



MASTER 2
ECONOMIC THEORY AND ECONOMETRICS

Master's Thesis
Institutional Shocks: The Impact on Firms of the Zetas Cartel

Author: Oscar Fentanes
Advisor: Matteo Bobba
Jury: Milo Bianchi and Stéphane Straub

June, 2019

Abstract

Despite more than a decade of war on drugs in Mexico, there is little microeconomic evidence of the impact of criminal groups on firms and the possible persistence of those effects. We take advantage of a new panel data set from 1999 to 2014 to study the impact of the Zetas cartel on the economy using a difference-in-difference approach. We find that the arrival of the Zetas cartel to a municipality lowers the survival rate of establishments by 1.7 points, affecting disproportionately more the manufacturing sector. We find that the average size is not affected but surviving firms become more informal. Finally, we find that when the Zetas left a municipality, firms hire salaried workers again.

I would like to thank INEGI, and particularly Natalia Volkow, for facilitating the access to firm level data at the Microdata Laboratory in Mexico City. Access to confidential information took place under strict surveillance. I am also thankful to Matteo Bobba, Sébastien Montpetit, Sophie Lestrade, Ignacio Hernandez, Alejandro Bernal and Sindy Arango for their valuable comments and suggestions.

Introduction

Violence in Mexico has steadily increased over the past 13 years, since the war on drugs was declared in 2006 by president Felipe Calderon. The Calderon presidency saw 121,669 homicides and around 20,000 missing persons. The following administration, by Enrique Peña Nieto (2012-2018), registered more than 150,000 homicides and also around 20,000 missing persons [Calderón et al., 2018]. In 2018, the presidency of Andres Manuel Lopez Obrador started with homicide rates at historical high levels and without any sign that the trend will be reversed.

This violence has been mostly caused by two types of confrontations. First, the State against targeted criminal groups; and second, rival criminal groups fighting for territorial control. Once the State has weakened a criminal group in a region, it creates a power vacuum that is usually filled by rival groups willing to fight for the market.

Violence and crime related to drug trafficking motivated the declaration of war against cartels, but this war also exacerbated the problem. The costs of the war in terms of human lives (homicides and missing persons) are well quantified, constantly tracked by the government and NGO's; and reported by the media. However, the economic costs are less known and its measurement is less obvious. Moreover, reliable data sources to build indicators are scarce and methodologies to compute them are numerous.

The economic costs of violence and crime have been largely studied in the literature. Some macro studies evaluate the impact of criminality on economic growth, inequality or resource misallocation. Microeconomic studies primarily focus on the effects on firms behavior or labor markets. However, microeconomic studies for Mexico have had a limited scope due to the lack or large data sets at the firm level.

The main contribution of this paper is the use of a new and unusually rich panel data set to determine the effects on the economy of one of the newest and most widespread and violent cartels in Mexico: the Zetas Cartel. This cartel is particularly interesting because of its erratic market strategies, highly extractive behavior and relatively recent beginning of their operations. We will answer first if the arrival of this cartel affects the economy; then, if it does, which are the economic variables affected and to what extent. Finally we will test whether the effects are persistent once the Zetas left a municipality.

Our study also tries to contribute to the literature that relates institutions and economic development. Particularly, we estimate the effects caused by a sudden change in institutions, and their possible persistence once the rules of the game are reestablished to the ones existing before the shock.

The rest of the paper is structured as follows. In Section 1 we present the context and summarize attempts to measure the impact of violence and crime on economic outcomes. In Section 2 we describe the data. In section 3 we present the econometric specification. Section 4 shows our main results and some robustness checks. In section 5 we talk about the limitations of our work and in 6 we provide some concluding remarks.

1 Context and Related Literature

The institutional shock that we consider in this study is the sudden occupation of territories by the Zetas cartel. Their erratic market strategy to expand to new markets creates a natural experiment that will allow us to attribute changes in economic variables to differences in exposure. The rest of cartels in Mexico lack this quasi random assignment feature as they have more attachment to the regions they originated from. Also, the Zetas aggressive behavior to extract resources from occupied territories represents an abrupt shift to more extractive institutions, which can have persistent effects after the Zetas leave a territory.

1.1 The Zetas Expansion

Even though 2005 already saw a sharp increase in cartels presence across all the Mexican territory, it was the war on drugs that started in 2006 what triggered waves of violence and accelerated the expansion of cartels to municipalities topically not occupied by organized crime. According to Dell [2015], the increase in violence was due to confrontation between the Mexican army and the police against cartels; and also, among cartels themselves fighting for the control of territories formerly belonging to other groups weakened by the government. Moreover, the expansion to new municipalities was partially explained by the fact that municipalities governed by the ruling party PAN were not safe anymore for cartels to bring drugs to the US, pushing them to alternative routes.

As documented by Coscia and Rios [2012], Table A2 and Figure 1 show that the presence of the 6 main cartels in Mexican municipalities was modestly growing from 1990 to 2004. In 1990 the current 10 main cartels were nonexistent¹; and by 2004, only 4.7% of all municipalities were occupied by at least one of them. This trend changed in 2005 when the percentage increased to 9.2% and then when the war on drugs was declared in 2006, the percentage increased to 12.1%, to eventually reach 28.9% in 2010 ².

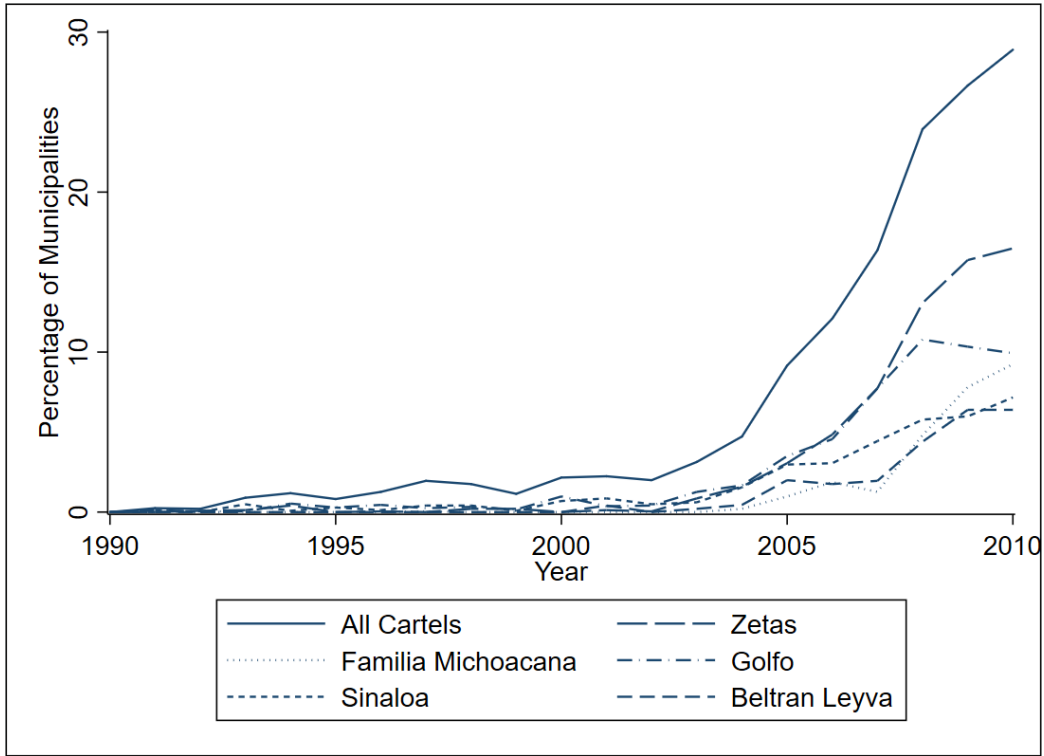


Figure 1: Percentage of Municipalities with Cartels

Although almost all the cartels expanded their territorial presence after 2005, it was the Zetas cartel the one that grew the most. Before 2003 they were a minor player in the organized crime scenario, born as the enforcement arm of the Gulf Cartel. In 1998 they were present in only 4 of the 32 States, by 2003 the number increased to 9, and by 2008, they were already in 31 (see Figure 3). The Zetas cartel presence grew disregarding if new municipalities

¹Some disperse drug trafficking groups existed before 1990 concentrated mainly in Guadalajara, Sinaloa and Tijuana.

²By 2010, all of the 32 Mexican States had presence of at least one drug cartel.

