# Exporting the Second Amendment: U.S. Assault Weapons and the Homicide Rate in Mexico

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### ABSTRACT

In the four years following the expiration of the U.S. Federal Assault Weapons Ban (AWB), the homicide rate in Mexico increased 45 percent. Over the same period, over 60,000 firearms recovered in Mexico have been traced back to the U.S. A difference-in-difference approach is used to estimate the effect of the expiration of the AWB on homicide rates in Mexico; states with a strong pre-2005 drug cartel presence are defined as the treatment group. The baseline estimates suggest the expiration of the AWB is responsible for at least 16.4 percent of the increase in the homicide rate in Mexico between 2004 and 2008.

(Keywords: assault weapons ban; Mexico; guns; drug cartels; homicides)

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## **I. Introduction**

Drug violence in Mexico has risen to alarming levels, where over 30,000 people have been killed in narcotics-related violence since the beginning of 2005 (Trans-Border Institute and Reforma, 2010). According to Mexico's President Calderón, the catalyst for the most recent wave of violence has been the expiration of the Federal Assault Weapons Ban (AWB) in the United States, which according to his administration, has allowed Mexican drug cartels easy access to high powered weapons.<sup>1</sup> Originally passed on September 13, 1994, as part of a larger anti-crime bill, the law had a 10-year sunset provision that was not extended by Congress. As a result, the law expired on September 13, 2004. The AWB banned the domestic sale and production of a large class of semi-automatic firearms with particular characteristics, for example, the ability to accept a detachable magazine, a collapsible stock that allows for easier concealed transportation, and a threaded barrel that could attach a flash suppressor or silencer. There were also a number of guns banned by name, including the AR-15, AK-47, MAC-10, and TEC-9.<sup>2</sup> During an in-person appeal to the United States, President Calderón asked Congress to consider reinstating the assault weapons ban.<sup>3</sup>

Previous work has found a positive relationship between gun prevalence and homicides (Duggan, 2001; Miller et al., 2002; Cook, 1983; Cook and Ludwig, 2004), and a survey of the literature by Hepburn and Hemenway (2004) concluded that available evidence finds a consistent positive relationship between firearm prevalence and homicides.<sup>4</sup> Instead of focusing on the relationship between homicides and firearm prevalence, this paper focuses on the relationship between homicides and the type of firearms available. Specifically, I investigate whether the expiration of the AWB, and the subsequent increased availability of assault weapons, has had a significant impact on the homicide rate in Mexico.

Time series data on the extent of violence in Mexico provides suggestive evidence that the AWB may have some role in the current crisis in Mexico. In Figure 1, I graph the national homicide rate (fatalities per 100,000 people) from 1990 through 2008. Between 1990 and 1994,

<sup>&</sup>lt;sup>1</sup> Hawley, Chris, Solache, Sergio, 2007. U.S. guns pour into Mexico. The Arizona Republic, January 16.

<sup>&</sup>lt;sup>2</sup> Complete text of the AWB definition of an assault weapon is included in the appendix.

<sup>&</sup>lt;sup>3</sup> Sheridan, Mary Beth, 2010. "Mexico's Calderon tells Congress he needs U.S. help in fighting drug wars." The Washington Post, May 21.

<sup>&</sup>lt;sup>4</sup> In contrast to this literature other work finds that increased access to firearms through gun shows, which generally have less regulated firearm sales, does not increase firearm-related deaths (Duggan et al., forthcoming). More controversial work finds that less restrictive gun carrying laws decrease crime (Lott, 1997), however, other work on has not found the same result (Ludwig, 1998; Ayres and Donohue, 2003).

homicide rates in Mexico increased nearly 23 percent, to 16.91 homicides per 100,000 people (Sistema Nacional de Información en Salud, 2010). For each of the next ten years, when the AWB was in effect, homicide rates in Mexico declined. In the year after the sunset of the AWB, the homicide rate in Mexico increased for the first time in a decade. Between 2004 and 2008, the homicide rate in Mexico increased 45 percent (Sistema Nacional de Información en Salud, 2010). The available evidence suggests that homicide rates have continued to increase through 2010. In order to link the expiration of the AWB in the United States with the drug violence in Mexico, I need to establish three facts. First, the expiration of the ban increased the production of assault weapons in the U.S. Second, firearms from the United States are being trafficked to Mexico and were sold after the expiration of the AWB. Third, the availability of these weapons has led to increased violence in Mexico.

The first question is difficult to answer because there are no publicly available data on the production or sales of assault weapons in the United States. To solve this problem, I exploit the timing of the expiration of the AWB. If the ban successfully accomplished its goals while in place, assault weapons should have become more available after September 2004. Without data on the production of specific types of firearms, I focus on categories of pistols and rifles that are most likely to contain assault weapons. I find that production in the categories most likely to include assault weapons increased considerably in the years immediately following the ban's expiration, and that production has stayed consistently above pre-2004 levels.

Due to many of the same data restrictions, answering the second question is at least as difficult as the first. Everyday millions of dollars worth of goods cross the vast border between the United States and Mexico. Unfortunately, the border is also home to immeasurable amounts of illegal trafficking. Numerous U.S. officials have acknowledged that firearms are included in the bundle of illegal goods smuggled across the border, including President Obama, Secretary of State Clinton, and senators from both sides of the aisle.<sup>5</sup> Bureau of Alcohol, Tobacco, Firearms and Explosives (ATF) initiatives to combat firearm trafficking have uncovered a large amount of trafficking related crime in states along the southwest border. Between 2005 and 2009 these initiatives have led to over 800 indictments being filed by the U.S. government on charges relating to firearm trafficking (Melson, 2010). The two largest sting operations carried out by the

<sup>&</sup>lt;sup>5</sup> Meyer, Josh, 2009. U.S. shares blame for Mexico drug violence, senators say. Los Angeles Times, March 18; Ellingwood, Ken, 2009. U.S. shares blame for Mexico drug violence, Clinton says. Los Angeles Times, March 26; Stolberg, Sheryl Gay, 2009. In Mexico, Obama Seeks Curbs on Arms Sales. New York Times, April 16.

ATF led to over 40 arrests on charges related to trafficking over 1,000 weapons into Mexico.<sup>6</sup> Trafficking rings purchase the firearms from "straw purchasers," who can legally buy guns, and then move them across the border.<sup>7</sup> Since the expiration of the AWB, U.S. officials note that at least 60,000 guns recovered in Mexico have been successfully traced back to the United States; President Calderón has suggested that the number is closer to 85,000.<sup>8</sup> The most common guns seized by Mexican authorities and traced back to the United States are the AR-15 and AK-47 (Goodman and Marizco, 2010). In 2008, about 25 percent of all firearms traced back to the United States where variants of the AR-15 and AK-47 (Chu and Krouse, 2009). In addition, in 2009 the average time between a gun being purchased in the United States and being recovered by police in Mexico was less than 3 years (MAIG, 2010), the assault weapons being recovered in Mexico were likely purchased after the 2004 expiration of the AWB.

In order to answer the final question, I estimate a model that exploits the timing of the AWB's expiration and the location of drug cartels across Mexican states. Mexican drug cartels are responsible for a large amount of the firearm trafficking across the southwest border, including the two major trafficking rings uncovered by the aforementioned ATF stings (Goodman and Marizco, 2010). If there is an effect of the AWB on the homicide rate in Mexico, it is most likely to occur in states with a strong cartel presence, the destination for many of the trafficked firearms. I identify eight states in which independent cartel leadership was based prior to the expiration of the AWB. Using this group of "cartel" states as my treatment group, I employ a difference-in-difference approach to estimate the effect of the AWB's expiration on the homicide rate in Mexico.<sup>9</sup> Using population and mortality data from Mexico's Sistema Nacional de Información en Salud (SINAIS), along with crime and GDP data from Mexico's Instituto Nacional de Estadística y Geografía (INEGI), I find that the expiration of the AWB had a large, positive, and statistically significant impact on the homicide rate.

Two alternative events in Mexico are occurring in the post-AWB time period that could be biasing the results. First, promptly after taking office in December 2006, President Calderón

<sup>&</sup>lt;sup>6</sup> U.S.Department of Justice, 2010. Review of ATF's Project Gunrunner. November; Murphy, Kim, 2011. 20 arrested in gun smuggling case. Los Angeles Times, January 25.

 $<sup>^{7}</sup>$  A "straw purchaser" is someone who can legally purchase a firearm, but does so for an individual or organization that is unable to legally make the purchase themselves.

<sup>&</sup>lt;sup>8</sup> Grimaldi, James, Horwitz, Sara, 2010. As Mexico drug violence runs rampant, U.S. guns tied to crime south of border. The Washington Post, December 15; Hiatt, Fred, 2011. What Felipe Calderon wants from the U.S. The Washington Post, March 3.

