The Economic Consequences of Drug Trafficking Violence in Mexico

Robles, Gustavo*
grobles@stanford.edu

Calderón, Gabriela
gabcal@alumni.stanford.edu

Magaloni, Beatriz
magaloni@stanford.edu

Working Paper

August, 2015

Abstract

The levels of violence in Mexico have dramatically increased in the last few years due to structural changes in the drug trafficking business. The increase in the number of drug trafficking organizations (DTOs) fighting over control of territory and trafficking routes has resulted in a substantial increase in the rates of homicides and other type of crimes. This study evaluates the economic costs of drug-related violence. We propose electricity consumption as an indicator of the level of municipal economic activity and use two different empirical strategies. First, we use an instrumental variable regression using as exogenous variation the instrument proposed by Castillo, Mejia & Restrepo (2014) based on historical seizures of cocaine in Colombia interacted with the distance of the Mexican border towns to the United States. We find that marginal increases of

*Beatriz Magaloni, Associate Professor of Political Science and Senior Fellow, Freeman Spogli Institute for International Studies; Gustavo Robles, Senior Researcher at the Program on Poverty and Governance and Ph.D Student in Political Science; Gabriela Calderón, PhD in Economics and Social Entrepreneur. A previous version of the paper was published as the working paper #IDB-WP-426 for the Interamerican Development Bank

violence have negative effects on labor participation and the proportion of unemployed in an area. The marginal effect of the increase in homicides is substantive for earned income and for the proportion of business owners, but not for energy consumption. In the second part of the study we use synthetic controls to evaluate the effect that inter-narco wars have on local economies. We define the beginning of a turf war as the moment when homicide rates at the municipal level increase beyond an historical threshold, and construct counterfactual scenarios as an optimal weighted average from potential control units. We found that municipalities that observed dramatic spikes in violence between 2006 and 2010 significantly reduced their energy consumption in the years after the turf war started.

1 Introduction

Since the end of 2006 the levels of violence in Mexico have soared due to structural changes in the drug trafficking business and the government strategies to combat organized crime. Over 50,000 drug-trafficking-related deaths were registered by 2011. The vast majority of these deaths were caused by confrontations between Drug Trafficking Organizations (DTOs) competing for control of routes and locations strategic for the traffic of drugs to the world's largest market: the United States.

Violence in Mexico dramatically intensified due to three main factors: exogenous changes in the narcotics market, including the relative success of Colombia at counter narcotics operations and drug seizures (Castillo et al. 2014); the increased fragmentation of drug cartels into numerous smaller organizations and criminal cells; and the militarized fight against drugs and drug trafficking that began during the administration of President Felipe Calderón (Guerrero 2011, Dell 2015, Calderón et al. 2015).

Most academic studies to this point have focused on the causes and escalation of violence. In our study, we measure the economic consequences of drug-related violence. Economic activity in Mexico has decelerated in recent years. During the government of Felipe Calderón, the economy grew at an average rate of 1.84%, the lowest rate of the last four administrations. Although this low performance could be attributed in part to the violence, it is difficult to separate this effect from other factors that strongly affected economic performance. The financial crisis in the United States between 2008 and 2009 was followed by a severe contraction of the GDP in Mexico. In the same year, the government cut public spending significantly, and the country was impacted by the Influenza A(H1N1) epidemic that paralyzed economic activity for several weeks.

DTOs are fundamentally organized to maximize profits from trafficking drugs illegally into the United States (NDIC 2010). *El Narco* is primarily an industry, and as an industry, the production and distribution of drugs are fundamental (Grillo 2011). It is conceivable that under certain conditions the narco- traffickers operate, produce, and traffic drugs, all without using coercive strategies against citizens, and without extorting businesses. We could therefore conceive of situations in which drug trafficking is carried out under moderate levels of violence and that it therefore has little impact on economic activity.

However, as the *Drug War* has escalated in Mexico, the cartels and their criminal cells have diversified their portfolios of activities to include kidnapping, extortion, human trafficking, and oil

theft, among other crimes (Guerrero 2010). These criminal activities are expected to have a much more direct impact on society and therefore on economic activity.

To explore how drug-related violence affects the economy, we use Olson's analogy (2000) equating drug cartels to either 'stationary bandits' or 'roving bandits' depending on the way in which they insert themselves into society. 'Stationary bandits' are those that are capable of maintaining control over a certain territory in the long term, while 'roving bandits' have temporary domain over an area. Olson argues that the former have rational incentives to restrict their ability to extract resources and use violence against the society because they wish to encourage investment and therefore long-term gain. In contrast, 'roving bandits' extort, rob, kidnap, and murder to enhance short- term gain without regard for the long-term impacts on the area.

There is evidence that Mexican drug traffickers sometimes behave like 'stationary' or 'roving' bandits. For example, El Cartel de Tijuana underwent an internal split between two factions, one led by Teodoro García Simental (alias *El Teo*), that favored kidnappings in Tijuana [1], and the other faction, led by Luis Fernando Sánchez Arellano (alias *El Ingeniero*-the Engineer) with strong political and economic connections in the city, that wanted to focus primarily on drug trafficking. El *Ingeniero* feared that kidnappings were attracting too much attention from the government and were contributing to the destruction of businesses [2]. After the arrest of *El Teo*, the faction led by Arellano Félix regained control of the cartel and tranquility was restored in Tijuana after the wave of violence between the two factions.

A similar dynamic appears to have occurred with the cartel *La Familia Michoacana* and the population in the Mexican state of Michoacán. In the beginning, that cartel was formed from a group of vigilantes who emphasized helping and protecting the poor against smugglers and drug traffickers. The cartel gave aide and loans to farmers, businessmen, housewives, and churches, and publicized these services in local newspapers to win social support. The group over time transformed into a criminal gang that increasingly began using violence against the population and widespread extortion against citizens.

Initially formed from a group of army deserters, *Los Zetas* became one of the most powerful and violent cartels in the country. After splitting off from the *Gulf Cartel*, they established dominance in several states and municipalities across the country through excessive force, kidnapping and extortion of different types of business.

[1] *El Teo* was arrested in January 2010 and his faction was dissolved.
[2] The full story can be found here.

What factors lead cartels to traffic drugs on societal margins or turn against it? Díaz Cayeros, Magaloni, Matanock & Romero (2012) use list experiments and opinion surveys to investigate the dynamics of extortion in Mexico. They find that narco-traffickers tend to act as 'stationary bandits' when they have monopolistic control over a territory. In these scenarios the 'narcos' exert lower levels of extortion and even citizens resort to them for 'help when facing a serious problem'. Cartel behavior towards society changes in the disputed territories. In those areas, the competition for *plazas* and drug trafficking routes is associated with greater levels of extortion and increasingly predatory behavior (Díaz Cayeros et al. 2012).

Another factor that seems to have contributed to drug cartels behaving increasingly like 'roving bandits' are the neutralization of their main leaders. Felipe Calderón's government pursued an aggressive policy of arrests of criminal organization's kingpins, which differentiated the administration from its predecessors. Over half of the drug capos that operated in Mexico in 2008 were captured. By losing their top leaders, the cartels lost control of the smaller criminal cells, and thus lost their capacity to operate their international drug trafficking routes effectively, causing them to turn against civilians to extract resources through increasingly exploitative criminal behavior (Guerrero 2010, Calderón et al. 2015). Moreover, neutralization of leaders intensifies rivalries between criminal organizations in the short and medium term (Calderón et al. 2015).

Corrupt law enforcement, and collapsing policing and justice systems also favored the diversification of DTOs' criminal activity. Díaz Cayeros et al. (2012) also found that it is more common for a citizen to be extorted by the police than by narco-traffickers. The study also shows that over one third of the population believes that the local police is working for criminal organizations. The fear of being a victim of a crime is widespread and induces behavioral changes in people such that they stop leaving their homes at night, using public transportation, or driving on highways. These changes in behavior can have an impact on consumption and economic activity, especially in tourism, services, and commercial sectors.

Similarly, under these war-like conditions, the most affected business owners close their shops and look to move to safer territories. The Internal Displacement Monitoring Center warned that due to drug- trafficking related violence in Mexico, close to 230,000 people have been forced to leave their homes and approximately half of those people have immigrated to the United States (IDMC & NRC 2010). In addition, there is abundant anecdotal evidence of Mexican migration to the United States because of a lack of security in the country (Felbab-Brown 2009). A large proportion of the migrant population are business owners, who manage to continue their businesses from cities along the U.S.-Mexican border, like Brownsville and McAllen, Texas (Economist 2012).

The migration caused by violence does not just harm the labor supply but also investment in new capital and the creation of new businesses.

The objective of this study is to estimate the effect of drug-trafficking related violence on the economic activity and employment. Given that we do not have time-series GDP data available at the municipal level, we use electricity consumption per capita measured as a proxy for economic activity. We also measure the impact of drug-related violence on different labor outcomes, such as the proportion of people over age 14 who are working, unemployed, self-employed, and business owners, as well as the effect on average labor income.

To evaluate the impact of violence on the economy, we use two identification strategies. First, we use an instrumental variable specification to model the marginal impact of violence. The instrument was proposed first in Castillo, Mejia & Restrepo (2014) and interacts the exogenous variation of cocaine seizures in Colombia across time with the spatial distance from Mexican municipalities to the US border.

The results from our instrumental variable regression show that an increase of 10 homicides per 100,000 inhabitants in a municipality is related to: a decrease in the proportion of people working by about 2 and 3 percentage points in the current and next quarter respectively; an increase in the proportion of unemployed people by about a 0.5 percentage points; a decrease in the proportion of people owning a business by about .4 percentage points; and a decrease in the proportion self-employed by about 0.5 percentage points. Moreover, an increase of one homicide per 100,000 inhabitants decreases the average municipal income by 1.2% in the current and following quarter.