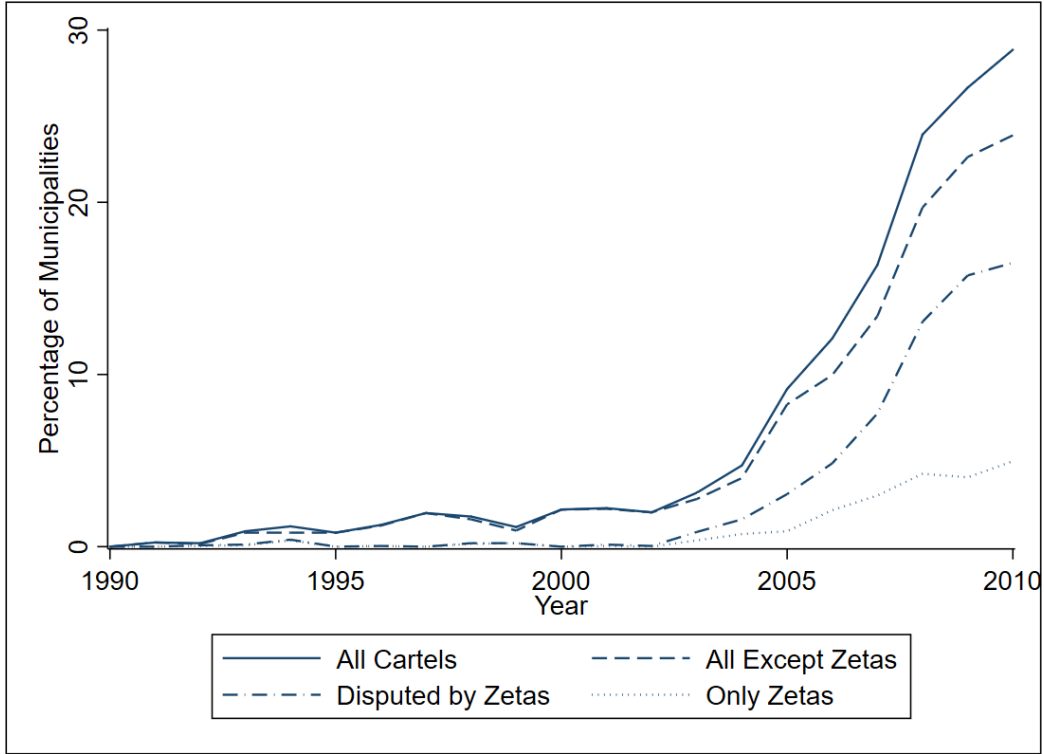


Figure 2: Percentage of Municipalities with Cartels

were already taken by rival groups. In fact, as shown in Figure 2, they expanded faster towards occupied municipalities.

The fast growth of the Zetas cartel can be explained by the use of franchising schemes as studied by Wainwright [2016]. They usually send emissaries to new municipalities to bargain with local criminals. The Zetas allow them to use the brand *Zetas* and provide them with military training and weapons. In exchange, local criminals share revenues with the cartel and fight for them in case of war against a rival criminal group. The advantage of using the *Zetas* brand is, as any other franchise, a standardization of the product; local criminals take advantage of the reputation of the cartel to enforce their criminal activities such as drug trafficking and extortion of local businesses.

The erratic expansion strategy of the Zetas has been documented by Coscia and Rios [2012]. According this study, criminal groups differ substantially in their territorial extension, the strategies they follow to expand, and their patterns of migration. Table A4 shows, first, that in 2010 the Zetas cartel operated in more municipalities than any other cartel; second, they started

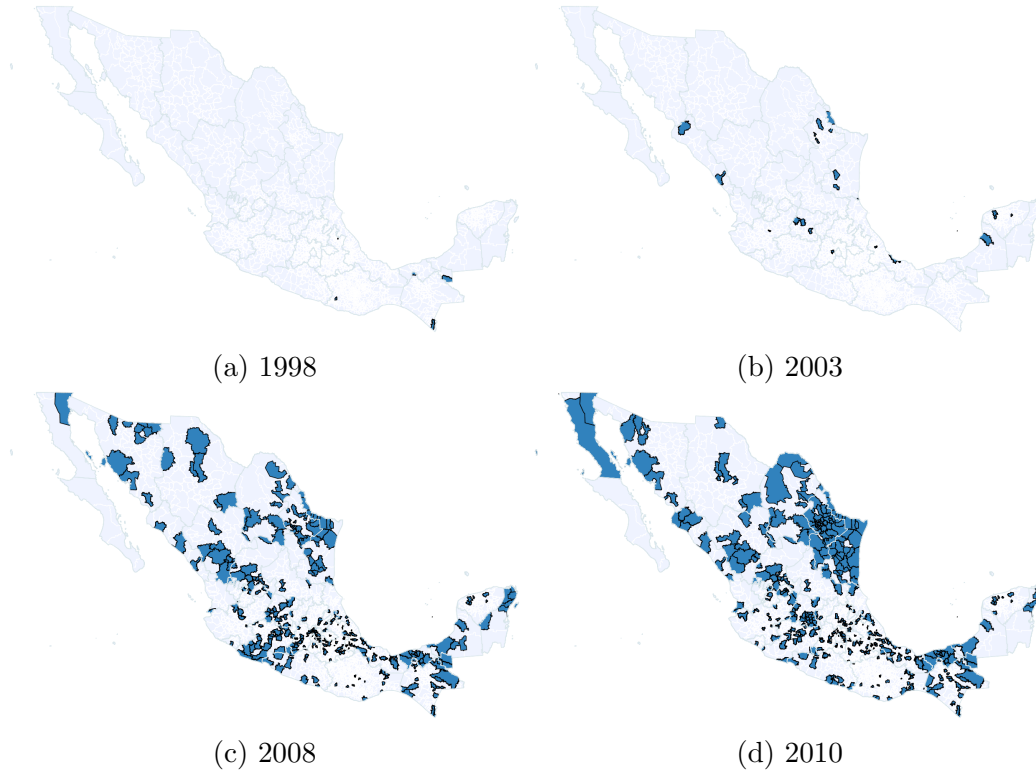


Figure 3: Zetas Expansion

their aggressive expansion after 2003 (coincidentally the pre-treatment edition of the Economic Census); third, they occupied and abandon more municipalities in average than any other cartel, occupying an average of 2.71 years consecutively the same municipality; and finally, they are the most aggressive and invasive cartel as implied by their competitive and exploratory index³.

For most cartels, the patterns of expansion are similar, they tend to concentrate in municipalities closer to ports of entry to the US, large cities within Mexico, and highways that connect cultivation areas or maritime ports to the US-Mexico border [Coscia and Rios, 2012]. But this is not the case for the Zetas cartel. As shown in Figure 3, they operate in 31 of the 32 states and in a large and volatile variety of municipalities.

³Coscia and Rios [2012] define the exploratory index as the number of standardized municipalities in which a cartel was the first to ever operate; and the competitive index as the standardized number of municipalities in which a given cartel was sharing a municipality with another one.

The territorial diversification of the Zetas cartel comes with a diversification in their criminal activities, no longer limited to drug trafficking. As documented by Beittel [2015], the main asset of the Zetas is not drug smuggling but organized violence; they carry out an extractive business model that includes activities such as fuel theft, extortion, human smuggling and kidnapping.

In summary, the Zetas cartel departed from the traditional behavior of cartels in two main ways; first, geographically, by expanding quickly to new territories or disputing already taken ones; and second, by extending their sources of income to a wide variety of criminal activities. This unprecedented behavior makes this cartel an interesting source of variation that mitigates the endogeneity problem, creating a natural experiment to test the effects on the economy of a sudden rise of crime and violence.

1.2 Measuring the Impact of Violence and Crime on the Economy

Institutional arrangements affect the performance of the economy. In particular, extractive institutions have a negative effect on economic activity and therefore on income per capita [Acemoglu et al., 2001]. However, not all institutional arrangements are the official ones. As defined by Helmke and Levitsky [2004], institutions can also be informal, that is, *all shared rules that are usually unwritten, socially created, and communicated and enforced outside of officially sanctioned channels*.

Drug cartels, and organized crime in general, fall into the category of informal institutions. Despite their lack of official status, they control territories, provide security (or insecurity) and public services, and collect taxes usually in the form of extortion or expropriation of assets. As the rest of institutions, organized crime has an impact on the economy. They distort entrepreneurial choices, capital accumulation and the labor market. Causality operates also in the opposite direction: economic conditions affect the way informal institutions such as organized crime are created and evolve.

One of the main difficulties in studying the economic impact of crime and violence is determining how the economy would have evolved without it. A common approach is to build a counterfactual scenario as control group and compare it to the treated group. The seminal work in this literature is Abadie and Gardeazabal [2003]. The author's case study is the terrorist

conflict in the Basque Country, Spain. As in the case of cartels in Mexico, firms and entrepreneurs were targets of assassinations, robberies, kidnappings and extortion by the terrorist group ETA; which caused a downturn in the economy. To build a counterfactual world without ETA, the authors combine other Spanish regions to construct a "synthetic" control region, mimicking relevant economic characteristics of the Basque Country before the rise of terrorism. The study finds that in times of credible cease fire, stocks of firms with presence in the Basque Country improved, while when the truces finished, stocks performed worse. For the Mexican case we have a great number of treated and untreated regions so we will not use synthetic control groups.

