Why did Mexico become a violent country?

Assessing the role of firearms trafficked from the U.S.

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Abstract

Whilst most countries have experienced a crime drop in the last few decades, Mexico experienced a dramatic increase in violent crime since the mid-2000s. In this paper, we test whether the increase in violence observed in Mexico is consistent with theories of crime opportunity. In particular, we explore whether the rise in violence between 1999 and 2011 can be explained by an increase in the availability of illegal weapons (a situational explanation) that resulted from policy changes (and increases in firearms production) in the bordering U.S.

Analyses are conducted to test whether changes to U.S. gun policy led to an increase in the production of guns in the U.S., particularly in southern states bordering Mexico. And, if this in turn, led to an increase in the illegal availability of weapons in Mexico, and consequently to an increase in homicide. In addition to examining country-wide trends, we test the theoretical expectation that there was a pattern of distance-decay from the U.S.-Mexican border.

Our findings suggest that changes to gun policy in the U.S. did increase the supply of firearms at the Mexican border, which increased opportunities for the trafficking into Mexico. Moreover, that there was a clear association between firearm availability and homicide rates. The analyses are thus consistent with the hypothesis that variation (across space and time) in illegal firearm availability in Mexico provides a parsimonious explanation for the observed variation in state-level homicide rates. These findings are observed after accounting for factors associated with traditional explanations of violence.

Keywords: U.S.; Mexico; firearms; illegal; trafficking; homicide

1. Introduction

Worldwide, homicide rates have been relatively stable over the last few decades (United Nations Office on Drugs and Crime, 2013; Hart, 2015). However, this overall trend masks variation across regions and, sometimes, even within countries (Wheeler & Kovandzic, 2017, pp. 123-125; Rogers & Pridemore, 2018, p. 31). For example, over the same period, homicide increased in some parts of Oceania and South America (Harrendorf, 2010, pp. 8-17; United Nations Office on Drugs and Crime, 2013, pp. 42, 67-69), but declined in others to include Europe, North America and Asia (United Nations, 2015; Tonry, 2014; Vilalta, 2015, pp. 6-7; Levitt, 2004, p. 163; Zimring, 2006; Farrell, Tseloni, Mailley, & Tilley, 2011, pp. 147-149). Unsurprisingly, this variation, and the reasons for it, has attracted considerable attention from the criminological community (Eisner, 2003, pp. 41-43; Thome, 2007, p. 187; Gurr, 1981, p. 298; Pinker, 2011).

This paper contributes to these debates by focusing on the case of Mexico. The country exhibits two contrasting trends over the last sixty years. Between 1950 and the early 2000s the murder rate substantially decreased, falling from 48 homicides per 100,000 population to 17 (Heinle, Molzahn, & Shirk, 2015; Sistema Nacional de Seguridad Pública, 2017; Aguirre Botello, 2018). During the mid-2000s, the incidence of most crimes in Mexico, including homicide, were at their lowest recorded levels ever. However, in the mid-2000s, homicide figures substantially increased from one year to the next. In 2011, Mexico reached 24 homicides per 100,000 inhabitants, and in 2017 it reached a rate of 25 per 100,000 population, one of the highest rates on record since the 1960s (Aguirre Botello, 2018). Over this latter period, organized crime rates also increased. This included a

significant rise in kidnappings, robberies and extortions, as well as new forms of public violence, including targeted attacks against policemen, journalists and the authorities (Heinle, Molzahn, & Shirk, 2015, pp. 21-26; Committee to Protect Journalists, 2015; Rios, 2011, p. 11; Perez Esparza & De Paz, 2018, p. 22; Calderón, 2018, p. 3). In some cities, levels of homicide soared to unprecedented levels. In the case of Tijuana, for example, homicides doubled from 872 in 2016 to 1,618 in 2017 (Sistema Nacional de Seguridad Pública, 2018). As a result of these increases, gun violence impacted upon estimated life expectancy, producing a fall in this metric for the first time in Mexico's history (Aburto, Beltrán-Sánchez, García-Guerrero, & Canudas-Romo, 2016).

Attempts to explain the increase in crime in Mexico vary. Some explanations draw on classical criminological perspectives that focus on the 'root causes of crime' such as social and economic factors like poverty or income inequality (Laycock, 2012; United Nations, 2015; Crutchfield & Wadsworth, 2003; Ouimet, 2012; Hart, 2015; Enamorado, Lopez-Calva, Rodriguez-Castelan, & Winkler, 2014; Enamorado, Lopez-Calva, Rodriguez-Castelan, & Winkler, 2014). Others point to institutional factors such as an inability to tackle corruption (Buscaglia, 2013) or problems associated with police and judicial inefficiency (López-Ayllón & Fix-Fierro, 2015; Hope, 2013; Ambrogi, 2015; Zepeda-Lecuona, 2004; Bergman, 2018). Some have suggested that punitive countering organized crime policies may have had unintended consequences that led to violence. For example, Escalante (2011), Guerrero (2011), and Phillips (2015) suggested that the increase in homicide could be attributed to the Mexican Army's anti-drug interventions, which, by taking down kingpins and fragmenting criminal groups, intensified both internal and external rivalry. Grillo (2011) and Chabat (2015) agree, stating that the

development of more violent organizations, such as the *Zetas*, was an outcome of these interventions. Other scholars proposed that political factors, such as democratization and decentralization, increased the *coordination costs* amongst different political parties when dealing with the crime problem, thereby expanding opportunities for organized criminal activity to flourish (Dell, 2015; Rios, 2012).

Advocates of *opportunity theories of crime* have remained largely silent with respect to the increase in violence in Mexico. Such theories argue that opportunity plays an important role in crime occurrence, and that it may be of (at least) equal importance to the personal and social factors considered in theories of the kind discussed above (Felson & Clarke, 1998; Clarke, 2017). As such, instead of studying offenders and their criminal propensities, research motivated by these theories aims to understand the crime event, the situational opportunities that make it possible, and how to remove them (Clarke, 2012; Wilcox & Cullen, 2018; Felson & Clarke, 1998). Such factors might include vulnerabilities in banking systems in the context of fraud (Levi, Bissell, & Richardson, 1991), access to children in the case of child sex offending (Wortley, 2018) or the availability of guns in the case of the current paper. Such theories do not argue that criminal motivation is unimportant, but that crime cannot occur absent opportunity. Farrell et al. (2011) compellingly argued that theories of *opportunity*, and not alternative explanations (such as those discussed above) might best explain the crime drop observed across industrialized countries. However, while such theories have been invoked to explain reductions in crime, they have not generally been used to try to explain rises in crime, such as that observed in Mexico.

While they do not explicitly frame their paper as such, a notable exception is Dube, Dube and García-Ponce's (2013) analysis. They proposed that the expiration of the Federal

Assault Weapons Ban (or AWB which is discussed in more detail below) 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 argument, they examined changes in illegal weapon availability in Mexico (estimated using data on gun confiscations) for the two-year periods before and after the policy change (i.e. 2002-2004 and 2004-2006). They found that the availability of assault weapons in Mexican cities (*municipios*) within 100 miles of the U.S.-Mexico border increased over this period. They also analyzed variations in the rates of homicide in these Mexican cities. They paid particular attention to how the rates changed for those Mexican cities in close proximity to Texas, Arizona, and New Mexico (where gun policy became more lenient following the expiration of the AWB), and those that shared a border with California (where a state-level ban on the production of these weapons remained after the ban was lifted). They found that, relative to cities situated along the Californian border, those located along the non-Californian segment of the border experienced a 38% increase in homicides following the gun policy changes (p. 407). In other words, Mexican states that bordered U.S. states with more permissive gun laws had, on average, more homicides than those bordering states with strict gun laws.