With the instrumental variable approach, however, we found no significant effect on energy consumption, which was our proxy for GDP. The instrumental variable strategy can identify the marginal effect of violence on our economic variables - that is, how the increase of one additional homicide per 100,000 people contributed to the observed variance. It is nevertheless possible that the violence does not affect the economy linearly. We can think of a scenario in which drug-trafficking related violence impacts the economy only after a certain threshold, which may reflect the beginning of a violent conflict between cartels.

To evaluate this argument, we use the methodology of synthetic controls developed by Abadie & Gardeazabal (2003), and Abadie, Diamond & Hainmueller (2010). This method constructs synthetic counterfactuals as weighted averages of the control units. The weights are optimally chosen such as the synthetic counterfactual best resembles the initial conditions and trends of the outcome variable of the treated unit before the event of interest.

In our analysis, we identify the onset of a turf war when the number of homicides year to year, in any two consecutive years between 2006 and 2010, increases by more than three standard deviations with respect to the historic average of annual homicides since 1998. Our results show that during the first and second year after the start of a turf war, treated municipalities consumed on average 4.2% and 7.4% less electricity, respectively, than their synthetic counterfactuals. In this way, our results indicate that wars between rival DTOs competing for strategic routes or territories in the last years have had a profound impact on local economies in Mexico.

This paper is structured as follows: Section 2 provides a literature review on drug-related violence in Mexico and in other Latin American countries. Here we lay out the mechanisms by which criminal violence affects the labor market and the economy. In Sections 3, we describe the variables of interest and justify the use of domestic electricity consumption as an indicator of economic activity. In Section 4 we present the results of the instrumental variable regression. In section 5 we briefly describe the methodology of synthetic controls and present the main results using this technique. The main conclusion of the study are available in the last section.

2 The Economic Costs of Violence

The cost of violence includes both tangible and intangible costs. Tangible costs include all activities related to the prevention of and punishment for violence, including investments, expenditures, and material losses, as well as the cost of activities aimed to identify and punish those who commit crimes that contribute to violence. The intangible costs are more difficult to measure because they include estimates of the victims' decreased quality of life (CICAD & OAS 2004, McCollister, French & Fang 2010), changes in behavior, and other personal traumas (Soares 2009), and the loss of interpersonal trust and social capital because of fear and loss of order and freedom.

Although there is not a unified framework to measure all types of costs related to violence and new methodologies keep emerging (Soares 2009), two of them are often found in the literature: accounting methodologies and contingent valuation. Accounting methodologies start with the premise that crime and violence impose costs on the victims and loss of resources that wouldn't exist otherwise. They measure the resources spent by society in order to prevent and reduce crime, material losses, lost investments in human capital, medical expenses, as well as those resources spent in law enforcement and persecution of offenders. Economic effects are also measured at aggregated level including effects of violence on investment, social cohesion, and economic growth.

In contingent valuation people are asked to state how much are they willing to pay in order to prevent being victims of a crime or improve their wellbeing (Cook & Ludwig 2000, Cohen, Rust, Steen & Tidd 2004). Such measures rely heavily on surveys and are taken as the value that individuals place on public goods such as security. A popular version of contingent valuation is the hedonic prices methodology that relied on stated preferences rather than subjective assessments on individuals. The method aims to disentangle the price of a property in terms of different characteristics of the property.

Accounting methodologies have provided a vast range of estimations for the cost of crime and violence. The US Department of Justice (1994) estimated the direct costs of violent crimes to victims in 0.02% of GDP which more than doubles once indirect costs and aggregated costs are taken into account NCPC (1999) . Alternative measures that aggregate other types of interpersonal violence get estimates of 3.3% and 6.5% of the US GDP (WHO 2004, Miller, Cohen & Wiersema 1996).

In Latin America, the region with the highest homicides rates in the world, accounting methodologies also vary. Buvinic, Morrison & Shifter (1999) provide estimates for the cost of violence for some countries in Latin America including Brazil (10.5%), Colombia (24.7%), El Salvador (24.9%), Mexico (1.3%), and Venezuela (11.8%). Londoño & Guerrero (2000) estimate the direct cost of violence at 14.2% of the GDP of the region, Acevedo estimates a 7.7% for Central America. Buvinic et al. conclude that the cost of violence in Mexico is much higher (12.3% of the GDP).

The main methodological challenge in estimating the economic consequences of violence is the problem of identification. Just as the violence has a negative effect on economic activities and unemployment, poor economic performance or low employment rates can also generate more violence. Dell (2015) uses a regression discontinuity design to estimate the impact of violence on the local economic activity. Dell uses the electoral calendar at the municipal level as a source of exogenous variation and shows that those municipalities that elected a mayor from President Calderón's party (National Action Party, PAN) by a small electoral margin observed an increase in violence in the months after the election when compared with those municipalities where the PAN lost by a similar margin.

Dell interprets these results as evidence that government actions generate violence, assuming that PAN mayors are more likely to implement the security policies coming down from the central government. A second interesting result from her study is that a PAN victory causes violence to overflow into neighboring municipalities that fall along drug trafficking routes. The author finds

results that this expanded violence results in a reduction of female labor market participation and a drop in wages for men in the formal sector.

Measuring the economic consequences of drug related violence presents a more challenging task for the researcher than measuring the costs of ordinary violence for three reasons. First, drug related violence is difficult to measure given the lack of accurate data identifying drug homicides from other types of murders. Second, by its very own nature, drug related violence is episodic, targeted at specific individuals, and characterized by intermittent but dramatic peaks of violence. These characteristics make this type of violence highly non-linear and therefore difficult to model and predict using common econometric techniques. Third, drug related violence comes with increases in other types of crimes such an extortion and property crime.

There are many reasons why we believe that other types of crime rise when inter-cartel wars erupt: 1) DTOs' need of resources to sustain an armed conflict, 2) the reduced probability of crime punishment as government resources get absorbed into the primary conflict, which increases opportunistic crime, 3) the desire to punish and intimidate any person suspected of cooperating with enemy cartels, and 4) the capture or assassination of leaders, which causes cartels to lose control of their subsidiary groups and criminal cells (Calderón et al. 2015). Disentangling the economic consequences of narco homicides from those imposed by other drug related crimes constitutes a formidable challenge to the analysis.

In this article we propose the use of an event approach to estimate the economic impact of drug wars. We define the onset of a 'turf war' in a municipality as the moment when violence increases from historical trends beyond a relatively high threshold. The economic consequences of drug related violence could then be estimated comparing the outcomes of interest before and after a turf war and using as counterfactuals similar municipalities where narco wars did not occur.

Other studies have used a similar approach. In particular, Abadie & Gardeazabal (2003) use the synthetic control methodology to find that terrorist activities in the Basque country brought with them a fall in GDP per capita of 10 percentage points relative to the synthetic control of the region without terrorism. With a similar empirical strategy, Pinotti (2012) estimates a decrease in GDP per capita of 16% as a result of the Italian Mafia activity in southern Italy.

In this study we argue that, below a certain threshold of violence, firms are able to internalize some costs related to royalty payments, robberies, need for increased private security, and security technology, among others. In this scenario, we expect to see adjustments in the labor market as smaller businesses could cease to operate, creating a decrease in the demand for labor, but

not significant effects on the economic activity overall. As it approaches the 'turf-war threshold', drug-related violence profoundly impacts economic performance in the country. Under these 'war' conditions, a greater number of entrepreneurs and businessmen will decide to close their operations and move their families to more secure areas. We expect then to see a reduction in the total production of goods and services, as well as investment, and therefore a sharp decrease in the GDP.

3 Description of the Data

While Mexico's homicide rate falls far below that of other countries in Latin America, there is no doubt that the country was in the middle of a wave of violence that erupted in late 2005. Figure 1 below shows the total number of homicides in Mexico from 2003 to 2011. It is possible to classify the violence into two categories: that related to drug trafficking organizations, and general criminal violence (manslaughter) not linked to organized crime but affecting the general population.

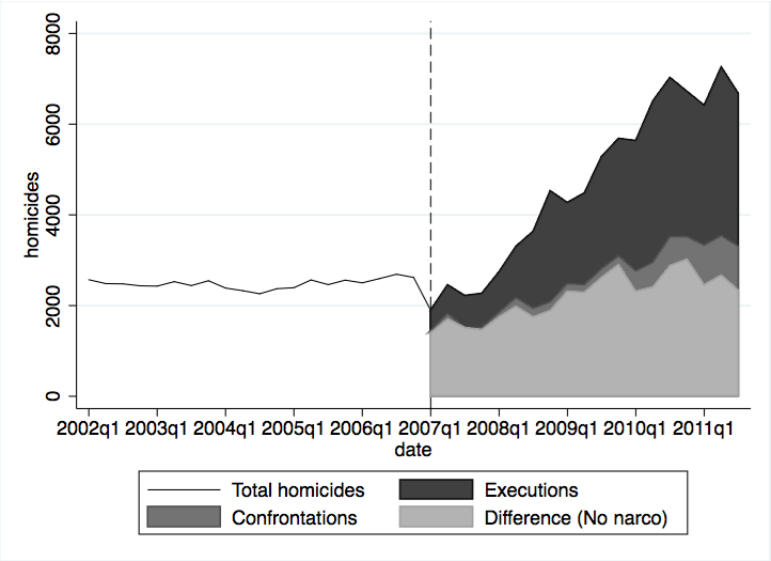
We use two data sources to measure violence. The first dataset was compiled by the federal government and contains "Deaths presumably related to DTOs' rivalry" from December 2006 to September 2011 (government data). Homicides are classified in three categories: deaths by *execution* (confrontations between criminal organizations without the involvement of authorities), deaths as a result of a direct *aggression* to law enforcement authorities, and deaths as a result of *confrontations* between police and criminal organizations.

The second dataset is provided by the National Health Information System (SINAIS), which is based on death certificates and reports the total number of deaths in the country since 1980, including homicides. Between December of 2006 and December of 2010, over half (53%) of the 80,976 homicides reported in this dataset were homicides in the population between 15 and 35 years old. We prefer to use SINAIS data over government data in order to evaluate the economic consequences of violence over a longer period of time.