1.3 Studies for Mexico

There is a broad consensus in the literature that violence and crime are negatively correlated with some economic outcomes. The correlation can be studied at the macroeconomic or microeconomic levels. Moreover, since this is a highly endogenous phenomenon, causal effects can be found in both directions.

The study of this relationship has been growing in Mexico since the war on drugs started in 2006. The fast growth of criminal groups across all the Mexican territory motivated studies that analyze the macroeconomic conditions that facilitated this expansion. For instance, Enamorado et al. [2016], shows that an increase in inequality by 1% in the Gini Index increases drug-related crimes at the municipality level by 36%. But once the criminals spread across the territory, they can further distort the economy; in this sense, Enamorado et al. [2013] shows that Mexican municipalities with higher drug-related crimes present lower income growth.

But our main concern here is at the microeconomic level, on how the behavior of firms is affected by the presence of criminal groups. Specifically, we are interested in managerial decisions such as size, informality and exit. In this body of literature, we find Rios [2016], who studies the effects of crime and violence on diversity of local economies in Mexico. She uses the Economic Census to create a Municipality-Industry panel data set and merges it with data on drug related crimes and presence of cartels. With that data, she shows that increases in criminal presence and violent crime reduce economic diversification in terms of 6-digit industries and increases concentration by shrinking the number of competitors by industry.

A more direct impact on Mexican firms is analyzed by Montoya [2016]. He studies the economic consequences of crime relying on a manufacturing survey (2007-2013 panel data set) and business victimization surveys. With a Diff-in-Diff approach, the author finds a decline in economic activity when crime increases: revenue, employment and hours worked fall by 2.5-4%.

The effects of crime and violence on entry and exit of firms in Mexico has not been broadly studied because of a lack of panel data for periods before 2006. A study that attempts to quantify the exit of firms because of violence is Utar [2018]. By using INEGI's Annual Manufacturing Survey 2005-2010, the study finds that increases in homicide rates decrease plant survival, small plants being the most affected.

Regarding the mechanism that explains how a cartel impacts the local economy we find Diaz-Cayeros et al. [2011]. The study shows that 14% more extortion occurs in contested municipalities; that is, when two or more cartels are disputing the same territory and trafficking routes, they extort citizens to extract resources. On the other hand, when cartels enjoy a stable presence in a region they tend to provide assistance to citizens through money transfers and infrastructure. Cartels such as the Zetas, who aggressively expand and invade new territories and with more diversified criminal activities may have a stronger impact on local economies through extortion.

Our study share some similarities with previous work. First, we also use the Economic Census as Rios [2016] except that we have a panel at the firm level. We also use a diff-in-diff approach as Montoya [2016] but with larger geographical and temporal coverage to test the parallel trend assumption and persistent effects. As other microeconomic studies, we will focus on exit and size decisions.

2 Data

2.1 Economic Census

Our main source of information is the quinquennial Economic Census, published by Mexico's National Institute of Statistics and Geography (INEGI). We use the editions 1999, 2004, 2009 and 2014, linked by Busso et al. [2018] at the establishment level. The Census captures information about all firms in Mexico performing economic activities in fixed facilities and located in

urban localities with more than 10,000 inhabitants⁴. Table 1 shows our sample, which includes all establishments corresponding to the manufacturing, commerce and services sectors. Table A1 shows the full Economic Census available. We restrict our sample to manufacturing, commerce and services and exclude government activities, agriculture and transportation because of difficulties to harmonize their variables and industrial classification across different editions.

Table 1: Economic Census Sample

	Industries (6-digits)	Establishments	Employment
1999	720	2,722,823	12,977,046
2004	726	2,923,048	14,411,753
2009	732	3,662,688	18,136,036
2014	735	4,169,533	19,658,126

With the panel identifiers we know which establishments survive through the next period, so we measure the survival rate in t as the percentage of establishments that are present in $t + 5$. Employment is computed as the sum of salaried workers and nonsalaried. Salaried are blue collar and white collar; and nonsalaried are the owners, outsourced workers and independent professional services. The census captures wages for blue and white collar workers, for the rest of workers, remunerations are treated as expenses. Capital is measured as the sum of fixed facilities, land, machines, vehicles and computers. Value added is the sum of revenues derived from the main activity minus expenses.

The variables mentioned above are directly obtained from the Economic Census. Moreover, we can compute additional measures such as informality and productivity rates. Informality can be measured in several ways. One noisy measure is the proportion of salaried workers. Another more precise is the percentage of social security payments. This last measure has been largely used in the literature [Levy, 2018, Busso et al., 2012]. For productivity we use two measures, first, value added per worker; and second, total factor productivity (revenue and quantity) as defined by Hsieh and Klenow [2009].

All nominal variables are deflated in 2013 prices. For wages we use as

⁴The Economic Census provides information about the year preceding its release. E.g. the 2009 Census captures information about 2008, and so on.

deflator the consumer price index, for value added the producer price index and for capital the implicit price of capital index. All indices published by Mexico’s INEGI.

2.2 Operation of Criminal Organizations

To track when and where cartels operated in each of the 2,400 Mexican municipalities we use the database built by Coscia and Rios [2012]. The authors developed a framework that uses Web content to obtain quantitative information and areas of operation of the main 13 cartels (and some smaller ones) in Mexico from 1999 to 2010.

They divide the cartels in four categories:

- Traditional: Juarez, Tijuana, Sinaloa.
- New: Barbie, Mana, Sinaloa Faction, Beltran Leyva Faction, Other.
- Competitive: Beltran Leyva, Familia Michacana.
- Expansionary Competitive: Zetas, Golfo.

As mentioned earlier, we will focus on the last category, specifically, the Zetas cartel. Traditional cartels usually stick to their region of origin and operated before 2003. New cartels and competitive don’t have an important geographical coverage or are factions created from traditional cartels.

3 Econometric Specification

To measure the effects of the Zetas Cartel on economic outcomes we use a Difference-in-Difference approach. We estimate average outcomes for treatment and control groups and compute the relative gains from the pre-treatment to the post-treatment periods (the difference in differences). We always control for industry, municipality size (population), and dummies for cities with ports and next to the U.S. border. Standard errors are clustered at the municipality level. We model outcomes Y_t as follows:

$$Y_t = \alpha + \gamma R + \delta t + \beta D + b\mathbf{X} + \varepsilon_t \quad (1)$$

With:

$$\mathbb{E}[\varepsilon_t|R, D] = 0$$

Where α is a constant term. γ is the treatment group specific effect. δ the time trend common to control and treatment groups, and β the true effect of treatment (difference in differences). Matrix \mathbf{X} is the set of controls and time unvarying characteristics mentioned above. The outcomes Y_t we will measure are:

- Survival Rate
- Average Size (Employment)
- Percentage of Salaried Workers

We consider two types of intervention for our specification. The intervention is applied at the municipality level, thus firms in intervened municipalities will have $R = 1$. Any of the 2,400 municipalities can be intervened in the following ways:

- Zetas were present in 2007, regardless if they stayed or left afterwards.
- Zetas were present in 2007 and 2008.
- Zetas were present in 2007 and then left.

The first intervention can be interpreted as a sudden shock on the (informal) institutions faced by firms and entrepreneurs regardless its duration; and the second, as a longer shock. The third intervention is to test for possible persistent effects.

In our specification $t \in \{0, 1\}$, where $t = 0$ for non-treated periods and $t = 1$ for the treated ones. Denote R the dummy variable that indicates if municipality i has been intervened or not. Then, denoting the treatment variable as D we have:

$$D = Rt$$

Where $R = 1$ if a firm belongs to a treated municipality in a treated period, and $R = 0$ otherwise.

3.1 Identification Assumption

The Diff-in-Diff parameter β can be written as⁵:

$$\beta = \mathbb{E}[Y_{2008}(1) - Y_{2008}(0)|R = 1]$$

Which means that the effect of the arrival of the Zetas to a treated municipality is the observed outcome $Y_{2008}(1)|R = 1$ minus the expected value of the outcome in a treated municipality given that the Zetas never arrived $Y_{2008}(0)|R = 1$. Since $Y_{2008}(0)|R = 1$ is not observed, we have to do the following assumption:

Assumption 1 *Parallel Trend Assumption*:

$$\mathbb{E}[Y_{2008}(0)|R = 1] - \mathbb{E}[Y_{2008}(0)|R = 0] = \mathbb{E}[Y_{2003}(0)|R = 1] - \mathbb{E}[Y_{2003}(0)|R = 0]$$

3.2 Parallel Trend Assumption Test

To test the parallel trend assumption we perform a difference in differences for 1998 and 2003, the two pre-treatment periods. We expect an absence of anticipatory effects, that is, treatment and control groups should not modify their trends from 1998 to 2003 if they expect to be treated or not in 2007. The econometric specification is the same as Equation 1.

For the parallel trend assumption test we have $t = 0$ for 1998 and $t = 1$ for 2003⁶. If the null hypothesis $\beta = 0$ cannot be rejected, we have evidence that the parallel trend assumption holds.