This paper builds upon the work of Dube et al. (2013), and does so in a number of ways. From a theoretical perspective, we explicitly frame the analysis in terms of opportunity theories of crime. We additionally test and control for alternative explanations motivated by the wider criminological literature (discussed above). Empirically, we examine patterns over a greater time period and for the entire Mexican territory, instead of focusing exclusively on the Mexican *municipios* within 100 miles of the U.S. border (which

account for less than 5% of Mexican territory). In doing so, we test hypotheses about how the effects of changes to gun policy might have diffused geographically.

The paper is organized as follows. First, to provide the reader with a clearer understanding of the key federal policy changes that occurred in the U.S., and why they might have affected the opportunity structure in Mexico, we discuss changes in gun policy and firearm availability in the U.S. and Mexico, respectively. Second, we review other empirical studies that have examined gun trafficking in these countries. Third, we further discuss the situational 'opportunity hypothesis' that is key to this paper. We then describe the methodology and analytic strategy employed to test hypotheses, before presenting our results. In the final section, we conclude with a discussion of our findings and their implications for policy.

2. Background

2.1 Gun policy in the U.S.

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 AWB. This 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). Being a federal law it applied to all American states.

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 the public shootings,

accidents and murders that had been occurring across the U.S. 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. Brauer (2013, p. 30) demonstrates that the manufacture of firearms, including assault weapons, increased as a result of the expiration. With the exception Brauer's study, research on this issue is limited, and consequently we examine this further in the results section.

The expiration of the AWB in 2004 is, however, not the only gun law change to occur during these years that merits attention. In 2003, U.S. Representative Todd Tiahrt (R-KS) proposed the *Tiahrt Amendments*. Originally, these were designed to prohibit the U.S. Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) from disclosing data that could be used to trace firearms, even if doing so was for the purposes of addressing gun violence (e.g. to identify gun traffickers and corrupt gun dealers). It was argued that if authorities were allowed to continue sharing such data, this would 'criminalize' gun owners and violate their 'right to keep and bear firearms' (something which has been guaranteed by the U.S. Second Amendment since 1791). These Amendments were reformed in 2008 and 2010 to remove some of the restrictions that originally blocked law enforcement agencies from exchanging data. However, the remaining regulatory framework continued to prohibit data disclosure to members of the public (including

researchers) and litigants. We argue that at least in their original form, the *Tiahrt Amendments* would have reduced the 'perceived risk' to offenders involved in gun-related offenses which, from a rational choice perspective (Cornish & Clarke, 2003), would do little to deter them from such activity. In this way, we suggest that the *Tiahrt Amendments* would have created incentives for offenders 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, U.S. President George W. Bush signed into law the *Protection of Lawful Commerce in Arms Act* (PLCAA). This new regulation, also enacted at a federal level, 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). An example of the scope of this Act became evident in February 2014 when relatives of the victims murdered during the *Sandy Hook school shooting* filed a lawsuit against the gun manufacturer, distributor, and the gun shop that supplied the weapon used in the attack. In October 2016, the Connecticut Superior Court dismissed this case based on the PLCAA, ruling that these companies could not be held liable for harm caused solely by the criminal misuse of a weapon.

It is important to acknowledge that different U.S. states have their own local laws, but changes to these three federal policies had significant implications for the U.S. gun market in general. This is particularly relevant considering the size of the 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, 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).

2.2 Gun policy in Mexico

In contrast to the U.S., Mexico has had some of the most restrictive gun laws in the world for almost one hundred years. Manufacturing for civilian use, for instance, has been almost non-existent. Production for government agencies is rare and, when it has occurred, the Mexican Army has carried it out (United Nations Office on Drugs and Crime, 2013). Civil possession is thus highly restricted and Mexican citizens who want to acquire a firearm legally have to pass an intense legal and medical 'background check' carried out by the Mexican Army. Where applicants meet the specified criteria, handgun ownership is restricted to 'justified causes' (such as hunting) and to low caliber weapons (.38 or below). In fact, there is only one legal gun store where civilians may legally purchase firearms in the whole of Mexico, and this is located inside an Army base in Mexico City, which is run by military personnel (Johnson, 2012). Furthermore, Mexican law does not permit citizens to carry guns in public places, either openly or concealed (United Nations Office on Drugs and Crime, 2013). The Mexican Army systematically

and rigorously enforces this policy, seizing all guns where no license has been granted. According to data from the Mexican Army, in 2013 only 3,140 private citizens (2.6 per 100,000 population) held a valid legal gun license in Mexico (Gutiérrez, 2014). As such, at least in principle, and as suggested by the only available estimates, very few people in Mexico are able to obtain guns legally, making their availability through legal markets relatively limited. This contrasts with the situation in the U.S. where guns are manufactured in large volumes and they can be obtained legally more easily.

2.3 U.S.-Mexico gun trafficking

The asymmetry in gun policy between these two bordering countries has created several opportunities and incentives for gun trafficking from the U.S. into Mexico. Whilst 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.

For instance, U.S. authorities from the Government Accountability Office (GAO) recently reported that between 70% and 90% of all firearms confiscated by Mexican authorities were traced back to U.S. gun-shops (GAO, 2009; GAO, 2016). In support of the main argument of this paper, ATF data also suggest that geography seems to play an important role in trafficking patterns. Specifically, the four U.S. states bordering Mexico (Texas, Arizona, California and New Mexico) accounted for almost 75% of all guns confiscated in Mexico between 2006 and 2009 (Everytown for Gun Safety, 2010, p. 1).

Considering the scale of, and the incentives associated with, the illicit firearms market in Mexico, a United Nations study (United Nations Office on Drugs and Crime, 2013) recently suggested that 20,000 American 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. Other research by McDougal, Shirk, Muggah and Patterson (2014) suggests that this is likely an underestimation.

Taking a different perspective, Goodman and Marizco (2010) interviewed officials from the U.S. Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) about 'recent trends' in the trafficking of weapons into Mexico by organized crime groups. Interviewees conducted between September 2008 and May 2010 suggested that during the years immediately before 2010, when the study was published, more and more powerful guns (e.g. AK-47 type semi-automatic rifles and AR-15 semi-automatic rifle clones) had been illegally moved to Mexico. The authors argue that the increase in the prevalence of illegal guns in Mexico reported between 2006 and 2010 may have encouraged criminal groups to use these weapons in all-out combat, rather than in the targeted killings they had previously (Bailey & Taylor, 2009).

2.4 The opportunity hypothesis

As noted earlier, a number of traditional criminological theories have previously been invoked to explain the rise in violence in Mexico. Nevertheless, with the exception of Dube et al. (2013), existing studies have not provided a comprehensive analysis of how situational factors – and the role of opportunity – might explain the increase in violence.

In line with *opportunity theories of crime* discussed above as well as Clarke & Felson (1998), previous research on the crime drop by Farrell et al. (2011), and Dube et al.'s study, we propose that a change in the opportunity structure associated with firearms can explain the rise in violence in Mexico. In particular, we argue that the three changes to federal gun policy in the U.S. in the mid-2000s described above created new *opportunities* for the illicit supply of firearms to Mexico, increasing the availability and accessibility of illegal firearms in the latter.