Drug trafficking related violence has its own characteristics and causes that distinguish it from general violent crime (intentional homicide) which, while it does affect a larger section of the population, does not compare to the intensity or cruelty of violence connected to narco-trafficking. Approximately 90% of the drug-trafficking related homicides are executions, which account for most of the increase in violence in Mexico in recent years.

Executions are carried out to settle scores between people involved in the production, transport, and sale of drugs who do not abide by existing rules and agreements associated with the

Figure 1: Total homicides and drug-related homicides, 2003-2010



Source: Data on total homicides comes from SINAIS. Data on executions and confrontations comes from government data.The gray area in the graph shows the difference between the two sources.

violent struggle for control of drug trafficking areas and routes. Organized crime-related violence is characterized by intentional intimidation towards those who are considered to be rivals.

The 25 most violent municipalities in Mexico contained over half of the homicides that occurred between December 2006 and December 2010. Ciudad Juárez, Culiacán, Tijuana, and Chihuahua were the most violent cities in this period, with a total 13 million drug trafficking-related deaths. Even though the violence has been concentrated in very few municipalities, it became increasingly disperse over time.

Maps in Figure A1 of the appendix show the total number of homicides for each municipality based on data from the federal government. Each map shows cumulative murders, by year, from 2007 to 2010, meaning that the final map contains data on the total number of violent deaths that occurred in this four-year period. The geographic dispersion of DTOs-related violence can be clearly observed in these graphics. While 2007 there were three violent areas -Tijuana, Ciudad Juárez, and Culiacán - by 2010 there were several clusters of violence across the country

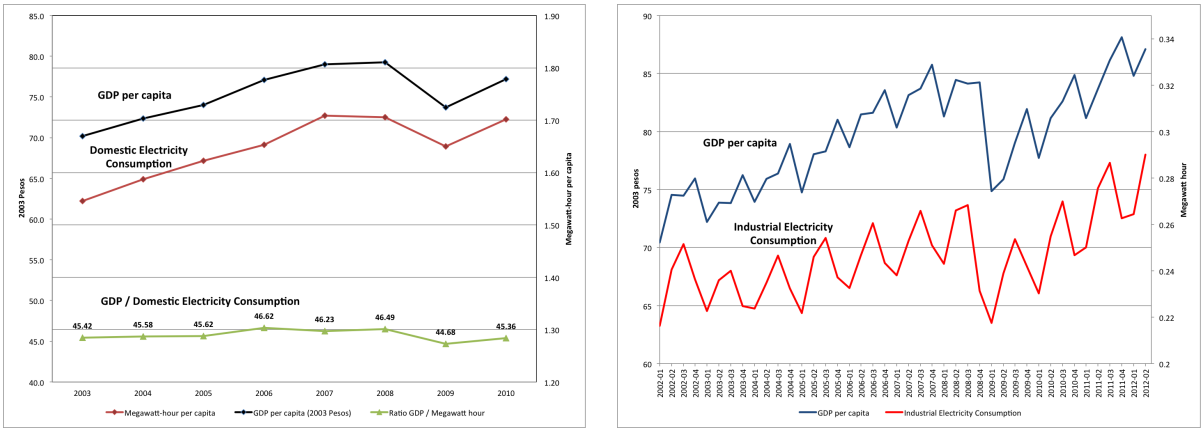
In this study we use domestic electricity consumption per capita as our indicator for economic activity. Official GDP series for the country are only available at the state and national level. Figure 2 below compares the time series from 2003 to 2010 of national GDP per capita (in constant pesos) with domestic consumption of electricity per capita measured in megawatt hours . It can

be seen that the two series present similar tendencies over time. Moreover, the ratio of GDP with respect to domestic electricity consumption has remained constant with an average of MX$45.75 per megawatt- hour and a standard deviation of 0.61. Approximately 60% of the domestic electric consumption comes from the industrial sector, while homes consume approximately 25%. The second graph in Figure 2 shows the quarterly series between GDP per capita and domestic electricity consumption. It can be seen that the series shows not just the same tendencies over time but also the same seasonal variation.

Under the assumption that the domestic consumption of electricity provides a good approximation of economic activity, our estimations of the effects of violence on consumption of electricity can be equated to those on economic activity and GDP.

Figure 2: GDP per capita and Domestic Consumption of Electricity

Yearly series **Quarterly series**



Source: National Institute of Geography and Statistics (INEGI).

Another advantage of using electricity consumption as our dependent variable is that it allows us to estimate the impact of violence not only on the formal sector, but also on all economic activity, including the informal one that is not accounted for in the GDP time series. This is particularly relevant in the case of Mexico, where the informal sector accounts for an estimated 29.1% of all employment. [3] Moreover, if the increase in criminal activities and violence leads to a movement of actors from the formal economy to the informal one, a negative effect on GDP may only suggests a change the composition of the economy, but not a decrease in the economy overall (Pinotti 2012).

Electricity data was provided by the National Institute of Geography and Statistics (Instituto Nacional de Geografía y Estadística, INEGI). Annual domestic consumption is measured in

[3]Data from the first quarter of 2012. INEGI.

megawatt-hours at the municipal level from 1994-2010. This information is available for the majority of the years in the period of study for most of urban and semi-urban municipalities [4]. This study is based on 1,308 municipalities for which there is complete and consistent electricity data from 2002-2010 [5] For this sample, the average consumption of electricity per capita between 2002 and 2010 is 1 megawatt-hour per person with a standard deviation of 1.288 per year. The distribution is slightly skewed to the right and around 10% of the municipalities show consumption per capita of over 2 megawatt-hours.

Table 1: Summary statistics

	Mean	Sd	Min	25%	50%	75%	Max
Yearly data from 2002 to 2010 (n = 1,308 municipalities)							
Electricity consumption	1.0	1.3	0.0	0.4	0.6	1.1	22.6
Homicides	8.5	62.5	0.0	0.0	1.0	5.0	3,965
Homicide rate	12.7	23.7	0.0	0.0	7.2	15.9	769.8
Quarterly Data from 2005 to 2010 (n= 1183 municipalities)							
Homicides	1.8	14.6	0.0	0.0	0.0	1.0	1,279
Homicide rate	4.2	18.3	0.0	0.0	0.0	3.2	1,498.6
Percentage of people:*							
Working	56	5.9	12.3	53.4	56.4	59	100
Unemployed	2.5	1.7	0	1.4	2.5	3.6	25
Business Owners	2.6	1.6	0.0	1.8	2.6	3.3	30.2
Self-Employed	12.7	5.9	0.0	9.4	10.8	14	78.7
Monthly Income	4,615	1568	49	3,555	4758	5,737	56,706

The table shows summary statistics of homicides and outcome variables.
*: Percentages are calculated over the population older than 14 years old.

We also measure the impact of violence on the proportion of people working, unemployed, self-employed, with their own business, and on the average labor income. This data comes from the National Survey on Employment and Occupation (*Encuesta Nacional de Ocupación y Empleo, ENOE*) , which is a representative survey at the national level and contains

[4]Most of the missing observations correspond to municipalities in the states of Chiapas and Oaxaca. Since the majority of these municipalities are primarily rural and have not shown increases in violence of the same magnitude as in more urban areas, we do not expect their omission to affect the results in a significant way.

[5]As an exclusion rule, we dropped municipalities for which electricity consumption varied by a factor greater than 10 or lesser that 0.1 in any consecutive years. While some municipalities dramatically increased their consumption of electricity after the entry of new firms and industries, there are reasons to suspect that such temporary increases are due more to measurement errors than industry growth.

information about the labor market in Mexico. The data has a rotating panel structure of households and targets the population over the age of 14 years old. We follow the definitions used by INEGI to define employment, unemployment, self- employment, and business owners. Our study uses quarterly data from 2005 to 2010.

Table A1 in the Appendix shows the correlation between selected socioeconomic variables and our labor and economic outcomes at the municipal level. We observe that energy consumption is negatively correlated with violence. Indicators of industrial activity are strongly correlated, as expected, especially those related to the manufacturing sector. The table also shows that marginalized areas consume less electricity than rich areas. Finally, the municipalities in the north and west of the country, and those near airports and seaports consume more electricity per capita than the rest of the municipalities.

Other socioeconomic variables included in the analysis come from the 2000, 2005, and 2010 Mexican Population Censuses, and from the 2004 and 2009 Economic Censuses. The variables for education, poverty, and the Human Development Index come from the population census. Information in the Economic Censuses includes, at a municipal level, the number of people employed and gross output per employee in the commercial and manufacturing sectors. Population variables were taken from the population projections of the National Population Council (Consejo Nacional de Población, CONAPO). The information on municipal income comes from the Database System on State and Municipal Public Finances (*Base de Finanzas Públicas del Sistema Estatal y Municipal de Bases de Datos*, SIMBAD). Information about land, air, and sea communications was provided by the United States Department of Transportation.

4 Empirical Strategy: Instrumental Variables

In this section we describe the empirical strategy that we use to identify the marginal effect of an increase in homicide rates on different economic variables. The initial equation is:

$$Y_{mt} = \alpha_m + \gamma_t + \beta \cdot TasaHom_{mt} + e_{mt} \tag{1}$$

The unit of observation is municipality m, observed through different time periods t, measured in all specifications on a quarterly basis (except for electricity consumption, which is available anually). Given the panel structure of the data, we use municipality fixed effects (α_m) and time fixed effects (γ_t), which will control for observable and non-observable characteristics in each municipality that does not change over time, and for economic shocks that affect the entire country over the period.

The dependent variable is represented by y_{mt} and includes different outcomes: energy consumption per capita, log of average labor income, and the proportion, over the population of 14 years old or older, of people that are working, unemployed, self-employed, and owners of their own business. The main independent variable is $HomRate_{mt}$, which measures the homicide rate per 100,000 inhabitants in municipality m during period t. The error is measured by e_{mt} and we assume robust standard errors clustered by municipality. The model where electricity consumption is the dependent variable uses yearly data from 2002 to 2010. The models using labor outcomes as dependent variables use quarterly data from 2005 to 2010.