3.3 Persistence

To measure persistence we modify the model. We cannot just take 2008 and 2013 and apply a Diff-in-Diff because from 2003 to 2008 the parallel trend assumption won't necessarily hold. We need to include 2003 to measure persistence effects with respect to the original parallel trend, which is determined before the intervention. We rewrite the model as⁷:

⁵In parenthesis, the dummy variable that indicates if the unit was treated or not.

⁶Implicitly, we are applying the forward operator to t and R .

⁷Abusing notation, the lag operator means the previous Census which is actually 5 years before.

$$Y_t = \alpha + \gamma R + \delta_1 t + \beta_1 D + \delta_2 L.t + \beta_2 L.D + b\mathbf{X} + \varepsilon_t \quad (2)$$

With $t = 0$ for 2003 and 2013, and $t = 1$ for 2008. We expect β_1 to be statistically different from zero, that is, municipalities with cartel's arrival in 2007 will have distorted outcomes in 2008. If β_2 is statistically different from zero, it means that we have persistence in 2013 of the treatment in 2007.

4 Results

By using Equations 1 and 2, we estimate the Diff-in-Diff coefficients as well as the parallel trend tests and persistent effects. As mentioned before, we employ 3 different interventions at the municipality level, which generate a different number of treated and control regions. Besides, we will perform later some estimations with a reduced sample, considering only Metropolitan Zones. Table 2 shows the number of municipalities corresponding to each group and by treatment.

Table 2: Control and Treatment Municipalities

All Municipalities			
	Control	Treatment	Total
Zetas in 2007	2,267	190	2,457
Zetas in 2007 and 2008	2,345	112	2,457
Zetas in 2007 but not afterwards	2,436	21	2,457
Municipalities in Metropolitan Zones			
	Control	Treatment	Total
Zetas in 2007	352	65	417
Zetas in 2007 and 2008	373	44	417
Zetas in 2007 but not afterwards	414	3	417

4.1 Effects of the Zetas Cartel

Table 3 estimates the Difference in Differences coefficients for 1998 to 2003 and for 2003 to 2008; it considers all observations and the presence of the Zetas cartel in 2007 as treatment. For all three outcomes shown, the parallel

trend assumption holds as estimated by row DID 1998-2003. As shown in row DID 2003-2008 and depicted in Figure 4, the presence of the Zetas Cartel in 2007 has a negative impact on survival rates of firms, had they not operated in intervened municipalities, around 62,000 more firms would be in business⁸.

The column employment measures the impact of the treatment on average number of employees by firm, the effects are not statistically significant. There is however, a statistically significant effect on the average composition of the employees: firms are hiring on average less salaried workers (white collar plus blue collar) in favor of nonsalaried workers (owners, outsourced and professional services). Table 4 estimations are similar except that the treatment is now the presence of the Zetas both in 2007 and 2008. As shown in row DID 2003-2008, the negative effect on survival rates is slightly higher, the longer the Zetas stay in town, the higher the impact on survival rates. The effects on employment and proportion of salaried workers are unchanged.

Table 3: Differences in Differences All Establishments

Treatment: Zetas in 2007						
	Survival Rate		Employment		Salaried Workers	
	Treat.	Cont.	Treat.	Cont.	Treat.	Cont.
Mean 1998	0.514	0.521	5.816	4.502	0.295	0.236
Mean 2003	0.506	0.511	5.902	4.533	0.277	0.222
Mean 2008	0.564	0.586	6.032	4.518	0.263	0.213
DID 1998-2003	0.003		0.054		-0.004	
s.e	(0.006)		(0.109)		(0.004)	
DID 2003-2008	-0.017***		0.145		-0.005*	
s.e	(0.005)		(0.152)		(0.003)	
Obs 1998	2,722,749		2,722,749		2,708,163	
Obs 2003	2,923,036		2,923,036		2,919,590	
Obs 2008	3,662,688		3,662,688		3,662,144	

Inference: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Estimations controlled by ports and U.S. border municipality.

Standard errors clustered by municipality.

⁸The diff-in-diff coefficient times the number of firms in 2003.

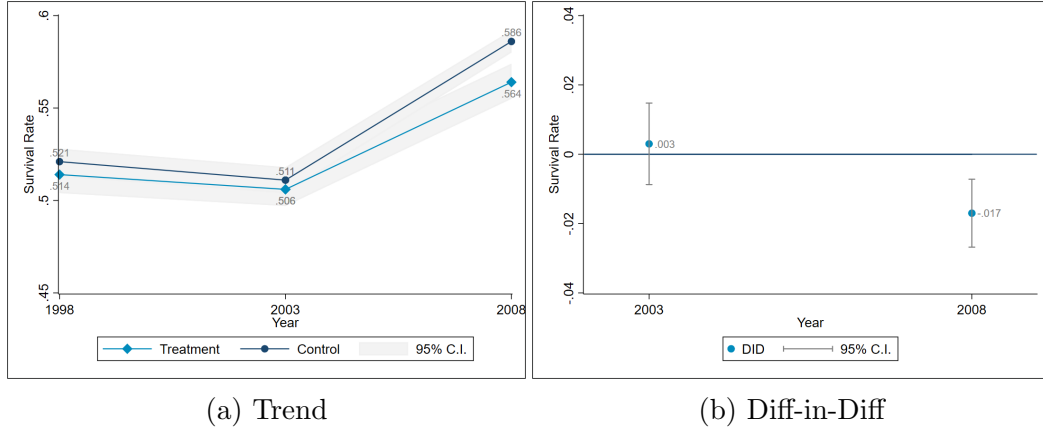


Figure 4: Effects of Zetas in 2007 on Survival Rates. All Firms.

Table 4: Differences in Differences All Establishments

Treatment: Zetas in 2007 and 2008						
	Survival Rate		Employment		Salaried Workers	
	Treat.	Cont.	Treat.	Cont.	Treat.	Cont.
Mean 1998	0.509	0.522	5.671	4.658	0.297	0.241
Mean 2003	0.501	0.512	5.760	4.690	0.281	0.226
Mean 2008	0.555	0.587	5.991	4.656	0.266	0.216
DID 1998-2003	0.001		0.057		-0.001	
s.e	(0.006)		(0.118)		(0.004)	
DID 2003-2008	-0.020***		0.265		-0.005*	
s.e	(0.005)		(0.174)		(0.003)	
Obs 1998	2,722,749		2,722,749		2,708,163	
Obs 2003	2,923,036		2,923,036		2,919,590	
Obs 2008	3,662,688		3,662,688		3,662,144	

Inference: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Estimations controlled by ports and U.S. border municipality.

Standard errors clustered by municipality.

Results in Tables 3 and 4 are estimated with the whole Economic Censuses. Table 5 estimates the Diff-in-Diff coefficients for the periods 1998, 2003 and 2008 but keeping only those establishments that survived the three periods. With this balanced panel, we find that establishments that were

present from 1998 to 2008, that is, before and after the arrival of the Zetas, modify the composition of their employees even more, the effect is twice as big as in Table 3. This pattern is shown in Figure 5. Again, there are no effects on average size. A possible explanation for this behavior could be that firms that survive several periods are not as willing to close as new firms, so in order to keep surviving in the presence of Zetas, they further modify the way they hire workers.

Table 5: Differences in Differences Balanced Panel

Treatment: Zetas in 2007				
	Employment		Salaried Workers	
	Treatment	Control	Treatment	Control
Mean 1998	8.642	6.483	0.304	0.236
Mean 2003	9.480	7.118	0.299	0.232
Mean 2008	9.221	7.059	0.280	0.223
DID 1998-2003	0.204		-0.001	
s.e	(0.131)		(0.002)	
DID 2003-2008	-0.201		-0.010***	
s.e	(0.166)		(0.003)	
Obs	890,253		890,047	

Inference: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Estimations controlled by ports and U.S. border municipality.

Standard errors clustered by municipality.

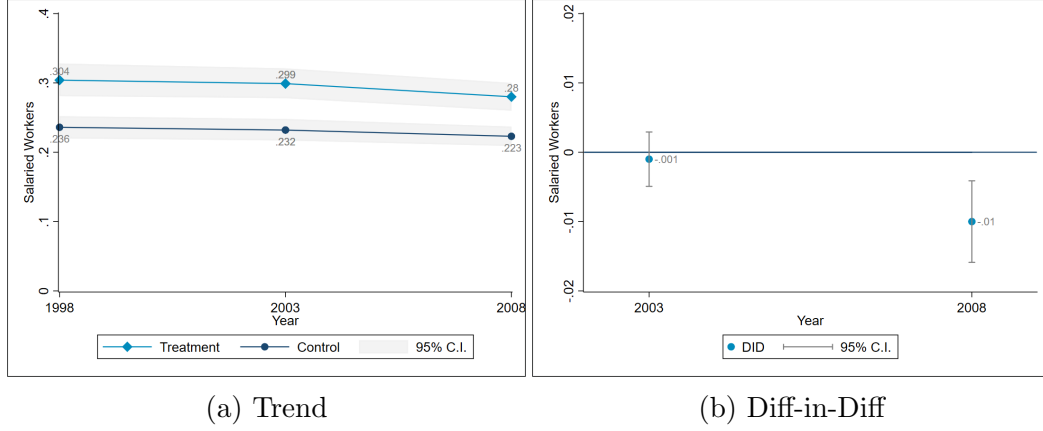


Figure 5: Effects of Zetas in 2007 on Salaried Workers. Balanced Panel.

