactly during the same period (See Chapter 4).

These results, however, should be observed critically, in particular considering some of the findings from previous Chapter 4. The most relevant example of this is the case of shotguns. In Chapter 4, it was found that the production of shotguns in the U.S. marginally reduced after the mid-2000s. According to this finding, it would be expected that confiscations of this gun type in Mexico would also reduce (during the same period). Nonetheless, this did not occur as shotgun confiscations in Mexico also increased. A number of possible reasons can explain this unexpected pattern. A likely explanation can be found in the spatial trends of shotgun manufacturing. As previously discussed also in Chapter 4, the production of shotguns in the U.S. is the one which moved the most from the north to the south (towards the border with Mexico). In fact, as discussed in the previous chapter, Texas became the national leader in the production of shotguns. This consideration would then explain why even though overall shotgun production in the U.S.
decreased, the increases in production reported in Texas may have provoked an increase in confiscation (of this type of gun) in bordering Mexico.

Moreover, further research is required to provide an explanation concerning other patterns found. In this chapter, for example, it was observed that the market for other guns was the only one that relocated from the north to the south. Ideally, further studies should include a more comprehensive analysis to explain why this pattern occurs.

Table 5.8 also summarises the evidence regarding agglomeration and other spatial patterns found in the illegal demand for guns in Mexico. Although the evidence is very diverse, some interesting patterns are noteworthy. On the one hand, it is evident that for around half of the studied markets over time, the statistical tests found data to be clustered. Similarly, it is remarkable that many of the results found from the Anselin Local Moran’s I suggested the relevance of two areas with most confiscations: the North West (where high-high states were mostly reported), and the West, around Michoacán and Guerrero (where high-high clusters and high-low outliers were often described).

5.6. Conclusion

There are three major conclusions from this chapter that deserve particular attention. First, there is evidence to suggest that, irrespective of the gun type, confiscations of all guns increased after the mid-2000s in Mexico.
Second, there is also evidence to suggest that confiscations were not uniformly distributed neither in time nor in space, and that this heterogeneous pattern became more evident after the mid-2000s (when more guns were apparently trafficked). The increases in guns confiscated tended to concentrate in ‘corridors’ or zones of higher intensity that can be detected in some areas of the country, mainly during the second period. As expected, states in the north (and in close proximity to the U.S.) often saw the largest increases in confiscations after 2005. Similarly, as expected, the analyses on confiscations also show there were states in the centre of the country (and particularly in the south) with no substantial increases and even relative reductions in confiscations.

Third, while there is evidence of change that is consistent with the hypotheses explored in this chapter, it is also true that there were other states that challenged this argument. Across all gun markets it was evident that Tamaulipas, Michoacán and Sinaloa had some of the largest increases in confiscation. Of these three states, Tamaulipas borders Texas, and Sinaloa is a northern state, thus in these cases the patterns of consistent with expectation. However, the western state of Michoacán also ranked amongst the states with the most confiscations. As a matter of fact, Michoacán (and to some degree, other southern states such as Guerrero) can probably explain why the overall relocation effect south-north was not as evident as expected.
This certainly raises a key question: what do Sinaloa, Michoacán, and Tamaulipas share in common? For instance, it is relevant to note these three states had the presence of the largest criminal organisations operating in the country (Mexican Government, 2012). These were La Familia in Michoacán, the Zetas-Golfo in Tamaulipas, and the Sinaloa cartel in Sinaloa. Additionally, these criminal groups also confronted each other during some years across the studied period. In this context, the increases in the levels of confiscations can be understood as a result of rises in the demand for guns by these criminal organisations. In other words, it is possible to assume that there were more guns in these states as the criminal groups operating there may have been preparing to confront each other, and the state authorities as well.

While an in-depth study of the links between illegal gun prevalence and criminal groups’ operations is outside the scope of this chapter, the analyses presented here effectively suggest that there is a possible nexus. Clearly, further research is required particularly to understand whether there are other situational, contextual, spatial, or social variables that explain why some states present a higher demand for illegal guns than the others.

Evidence presented in this chapter suggest that having more empirical evidence about the illegal demand for guns can undoubtedly open several avenues for possible crime-reduction interventions. Specifically, more comprehensive analyses of the illegal markets can be useful to design interventions that can effectively mitigate gun trafficking, and that can
eventually help to mitigate the gun violence challenge experienced since the mid-2000s in Mexico. Some additional analyses that link the supply and the demand of guns are presented in the next Chapter 6.
Chapter 6. Triangulation

In Chapters 3-5, I examined key patterns in the supply and demand for guns in the U.S.-Mexico context and tested the opportunity hypothesis using a range of datasets. In this Chapter, I draw on alternative sources of data to provide additional evidence and a further test of the main *opportunity hypothesis* proffered through this thesis. The intention is that these analyses further assist in assessing the plausibility of the argument. First, I conduct a number of basic empirical analyses to provide additional evidence regarding the link between gun production in the U.S. and gun confiscation (and violence) in Mexico. Second, I report the findings of a series of novel interviews with law enforcement officers who have experience of tackling and disrupting the illegal market of guns between the U.S. and Mexico. The aim of the second section is to provide the reader with more information regarding the context, dynamics, and the *modus operandi* that gun traffickers implement in this binational setting. Overall, through the triangulation of data sets, the aim is to help further validate the key patterns discussed in previous chapters of this thesis.

6.1. More guns, more crime: further evidence

In Chapter 3, I presented an *input-output-outcome* model that summarises the key rationale of the thesis. This model represents three steps. The first is the *input*, which suggests there was an increase in the production of guns in the U.S. The second represents the *output*, which indicates there were more
(illegal) guns in Mexico due to trafficking. The third is the outcome, which suggests that an increase in the number of (illegal) guns in Mexico facilitated a rise in violent crime there.

This section presents three analyses that follow these steps to provide additional evidence concerning the opportunity hypothesis tested in this thesis. As discussed, the input concerns the increase in guns in the U.S. (as well as opportunities for trafficking in general). The output concerns gun confiscations in Mexico. Finally, the outcome is related to gun violence (resulting from these guns) in Mexico.

6.1.1. Input: U.S. gun producers and dealers at the border with Mexico

Over the course of this thesis, I have argued that a key factor to understanding why the trafficking of guns between the U.S. and Mexico has increased after the mid-2000s is the rise in the production of guns in the U.S. (and its associated spatial distribution towards the south with Mexico). While I presented empirical evidence to support the existence of this specific pattern, there might be additional contributing factors. Amongst others, it could be expected that the number of private firms that produce and/or sell guns in the U.S. might also provide additional information concerning the input under scrutiny (i.e. the supply of guns the U.S.).

If there were a rise in the number of gun producers and dealers in the U.S. after the mid-2000s, the argument would be therefore that not only gun
production has increased, but also the number of firms involved. This pattern may have several implications for the thesis. For instance, a large number of manufacturers and retailers may suggest a more competitive market, and possibly, a reduction in the prices of the guns, with a potential impact upon the black market discussed in Chapter 5.

Indeed, existing evidence suggests that the number of U.S. Federal Firearms Licensees (FFLs) that can trade guns (officially called FFL Type 01=dealer, 02=pawnbroker and 03=collector by the ATF) has increased after the mid-2000s (see: Figure 6.1). Likewise, ATF data suggests that the number of gun manufacturers (officially called Type 06 and 07 by the ATF) has also increased in the U.S., following a similar pattern (see: Figure 6.2).

![Figure 6.1. Number of U.S. FFL gun dealers per year](image)

Figure 6.1. Number of U.S. FFL gun dealers per year
Based on ATF data (2015)
While these two figures show a national trend that is similar to those in ‘U’ form previously observed for other data (such as homicide in Mexico, discussed in Chapter 3), they do not necessarily suggest that the increase was larger at the southern U.S. border with Mexico. Yet, other evidence suggests this could be the case. For example, Figure 6.3 shows that, in addition to hundreds of gun manufacturers, there are over 730 gun dealers (Type01) in the counties along the U.S.-Mexico border. This level of concentration is higher than in other locations (further from the border) with more population. In New York City, for example, there are 159 gun dealers, while in Chicago there are 101 (Safer America, 2018). That is, there is a proportion of (around) 6 to 1. These figures provide additional evidence regarding the observation by Mc Dougal (2014) discussed in Chapter 5, who noted ‘the possibility that FFLs may tend to cluster at the US–Mexico border in numbers disproportionate to the local U.S. population they serve’ (p. 303).
Overall, this provides additional evidence in favour of an increased input, as I argued in Chapters 3 and 4.

Figure 6.3. U.S. gun dealers along the Mexican border
Generated by MetricMaps based on ATF data, referenced by Ingraham (2016)

6.1.2. Output: Gun confiscation in Mexico is linked to U.S. production

Having a large number of guns in the U.S. is a basic condition for the model presented here, but it is not the only one. The second factor required for this model to be valid is an increase in the output. In other words, an increase in the number of guns that are trafficked to, and then circulate through Mexico.

Previously, I also argued that the increase in the production of guns in the U.S. (after the mid-2000s) was associated with the increase in the number of guns confiscated in Mexico. While I discussed this in Chapter 3, additional analyses provide more explicit evidence of this pattern. More specifically, three analyses in particular (discussed below) provide additional support of
the existing links between the trends in guns production in the U.S. and confiscations in Mexico.

The first evidence discussed concerns the similarity between the trends in gun production in the U.S. and those reported for confiscations in Mexico when the types of weapon are considered. To elaborate, in Chapter 4 I presented the types of firearms manufactured in the U.S. In that chapter, ATF data corresponding to the 2006-2011 period suggested that around 36% of all the guns produced in the U.S. were pistols, 10% were revolvers, 39% were rifles and 15% were shotguns. Interestingly, firearm trace data of U.S. guns confiscated in Mexico during 2011 shows a very similar pattern (ATF, 2012). For example, around 38% of all guns confiscated in Mexico during 2011 were pistols, which is similar to the 36% of all guns manufactured in the U.S. (that were also pistols). In the same manner, around 10% of all guns confiscated in Mexico were revolvers, which is similar to the proportion of guns considered revolvers (out of the total) that were manufactured in the U.S. A similar proportion between the type of guns produced in the U.S. and those confiscated in Mexico is also seen for other markets of guns (see: Figure 6.4). This pattern is certainly consistent with the suggested link between gun production in the U.S. and gun circulation in Mexico.
Second, there is evidence to suggest that southern U.S. states tend to participate more in the trafficking of guns to Mexico than those further from the border. This indicates that both geography and spatial proximity play an important role in the spillover effect that I study here. To elaborate, a report using ATF trace data detailed the source of all American guns confiscated in Mexico during 2006-2009 for which the exact source location in the U.S. was known. I present the most relevant findings here (see Figure 6.5 and Figure 6.6 below).

