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THE PRICE OF INEQUALITY: INCOME INEQUALITY AND CRIME IN MEXICO

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I want to dedicate this paper to...

Daniela and Paulina, my sisters.

I want to thank...

El Colegio de México for giving me the opportunity to improve myself not just as an economist, but also as a person.

My advisor, Aurora Ramírez, for her support and guidance during the development of this research.

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Abstract

I estimate the effect of inequality on different types of crimes at the municipality level in Mexico. Using panel data estimates and solving reverse causality problem with an instrumental variable approach, I find evidence of a positive and significant effect of inequality on robberies, injuries, homicides, and property crimes, while not significant on kidnapping and sexual crime. This for the 2010-2015 period. Focusing just on homicides, the effect is significant for the 2000-2015 period. Possible mechanisms explaining these results come from the economic theory of crime. Implications of policy design for the mitigation of crime in the country are discussed.

Contents

Chapter 1

Introduction

Among all social problems usually common to developing countries, crime arises as one of the most painful ones. If we take a look at official records of violent crime, we find that Latin America is notoriously the most violent region of the world,[1] and even more alarming, in the region, Mexico stands out as one of the most violent countries.[2]

The impact of these high crime rates in Mexico is reflected easily on society and the economy. According to official data by the National Institute of Statistics and Geography (INEGI) in 2017, 35.6% of households in Mexico had at least one member victim of some type of crime. Besides, crime costs in the country represented 1.65% of the GDP for the same year. Specific examples of the impact of crime on the economy are found in the work of Robles and Calderón (2013) who discover a negative impact of crime on labor participation, and; the work of Ríos (2016) who finds a negative impact on economic diversification (this is, a greater economic concentration and less competition).

A primary explanation given for these high rates of violence is found in the so-called Drug War implemented since 2007. As reported in official records, this conflict hasn't brought a decline in violence rates, rather fostering a higher level of violence in the country and the increase of other types of crimes in addition to homicides (Robles, Calderón, and Magaloni 2013). At this point, it turns out reasonable to rethink the problem of violence in the country, also putting attention on other possible sources of variation of crime.

The three most influential theories of crime, the economic theory of crime, the strain theory, and the social disorganization theory point out at social and economic factors that contribute to explain crime in a society. Among all these factors, income inequality, directly

[1] According to the World Bank in 2014 (Ojea 2014), The Latin American and Caribbean region was home to nearly 9% of the global population but accounted for over 30% of the world's homicides. Seven of the 10 countries with the world's highest homicide rates were in the region, and of the 50 cities with the highest rates in the world, 42 were in Latin America, including the top 16.

[2] Mexico has the 8th highest murder rate in Latin America and the 25th in the world (Pariona 2018).

or indirectly, surges as a possible source of explanation for crime. For example, in the economic theory of crime, individuals with low returns from legal activities have incentives to enter illegal activities which could bring higher expected returns. In this setting, inequality plays an important role, given that it reduces relative income from legal activities, increasing expected returns from illegal activities and placing poor individuals next to individuals with goods worth taking.

Several factors hinder the analysis of inequality as an economic and social explanation for the crime at the local level. First, it is difficult to generate inequality measures at the municipality level given the lack of detailed income records, which are available only at the national level. Second, crime records are limited to just recent years, and they are subject to measurement error given the underreporting of the actual number of crimes. Finally, the relationship between inequality and crime can be subject to reverse causality, given that higher rates of crime might foster migration of high-income deciles, changing income distribution and making compatible higher levels of crime with lower levels of inequality. An analysis attempting to explore the causality of inequality on crime must account for these problems.

In this paper, I study the relationship between crime and income inequality at the municipality level. I propose inequality as a source of variation for crime based on theories of crime. The main objective is to find whether social and economic variables such as inequality give an alternative explanation to increases in crime rates. The analysis consists of two parts: i) firstly, I analyze homicides for the period 2000-2015; secondly, I explore the relationship for different types of crimes for the period 2010-2015.

To generate measures of inequality at the municipality level I follow the approach proposed by Elbers (2003) which consists of matching income surveys to censuses to predict income for individuals in the census. In this way, not just we solve the problem of small sample implicit in income surveys, but also obtain a predicted image of total income, which is the recommended unit to measure inequality. To solve the endogenous problem between inequality and crime rates I follow the instrumental variables approach proposed by Boustan (2013) and instrument the Gini coefficient, which is my measure of inequality. Finally, I use panel data estimates in order to control for unobservable factors explaining crime. To estimate the inequality-crime relationship, through the analysis of crime theories I come to a specification where crime in a municipality is explained by inequality, unemployment, police activity, poverty, racial heterogeneity, residential mobility, and familial instability. Given the current source of crime represented by the Drug War, when possible, I control for the presence of criminal organizations in a municipality.

I find that higher inequality increases different types of crimes. This effect is significant

for patrimonial crimes, homicides, injuries, and robberies. This effect is especially strong for robberies. On the other hand, results suggest inequality doesn't explain sexual and kidnapping crimes. In the case of homicides, the effect is consistently significant for its whole period of analysis.

My work contributes to the growing literature that investigates the determinants of violence in Mexico (Dell 2015; Osorio 2012; Castillo, Mejia, and Restrepo 2013; Calderón et al. 2015; among others). The paper closest to my work is Enamorado, López-Cálva, Rodríguez-Castelán, and Winkler (2016), who analyze the effect of inequality on homicide rates at a municipality level for 1990-2010. My work extends the period of analysis on homicides made by these authors in order to obtain a recent picture of the effect of inequality on homicides. Although, more importantly, my work analyzes the effect of inequality on a variety of crime categories. As far as I'm concerned, no study has made this type of analysis for Mexico before.

The rest of the paper is organized as follows. Chapter 2 surveys related literature and examine recent trends in crime and inequality in Mexico. Chapter 3 describes the data and methods used to generate measures for the proposed econometric specification to estimate. Chapter 4 gives the results and discuss them. Chapter 5 concludes.

Chapter 2

Literature and Background

2.1 Crime Theories

As pointed by Kelly (2000), there are three main theories that attempt to explain the causes of crime. In the economic theory of criminal behavior of Becker (1968) individuals split time between legal work and criminal activities by comparing expected returns and accounting for the possibility of being punished. Income inequality plays an important role by reducing the expected return of legal activities, and as a consequence, making illegal activities more profitable, relative to legal activities. Likewise, the prosecution and police system play an important role by decreasing the expected return of illegal activities.