So far, our estimations show that when the Zetas arrive to a municipality, the mortality rate of establishments increases and those firms that survive do so by reducing the proportion of salaried workers. Salaried workers is a noisy signal of informality, by not hiring employees as salaried, firms can increase their flexibility to adjust the amount of labor in case of an institutional shock; in other words, our implicit mechanism is on the demand side. The arrival of the Zetas causes firms to close and those that don't exit, adjust the way they hire workers in case they have to reduce their size or close.

Nonetheless, another explanation for the reduction of salaried workers in violent regions is given by Utar [2018]. The study, on the contrary, argues that it is due to a labor supply shock. As violence increases, workers increase their reservation wage to account for the increase in risk taken by going to work, diminishing their supply.

4.2 Effects by Sector

We use again the model specified in equations 1 and 2, including all firms from all municipalities, but estimated separately by sector to test for possible heterogeneity. Again, we don't find statistically significant effects of the Zetas cartel on average size or percentage of salaried workers. However, the survival rates are differently distorted by the Zetas cartels depending on the sector.

Table 6 estimates that the manufacturing sector was disproportionately more affected when the Zetas operated in 2007. While in the commerce and services sectors the survival rates dropped 1.5 and 1.3 points respectively, the

effect on the manufacturing sector was more than double, 3.8 points less (see Figure 6). If we now consider the treatment as the presence of Zetas both in 2007 and 2008, the effects on the manufacturing sector are still disproportionately higher; nevertheless, they are not as big as when the treatment in Zetas in 2007. For commerce and services the effects are slightly higher when the Zetas are present in both 2007 and 2008.

Table 6: Survival Rate by Sector

Treatment: Zetas in 2007						
	Manufacturing		Commerce		Services	
	Treat.	Cont.	Treat.	Cont.	Treat.	Cont.
Mean 1998	0.451	0.437	0.555	0.569	0.477	0.475
Mean 2003	0.502	0.495	0.533	0.542	0.471	0.465
Mean 2008	0.572	0.603	0.588	0.612	0.534	0.542
DID 1998-2003	-0.007		0.006		0.004	
s.e	(0.008)		(0.007)		(0.006)	
DID 2003-2008	-0.038***		-0.015***		-0.013***	
s.e	(0.007)		(0.006)		(0.005)	
Obs 1998	342,659		1,442,598		937,492	
Obs 2003	328,827		1,580,538		1,013,671	
Obs 2008	436,943		1,858,529		1,367,216	

Inference: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Estimations controlled by ports and U.S. border municipality.

Standard errors clustered by municipality.

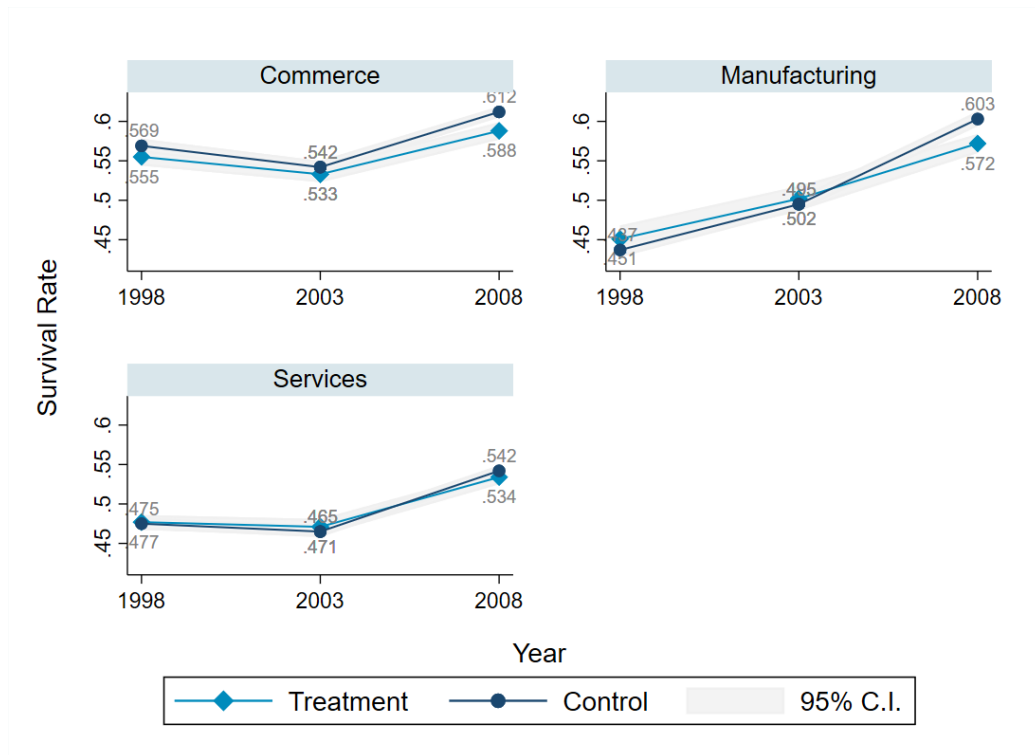


Figure 6: Survival Rate by Sector. Zetas in 2007.

Table 7: Survival Rate by Sector

Treatment: Zetas in 2007 and 2008						
	Manufacturing		Commerce		Services	
	Treat.	Cont.	Treat.	Cont.	Treat.	Cont.
Mean 1998	0.442	0.440	0.548	0.570	0.474	0.476
Mean 2003	0.491	0.498	0.527	0.543	0.467	0.467
Mean 2008	0.560	0.603	0.579	0.613	0.526	0.544
DID 1998-2003	-0.009		0.006		0.002	
s.e	(0.008)		(0.007)		(0.007)	
DID 2003-2008	-0.036***		-0.018***		-0.017***	
s.e	(0.007)		(0.006)		(0.005)	
Obs 1998	342,659		1,442,598		937,492	
Obs 2003	328,827		1,580,538		1,013,671	
Obs 2008	436,943		1,858,529		1,367,216	

Inference: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Estimations controlled by ports and U.S. border municipality.

Standard errors clustered by municipality.

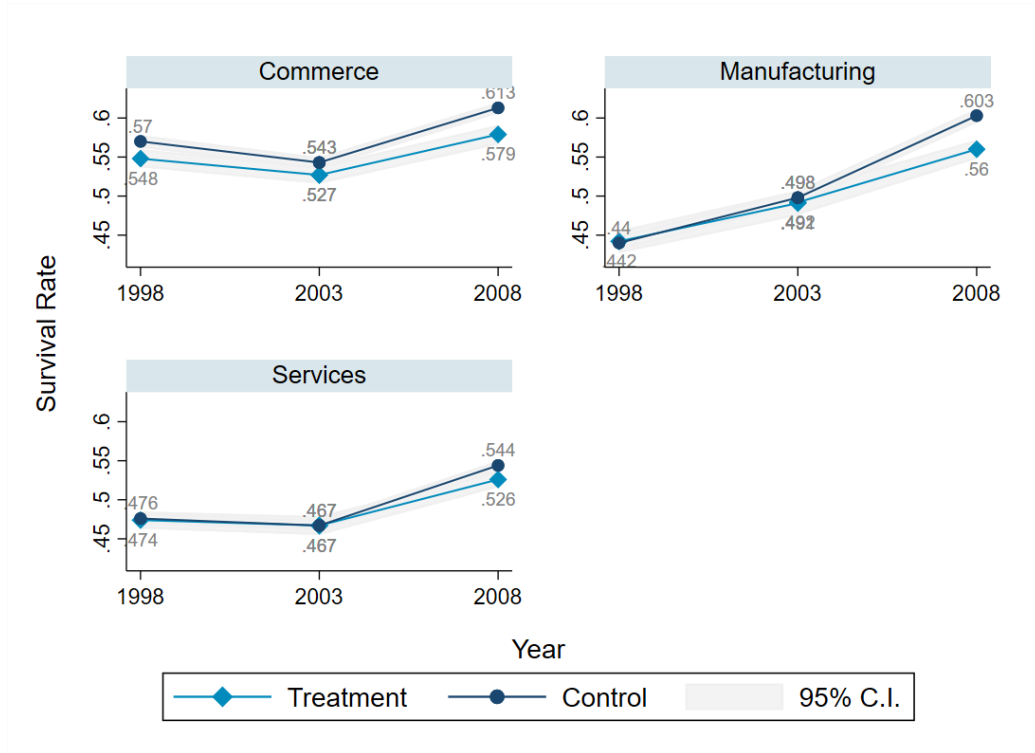


Figure 7: Survival Rate by Sector. Zetas in 2007 and 2008.