For instance, analyses suggest that southern U.S. states that border Mexico were found to be overrepresented in terms of the number of guns that were illegally exported to Mexico that originated from that state. In fact, the four states that border Mexico account for more than 70% of all guns confiscated in Mexico. Theoretically, they should account for around 8% if the likelihood of guns being trafficked from a state was equally distributed.
Figure 6.5. Source of guns confiscated in Mexico by U.S region
Based on ATF- Mayors Against Illegal Guns (2010)

Third, analyses suggest that, in terms of the origin of guns that are confiscated in Mexico, the role of the southern U.S. states that share a border Mexico has increased over time (and naturally, that the role of states further from the border has decreased). Figure 6.6 presents evidence of this specific pattern.

Figure 6.6. % of guns conf. in Mexico from U.S. four border states / total
Based on ATF- Mayors Against Illegal Guns (2010)
These previous patterns can be observed more clearly when the figures for the trace data across states are compared. Table 6.1 presents the information for all states, considering the four-year period for which data exist (2006-2009). The subsequent figures also show that Texas, California, Arizona, New Mexico and other southern states that are relatively close to the border with Mexico (such as Florida and Colorado) account for most of the confiscated guns in Mexico.

In fact, more than half of all guns confiscated in Mexico during this period came from Texas and Arizona only. Furthermore, the (relative) prominence of these two southern states would be even greater nationwide and in terms of the comparison with other southern states if population was controlled for. The figures presented below offer (spatial) evidence of this pattern in much more detail. In all cases, Texas and Arizona emerge amongst the most important ‘gun exporter’ states, and become even more so, when controlling for population (not shown). This provides additional evidence to support the findings presented in Chapters 3 and 4.
Table 6.1. U.S. source states for guns recovered and traced in Mexico

<table>
<thead>
<tr>
<th>Source state</th>
<th>2006</th>
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<th>2008</th>
<th>2009</th>
<th>2006-2009</th>
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<tr>
<td>South Dakota</td>
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<td>10</td>
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<tr>
<td>Vermont</td>
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<td>1</td>
<td>1</td>
<td>1</td>
<td>3</td>
</tr>
<tr>
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<td>4,439</td>
<td>8,021</td>
<td>5,190</td>
<td>18,850</td>
</tr>
</tbody>
</table>

Source: ATF- Mayors Against Illegal Guns (2010)
Figure 6.7. Source of U.S. guns confiscated in Mexico 2006

Figure 6.8. Source of U.S. guns confiscated in Mexico 2007

Figure 6.9. Source of U.S. guns confiscated in Mexico 2008

Figure 6.10. Source of U.S. guns confiscated in Mexico 2009
6.1.3. Outcome: violence in Mexico

The third component of the model is the outcome. That is, all the different consequences in terms of crime and violence that may be related with (or facilitated by) the guns trafficked into Mexico. In this case, I present nine examples that provide additional evidence to suggest that outcomes changed in line with expectation. The first is that there has been an increase in the use of firearms in homicides committed in Mexico (as opposed to the rate of homicides alone). As with most countries, the reporting rate for homicide in Mexico is very high (INEGI, 2015). Since firearms have been consistently controlled in Mexico, if their availability remained constant, then it is reasonable to assume that their use in homicides should also remain stable over time. In contrast, if their use in such offences increases (after the changes in gun law in the U.S.), this would provide further evidence to suggest that more guns became available over time and increased opportunities for offending.

Figure 6.11. Annual total homicides in Mexico (by use of gun)
Source: Produced by the author based on INEGI (2015)
Figure 6.11 shows the trends in firearms use over time in homicides. This figure indicates that homicide in Mexico not only changed in terms of volume, but also in terms of the violence used. For the period 1999-2004, the annual count of homicides was generally on the decline. This trend can mostly be attributed to a reduction in offences that involved weapons. However, after 2005, the ratio of homicide offences that involved weapons increased, and did so around the same time that the volume of confiscations of firearms also increased. To some degree, this provides additional evidence that a higher volume of guns was illegally introduced (and used) in Mexico after the mid-2000s.

Figure 6.12 shows the trends in firearm injuries (for the years in which data exist). For the period 2002-2004, the number of overall firearm injuries, as well as the number of intentional firearm injuries, were on the decline. By 2004, the number of intentional firearm injuries was at the lowest recorded level. Nonetheless, after the mid-2000s, the number of intentional firearm injuries increased, and a result of this, the volume of overall firearm injuries also increased. Like in the case of gun homicide (previously discussed), this pattern also provides some support that a higher volume of guns was illegally trafficked to (and used in) Mexico after the mid-2000s.
The other seven cases that I discuss below also suggest that an increase in the availability of (illegal) guns in Mexico facilitated the emergence or growth of violent offences. In general, there is available evidence to suggest that there has been an intensification of the violent operations conducted by OCGs in Mexico, potentially, as a result of more firepower. In effect, since the mid-2000s, there has been an increase in crimes that benefit from having access to an illegal firearm, such as extortion and kidnapping (SNSP, 2014). Furthermore, it is also evident that in most cases the trend observed across these offences is similar to the one of ‘U-form’ observed for homicide (previously discussed). That is, that crime reduced during the first years of the period, reached a low level during the mid-2000s, and then experienced a substantial increase. This pattern can be observed across a number of serious crimes, including auto theft (Figure 6.13), kidnapping (Figure 6.14), robbery (Figure 6.15), and to a lesser degree, extortion (Figure 6.16).
Figure 6.13. Auto theft (rate per 100,000 inhabitants in Mexico)
Generated by the author based on SNSP data (2014)

Figure 6.14. Kidnapping (rate per 100,000 inhabitants in Mexico)
Generated by the author based on SNSP data (2014)
In addition to these cases, it is also relevant to note that other crimes (not typically considered as serious offences), which will now be discussed, also increased substantially during the studied period. What these offences have
in common is the use of physical violence, threat and intimidation, made possible by the use of firearms.

One relevant example is the case of oil theft. As shown in Figure 6.17, the number of clandestine taps – that are used to illegally extract oil from supply lines - has increased substantially since the mid-2000s. Evidence from the Security area of PEMEX, the national oil company, also suggests that rather than being a disorganised crime, heavily armed groups are those in charge of illegally extracting the oil from the pipelines. In fact, armed confrontations between the Army/Federal Police and these groups have already occurred: on average 2 per month were reported in 2017 (Mendez, 2017). Potentially, some OCGs (that were perhaps previously focused on other crimes such as drug trafficking) might have eventually diversified their activity to this lucrative crime too, taking advantage of the firepower they had recently acquired.

![Figure 6.17. Oil theft reported cases - pipeline clandestine taps (totals)](Generated by the author based on Pérez Esparza & De Paz (2017))
Another example concerns deadly attacks against security personnel (Army and Police officers), as shown in Figure 6.18. Before the mid-2000s, no member of the Mexican Army had been killed by organized criminals (the victims were mainly local police). However, this situation subsequently changed, presumably as a result of criminals accessing more powerful guns which were used to threaten institutions (and the public servants who work for these). Some specific examples may provide additional evidence to support the emergence of this new modus operandi. For instance, some places in the north of Mexico have accounted for a large number of cases, with the number of attacks escalating substantially over time. The northern state of Tamaulipas, for example, reported one attack in 2007, but a total of 42 by 2011 (Sanchez, 2013). Most of these attacks have occurred in this state. This observation is particularly pertinent as Tamaulipas was identified in Chapter 5 amongst the states with the highest volume of confiscations. Tamaulipas also borders Texas, which, as discussed, became a leading manufacturer of rifles and shotguns in the U.S after the mid-2000s.

![Figure 6.18. Deadly attacks against security personnel (totals)](image)

*Figure 6.18. Deadly attacks against security personnel (totals)*

Generated by the author based on INEGI (2018)
Figure 6.19 shows the trends of attacks on local politicians, particularly Mayors. As briefly discussed in the introduction, it is relevant to note these attacks began in 2004/2005 and have substantially increased since. Again, the trend observed is consistent with expectation, given the opportunity hypothesis.

![Figure 6.19. Deadly attacks against Mexican Mayors (totals)](source: Produced by the author based on Pérez Esparza & De Paz (2018))

As discussed above, the aim of this chapter was to provide additional evidence concerning the main opportunity hypothesis proffered throughout this thesis. This first section aimed to present a number of basic empirical analyses to show the links between the input (production of guns in the U.S.), output (confiscation of guns in Mexico), and outcome (violence in Mexico) studied in this thesis. The key remark from this section is that, in addition to the empirical analyses presented in previous chapters (i.e., Chapter 3), other data and patterns help to assess the plausibility of the key argument of this thesis. Perhaps the most important contribution is that all of
the examples presented here suggest that, after the mid-2000s, (a) gun production in the U.S. increased, (b) the illegal prevalence of guns in Mexico increased, and (c) different types of violent offences (that benefit from having access to an illegal firearm) also increased. By and large, this evidence suggests that there has been an intensification in the violent operations conducted by OCGs in Mexico, and that this coincided with an increase in the availability of weapons produced in the U.S. and that (on the basis of data concerned with confiscations) were circulating in Mexico.

In the following section, I report the findings from a series of novel interviews conducted with law enforcement officers with experience of tackling and disrupting the illegal market of guns between the U.S. and Mexico. The aim of this particular section is to provide the reader with more information regarding the context, dynamics, and the modus operandi that gun traffickers implement in this binational setting. Essentially, the objective of this specific research is to provide still more evidence to enable the triangulation of results, but this time using a different research methodology.

6.2. Gun trafficking: modus operandi

Despite the magnitude of the U.S.-Mexico illegal gun markets, which -as discussed in Chapter 5- are considered to be amongst the largest and most profitable around the globe (UNODC, 2013; UNODC, 2015), very little is known about how trafficking occurs. The only academic research on this issue of which I am aware is by Goodman and Marizco (2010), who
interviewed government officials to study the *modus operandi* of gun traffickers in the U.S.-Mexico region (discussed below). This section builds upon Goodman and Marizco’s (2010) study. The research reported here is based on a qualitative study of 45 interviews with law enforcement and state security officers in both the U.S. and Mexico. The intention of this section is twofold. On the one hand, it aims to provide further insight into how gun trafficking occurs, as this offers additional context to the findings reported elsewhere in this thesis. On the other, it aims to support the validation of key patterns related to the studied phenomenon. To do this, this section follows the strategy of cross verification. That is, the study of the same phenomenon, using a different research method, with the aim of increasing the validity of the findings (in this case, through interviews).