In the context of retail and other sectors (Reilly, 1929; Stewart, 1948) there is typically a pattern of distance-decay in terms of the geography of supply and demand. The distance decay phenomenon is partly explained by the fact that (all else equal) the cost of transporting goods generally increases with distance. This means that products tend to be shipped to locations nearer to suppliers than those further afield, and shoppers tend to visit stores nearer to them than those located elsewhere. These are examples of the principle of least effort (Zipf, 1949). Returning to the issue of illegal firearms, like other 'industries', we expect geographical patterns of supply to exhibit distance decay. This is the case because (all else equal) it is likely to be cheaper, faster, easier and less risky to move guns to nearby locations than those further away. Moreover, as the opportunities for gun trafficking will be the most apparent at the U.S.-Mexico border, we anticipate gun trafficking to be the most acute in northern areas of Mexico.

In the current study, time series data are used to test the opportunity hypothesis and to examine if and how patterns varied spatially. A pattern of distance decay would be in line with the above argument and would represent a signature consistent with the idea that

weapons circulating in Mexico illegally came from the U.S. as opposed to (say) Central America (discussed below). In addition to examining these core research questions, we control for variables associated with other criminological explanations. Table 1 provides a summary of each of the explanations considered both in Mexico or elsewhere, and provides citations to the related literature.

INSERT TABLE 1 ABOUT HERE

To test the opportunity hypothesis, three sets of analyses are conducted sequentially to examine each stage in the process. The first stage considers the extent to which the key regulatory changes (e.g. AWB expiration, etc.) were associated with an increase in gun production in the U.S. (see 3.2.1 below). The second stage considers the extent to which variation in the availability of illegal firearms in Mexico over time was associated with gun production in the U.S. (see 3.2.2 below). In addressing this question, we explore how such patterns varied geographically and how any geographic patterns shifted after the changes to U.S. gun policy discussed above. After providing evidence to show that the availability of weapons did increase in Mexico, the third stage is concerned with whether changes in illegal gun availability in Mexico were associated with changes in the homicide rate over time, and if and how this varied geographically (see 3.2.3 below). As discussed, our expectation is that changes would be most acute at the border and decay with increasing distance from it.

3. Method and Results

3.1 Data

Table 2 provides a summary of the variables for which data were collected including how they were constructed, and their provenance, for each hypothesis (H) tested. All data are annual, and with the exception of Mexico City, for which data were unavailable, data were collected for all 31 Mexican states. To provide data for equal intervals of time before *and* after the year in which the AWB expired, and the PLCAA came into effect (2005), we study the period 1999-2011. For simple before and after contrasts, this provides us with data for comparable (six-year) periods, while for more detailed analyses we have data for 13 years[1]. In this case, our unit of analysis is the state-year, and the dataset has a times-series cross-sectional structure with 403 observations (31 states x 13 years). In the analyses that follow, we do not substantively assess the influence of the covariates, since they are not the focus of the paper, but we include them in the model to control for their potential influence.

INSERT TABLE 2 ABOUT HERE

To examine spatial variation in estimates of firearm availability in Mexico, it was necessary to collect and aggregate data for discrete spatial regions. A variety of approaches could be taken, but here we assembled data for each of the 31 states in Mexico and then allocated each state to one of the four spatial regions based on contiguity and how far their capital city was located from the U.S. border. The geographical boundaries for the 31 states and the four regions are shown in Figure 1, and additional details are

[1] We have data for the six-year periods before and after the AWB and also for the year in which it was implemented (2005).

provided in Table 3. Region A, which represents all northern states that share a direct border with the U.S., has six states (Baja California, Chihuahua, Sonora, Coahuila, Nuevo León, Tamaulipas) and is situated about 244 km from the U.S border. Region B, which represents the central-north location, has eleven states (Baja California Sur, Sinaloa, Durango, Zacatecas, San Luis Potosí, Nayarit, Jalisco, Aguascalientes, Guanajuato, Querétaro, Hidalgo) and its center is located 873 km from the U.S border. Region C, which represents the central-south location, has eight states (Colima, Michoacán, State of Mexico, Morelos, Tlaxcala, Puebla, Veracruz) and is located about 1,024 km from the U.S border. Finally, Region D, which represents the south of Mexico, has seven states (Guerrero, Oaxaca, Chiapas, Tabasco, Campeche, Yucatán, Quintana Roo) and is about 1,609 km from the U.S. border.

INSERT FIGURE 1 ABOUT HERE

INSERT TABLE 3 ABOUT HERE

To provide a broad overview of historical trends, we 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.

(a) Data on firearm production in the U.S

Figure 2 shows yearly estimates of gun production in the U.S. compiled by the ATF. It shows three general trends. First, gun production decreased between 1999 and 2001.

Second, between 2001 and 2005, levels of gun production remained relatively stable at about 3 million units per annum. Finally, from 2006 onwards, gun production increased year-on-year. Initially, the increase was about 300-400 thousand guns per annum, but this increased dramatically in 2009 when more than one million additional guns were produced. In 2011, annual gun production in the U.S. was more than twice the annual average recorded between 2001 and 2005.

INSERT FIGURE 2 ABOUT HERE

To examine changes in the spatial variation of gun production in the U.S., we also analyze ATF data at the state-level for gun manufacturing. As shown in Figure 3, 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% during the first period to almost 14% during the second.

INSERT FIGURE 3 ABOUT HERE

Figure 3 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 4,

indicates that the proportion of guns produced in these two states increased more dramatically than Figure 3 might suggest. For instance, this Figure shows that during 1999 and 2000, the percentage of guns manufactured in Texas and Arizona (as a proportion of U.S. national production) were 7.5% and 9%, respectively. Between 2001 and 2007, this proportion reduced to between 4 and 6%. However, large increases were reported subsequently, with 18% of all guns in the U.S. being manufactured in Arizona and Texas during 2011. Overall, the expansion in gun production reported in these two states is particularly noteworthy for three reasons. First, after the policy changes, Arizona and Texas are overrepresented, accounting 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). Third, a study which examined ATF data suggested that more than half of all guns confiscated in Mexico during the 2006-2009 period came from these two U.S. states (Mayors Against Illegal Guns, 2010).

INSERT FIGURE 4 ABOUT HERE

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.

(b) 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, we 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, Rowell, Guyatt, Kerr, Montaner, & Wood, 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 (United Nations Office on Drugs and Crime, 2013), this suggests that counts of confiscations will provide a good estimate of illegal firearm availability.

Figure 5 shows the count of firearms seized across the whole of Mexico and by region (A, B, C and D). For illustrative purposes, it also shows the levels of gun production reported in Texas and Arizona. Two observations are particularly noteworthy. First, estimates of firearm availability in Mexico remained stable or declined during the initial period (1999-2005). In fact, confiscations dropped by half from 3,406 firearms during 1999 to 1,648 during 2005. However, they increased dramatically after 2006, much like the pattern of gun production in the U.S. As such, the increases in confiscations reported

in Mexico follow a similar trend to gun production in Texas and Arizona. With respect to these trends, 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 (regions A and B), 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.