<sup>&</sup>lt;sup>9</sup> I am not able to reject the null hypothesis that the pretreatment, 1995 to 2004, trends of the dependent variable are equal for cartel and non-cartel states.

deployed federal troops to combat drug violence. This initially reduced the homicides rate in 2007, before further escalating the conflict in 2008. To ensure that the initial results are not driven by the deployment, I examine whether the result holds after removing the 2007 and 2008 post-deployment years from the sample. The estimate remains similar to the baseline result. Second, conflict between the Juarez Cartel and Sinaloa Cartel has led to the two states in which the cartels are based, Chihuahua and Sinaloa, to be home to the highest levels of post-AWB drug violence. I remove these two states from the sample to verify that the result is not being driven by this inter-cartel conflict, and again, the results are similar to the initial estimates. I also remove both the post-deployment years and the Chihuahua and Sinaloa observations simultaneously from the sample; the estimates again show a strong positive relationship between the expiration of the AWB and the homicide rate in Mexico. Finally, I repeat this process using homicide crime data from the Secretariado Ejecutivo del Sistema Nacional de Seguridad Pública (SESNSP), available beginning in 1997, and find similar estimates.

The selection of the "cartel states" was based on state characteristics prior to the passage of the AWB. A potential concern could be that the baseline results are biased due to misspecification of the treatment group. To test if the results are unique to how it was originally defined, I construct alternative definitions of the treatment group using measures of pretreatment crime, violations of Mexican federal firearms law and narcotics related crime, all measures that are highly correlated with cartel activity. The results are shown to be robust to redefining the treatment group to be states with high levels of cartel related crime.

In the four years following the expiration of the AWB, the homicide rate in Mexico has increased 45 percent. A back of the envelope calculation using results from the baseline model estimates that the expiration of the AWB can explain 16.4 percent of the increase in the homicide rate following the sunset of the ban. This implies that between 2005 and 2008, the expiration of the AWB has led to at least 2,684 additional homicides in Mexico. Alternative specifications of the model suggest that the effect of the AWB's expiration may be even greater.

A recent working paper from Dube et al. (2011) also investigated the impact of U.S. assault weapons in Mexico. They exploited the timing of the AWB's expiration and the fact that California had a state-level assault weapons ban, and concluded that areas in Mexico closer to Arizona and Texas border crossings have higher rates of homicide, relative to those near California border crossings. The analysis from Dube et al. (2011) focused on homicides within

100 miles of the border, for the years 2002 to 2006. Unlike Dube et al. (2011) this paper uses data from every Mexican state over the life of the AWB, through 2008. Furthermore, I exploit variation in cartel activity in Mexico, both by focusing on the main areas of cartel operation and on states with high levels of cartel related crime. Most importantly, however, the results from Dube et al. (2011) reinforce the conclusion of this paper, which finds that the expiration of the AWB led to increased violence in Mexico.

#### II. The Sunset of the Federal Assault Weapons Ban and Assault Weapon Availability

As part of the Violent Crime Control and Law Enforcement Act of 1994, the Federal Assault Weapons Ban (AWB) was passed by the United States Congress, and signed into law by President Clinton in September 1994. <sup>10</sup> The law made the manufacture, transfer, or possession of any semiautomatic assault weapon illegal. Firearms were banned if they possessed the specific characteristics of assault weapons, and many other firearms were specifically banned by name: the Colt AR-15, AK-47, Baretta AR-70, M-10, TEC-9, etc. Furthermore, the law banned the transfer and possession of magazines, or similar devices that accept more than ten rounds of ammunition. The preceding restrictions did not apply to the possession or transfer of any firearms or ammunition magazines that were lawfully possessed on September 13<sup>th</sup>, 1994, the day the bill was signed into law.

As written into the original law, the AWB was scheduled to expire after ten years. On September 13<sup>th</sup>, 2004 the 108<sup>th</sup> United States Congress allowed the AWB to expire without any action. The expiration of the ban was largely anticipated, enabling manufacturers to sufficiently invest in production capacity and rapidly increase production of assault weapons soon after the law's expiration.<sup>11</sup>

Firearm manufacturing data available from the Bureau of Alcohol, Tobacco, Firearms and Explosives' (ATF) webpage show large increases in the production of firearm categories that disproportionately include assault weapons. The AWB banned many semiautomatic assault pistols by name, nearly all of them were either 9mm (these included the TEC-9, Uzi, SWD M-10, M-11/9), or .380 caliber (the SWD M-11 and SWD M-12).<sup>12</sup> Using ATF firearm manufacturing data, it is possible to compare the manufacture of pistols by caliber.

<sup>&</sup>lt;sup>10</sup> Subtitle A of the Violent Crime Control and Law Enforcement Act of 1994. H.R. 3355

<sup>&</sup>lt;sup>11</sup> Welna, David, 2004. Renewal of Assault Weapons Ban in Doubt. National Public Radio, July 21.

 $<sup>^{12}</sup>$  The exception to this is the .22 caliber TEC-22, which was also banned by name.

In Figure 2, I compare production of higher caliber pistols, of the type that are more likely to contain assault pistols mentioned above (9mm and .380 caliber) with the production of popular low caliber pistols (.22 and .32 caliber) that are less likely to include assault weapons. To make comparison of the change in manufacturing over time easier, the level of production in 1998 is normalized to one for each caliber. The 1998 level of production is recorded in parenthesis in the legend, next to the appropriate caliber size. The two low-caliber categories are represented by dotted lines, the high-caliber categories by dashed lines. The solid vertical line is placed at 2004, the expiration of the AWB. As can be seen in Figure 2, after the AWB expires in 2004 there is no increase in the production levels of either low caliber pistol category. However, the manufacture of the higher caliber pistols that include TEC-9, M-10 and the other banned assault weapons drastically increased in the year immediately following the AWB's expiration.<sup>13</sup> This is evidence that assault weapons production was constrained during the ban and that availability of these weapons increased after the expiration of the AWB.

The same type of exercise can be repeated with data on the U.S. production of rifles. The ATF does not report rifle production by caliber, but instead by manufacturer. A 2004 report from the Violence Policy Center (VPC) highlights firearm manufacturing firms that altered specific characteristics of their firearms to avoid their products being classified as assault weapons. The firearms manufactured by these firms, while the ban was in place, are functionally equivalent to assault weapons, except for cosmetic adjustments made to the firearms to avoid the assault weapon classification as defined by the law. These manufacturers are most likely to have assault weapons as part of their post-2004 production portfolio and I classify seven firms mentioned in the Violence Policy Center report as the "Assault Rifle Firms" group.<sup>14</sup> I then construct a group of three large rifle manufacturers, who produce mainly hunting, non-assault rifles. These "Non-Assault Rifle Firms" manufacture between 20 and 27 percent of all rifles produced in any given year.<sup>15</sup> Finally, a third group labeled as "All Other Rifles" contains data for all rifles manufactured and not included in either of the first two groups.

<sup>&</sup>lt;sup>13</sup> Both Intratec and SWD went out of business before the sunset of the AWB. However, there are many other companies that continue to produce what would be classified as assault pistols of the same caliber. For example, variants of the Military Armament Corporation (MAC) models and AR-15 pistol models.

<sup>&</sup>lt;sup>14</sup> These seven firms are the only firms that produced all years, at an average of at least 1,000 rifles per year. The firms are Armalite, Inc., Barrett USA Corp., Bushmaster Firearms, Inc., Defense Procurement Manufacturing Services, Inc., DS Arms Inc., Olympic Arms, Inc., and Rock River Arms, Inc.

<sup>&</sup>lt;sup>15</sup> The "hunting rifle" firms are H&R 1871, LLC, Keystone Sporting Arms, LLC, Marlin Firearms.

Production indexes for these three groups of manufacturers are reported in Figure 3. As in the previous figure, the levels of manufacturing are normalized to one for the base year, 1998. The base year levels are shown in parentheses in the figure's legend. Again, there is a dramatic increase in production of firearms immediately following the expiration of the AWB for the group that has the highest concentration of assault weapons. Post-AWB production for these firms has increased to levels twice as high as the pre-expiration peak. For this group the result is perhaps more striking due to the fact that these firms produced altered versions of assault weapons during the ban and still greatly increased their output after 2004.

A key question is whether the increase in the production of U.S. made assault weapons, after 2004, led to more assault weapons being moved to Mexico. It is important to note that these firearms are not available in Mexico. Firearm legislation in Mexico is much stricter than the United States, all retail sales of firearms are controlled by the federal government, and federal law requires annual renewal of licenses for both use and transportation of any firearm. Furthermore, private ownership of high caliber pistols and any military-style firearm, as defined by Article 11 of Mexico's Federal Firearms and Law, is illegal. It is also illegal to bring any firearm or round of ammunition into Mexico without written authorization from the Mexican government. Although data on the number and types of guns being trafficked into Mexico are not accessible, public officials have little doubt that guns from the United States are being trafficked south, into Mexico.<sup>16</sup> The Secretary of Homeland Security, Janet Napolitano, Secretary of State, Hilary Clinton, President Calderón, various U.S. Senators from both sides of the aisle, the assistant director of the ATF, and President Obama have all acknowledged that the United States south into Mexico.<sup>17</sup>

U.S. anti-trafficking policy focuses on preventing Mexican cartels from obtaining firearms purchased in the United States. The stated purpose of the ATF's Project Gunrunner is to

<sup>&</sup>lt;sup>16</sup> The ATF cannot legally provide gun trace data to the public. There is even evidence that police, cities, and Mexican officials often struggle to receive sufficient data to successfully stop the flow of weapons (U.S. Department of Justice, 2010).