The section is organised as follows. First, I discuss the key findings reported by Goodman and Marizco (2010) since they help to frame this chapter. Next, I describe how the interviews with law enforcement officials were conducted. Finally, I discuss the key findings from the interviews, and the implications for this study.

### 6.2.1. The Goodman and Marizco (2010) Study

In their research, Goodman and Marizco (2010) used a qualitative approach to interview government officials about the *modus operandi* reported in the trafficking of firearms between the U.S. and Mexico. While these scholars did not report the number of officers who participated in this study, their
research suggests they conducted most interviews with personnel from the U.S. Immigration and Customs Enforcement (ICE) and the U.S. Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF). A number of interviews were conducted by phone and email, while others were conducted face to face in Arizona, California, and Washington, DC. A visit to Mexico was also reported. There they conducted an interview with an official from the Centre for Research and National Security (CISEN), and with two Mexican Customs officials in Ciudad Juarez (Chihuahua) and Nogales (Sonora). Interviews were conducted between December 2009 and August 2010.

Goodman and Marizco (2010) reported a wide range of findings. For example, those interviewed suggested that traffickers and organised crime groups (OCGs) tend to prefer dealing in and using specific types of guns. Interviewees suggested that criminals prioritise the importation of semiautomatic assault rifles, such as AK-47s, AR-15s, and their clones. Traffickers typically obtain guns through straw purchasers and gun shows. Most pertinent to this thesis, however, were the findings related to transportation routes and techniques used for the commission of this crime. The study identified three key corridors: (1) The “Houston Corridor,” running from Houston, San Antonio, and Laredo, Texas, and crossing the Tamaulipas border; (2) The “El Paso Corridor,” running from El Paso, Texas, across the border at Ciudad Juarez, in the Mexican state of Chihuahua; and (3) The “Tucson Corridor,” running from Tucson, Arizona, across the Sonora border. Interviewees also agreed that the most common method of transporting firearms across the U.S.-Mexican border was by
vehicle. Nevertheless, not all traffickers were believed to use the same *modus operandi*. Some do not hide guns assuming that inspections are unlikely, while others employ more complex techniques such as ‘concealing the guns inside boxes and bags’, ‘zip tying the firearms to a hidden compartment of the vehicle’, or ‘stuffing the firearms under a truck bed liner or in a fuel tank’ (Goodman and Marizco, 2010, p. 194).

Goodman and Marizco’s (2010) research provides clear support to suggest that U.S. officials (at least) perceive that guns are routinely trafficked from the U.S. to Mexico and contributes to our understanding of these patterns of gun trafficking. However, this research leaves some questions unanswered and consequently additional interviews were conducted.

### 6.2.2. Data

Data were drawn from semi-structured interviews with 45 law enforcement personnel from the U.S. and Mexico. Of the 45 interviewees, 36 were conducted with Mexican officials, and 9 with U.S. officials. The reason for the larger sample of Mexican officials was to compliment the study by Goodman and Marizco (2010) who effectively reported the viewpoints of U.S. officials, while the perspectives of their Mexican counterparts were almost not considered. Interviewing a larger sample of Mexican officials was also intended to shed more light on how traffickers move and distribute weapons once they are in Mexico.
A questionnaire with 25 items was designed and used to guide the interviews (see Appendix A). The items were open questions as this approach offers the advantage of encouraging respondents to provide a full and meaningful answers using their own knowledge and expertise, as suggested by Worley (2015). In all cases, I encouraged the discussion of other topics that came up during the interviews as they were likely to be relevant for the study of gun trafficking.

Due to differences in the expertise of the participants, some of the questions were more relevant to specific interviewees. For this reason, the questionnaire follows a flexible approach, including branching questions. That is, the possibility of skipping some questions depending on the answers given. Hence, not all interviewees answered all questions.

6.2.2.1. Sampling

Participants were recruited using snowball sampling. More specifically, non-probability purposive sampling was used to ensure that individuals with particular backgrounds or characteristics were interviewed (Etikan, Musa, & Alkassim, 2016; Guest, Namey, & Mitchell, 2013). In this case, the ‘eligibility criteria’ for participants were that they had to have working experience in the security sector, and a background in the fields of firearms trafficking and/or border control. Stakeholders considered in the U.S. included officials working for the U.S. Customs and Border Protection (CBP), U.S. Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF), U.S. Drug Enforcement
Administration (DEA), U.S. National Security Agency (NSA), and police authorities with experience of gun trafficking. Stakeholders considered in Mexico included officials working for the Army (SEDENA), the Navy (SEMAR), the Federal Police (PF), the Centre for Investigation and National Security (CISEN-Interior Ministry), the General Attorney Office (PGR), Customs (SAT), Foreign Affairs (SRE), and local police agents.

The inclusion criteria strategy also aimed to accomplish two additional goals. First, I intended to include the perspective of law enforcement officials who had knowledge both on the national picture, as well as officials with local expertise. Second, I also focused on recruiting participants with experience across states that were found to be relevant for this illicit market, either for the supply (U.S.) or the demand for guns (Mexico).

Following this strategy, around half of the interviews with Mexican officials occurred in Mexico City. The aim of these interviews was to understand the key national patterns of gun trafficking. I also visited and/or interviewed authorities with local experience across different regions of Mexico. As the aim was to achieve a balanced interpretation of this security challenge, the cities in which interviews were conducted were: the city of Parral in the state of Chihuahua (north-west of Mexico), the city of Monterrey, Nuevo León and the corridor of Reynosa-Laredo-Matamoros, in the state of Tamaulipas (the northeast-border with Texas), the city of Oaxaca, Oaxaca (in the south), the port of Tampico, Tamaulipas (northeast), and Morelia and Apatzingán, Michoacán (in the west). Interviews with U.S. officials were conducted in
Washington D.C. to provide a picture of national patterns. And, interviews were conducted in Houston, Austin, San Antonio, and McAllen (Texas), to elicit information concerning more local dynamics. These cities were chosen as they had been found to be amongst the key sources for gun trafficking into Mexico, according to the ATF data analysed in this thesis, and also in the study by Goodman and Marizco.

More generally, I also followed an approach called ‘maximum variation purposive sampling’, one of the seven types of purposive samples (Etikan, Musa, & Alkassim, 2016). The key advantage of this approach is that it helps to select as heterogeneous a sample as possible within an initially narrow set of parameters, with the aim of providing a diverse range of cases that are relevant to the phenomenon under examination (Guest, Namey, & Mitchell, 2013). An essential element of the approach is, for example, to find and recruit participants who are as dissimilar as possible even when snowball sampling is used. As a result of this method, I recruited participants with different tasks and hierarchy (within the agencies), with the aim of providing more viewpoints concerning the studied phenomenon. In terms of the sample, one U.S. respondent held a leading position in his enforcement agency, around half of the remaining U.S. participants had middle management positions, whereas the other half had operational-field experience. Heterogeneity was higher still in Mexico. Four respondents held leadership positions (they were Directors or State Secretaries), approximately half of the other respondents had middle-to-high level
managerial positions, while the other half had working experience that can be better described as operational-field jobs.

6.2.2.2. Challenges

Perhaps not surprisingly, the research was not without challenges. Three issues are particularly noteworthy. First, was the problem of accessing participants and convincing them to share their knowledge. In both countries, it was difficult to find security officers that were open to discussing the phenomenon under study. This is not surprising as security officials are trained not to communicate what they do. As such, it was necessary to employ a snowballing strategy whereby a few participants were interviewed first, their trust gained, and then they were asked to recommend peers who might also participate. This approach was challenging and naturally took time. Additionally, from a methodological point of view, the use of snowballing requires the discussion of an important caveat. That is, that the information reported in this Chapter is not, and cannot, be considered as representative of all officials.

Second, confidentiality was a key consideration in the participant recruitment process. At a very early stage of the research, it became evident that security agents, mostly in Mexico, would not participate if they were recorded. One likely reason for this is that in Mexico security officials are not familiar with being quoted or recorded, and academic research of this kind is still uncommon. Moreover, officials were not comfortable providing precise
examples of *modus operandi*, as some of the investigations were still underway. To overcome this challenge, I decided to ask participants to allow me to take notes but not to record the interviews. Although this approach has limitations, it was the only available alternative to gather data. However, the approach allowed me to gain rich information by allowing officials to speak freely. Other researchers including Ashby (2016), Alusala (2010), and Goodman and Marizco (2010) have adopted a similar tactic to elicit information from interviewed participants.

The final challenge was logistical. Due to their professional work and routines, interviews have to be conducted at times and places that were convenient for participants, but not necessarily for the researcher. In practice, this meant that a few interviews were postponed or interrupted, which increased the time and costs involved in completing the interviews.

6.2.2.3. Procedure

Before agreeing to participate, potential candidates were informed that they were able to stop the exercise at any point, as suggested by the ethical standards used in these studies. Participants provided their explicit informed consent to participate and all UCL regulations applicable to appointed public officials were followed. No private information were required from participants, and hence no records on these exist.
Interviews typically lasted one hour. Nonetheless, according to the availability of participants, a few (around 30%) lasted up to approximately 90 minutes. Around two-thirds of the interviews took place within the official buildings of the security agencies, while the rest were conducted in public places, such as cafés or restaurants. Most of the interviews (around 80%) were conducted face to face, and in the other cases, interviews were conducted using Skype or Telephone.

As previously discussed, the interviews focused on asking participants to share their knowledge and expertise concerning the most relevant features that characterise the trafficking of guns between the U.S. and Mexico. A number of approaches can be considered for the analysis of these interviews. Borrowing the concept of ‘themes’ from the qualitative research, I focus on the most common topics that (a) extended across the set of interviews and (b) were important to increase existing knowledge about the crime commission process of this offence (Braun & Clarke, 2006; Vaismoradi, Turunen, & Bondas, 2013; DeSantis & Noel, 2000; Ryan & Bernard, 2003).

In this manner, the most common topics discussed across the interviews included respondents’ perceptions on gun trafficking, the common sources from which guns are obtained, the *modus operandi* for the trafficking of guns across the border, and the strategies adopted by offenders to move the guns once they were inside Mexico.
An important caveat to remember is that not all interviewees responded to all questions. Therefore, what I present in the following section can only be considered as my interpretation of the descriptions shared by those participants, and cannot be understood as a 'universal answer'. Aiming to be as explicit as possible about how common the specific answers across participants were, I also report the number of officials who agreed on specific information/detail. For completeness, when data is available I also present the number of interviewees who did not share these perceptions as a way to provide the reader with an idea of the extent to which answers were consistent. In cases where the answers provided by interviewees were inconsistent, I comment on these contrasting responses.