The second main theory of crime is the social disorganization theory, developed by Shaw (1942) and Kornhauser (1978). This theory considers factors that diminish the effectiveness of informal social controls. Among the main factors pointed out are poverty, racial heterogeneity, level of residential mobility and familial instability. These factors weaken networks of social control and undermine the ability and willingness of communities to exercise informal control over their members. For social disorganization theory, inequality causes crime indirectly by being associated with poverty.

Finally, we have the Strain Theory developed by Merton (2000). In this theory, individuals at the bottom of social structure are frustrated for not getting the material attributes related to social success and in consequence, they get alienated by society. As a response, these individuals commit crime, where inequality is an important factor that contributes to this alienation.

2.2 Related Literature

There are several studies that analyze the relationship between inequality and crime, though most of them focus on developed countries. Some of these notable studies are developed by Morgan Kelly (2000), Daly (2001), J. Brush (2007), Chintrakarn (2012), Neumayer (2005) and Fajnzylber (2002), among others. Some of these works focus on examining the relationship at an aggregated level, comparing countries (e.g. Fajnzylber, 2002), while others put attention on the relationship at a municipality level (e.g. Kelly, 2000). Regarding the conclusions of these researches, there is a predominant consensus about that evidence points out a positive significant causal effect of inequality over levels of crime, in particular, violent crime. On the other hand, there are few works concluding that the relationship could be spurious (e.g. Neumayer, 2005).

Most of these works perform empirical analysis, focusing primarily on trying to find a statistical relationship between inequality and crime, while there are few works that accompany their analysis with theoretical support in order to explain possible mechanisms that connect inequality and crime (e.g. Kelly, 2000).

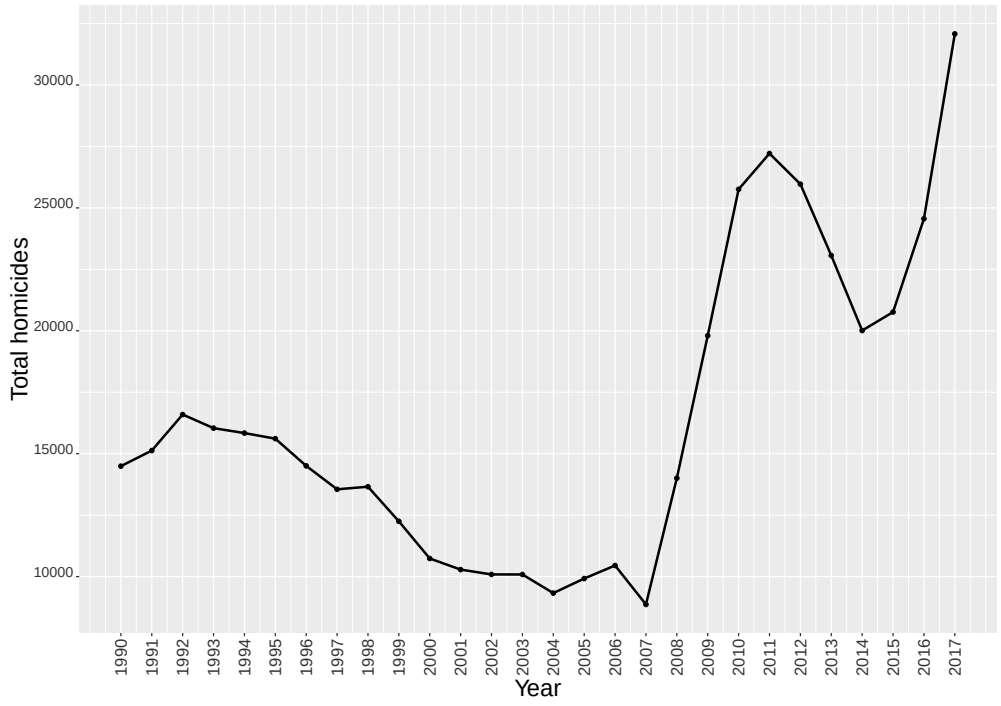
In the case of developing countries, there are few works that analyze the effect of inequality on crime. Some of them are developed by Demombynes and Özler (2002) who use cross-sectional data to study the effect on property and violent crime in South Africa; Poveda (2011) who uses panel data to study the causes of homicides in Colombia; and Cheong and Wu (2013) who use generalized method of moments (GMM) estimations to study the relationship in China. For the Mexican case, as far as I am concerned, there exists just one research. In their study, Enamorado et al. (2016) analyze the relationship between inequality and homicides for the 1990 - 2010 period, at the municipal level. Through a panel data analysis and the implementation of an instrumental-variables approach, the authors find a significant relationship just for the post-2005 period and that this relationship is particularly strong for homicides related to organized crime.

My work differentiates from the work of Enamorado et al. (2016) mainly in two points. First, I extend the analysis till the 2015 year in order to obtain a recent picture of the relation of attention. Second, I propose a more disaggregated approach by analyzing relationships at different categories of crime. As far as I'm concerned, no study of this type has been performed for Mexico before.

2.3 Crime in Mexico

Mexico is characterized as one of the most dangerous countries, not just in Latin America, but also in the world. Homicides have undergone a dramatic-upward tendency since the start of the Drug War in 2007. This dramatic increase in homicides is mainly explained by confrontations among cartels or cartels and authorities (Dell 2015). For example, drug-related crime homicides have increased 120% annually from 2007 to 2011, while non-drug related homicides have actually decreased by 4.6% annually over the same period (Enamorado et al. 2016). An additional support to this fact is the downward tendency in homicides before the Drug War, as it can be seen in Figure 1. Thus, the Drug War has been more a circumstantial cause of high levels of homicides than a systemic source of explanation for them.