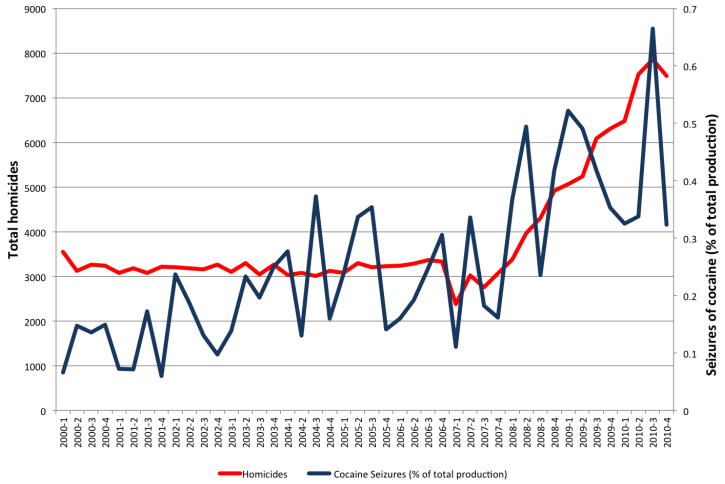
There are two potential identification problems related to the simple OLS model described above. The first one is the existence of unobservable omitted variables that could simultaneously cause greater levels of violence and worse economic outcomes. The second problem is related to inverted causality as we can imagine a scenario in which turf wars occur precisely in those locations with better economic conditions due to greater commercial relations with the United States and therefore greater expectations of growth. In other words, strategic locations for DTOs may be prosperous areas for international trade, and therefore already have strong economies.

Given the potential challenges of identification, we use an instrument to isolate the variation of violence from factors that could affect homicide rates and the economic activity at the same time, or from economic variations that could affect homicides. We use the instrument first proposed by Castillo, Mejia & Restrepo (2014), which was constructed from the interaction of two variables: the proportion of cocaine seized in Colombia each year and the geographic distance of Mexican municipalities to the US border.

Castillo et al. argue that large seizures of cocaine in Colombia starting in 2006 brought a

drop in the supply and an increase in the international price for the drug (given the relative inelasticity of its demand). Moreover, municipalities that are closer to the border increased their market value the most, as they have a comparative advantage due to their strategic geographic location. Given that their control also became more valuable to drug trafficking organizations, it is in these municipalities where we should expect the greater increments of violence after 2006. Figure 3 below shows the temporal correlation between cocaine seizures in Colombia and number of homicides in Mexico.

Figure 3: Violence in Mexico and Drug Seizures in Colombia 2000-2010



Source: Data on homicides come from SINAIS. Data on cocaine seizures as a percentage of estimated production comes from Castillo et al. (2014).

The exclusion restriction is satisfied as long as the change in the proportion of cocaine seizures in Colombia jointly with the distance to the nearest border affects the economic activity in Mexico only through its effect on violence. In this way, the equation of the first stage of the two stage least squares specification is:

$$TasaHom_{mt} = \alpha_m + \gamma_t + \theta DistBorder_m \times CocSeiz_t + e_{mt} \tag{2}$$

where $DistBorder_m$ is the distance to the nearest border, and $CocSeiz_t$ is the percentage of the cocaine seized in Colombia with respect to estimated production. We weighted observations by municipal population size in all specifications. Table 2 shows the results of the instrumental variables regression, as described in equations 1 and 2.

The first result suggests that an increase of one homicide per 100,000 inhabitants does not have a statistically significant effect on energy consumption. On the other hand, an increase of one standard deviation in the homicide rate per 100,000 inhabitants (i.e. an approximate rate of 18.29 homicides) generates an approximate drop of 4 percentage points (pp) in the proportion of people working, an increase in 2.7 pp in the proportion of unemployed, a decrease of 0.73 pp in the proportion of business owners, and a decrease of 22% on labor income. We do not find a statistically significant effect on the self- employed population.

Between 2009 and 2010, the average increase in violence was 5.98 homicides per 100,000 people [6]. Our model predicts that this increment is related to a reduction of 1.32 pp - or 2.37% - from the 56.07% of the total population over 14 years old working. We can conclude then that the working population was not severely affected by marginal changes in the average homicide rates.

Nevertheless, the model predicts that an increase of 5.98 in homicide rates reduces the proportion of business owners by 0.24 pp, which represents a decrease of approximately 9% of the proportion observed between 2005 and 2010 (2.63%). The same increase in violence is related to a substantial reduction of 7% in the average labor income. In other words, if a citizen earns an average of $4,615 (2002 pesos), their income in the second period will diminish by approximately $330 pesos.

To measure whether the increase in homicide rates have a medium term effect, we analyzed our dependent variables in a later period (one quarter or one year later). In Table 3 we can see that the effects of violence are a little more pronounced in this period for those variable in those economic variables for which we had already observed a significant immediate effect. We also tried to measure the effect of violence in later periods (by including lags in the dependent variables) in order to estimate long-term effects more accurately. Nevertheless, our instruments for violence were not strong enough.

The instrumental variable regression analysis shows that the labor market is affected by marginal changes in homicide rates. We found that small businesses are one of the most affected groups and a significant decrease in average labor income. However, this specification failed to capture any effects of violence on electricity consumption, which is our proxy for

[6] Increases in homicide rates by municipality were weighted by population size.

Table 2: Effects of an increase in homicide rates on selected economic variables

	Electricity consumption (1)	Working population (2)	Unemployed (3)	Business owners (4)	Self-employed (5)	Log-Labor income (6)
Homicide Rate	-0.002	-0.222***	0.148**	-0.040**	0.048	-0.012*
	(0.002)	(0.068)	(0.059)	(0.019)	(0.03)	(0.007)
Observations	14,073	25,182	25,182	25,182	25,182	25,166
Municipalities	1,308	1,183	1,183	1,183	1,183	1,183
F-test	695.45	650.47	650.47	650.47	650.47	651.72

Notes: The table shows the results of an instrumental variable regression of homicide rates on selected economic variables. Homicide rates are instrumented with the interaction of the geographic distance from each municipality to the US and the percentage of cocaine seizures in Colombia over the estimated production (as reported in Castillo, Mejia & Restrepo (2014)). Models include municipality and time fixed effects. Model (1) uses yearly data from 2002 to 2010. The rest of the models use quarterly data from 2005 to 2010. Robust standard errors are in parentheses and are clustered at the municipality level. The percentage of people working, unemployed, business owners or self employed was computed over the population older than 14 years old. Standard errors are in parenthesis.*** p<0.01, ** p<0.05, * p<0.1.

Table 3: Effects of an increase in homicide rates on selected variables $(t+1)$

	Electricity consumption $t+1$ (1)	Working population $t+1$ (2)	Unemployed $t+1$ (3)	Business owners $t+1$ (4)	Self-employed $t+1$ (5)	Log-Labor income $t+1$ (6)
Homicide Rate	-0.001	-0.293***	0.153**	-0.036**	0.023	-0.012*
	(0.002)	(0.097)	(0.07)	(0.015)	(0.024)	(0.007)
Observations	13,030	23,973	23,973	23,973	23,973	23,957
Municipalities	1,308	1,177	1,177	1,177	1,177	1,177
F-test	318.55	700.03	700.03	700.03	700.03	700.39

Notes: The table shows the results of an instrumental variable regression of the first lag of homicide rates on selected economic variables. Homicide rates are instrumented with the interaction of the geographic distance from each municipality to the US and the percentage of cocaine seizures in Colombia over the estimated production (as reported in Castillo, Mejia & Restrepo (2014)). Models include municipality and time fixed effects. Model (1) uses yearly data from 2002 to 2010. The rest of the models use quarterly data from 2005 to 2010. Robust standard errors are in parentheses and are clustered at the municipality level. The percentage of people working, unemployed, business owners or self employed was computed over the population older than 14 years old. Standard errors are in parenthesis.*** p<0.01, ** p<0.05, * p<0.1.

economic performance.

As we have argued, it is feasible that violence does not impact the economy in a linear way, but only after a certain threshold of violence, as the one caused by the onset of an inter-cartel war. Our second strategy will use then the synthetic control methodology to

explore the effect of these wars on economic performance and to assess whether drug related violence has a long-term effect on the economy.

5 Synthetic Controls

In this section we estimate the impact of inter-cartel wars between drug cartels over economic performance. These conflict generally begin abruptly and due to breaks or disagreements between criminal factions. For example, one of the most violent narco wars in recent years began with a division between Sinaloan drug traffickers after the arrest of its leader Alfredo Beltrán Leyva 'El Mochomo'. The criminal organization split into two irreconcilable factions: the Sinaloan cartel and the Beltran Leyva cartel [7]. The fight began with numerous executions and included not only drug traffickers but also politicians and local security forces [8].

Another one of the most violent wars in the country began with the spin off of the Zetas from the Gulf Cartel in 2010. The Zetas worked at first as the strong arm of the Gulf Cartel and were primarily comprised of former Mexican Army officers. Due to internal conflicts within the organization and the superior training of its members, the Zetas were able to contest control of the Gulf Cartel, resulting in a significant increase in violence in the cities in northeastern Mexico [9].

We argue that the onset of a war between DTOs and an increase in the intensity of violence have three effects. First, cartels have greater pressure to increase the level of extortion and extraction of resources from the community that they control in order to finance the impending armed struggle. Rival cartels competing for trafficking routes and plazas also have incentives to terrorize and threaten anyone – politicians, authorities, business people, and journalists, among others – suspected of cooperating with their enemies.

Second, wars between cartels sometimes go hand-in-hand or are immediately preceded by the capture of capos (Calderón et al. 2015). But when cartels' leaders are neutralized, subordinate gangs and criminal cells are left unemployed and without central control, creating incentives to engage in criminal activities without restrictions.