<sup>&</sup>lt;sup>17</sup> Meyer, Josh, 2009. U.S. shares blame for Mexico drug violence, senators say. Los Angeles Times, March 18; Ellingwood, Ken, 2009. U.S. shares blame for Mexico drug violence, Clinton says. Los Angeles Times, March 26; Statement of William Hoover before the U.S. House of Representatives Committee on Foreign Affairs Subcommittee on the Western Hemisphere, 2/7/2008; Statement of Secretary Janet Napolitano before Senate Homeland Security and Governmental Affairs Committee, 3/25/2009; Sheridan, Mary Beth, 2010. Mexico's Calderon tells Congress he needs U.S. help in fighting drug wars. The Washington Post, May 21; Stolberg, Sheryl Gay, 2009. In Mexico, Obama Seeks Curbs on Arms Sales. New York Times, April 16.

"stem the firearms trafficking to Mexico by organized criminal groups."<sup>18</sup> The Government Accountability Office also concludes that of the firearms being trafficked "most firearms are intended to support operations of Mexican [drug trafficking organizations], which are also responsible for trafficking arms to Mexico."<sup>19</sup>

Beginning in 2006, U.S. and Mexican officials have been working together as part of the ATF's Project Gunrunner to combat illegal firearm trafficking. A key element of this project is attempting to determine the origin of the weapons that are being trafficked into Mexico. Both U.S. and Mexican officials use the ATF's e-trace system in an effort to collect more evidence on the origin of firearms recovered in Mexico. The e-trace program allows officials to electronically submit serial numbers to the ATF, allowing the ATF to indentify the firearm's manufacturer and location of first sale. This program is available to authorities both in the U.S. and Mexico.<sup>20</sup> U.S. officials have stated that over 60,000 U.S. firearms have been seized in Mexico since the expiration of the AWB, and President Calderón has suggested that the number is closer 85.000.<sup>21</sup> Analysis of the trace data revealed about 25 percent of the firearms successfully traced to the United States in 2008 are variants of the AR-15 and AK-47 (Chu and Krouse, 2009). Based on these data, in the Spring of 2010, President Calderón personally appealed to the United States Congress to consider reinstituting the Federal Assault Weapons Ban. Although this e-trace program provides the best information currently available, the cooperation between U.S. and Mexican officials has been insufficient (Department of Justice, 2010). Mexican officials are often unmotivated by the importance of tracing seized firearms due to the tardiness and lack of executable information that the ATF is able to share with Mexican officials. The inefficiencies in the e-trace submission process allows for the possibility that the number of U.S. firearms recovered in Mexico may be significantly higher than the released tallies.

In addition to the fact that tens of thousands of firearms from the United States have been recovered in Mexico, there is evidence that Mexican drug trafficking organizations are choosing to purchase foreign made firearms in the United States. Although there may be other sellers from which the cartels can acquire assault weapons, it is legal to purchase them in the United States,

<sup>&</sup>lt;sup>18</sup> U.S. Department of Justice, 2009. Fact Sheet: Department of Justice Efforts to Combat Mexican Drug Cartels. April 2.

<sup>&</sup>lt;sup>19</sup> U.S. Government Accountability Office, 2009. Firearms Trafficking: U.S. Efforts to Combat Arm Trafficking to Mexico Face Planning and Corrdination Challenges. June.

<sup>&</sup>lt;sup>20</sup> https://www.atfonline.gov/etrace/

<sup>&</sup>lt;sup>21</sup> Grimaldi, James, Horwitz, Sara, 2010. As Mexico drug violence runs rampant, U.S. guns tied to crime south of border. The Washington Post, December 15; Sheridan, Mary Beth, 2010. Mexico's Calderon tells Congress he needs U.S. help in fighting drug wars. The Washington Post, May 21.

and cartels take advantage of this with their use of "straw purchasers." Furthermore, transport costs are minimized by purchasing the firearms in gun shops along the border and utilizing existing trafficking routes, which they use to move drugs across the border. One of the two most common types of firearms recovered in Mexico, and traced back to the U.S., is the AK-47, specifically the Romarm AK-47, manufactured in Romania (Goodman and Marizco, 2010). Cartels operating in Mexico can bring these firearms into the country by any means, the fact that they are choosing to purchase these firearms in the United States suggests that this is their preferred method of obtaining an internationally available weapon.

Finally, a report from Mayors Against Illegal Guns (MAIG, 2010) has found that, on average, guns seized in Mexico are recovered by police less than three years after their initial sale in the U.S. This is important for two reasons. First, this means that a majority of the guns recovered in Mexico and traced back to the U.S. have been purchased since the expiration of the AWB. Second, such a low "time to crime" statistic is indicative of firearms being purchased for intended use in crime. This is evidence that guns not available prior to 2005 are now being recovered in Mexico in vast quantities. A separate report from the Violence Policy Center (2009), which surveyed guns involved in over 20 firearm trafficking cases along the southwest border, found that 63 percent of the 501 guns involved were assault weapons.

## **III. Mexican Drug Cartels**

In 2008, Mexican drug cartels operated in at least 45 states across the United States.<sup>22</sup> However, the strength and reach of these organizations is not unique to today. Over the past 20 years, the epicenter of drug trafficking in the Western Hemisphere has been shifting from Colombia north towards Mexico. Although the relative importance of Mexican cartels is growing, the strength of the organizations is not without precedent. In the 1990s, Mexican cartels had already begun trafficking large quantities of Colombian cocaine; the Juarez Cartel was known to forward \$20 – \$30 million to Colombian criminal organizations for each shipment of cocaine. These large shipments allowed the Juarez Cartel to earn tens of millions of dollars in profit each week (Constantine 1997 and 1998). A U.S. Drug Enforcement Agency (DEA) investigation revealed that between 1996 and 1997, a single Juarez Cartel distribution cell moved 30 tons of cocaine into the U.S. and made over \$100 million in profit (Constantine 1997 and

<sup>&</sup>lt;sup>22</sup> Hossain, Farhana, G.V., Xaquin, 2009. The Reach of Mexican Drug Cartels. The New York Times, March 22.

1998). In the mid-1990s, the Tijuana Cartel, a rival of the Juarez Cartel, weekly handed out more than \$1 million in bribes to Mexican officials allowing the cartel to operate without interruption. The influence exerted by these organizations is not unique to the twenty-first century, neither is the continuous turmoil within and between cartels.<sup>23</sup>

Under international pressure the Mexican government began to crackdown on the drug cartels in the late 1990s.<sup>24</sup> In 1996, the leader of the Gulf Cartel, one of Mexico's most powerful cartels, was arrested and extradited to the United States (Miro and Curtis, 2003). Under pressure from both Mexican and U.S. authorities, Amado Carrillo Fuentes, the most powerful drug lord in Mexico at the time, died during plastic surgery while attempting to change his appearance (Miro and Curtis, 2003). The leader and founder of the Colima Cartel, Jesus Amezcua, was arrested in 1998. In 2000, the election of President Fox ended the 71 years of uninterrupted rule by the rival Institutional Revolutionary Party (PRI). President Fox's election and aggressive fight against corruption led to increased confrontations between cartels and the federal government. After President Fox's election, top members of Sonora, Colima, Tijuana, and Gulf Cartels were all either arrested or killed by government. Such targeting has been a constant of the government's strategy for at least the last ten years.

The landscape in which cartels operate in Mexico has not dramatically shifted in the past fifteen years. Mexican cartels have been successfully moving large amounts of inventory into the United States since at least the early 1990s, and cartel activity has been continuously, although to varying degrees, targeted by the government. What has changed since September 13, 2004, as demonstrated in the previous section, is the high powered weapons newly, and readily, available to cartels.

#### **IV. Data and Methodology**

I examine the impact of the U.S. AWB on violence in Mexico within the context of a difference-in-difference model. Specifically, I compare the homicide rates in the cartel states,

<sup>&</sup>lt;sup>23</sup> Since the 1989 arrest of Miguel Angel Felix Gallardo, "the Godfather," the power structure between Mexican cartels has been consistently evolving. At different times in the past fifteen years, the distinction of the most powerful cartel has been traded between the Juarez, Tijuana, Gulf, and the Sinaloa Cartel. As the influence of the most powerful cartel has risen and fallen so has the existence and strength of many other cartels throughout Mexico.

<sup>&</sup>lt;sup>24</sup> Dillon, Sam, 1996. U.S. Starts Trial of Reputed Drug Boss. The New York Times, September 17. Fineman, Mark, 1997. Zedillo Vows to Fight for Dignity in War on Drugs. Los Angeles Times, March 8.

where assault weapons are likely destined in higher quantities, before and after the sunset of the AWB, with the rates in other Mexican "non-cartel" states over the same period. Mexico has 31 states and a federal district; using pre-2004 information from both the U.S. and Mexican governments I define eight "cartel states." These are states where the leaderships of Mexico's largest cartels were based before the expiration of the AWB.<sup>25</sup>

The data used in this paper come from two main sources. State-level population and mortality data are from Mexico's Sistema Nacional de Información en Salud (SINAIS). Cause of death information used by SINAIS, including homicides, is taken from death certificates. The initial conclusion from the coroner classifies the cause of death to be an accident, suicide, homicide, etc. Any conclusion of an investigation or criminal proceeding can then correct or ratify the original entry on the death certificate. An alternative measure of homicides is also used to verify the initial findings. Crime data, including homicide information, based on the number of reports filed by Mexican authorities are available from Secretariado Ejecutivo del Sistema Nacional de Seguridad Pública (SESNSP), beginning in 1997. Homicide data from SESNSP is separated into two categories, intentional and negligent. Only homicides that SESNSP classifies as intentional are used in this paper.