INSERT FIGURE 5 ABOUT HERE

(c) Data on homicide in Mexico

Annual counts of recorded homicides in Mexico were obtained from INEGI (2012) and are shown in Figure 6 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 (and a reduction of around 18% between 1999 and 2003), similar to the trend observed in developed countries (see: Farrell et al., 2011). During the second stage (2004-2007) the homicide rate appears to stabilize. Post-2007 however, homicide escalated substantially, exceeding the levels observed in previous years by a factor of up to four. As shown in Figure 6, the largest increase is reported in Region A, which corresponds to the north of

Mexico. In that region, the number of homicides recorded during 2010 was almost six times higher than that in (for example) 2004. For comparative purposes, national data concerning gun confiscations in Mexico are also shown (dotted line), and can be seen to anticipate the trend in national counts of homicide.

INSERT FIGURE 6 ABOUT HERE

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 firearms seizures, homicide 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.

3.2 Inferential Analyses

In this section, we conduct formal statistical analyses to test hypotheses.

3.2.1 Were changes to gun policy associated with gun production in the U.S.?

We 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, we

correlate the time elapsed (in years) since these key regulatory changes with the natural logarithm[2] of annual counts of gun production in the U.S. We create a variable to capture the former, and code this as zero for all years prior to 2004, and use incremental values for subsequent years (+1 for 2005, +2 for 2006, ….). The correlation coefficient of $r(12)=0.90$ ($p<.001$) was clearly strong, positive and statistically significant, indicating that gun policy changes (e.g. the expiration of the ban in the U.S.) were associated with the production of guns in that country.

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

We next examine whether variation in gun production in the U.S. was associated with (illegal) gun availability in Mexico. To do this, we 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.

We also study this phenomenon at the regional level. In particular, we test whether the association between gun production in the U.S. differs when we correlate gun confiscations across Mexican regions that are in close proximity to the border, compared to those that are further away. We anticipate that gun production in the south of the U.S.

[2] The data were transformed as the raw values were skewed.

would have a higher impact on gun availability in the north of Mexico (i.e. Region A) than other regions (e.g. Region D) and hence for the correlation to be stronger for the former than the latter.

To this end, we 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). We 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, p. 2). 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 we include the data from these two U.S. states. To examine the effect of proximity, we then correlate annual gun production reported in the non-bordering U.S. states with confiscations across the four Mexican regions.

In both cases, we test whether there was a change in the associations following the observed changes to gun policy, since we would expect a clearer association for the latter than the former. To do this, we report separate correlations for the periods before (1999-2004) and after 2005 (2006-2011). Table 4 shows the results of these correlations. For all correlations, we work with the natural logarithm of the two variables.

INSERT TABLE 4 ABOUT HERE

In line with expectation, in all cases, the correlation coefficients were positive. For the states of Texas and Arizona, 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. To take some examples, the first two columns of Table 4 show the correlation for gun production in the U.S. with confiscations in Region A (the north of Mexico that borders the U.S.). In this case, it can be seen that while gun production in Texas and Arizona was not found to be reliably correlated with confiscations in Region A during the first period (.41), the correlation was statistically significant and close to unity in the second (.95**). Considering the correlations with production at the border and elsewhere, the second column (corresponding to the 2006-2011 period) indicates that while gun production was associated with confiscations in Region A for both U.S. geographies, it was much higher for Texas and Arizona (.95**) than it was for the non-bordering states (.86*).

In sum, the findings reported above are consistent with the hypothesis 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, we examine whether illegal gun availability in Mexico was associated with homicide.

3.2.3 Was illegal gun availability in Mexico associated with the increase in homicide?

We 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 *spatially* and *over time*. In the regression models, the dependent variable is either

the overall annual count of homicide, or homicide involving guns. All data were acquired from the National Institute of Statistics (INEGI) and expressed as a natural logarithm. Our unit of analysis is the state-year, and 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' hypotheses. To do this, we model estimates of annual gun availability for each state. The second set of variables are used to test the alternative explanations summarized in Table 1 (e.g. that a change in inequality can explain the changes in Homicides observed at the state level).

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

As our aim is to explain yearly counts of homicide across states, we use a *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 Eq. (1) we formalize our model as:

$$Y_{ijt} = \alpha_j + (\sum_j \beta_j X_{ij} * Firearms_{ijt}) + Pop_{it} + GDP_{it} + Hdi_{it} + Gini_{it} + Un_{it} + Df_{it} + Erc_{it} + Corr_{it} + Drug_{it} + Calderon_{it} + E_t$$

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*

α_j is the intercept (the average value of the fixed effects in region *j*)

$Firearms_{ijt}$ is the count of firearms in state *i*, located in region *j* in year *t*

β_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*

Pop_{it} is the population (expressed as a natural logarithm) in state *i* in year *t*

GDP_{it} is gross domestic product (expressed as a natural logarithm) in state *i* in year *t*

HDI_{it} is the human development index in state *i* in year *t*

$Gini_{it}$ is the Gini index in state *i* in year *t*

Un_{it} is unemployment rate in state *i* in year *t*

Df_{it} is dark figure of crime (unreported crime) in state *i* in year *t*

ERc_{it} is the judicial system efficiency in punishing reported crimes in state *i* in year *t*

$Corr_{it}$ is the perception of corruption in state *i* in year *t*

$Drug_{it}$ is all drug crimes (expressed as a natural logarithm) in state *i* in year *t*

$Calderon_{it}$ is all soldiers deployed in anti-drug trafficking efforts in state *i* in year *t*

E_t 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, we run the analyses for all homicides and for homicides that only involve firearms separately. All analyses were conducted in STATA 14. Table 5 provides a summary of the main results. Models 1 and 2 focus on all homicides. 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.

INSERT TABLE 5 ABOUT HERE

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 example, for Model 1, the coefficient for Region A (0.19) was more than twice that for Region B (0.09). Likewise, for Model 2, the coefficient for Region A of 0.12 was over three times larger than that for Region B (.04). The same trend was observed for Models 3 and 4. For regions C and D, the associations are smaller in magnitude (all models) and also non-significant for models 2 and 4 which include other explanatory variables. These findings are consistent with a pattern of distance-decay.

As discussed above, the aim of this paper was not to test each of the alternative hypotheses shown in table 1, but to control for them. However, a few comments are necessary. First, we note that the majority of the associated coefficients (shown for transparency) were either non-significant or in line with expectation. Second, we 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 our 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, we 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.

4. Discussion

The aim of this paper was to test a crime opportunity hypothesis regarding the rise in violence observed in Mexico. In terms of causality, three steps are hypothesized and tested: (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 in Mexico.

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 hypotheses. Our analyses support our expectations, and (in line with Dube et al., 2013) suggest that the rise in violence in Mexico was (at least in part) explained by changes in opportunity. Furthermore, these effects exhibited a pattern of distance decay, as expected. The findings thus provide further support for the role of opportunity in crime.

It is important to note that the aim of this study is *not* to suggest that changes in gun policy in the U.S. *are the only reasons* for (an increase in) illegal gun circulation in Mexico. In fact, we assume that other factors also contributed. An alternative, for example, is that guns confiscated in Mexico were imported illegally from Central America, where firearms that remained from the conflicts that occurred during the 1970s-1980s may still be in circulation (Stohl & Tutte, 2008; United Nations Office on Drugs and Crime, 2013; Insight Crime, 2018; Salcedo-Albarán, 2017). However, as suggested by Goodman and Marizco (2010), this scenario seems less likely as organized crime groups operating in Mexico would be expected to prefer the newer and more powerful guns recently produced in the U.S. Additionally, the data on gun confiscations analyzed throughout this paper do not provide support for this argument. For instance, during the later period studied (2006-2011) confiscation volumes across the southern states of Mexico (which border Guatemala and Belize) were fifteen-times lower than those reported in the northern states (which border the U.S.). If we assume that confiscations are a good proxy of gun availability, this suggests that illegal guns were more readily available in the North than the South of Mexico – a pattern that is consistent with the idea that they were imported from the U.S. rather than Central America.