According to these results, when the Zetas arrive to a municipality, the most sensitive sector is manufacturing. A sudden arrival of this cartel causes manufacturing firms to close more often than firms from commerce and services. However, when the Zetas stay for more than a year, commerce and services become more sensitive and manufacturing firms resist slightly more.

One explanation for this heterogeneity, and particularly for the higher sensitiveness of the manufacturing sector is offered by Utar [2018]; since operation costs for manufacturing firms are higher, they might not be able to cover the additional cost imposed by the cartels and the violence they create. The same paper sheds some light on why when the Zetas operate several years manufacturing plants don't exit that often. Manufacturing firms may assimilate the additional costs of permanent cartel occupation if, for instance, they depend on foreign imports, so they can adjust to permanent presence of cartels and continue operations. On the other hand, commerce and services have a different nature, they don't usually depend on large supply chains and are not as likely to absorb additional and permanent costs. Besides, since they usually have higher cash flows, they can be more easily victims of

extraction by Zetas through constant extortion.

4.3 Persistence

We now test the effects on municipalities occupied by the Zetas in 2007, but no longer in 2008, 2009 and 2010. We assume, may be incorrectly, that the Zetas don't come back for 2011 and 2012. We do this assumption because the Coscia and Rios [2012] data base ends in 2010. We use specification 2 to estimate the effects in 2013 of Zetas occupation in 2007. We don't find any statistically significant persistent effects except for the proportion of salaried workers.

Table 8 estimates the Differences in Differences for 1998-2003 to test for parallel trends (Eq. 1); for 2003-2008 for the effects of Zetas operating in 2007 and not afterwards (Eq. 1); and 2008-2013 to know if there are persistent effects (Eq. 2). Those same effects are depicted in Figure 8. First of all, the parallel trend assumption holds. Second, the presence of Zetas in 2007 reduces the percentage of salaried workers by 0.6 points. However, after the cartel left a municipality, firms located there increase the percentage of salaried workers by 0.8 percentage points, which is good news because it suggests that the informality caused by the cartel may be reversed once they left the territory.

Table 8: Persistent Effects on Salaried Workers

Treatment: Zetas in 2007 but not afterwards			
Salaried Workers			
	1998-2003	2003-2008	2003-2013
R	0.001	0.004	0.001
s.e.	(0.002)	(0.002)	(0.002)
t		-0.004	-0.008
s.e.		(0.000)	(0.000)
D		-0.006***	-0.008
s.e.		(0.002)	(0.003)
F.t	-0.011		
s.e.	(0.000)		
F.D	-0.005***		
s.e.	(0.003)		
L.t			-0.024
s.e.			(0.000)
L.D			0.008***
s.e.			(0.003)

Inference: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Estimations controlled by ports and U.S. border municipality.

Standard errors clustered by municipality.

L is the lag and F the forward operators.

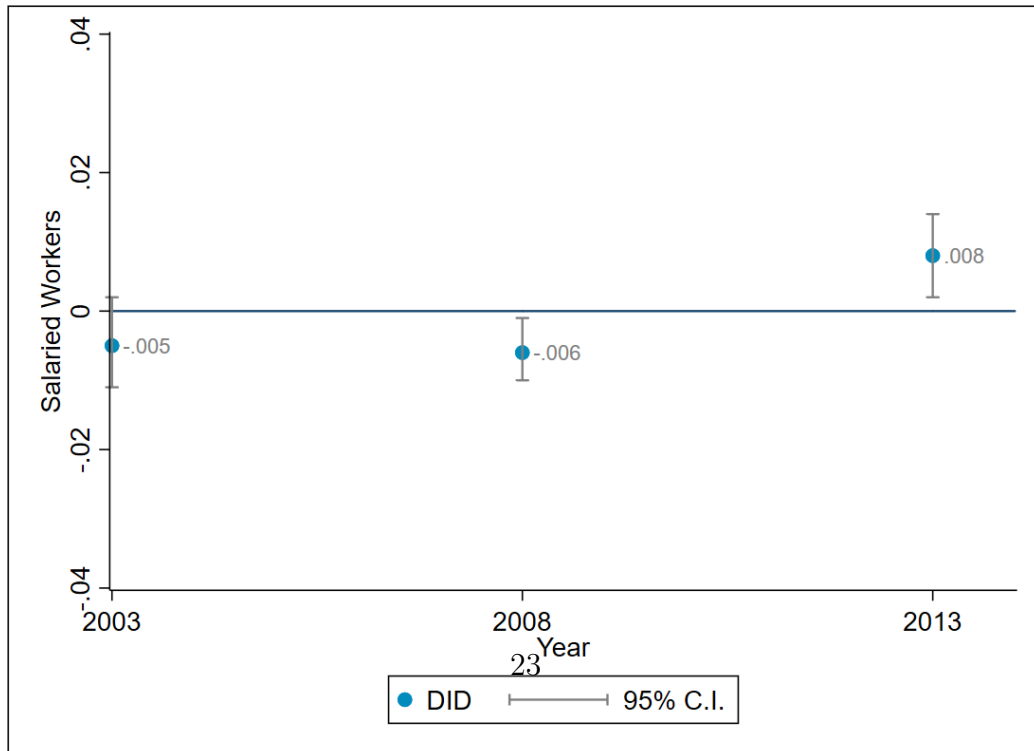


Figure 8: Persistent effects on Salaried Workers

4.4 Metropolitan Zones Subsample

So far we have considered all the 2,457 municipalities to be either from the control or treatment groups (see Table 2). Even though the parallel trend assumption holds for the variables we are analyzing, the differences between the treated and the treatment groups may induce different reactions to the treatment. We use Metropolitan Zones to assess how the results change if we consider only big cities composed by several municipalities.

We will now focus on Mexico's Metropolitan Zones (MZ). The Mexico's National Institute of Statistics and Geography (INEGI), defines 74 metropolitan zones, composed by 417 municipalities. By definition, they are sets of two or more municipalities containing a city with at least 100,000 inhabitants and maintaining high degree of socioeconomic integration ⁹.

According to INEGI, a MZ is composed by a *central municipality* and one or more *exterior municipalities*. The central municipality is the origin of the city, contains at least 100,000 inhabitants and is physically and functionally integrated to equal or less populated municipalities around. Functional integration is based on the amount of people commuting between municipalities to work. Exterior municipalities are functionally integrated and located at no more than 15 kilometers from the central municipality; they primarily focus on non rural activities and have a similar population density as the central municipality. Figure 9a shows the location of the MZ on the Mexican Territory. Each of the 32 States has at least one MZ.

The number of MZ with cartel's presence has increased over time. While in 1998 only 24 out of 74 MZ had criminal groups operating, the number increased to 37 in 2003 and then to 71 in 2008. Table 9 shows that in 2007, half the MZ had Zetas presence, accounting for almost two thirds of all the municipalities integrating the MZ. Among the 36 MZ with Zetas in 2007, 28 were partially occupied; that is, the Zetas did not fully controlled most of the cities in which they operate, only partially affecting them.

⁹Despite this official definition, there are 12 MZ composed by only one municipality.

Table 9: Zetas by Metropolitan Zone

	Metropolitan Zones	Municipalities
No Zetas	38	146
Partially Occupied	28	262
Fully Occupied	8	9
Total	74	417

The fact that the Zetas partially control some cities creates regions that are socioeconomically fully integrated but partitioned in zones with and without Zetas. We take advantage of this fact to perform the Diff-in-Diff regressions in a sub-sample that includes treated and control sub-regions.