[7] Note published in the newspaper *La Jornada* on May 13th, 2008. Available here.
[8] Newspaper *El Universal* on Feb 26th, 2009. Available here.
[9] Newspaper *La Jornada* on May 5th, 2012. Available here.

Finally, an increase in violence attract the attention and resources from local and federal authorities. This reduces the probability of punishment for other crimes and leads to an increase in opportunistic crime. Common quarrels can easily escalate into violent crimes because there is little chance that they will be detected and punished. Law enforcement institutions generally collapse and cartels become the *de facto* powers [10].

This class of inter-cartel wars is expected to have a profound economic effect. Employers are likely to be extorted and their family members kidnapped, which could make them to migrate to safer areas; businesses might suffer from robberies and attacks on their facilities; and workers may feel afraid to go outside or go to work. It is common that, in these violent environments, parents feel afraid to send their children to school. There is also evidence that violence creates higher school dropout rates and affects academic performance, especially among young male who are more susceptible to join gangs or criminal organizations (Jaramillo et al. 2016).

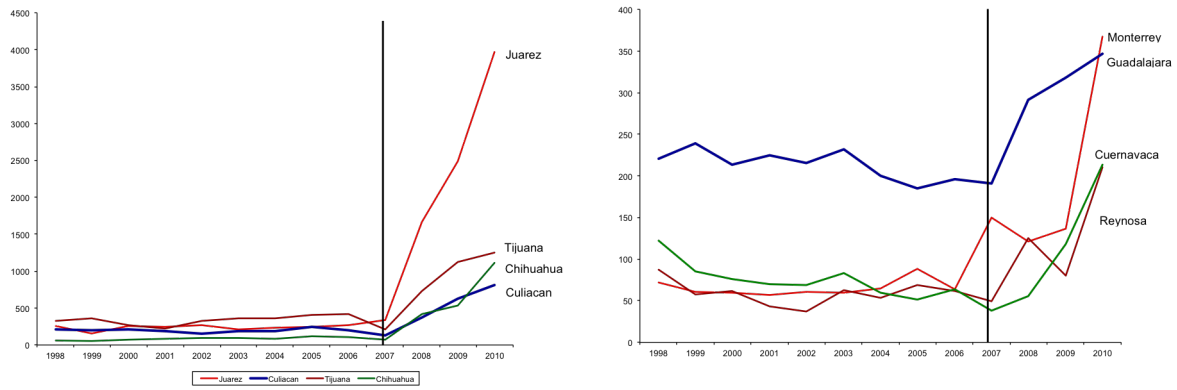
A dramatic increase in homicides indicates then the onset or escalation of an armed conflict between rival criminal organizations. Thus, for the purpose of this study, we look at waves of violence as indicative of the occurrence of turf wars. To evaluate the impact of this war-like situation on the economy, we define a municipality as having a turf war or being 'treated' when the number of homicides from one year to another, in any pair of years from 2006 to 2010, increases by more than three standard deviations with respect to the municipality's historic mean of homicides since 1998.

An advantage of using this definition for the treatment group is that it identifies municipalities with dramatic changes in their levels of violence. Changes of this magnitude are strongly correlated with violent conflicts between criminal organizations meaning that by using this definition we are selecting the municipalities most affected by drug-related violence. A simple visualization of the data shows that homicide series present abrupt increments for the cities with the highest numbers of drug-related murders. The following figure shows these trends for selected cities:

Using this definition, we identify 642 out of 2441 municipalities in the country as 'treated'

[10] After the assassination of the photographer Luis Carlos Santiago from *El Diario de Juárez* in September, 2010, the newspaper published an editorial directed at criminal organizations, referring to them as the *de facto* authorities of Ciudad Juárez. The editorial, "What do you want with us?", expressed a feeling of helplessness against both the criminals and the authorities that is common in some regions of the country.

Figure 4: Homicide trends for selected municipalities: 1998-2010



The graphs show total number of homicides from 1998 to 2010 for selected cities.
Source: National Institute of Geography and Statistics (INEGI).

(26.3% of the total) [11]. This proportion of municipalities is similar to the ones found in other studies. Coscia & Rios (2012) estimate the territorial and temporal activity of the drug trafficking organizations using available information in news media, blogs, and websites. The authors found that between 1991 and 2010, approximately 13 drug trafficking organizations operated in 713 municipalities in the country (29.2% of the total). Moreover, they found activity of more than one criminal organization in 444 localities.

Given the availability of electricity data, in this study we were able to analyze the impact of violence on 340 'treated' municipalities. This group covers the 100 most violent municipalities, 90% of the municipalities with the highest homicide rates, 84% of the municipalities with the highest homicide rates related to drug trafficking, and 80% of the units with the greatest increases in homicide rates between the periods of 2002- 2005 and 2006-2010 [12]. This coverage is higher under less strict measurements of treatment, for example, increases of 1 or 2 standard deviations with respect to the historic mean. Nevertheless, under these definitions, we would include a large number of additional municipalities with minimal levels of homicides that are predominantly rural and not disputed by drug traffickers.

Estimating the causal effect of drug-related violence on economic activity is a complex task given the challenge for observational studies of finding an adequate counterfactual sce-

[11] We consider Mexico City as a single municipality.

[12] These proportions are estimated with respect to the sample of municipalities for which information on electricity consumption is complete and consistent. Proportions using the full sample of municipalities are similar.

nario for comparison purposes. For example, drug-related violence is predominantly an urban phenomenon (see Table 4), DTOs fight against each other and the government to establish control over plazas for distribution and trade routes, which are regularly found in the major economic centers. Therefore, a simple extrapolation between the treated and control municipalities will not result in a reliable estimate due to significant observable and unobservable differences between the two groups.

To control for this threat to identification we use the synthetic control methodology proposed by Abadie & Gardeazabal (2003) and Abadie, Diamond & Hainmueller (2010). The synthetic control methodology follows the same principle as matching. However, instead of matching each treated unit to a unique control with similar characteristics in the pre-treatment period, the method constructs an optimal 'synthetic' unit as an weighted average of the potential controls. It assigns greater weights to the control units that are most similar treated ones in a set of covariates or predictors defined by the researcher.

The optimization problem consists then on finding the optimal set of weights for the control units such that the synthetic control best resembles the initial conditions of the treated unit and the pre-treatment trends of the variable of interest. Once the weights are found, the treatment effect is estimated as the difference, in the post-treatment period, of the variable of interest between the treated unit and its synthetic control.

More formally, let X_1 be a vector of dimension $k \times 1$ of observable variables during the pre- treatment period for the treated unit, and let X_0 be a matrix of dimension $k \times J$ of the corresponding variables for the J control units. Then, the estimation problem is to find the $j \times 1$ vector of weights W that solves:

$$W^* = argmin||X_1 - X_0 \cdot W||$$

Such that:

$$W^* = (w_1, w_2, w_3, ..., w_J), w_j \geq 0, \sum w_j = 1$$

Once the weights are found, the treatment effect is calculated as:

$$Y_1 = Y_0 \cdot W^*$$

Where Y_1 is a $T \times 1$ vector of the outcome variable in the post-treatment period, and Y_0 is a vector of similar dimensions with the weighted averages of control units for each period t after the treatment (T periods in total) [13].

Our estimation was implemented using the R package *Synth* developed by Abadie, Diamond & Hainmueller (2011). In particular, the algorithm finds the optimal synthetic weights W* that minimize:

$$W^* = argmin||X_1 - X_0W||_V = \sqrt{(X_1 - X_0W)'V(X_1 - X_0W)}$$

where V is a positive semi-definite matrix $k \times k$ that allows for different weights between predictor variables, further minimizing the mean squared error of the estimation.

An additional complication in the analysis is that treated municipalities experience turf wars in different points in time. For example, cities such as Tijuana, Ciudad Juárez, and Chihuahua observed dramatic increases in the number of homicides in 2008, while cities in the Northeast were affected in later years. The following table shows descriptive statistics of the treated units by treatment year. It can be observed that municipalities where turf wars started in 2006 had a lower consumption of electricity per capita, and that places where violence erupted in 2008 already had higher homicide rates.

We estimated 340 synthetic controls for the treated units from 956 control municipalities. To construct the synthetic units, we use the following socioeconomic variables as predictors of economic activity and consumption of electricity:

- Electricity consumption per capita from 2002 to the year before treatment.
- Log of population (2005).
- Household density (2005).
- Share of workers (ages 15-70) in the manufacturing sector (2003).
- Share of workers (ages 15-70) in the commercial sector (2003).
- Human Development Index (2005).
- Schooling (2005).
- Geographic latitude.

[13] See Abadie & Gardeazabal (2003) and Abadie, Diamond & Hainmueller (2010) for a detailed description of the synthetic control methodology.

Table 4 below shows the demographic characteristics in the pre-treatment period for the treated municipalities and their corresponding synthetic controls. It can be noted that, in comparison with the unweighted control group, the synthetic control group better approximates the average consumption of electricity of the target group in the period before treatment. Additionally, the synthetic control group shows more similar socioeconomic characteristics during the pre-treatment period to those of the treatment group.