As with most studies of criminological phenomena, there are strengths and weaknesses to our approach. 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. Perhaps the most important caveat to consider is that while we employ a type

of quasi-experimental design, correlation does not imply causality. Our findings are thus consistent with expectation but they are not unequivocal.

With this in mind, existing data provide the opportunity to conduct a set of simple analyses to allow a form of triangulation that can assist in further assessing the plausibility of our argument. First, consider the use of firearms in homicide (as opposed to the rate of homicides alone). As with most countries, the reporting rate for homicide in Mexico is very high (INEGI, 2014). As 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 offenses is observed to increase after the changes in gun law in the U.S., this would provide further evidence to support our argument that more guns became available over time and increased opportunities for offending.

Figure 7 shows trends in the use of firearms over time in homicides recorded. It indicates that the homicide rate in Mexico not only changed in terms of volume, but also in terms of the violence used. For the 1999-2004 period, it is apparent that the annual count of homicides was generally on the decline and that this trend can mostly be attributed to a reduction in offenses that involved weapons. However, after 2005, the ratio of homicide offenses that involved the use of weapons increased, and did so around the same time that the volume of confiscations of firearms also increased.

INSERT FIGURE 7 ABOUT HERE

Like changes in the volume of crimes involving firearms, evidence of changes in the operational strategies adopted by organized crime groups, particularly those made possible by firearms, would also provide support for the hypotheses tested here. Five observations regarding such changes are worthy of discussion.

First, 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). Second, the assassination of the first Mexican Mayor (*Alcalde*), killed by an organized crime group occurred in northern Mexico in late 2004 (Rios, 2011) following the expiration of the AWB. Third, organized criminal groups did not use high caliber guns until 2005 (BBC, 2005; Sánchez V. , 2009; Buxton, 2011; Iniesta, 2016). Fourth, before the mid-2000s, no member of the Mexican Army had been killed by organized criminals. However, this situation changed, (presumably as a result of criminals accessing more powerful guns to challenge the institutions) with, for example, the case of northern Tamaulipas (bordering Texas), which reported one attack in 2007, but a total of 42 by 2011 (Sanchez, 2013). Finally, data collected by Trejo and Ley (2016) suggest that there has been a dramatic increase in mass shootings and criminal attacks on public figures (e.g. authorities, candidates and political activists) since the mid-2000s, with 90 attacks taking place in 2011. This contrasts with the situation prior to 2005 when there were little to no incidents each year, as also noted by Pérez Esparza and De Paz for the case of attacks against Mayors (2018, p. 22). Taken together, these five trends provide further support for our argument that the increase in crime and violence in Mexico is associated with the proliferation of illegal weapons available to criminals.

In contrast to the majority of previous research on crime in Mexico, in this paper we tested hypotheses motivated by *opportunity* theories of crime. Our 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. Our findings also extend those of Dube et al. (2013) by explicitly examining how the patterns evolved spatially, by examining patterns over a longer period of time, during which more dramatic changes in gun production occurred in the U.S., and by controlling for the effects of other factors that criminological theory would predict might account for the rise in violence.

More generally, our study has broader implications related to gun policy. As discussed, one of the key motivations for this research was to explore the role of three federal gun laws implemented during the mid-2000s. One of the key concluding remarks from this research is that very little is known about the specific outcomes associated with each gun reform. As such, further research is required to better understand the mechanisms that can explain the extent to which specific gun laws can change the incentives (amongst gun manufacturers) to increase gun production. This is important not least because the U.S. could reform some of its gun laws in the future. For example, in May 2018, U.S. President Donald Trump proposed a new reform that aimed to ease firearm export controls for U.S. weapons manufacturers (U.S. Government, 2018; Asman, 2018). Likewise, throughout 2018, there have been a number of lawsuits (that could eventually motivate new gun reforms) concerning a Texas-based company which developed blueprints to allow citizens to '3D print' their own untraceable guns (Foldy, 2018; Bellon, 2018). Despite the differences between these issues and the ones considered in this paper, we suggest the

findings presented here should inform discussions about future gun reform in the U.S., and their possible impacts elsewhere.

While a considerable research agenda remains to fully explain the evolution of crime and violence in Mexico, our results 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.

Table 1. Summary of the hypotheses tested

Hypotheses	Explanation and rationale	Studies in which hypothesis was proposed
	Opportunity explanations for homicide in Mexico:	
H1	An increase in the availability of illegal firearms led to a rise in homicide in Mexico	Current
H2	The association between firearm availability and homicide is expected to be more acute at the U.S-Mexico border and nearby	Current
H3	The association between firearm availability and homicide is expected to show a pattern of distance decay	Current
	Traditional explanations for homicide in Mexico (control variables):	
H4	An increase in the population in Mexico led to a rise in opportunities for and hence the count of homicides	Braithwaite (1975); Nolan (2004)
H5	An increase in poverty led to a rise in homicide in Mexico	Ludwig et al. (2001); Webster and Kingston (2014)
H6	A reduction in human development, as measured by the Human Development Index (HDI), led to an increase in homicide	LaFree (1999); Nivette (2011)
H7	An increase in inequality led to a rise in homicide	Blau and Blau (1982); Elgar and Aitken (2010)
H8	An increase in unemployment led to a rise in homicide	Chircos (1987); Paternoster & Bushway (2001)
H9	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	Skogan (1977); MacDonald (2001)
H10	An increase in judicial inefficiency led to a rise in homicide	Montenegro & Posada (1994); Levitt and Miles (2006)
H11	An increase in corruption led to a rise in homicide	Buscaglia and Van Dijk (2003); Daday, Broidy &Willits (2007)
H12	An increase in all drug crimes led to an rise in homicide	Fearon (2011); Mejia and Restrepo (2013)

		Goldstein (1985); McBride et al. (2003)
H13	An increase in military action (enforcement) to reduce drug crime led to an increase in homicide, either by exacerbating conflict or displacing criminal activity	Resignato (2000); Werb (2011)

Table 2. Dependent variables, covariates and data sources used

	Variable(s)	**Variable construction**	**Source**
DV	Homicide or gun homicide	Homicide (and gun homicide) as a natural Logarithm	INEGI (2014)
IV	Firearms illegal prevalence by spatial zone	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	Data on gun confiscations based on INAI (2014). Interaction variable used was coded by the authors (see: Map 1, Figure 1 and Methods section)
C	Population	State population expressed as a natural Logarithm	INEGI (2014)
C	Poverty	State gross domestic product (GDP) expressed as a natural Logarithm	INEGI (2014)
C	Social development	State human development index (HDI)	INEGI (2014)
C	Inequality	State Gini index	INEGI (2014)
C	Unemployment	State unemployed population (percentage)	INEGI (2014)
C	Dark figure of crime	State dark figure of crime based on victimization survey data	INEGI (2014)
C	Judicial inefficiency	State percentage of reported crimes satisfactorily solved by the authorities (proxy of no impunity)	INEGI (2014)
C	Corruption	State level of corruption based on perception survey	Transparency International (2014)
C	All drug crimes	State count of all reported drug-related crimes (production, possession, trafficking, and others) as a natural Logarithm	Presidential Report (2012)
C	Military use of force	State sum of all soldiers deployed by the Mexican Army during Felipe Calderón term (2006-2012)	INAI (2014)