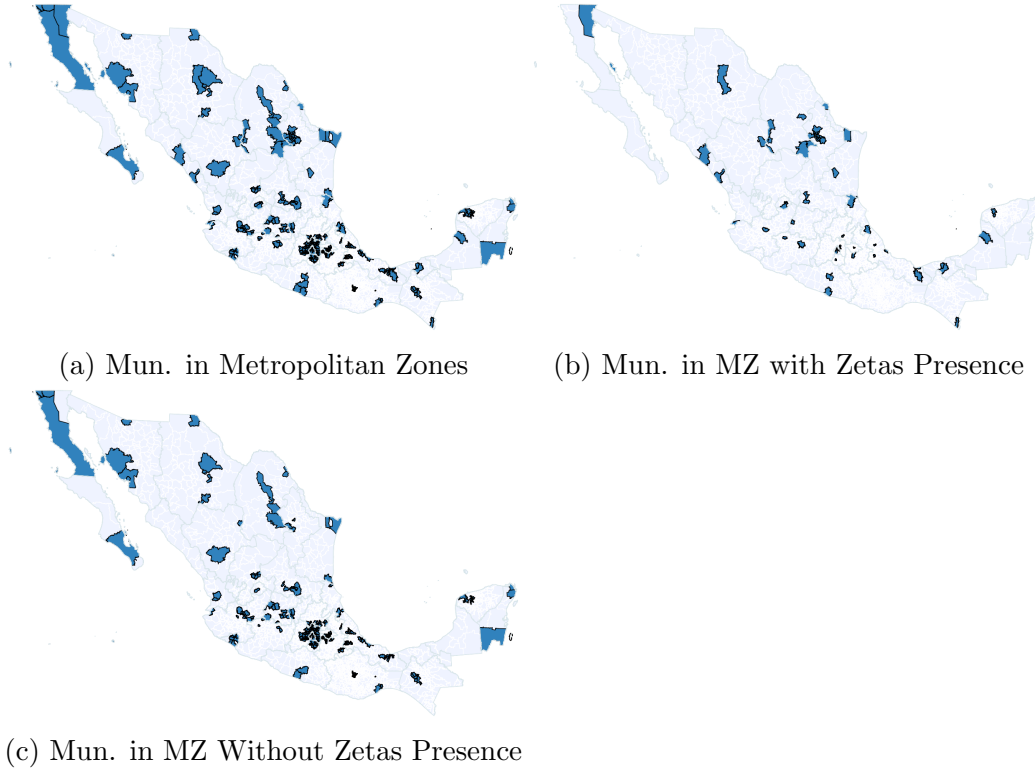


Figure 9: Municipalities in MZ with Zetas in 2007

Table 10 estimates the effects of the Zetas cartel in 2007 on metropolitan zones. Survival rates effects are shown in Figure 10. Despite the limited size of the sample in terms of number of municipalities, we don't find different survival rates with respect to the full sample case. The number of munici-

palties in MZ is around 20% of the total, however, since they are the biggest cities, they account for two thirds of the establishments.

Table 10: Differences in Differences MZ Establishments

Treatment: Zetas in 2007						
	Survival Rate		Employment		Salaried Workers	
	Treat.	Cont.	Treat.	Cont.	Treat.	Cont.
Mean 1998	0.507	0.516	6.447	5.397	0.311	0.257
Mean 2003	0.496	0.493	6.553	5.335	0.291	0.239
Mean 2008	0.557	0.570	6.678	5.357	0.277	0.230
DID 1998-2003	0.012		0.168		-0.002	
s.e	(0.007)		(0.136)		(0.004)	
DID 2003-2008	-0.017***		0.103		-0.005	
s.e	(0.006)		(0.194)		(0.004)	
Obs 1998	1,881,709		1,881,709		1,871,738	
Obs 2003	2,000,028		2,000,028		1,997,656	
Obs 2008	2,457,767		2,457,767		2,457,278	

Inference: *** $p < 0.01$; ** $p < 0.05$; * $p < 0.1$

Estimations controlled by ports and U.S. border municipality.

Standard errors clustered by municipality.

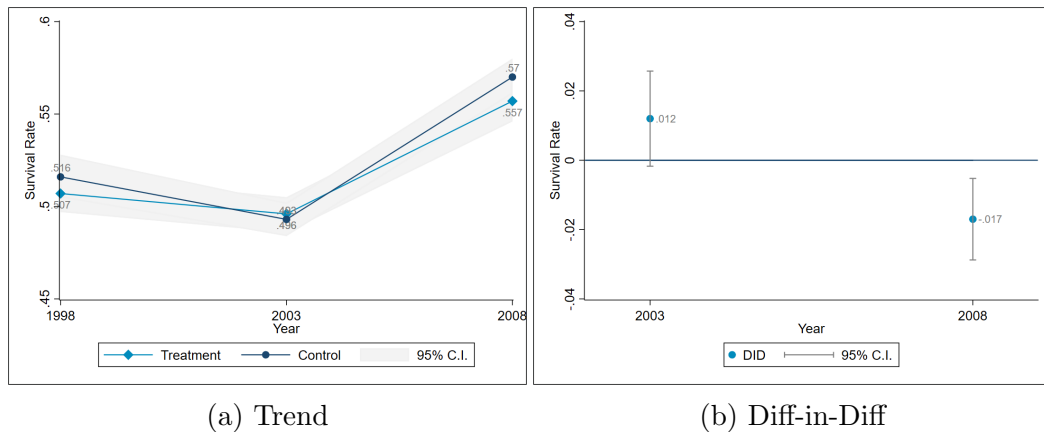


Figure 10: Effects of Zetas in 2007 on Survival Rates. Balanced Panel.

4.5 Disputed Municipalities

To rule out the possibility that the effects found are explained not by the Zetas presence but by the violence cause by cartel's disputes, we now define the treatment as the Zetas occupation of a municipality in which another cartel already operates. In Figure 11 we show the Diff-in-Diff coefficients in disputed municipalities. We find that the effect (-0.015) is actually lower, in absolute value, in disputed municipalities than in all municipalities considered (-0.017). A possible explanation is that the Zetas cartel was more aggressive to extract resources when it enjoyed a monopoly position in a municipality. This result, however, contradicts the findings of Diaz-Cayeros et al. [2011], whose study finds that contested municipalities are more likely to experience higher rates of extortion to firms. They argue that when cartels are competing for a territory, the government intervenes more often to retake control of the region, forcing cartels to diversify their criminal activities to compensate for the reduction in drug trafficking caused by the government intervention.

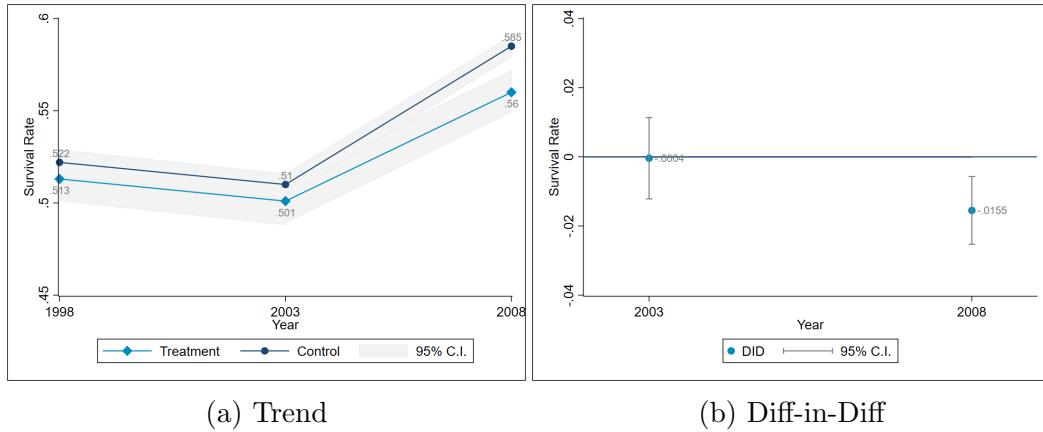


Figure 11: Effects on Disputed Municipalities.

5 Limitations and Future Work

5.1 Limitations

One important limitation in our work is that we are not accounting for migration of firms from treated to control regions. This issue can be problematic since it is possible that a proportion of firms that supposedly exited the market in treated regions simply moved to non occupied regions, biasing upwards

in absolute terms the effects on survival rates.

We cannot know to what extent violence and crime affects misreporting. If entrepreneurs perceive that the environment is dangerous they may under report the performance and assets of their firms fearing information leaks that could make them targets to criminal groups.

5.2 Future Work

The main extension of this work is the evaluation of the impact of our institutional shock on other variables. For instance, investment, remunerations, value added and productivity. So far we have only studied non nominal variables such as number of firms and employment.

Another useful modification is about our Metropolitan Zones exercise, we could limit the control and treatment groups to only MZ that are partially occupied by the Zetas. In that case, we would have intervened territories and their counterfactual versions. Instead we are pooling all municipalities belonging to MZ.

An interesting extension of our work would be to consider multi-treatments. That is, to test the effects in 2013 of cartel's presence in both 2008 and 2014. Also, we could measure anticipation effects, that is, to asses how firms change their behavior when cartels arrive to contiguous municipalities, increasing the likelihood that they will soon occupy the one in which a firm operates.

6 Conclusions

In this study we examined the effects of a sudden institutional shocks on firms survival and labor composition. In particular we studied the Zetas cartel effects on firms located in occupied municipalities, obtaining the following results. First, survival rates of firms in occupied municipalities dropped. The highest instant effect is on manufacturing firms but its difference with respect to commerce and services is reduced when the Zetas remain for more than one year. Second, the Zetas cartel presence has no impact on average size of firms; however, firms do hire less salaried workers in favor of more non-salaried ones, suggesting a change in the composition of employment towards informality.

We don't find negative persistent effects once the Zetas cartel left municipalities. We find, nonetheless, one positive effect: when the Zetas leave municipalities, firms located there hire salaried workers again. This is good news because it provides evidence that some trends can be reversed by eliminating the presence of highly extractive criminal groups from municipalities.