Annual state level GDP and data on the number of criminal suspects are from the Instituto Nacional de Estadística y Geografía (INEGI). Data on criminal suspects are available beginning in 1997. All rates have been calculated using annual state population estimates from SINAIS. Population estimates are available beginning in 1990; therefore, this is the earliest year homicide rates can be calculated. The population data are also used to calculate the per capita GDP variable, using constant 2008 pesos. Means for the variables of interest are shown in Table 1. The means for the years the assault weapons ban was in place, 1995 to 2004, are shown in the first two columns. The means are separated for "cartel" and "non-cartel" states. In the next two columns the means are again reported separately by state type, for the post-AWB years, 2005 to 2008. The values in the last two columns of Table 1 demonstrate that characteristics of both "cartel" and "non-cartel" states are changing at similar rates. Demographic characteristics of the two groups of states changed at the same rate. Both "cartel" and "non-cartel" states saw their population increase eight percent over this time period, with a three percent increase in the fraction of the population aged between 20 and 45 years old. The growth in per-capita GDP is

<sup>&</sup>lt;sup>25</sup> The eight "cartel states" are: Baja California, Colima, Chihuahua, Jalisco, Michoacán, Sinaloa, Sonora, and Tamaulipas.

similar across both groups of states, as is the change in crime rates. The only variable that changes differentially across the two groups is the homicide rate. The homicide rate in "cartel states" increased after the expiration of the AWB, the homicide rate in "non-cartel states" moved in the opposite direction.

A graphical presentation of aggregate data used in the difference-in-difference model is presented in Figure 5 where I report the homicide rates, per 100,000 people, for both cartel states (black) and the non-cartel states (grey). The pretreatment period used in this paper will begin with the year 1995, the first full year with the AWB in effect. The years between the two vertical dashed, lines are the pretreatment years, when the AWB was in effect. The pretreatment cartel and non-cartel homicide rate trends are not statistically different from one another. After the 2004 expiration of the AWB, the homicide rate in cartel states becomes much more volatile. After increasing for the first two post-ban years, there is a sharp reduction in 2007. The 2007 reduction is due to an increased military deployment by President Calderón, and a short-lived truce between the cartels in response to this deployment. Starting in 2008 there is a dramatic increase in violence after the truce collapsed and conflict between the cartels and the military increased. Results presented in the following section will show the estimates in the basic models are not driven by the increase in post-military deployment violence.

The difference-in-difference model can be represented by the following equation:

 $Ln(homicide \ rate_{st}) = \alpha + (cartel_s * post-AWB_t)\beta_1 + cartel_s\beta_2 + post-AWB_t\beta_3 + \varepsilon_{it}$ (1) The dependent variable is the natural log of the state/year specific homicide rate. The variable

*cartel* is equal to one for the eight states which have been identified as the cartel states, equal to zero for the other 24 states. Post-AWB is equal to one for the years after the AWB expired, 2005-2008, and is equal to zero for the years from 1995-2004.<sup>26</sup> The variable of interest is  $\beta_1$ , which will represent the percent change in the cartel state homicide rate after the expiration of the AWB. All results are weighted by population and standard errors are calculated allowing for arbitrary correlation in errors within a state over time.<sup>27</sup>

<sup>&</sup>lt;sup>26</sup> Unless otherwise noted, regressions include the years 1995-2008.

<sup>&</sup>lt;sup>27</sup> Cook and Tauchen (1984) show that the "interstate differences in volatility imply that the variance of the error term differs systematically across states." The resulting heteroskedasticity leads to inefficient parameters and biased estimates of the standard errors. All of the results presented in this paper are weighted by population, with standard errors clustered at the state level. Although this is not fully taking advantage of the method developed by Cook and Tauchen (1984) the results are very similar to the estimates obtained following their method.

Additional covariates can be added to equation (1) to control for other factors that could be affecting the estimation of  $\beta_1$ . To control for time invariant state characteristics, the cartel variable has been replaced with state specific fixed effects,  $\mu_s$ , and year fixed effects,  $v_t$ , have been substituted for the post-AWB variable. Likewise, I add a vector of control variables  $X_{it}$ . The new equation now can be written in the form:

$$Ln(homicide \ rate_{st}) = \alpha + (cartel_s * post-AWB_t)\beta_1 + X_{it}\gamma + \mu_s + v_t + \varepsilon_{it}$$
 (2)  
The first covariate in X<sub>it</sub> is the real state level per-capita GDP, to control for the economic  
condition of the state, which could affect both violence and cartel participation. I also add the  
percent of the population that is between 20 and 45 years-old since this is the population that is  
most affected by homicides and is most involved in illegal activity. The final control variable is  
the vehicular accident mortality rate. Like homicides, death due to vehicle accidents  
disproportionately affects young people. The vehicular mortality rate controls for any increase in  
young adults' appetite for risky activity that may have led to increased homicide rates.

## V. Results

#### a) Baseline Results

The results from the difference-in-difference represented in equation (1) are displayed in column (1) of Table 2. The coefficient on the interaction term, 0.237, can be interpreted to mean that the expiration of the AWB led to a 23.7 percent increase of the homicide rate in cartel states. The estimate from equation (2) is presented in column (2). The model estimates that the expiration of the AWB increased the homicide rates in Mexican cartel states by 24.6 percent. The point estimate changes only slightly from the estimates in the first column and is still statistically significant.

Using the baseline result from column (2) of Table 2, a back of the envelope calculation reveals that the expiration of the AWB can explain 16.4 percent of the increase in the homicide rate in Mexico, between 2004 and 2008. The 2004 homicide rate in "cartel states" was 10.74 homicides per 100,000 people. Using the estimate reported in column (2) of Table 2, the model estimates that the expiration of the AWB led to an additional 2.65 homicides per 100,000 people in "cartel states". From the low point in 2004, the homicide rate in "cartel states" increased to 23.92 in 2008, an increase of 13.18 homicides per 100,000 people. The expiration of the AWB can explain 20.1 percent of this increase in the "cartel state" homicide rate.

The 2004 population in the eight "cartel states" was approximately 25.3 million, and the national population of Mexico was about 103 million. Using the strict assumption underlying the difference-in-difference approach that the AWB's expiration had no affect on "non-cartel state" homicides, the "cartel state" homicide rate can be expressed as a change in the national homicide rate by multiplying it by the ratio of the "cartel state" and national populations (25.3/103). This calculation yields that the expiration of the AWB led to a 0.65 increase in the national homicide rate. From 2004 to 2008 the homicide rate in Mexico increased from 8.79 to 12.77, an increase of 3.98 homicides per 100,000 people. The expiration of the AWB can explain 16.4 percent of this increase. Again using the 2004 population, the increase in the homicide rate is equivalent to an annual increase of about 671 homicides, or about an additional 2,684 homicides from 2005 to 2008.

## b) Robustness: Alternative Explanations and Distance from the Border

There are two other potentially important explanations that could be affecting the estimated effect of the AWB. First, the increased deployment of the military by President Calderón in late December, 2006 and early January 2007 has significantly impacted the homicide rate. In 2007, the cartels reacted to the deployment by forming a truce to quell fighting amongst themselves (Grayson, 2007). However, fighting began anew in 2008 both between cartels and with the government forces. This led to a tremendous spike in violence in 2008 and the violence has only escalated since (Trans-Border Institute and Reforma, 2010). As seen in Figure 5, after the military deployment, the rise in homicide rates mainly occurred in the cartel states, which may be increasing the estimated effect of the assault weapons. To examine whether the results in Table 2 can be explained by the military deployment, the years after the deployment (2007 and 2008) are removed from the sample. The results after removing the post-deployment years can be found in column (1) of Table 3. As expected the coefficient of interest decreases after removing the post-deployment years, nevertheless, the coefficient on the interaction term is still large, 0.186, and statistically significant at the five percent level.

Another explanation for the increase in violence could be the conflict between the Juarez and Sinaloa cartels. Once allies, the two cartels have violently turned against one another. On September 11, 2004 Rodolfo Carrillo, the brother of the Juarez Cartel leader, was murdered by order of Joaquin "El Chapo" Guzman, the leader of the Sinaloa Cartel. According to the official report from the Attorney General's Office, the initial killing of Rodolfo Carrillo was in response to the murder of two Sinaloa Cartel members. The Juarez Cartel quickly responded with the assassination of Joaquin Guzman's brother, Arturo "El Pollo" Guzman.<sup>28</sup> The violence did not escalate immediately after the deaths of Rodoflo Carrillo and Arturo Guzman, most likely due to the fact that the Sinaloa Cartel was already involved in conflicts with other cartels. By 2008, the conflict between these two cartels had finally boiled over and the amount of violence in Chihuahua and Sinaloa skyrocketed. The 2008 homicide rate of drug related homicides is displayed in Figure 6 (Trans-Border Institute and Reforma, 2010).<sup>29</sup> Not surprisingly, the two states with the most drug related violence are Chihuahua and Sinaloa. The assassinations of the two brothers occurred within months of the AWB's expiration, this timing is potentially troubling for the difference-in-difference model. To ensure that the result is not being driven by the conflict between these two cartels I remove the observations from Chihuahua and Sinaloa and rerun the model, the result can be seen in column (2) of Table 3. Again, the results remain large, positive, and statistically significant.