DV = dependent variable IV = key independent variable C = covariate

Table 3. Summary of the spatial zones used in the analysis

Zone	Location	Number of states included	Average distance to U.S. border from Mexico's capital cities	States included
A	North (border with the U.S.)	6	244 km	Baja California, Chihuahua, Sonora, Coahuila, Nuevo León, Tamaulipas
B	Central- North	11	873 km	Baja California Sur, Sinaloa, Durango, Zacatecas, San Luis Potosí, Nayarit, Jalisco, Aguascalientes, Guanajuato, Querétaro, Hidalgo
C	Central-South	8	1024 km	Colima, Michoacán, State of Mexico, Morelos, Tlaxcala, Puebla, Veracruz
D	South	7	1609 km	Guerrero, Oaxaca, Chiapas, Tabasco, Campeche, Yucatán, Quintana Roo

Table 4. Correlation coefficients between gun production in the U.S. (logged) and gun confiscations (logged) in Mexico, by period

		Gun confiscations in Mexico's regions (logged)									
		Region A (U.S. border)		Region B (north-center)		Region C (south-center)		Region D (south)		Mexico (all national data)	
		1999-2004	2006-2011	1999-2004	2006-2011	1999-2004	2006-2011	1999-2004	2006-2011	1999-2004	2006-2011
Gun production in the U.S. (logged)	Texas (TX) and Arizona(AZ)	0.41	0.95**	0.71	0.96**	0.88*	0.87*	.86*	.90*	.87*	0.97**
	All U.S. non-border states	0.38	0.86*	0.82*	0.86*	0.77	0.60	.52	0.84*	0.74	0.83*

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

Table 5. Econometric models of homicide (M1 and M2) and gun homicide (M3 and M4), in Mexico (expressed as natural log)

H		Tested argument	All homicide		Gun homicide	
			Model 1	**Model 2**	**Model 3**	**Model 4**
1	Opportunity explanations	Firearms in Region A (log)	.1963***	.1236***	.2364***	.1551***
2		Firearms in Region B (log)	.0893***	.0370**	.1035***	.0435**
3		Firearms in Region C (log)	.0514*	-.0048	.0804**	.0133
4		Firearms in Region D (log)	.0413	.0144	.0602*	.0303
6	Traditional Explanations (control)	Population (log)	N/A	-.2668	N/A	.3358
7		Gross domestic product (GDP, log)	N/A	15.41	N/A	.0774
8		Human development index (HDI)	N/A	5.594	N/A	10.340*
9		Gini index	N/A	1.966*	N/A	2.2641*
10		Unemployment	N/A	.1623***	N/A	.1760***
11		Dark figure of crime	N/A	-.0047	N/A	-.0045
12		Judicial efficiency in reported crimes (crimes satisfactorily solved)	N/A	.0497**	N/A	.0529*
13		Corruption	N/A	-.0110	N/A	-.0084
15		Drug-related crimes (log)	N/A	-.0270	N/A	-.0359
16		Soldiers deployed in anti-drug operations ('Calderon hypothesis')	N/A	.00001	N/A	-7.03e-06
		N [observations]	403	403	403	403
		Constant	4.992***	1.85	4.145***	-10.881
		R^2 (within)	0.2423	.4958	0.2488	.4942
		R^2 (between)	0.2132	.0408	0.3213	.0994
		R^2 (overall)	0.2116	0.0002	0.2904	.1499