Figure 1: Homicide trend in Mexico (1990-2017)



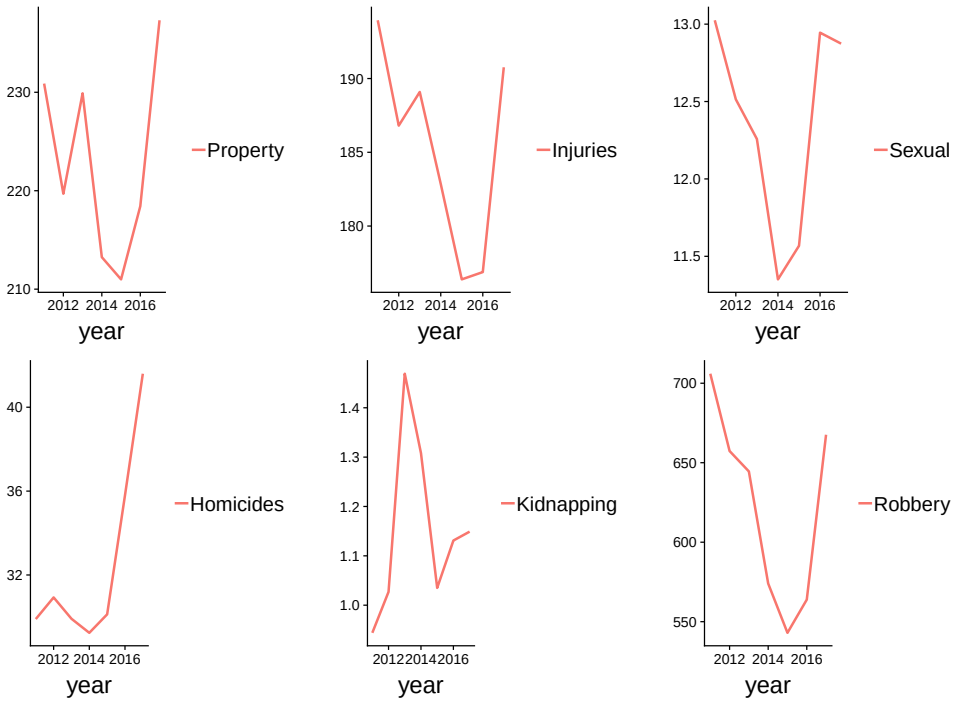
Source: INEGI

We put more attention to homicides than any other type of crime. This is not surprising, nor incorrect. Homicides are the only type of crime for which there are somewhat long records. Besides, although all criminal records are subject to underreporting, homicide records are the closest to the real-unknown figures given that their reporting don't depend on the victims denunciation, therefore conclusions are probably more accurate. Nonetheless,

if we attempt to understand the whole phenomenon of crime in the country is essential to examine all types of crime.

To describe tendencies in other types of crimes, we can't go beyond a couple of years behind. Extensive records on crimes like robbery, kidnapping or of sexual type are supplied by the Executive Secretary of the National System of Public Security (SESNSP) and are available just for a couple of years. Figure 2 shows numbers for these crimes.

Figure 2: Thousands of crimes by type (2011-2017)



Source: Executive Secretary of the National System of Public Security (SESNSP)

For the period of 2011-2017, robbery is by far the most frequent crime in the country. It is followed by property crimes and injuries. Homicides present a lower frequency, while sexual and kidnapping are relatively the less frequent crimes. These facts are not surprising given the nature of each type of crime, but they are relevant because they reveal homicides don't represent the burden of criminality.

Some more notable features well from Figure 2. There exist some important similarities between the tendencies of various crimes. Homicides present an important increase in the last three years, which is notoriously followed by all other types of crimes. On the other hand, while for 2011-2015 homicides present a stable behavior, the other crimes present a decreasing tendency, but it stops at 2015 to increase and return to initial levels, so in net

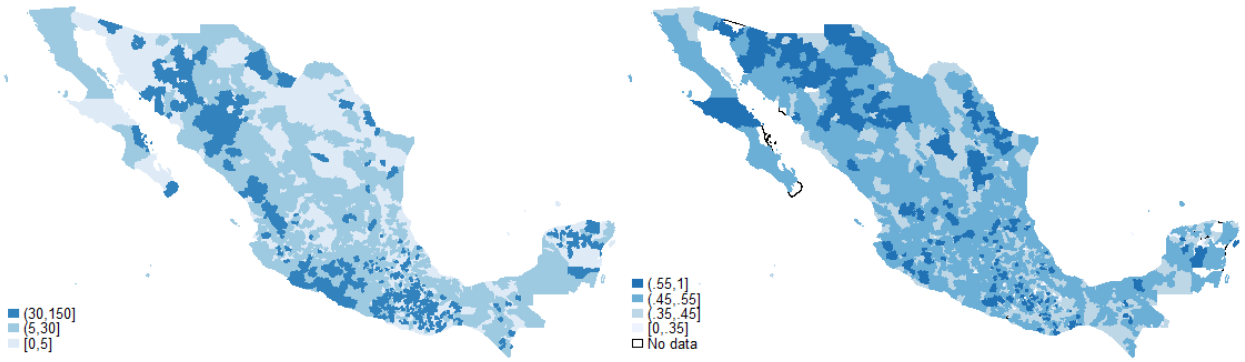
terms, they change little for the period. On balance, homicides are the only type of crime that presents a strong increase for the period.

2.4 Inequality in Mexico

According to estimations of the United Nations Economic Commission for Latin America and the Caribbean (ECLAC), although income inequality has fallen in recent years, Latin America remains the most unequal region in the world. In 2014 the richest 10% of people in Latin America had amassed 71% of the region's wealth (Cecchini and Martínez 2011). Notwithstanding, it seems Mexico performed well if we compare it to the other countries in Latin America, outperforming countries like Brazil, Colombia, and Chile, but falling behind countries like Uruguay and Argentina, for estimations in 2012 (De Ferranti et al. 2004). Nonetheless, in absolute terms, it is clear inequality in Mexico remains at high levels.

The evolution of inequality in Mexico for the last years has been yet kind. Inequality declined between the mid-1990s and 2010. The Gini coefficient for per capita (disposable monetary) income rose from 0.548 to 0.571 between 1989 and 1994 and declined to 0.510 in 2010. The period of declining inequality can also be divided into two: 1994-2006, when inequality decidedly fell (Gini fell from 0.571 to 0.512); and, 2006-10, when the decline in inequality loses its steam (Campos-Vázquez, Esquivel, and Lustig 2014). Figures 3 and 4 present a general picture of this evolution, comparing years 2000 and 2010.

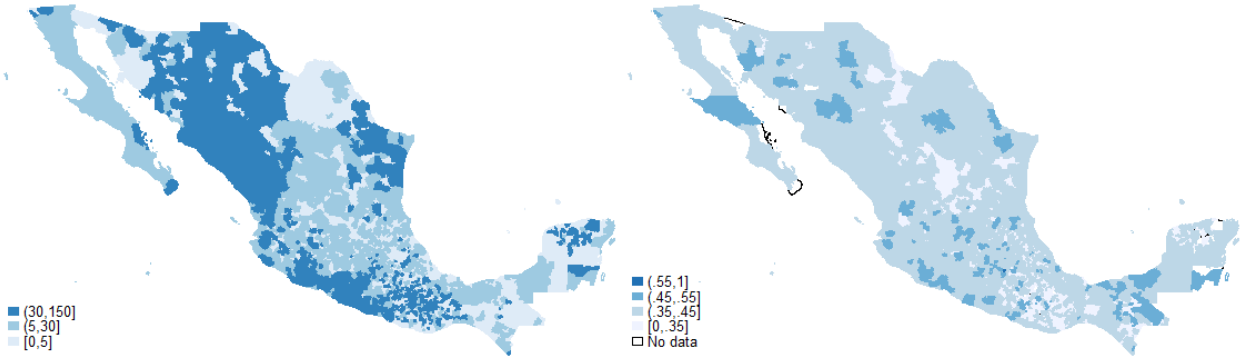
Figure 3: Homicides per 100 thousand inhabitants and Gini coefficient (2000)



(a) Homicides (b) Gini

Source: SESNSP and Coneval.