6.2.3. Key results

Perhaps the most important finding from the interviews is that all participants commented that they believed gun trafficking between the U.S. and Mexico had increased over the last decade. Some were more explicit and suggested different years around the mid-2000s. There were, however, additional themes that are relevant to the thesis, which I discuss below.

A large body of literature (discussed in Chapter 2) suggests that offenders need to be also aware of specific opportunities, which are influenced by the spatial environment (Clarke & Cornish, 1985). Crime pattern theory (CPT) has developed this notion by suggesting that people's everyday activities influence their awareness spaces and, in the case of offenders, this impacts
their spatial decision-making when it comes to offending (Brantingham & Brantingham, 1993; Brantingham & Brantingham, 1995). According to this theory, offenders typically commit most of their crimes close to the places that they are familiar with, including their home location and other routine activity spaces (Rossmo, 2000; Townsley & Sidebottom, 2010).

Based on these theories, I aimed to explore whether traffickers are likely to get their guns from places with which they are familiar. In other words, whether individuals participating in this offence may be more likely to get firearms from gun shops or gun shows they had already visited, or those that are close to their homes or premises that are part of their daily routines. CPT theory refers to such locations as being within an offender’s awareness space.

Three U.S. officials discussed patterns that are relevant to this issue. Participant 42 indicated that people living near gun shops (or places where guns shows are organised) could be at higher risk of participating in this illegal activity, simply because guns are more accessible. A second participant agreed and suggested that -like in any crime- places closer to the offender’s home ‘would be preferred over distant ones’ (Participant 45). A third participant (a police officer in the U.S.) elaborated further on cases of gun theft in the U.S., as he argued that this is also a scheme used to obtain guns for trafficking into Mexico (Participant 44). According to him, there are basically two factors that influence the decision of offenders who steal guns (that may be later diverted into trafficking). The first factor is to find an
(unguarded) gun, as suggested by Eck’s Crime Triangle (2003) previously discussed. This explains, for example, the cases in which guns are stolen from vehicles in parking lots. A second factor that influences offender decision-making is their perception of the availability of (quick) escape routes. This officer suggested that places that ‘are more accessible’ (or easier to connect via a highway) would be more attractive than those that are not.

Five Mexican officials commented that being familiar with crossing the international border is a relevant skill to traffic guns. They suggested that individuals with more knowledge of the checkpoints and routes were more likely to become aware of trafficking opportunities. This idea, however, was not shared by all Mexican officials. In fact, two Mexican officers indicated that there is nothing that makes traffickers different from the rest of the population.

6.2.3.1. Routes

Interviewees were asked to identify the most common routes along which guns are moved, both in the U.S. and Mexico. One ATF official and one U.S. police officer (Participants 43 and 45) suggested that, according to their experience in the U.S., guns tend to move from areas where they are abundantly produced and sold, to areas where they are not. Likewise, they suggested that guns move from places of weaker regulation to areas of stronger regulation (where they often become ‘black market’ weapons). Such
responses are clearly in line with the perspective on black markets presented in Chapters 2 and 5.

In Mexico, due to their specialisation, officials from the Intelligence Agency (CISEN) and from the General Attorney Office (PGR) were particularly well informed about the trafficking networks used to smuggle guns. Four Mexican officers described the three routes defined by their U.S. counterparts: the Houston, El Paso, and Tucson corridors (discussed above by Goodman and Marizco, 2010). They also identified a ‘South route’, the only one that includes the movement of guns from locations south of Mexico to the north (i.e. from Guatemala and Belize, to Mexico). According to these participants, guns that moved along this specific route are typically older, as they are ‘left overs’ from the 1970s and 1980s wars in Central America. Additionally, the four participants who were familiar with these routes suggested that this specific route explained no more than 5-10% of all the trafficked weapons to Mexico. It was suggested that the reason for this was because ‘cheaper and newer guns can be found instead in the U.S.’ (Participant 28). In general, these routes described by the participants are similar to the spatial patterns of confiscations in Mexico presented in Chapter 5.

6.2.3.2. Sources

Officials were asked how -and where- individuals (with the explicit motivation for trafficking) get the guns in the U.S. In Mexico, a number of officials (10) commented that, to the best of their knowledge, the most common modus
operandi is for traffickers to use ‘straw purchasers’ to acquire guns, who then pass the weapons on to smugglers who move them across the border. This was believed to be particularly common for guns obtained from established gun shops, where prospective buyers are requested to present their ID (i.e., driving licence), and their personal information is subsequently used to conduct a background check.

One Mexican officer suggested that, despite restrictions, traffickers and straw purchasers can easily find a way to obtain guns. For example, this officer commented that since 2011 the ATF implemented the Federal Multiple Sale Reporting requirement. This requirement mandates FFL dealers in Arizona, California, New Mexico and Texas to report the sale of two or more semiautomatic rifles (with a calibre greater than .22). The idea was to identify transfers that occur at the same time or within five consecutive business days of each other, with the purpose of deterring traffickers.

As a result of this requirement, the system would identify potential traffickers who buy two rifles (or more) from the same gun shop. According to the officer, this specific requirement creates a loophole since the existence of many gun shops allow the same people to obtain several guns from different stores without being identified (or flagged, as officers called this). This fact, and the observation that gun shops are particularly concentrated across some counties near the U.S. border with Mexico (Ingraham 2016; GAO, 2016), would make trafficking guns purchased from gun shops at the Mexican border relatively easy (in terms of sourcing them at least).
Mexican officials were also asked about alternative sources of weapons in addition to gun shops. Seven Mexican officers suggested that gun shows (i.e. unofficial bazars) in the U.S. were a major source for the guns trafficked to Mexico. In contrast to regulated gun shops (where an ID and a ‘background check’ are often required for buying a gun), when individuals acquire firearms from gun shows they face no buying restrictions, neither in terms of the numbers of guns that can be bought, or in terms of their technical capability or firepower. According to the two Mexican officials who were more familiar with guns shows, this lack of control might create opportunities for trafficking into Mexico, as the law does not require a record of these transactions and guns are very accessible at these events. Almost all officials in the U.S. suggested that gun shows are more common in the south of the U.S. (particularly in Texas). Two officers suggested that this pattern can be seen throughout the number of gun show ads that appear in the monthly magazines, such as American Rifleman (published by the NRA), or through any weekly mailing list reporting the planned shows for the upcoming weekend, such as the Gun Show Trader.

Half of the U.S. respondents also suggested that local law enforcement agencies across the country are increasingly concerned about gun thefts, both from individual gun owners (i.e. guns taken from vehicles) as well as established gun shops. Participant 45, for example, commented a case of a gun shop robbery in 2016. In that case, ten men used a truck to pull the doors off of a Houston gun shop, taking more than 50 weapons in 30 seconds. This concern shared by some interviewees is echoed by additional
official and academic evidence. According to official statistics, at least 577 stores licensed to sell firearms in the U.S. were burgled in 2017 alone (ATF, 2017). A study conducted by Parsons and Weigend (2017) also showed that a firearm is stolen in the U.S. every 2 minutes, and that a large majority of these cases occur in the southern states that are near to Mexico. Additionally, this study reported that some states are overrepresented in the number of stolen guns. Texas, for example, reported the largest volume of guns stolen across the U.S. With more than 182,000 guns stolen in four years, the state of Texas is a clear hotspot of concern (Parsons & Weigend, Stolen Guns in America: A State-by-State Analysis, 2017).

6.2.3.3. Criminal networks

Participants were asked to provide insight into how they visualise the structure of the illegal network of actors involved in gun trafficking between the U.S. and Mexico. One U.S. official suggested that he and his team visualise a ‘blend of actors and networks’ (Participant 38). According to his perspective, some transactions are conducted by (one or more) opportunistic ‘entrepreneurs’ acting alone. In others, a Mexican, American, or Mexican-American organisation is directly involved, coordinating most of the operation, from acquiring the guns at a source location in the U.S. to trafficking them to their destination in Mexico.

Respondents from Mexico’s General Attorney Office (PGR) seemed to agree with the perception that individuals, small groups (i.e. gangs), and members
of more established cartels are all involved in this crime. One participant suggested that although it is evident that guns are trafficked for the use of OCGs in Mexico who demand these for protection, intimidation, and for the commission of crimes that would not be as easy and profitable without guns (i.e. kidnapping), not all groups get their guns in the same way. This participant suggested that while some criminal organisations are more disposed to *outsource* the way in which they illegally import guns, older and more hierarchical cartels (such as Sinaloa) tend to have ‘more formal networks and more specialised teams who are in charge of supplying the guns to all the group’ (Participant 26).

While assessing the role of the *established cartels*, three officials from the PGR suggested that they had found some patterns that provide key information about the network. According to one participant, the Cartel of Sinaloa, for example, is believed to have an alliance with criminals that provide guns in the states of Oregon, Utah, Arizona, Colorado, California, and to a lesser extent, Massachusetts. The Zetas-Golfo, on the other hand, was believed to have connections in Washington, Minnesota, Wisconsin, and the Northeast of the U.S. Criminal organisations from Michoacán are believed to have imported guns from Colorado, Kansas, Oklahoma, Florida, and Virginia. Two participants from the PGR also indicated that they believe that all major Mexican OCGs have imported guns from three out of the four U.S. southern states that border Mexico (Arizona, California and Texas), and that they estimate these three states are the largest exporters of illegal guns to this country (Participants 26 and 27). It is important to note that almost all
officials perceived Arizona and Texas -states found to be major gun producers in Chapter 4- to be major sources of illegal weapons.

One interviewee from the PGR also suggested that, while there is no universal rule, they estimated that southern states in the U.S. ‘tend to export more illegal guns to Mexico than northern ones’ (Participant 27). When asked for possible reasons that could explain this pattern, he discussed a number of factors that are common to the southern states, including (a) proximity to Mexico, (b) higher levels of gun production and supply, and (c) ‘more flexible approaches to guns than in the north’. Markedly, these explanations seem to provide additional evidence to support the findings discussed in previous chapters.

6.2.3.4. The border

A key component of the interviews concerned participants knowledge of specific examples of common _modus operandi_ that they have witnessed (or have heard from peers) when traffickers move guns across the U.S.-Mexico border. Respondents in the U.S. suggested that the most common technique employed is what in Spanish is called _tráfico hormiga_. That is, rather than trafficking guns in large amounts (i.e. for example, using large containers or big trucks full of guns), participants suggested that smugglers actually traffic most guns in the U.S. in very small batches, using vehicles.
Interviewees from Mexico seemed to agree that these batches often contain between two and seven weapons in each transaction. Participants on both sides of the border also agreed that there are rational reasons for choosing the *hormiga* system, including the possibility of reducing the risks (and the costs) in the case that guns are interdicted by authorities.