The validity of methodology requires the parallel trend assumption to hold. We tested this assumption by taking advantage of a longitudinal data set that includes two pre-treatment and two post-treatment periods. Moreover, the reverse causation problem is attenuated by the erratic market expansion strategy of the Zetas cartel and their short average periods of operation inside municipalities.

This study is relevant in the context of the fight against criminal groups and particularly drug cartels. When the government seeks to eliminate drug trafficking but don't dismantle criminal organizations, the latter can diversify their activities and extract resources from firms. This can also be an issue regarding legalization of drugs; if criminal groups migrate from the drugs business to other illegal activities after legalization, firms may suffer from resource extraction. Governments have to strengthen the rule of law and protection of property and businesses before engaging in fights against certain criminal groups with capacity to diversify their sources of income.

References

- Alberto Abadie and Javier Gardeazabal. The economic costs of conflict: A case study of the basque country. *American economic review*, 93(1): 113–132, 2003.
- Daron Acemoglu, Simon Johnson, and James A Robinson. The colonial origins of comparative development: An empirical investigation. *American economic review*, 91(5):1369–1401, 2001.
- June S Beittel. Mexico: Organized crime and drug trafficking organizations. *Washington: Congressional Research Service*, 2015.
- Matías Busso, Maria Fazio, and Santiago Algazi. (in) formal and (un) productive: the productivity costs of excessive informality in mexico. 2012.
- Matías Busso, Oscar Fentanes, and Santiago Levy Algazi. The longitudinal linkage of mexico’s economic census 1999-2014. Technical report, Inter-American Development Bank, 2018.
- Laura Calderón, Octavio Rodríguez Ferreira, and David A Shirk. Drug violence in mexico: Data and analysis through 2017. *Justice in Mexico Project, University of San Diego (<https://justiceinmexico.org/2018-drug-violence-mexico-report/>)*, 2018.
- Michele Coscia and Viridiana Rios. Knowing where and how criminal organizations operate using web content. pages 1412–1421, 2012.
- Melissa Dell. Trafficking networks and the mexican drug war. *American Economic Review*, 105(6):1738–79, 2015.
- Alberto Diaz-Cayeros, Beatriz Magaloni, Aila M Matanock, and Vidal Romero. Living in fear: The dynamics of extortion in mexico’s criminal insurgency. In *ponencia presentada en Violence, Drugs and Governance: Mexican Security in Comparative Perspective Conference, Stanford, octubre*, 2011.
- Ted Enamorado, Luis F López-Calva, and Carlos Rodríguez-Castelán. *Crime and growth convergence: Evidence from Mexico*. The World Bank, 2013.
- Ted Enamorado, Luis F López-Calva, Carlos Rodríguez-Castelán, and Hernán Winkler. Income inequality and violent crime: Evidence from mexico’s drug war. *Journal of Development Economics*, 120:128–143, 2016.

- Gretchen Helmke and Steven Levitsky. Informal institutions and comparative politics: A research agenda. *Perspectives on politics*, 2(4):725–740, 2004.
- Chang-Tai Hsieh and Peter J Klenow. Misallocation and manufacturing tfp in china and india. *The Quarterly journal of economics*, 124(4):1403–1448, 2009.
- Santiago Levy. *Under-Rewarded Efforts: The Elusive Quest for Prosperity in Mexico*. Inter-American Development Bank, 2018.
- Eduardo Montoya. Violence and economic disruption: Firm-level evidence from mexico. Technical report, Technical report, Working Paper, 2016.
- Viridiana Rios. The impact of crime and violence on economic sector diversity. 2016.
- Håle Utar. Firms and labor in times of violence: Evidence from the mexican drug war. 2018.
- Tom Wainwright. *Narconomics: How to run a drug cartel*. PublicAffairs, 2016.

A Appendix Tables

Table A1: Full Economic Census

	Industries (6-digit)	Establishments	Employment
1999	840	2,804,984	14,825,284
2004	868	3,005,157	16,239,536
2009	883	3,724,019	20,116,834
2014	884	4,230,745	21,576,358

Table A2: Cartels by Year

Year	B. L.	B. L. Fact.	Fam. Mich.	Golfo	Juarez	Sinaloa	Sin. Fact.	Tijuana	Zetas	Others	All
1990	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
1991	0.0	0.0	0.0	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.2
1992	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1	0.1	0.0	0.2
1993	0.0	0.0	0.0	0.0	0.1	0.5	0.0	0.2	0.1	0.0	0.9
1994	0.0	0.0	0.0	0.5	0.0	0.1	0.0	0.2	0.4	0.0	1.2
1995	0.0	0.0	0.0	0.3	0.2	0.3	0.0	0.2	0.0	0.0	0.8
1996	0.0	0.0	0.0	0.4	0.4	0.1	0.0	0.4	0.0	0.0	1.3
1997	0.0	0.0	0.0	0.2	0.8	0.4	0.0	0.6	0.0	0.0	2.0
1998	0.0	0.0	0.0	0.3	0.7	0.4	0.0	0.3	0.2	0.0	1.8
1999	0.0	0.0	0.0	0.2	0.4	0.1	0.0	0.4	0.2	0.0	1.1
2000	0.0	0.0	0.0	1.0	0.3	0.7	0.0	0.5	0.0	0.0	2.2
2001	0.4	0.0	0.0	0.4	0.4	0.9	0.2	0.6	0.1	0.0	2.2
2002	0.0	0.0	0.0	0.4	0.6	0.5	0.0	0.7	0.0	0.0	2.0
2003	0.2	0.0	0.0	1.3	0.7	0.6	0.0	0.7	0.9	0.0	3.1
2004	0.4	0.0	0.2	1.7	0.7	1.5	0.0	0.6	1.6	0.2	4.7
2005	2.0	0.0	1.0	3.5	1.4	3.0	0.2	0.7	3.1	0.1	9.2
2006	1.8	0.3	1.9	4.6	1.2	3.1	0.0	1.3	4.8	0.5	12.1
2007	2.0	0.4	1.3	7.7	1.7	4.4	0.4	1.2	7.7	0.9	16.4
2008	4.4	1.1	4.8	10.8	2.0	5.8	1.5	1.1	13.1	1.3	23.9
2009	6.4	2.2	7.8	10.3	2.4	6.0	1.5	1.5	15.8	1.8	26.7
2010	6.4	2.3	9.2	9.9	3.0	7.2	2.2	1.6	16.5	2.2	28.9

Table A3: Zetas by Year

Year	No Cartels	Any Cartel	Any But Zetas	Only Zetas	No Zetas	Zetas
1990	100.0	0.0	0.0	0.0	100.0	0.0
1991	99.8	0.2	0.2	0.0	100.0	0.0
1992	99.8	0.2	0.2	0.0	99.9	0.1
1993	99.1	0.9	0.8	0.1	99.9	0.1
1994	98.8	1.2	0.8	0.4	99.6	0.4
1995	99.2	0.8	0.8	0.0	100.0	0.0
1996	98.7	1.3	1.2	0.0	100.0	0.0
1997	98.0	2.0	2.0	0.0	100.0	0.0
1998	98.2	1.8	1.6	0.2	99.8	0.2
1999	98.9	1.1	0.9	0.2	99.8	0.2
2000	97.8	2.2	2.2	0.0	100.0	0.0
2001	97.7	2.2	2.2	0.0	99.9	0.1
2002	98.0	2.0	2.0	0.0	100.0	0.0
2003	96.4	3.1	2.8	0.4	99.1	0.9
2004	94.4	4.7	4.0	0.7	98.4	1.6
2005	88.7	9.2	8.3	0.9	96.9	3.1
2006	85.2	12.1	10.0	2.1	95.2	4.8
2007	78.9	16.4	13.4	3.0	92.3	7.7
2008	67.2	23.9	19.7	4.2	86.9	13.1
2009	61.6	26.7	22.6	4.0	84.2	15.8
2010	59.6	28.9	23.9	5.0	83.5	16.5

Table A4: Coscia and Rios (2012) DTO Characteristics

Trafficking Org	2010 Territories	Start Year	Territories	Abandoned	Years operated	Competitive	Exploratory
Juarez	74	1997	13.85	10.15	2.78	-0.67	-0.03
Tijuana	39	1997	10.1	8.15	2.74	-0.96	-0.21
Sinaloa	176	1993	25.6	16.95	2.84	0.18	0.64
Barbie	66	2006	5.75	2.45	1.63	-0.48	-0.72
Mana	32	2006	3.8	2.2	2.15	-0.82	-0.73
Sinaloa Faction	53	2008	5.15	2.5	1.96	-0.67	-0.7
BL Faction	57	2008	5	2.15	1.79	-0.52	-0.75
Other	24	2008	2.15	0.95	1.38	-0.99	-0.75
BL	157	2004	18.65	10.8	2.08	0.81	-0.36
Fam	227	2005	18.75	7.4	2.09	0.95	0.01
Golfo	244	1994	35.55	23.5	3.01	1.25	1.07
Zetas	405	2003	42.2	21.95	2.71	1.94	2.55