Figure 4: Homicides per 100 thousand inhabitants and Gini coefficient (2010)



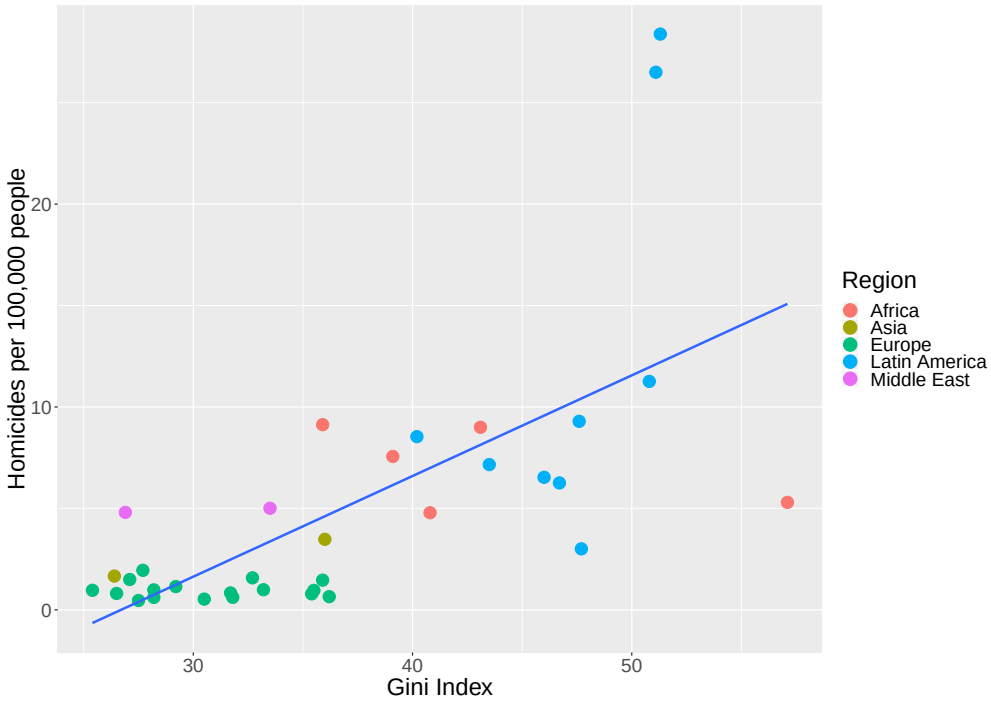
(a) Homicides (b) Gini

Source: SESNSP and Coneval.

2.5 Stylized facts of the relationship Inequality-Crime

Latin American and Caribbean countries lead the world in terms of crime and violence. In 2016, 43 of the 50 most violent cities were situated in the region (Muggah, Carvalho, and Aguirre 2018). Parallelly, as stated above, Latin America is found to be the most unequal region in the world. At this point, it is fair to wonder if there could be some relation between these features at the cross-country level. Figure 5 gives some suggestions at respect.

Figure 5: The relationship inequality-homicides for various countries (2016)



Source: World Bank

For Mexico, in Figures 3 and 4, a simple graphical comparison doesn't reveal an evident positive correlation between inequality and homicides. Rather, an inverse relationship is observed (i.e. more homicides relates to less inequality). This direct inference can be misleading by the phenomenon of the Drug War, discussed above, and by a possible problem of reverse causality, discussed later. So especially for the type of crime of homicides, whether a positive connection exists between inequality and crime, it is needed an identification strategy that helps to give solutions to these problems and reveals a clearer picture of the relation inequality-crime.

Chapter 3

Strategy

3.1 Data

I divide the analysis into two parts: In the first part, I just focus on the relationship between inequality and homicides for 2000 - 2015. This is owing to a lack of information for other types of crimes before 2010. For the second part of the analysis, I focus on diverse types of crime, including homicides, injuries, kidnappings, robbery and property and sexual crimes for 2010 - 2015.

Data of homicides at the municipality level for 2000-2015 are from the Mexican National Institute of Statistics and Geography (INEGI) website. The homicide rate is constructed to account for the number of homicides per 100,000 people in each municipality.

Data of types of crime at a municipality level for 2010 and 2015 are from the Executive Secretary of the National System of Public Security (SESNSP). Likewise, a standardization is made to measure the frequency of crime per 100,000 inhabitants. Types of crime include homicides, injuries, robbery, kidnappings, and property and sexual crimes.

Control variables include unemployment rate; proportion of indigenous as a proxy for racial heterogeneity; proportion of inhabitants who lived in another state 5 years ago as a proxy for residential mobility; proportion of households where there are divorced or separated individuals as a proxy for family instability; urbanization level measured by 4 ranges of number of inhabitants; and number of years of average education of the population. All these variables are constructed using the National Survey of Household Income and Expenditure (ENIGH). The proportion of the population on poverty is constructed with data from ENIGH and National Council for the Evaluation of Social Development Policy (CONEVAL). Policemen per 100 thousand inhabitants variable is constructed with data from the National Census of Municipal and Delegational Governments and the National Council on Population (CONAPO). Finally, the number of cartels operating in the municipality as a measure of

cartel presence is obtained from Coscía and Ríos (2012). My final dataset is an unbalanced panel with five years frequency.

3.2 Construction of inequality measures

When measuring income inequality, it is important what type of income is used since different definitions could lead not only to different estimates of inequality but also to different conclusions (Esquivel and Cruces 2011). To obtain an accurate picture of inequality is preferable to take into account total income. Income Surveys offer a whole register of income, reflecting precisely the total income of households. However, since income surveys are representative only at the national level, to obtain measures of inequality at the municipality level is not possible.

Using directly censuses to measure inequality might be insufficient. For some years there is no income information, for others, information about labor income is available. Nonetheless, labor income is usually under-reported (Vazquez, Lustig, and Santillán 2014) while inequality measures based solely on labor income might not deploy an accurate picture of overall inequality.