Of particular interest to this research was the question of whether gun traffickers use the official crossing points for vehicles (as opposed to remote areas of the border). Around half of the Mexican participants and all U.S. interviewees agreed that traffickers move most guns into Mexico by using one of the 48 authorised international official crossing points for vehicles.

Two officials in the U.S. and three in Mexico explained this as a result of the observed differences between the security measures employed by the two countries. To explain, they commented that as a result of 9/11, the U.S. government implemented a number of administrative reforms to better protect the border, including the creation of the Department of Homeland Security. This Department has increased the use of technological detection instruments and K-9 border patrol dogs. As explained by four participants, there are three key aims of this policy: (a) to deter illegal migration, (b) to prevent the trafficking of drugs, and (c) to stop terrorists who plan to enter the U.S. As a result, when driving from Mexico (south) to the U.S. (north), all vehicles are inspected. However, no attention is given by U.S. authorities to vehicles travelling from the U.S. to Mexico. Summarising this tactic, one of
the U.S. participants suggested that ‘they care for what is coming in, but not really for what is coming out’ (Participant 40).

Two security officers in Mexico criticised this approach and the lack of effective measures implemented by the Mexican authorities as a whole. Traditionally, according to their own description, Mexican officials are trained to focus only on confiscating drugs that move from the south of the country, to the northern U.S. border. They suggested that most law enforcement attention from Mexican authorities is devoted to monitoring south-north flows. As such, no real consideration is given to screening vehicles driving from the U.S. into Mexico. Unsurprisingly, this lack of guardianship creates several opportunities for gun trafficking.

Four interviewees in Mexico suggested that there used to be checkpoints between the Mexican border cities and the rest of the Mexican territory. Although their purpose was linked with the tax policy of the time, and was not security-related, these checkpoints were useful in deterring gun traffickers since they were aware that their vehicles were subject to inspection (e.g. a diffusion of benefit scenario). However, with the aim of facilitating trade, particularly after 1994 when the North American Free Trade Agreement (NAFTA) was signed, these checkpoints were eventually removed. This decision could have had the unintended consequence of increasing opportunities for gun trafficking. The interplay of all of these factors may explain, at least partially, why traffickers mostly use official crossing points (i.e. least effort principle). Likewise, it may also explain why most of them see
no major risk of detection. These findings provide support to the theoretical considerations regarding Rational Choice presented in Chapter 2, and to the idea of *opportunities* discussed in the course of this thesis, more generally.

As discussed by three Mexican participants, most of the efforts implemented by authorities in Mexico do not focus on inspecting the movement of vehicles from north to south. There are, however, some exceptions in which inspections have been implemented, offering key lessons. For instance, respondents from the Mexican Army and the Federal Police suggested they have found the use of allegedly legitimate businesses acting as a ‘mask’ for gun trafficking. One participant from the Federal Police indicated that they have identified private companies that, due to internal corruption or threats from OCGs, are found to be trafficking guns. Interestingly, the companies were not thought to be chosen at random. Some firms that transport chemicals were believed to be emerging as a common target, as they are often excluded from intensive screening for security reasons. Likewise, companies transporting metals are a natural alternative as guns (or their parts) are easily concealed, and their vehicles are not subject to metal detector screening. These are examples of offenders taking advantage of legitimate activities to conceal their illegal ones, a strategy that has been discussed elsewhere in the literature (e.g. Felson, 2006, p.11).
6.3. Conclusion

The aim of this Chapter was to discuss additional evidence that makes use of different data to test the main *opportunity hypothesis* presented in this thesis. In the first section, using different data to that used in Chapters 3-5, I presented a number of simple empirical analyses to show the links between the *input* (production of guns in the U.S.), *output* (confiscation of guns in Mexico), and *outcome* (violence in Mexico).

Regarding the input, I presented evidence that suggests that the number of U.S. gun manufacturers and gun shops has increased after the mid-2000s. There are some signs that this increase was probably larger at the southern U.S. border with Mexico. In addition to a larger volume of guns manufactured (discussed in Chapter 4), these patterns may also have facilitated the trafficking of guns into Mexico.

I also presented evidence that shows an increase in the number of available guns in Mexico (i.e. the output). In fact, more specifically, the evidence presented suggests an association between the patterns of gun manufactured in the U.S. and those confiscated in Mexico. One of the key findings in this regard is that most of the guns confiscated in Mexico after the mid-2000s came from Arizona and Texas, which as discussed in Chapter 4, became top gun manufacturers after the mid-2000s.
The last set of analyses presented in the first section of this Chapter concerned the increase in violence in Mexico after the mid-2000s (i.e. the outcome). A first key remark is the fact that gun homicide (as opposed to homicide in general) has substantially increased since 2005. A similar pattern is observed for firearm injuries. Furthermore, I also presented evidence that indicates that offences that benefit from having access to an illegal firearm also increased after the mid-2000s. This is evident for serious crimes (e.g. auto theft, kidnapping, robbery), but also for offences that did not exist before in the country, such as oil theft, attacks on military personnel, and deadly assaults on elected politicians. These analyses further contribute to assessing the plausibility of the key argument presented in this thesis, and the findings are consistent with it.

In the second section of this Chapter, I reported the findings from a series of novel interviews with law enforcement officers who have experience of tackling the illegal market of guns between the U.S. and Mexico. The aim of the second section was twofold. First, it aimed to provide further insight into how gun trafficking occurs, as this offers additional context to the findings reported elsewhere in this thesis. Second, the interviews aimed to support the validation of key patterns related to the studied phenomenon.

There are three observations from this section that are of particular relevance to the thesis. The first is that all participants commented that gun trafficking between the U.S. and Mexico has increased during the last decade. The second concerns the involvement of the southern U.S. states.
In this regard, Texas and Arizona, were considered by the interviewees as major sources of the guns that are trafficked into Mexico. The third is that places in Mexico with the largest volume of confiscations were the same as those recognised by security officers as major routes in this country. The additional findings discussed in this chapter are thus largely in line with opportunity argument articulated throughout the thesis and help to provide further support for the key patterns discussed in the previous chapters.
Chapter 7. Conclusions

7.1. Gun trafficking as an explanation for violence

Poverty, corruption, weak security-sector institutions, illicit drug markets, and other hypotheses have been articulated by academics and policymakers as explanations for why Mexico became a violent country. These hypotheses are similar to the mainstream arguments that most Mexican citizens would consider as explanations for the increase in violence. In a recent survey, most respondents in Mexico suggested that poverty, the lack of values, corruption, the high demand for illicit drugs from the U.S., and the Calderón’s military crackdown on the drug cartels were the key factors that explain the rise in violence (Schedler, 2014). Most of these possible explanations have been repeated systematically in public debates, but lack empirical evidence.

A number of reasons can explain why this debate has been so incomplete, flawed and uniformed. On the one hand, it should be recognised that, as crime data suggest, violence in Mexico was not considered an issue until recently (Heinle et.al., 2015; SNSP, 2015). Therefore, empirical studies on crime and violence have not been common. On the other hand, it should be acknowledged that studying criminal violence has been particularly challenging in Mexico due to the way it has emerged and evolved. As data analysed through this thesis suggest, violence in Mexico has not only increased intensely in a very short time period, but has also displaced tactically and spatially as never before; and probably, as in no other country...
in peace in recent times (IISS, 2018). Immersed in such a challenging context, a key question that still needs to be answered is the extent to which these popular hypotheses can actually explain what occurred in Mexico after the mid-2000s.

Throughout this thesis, and particularly in Chapter 3, I presented empirical evidence that suggests that most of these traditional hypotheses do not seem to explain the rise in violence in Mexico. Perhaps most importantly, these perspectives also ignore three relevant factors that restrict their ability to explain crime (and homicide) increase in the long term.

For instance, these popular explanations tend to ignore the fact that homicide in Mexico reduced during the twentieth century. As such, since they only focus on the years after crime increased, they ignore other structural factors that can also inform long-term variations in crime. Second, these hypotheses often fail to recall that some of the explanations presented are not exclusive for the years in which crime increased, as the same conditions existed before. Third, these common notions also disregard new offending patterns that can also help to explain violent crime more generally.

Two examples illustrate this point. First, consider the hypothesis concerning illicit drug markets as the key factor for homicide increase. As reported by the survey discussed above (Schedler, 2014), many people in Mexico think that illicit drug markets alone explain why violence increased in the country. While official and academic evidence suggests that OCGs operating in Mexico do
produce some illicit drugs -such as marijuana or heroin-and traffic others, such as cocaine (Astorga, 2016; Valdés Castellanos, 2013; Mexico’s Government, 2018), this argument still ignores the important fact that OCGs involved in these trafficking networks (from and throughout Mexico) are not new. In contrast, and as suggested by scholars, these criminal organisations have effectively participated in the global illegal drug industry for at least one hundred years (Astorga, 2016; Valdés Castellanos, 2013). Hence, this phenomenon is not new, and as such, it seems an unlikely candidate to explain all of the increases in violent crime reported in Mexico since the mid-2000s.

Second, there are also new offending patterns that, I argue, provide insight into the increase in violent crime in Mexico that have been absent from the debate. One key example of this is the change in the relationship between OCGs and Mexican authorities. As I briefly discussed in the introduction to this thesis, during recent years OCGs started to attack not only the police and army officers, but also candidates and elected politicians. A recent study explored this, focusing on the spatial and temporal patterns associated with the deadly attacks against the local authorities, particularly Mayors. Since no official dataset existed, the study used Open Source Intelligence techniques (OSINT), and found that almost 200 Mayors, former Mayors, and elected Mayors have been attacked and murdered across Mexico (Pérez Esparza & De Paz, 2018). Notoriously, the first deadly attack against a Mexican Mayor by an OCG (in all recorded history) occurred around the mid-2000s, specifically in late 2004. Since then, attacks have become much more
frequent. Unsurprisingly, this apparent coincidence raises a key question: Why did these attacks start after the mid-2000s, and not before then?

One explanation for this was offered by Bailey and Taylor (2009) who suggested that, for decades, OCGs in Mexico decided to operate under the radar, doing everything possible to avoid been detected by the authorities. Rational choice theory would suggest that OCGs took this strategy, as it was probably the most cost-effective for them. The argument suggests that OCGs operated under the radar since they were aware that the authorities had more firepower and capability to use armed violence than they did. That these attacks against authorities began after the mid-2000s suggests that a key factor might have changed that affected this balance. I argue this factor is their capability to arm themselves as a result of new opportunities for gun trafficking. Absent the previous asymmetry in the potential for arms, OCGs may have found it more rational and profitable to use open and visible armed violence against the State’s authorities. This type of argument is, however, absent in the public (and most of the academic) debate on the increase in violence.