After checking two important alternative hypotheses separately, column (3) of Table 3 combines the two cuts used in columns (1) and (2). If the result in column (3) remains positive and statistically significant, the alternative hypotheses that the military deployment or the conflict between the Sinaloa and Juarez Cartels are driving the results can be ruled out. The result in column (3) is still statistically significant and the estimates indicate that the expiration of the AWB led to a 21 percent increase in the homicide rate of the cartel states.

In the fourth column of Table 3, I look at the effect of the AWB's expiration at different distances from the border. For the hypothesis being tested in this paper it is not necessary for the effect of the AWB's sunset to be strongest at the border. However, it would be difficult to argue that assault weapons from the United States are responsible for an increase in the violence in Mexico if the effect is centered away from the border. For two reasons it is reasonable to assume that the impact of the expiration of the AWB could be greatest along the border. First, over 85 percent of the firearms recovered in Mexico were purchased in U.S. states along the southwest

<sup>&</sup>lt;sup>28</sup> Sevilla, Ramon, 2005. Cinco líneas de investigación en el homicidio de El Pollo. La Cronica de Hoy, January 4.

<sup>&</sup>lt;sup>29</sup> Drug related homicide data is compiled by Reforma newspaper. Reforma classifies drug related killings as "narco-executions" based on a variety of factors: the use of a high-caliber or automatic weapons often used by organized crime groups, execution style or mass casualty shootings, indicative markings or written messages, decapitation or dismemberment of corpses, the presence of large quantities of illegal drugs, currency or weapons, or official reports explicitly indicating the involvement of organized crime groups (Rios and Shirk, 2011).

border (MAIG, 2010). Second, a significant amount of cartel activity and violence occurs in Mexican states that border the U.S. Distance is measured from the population center in each state to the U.S. border. States are then separated into quartiles; the first quartile consists of the six states that border the U.S. The reference group in column (4) is the furthest quartile. The results in column (4) show that the effect of the AWB's expiration is the greatest along the border. The increase in the homicide rate along the border is 37 percent higher than the furthest quartile. The rincrease in the second and third quartiles is not significantly different than the fourth quartile. Due to the relationship between the border and drug cartels this result does not contribute to an independent hypothesis, but it does show a result that would be expected if assault weapons are being trafficked from the United States and not an alternative source.

#### c) Crime Rates and an Alternative Source of Homicide Data

A potential concern would arise if the level of crime in "cartel states," especially crime that is not likely to be affected by the availability of assault weapons, increased in the same way as the homicide rate. If this were the case, the homicide rate results from Table 2 and Table 3 could actually be the result of an increase in the general criminal activity, and not the expiration of the AWB. To test this hypothesis, I replace the dependant variable with the natural log of five different measures of crime, and re-estimate equation (2). The results for these estimates can be seen in Table 4. The dependant variable in each of the columns is the natural log of a given crime rate. The dependant variable in the first column is calculated using thefts, the number reported of rapes is used to calculate the dependant variable in the second column, and all non-homicide crime is used in the third column. Violations of Mexico's federal firearms law (which includes possession, transportation, unpermitted use, etc.) is used in column (4), and narcotics crime (which includes production, possession, transportation) is used in the fifth column. The crimes used in the last two columns tend to be more prevalent in "cartel states," this is discussed in more detail in the following subsection.<sup>30</sup>

The estimates across all five columns of Table 4 are statistically insignificant. The estimates in the first, third, and fourth columns, for theft, all non-homicide crime, and violation of the federal firearms law, are also small in magnitude. These results demonstrate that general

 $<sup>^{30}</sup>$  Crime data used in columns (1) to (3) comes from SESNSP, and represents crime reports. Crime data used in columns (4) and (5) were obtain through INEGI, and consist of the number of criminal suspects.

crime rates were not moving in sync with the homicide rate, and that the increase in the homicide rate at the time of the AWB's expiration could not have been caused by an overall increase in criminal activity. More specifically, the results in the last two columns show that the increase in the homicide rate was not accompanied by an increase in cartel related crime. This is evidence that the post-AWB increase in the homicide rate was not due to increased cartel activity in general, further isolating the expiration of the AWB as a central cause of the increased violence.

SESNSP has also compiled homicide reports at the state level, dating back to 1997. This measure of homicide is completely independent from the SINAIS data. The data from SINAIS, used to estimate the results from Table 2 and Table 3, only classifies a death to be a homicide after a medical examination. The homicide statistics from SESNSP are created by compiling the number of crime reports filed by local authorities, in which a homicide is alleged to have occurred. Using these data I can test if the effect is robust across different data sources. Estimates using the SESNP data are reported in Table 5. The estimate using all years and all states from SESNSP is available in column (1). The point estimate, 0.332, is larger than the previous estimates, but qualitatively similar. I then repeat the same procedure from the previous subsection to rule out possible alternative explanations. As with the previous estimates, the results remain positive and significant when post-deployment years are removed, and when the high conflict states are removed.

## d) Alternative Treatment Groups

A potential concern with the initial difference-in-difference specification could be the selection of the treatment group. The selection of the eight "cartel states" was based on pretreatment state characteristics. This definition of the treatment group may be too restrictive in that although Mexican cartel operations are centralized in the states defined as "cartel states," the territory claimed by cartels stretches to nearly all Mexican states. This type of misspecification could lead to contamination of the control group and biasing of the results. However, a more important concern may be that the original selection of states into the treatment group was in some ways subjective. To insure the result found in the previous estimates is not specific to the definition of the treatment group used, I redefine the treatment and control groups in a manner independent from the previous definition. I do this using pretreatment crime data for two crimes highly related to cartels: the number of suspected criminals violating Mexican narcotics law

(which includes production, possession, transportation), and federal firearms law (which includes possession, transportation, unpermitted use, etc.).<sup>31</sup> Redefining the treatment group in this way accomplishes two objectives. First, it allows for the treatment group to be defined in an objective manner. Second, I can now test if the effect extends beyond the original eight "cartel states" by making the cutoff for the redefined treatment group more or less restrictive. I have created two measures of pretreatment crime, one for each crime, suspected violators of Mexican narcotics and federal firearms laws. I will use these measures of pretreatment crime to redefine the treatment and control groups in a manner independent from the previous definition and test if the results from Table 2 are robust to alternative definitions of the treatment group.

For both narcotics crime and federal firearm law crime, I construct an average pretreatment crime rate using the following equation:

$$Pre-Firearms_{s} = \frac{1}{7} \sum_{i=1997}^{2003} \left\{ \left( \frac{federal \ firearms \ crime_{si}}{population_{si}} \right) \times 100,000 \right\}.$$
(3)

Equation (3) is also used to calculate the Pre-Narcotics<sub>s</sub> variable. I do not include 2004 crime in the calculation because I want to ensure that my pretreatment crime levels are not affected by the September 2004 expiration of the AWB. The pretreatment crime levels for violation of narcotics law and federal firearm law is shown in Figure 7 and Figure 8, respectively. In both figures the eight states that were previously defined as cartel states are highlighted in black, in both cases the cartel states are more likely to have higher crime rates.

I then use these values to define cutoffs where there is a drop in the crime rate from one state to the next. All states above the cutoff are treated as the treatment group and are assigned a variable equal to one; states below the cutoff are assigned a value of zero. I use the same estimating equation previously used, equation (2).  $\beta_1$  is estimated by replacing the cartel variable with the cutoff variable equal to one for all states above the cutoff. Three cutoffs are used for each crime; the value used for each cutoff is reported with the independent variable in Table 6. The cutoffs used in top panel of Table 6 refer to the pretreatment average number of suspected violators of narcotics law per 100,000 people, plotted in Figure 7. The cutoffs used in bottom

<sup>&</sup>lt;sup>31</sup> I use the number of suspects instead of crimes to allow for a more robust measure of criminal activity. The crime rate I calculate is then the number of people per 100,000 who have committed any given crime. I use suspects due to the fact that bribery is rampant in much of Mexico, especially areas with large cartel presence. These are the same two crimes used in the fourth and fifth columns of Table 4.

panel refer to the values plotted Figure 8, the pretreatment average number of suspected violators of federal firearms law, per 100,000 people.<sup>32</sup>

The results for the regressions using these alternative group specifications are presented in Table 6. Column (1) of both panels presents the estimates using the highest cutoff, column (2) the results using the second cutoff, and column (3) using the lowest cutoff. All results are statistically significant and qualitatively similar to the results using the cartel treatment group from the previous section. The estimates from the original model are robust to alternate definitions of the treatment group; the cartel state definition is not driving the results.

#### e) Estimates Using Pretreatment Crime and Suicide Variables

There are two central shortcomings of the previous estimates. First, the implementation of the difference-in-difference model implicitly implies the effect of assault weapons is zero in the control states. This may be underestimating the effect of the AWB's expiration in the control states. To address this point I interact the average pretreatment crime rates, shown in Figures (7) and (8), with the post-AWB indicator variable. This allows for variations across all states. Both crime variables are strongly related to cartel activity, as the figures show, but allows for variation across all of the Mexican states.