To solve these problems we follow the methodology applied by Enamorado et al. (2016), which is proposed by Elbers (Elbers, Lanjouw, and Lanjouw 2003). It consists of pairing income surveys to the census, looking for variables with statistically similar means. In this way, we can see these variables in the census as valid extensions of the variables in the surveys. Thereafter, we use income in survey observations to predict income for the observations in the censuses.

Firstly, I matched Census 2000, 2005, 2010 and 2015 with ENIGH 2000, 2004, 2010 and 2014, respectively. To do this, in most of the cases I simply paired variables with equal or similar definitions between ENIGHs and censuses. For other cases, I had to retrieve some variables either in the censuses or the ENIGHs in order to make these variables have similar definitions across censuses and ENIGHs. Afterward, I tested for equal means between the distribution of the variables in the censuses versus the variables in the ENIGHs. I obtained 14 statistically common variables between censuses and income surveys.[1] To check the power to predict income of these variables, I applied Lasso. Then, I kept just a subset of the common variables and some interactions or transformations of them, plus some indicators by state to control for regional effects.

[1]These variables include labor income, sex, kinship, handicaps, access to *seguro popular*, schooling, marital status, worked hours, stove possession, occupation, number of dormitories in the house, house tenure, number of inhabitants, and household type. Although age turned out to be nonsimilar between ENIGHs and censuses, I added it owing to its importance for explaining income.

Then, I split ENIGHs into training and testing subsets[2] and ran OLS estimations of total income on the subset of control variables, looking for specifications that could minimize prediction error. To check the robustness of prediction error, I used 5-fold cross-validation. Finally, I used the coefficients from the OLS estimates in the ENIGHs to predict total income for observations in the censuses. This let me replicate the income distribution of each municipality in the censuses based on a greater number of observations than just the small number of observations from the ENIGHs. Although I obtained the income distribution for all municipalities, I could only use a subset of them because I didn't have control variables for all municipalities.

3.3 Descriptive Statistics

Relevant statistics are presented in tables 1 and 2. Table 1 shows that for municipalities, inequality on average decreased in the 2000-2005 period and then it stagnated until 2010, but it then increased strongly in 2015. Regarding homicides, on average they decreased from 2000 to 2005, but then they almost doubled in 2010, while for 2015 they decreased slightly. Table 2 shows that except for kidnappings and other types of crimes, on average all types of crimes decreased from 2010 to 2015. Additionally, for both periods it is robbery the most frequent crime, while kidnapping is the less frequent one. At the same time, the standard deviation for most of the crimes decreased, probably reflecting an important homogenization of crime levels among municipalities.

3.4 Econometric Specification

In accordance with crime theories revisited in chapter 2, we would expect for each municipality i in each year t, that crime level is explained in the following way:

$$Y_{it} = \beta_1 ineq_{it} + X'_{it}\beta_2 + v_i + \epsilon_{it} \tag{3.1}$$

Where :

- Y_{it} : crime level

[2]Training and testing subsets represent 80% and 20% respectively. This is following recommendations from James et al. (2013).

- $ineq$: income inequality level

- X : includes: unemployment rate, police activity, proportion of population in poverty condition, racial heterogeneity, residential mobility and family instability.

v_i is the part of the error that captures invariant-unobservable characteristics of each municipality, which explains crime levels.

β_1 represents our coefficient of interest since it captures the effect of inequality on crime levels. It predicts on average how many homicides, robberies, etc. per one thousand inhabitants are expected to increase owing to an increase of 1% in inequality in a municipality. A naive OLS estimation of our equation probably wouldn't reflect unbiasedly the effect of inequality on crime. There could be important unobservable factors, such as culture, customs, etc., which could be correlated with inequality and for which a simple pooled OLS would not control for. Even with panel data estimates, β_1 could not be reflecting the causal effect of inequality on crime if some problem of endogeneity is present. A discussion of this latter issue is expanded in the next chapter.

Chapter 4

Results and Discussion

4.1 Main Results

Initial estimates are presented in table 3. Results indicate there is a negative relationship between inequality and homicides. This means that given an increase in inequality this corresponds with a decrease in the number of homicides. This outcome turns out to be counterintuitive, given the preliminary analysis of theories of crime and the evidence found in studies for other countries.

Nonetheless, these results are consistent with the first estimations of Enamorado et al. (2016). An explanation given by these authors is the presence of a reverse causality problem. A channel of explanation of this negative relationship between inequality and crime comes from migration. If crime increases in a municipality this might provoke that households in high deciles might decide to move out to municipalities with lower rates of crime. This modifies income distribution in the municipality lowering inequality and making reasonable that increases in crime correspond with reductions in inequality. Evidence supporting this migration effect is supplied by Rios (2014) who finds that 264, 693 individuals have migrated owing to organized crime activities between 2005 and 2010.

To solve the endogeneity problem, I follow the methodology proposed by Boustan (2013) to construct an instrument for the Gini coefficient. It consists of dividing households in ENIGH by percentiles. Then, I estimate the growth rate of the median in each percentile for the years 2005, 2010 and 2015. Thereafter, I take households in ENIGH 2000 as a baseline sample and let income for each household to growth at the previously estimated rates. In this way, a counter-factual of the income distribution can be obtained, which reflects what would have been income distributions if every household would have followed national trends of income growth. As a result, we obtain income distributions which respond only to growth in the income of households and not to their possible mobility among percentiles.

Therefore, by construction, inequality measures constructed based on these counterfactual income distributions cannot be correlated with household migration.

A two-stage estimation is implemented to identify the causal effect of inequality on crime. First stage estimates are presented in table 4.

Table 5 shows second-stage estimates for homicides (2000-2015). Results disclose a positive relationship between inequality and homicides. This relation is sustained for every sub-period of analysis. For 2000-2005 an increase of 1% in inequality corresponds with an increase of 0.038 homicides; for 2005-2010, the effect is stronger representing an increase of 0.85 homicides; and for 2010-2015, the effect lowers but remains significant, representing an increase of 0.15 homicides.

The effect is especially strong for the period 2005-2010. This is remarkable given that the effect attributed to cartel presence is of 2.5 homicides for an additional cartel in a municipality. Therefore, an increase of 2.98% in inequality equates the effect on homicides owing to the presence of a cartel in a given municipality.

Another worth noting feature is the permanence of the effect, though somewhat unstable, remains significant for the whole period, even before the start of the Drug War in the middle of the period 2005-2010.