Instead of adopting the traditional positivistic perspectives previously discussed, in this thesis I postulated that what recently occurred in Mexico is, to a large degree, the result of an increase in opportunities for violence resulting from changes in the criminal setting that facilitated violent crime (Clarke, 1997). In particular, I found evidence to support a situational hypothesis. In other words, that the increase in violence observed in Mexico
since the mid-2000s might be better explained by an increase in the availability of illegal weapons that are trafficked from the U.S. to Mexico.

To test this first hypothesis, I examined whether federal changes to gun policy in the U.S. during the mid-2000s might be associated with the increased availability of illegal guns (and gun violence) reported in Mexico since then. I found that the Tiahrt Amendment in 2003, the AWB expiration in 2004, and the PLCAA enactment in 2005, are all likely to have increased gun availability in the U.S. Furthermore, I proposed that these, in turn, might have created new opportunities for the illegal supply of firearms to Mexico, which facilitated the use of violence by OCGs.

In this manner, in this thesis I provided a very different explanation for the violence experienced in Mexico since the mid-2000s. Specifically, I suggest that an exogenous shock (from the U.S.) created additional incentives amongst criminal groups to traffic more guns into Mexico (to use these against rivals, authorities, and civilian populace). Overall, I argue that this hypothesis is much more useful to explain some patterns recently observed in Mexico. For instance, a larger amount of illegal guns amongst criminal groups would help to inform why homicide, gun homicide, and other serious crimes in which the use of guns facilitate the offence (i.e. extortion, kidnapping, armed robbery, oil theft, etc.) have flourished in the country after the mid-2000s (and not before). In addition, this hypothesis would also help to explain why criminal organisations became violent after the mid-2000s, while they were not violent earlier. Likewise, and at least to some degree, the
argument that I present in this thesis would additionally help to explain why criminals in Mexico are now openly confronting the authorities, when they used to operate unnoticeably, and *under the radar*, only few years ago.

Essentially, the first key argument of this thesis is that higher access to guns in favour of criminals in Mexico has changed the rational incentives in the setting. In particular, following a rational choice approach, I argue that higher access to guns in Mexico has changed the incentives and dynamics seen in the relationship between rival criminal groups, between the law enforcement agencies and the criminals, and between the criminals and the citizens as a whole. These new incentives have allowed criminal groups to take more violent strategies as a result of a new calculation in which the expected benefits of acting violently (using guns) are higher than the costs and risks of not doing so.

### 7.2. The case for studying gun markets: supply and demand

The findings presented in Chapter 3 of this thesis suggested the relevance of studying in detail the way in which weapons (illegally) move from the U.S. to Mexico. To do this, I took a *market approach* that focuses on studying the supply and the demand for guns. For the purpose of this thesis, the supply of guns included the production of firearms in the U.S. (Chapter 4). Conversely, the (illegal) demand for guns included an analysis of all confiscations in Mexico (Chapter 5).
In general, for both the demand and the supply, I studied all the different types of guns individually (i.e. pistol, revolver, rifle, shotgun, other guns), but also all guns as a whole. I called these gun markets. Furthermore, to analyse the supply and the demand in more detail, I developed and followed a methodology including six steps. This approach involved comparing each of the gun markets (in both the supply and the demand) in a number of different ways, before and after the mid-2000s.

In the first step, I examined overall patterns of gun production (or confiscation), focusing mainly on observing the key trends over time, and across the states (as these were the units of analysis). In the second step, I studied the geographical distribution of guns, by producing maps of the U.S. and Mexico, before and after the mid-2000s, as well as one map comparing these two. In the third step, I studied the market share of the states with the largest volume of production (and confiscation), focusing on how these changed over time. I then analysed the extent to which there was evidence of the geographical concentration of gun production (and confiscation) over time, computing Lorenz curves and calculating the Gini index for each gun market. In the fifth step, I studied the evidence of geographical relocation of gun production (and confiscation) over time, using the weighted geographical mean centre (WMC). Finally, I analysed the existence of clusters of gun production (and confiscation) as they might be relevant to understand the gun markets. Overall, this market approach revealed important patterns in both the supply and demand for guns, as discussed below.
7.2.1. The supply of guns: key findings

In Chapter 4, which focuses on the supply of guns, I found evidence to suggest that new key patterns emerged in the U.S. around the mid-2000s, and that these are likely to have had an impact upon opportunities for gun trafficking to Mexico. For instance, I found that gun production in the U.S. substantially increased. In effect, when the two periods studied were contrasted (1999-2004 and 2006-2011), evidence suggests that overall production increased from around 20 to 28 million guns. Furthermore, with the exception of shotguns, all other markets (or types of guns) exhibited an increase in production between periods (nationwide). Nonetheless, these increases varied across markets. While the overall production of rifles increased by 36%, the manufacturing of pistols increased by 84%.

Second, I found that not all increases in firearms production were evenly distributed across the U.S. states - some states had larger increases than did others. Moreover, each single gun market and each state changed in different ways. In effect, it is possible to observe that increases in some states positioned them as relative specialists in some types of guns. In this manner, the increase in the production of shotguns was particularly apparent for Texas, while the increase in the manufacturing of pistols and revolvers was particularly evident for Arizona.

Third, I found that the production of guns was concentrated in relatively few states, but not all types of weapons were found to be concentrated to the
same extent. In particular, the production of revolvers and shotguns was
highly concentrated in only a few states. In contrast, the production of other
types of guns was distributed across more locations, albeit that production
was still highly concentrated.

Fourth, I found that the leading states across some gun markets changed,
and that a number of markets exhibited geographical relocation. Even though
the leading states with the highest level of production were often similar
across the two periods, there were also cases in which reductions or
increases were considerable, and this changed the ranking of the most
important states. This, in turn, also influenced the overall distribution of
production. Take, for example, the case of Connecticut (where reductions in
production were observed for rifles and shotguns), and those of Texas and
Arizona (where increases were observed for a number of types of weapons).
Furthermore, there were also cases in which the reduction of production in
some places was substituted for the increase in others, as companies
decided to relocate. This substitution effect was particularly evident for some
specific markets, such as the production of shotguns. For this particular type
of firearm, it was possible to identity a firm (i.e., Mossberg & Sons, Inc.)
which reduced its manufacturing levels in Connecticut but then increased its
levels of production (with the name of Maverick Arms) in Eagle Pass, Texas.

More generally, evidence presented in Chapter 4 suggested that the
production of all types of weapons tended to relocate from the north of the
U.S. to the south towards Mexico. Furthermore, in almost all cases, the
markets also relocated from east to the west. Nonetheless, these changes were of different proportions according to the market. While the production of shotguns moved 877km southwest, other markets such as revolvers only relocated 29km (in the same direction). While the findings of this chapter cannot establish causality, they are consistent with two key arguments that are relevant for the thesis. First, that there was an increase in the overall production of guns in the U.S. after the mid-2000s. Second, that the increase of production was particularly apparent nearer to the border with Mexico. Both findings might help to explain why there has been an increase in the trafficking of guns into Mexico since then.

7.2.2. The demand for guns: key findings

In Chapter 5, which focused on the (illegal) demand for guns in Mexico, I found evidence consistent with the idea that (estimates of) the illegal prevalence of guns in this country are associated with patterns of gun production reported in the U.S. For instance, analyses suggested that, irrespective of the gun type, confiscations of guns in Mexico substantially increased after the mid-2000s. In fact, the volume of confiscated guns increased almost twenty-fold between 2005 and 2011. Increases were particularly evident for some gun types. For example, in the case of other guns there was a 1,000-fold increase between the two periods.

An additional finding from this Chapter is that the increases for each type of weapon were generally consistent with the increases in production in the
U.S. The only exception was the case of shotguns, for which (overall) manufacturing marginally reduced in the U.S., but an increase in confiscation was reported in Mexico. As discussed, a likely explanation for this unexpected pattern is that Texas became the top producer of this gun type. As such, the increases in shotgun production reported in this state may have provoked an increase in confiscation (of this type of gun) in bordering Mexico (even when overall production in the U.S. decreased). To some degree, this may provide additional support to the argument that their legal and illegal domains are interconnected.

Second, as was reported for the analyses of gun production in the U.S., I found that not all changes (or increases) in confiscation levels in Mexico were homogenously distributed across space. In effect, the majority of the guns were confiscated in particular zones of Mexico. Of specific note were the northern states that border the U.S., as well as states with high-level intercriminal conflict in the north and west of Mexico (i.e. Sinaloa, Tamaulipas, and Michoacán). In contrast, the analyses showed that there were states in the centre of Mexico (and particularly in the south) where – also in line with expectation - relative reductions in confiscations were observed.

Third, I found that the confiscation of guns was concentrated in relatively few states, but that not all types of weapons were concentrated to the same extent. In general, analyses across all markets suggested that confiscation of guns became more concentrated over time (i.e. fewer states accounted for a higher concentration of guns). Nevertheless, each type of gun concentrated
differently. For example, the top-5 states with larger figures of pistol and rifle confiscation accounted for 50% of all confiscations during the first period, and for around 60% during the second. Similarly, the top-5 states with more confiscations of shotguns and other guns accounted for around 60% of all confiscations during the first period, but their concentration only increased marginally afterwards. In contrast, analyses for the market of revolvers suggested that concentration reported in the top-5 states increased from 38% to 65% across periods.

Fourth, I found that changes in the levels of confiscation might have provoked an overall geographical relocation of this black market. In general, although the illicit markets of guns in Mexico relocated less than those reported for the U.S., there is some evidence to suggest that they did in fact move. Essentially, analyses conducted suggested that for all but one of the illicit gun markets, there was evidence of relocation from the south to the north of Mexico (the category on ‘other guns’ was the exception). Notably, the pattern observed in Mexico is the opposite to the one identified in the U.S., in which the production of guns moved from the north to the south. This gravitation towards the Mexico-U.S. border is, of course, consistent with the argument put forward throughout this thesis.

7.3. Further research

There are, of course, several opportunities for further research. These will be identified and discussed in this section.
7.3.1. Expanding existing evidence and analyses

This thesis used data on gun production in the U.S. and gun confiscation in Mexico. While I argue that these two types of data advanced existing knowledge concerning the trafficking of guns between the U.S. and Mexico, it is also true that further research (and better data) is required.

Take, for example, the case of data on confiscations in Mexico. After a long process dealing with the Freedom of Information (FOI) procedure, I managed to obtain the data on all confiscations for the 1999-2011 period. The data, however, is limited from a geographical and tactical point of view. While there were some years for which information was provided at the city level (municipio), for most confiscated guns the data was disaggregated only at the state level. It was for this reason that the analyses reported in this thesis were conducted at this level. Analyses for smaller spatial units of analysis would obviously open up further avenues for future research and crime prevention.