Second, within the baseline difference-in-difference framework it will not be possible to identify if the assault weapons or drug cartels are more responsible for the increase in the homicide rate. However, a conclusion can be made regarding the consequences of providing violent, well funding, international criminal organizations with easy access to powerful weapons. In an attempt to remove the influence of cartels from the result as much as possible, I will examine if states with higher pretreatment levels of firearm prevalence experience larger increases in violence.

Crime data are available beginning in 1997. In order to include state and year specific controls of the crime rates, in addition to the interaction between the average pretreatment crime

<sup>&</sup>lt;sup>32</sup> The treatment states for the highest narcotics law cutoff are Sonora, Baja California, Baja California Sur, Chihuahua, and Sinaloa. For the second narcotics law cutoff the treatment states include all of the treatment states from the first cutoff along with, Colima, Durango, Nayarit, Quintana Roo, and Tamaulipas. Finally the third cutoff includes all the previously mentioned states as well as, Morelos, Jalisco, Campeche, Coahuila, Guerrero, Michoacán, Zacatecas, and Aguascalientes. The highest treatment group for the cutoff of federal firearm law includes Baja California, Sinaloa, Sonora, Tamaulipas, Colima, and Nayarit. The second cutoff adds Chihuahua and Durango, Morelos, Michoacán, Jalisco, Baja California Sur, San Luis Potosi, and Oaxaca. The treatment group for the third cutoff of the federal firearms law includes all the states in the previous two treatment groups in addition to, Guanajuato, Guerrero, Campeche, Queretaro, Zacatecas Coahuila, Aguascalientes, Nuevo Leon, and Chiapas.

rates and post-AWB, I drop the pre-1997 observations. This results in 384 state, year observations. The first two columns of Table 7 show the estimates of the baseline interaction between cartel and post-AWB using only the years from 1997 to 2008. Column (1) includes the same set of controls used in previous regressions; column (2) includes additional controls for narcotics and federal firearm crime rates. It is important to note that the results in the first two columns of Table 7 do not differ much from the results in column (2) of Table 2, removing the pre-1997 years does not affect the results. The interaction term between the pretreatment firearm crime rate and post-AWB, in column (3), is greater than the interaction between post-AWB and pretreatment narcotics crime rate, in column (4). The rows at the bottom of Table 7 show the impact of the estimated coefficient at the state with the median pretreatment crime rate. The results from columns (1) and (2) equate to the expiration of the AWB increasing the homicide rate nationally by about 7%, this is under the assumption that the effect is zero in the non-cartel states. The estimated impact evaluated in the median state is larger when allowing an effect in every state by exploiting the variation in pretreatment crime rates. The estimated effect of the expiration of the AWB in column (4), using the pretreatment narcotics crime estimate is similar to the baseline estimates in columns (1) and (2). However, when interacting pretreatment firearm law crime rate with the expiration of the AWB the estimated effect is twice as large; the result is reported in the bottom row of column (3). The estimate using the pretreatment firearm crime rate equates to the expiration of the AWB being able to explain 39.4 percent of the 2004 to 2008 increase in the homicide rate.

Both crime rates used to estimate the results in columns (3) and (4) of Table 7 are likely to be related to cartel activity. In an attempt to remove cartel activity from the estimate as much as possible, I use a measure of gun ownership, the fraction of suicides committed using a firearm. The firearm suicide data used in this paper, from SINAIS, are available beginning in 1998. Most suicides are attempted impulsively, 70 percent of people making a near-lethal suicide attempt took less than one hour between the decision to attempt the suicide and the action itself (Simon et al., 2001), and 24 percent took less than five minutes. Firearms are an easy way to react to this impulse decision. Firearms are also far more likely to lead to a successful suicide attempt, and firearm availability is strongly correlated with higher levels of both firearm suicide and overall suicide (Miller and Hemenway; 1999, 2008). Furthermore, previous work has found

that the fraction of suicides involving guns is the best available proxy of firearm prevalence when compared to survey data (Azrael et al., 2004; Cook and Ludwig, 2004).

Repeating the same methodology as was used with the crime variables, an equation similar to equation (3) is used to calculate the average pretreatment fraction of suicides that are committed with firearms, for each state. The result is graphed in Figure 9. The pretreatment measure of the fraction of suicides is then interacted with the indicator variable for post-AWB. The result is reported in column (5) of Table 7, the regression in column (6) includes controls for federal firearm law and narcotics crime rates. Both estimates show that the effect of the AWB is greater in states with higher levels of gun ownership. Under the assumption that a state's level of gun ownership did not increase around the 2004 expiration of the AWB, then the increase in the homicide rate could be due to individuals possessing the newly available assault weapons. Evaluated at the median state, the estimate reported in column (6) can be interpreted to mean that the AWB led to an increase in the homicide rate of 20.05 percent in the state with the median level of gun ownership. This suggests that the AWB can explain as much as 44.3 percent of the overall increase in the homicide rate between 2004 and 2008.

#### **VI.** Conclusion

The AWB is shown to have a significant impact on the homicide rate in Mexico. The baseline results in this paper estimate that the expiration of the AWB has led to a 24.6 percent increase in the homicide rate of cartel states, and can explain at least 16.4 percent of the increase in the homicide rate nationally. This is equivalent to approximately an additional 2,684 homicides, and alternative specifications suggest that the impact could actually be much larger. This result is shown to be robust to alternative explanations of the increase in the homicide rate and to alternate definitions of the treatment group.

The effect of the AWB is shown to be greater in states with higher rates of pre-2004 narcotics crime and violations of the federal firearms law. In addition, the expiration of the AWB seems strongly related with a state's pretreatment level of gun ownership. This is preliminary evidence, suggesting that the increase in violence after the expiration of the AWB is significantly driven by the post-2004 availability of the illegal assault weapons themselves in addition to drug cartel activity. This sudden increase in the availability of assault weapons may be useful to future work investigating how the increase in violence has impacted other aspects of life in Mexico.

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Figure 2 – U.S. manufacture of pistols by caliber, 1998=1





Figure 3 – U.S. manufacture of rifle by firm type, 1998=1



Source: http://www.excelduc.org.mx/index.cfm?catID=21&subcatID=195









Figure 7 – 1997-2003 Average Number of Suspected Violators of Narcotics Law, per 100,000

Figure 8 - 1997-2003 Average Number of Suspected Violators of Federal Firearms Law, per 100,000





#### Figure 9 – 1997-2003 Average Fraction of Suicides Committed Using a Firearm

Table 1	– State	Means	Before	and After	the Ex	piration	of the	Assault V	Weapons	Ban
I UDIC I	Dunc	Tri cuilo	DUIUIC	unu muu		pination	or the	Toparte	// cupoins	Dun

	1995-2004	(AWB)	2005-2008 (Post-AWB)		Change (Post/AWB)	
	Non-Cartel	Cartel	Non-Cartel	Cartel	Non-Cartel	Cartel
Population	3,072,951	2,984,928	3,309,387	3,237,289	1.08	1.08
Homicide Rate (SINAIS)	11.19	13.81	8.26	15.06	0.74	1.09
Vehicle Mortality Rate	7.64	12.24	9.30	14.07	1.22	1.15
Per Capita GDP	58.81	58.39	77.99	75.83	1.34	1.30
Percent of Population 20 – 45	0.38	0.38	0.39	0.40	1.03	1.03
Federal Firearm Crime Rate	6.74	19.57	6.58	19.44	0.98	0.99
Narcotics Crime Rate	6.97	28.14	9.31	35.35	1.34	1.26
Fraction Suicides With Firearm	0.17	0.24	0.12	0.17	0.71	0.69

Each value represents the average of the states in the appropriate category. All means, except for the population itself, are weighted by state/year population. All values are rounded. Per capita GDP is recorded in constant 2003 pesos. Data for the federal firearm crime rate, and the narcotics crime rate are available beginning in 1997. Data used for firearm suicides is available beginning in 1998.

	Ln(homicide rate <sub>st</sub> )					
Cartel <sub>s</sub> *Post-AWB <sub>t</sub>	(1) 0.237* (0.142)	(2) 0.246*** (0.079)				
<b>Cartel</b> <sub>s</sub>	0.324*** (0.078)					
Post-AWB <sub>t</sub>	-0.261*** (0.070)					
State/Year FE Controls R <sup>2</sup>	0.102	X X 0.912				
Ν	448	448				

Table 2 - Effect	of the Expiration of the AWB on the Homicide Rate
	I n(homicida rata )

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1. The dependent variable is the natural log of the homicide rate. Cartel is equal to one for Baja California, Colima, Chihuahua, Jalisco, Michoacán, Sinaloa, Sonora, and Tamaulipas. Post-AWB is equal to one for all years after 2004. Sample includes years from 1995 to 2008. Where indicated, includes controls for state and year specific per capita GDP, vehicular accident mortality rate, the percent of the population between 20 and 45, state fixed effects, and year fixed effects. Each regression is weighted by state population, and standard errors are clustered at the state level for regressions including fixed effects.