Overall, these results are consistent with findings in Enamorado et al. (2016) for Mexico, Poveda (2011) for Colombia, Kelly (2000) for USA and Sachsida (2010) for Brazil.

Table 6 shows second-stage estimates for every type of crime. Results disclose a positive and significant relation for property crimes, homicides, injuries and robbery, while for kidnappings and sexual crimes there is no significant effect.

For homicides, an increase of 1% in inequality corresponds with an increase of 0.16 murders. This outcome using data from SESNSP is slightly stronger than the one found with data from INEGI reported in table 5. This is not surprising since both indicators report homicides based on different definitions. [1] Besides, data from SESNSP presented higher levels as reported in figure 2 compared to figure 1.

The most sensitive effect comes from robbery. An increase of 1% in inequality corresponds with an increase of 5 robberies. The magnitude of this effect is not surprising since, as pointed out in chapter 2 through Figure 2, robbery is by far the most common crime.

For property crimes, the effect is of 1.7 additional crimes for an increase of 1% in inequality. Likewise, injuries increase in 1.25 additional crimes. Both reactions are importantly lower than the one presented by robbery, but they are quite stronger than the one for homicides.

[1] Records from INEGI are measured as registers of deaths, while records from SESNSP are measured as case folders for presumed deaths, thus including not just registers of deaths, but also missings. Therefore, figures from SESNSP are higher than the ones from INEGI.

These outcomes are striking because they reveal that inequality relates not just to homicides, but also to a variety of crimes, implying the existence of a wide channel of explanation for the burden of crimes.

The fact that there is no significant relationship for sexual crimes is not surprising since revisited crime theories make reference to crimes motivated by economic variables, while sexual crimes seem related to other factors. For example, this is shown by the significant relation with familial instability in table 6.

4.2 Robustness Checks

To show that the main results are not driven or significantly affected by a few observations I present estimations trimming outliers for inequality as a robustness check. For this purpose, I trim observations below the 5th percentile or above the 95th percentile of the Gini coefficient distribution for each year. Results are shown in tables 7 and 8.

Tables 7 and 8 show that results remain robust to trimming.

4.3 Weaknesses

The main concern about the validity of my estimations come from the critic of Tarozzi and Deaton (2009) to the methodology proposed by Elbers et al. (2003) to estimate local inequality measures, which has been applied here. A possible important issue is biased coefficients of the projections when imputing income to observations in the censuses. This is principally explained by omitted variables that account for the heterogeneity of each regional unit in the censuses and in the income surveys. In order to partially address this problem, at the moment of estimating income in surveys, I included indicators by state, expecting to capture some of the heterogeneity not controlled by the variables we found common between surveys and censuses.

When homicides were analyzed for the period 2000-2010 we found that cartel presence is an important variable for explaining homicides. However, the inclusion of this variable is not possible beyond 2010 owing to a lack of information. Therefore a second concern for the validity of my estimations come from bias by omitted variables, such as the one that explains cartel presence.

To verify whether it is possible that omitting the cartel-presence variable could bias the coefficient of inequality, I estimate equations for homicides without the cartel variable for the 2000-2005 and 2005-2010 subperiods. Results (not reported here) show that when

omitting the cartel variable, the coefficient for inequality doesn't change much in magnitude.[2] Therefore, this suggests that the coefficient of inequality for the subperiod 2010-2015 is not probably affected by the omission of the cartel-presence variable.

[2]For example, for the 2000-2005 subperiod, when including cartel presence the coefficient for inequality is 3.824 with SE 1.438, but if cartel presence is not included, the coefficient is 3.084 with SE 1.341.

Chapter 5

Conclusions

In this research, I find evidence of a positive effect of inequality on various types of crime at the municipality level. This effect is significative for robberies, injuries, homicides, and property crimes, while not significative for kidnapping and sexual crimes for the 2010-2015 period. Focusing just on homicides, the effect is significative for the 2000-2015 period. The estimated effect varies among the types of crimes and periods. The effect of a 1% increase in inequality on homicides ranges from 0.03 in 2000-2005 to 0.85 homicides per one thousand inhabitants in 2005-2010. When analyzing types of crimes for the 2010-2015 period, the effects on robberies, injuries, homicides, and property crimes are 5.18, 1.25, 0.16, 1.73 crimes per one thousand inhabitants, respectively.

Possible mechanisms explaining these results come from the theories of crime, especially the economic theory of crime. The economic theory of crime points out that individuals with low income from market activities are prone to commit crime if they find that expected return from illegal activities is high enough. Inequality plays an important role here, given that it reduces relative income from legal activities, increasing expected returns from illegal activities and placing poor individuals next to individuals with goods worth taking. This theory fits well at explaining my results for robbery, property crimes, and homicides, given that they are crimes that directly or indirectly involve economic incentives. At the same time, this theory doesn't give reasons why inequality should explain crimes not motivated by economic factors, such as sexual crimes. Therefore, the null effect of inequality on sexual crimes reported here is consistent with the economic theory of crime, too.

The effects found here suggest that inequality has a wide channel of explanation for the burden of crime levels in a municipality. This effect is not restricted to just homicides, as found in previous works, but also to a variety of crimes, mainly explained by economic incentives, as proposed by the economic theory of crime. Nonetheless, the effect of inequality doesn't touch types of crimes such as kidnapping or sexual crimes, which could be explained

better by non-economic factors.

These findings also reveal that, in order to attempt to reduce high crime rates in the municipalities, it is important not just to implement strategies of direct confrontation to criminals, but also accompany the policy design with plans that help to reduce inequality conditions. This indeed could be more effective to permanently reduce crime rates since inequality has a more systematic and broader effect on crime.