The fact that data on gun confiscations is now being reported at the city level is certainly a step forward. Nonetheless, it might be still insufficient to propose specific situational interventions to address the large black market in Mexico. For instance, data at the city level does not provide the exact location where confiscations occurred. This is problematic as some Mexican municipios can be very large. For example, the municipio of Ensenada in
Mexico encompasses a total area of 52,482 km², which is roughly 35 times the size of London.

In contrast, having more precise information about the exact location of gun confiscations (i.e. precise x and y co-ordinates) could offer several advantages for the purposes of crime reduction. Existing academic research suggests that crime tends to concentrate in very small areas, a finding which has been suggested to reflect the ‘law of crime concentration at places’ (Weisburd, 2015). And evidence suggests that focusing crime reduction resources in such hotspots can reduce crime (Ratcliffe, 2004). With still more precision, recent empirical research has shown that the street network influences offender spatial decision making for other forms of offending, such as acquisitive (Frith, Johnson, & Fry, 2017; Davies & Johnson, 2015; Shu, 2009; Zaki & Abdullah, 2012) and violent crime (Summers & Johnson, 2017; Nubani & Wineman, 2005), findings which may enable the targeting of interventions to be even more specific than they currently are, and to better inform our understanding of why crime occurs where it does. In theory, such analyses could be applied to gun trafficking. Certainly, there are key differences between the static crimes that occur in one place with a precise location (such as burglary) and those that are closer to the concept of non-static, as defined by Newton (2004, p. 25) for the case of crime on public transport. Despite these differences, further research might test (and inform) innovative ways to capture the estimated location of the trafficked guns for the purpose of crime reduction.
In addition to gathering better data about the places at which crimes (i.e., the confiscation) occur, it is also possible to obtain more information about when confiscations occur, with a view to informing efforts at prevention. Examining “seasonality” (e.g. Ashby, 2016), be it in terms of patterns associated with specific hours of the day, days of the week, or months of the year may provide specific intelligence that is relevant to law enforcement efforts as well as informing criminological understanding. Researchers might examine whether traffickers prefer specific times of the day for committing their offences, and the extent to which patterns change over time (perhaps, after a gun show, a confiscation, or other interventions). This approach to analysis has long been applied to other forms of urban crime (e.g. Haberman & Ratcliffe, 2015; Haberman, Sorg & Ratcliffe, 2018) and there are likely to be benefits associated with doing this for gun trafficking.

In a similar vein, unfortunately, Mexican authorities do not currently seem to gather data on how each confiscation occurred. For example, authorities do not distinguish in their records as to whether a gun was confiscated at a motorway checkpoint, or whether the confiscation occurred after a homicide or other crime. Likewise, despite authorities having data on the number of offenders that were arrested for violations of a firearms law (overall), they do not link these data to information concerning each confiscation.

Unsurprisingly, substantial specifics of the crime are lost by not capturing and merging these details. Ideally, it would be very useful to record for each crime event (i.e. each confiscation) the number of offenders, as well as
additional details concerning how the gun was obtained (i.e., the source), which route was taken before it was introduced to Mexico, and if possible, the ‘back story’ of the gun more generally.

Recording information about the specific modus operandi in which each gun is confiscated would offer several avenues for applied research. To date, with the exception of the study by Goodman and Marizco (2010), (briefly discussed in Chapter 6), there exists no academic research on the specific schemes that traffickers use to smuggle the guns. If this form of trafficking is to be better understood and disrupted, this lack of evidence demands a serious research effort.

One approach that would aid such an endeavour is the use of the crime script technique - a framework developed by environmental criminologists to detail the crime-commission process. (Cornish D. , 1994; Leclerc, 2014). Crime script analysis focuses on studying the complete sequence of individual decisions and actions (i.e. steps) that are involved in a crime as a whole. The underlying idea of this method is that, understanding what occurs prior to, during, and after a crime has been committed can provide an effective way of understanding how the crime unfolds and for identifying methods of disrupting it (Cornish D. , 1994). The use of such an approach may help to identify situational (or other) approaches that might be used to disrupt gun trafficking flows, and illegal gun markets more generally.
Likewise, additional information about the offenders involved in such offences would be beneficial for both theoretical and practical reasons. Following the required cautions concerning data protection, it would be useful to gather information to test whether traffickers get most of their guns from locations near to their homes, or other places that are familiar to them, as Crime Pattern theory would suggest. Or, are they prepared to travel greater distances and to travel to unfamiliar locations to trade in weapons? Having more information about the offenders would also allow to conduct studies on ‘journey to crime’. These studies, which have been found to be very useful for the research of other offences, attempt to understand how offenders’ movements in space influence the detection of targets, leading to crimes of opportunity (Iwanski, Frank, Dabbaghian, Reid, & Brantingham, 2011). The key argument is that offenders do not engage in crime in areas that are distant from their place of residence (Brantingham & Brantingham, 1984). In fact, it is believed that most offenders engaged in volume (or serious crime) commit most of the offences close to their home location (Rossmo, 2000; Townsley & Sidebottom, 2010). Nonetheless, it is still unknown the extent to which this applies to all trafficking crimes, and to gun trafficking in the U.S.-Mexico context specifically.

Further information about the *modus operandi* of the traffickers would also help to assess the potential utility of using approaches such as ‘geographic profiling’ to inform law enforcement activity. Geographic profiling is an investigative methodology (and an information management system) used to prioritise the locations in which to focus law enforcement activity. Proposed
by Rossmo (2000) and more extensively by Canter & Youngs (2008), the approach uses the locations of a series of connected crimes to estimate the most probable area of an offender’s residence or routine activity space. Evidence gathered from tools such as these could guide law enforcement agents about where and how to implement specific interventions following the key lessons that have emerged from other offenders, such as serial murders (e.g. Lundrigan & Canter, 2001).

7.3.2. Including additional data sources

A variety of datasets were used in this thesis. However, future research might use other types of data. For example, one alternative would be to analyse court data (i.e. legal cases), as has been used by leading scholars for other crimes (Levi & Reuter, 2006). The advantage of using this type of source is that it can help to capture specific characteristics of the offence, the criminal, the place, or the decision-making process of the offender (i.e. modus operandi). In other words, it can reveal useful information about why offenders commit a specific crime, how they commit the offence, and what mechanisms are likely to stop (other similar offenders) from committing the crime. The recent popularisation of platforms such as LexisNexis® and Google Scholar Case Law® searching tool has opened several avenues for potential crime-related applied research that can also be implemented for gun trafficking.
A further approach, commonly used in the study of other types of crime would be to ask offenders how they obtain(ed) their guns. In the U.S., some scholars have conducted interviews with arrestees and prosecuted offenders who accepted to discuss their *modus operandi* in general, and sometimes they also accept to discuss how they obtained their guns, specifically (see: Cook et. al., 2015). There are some relevant studies in other settings, including the UK (Hales, Lewis, & Silverstone, 2006). To the best of my knowledge, no research has focused on this specific issue for the case of Mexico. There are, however, some interesting emerging windows of opportunity. Recently, the National Institute of Statistics and Geography (INEGI) launched a new national survey focusing on the incarcerated population (ENPOL 2016). Adding questions to this instrument that are intended to obtain information regarding the illegal acquisition of guns would increase our knowledge of how the trafficking of guns occurs in the U.S.-Mexico context.

### 7.4. Study contributions

The findings presented in this study offer a number of theoretical and practical implications, both for academics and law enforcement practitioners. Some of the most important points are discussed below.

#### 7.4.1. Economic theory, rational choice, and the market approach are useful for understanding the trafficking of guns
In general, this thesis illustrates the benefit of the application of basic economic theory to issues related with crime and security. As with any other economic good, this thesis aims to provide a reminder that guns can also create markets. Specifically, the research aimed to provide an empirical example concerning the influence that legal markets might (unintentionally) have upon illegal ones. As previously discussed in the literature review, this is relevant for the emergence of black markets. In effect, illicit markets (and specifically those of guns) can emerge as a result of (at least) two things. The first occurs, for example, when a gun is stolen and it becomes part of the black market; in other words, when it shifts from a legal to an illegal domain. The second has a spatial dimension. That is, a black market can emerge because of the physical movement of guns from a place where they are legal, to another where they are not. These two considerations are essential, but as discussed, they are not the only issues. Other notions from economic theory (and the rational choice perspective) are also appropriate to the framing of studies such as this presented here. For instance, the findings presented in this thesis suggest that the black market of guns (and the trafficking between the U.S. and Mexico that goes in parallel) is also the result of the differences in availability (and price). This, however, is mediated by the perceived risks from the side of the offenders. The findings from this thesis aim to act as an illustration that offenders involved in this type of crime are (likely) rational actors who aim to maximise their benefits. As such, possible interventions should consider these factors as a way of thinking about how to disrupt this form of offending.
Rational choice theories are also useful in forming hypotheses as to why gun trafficking and its associated illegal prevalence have a particular relevance in places that have become more violent. Two factors are relevant here. On the one hand, illegal guns in criminal possession diminish the capability of the state as guardian. In short, a larger amount (or more powerful) guns in criminal ownership (i.e. cartels) naturally reduces the incentives of police officers to react against armed criminals. This increases impunity, as well as other negative outcomes such as reducing social distrust in the authorities and institutional legitimacy. On the other hand, more guns owned by criminals increase the suitability and amount of targets. This scenario also creates additional costs for societies that are the victims of trafficking. As discussed, from a situational perspective, an increase in illegal prevalence basically (a) reduces a criminal’s perceived effort, (b) minimises a criminal’s perceived risk, and (c) increases the chances of anticipated rewards.

More specifically, this thesis advocates for the use of rational choice theories when aiming to disrupt (trafficking) crimes. As discussed, this approach was first proposed by Becker (1968) who suggested that criminals are rational actors. Offenders are defined as self-interested individuals who want to maximise their goals, and who use information from their environment to make purposive decisions related to committing a crime (or not). Lawbreaking is the result of expected utilities: offenders commit crime if the expected benefits from illegal action outweigh the associated costs (e.g., the probability of apprehension, conviction, and punishment).
As previously discussed, Cornish and Clarke (1975; 1986) later offered a more comprehensive argument based on Becker's notion. They analysed the relationship between the (perceived) costs and benefits of crime, and proposed that *opportunities* are relevant factors for understanding *why* crime happens at particular times and places. In this manner, instead of focusing on studying ‘criminals’ (i.e. personal stories or long-distance causes of crime), these scholars suggested that a focus on the specific dynamics associated with lawbreaking would be more productive. In other words, rather than concentrating exclusively on the offender, they suggested focusing on disrupting the *crime-commission process*. What would be the implications of using this school of thought for disrupting the trafficking of guns in the U.S.-Mexico context?