Table 4: Socio-demographic Characteristics by treatment group

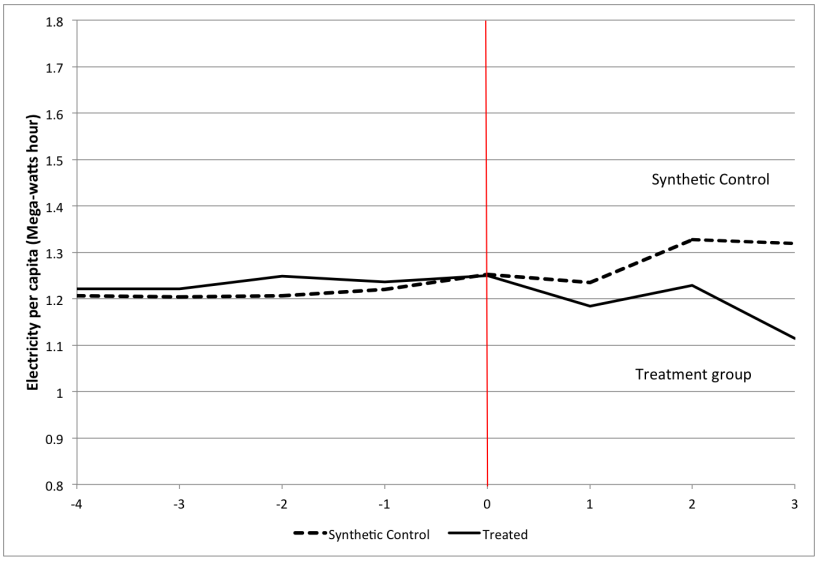
	Treated units		**Synthetic controls**	**Unweighted controls**	
Variable	Mean	Sd	Mean	Mean	Sd
Electricity consumption (MWh), 00-05	1.2	(1.15)	1.21	0.86	(0.99)
Log Homicides, 2000 - 2005	10.02	(11.76)	13.57	10.91	(11.04)
Log population, 2005	80,322.08	(209,595.7)	125,341.6	50,932.49	(299,268)
Population density, 2005	337.81	(1427.25)	368.8	278.29	(839.63)
Household density, 2005	79.59	(337.78)	87.79	64.44	(201.44)
Commercial sector					
Share of workers (%), 2003	0.05	(0.03)	0.05	0.05	(0.03)
Product per employee (pesos)	0.08	(0.06)	0.08	0.06	(0.06)
Manufacturing sector					
Share of workers (%), 2003	0.04	(0.07)	0.04	0.04	(0.06)
Product per employee, 2003	0.28	(0.58)	0.27	0.26	(0.69)
Schooling, 2005	6.5	(1.66)	6.55	6.16	(1.54)
Iliteracy, 2005	0.14	(0.09)	0.15	0.16	(0.09)
Marginalization Index, 2005	(0.52)	-0.86	-0.41	-0.21	(0.79)
Human Development Index, 2005	0.78	(0.06)	0.78	0.76	(0.06)
Municipal own revenue (pesos), 00-05	1,827.93	(739.71)	2,182.35	1,814.34	(985.12)
Urban	0.54	(0.50)	0.46	0.51	(0.50)
Surface (km2)	1497.7	(2904.06)	3265.92	591.51	(2099.7)
Altitude	1352.02	(841.33)	1240.01	1307.53	(906.37)
Ports	0.02	(0.2)	0.12	0.02	(0.15)
Airports	0.07	(0.29)	0.11	0.03	(0.18)
Northeast Zone	0.18	(0.41)	0.21	0.02	(0.14)
Northwest Zone	0.21	(0.38)	0.12	0.09	(0.28)
Central Zone	0.23	(0.42)	0.27	0.35	(0.48)
Southwest Zone	0.14	(0.35)	0.25	0.33	(0.47)
Southeast Zone	0.24	(0.43)	0.15	0.21	(0.41)

The graph shows means and standard deviations of selected socioeconomic variables for treated units, synthetic controls, and control units.

Figure A2 in the Appendix shows the trends in electricity consumption per capita for selected cities and their synthetic units. Given the high number of municipalities in the control sample, it was possible to construct synthetic counterfactuals that closely replicate the trends in electricity consumption of the treated municipalities in the years before treatment. We excluded from the analysis municipalities above the 98th percentile of the electricity consumption distribution since there was no suitable synthetic control for them (12 cases).

Figure 5 below shows the average electricity consumption per capita between the treatment group and the control group weighted by the synthetic control estimates. The graph is normalized to show the first four years before and after the treatment year, which is shown as period zero. It can be seen that municipalities that observed inter-cartel wars consumed on average less electricity than their synthetic counterparts in the years after the onset of the conflict. This is difference is close to zero during the initial year but it increases in the years following, especially during the second and third year after the onset of the turf war.

Figure 5: Average electricity consumption by treatment group



The graph shows the average electricity consumption of treated units and their respective synthetic controls. Time is normalized such that the onset of a turf war or 'treatment' corresponds to time zero.

In Table 5 below we show the differences on electricity consumption between treated and synthetic control units by year after treatment. We see that the municipalities that experienced drastic increases in violence between 2006 and 2010 consumed on average 4.2% less electricity per capita in the year after treatment than their counterfactual scenarios.

This difference increases to 7.2% for the second year after treatment, and 15.5% in the third year.

In the aggregate, we see that affected municipalities by DTOs' violence consumed on average 4% less electricity per year, from the treatment year through the following years, with respect to their counterfactual scenario. This difference gets larger when we consider longer periods of time, reaching an annual average of 6.8% less consumption during the four years after the start of a *narco* war.

Table 5: Electricity consumption by treatment group and year

	Electricity consumption			**Homicide rates**			
Period	Treated units	Synthetic controls	Diff. (%)	Treated units	Synthetic controls	Diff. (%)	Units
Pre-treatment (t_{-4} to t_{-1})	1.23	1.21	1.88%	11.06	13.57	-18.49	340
Year of Treatment, t_0	1.25	1.25	-0.21%	59.01	14.71	301.09	340
Year t_1	1.18	1.24	-4.19%	34.5	11.54	199.04	231
Year t_2	1.23	1.33	-7.40%	46.35	14.72	214.78	149
Year t_3	1.11	1.32	-15.50%	19.43	17.07	13.84	79
Year t_4	0.89	0.94	-5.81%	17.03	13.94	22.21	50
Yearly average from t_0 to t_1	1.22	1.24	-2.19%	46.76	13.13	256.24	231
Yearly average from t_0 to t_2	1.22	1.27	-4.00%	46.62	13.66	241.34	149
Yearly average from t_0 to t_3	1.19	1.28	-6.95%	39.82	14.51	174.44	79
Yearly average from t_0 to t_4	1.13	1.22	-6.78%	35.26	14.40	144.96	50

The table shows average electricity consumption and homicide rates of treated units and their respective synthetic controls for the period before the onset of a turf war or 'treatment' and each of the following years after it. Time is normalized such that the start of a conflict corresponds to time zero.

6 Conclusion

One of the greatest challenges for governments in Latin America is to ensure order and provide security. The levels of violence and crime in the region have increased dramatically in the last years with Mexico as one of the most affected countries by this crime wave.

The dramatic change in the patterns of violence, especially the increased murder rate, is clearly related to structural changes in the drug trafficking business since 2006. External factors such as the increased flow of trade with the United States, the greater availability of

weapons, and the reduced cocaine supply from Colombia, increased profitability substantially and attracted new competitors and suppliers into the drug trade.

The increase in the market size also changed the operation and internal organization of drug trafficking organizations from being family businesses to hierarchical organizations stratified into regional units. The interaction of DTOs with local and national governments has also changed with the liberalization of politics in the country and the entry of multiple political actors and parties, making more complex the operation of the drug trafficking business. Finally, the ambitious security policies of former President Calderón to combat and contain organized crime fragmented the cohesion and organization of the narco-trafficking groups.

As a result of profound domestic and structural changes, the number of people involved in drug trafficking has grown. However, unlike firms participating in legal markets, drug cartels usually do not compete on prices but instead compete directly to monopolize the means of distribution into the United States through the use of force. The growing rivalries between drug trafficking factions have resulted in an unprecedented increase in the levels of violence in the country.

Estimating the impact of the drug related violence on the economic activity is a complex activity given the nature own nature of such violence that makes it different than common crime. Most killings correspond to strategic assassinations of members of rival organizations or clashes with authorities. In addition to be targeted, drug-related violence is sporadic and has a higher volatility than common criminal violence.

Moreover, this type of violence is not seen in all municipalities with drug production, distribution, or trafficking ties. This makes even more difficult to isolate the economic effect of increased levels of violence from the potential 'benefits' on the local economies of the drug trafficking industry. This study argues that it is the violent competition between rival drug organizations – as opposed to the ordinary drug-trafficking activities – that has a negative effect on the economy. To understand the mechanism, we use the analogy of Olson (2000) to imagine cartels as 'stationary' or 'roving bandits' depending on how they decide to integrate themselves into society. 'Stationary bandits,' or benefactors, have the ability to maintain control over their territories over the long term and therefore have incentives to

reduce predatory behavior as they look for greater long-term gains. 'Roving bandits' have temporary or uncertain control over their territory, which induces them to extract rents and resources from the community at the highest rate possible through extortion, robbery, and other crimes, to maximize short-term gain.

The main argument of this study is that violence between cartels for control over certain trafficking routes and distribution areas have been matched with a substantial increase in other types of crime, including theft, extortion, and kidnapping. Faced with greater competition, cartels turn against society due to their need for resources to sustain armed conflicts, to intimidate or punish members from rival organizations, and to exploit new opportunities for opportunistic crime.

Given the particular nature of drug-related violence, we claim that this type of violence has a non-linear effect on economic performance, instead, there is a threshold of violence after which economic activity significantly shrinks. Below this 'turf-war threshold', individuals and companies are able to internalize higher costs of security and protection, depending on their economic capacity and size. If anything, these adjustments should be reflected on the labor market, both in the supply and demand, so we can expect to find a marginal effect of violence in this area.

Once drug-related violence have passed historical levels, companies and individuals change their medium and long term decisions, including location, investment, and production, in the case of commercial enterprises, and participation in the labor market and economic sector, in the case of individuals. We can expect then a significant contraction in the economic activity that might not be adequately captured with a linear model.

In our study we used two empirical strategies to estimate both the marginal effects and the 'threshold' effects of violence on the economic activity and labor. To estimate marginal effects, we used an instrumental variable regression exploiting the exogenous variation of cocaine seizures in Colombia to instrument for violence. This variable was interacted with the distance from a municipality to the US border to add geographic variation.

To estimate medium and long-term effects of drug-related violence, we used the synthetic control group methodology to construct counterfactual scenarios as an optimal weighted average of the control units. We exploited the close correlation between GDP and domestic

electricity consumption to estimate the level of economic activity at the municipal level.