Table 3 - Testing the	Robustness of the	Effect of the Exp	$\mathbf{A}$	VB on the Homicide Rate
Table 5 - Testing the	KUDUSINESS UI IIIC	Effect of the Exp	mation of the Av	D on the moniture Nate

	Ln(homicide rate <sub>st</sub> )						
	Only Years < 2007	No Chihuahua/Sinaloa	No Chihuahua/Sinaloa	All Years,			
	(1)	(2)	(3)	(4)			
Cartel <sub>s</sub> *Post-AWB <sub>t</sub>	0.186**	0.215**	0.210**				
	(0.077)	(0.084)	(0.096)				
Border <sub>s</sub> *Post-AWB <sub>t</sub>				0.370***			
				(0.115)			
2 <sup>nd</sup> Distance Quartiles				-0.007			
*Post-AWB <sub>t</sub>				(0.117)			
3 <sup>rd</sup> Distance Ouartile				-0.082			
*Post-AWB <sub>t</sub>				(0.097)			
$\mathbf{R}^2$	0.946	0.914	0.944	0.918			
Ν	384	420	360	448			

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1. The dependent variable is the natural log of the homicide rate. Cartel is equal to one for Baja California, Colima, Chihuahua, Jalisco, Michoacán, Sinaloa, Sonora, and Tamaulipas. Post-AWB is equal to one for all years after 2004. Sample includes years from 1995 to 2008, unless otherwise noted. All regressions include controls for state and year specific per capita GDP, vehicular accident mortality rate, the percent of the population between 20 and 45, state fixed effects, and year fixed effects. Each regression is weighted by state population, and standard errors are clustered at the state level.

Table 4 – Effect of the Expiration of the AWB on Crime Rates							
	Ln(theft rate <sub>st</sub> )	Ln(rape rate <sub>st</sub> )	Ln(non-homicide crime <sub>st</sub> )	Ln(narcotics crime rate <sub>st</sub> )			
	(1)	(2)	(3)	(4)	(5)		
Cartel <sub>s</sub> *Post-AWB <sub>t</sub>	0.021 (0.158)	0.100 (0.074)	-0.033 (0.111)	0.015 (0.070)	-0.111 (0.174)		
$\mathbb{R}^2$	0.858	0.813	0.829	0.916	0.884		
Ν	384	384	384	384	384		

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1. The dependent variable is the natural log of the given crime rate. Cartel is equal to one for Baja California, Colima, Chihuahua, Jalisco, Michoacán, Sinaloa, Sonora, and Tamaulipas. Post-AWB is equal to one for all years after 2004. Sample includes years from 1997 to 2008. All regressions include for state and year specific per capita GDP, vehicular accident mortality rate, the percent of the population between 20 and 45, state fixed effects, and year fixed effects. Each regression is weighted by state population, and standard errors are clustered at the state level.

Table 5 - Effect of the Expiration of the AWB on the Homicide Rate – Alternative Homicide Data, SESNSP							
		Ln(ho	micide rate <sub>st</sub> )				
	1997-2008	Only Years < 2007	No Chihuahua/Sinaloa	No Chihuahua/Sinaloa and Only Years < 2007			
	(1)	(2)	(3)	(4)			
Cartel <sub>s</sub> *Post-AWB <sub>t</sub>	0.332***	0.230**	0.246**	0.197*			
	(0.125)	(0.102)	(0.118)	(0.113)			
$\mathbf{R}^2$	0.743	0.768	0.733	0.759			
Ν	383	320	359	300			

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1. The dependent variable is the natural log of the homicide rate. Cartel is equal to one for Baja California, Colima, Chihuahua, Jalisco, Michoacán, Sinaloa, Sonora, and Tamaulipas. Post-AWB is equal to one for all years after 2004. Sample includes years from 1997 to 2008, unless otherwise noted. Homicide data for Tlaxcala is missing in 2007, this reduces the number of observations in columns (1) and (3) by one. All regressions include for state and year specific per capita GDP, vehicular accident mortality rate, the percent of the population between 20 and 45, state fixed effects, and year fixed effects. Each regression is weighted by state population, and standard errors are clustered at the state level.

	a. Narcotics La	aw	
	L	n(homicide rate	e <sub>st</sub> )
	(1)	(2)	(3)
Post-AWB*			
Pre-Narcotics <sub>s</sub> >30	0.301***		
	(0.082)		
Pre-Narcotics <sub>s</sub> >15		0.264***	
		(0.071)	
Due Newsoting > 0			0.015***
Fre-marcoucs <sub>s</sub> >9			(0.074)
			(0.074)
$\mathbf{P}^2$	0.911	0.912	0.912
ĸ	0.911	0.912	0.712
Ν	448	448	448
b. 1	Federal Firearn	n Law	
	L	n(homicide rate	e <sub>st</sub> )
	(1)	(2)	(3)
Post-AWB*			
Pre-Firearm <sub>s</sub> >20	0.251***		
	(0.077)		
Pre-Firearm <sub>s</sub> >10		0.158*	
		(0.081)	
			0.220***
Fre-Firearin <sub>s</sub> >0			$(0.239^{\circ})$
			(0.009)
$\mathbf{P}^2$	0 909	0 909	0.913
ĸ	0.707	0.707	0.715
Ν	448	448	448

 Table 6 – Treatment and Control Groups Defined by Pretreatment Crime Rates

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1. The dependent variable is the natural log of the homicide rate. Cartel is equal to one for Baja California, Colima, Chihuahua, Jalisco, Michoacán, Sinaloa, Sonora, and Tamaulipas. Post-AWB is equal to one for all years after 2004. Sample includes years from 1995 to 2008. All regressions include for state and year specific per capita GDP, vehicular accident mortality rate, the percent of the population between 20 and 45, state fixed effects, and year fixed effects. Each regression is weighted by state population, and standard errors are clustered at the state level.

	Ln(homicide rate <sub>st</sub> )						
	1997-2008	1997-2008	1997-2008	1997-2008	1998-2008	1998-2008	
	(1)	(2)	(3)	(4)	(5)	(6)	
Cartel <sub>s</sub> *Post-AWB <sub>t</sub>	0.235*** (0.071)	0.244*** (0.072)					
Pre-Firearm <sub>s</sub> *Post-AWB <sub>t</sub>			0.019*** (0.004)				
Pre-Narcotics <sub>s</sub> *Post-AWB <sub>t</sub>				0.007*** (0.002)			
Pre-Suicide Fraction <sub>s</sub> *Post-AWB <sub>t</sub>					1.186*** (0.398)	0.996** (0.378)	
Suicide Fraction <sub>st</sub>					0.079 (0.340)	-0.190 (0.363)	
Federal Firearm Crime Rate $_{st}$		0.015* (0.008)	0.008 (0.005)	0.015* (0.008)		0.020** (0.009)	
Narcotics Crime Rate <sub>st</sub>		-0.001 (0.003)	-0.003 (0.003)	-0.003 (0.003)		0.000 (0.003)	
$\mathbf{R}^2$	0.909	0.913	0.918	0.912	0.906	0.912	
Ν	384	384	384	384	347	347	
Effect of AWB Expiration Evaluated At Median Value of Pretreatment Crime Variable							
Percent Increase in National Homicide Rate	7.05	7.32					
Percent Increase in Homicide Rate			17.82	7.21	23.88	20.05	

Table 7 - Effect of Expiration of the AWB on the Homicide Rate, Pre-2004 Crime & Fraction of Suicides with Firearm

\*\*\* p<0.01, \*\* p<0.05, \* p<0.1. The dependent variable is the natural log of the homicide rate. Cartel is equal to one for Baja California, Colima, Chihuahua, Jalisco, Michoacán, Sinaloa, Sonora, and Tamaulipas. Post-AWB is equal to one for all years after 2004. Pre-Firearm is a state specific variable equal to the average federal firearms law crime rate for the pretreatment years, 1997 to 2003. Pre-Narcotics and Pre-Suicide Fraction are calculated the in the same way as pre-firearm, using narcotics crime rates and the fraction of suicides committed using a firearm, respectively. Federal firearm crime rate, narcotics crime rate, and suicide fraction are state and year specific. Data for the crime variables are available beginning in 1997; firearm suicide data used are available beginning in 1998. All regressions include state and year specific per capita GDP, vehicular accident mortality rate, the percent of the population between 20 and 45. Each regression is weighted by state population, and standard errors are clustered at the state level.

## **Appendix (Not for publication)**

A.I) Text of the U.S. Federal Assault Weapons Ban

The AWB was Subtitle A of H.R. 3355, the Violent Crime Control and Law Enforcement Act of 1994. The key text banning assault weapons is as follows:

(1) It shall be unlawful for a person to manufacture, transfer, or possess a semiautomatic assault weapon.

The following paragraph allows firearms legally owned before the enacted of the law.

(2) Paragraph (1) shall not apply to the possession or transfer of any semiautomatic assault weapon otherwise lawfully possessed under Federal law on the date of the enactment of this subsection.