First, these notions suggest a focus on the importance of discrete *crime events*. For instance, instead of debating the background of the smugglers (i.e. their education or parenthood), rational choice theories assume that firearms traffickers are simply profit-maximising individuals (or groups) that take any available chance to commit this offence. Likewise, and as previously discussed, gun trafficking involves a group of crime events, as individuals can participate in different parts of the illegal chain. For instance, there are different levels of risk, legal responsibility, and benefit between those individuals who sell the guns in the place of source -knowing that they will be trafficked somewhere else- and those who act as ‘straw-purchasers’ in a gun shop, and those who personally move the guns across the borders.
Regardless the differences in motivations, at this point it is sufficient to say that all of them have something in common: their involvement in the offence is a decision based on the idea that the financial incentives (i.e. a ‘fee’ or ‘commission’) are greater than the risks of being arrested. By definition, this calculation between rewards and risks essentially justifies why traffickers *decide* to smuggle guns and this argument should be taken into account in any analysis of possible crime-reduction interventions.

Second, rational choice theories are useful for framing the phenomenon of firearms trafficking as they recognise the key role of opportunities in the local context. This statement has many practical implications. For instance, it suggests that, in places where guns are highly prevalent and accessible, individuals would be more likely to perceive plenty of opportunities for trafficking; and, if no strict enforcement exists, lower risks. In general, it is argued that more opportunities and lower risks are likely to explain why some places have a more important role as a source of weapons than others.

Third, as suggested by the Routine Activity Theory, any crime (including gun trafficking) is the result of the combination of three elements: a motivated offender, a suitable target, in the absence of a capable guardian. According to this theory, if gun trafficking occurs, this is the result of the interplay of these three criteria, and the lack of the three specific controllers who normally help to prevent crime. In other words, every single case of gun trafficking would suggest the existence of a *motivated offender* with criminal intentions and the ability to act on these inclinations (i.e. the trafficker), who,
in addition, did not have a handler to stop him/her, such as the partner, or the parents. Likewise, each case of trafficking would also indicate that the manager/guardian who should protect the key place, such as the border/custom official, did not achieve the required goal of stopping the smuggling. Thinking of gun trafficking in this way may provide additional ideas for disrupting the network efficiently and more strategically.

Finally, this thesis is, to the best of my knowledge, the first piece of research that combines rational choice approach with the market analysis (supply and demand). This approach could potentially offer new avenues for research considering other goods that are trafficked around the globe, including illicit drugs, or counterfeit legal products that are moved illegally (such as medicines or tobacco).

7.4.2. Gun markets change over space and time, and each gun market operates differently

To the best of my knowledge, this is also the first piece of research (at least in the U.S.-Mexico context) that shows just how the legal and illegal markets of guns have changed over time and space. The findings suggest that markets are not static or permanent, and by contrast, they change and move more than might be expected. I argue that this is relevant in two ways. On the one hand, with the exception of the studies conducted by Bauer (2013), few scholars have focused on studying the long-term commercial decisions (i.e. production) of the U.S. arms industry and the impact that this could (unintentionally) have on crime. More specifically, previous to this thesis,
there was probably no other empirical study that focused on exploring the impact of firms’ manufacturing relocation upon the spatiotemporal patterns of gun production in the U.S. In fact, this area of research is largely unexplored, and hence I aimed to participate in filling this gap. On the other hand, this is, to the best of my knowledge, the first study that has focused on the analysis of the spatial and temporal patterns of gun confiscation in Mexico. While there are limitations to the use of the data (i.e. they are a function of police/army activity), this can be considered a valid approach when analyses are conducted over time (see: Nowak, 2016); and perhaps even better, when data are triangulated to test hypotheses more thoroughly.

Also to the best of my knowledge, this is the first piece of research that shows that each gun market operates differently. This notion is important as, this factor has not been discussed in existing research. This finding can be useful in the design and implementation of interventions intended to disrupt illegal networks. For example, some of the findings might help to improve interdiction efforts. In Chapter 5 on Mexico, I found that the confiscation of illegal guns is concentrated in some states in particular, specifically in the north and west of the country. If authorities take these patterns of concentration into account, they are more likely to focus their interdiction efforts there; this might involve, for instance, inspecting specific motorways that connect these states. Similarly, I found that some states tend to import specific types of weapon. Being aware of this and the weapons preferred could increase the likelihood of detection. Suppose, for example, that offenders in one state mostly demand small pistols (as opposed to
shotguns). If X-ray (or other) detection systems are installed in the motorway heading to this particular state, it would make sense to calibrate these for the detection of the most popular guns along these routes. Additionally, having the capacity to monitor the trafficking of guns could help authorities to anticipate potential criminal spirals of violence. An increase in levels of confiscations in specific places might indicate that the OCGs operating there are planning to confront rival groups or authorities. Assuming that not all of the trafficked weapons are confiscated, such knowledge might usefully raise an alarm to encourage authorities to respond appropriately.

7.4.3. SCP is valuable to promote specific crime-reduction interventions

The situational crime prevention (SCP) matrix previously discussed in the literature review might be employed to inform specific strategies for preventing and disrupting gun trafficking.

One approach, for example, would be to implement a program that aimed to ‘reduce anonymity’, which in the context of this research would suggest, for example, that people participating in gun shows are invited to display their ID when attending them. Another approach would be to discourage imitation, by posting details of individuals who have been arrested and convicted for acting as straw-purchasers in gun shops. Similarly, another cell of the SCP matrix highlights the potential value of ‘removing excuses’. In this context, such a strategy would involve, for example, posting signs at the borders or custom areas, raising awareness about the gun problem, and communicating
the possible sanctions incurred if those involved are prosecuted for trafficking guns.

Similarly, Wortley and Mazerolle (2008) also suggest that the availability of weapons’ has an important role in acting as precipitator for crime. This is particularly significant if one assumes that the immediate environment can actively induce illegal behaviour, by creating or intensifying criminal motivations in individuals who may not have otherwise contemplated committing a crime at that time or place. At this point, perhaps the most relevant example to discuss is the lab-experiment of Berkowitz and LePage (1967) in which they found that the simple presence of a gun in a setting elicited more aggressive behaviour in participants in comparison to the same conditions without a gun. An intervention considering this argument may consider the implementation of measures aimed at increasing surveillance (i.e. guardianship), the effort required, or the risks perceived by offenders who smuggle guns through the border; for example, by implementing interdiction technology (i.e. x-ray) and evidence-based checkpoints.

In concluding, in Table 7.1 I summarise the key findings and recommendations reported in the thesis.
### Table 7.1. Summary

| Problem | • Many “traditional” and populist theories do not seem to explain the rise in violence in Mexico.  
• The findings of this thesis provide evidence to suggest that the increase in violence observed in Mexico since the mid-2000s might be better explained by an increase in the availability of illegal weapons that are trafficked from the U.S. to Mexico. |
| --- | --- |
| Factor: Supply | • The Tiahrt Amendment in 2003, the expiration of the AWB in 2004, and the enactment of the PLCAA in 2005, are all likely to have increased overall gun availability in the U.S.  
• The increase in the availability of guns is particularly evident across the U.S. southern states that share the border with Mexico.  
• These two previous factors -the national increase in gun availability, and the remarkably high increases alongside the U.S. southern border- might have created new opportunities for the illegal supply of firearms to Mexico. |
| Factor: Demand | • An increase in the number of illegal guns in Mexico changed the incentives and dynamics seen in the relationship between rival criminal groups, law enforcement agencies and the citizens as a whole. |
| Proposed solutions | • A more resilient and smart border (i.e. checkpoints)  
• More and better data on both sides of the border  
• More advanced analytical methods (i.e. predictive analytics)  
• SCP measures should be implemented with the intention of preventing trafficking |
This chapter presented a number of possible interventions aimed at disrupting the trafficking of firearms between the U.S. and Mexico. If these solutions are implemented, there needs to be a comprehensive agenda to systematically evaluate them. There are, of course, a number of different alternatives for this purpose. In the context of crime prevention interventions, Johnson, Tilley & Bowers (2015), proposed the EMMIE framework, which identifies five dimensions that can be useful for assessing evidence. These are: the Effect of intervention, the identification of the causal Mechanism(s) through which interventions are intended to work, the factors that Moderate their impact, the articulation of practical Implementation issues, and the Economic costs of intervention (p. 459). Ultimately, it is important to note that this thesis calls for the use of evidence; not only for completing an accurate diagnosis of the security problem, but also for developing and implementing suitable, effective, and long-term solutions.
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Appendix

Interview guide

1. How would you describe your professional link/experience with the trafficking of firearms?
2. What are the main challenges that you experience when implementing measures to tackle this offence?
3. What are the possible benefits that motivate offenders to participate in the trafficking of guns?
4. Are you familiar with the most common sources used by traffickers in the U.S.? What can you tell me about these?
5. What would you suggest about the main routes used by the traffickers?
6. How do you think that traffickers decide their routes? Are there any considerations they take?
7. Do you think that traffickers prefer some specific type of firearm? Why?
8. Would you suggest that the trafficking of firearms has remained the same across the years? Is there any particular change that you have noticed? When? Why?
9. Is there any difference between the traffickers according to the region where they operate?
10. Do you have any idea concerning how traffickers introduce the guns into Mexico?
11. Would you say that there are specific times and places in which there are more episodes of gun trafficking?
12. Could you describe some of the steps that you think traffickers follow for the commission of this offence?
13. Have you noticed any distinctive pattern that is shared by most traffickers?
14. Do you have any idea that you can share regarding the groups or individuals that participate in this offence?
15. Do you think firearms traffickers are only engaged in this crime, or would your experience suggest that they may be linked to other illegal acts as well?
16. Do you have any hypothesis about the specific modus operandi that traffickers used to introduce the firearms into Mexico? Do you think this trend has been stable or has changed over time?
17. Have you heard of any particular case of gun confiscation (or arrest) conducted by your peers, or have you participated in any? Can you describe how this occurred?
18. Are you familiar with the modus operandi used by traffickers to move the weapons once they are in Mexico?
19. How large and organised are these groups?
20. How would you describe the network?
21. Have you heard about any measure implemented by the U.S. authorities to tackle this offence?
22. Have you heard about any measure implemented by Mexican authorities to tackle this offence?
23. What do you think about the strategies implemented to date?
24. How would you improve these tactics and strategies?
25. What are the main lessons from your experience tackling this offence?