We found that those municipalities that saw dramatic increases in violence between 2006 and 2010 significantly reduced their energy consumption in the years after the start of the inter-cartel conflict. By analyzing 'threshold' effects, we provide a baseline for future research to model, with more sophisticated techniques, the relation between economic performance and particular forms of violence, like the one related to the drug-trafficking industry.

References

Abadie, A., Diamond, A. & Hainmueller, J. (2010), 'Synthetic Control Methods for Comparative Case Studies: Estimating the Effect of California's Tobacco Control Program', *Journal of the American Statistical Association* **105**(490).

Abadie, A., Diamond, A. & Hainmueller, J. (2011), 'An R Package for Synthetic Control Methods in Comparative Case Studies', *Journal of Statistical Software* **42**(13).

Abadie, A. & Gardeazabal, J. (2003), 'The Economic Costs of Conflict: A Case Study of the Basque Country', *American Economic Review* **93**(1).

Buvinic, M., Morrison, A. & Shifter, M. (1999), Violence in Latin America and the Caribbean: a framework for action., *in* A. Morrison & B. Orlando, eds, 'Too close to home: domestic violence in the Americas', Inter-American Development Bank, New York, pp. 3–34.

Calderón, G., Robles, G. & Magaloni, B. (2015), 'The Beheading of Criminal Organizations and the Dynamics of Violence in Mexico', *Journal of Conflict Resolution* **59**(8), 1455–1485.

Castillo, J. C., Mejia, D. & Restrepo, P. (2014), Scarcity without Leviathan: The Violent Effects of Cocaine Supply Shortages in the Mexican Drug War, Working Paper 356, Center for Global Development.

CICAD & OAS (2004), *Programa de entrenamiento de Formadores en materia de normas y técnicas de lucha contra el lavado de activos y financiamiento del terrorismo. Manual del instructor.*, Inter-American Drug Abuse Control Commission and Organization of American States, Washington D.C.

Cohen, M. A., Rust, R. T., Steen, S. & Tidd, S. T. (2004), 'Willingness to Pay for Crime Control Programs', *Criminology* **42**(1), 89–109.

Cook, P. J. & Ludwig, J. (2000), *Gun Violence: The Real Costs*, Oxford University Press, New York.

Coscia, M. & Rios, V. (2012), 'Knowing Where and How Criminal Organizations Operate Using Web Content', *CIKM'12* .

Dell, M. (2015), 'Trafficking Networks and the Mexican Drug War', *American Economic Review* **105**(5), 1738.

Díaz Cayeros, A., Magaloni, B., Matanock, A. & Romero, V. (2012), Living in Fear: Mapping the Social Embeddedness of Drug Gangs and Violence in Mexico, Working paper, Stanford University.

DOJ (1994), The Costs of Crime to Victims: Crime Data Brief, Technical report, Bureau of Justice Statistics, US Department of Justice.

Economist (2012), 'The ebbing mexican wave: The worlds biggest migration has gone into reverse', *The Economist* .

Felbab-Brown, V. (2009), The Violent Drug Market in Mexico and Lessons from Colombia, Policy Paper 12, Foreign Policy at Brookings.

Grillo, I. (2011), *El Narco: Inside Mexico's Criminal Insurgency*, 1st edition edn, Bloomsbury Press.

Guerrero, E. (2010), 'Como reducir la violencia en México', *Nexos* .

Guerrero, E. (2011), 'La raíz de la violencia', *Nexos* .

IDMC & NRC (2010), Forced Displacement in Mexico due to Drug Cartel Violence, Technical report, Internal Displacement Monitoring Center and Norwegian Refugee Council, Geneva, Zwitzerland.

Jaramillo, B., Magaloni, B., Robles, G. & Franco, E. (2016), 'How the Mexican Drug War Affects Kids and Schools? Evidence on Effects and Mechanisms', *International Journal of Educational Development* .

Londoño, J. L. & Guerrero, R. (2000), Violencia en America Latina: Epidemiología y Costos, *in* 'Asalto al Desarrollo: Violencia en América Latina', Inter-American Development Bank, Washington, D.C.

McCollister, K., French, M. & Fang, H. (2010), 'The Cost of Crime to Society: New Crime-Specific Estimates for Policy and Program Evaluation', *Drug Alcohol Depend* **108**, 98–109.

Miller, T., Cohen, M. A. & Wiersema, B. (1996), Victim Costs and Consequences: a New Look, Technical report, National Institute of Justice Research, US Department of Justice, Office of Justice Programs., Landover, Maryland.

NCPC (1999), Saving Money while Stopping Crime., Technical report, National Crime Prevention Council.

NDIC (2010), Drug Trafficking Organizations, Technical report, National Drug Intelligence Center.

Olson, M. (2000), *Power and Prosperity: Outgrowing Communist and Capitalist Dictatorships*, Oxford University Press.

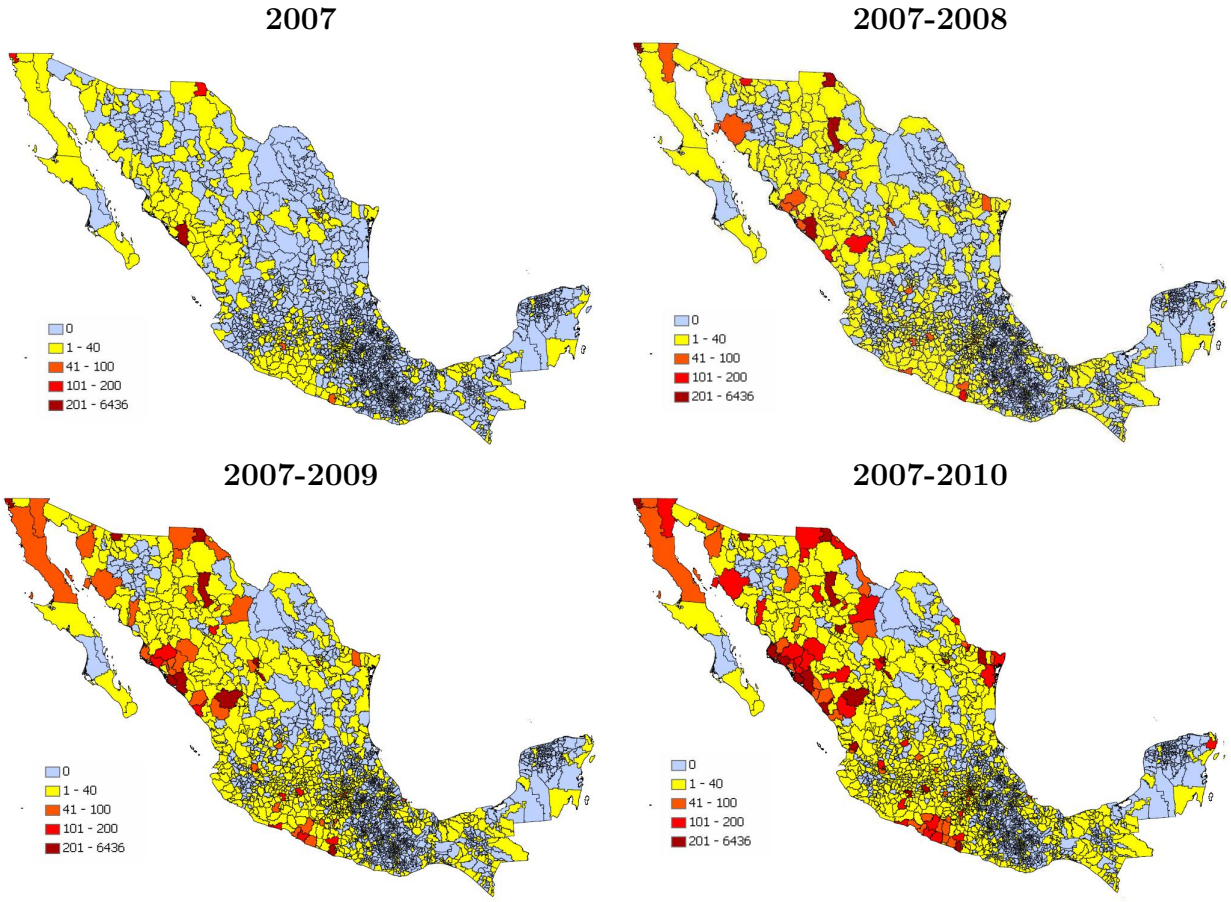
Pinotti, P. (2012), The Economic Consequences of Organized Crime: Evidence from Southern Italy, Working Paper 868, Banca d'Italia.

Soares, R. (2009), Welfare cost of crime and common violence: A critical review, *in* 'The Cost of Violence', The World Bank, Washington D.C.

WHO (2004), The Economic Dimension of Interpersonal Violence, Technical report, World Health Organization, Geneva, Zwitzerland.