The assault weapons were defined as follows:

(b) DEFINITION OF SEMIAUTOMATIC ASSAULT WEAPON- Section 921(a) of title
18, United States Code, is amended by adding at the end the following new paragraph:
(30) The term `semiautomatic assault weapon' means--

(A) any of the firearms, or copies or duplicates of the firearms in any caliber, known as--

(i) Norinco, Mitchell, and Poly Technologies Avtomat Kalashnikovs (all models):

(ii) Action Arms Israeli Military Industries UZI and Galil;

(iii) Beretta Ar70 (SC-70);

(*iv*) *Colt AR-15;* 

(v) Fabrique National FN/FAL, FN/LAR, and FNC;

(vi) SWD M-10, M-11, M-11/9, and M-12;

(vii) Steyr AUG;

(viii) INTRATEC TEC-9, TEC-DC9 and TEC-22; and

(*ix*) revolving cylinder shotguns, such as (or similar to) the Street Sweeper and Striker 12;

(*B*) a semiautomatic rifle that has an ability to accept a detachable magazine and has at least 2 of--

(*i*) a folding or telescoping stock;

*(ii) a pistol grip that protrudes conspicuously beneath the action of the weapon;* 

(iii) a bayonet mount;

*(iv) a flash suppressor or threaded barrel designed to accommodate a flash suppressor; and* 

(v) a grenade launcher;

*(C)* a semiautomatic pistol that has an ability to accept a detachable magazine and has at least 2 of--

*(i) an ammunition magazine that attaches to the pistol outside of the pistol grip;* 

(*ii*) a threaded barrel capable of accepting a barrel extender, flash suppressor, forward handgrip, or silencer;

(iii) a shroud that is attached to, or partially or completely encircles, the barrel and that permits the shooter to hold the firearm with the nontrigger hand without being burned;

*(iv) a manufactured weight of 50 ounces or more when the pistol is unloaded; and* 

(v) a semiautomatic version of an automatic firearm; and

(D) a semiautomatic shotgun that has at least 2 of--

(i) a folding or telescoping stock;

*(ii) a pistol grip that protrudes conspicuously beneath the action of the weapon;* 

(iii) a fixed magazine capacity in excess of 5 rounds; and

(iv) an ability to accept a detachable magazine.

Finally, large capacity magazines were also banned.

(b) DEFINITION OF LARGE CAPACITY AMMUNITION FEEDING DEVICE- Section 921(a) of title 18, United States Code, as amended by section 110102(b), is amended by adding at the end the following new paragraph:

(31) The term `large capacity ammunition feeding device'--

(A) means a magazine, belt, drum, feed strip, or similar device manufactured after the date of enactment of the Violent Crime Control and Law Enforcement Act of 1994 that has a capacity of, or that can be readily restored or converted to accept, more than 10 rounds of ammunition;

#### A.II) Focusing on Expiration, Not Implementation

There are a number of reasons that this paper focuses on the likely impact of the expiration of the AWB and not its implementation. The evidence presented in Figures 2 and 3 strongly suggest that there was an immediate increase in the stock of available assault weapons after the ban's expiration. However, the ban allowed legal possession and transfer of all assault weapons which were legally owned at the time the ban went into effect. The law did not change the existing stock of assault weapons available when it was implemented, in 1994. In fact, there is evidence that the anticipation of the ban allowed manufacturers to increase production of the soon to be banned weapons prior to the AWB becoming law.

In Table A.1 the average number of firearms manufactured between 1989 and 1993 is compared to the number of firearms manufactured in 1994, for both assault weapon and non-assault weapon categories.<sup>33</sup> Production in the assault weapons categories, AR-15, Intratec, and SWD/MAC, all increase by at least 36 percent relative to their prior 5-year average. However, the production of the non-assault weapon groups increases no more than 7.9 percent. Not only does the 1994 implementation of the AWB not have any impact on the existing stock of assault weapons, it seems to have actually led to a jump in production just prior to the onset of the law.

Previous work examining the 1994 implementation of the AWB finds no evidence of a significant impact on either prices (Koper and Roth 1997; 2002) or crime (Koper, 2004). This work finds that prices increased in expectation of the AWB, but quickly return to at least their pre-ban levels (Koper and Roth 1997). A study including all of the ban years (Koper, 2004), 1994-2003, finds that crime involving assault weapons fell between 17 and 72 percent across various cities in the United States. However, there is also evidence that crime with firearms using large capacity magazines held steady or possibly increased over the life of the ban; furthermore, Koper (2004) does not attempt to disentangle the effect of the AWB itself with the larger Violent Crime and Law Enforcement Act of 1994.

<sup>&</sup>lt;sup>33</sup> Information for AR-15, Intratec, SWD/MAC, Lorcin, and Davis manufacturing is from Roth and Koper (1997). Manufacturing information for Marlin Firearms and U.S. (Winchester) Repeating Arms is from VPC (2003). All data is originally collected and released by the ATF.

Due to the findings of existing work and the continued availability of assault weapons before and after September 13, 1994, there is little reason to expect an immediate effect from the implementation of the AWB.

#### A.III) Summary of Mexican Cartels

The main cartels during the pretreatment period were the following:<sup>34</sup> *Colima Cartel (Based in Colima and Jalisco)* – The Colima Cartel originally operated under Jesus Amezcua until his arrest in 1998. The cartel mainly conducts international trafficking and importation of large amounts of methamphetamine products from India and Thailand (Constantine, 1997 and 1998). The cartel directly exports to the United States and was the subject of a major DEA sting operation in 1997 (Constantine, 1998). The third Amezcua brother, Adan, was arrested in 2001. Prior to 2004 the cartel had fallen from its peak in the early 1990s (Miro and Curtis, 2003).

*Gulf Cartel (Tamaulipas)* – Osiel Cardenas Guillen (OCG) rose to the top of the organization after a 1996 crack down on the Gulf Cartel which led to three of its leaders either being arrested or killed. The cartel grew under Cardenas Guillen's leadership until 2002 when it was responsible for transporting 15 percent of all cocaine moved through Mexico (Miro and Curtis, 2003). In 2003, the government began to focus its efforts on the Gulf Cartel as the influence of the Tijuana Cartel waned (Campbell, 2006). This led to the 2003 arrest of OCG, and the eventual partnership between the Tijuana and Gulf Cartel to push back against their mutual enemy, Joaquin Guzman's Sinaloa Cartel.

*Juarez Cartel (Chihuahua)* – The cartel was the largest and most influential cartel in Mexico for most of the 1990s. The cartel was very well connected to Columbian drug traffickers (Constantine, 1997) and to the head of Mexico's anti-drug agency (Campbell, 2006; Constantine, 1997). Under Amado Carrillo Fuentes, "the Lord of the Skies," the Juarez Cartel transported \$20 to \$30 million shipments from Columbia using their own fleet of aircraft. In 1997, under

<sup>&</sup>lt;sup>34</sup> The largest omission is most likely the Oaxaca Cartel. The decision was made to not include Oaxaca due to its very close relationship with the Tijuana Cartel. The Oaxaca Cartel did not operate with enough independence to be considered in the treatment group. The results however would not drastically change if Oaxaca were to be included in the treatment group. All significance would remain, and the point estimates would only be slightly reduced.

tremendous pressure from authorities on both sides of the border, Amado Carrillo-Fuentes died from complications with plastic surgery while attempting to change his appearance (Constantine, 1998). Vicente Carrillo-Fuentes took over control from his deceased brother; the cartel remained influential, it never regained the stature it had under Amado Carrillo-Fuentes.

*Millennium Cartel (Michoacán)* – In 1999 the Millennium Cartel began operations in Michoacán and challenged the Colima Cartel for control of the state after the third Amezcua brother was arrested in 2001 (Campbell, 2006). The location on the west coast of Mexico positions the cartel to receive shipments from Colombia. The DEA estimates that the organization imported up to 20 tons of cocaine a month, mainly for distribution to other Mexican trafficking organizations (Miro and Curtis, 2003).

*Sinaloa Cartel (Sinaloa)* – Although the organization existed before his escape, the Sinaloa Cartel has increased its influence after Joaquin Guzman's escape from prison. In 2002, the government's crackdown on the Tijuana Cartel allowed the Sinaloa Cartel room to expand its influence in northwest Mexico (Campbell, 2006). After the government shifted its focus to the Gulf Cartel in 2003, Guzman took the opportunity to attempt to encroach on the Gulf Cartel's territory only to be repelled (Reuters, 2009). The 2004 killing of Vicente Carrillo-Fuentes' brother, Rodolfo Carrillo, led a revenge killing of Guzman's brother (La Cronica, 2005), and eventually to conflict between the Sinaloa and Juarez Cartels.

*Sonora Cartel (Sonora)* – This cartel was run by Miguel Caro-Quintero, who was arrested in December 2001. After the arrest of Miguel operations shifted to his two brothers Jorge and Genaro (Miro and Curtis, 2003). The Sinaloa Cartel mainly grew large amounts of marijuana on ranches in rural Northern Sonora.

*Tijuana Cartel (Baja California)* – The Tijuana cartel is one of the largest in Mexico, and is run by the Arellano-Felix family. After the death of Amado Carrillo-Fuentes in 1997, the Tijuana Cartel grew to be the most powerful cartel in Mexico around the turn of the century. It is estimated that in the late 1990s the cartel paid out nearly \$1 million in bribes every week for the ability to run their business uninterrupted. The cartel was dealt a major blow in 2002 when a

government crackdown focused on the cartel, one Arellano-Felix brother was killed and another arrested. Although still one of Mexico's more powerful cartels, the government crackdown and conflict with Guzman's Sinaloa cartel have left the Tijuana cartel weakened.

## **Appendix Tables**

Table A.1 – U.S. firearm production prior to the AWB							
	Firearm Production						
	1989-1993 Average	1994	Ratio				
AR-15 Group	38,511	66,042	1.714				
Intratec 9mm	33,578	102,682	3.058				
SWD & MAC	10,508	14,380	1.368				
Lorcin/Davis	282,603	184,139	0.652				
Marlin Firearms	352,856	358,372	1.016				
U.S. Repeating Arms	107,199	115,664	1.079				

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