Appendices

Table 1: Descriptive statistics for homicide and covariates (2000-2015)

Year	Variable	Obs	Mean	Std. Dev.	Min	Max
2000	homicides	377	10.13294	15.59841	0	189.7362
	gini	377	0.5878108	0.0998489	0.41206	0.96407
	unemployment	377	1.893992	3.66304	0	28.57143
	police	0				
	poverty	377	24.06134	17.58707	0	88.59951
	racial heterogeneity	0				
	residential mobility	0				
	familial instability	377	5.763654	4.085543	0	25
	cartels	377	0.0795756	0.3162813	0	2
	education	377	6.898879	2.336408	0.3333333	14.25
	urbanization	377	2.323607	1.187837	1	4
2005	homicides	496	10.52456	18.46485	0	219.7802
	gini	496	0.303296	0.0536756	0.20685	0.46414
	unemployment	496	2.632394	3.641123	0	30
	police	0				
	poverty	496	19.93708	16.61641	0	80
	racial heterogeneity	0				
	residential mobility	0				
	familial instability	496	7.064831	4.058164	0	34.14634
	cartels	496	0.3870968	0.8061348	0	4
	education	496	7.434318	2.479146	1.456522	13.41931
	urbanization	496	2.310484	1.163576	1	4
2010	homicides	459	20.17117	34.55324	0	277.8395
	gini	459	0.3688642	0.0582721	0.23274	0.57956
	unemployment	459	4.854658	4.87668	0	42.85714
	police	459	178.5312	143.857	1.845563	2385.686
	poverty	459	19.65941	18.29942	0	89.47369
	racial heterogeneity	459	11.31828	24.03205	0	96.8421
	residential mobility	0				

Table 1 continued from previous page

Year	Variable	Obs	Mean	Std. Dev.	Min	Max
	familial instability	459	6.824689	3.790776	0	27.08333
	cartels	459	1.361656	1.637421	0	9
	education	459	7.918378	2.031801	1.636364	13.22222
	urbanization	459	2.28976	1.082273	1	4
2015	homicides	450	16.44953	29.39541	0	372.4219
	gini	450	0.6126064	0.0939648	0.30901	0.93756
	unemployment	450	3.651253	4.258135	0	30
	police	450	132.7048	96.49684	0	781.4927
	poverty	450	25.09099	19.78089	0	100
	racial heterogeneity	450	9.138133	22.07008	0	98.61111
	residential mobility	450	12.16191	5.873528	0	48.76023
	familial instability	450	7.996139	4.17474	0	29.41176
	cartels	0				
	education	450	8.636064	2.053794	2.102041	14.11765
	urbanization	450	2.386667	1.08515	1	4

Homicides and number of policemen are measured by number per 100 thousand inhabitants.
Unemployment refers to unemployment rate.
Poverty is proportion of households with income below income poverty line, a measure indicated by Coneval.[1]
Racial heterogeneity is proportion of indigenous population
Residential mobility is proportion of population who lived in another state 5 years ago.
Family instability is proportion of households where there are divorced or separated individuals.
Cartel presence is number of cartels with operations in a municipality.
Education is average years of education of population.

[1] https://www.coneval.org.mx/Medicion/MP/Paginas/Lineas-de-bienestar-y-canasta-basica.aspx/

Table 2: Statistics by crime category (2010-2015)

Year	Variable	Obs	Mean	Std. Dev.	Min	Max
2010	property	459	157.6258	206.5064	0	2333.335
	sexual	459	9.84788	10.45064	0	52.2827
	homicides	459	29.74653	41.21326	0	582.2416
	injuries	459	147.6882	149.4278	0	1338.487
	kidnappings	459	0.7846026	1.900121	0	19.15619
	robbery	459	420.7339	487.9	0	3459.34
	others	459	301.7852	363.0502	0	3188.068
2015	property	450	135.1093	135.5139	0	741.7358
	sexual	450	8.759484	9.484929	0	82.65855
	homicides	450	26.36448	27.83935	0	376.953
	injuries	450	123.2119	110.5163	0	612.201
	kidnappings	450	0.928004	2.414972	0	27.30168
	robbery	450	327.8993	321.9147	0	2635.254
	otherss	450	350.5293	361.1878	0	3006.161

Each category of crime is measured by total number of official registers by the SESNSP [2]

[2]https://www.gob.mx/sesnsp

Table 3: Initial estimates of the effect of inequality on homicides (2000-2015)

	(1)	(2)	(3)
VARIABLES	2000-2005	2005-2010	2010-2015
Gini	-4.738	-13.54*	-31.95**
	(3.312)	(7.274)	(14.41)
unemployment	-0.0759	0.608***	0.0597
	(0.0938)	(0.183)	(0.307)
police			0.0250
			(0.0330)
poverty	-0.0123	0.0559	0.108
	(0.0243)	(0.0512)	(0.125)
racial heterogeneity			-0.0194
			(0.176)
familial instability	0.0427	0.0235	-0.500
	(0.0880)	(0.224)	(0.373)
education	-0.475**	0.0904	0.381
	(0.229)	(0.508)	(1.196)
urbanization	0.505	-4.059***	1.729
	(0.578)	(1.089)	(3.235)
cartels	0.0361	4.722***	
	(0.467)	(0.628)	
Constant	15.45***	22.21***	21.75
	(2.276)	(4.939)	(13.78)
Number of municipalities	343	347	401
Robust standard errors in parentheses			
** p<0.01, ** p<0.05, * p<0.1			

Dependent variable: Homicides per 100 thousand inhabitants
Number of municipalities refers to number of municipalities
for which there are observations in
both years of each fixed or random effects estimation in (1), (2), and (3)

Table 4: First stage for the instrumentation of the Gini coefficient

	(1)
VARIABLES	gini
instrument	0.769***
	(0.0135)
unemployment	-0.00188***
	(0.000453)
poverty	0.000143
	(0.000114)
family instability	-0.00114**
	(0.000507)
cartels	-0.00501***
	(0.00166)
education	-0.00526***
	(0.00114)
urbanization	0.0146***
	(0.00226)
Constant	0.103***
	(0.0102)
Observations	1,457
R-squared	0.710
Robust standard errors in parentheses	
** p<0.01, ** p<0.05, * p<0.1	

Dependent variable: Gini coefficient

Table 5: The effect of inequality on homicides (2000-2015)

	(1)	(2)	(3)
VARIABLES	00-05	05-10	10-15
Gini	3.824***	85.55***	15.61***
	(1.438)	(25.86)	(4.962)
unemployment	-0.0828	0.343*	0.123
	(0.0630)	(0.177)	(0.145)
police			0.0128
			(0.00871)
poverty	-0.0131	0.00572	-0.0115
	(0.0149)	(0.0501)	(0.0529)
racial heterogeneity			-0.0631
			(0.0439)
familial instability	0.0427	0.00747	-0.0787
	(0.0596)	(0.211)	(0.175)
education	-0.155	0.120	-0.280
	(0.144)	(0.487)	(0.507)
urbanization	0.585*	-2.746**	0.216
	(0.331)	(1.081)	(0.991)
cartels	0.586	2.548***	
	(0.362)	(0.912)	
Constant	5.642***	-13.21	8.088*
	(1.259)	(9.155)	(4.837)
Number of municipalities	343	347	401
Robust standard errors in parentheses			
** p<0.01, ** p<0.05, * p<0.1			