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

Figure 1. Spatial regions of Mexico used in this study

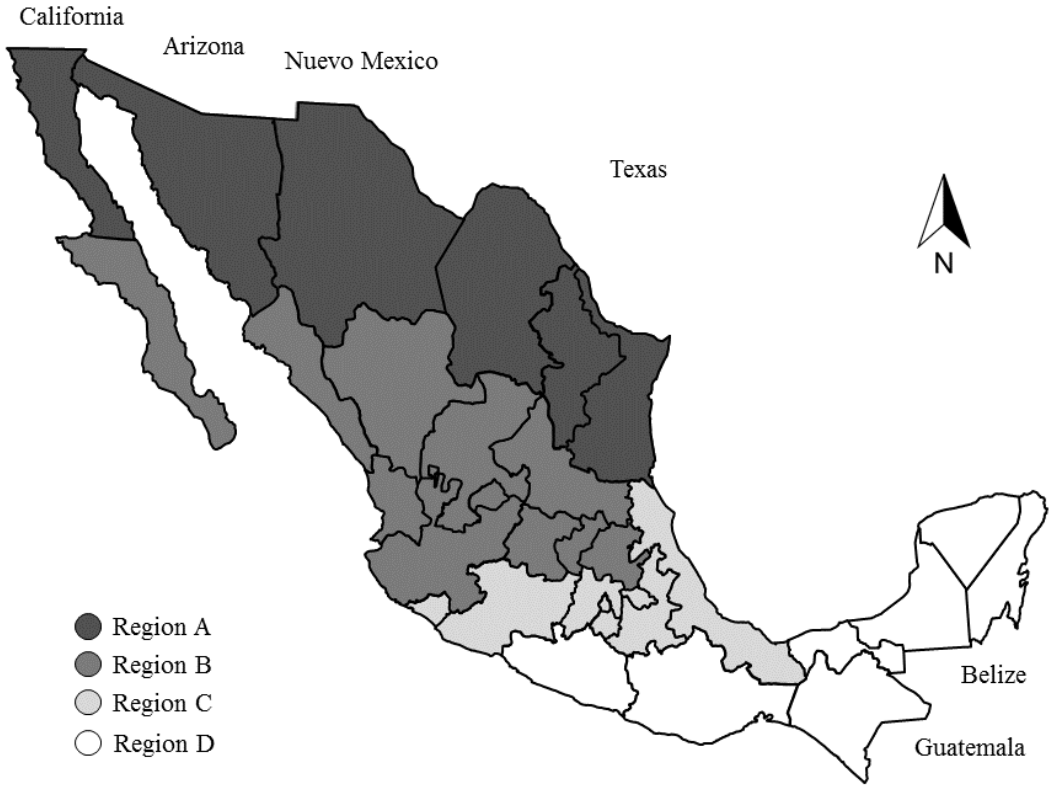
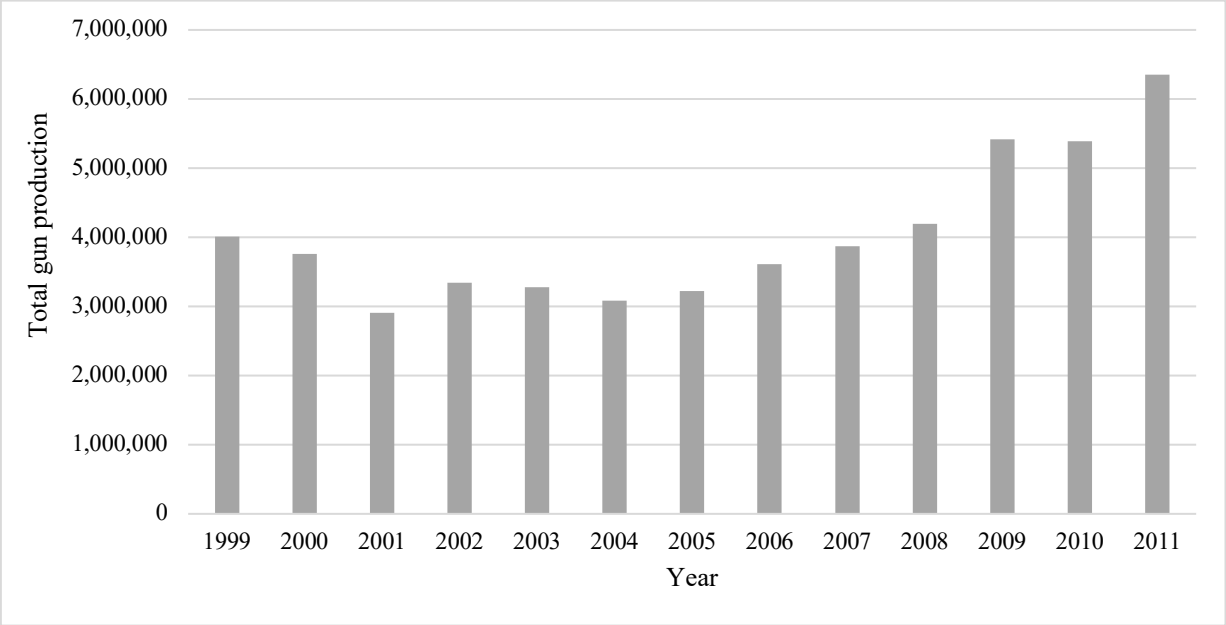
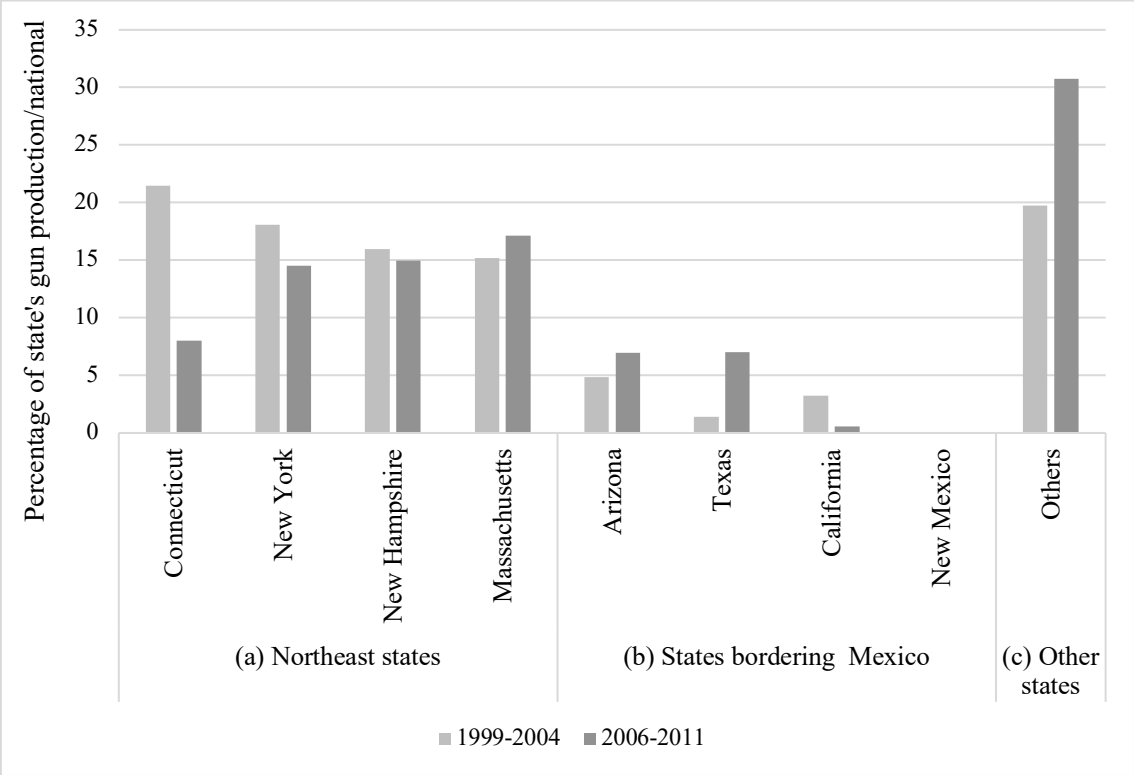


Figure 2. National production of guns in the U.S.



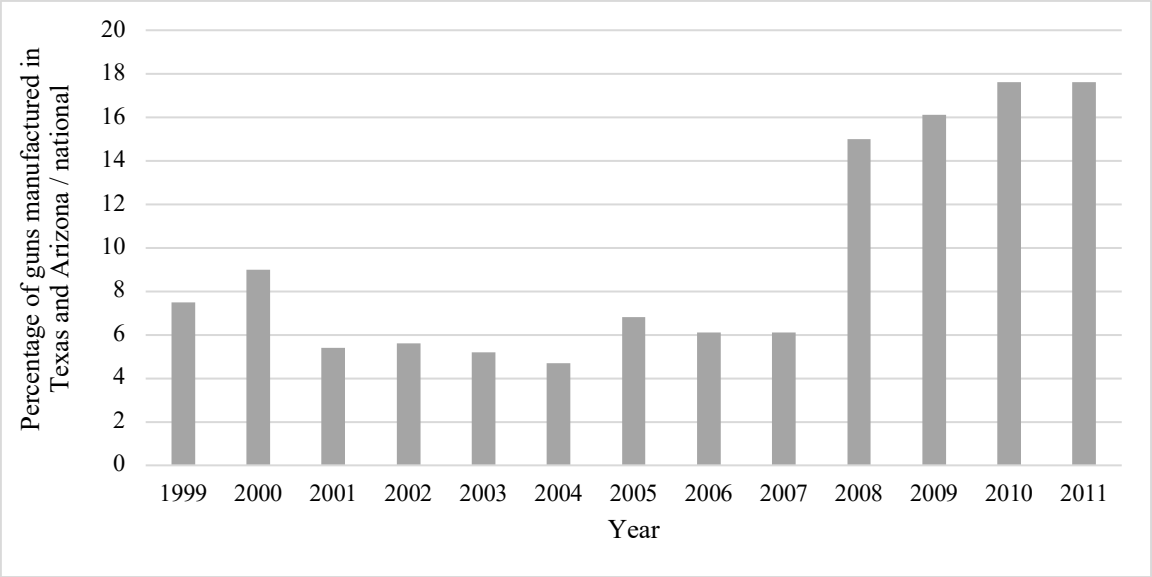
Source: ATF (2015)

Figure 3. Gun production in U.S. states as a percentage for the whole country (data for selected states shown)