Appendix A

Figure A1: Drug-related deaths in Mexico, 2007-2010



Source: Government data. Note: Maps show the cumulative number of drug-related deaths in Mexico since December 2006

Table A1: Correlations between outcomes and selected variables

	Electricity consumption (1)	Working population (2)	Unemployed (3)	Business owners (4)	Self-employed (5)	Log-Labor income (6)
Homicide rates, 02-05	-0.001	-0.005	-0.009**	0.009*	0.024	0.003***
	(0.003)	(0.022)	(0.004)	(0.005)	(0.018)	(0.001)
Log population, 2005	-0.073*	-0.435**	0.089**	-0.116**	-0.605***	0.029***
	(0.039)	(0.203)	(0.045)	(0.056)	(0.163)	(0.010)
Household density, 2005	-0.000*	-0.000	0.000	-0.000**	0.001***	-0.000**
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Urban	-0.158**	1.102**	0.115	0.124	-0.131	-0.037*
	(0.078)	(0.510)	(0.091)	(0.129)	(0.408)	(0.022)
Commercial sector						
Share of workers (%), 2003	-0.066	26.624***	-2.388	8.117***	22.958***	0.183
	(1.385)	(8.145)	(1.455)	(2.320)	(5.893)	(0.257)
Product per employee (pesos)	1.262**	7.091*	0.829	0.158	-9.826***	0.558***
	(0.638)	(3.627)	(0.841)	(0.846)	(2.774)	(0.182)
Manufacturing sector						
Share of workers (%), 2003	4.896***	6.619**	-1.404*	-0.700	2.624	-0.211**
	(0.485)	(2.999)	(0.718)	(0.732)	(1.837)	(0.102)
Product per employee, 2003	0.257***	-0.722***	0.122***	-0.105**	-0.458***	0.026***
	(0.049)	(0.201)	(0.043)	(0.048)	(0.132)	(0.008)
Municipal own revenue (pesos), 02-05	-0.060	-0.176*	0.011	0.045*	0.315***	-0.007
	(0.040)	(0.090)	(0.024)	(0.024)	(0.072)	(0.005)
Human Development Index, 2005	2.368	14.359	-0.433	4.026	25.064***	0.475
	(1.704)	(11.489)	(2.106)	(2.557)	(8.683)	(0.558)
Marginalization Index, 2005	-0.190	1.192	-0.561***	-0.138	6.370***	-0.304***
	(0.135)	(0.886)	(0.160)	(0.190)	(0.651)	(0.043)
Schooling, 2005	0.044*	0.107	0.048	-0.020	0.023	0.004
	(0.023)	(0.173)	(0.031)	(0.047)	(0.115)	(0.007)
Altitude, Km	-0.160***	-0.508*	0.168***	-0.121*	0.164	-0.057***
	(0.054)	(0.285)	(0.061)	(0.063)	(0.224)	(0.014)
Ports	0.712***	0.492	-0.161	-0.210*	-0.533	-0.009
	(0.200)	(0.788)	(0.147)	(0.127)	(0.342)	(0.029)
Airports	0.594***	0.924*	-0.101	0.163	0.024	0.012
	(0.165)	(0.493)	(0.139)	(0.135)	(0.344)	(0.019)
Central Zone	0.460***	1.295*	0.166	-0.228	-0.372	0.077**
	(0.117)	(0.683)	(0.123)	(0.145)	(0.524)	(0.032)
Northeast Zone	0.545***	-0.362	0.297**	-0.204	0.170	0.071**
	(0.120)	(0.702)	(0.140)	(0.164)	(0.461)	(0.031)
Northwest Zone	0.876***	-0.769	-0.447***	0.220	0.634	0.063**
	(0.154)	(0.927)	(0.151)	(0.192)	(0.514)	(0.032)
Southeast Zone	0.343***	2.046***	-0.040	0.574***	-0.311	0.076**
	(0.114)	(0.697)	(0.119)	(0.181)	(0.503)	(0.030)
Constant	-0.728	45.879***	0.169	0.039	4.767	7.172***
	(1.384)	(8.821)	(1.631)	(1.977)	(6.410)	(0.412)
Observations	1,301	1,048	1,048	1,048	1,048	1,048
R^2	0.294	0.124	0.546	0.241	0.624	0.765

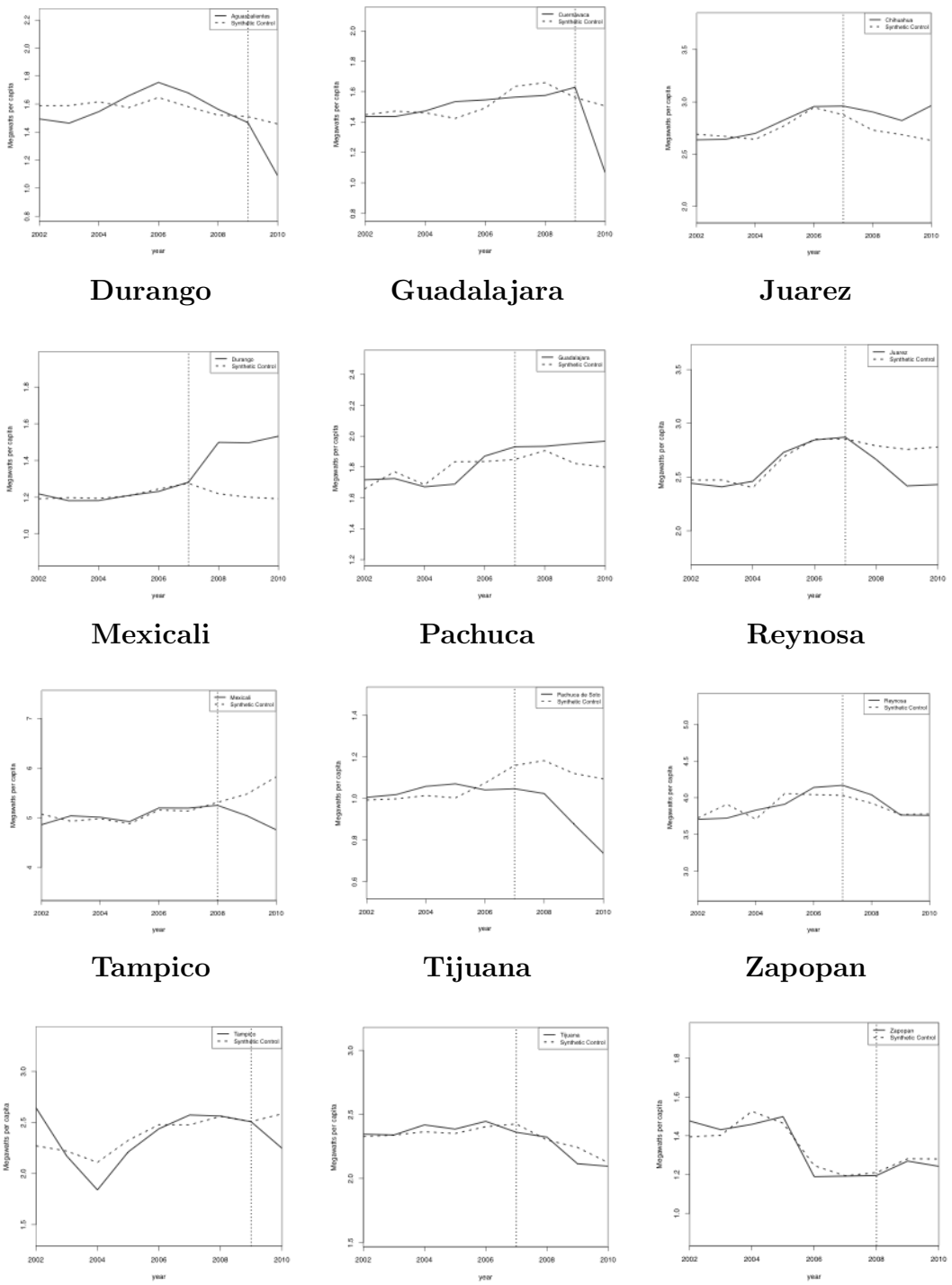
Notes: The table shows ordinary least square regressions of main economic and labor outcomes on selected sociodemographic characteristics. Labor outcomes are calculated as percentages over the population older than 14 years old (except log-labor income).
Standard errors are in parenthesis.*** p<0.01, ** p<0.05, * p<0.1

Table A2: Descriptive statistics by year of treatment

	Pre-treatment period				Post-treatment period			
	Mean	Sd	Min	Max	Mean	Sd	Min	Max
Municipalities treated in 2006 (obs = 50)								
Electricity consumption, 2002-2010	0.72	0.4	0.21	2.14	0.82	0.55	0.19	3.18
Homicides, 2002-2010	4.49	9.09	0	41.25	6.59	11.21	0.2	52.4
Homicide rates, 2002-2010	10.29	16.49	0	76.7	21.53	21.51	3.78	125.51
Municipalities treated in 2007 (obs = 29)								
Electricity consumption, 2002-2010	1.38	1.22	0.19	5.42	1.38	1.48	0.21	6.52
Homicides, 2002-2010	1.53	3.42	0	15.2	11.59	37.68	0.25	198
Homicide rates, 2002-2010	3.98	6.47	0	27.24	23.2	21.97	3.26	104.48
Municipalities treated in 2008 (obs = 70)								
Electricity consumption, 2002-2010	1.48	1.43	0.08	8.45	1.48	1.33	0.13	6.78
Homicides, 2002-2010	19.05	57.44	0	348.5	89.9	352.11	0.33	2,705.67
Homicide rates, 2002-2010	11	9.25	0	43.49	61.45	64.26	2.57	331.26
Municipalities treated in 2009 (obs = 82)								
Electricity consumption, 2002-2010	1.1	0.94	0.1	5.06	1.13	1.11	0.11	6.31
Homicides, 2002-2010	8.97	29.42	0	238.86	21.24	50.41	0.5	392
Homicide rates, 2002-2010	11.75	12.38	0	72.79	56.69	68.02	6.56	348.14
Municipalities treated in 2000 (obs = 109)								
Electricity consumption, 2002-2010	1.32	1.27	0.04	8.61	1.41	1.66	0.03	12.82
Homicides, 2002-2010	7.44	16.32	0	138.38	26.19	39.85	1	242
Homicide rates, 2002-2010	11.2	12.51	0	74	64.68	74.04	6.86	470.51
Full sample* (obs = 1296)								
Electricity consumption, 2002-2010	0.95	1.05	0.01	11.39	1.02	1.33	0.05	27.63
Homicides, 2002-2010	7.21	42.99	0	1,352.5	10.16	67.36	0	1,745.8
Homicide rates, 2002-2010	10.67	11.24	0	120.03	14.66	19.64	0	208.12

The table shows summary statistics of homicide rates and electricity consumption for treated municipalities by year of treatment (onset of a turf war). The percentage of people working, unemployed, business owners or self employed was computed over the population older than 14 years old.

Figure A2: . Synthetic controls for selected cities



The graphs show domestic electricity consumption per capita from 2002 to 2010 for selected cities and their respective synthetic counterfactual. Vertical lines depict the year of treatment (onset of a turf war).