Table 5 corresponds to second stage estimations.
Dependent variable: Homicides per 100 thousand inhabitants
(1) are estimations for 2000-2005
(2) are estimations for 2005-2010
(3) are estimations for 2010-2015
Number of municipalities refers to number of municipalities
for which there are observations in
both years of each fixed or random effects estimation in (1), (2), and (3)

Table 6: The effect of inequality on different crimes (2010-2015)

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	property	sexual	homicide	injuries	kidnapping	robbery
Gini	173.3**	-7.068	16.52*	125.0**	0.438	518.6***
	(75.52)	(4.865)	(9.089)	(51.28)	(0.737)	(154.0)
unemployment	1.560	0.0280	-0.0971	1.461	-0.00465	1.586
	(1.983)	(0.128)	(0.217)	(1.346)	(0.0162)	(4.044)
police	-0.199	0.0159	0.0377**	-0.238	-0.00128	-0.506
	(0.228)	(0.0147)	(0.0157)	(0.155)	(0.00100)	(0.465)
poverty	-0.213	-0.0569	-0.317***	-0.444	0.00458	-0.250
	(0.893)	(0.0575)	(0.0846)	(0.607)	(0.00589)	(1.822)
racial heterogeneity	0.533	0.0953	-0.0838	0.518	-0.000136	-0.0317
	(1.198)	(0.0772)	(0.0732)	(0.813)	(0.00461)	(2.443)
familiy instability	2.364	0.361**	0.0795	2.999*	0.0532***	2.662
	(2.542)	(0.164)	(0.274)	(1.726)	(0.0202)	(5.185)
education	-3.290	-0.576	-1.888**	-0.306	0.115**	-0.950
	(8.103)	(0.522)	(0.799)	(5.502)	(0.0566)	(16.53)
urbanization	-31.89	-0.390	0.757	-29.13**	0.0150	-21.73
	(20.92)	(1.347)	(1.507)	(14.20)	(0.0971)	(42.66)
Constant	340.7***	13.90**	35.81***	280.4***	-0.672	741.7***
	(86.46)	(5.569)	(7.568)	(58.71)	(0.546)	(176.3)
Number of municipalities	404	404	404	404	404	404
Robust standard errors in parentheses						
** p<0.01, ** p<0.05, * p<0.1						

Table 6 corresponds to second stage estimations.
Dependent variable: number of crimes per 100 thousand inhabitants
(1) are estimations for property crimes
(2) are estimations for sexual crimes
(3) are estimations for homicides
(4) are estimations for injuries
(5) are estimations for kidnapping
(6) are estimations for roberry
Number of municipalities refers to number of municipalities for which there are
observations in both years of each fixed or random effects estimation in (1), (2), (3), (4), (5), and (6)

Table 7: The effect of inequality on homicides trimming for outliers

	(1)	(2)	(3)
VARIABLES	00-05	05-10	10-15
Gini	3.821**	109.4***	15.65***
	(1.621)	(34.97)	(5.333)
unemployment	-0.101	0.148	0.174
	(0.0692)	(0.163)	(0.163)
police			0.0134
			(0.00945)
poverty	-0.0135	0.0192	-0.0349
	(0.0163)	(0.0484)	(0.0584)
racial heterogeneity			-0.0425
			(0.0477)
familial instability	0.0484	0.0241	-0.168
	(0.0653)	(0.197)	(0.193)
education	-0.0809	-0.0611	-0.169
	(0.153)	(0.467)	(0.545)
urbanization	0.516	-2.197**	0.219
	(0.347)	(0.998)	(1.054)
cartels	0.635	2.884***	
	(0.388)	(0.880)	
Constant	5.110***	-22.27*	7.818
	(1.334)	(11.39)	(5.253)
Number of municipalities	318	325	378
Robust standard errors in parentheses			
** p<0.01, ** p<0.05, * p<0.1			

Table 7 corresponds to second stage estimations.
Dependent variable: Homicides per 100 thousand inhabitants
(1) are estimations for 2000-2005
(2) are estimations for 2005-2010
(3) are estimations for 2010-2015
Number of municipalities refers to number of municipalities
for which there are observations in
both years of each fixed or random effects estimation in (1), (2), and (3)

Table 8: The effect of inequality on different types of crimes trimming for outliers

	(1)	(2)	(3)	(4)	(5)	(6)
VARIABLES	patrimoniales	sexuales	homicides	lesiones	secuestros	robbery
Gini	152.9*	-7.933	16.50*	96.40*	0.150	553.0***
	(88.92)	(5.204)	(9.480)	(53.98)	(0.768)	(178.4)
unemployment	1.627	-0.0902	0.0237	0.783	-0.00590	-1.376
	(2.629)	(0.154)	(0.236)	(1.596)	(0.0181)	(5.275)
police	-0.181	0.0190	0.0417***	-0.159	-0.00144	-0.322
	(0.284)	(0.0166)	(0.0162)	(0.172)	(0.00108)	(0.569)
poverty	-0.532	-0.00146	-0.308***	-0.579	0.00501	-0.0640
	(1.078)	(0.0631)	(0.0872)	(0.655)	(0.00651)	(2.163)
racial heterogeneity	0.394	0.0486	-0.0740	0.243	0.000859	-0.885
	(1.429)	(0.0836)	(0.0765)	(0.868)	(0.00509)	(2.868)
familial instability	2.667	0.500***	0.187	2.663	0.0554**	0.883
	(3.199)	(0.187)	(0.283)	(1.942)	(0.0220)	(6.419)
schooling	-8.266	-0.503	-1.799**	-5.314	0.121**	-6.203
	(9.625)	(0.563)	(0.833)	(5.843)	(0.0616)	(19.31)
urbanization	-33.29	-0.632	0.582	-28.72*	0.0122	-17.81
	(24.17)	(1.414)	(1.563)	(14.67)	(0.107)	(48.50)
Constant	380.3***	12.23**	33.30***	302.2***	-0.544	799.0***
	(105.2)	(6.156)	(7.927)	(63.86)	(0.591)	(211.1)
Number of municipalities	380	380	380	380	380	380
Robust standard errors in parentheses						
** p<0.01, ** p<0.05, * p<0.1						

Table 8 corresponds to second stage estimations (2010-2015).
Dependent variable: number of crimes per 100 thousand inhabitants
(1) are estimations for property crimes
(2) are estimations for sexual crimes
(3) are estimations for homicides
(4) are estimations for injuries
(5) are estimations for kidnapping
(6) are estimations for roberry
Number of municipalities refers to number of municipalities for which there are observations in both years of each fixed or random effects estimation in (1), (2), (3), (4), (5), and (6)

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