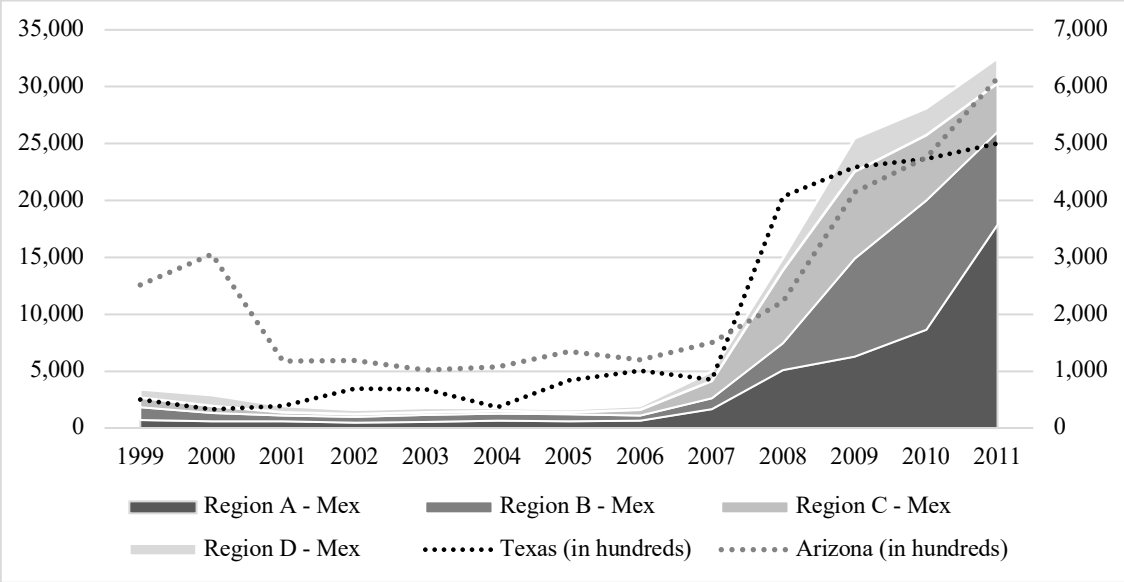
Source: ATF (2015)

Figure 4. Percentage of guns manufactured in Texas and Arizona as a proportion of U.S. national production



Source: ATF (2015)

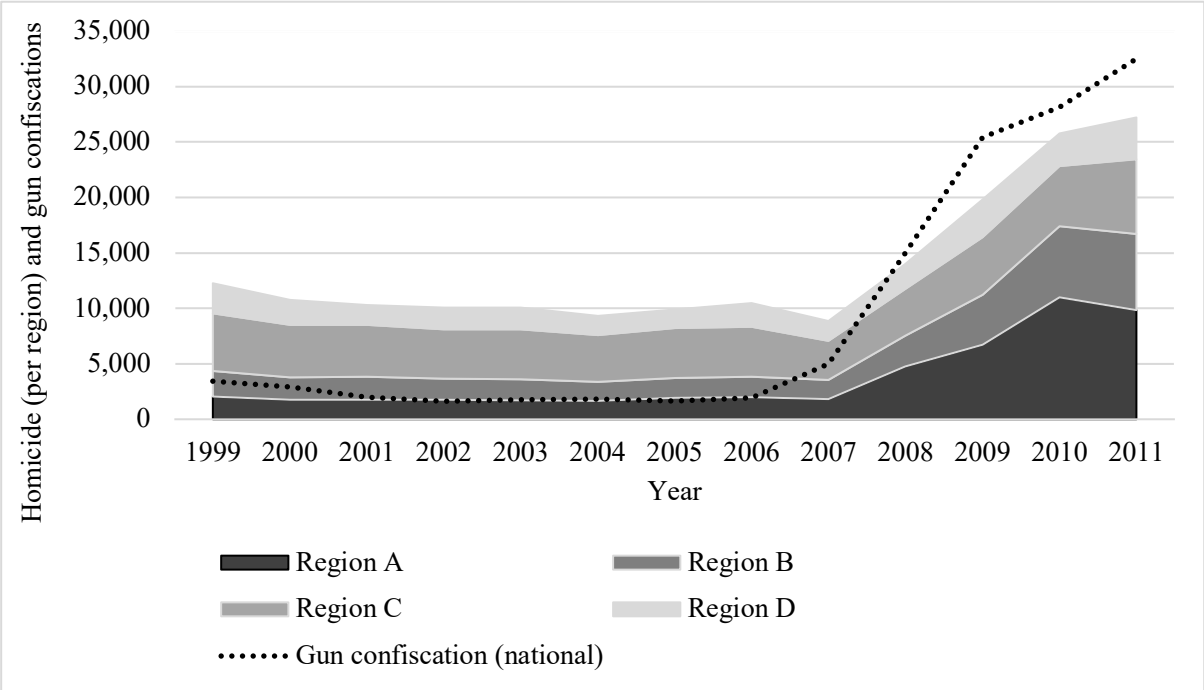
Figure 5. Illegal gun availability in Mexico (per region) *and* gun production in Texas and Arizona



Note: The y-axis (left) represent the guns confiscated across the regions in Mexico (overall from 0 to 35,000 firearms). The y-axis (right) represent the guns manufactured in Texas and Arizona. As these latter data are expressed in hundreds, they represent a range between 1 and 7 million.

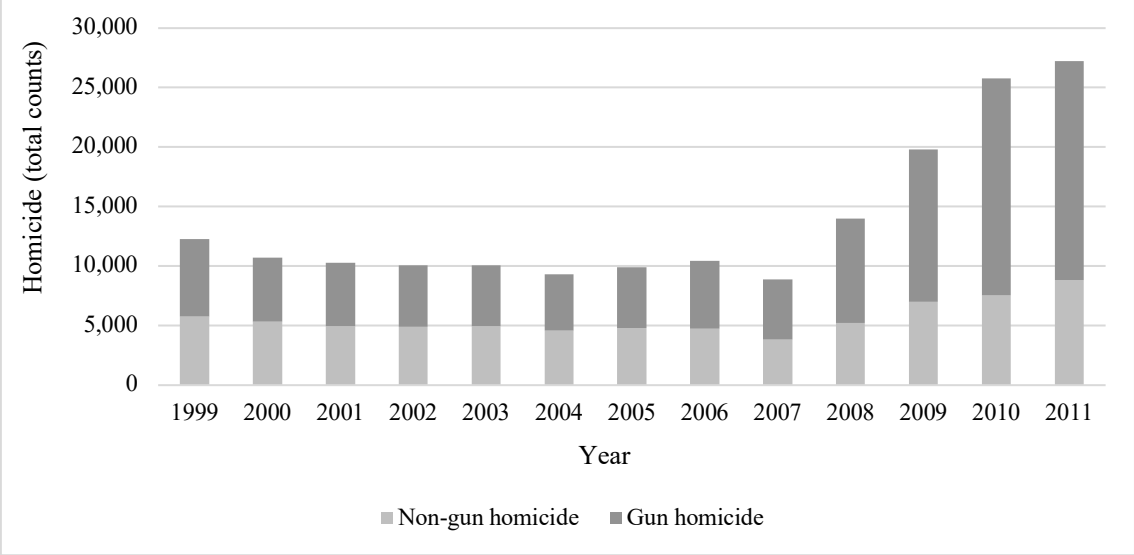
Source: INAI (2014) for firearms confiscated in Mexico and ATF (2015) for firearms manufactured in Texas and Arizona

Figure 6. Annual counts of homicide per region and national illegal gun availability



Source: INEGI (2014) for homicide, and INAI (2014) for gun confiscations

Figure 7. Annual total homicides in Mexico (by use of gun)



Source: INEGI (2014)

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