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Crime and Growth Convergence

Evidence from Mexico

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Abstract

Scholars have often argued that crime deters growth, but the empirical literature assessing such effect is scarce. By exploiting cross-municipality income and crime data for Mexico—a country that experienced a high increase in crime rates over the past decade—this study circumvents two of the most common problems faced by researchers in this area. These are: (i) the lack of a homogenous, consistently comparable measure of crime and (ii) the *small sample* problem in the estimation. Combining income data from poverty maps, administrative records on crime and violence, and public expenditures data at the municipal level for Mexico (2005–2010), the analysis finds evidence indicating that drug-related crimes indeed deter growth. It also finds no evidence of a negative effect on growth from crimes unrelated to drug trafficking.

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Crime and Growth Convergence: Evidence from Mexico

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1. Introduction

Does crime deter growth? Plausible causal mechanisms on why this may be the case have been discussed in the existing literature: crime diverts resources that could have been used in more productive ways, crime increases security costs for businesses, it decreases health, it represents a threat to private property, and it discourages domestic and international investment because the investment climate deteriorates (see Fajnzylber et al. 1998; Londoño and Guerrero, 2000; Demombynes and Ozler, 2002; Stone, 2006; Powell et al. 2010; Cardenas and Rozo, 2008; Detotto and Otranto, 2010). The type of crime incidence, its intensity, and its persistence also matter. The existing literature, however, contains only a few attempts at assessing the magnitude of the effect of violent crime on income convergence, mainly due to the lack of harmonized and reliable data sources on crime across countries. Another challenge faced by researchers when comparing countries refers to the limited number of observations—or the "small sample" problem. This paper looks at the recent experience of rapidly increasing crime rates in Mexico to examine the effect of crime over *regional development patterns*, or more specifically, growth convergence within the country.

Previously, Robles, et al. (2013) have used an instrumental variable approach to look at the effect of violence related to drug trafficking on labor force participation, local businesses and local rates of unemployment. This paper exploits harmonized data on crime, i.e., homicide rates differentiated by drug vs. non-drug related crimes, as compiled by Mexico's Technical Secretary for the National Security Council (*Sistema Nacional de Seguridad Publica,* SNPS). Moreover, to tackle the small-sample problem, the focus of attention is on municipalities across the country, which is feasible due to the construction of poverty maps for a panel of Mexican municipalities (consisting of 2,457 observations in each cross-section).

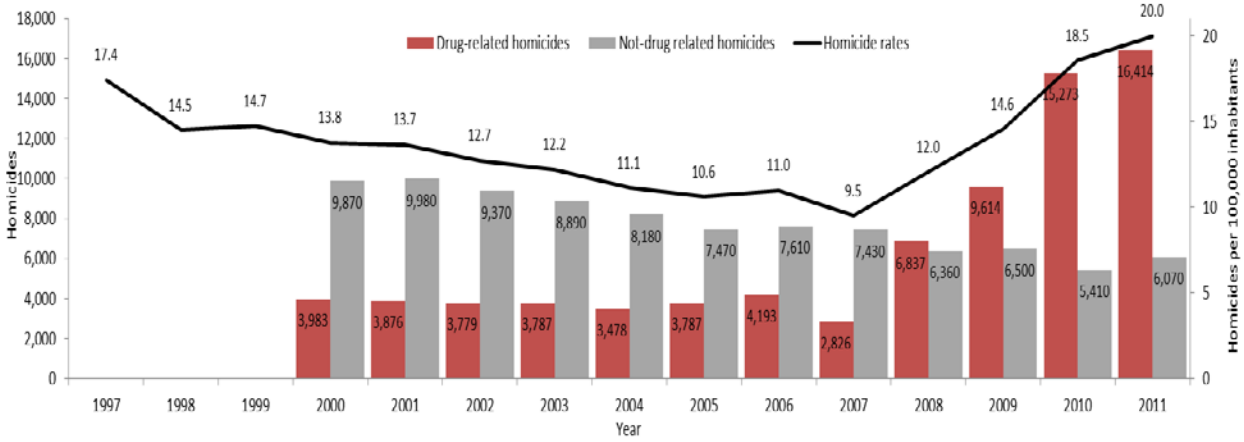
Mexico offers an interesting case for several reasons. First, the total number of homicides in Mexico has increased dramatically in recent years, more than doubling since 2007 following a 10-year period of reduction, with a decline of 45.4 percent, in the number of homicides (Figure 1). The rapid growth in the number of total homicides between 2007 and 2011 is explained mainly by an increase in drug traffic-related homicides, i.e., homicides resulting from confrontations among different criminal organizations or between the armed forces and policy against criminal organizations.[1]

Interestingly, while drug related homicides increased by 55 percent annually over the period, non-drug related homicides actually *declined* by an average of 4 percent each year between 2007 and 2011. Indeed, drug related murders accounted for 73 percent of all homicides in 2011, while in 2007 the figure was no more than 27.6 percent. The fact that it is possible to distinguish between drug and

[1] According to the SNPS, a homicide must meet two out of six criteria in order to be considered a drug-related crime: (i) victim was killed by high-caliber firearms, (ii) victims with signs of torture or severe lesions, (iii) victims found at the crime scene or in a vehicle, (iv) victims whose bodies were taped, wrapped or gagged, (v) if the murder happened in a prison and involved criminal organizations, and (vi) If one of several "special circumstances" occurred, including if the victim was abducted prior to assassination (*levantón*), ambushed or chased, if the victim was an alleged member of a criminal organization, or if a *narco-message* was left on or near the body (see Molzahn et al. 2012).

non-drug related homicides allows us to identify if the negative impact of crime rates over growth is the result of common crimes vs. organized crime (or both)—a distinction which has not previously been addressed in the literature.

Figure 1: Number of homicide cases and homicide rates by type (1997 – 2011)



Source: SNSP, 2011 and 2012; Rios, 2012.

2. Background: The drug-related crime wave in Mexico and its negative effects

Several drivers have been discussed behind the surge in drug-related crime in the country. By increasing the capture of drug cartels' leaders, the government's military offensive launched in 2006 may have increased instability within criminal groups—particularly when remaining cells fought each other to impose successors or split into factions that fought each other for turf. [2] When many (as opposed to one) kingpins are captured, instability and propensity for violence increases further (Guerrero-Gutierrez, 2009). Another factor refers to changes in the dynamics of illegal drug markets. After the 'Plan Colombia' was implemented in the late 1990s, drug trafficking operations relocated to Mexico, and crime became more prevalent as Mexico became a preferred transit route.

While the direct costs of crime and violence have been documented (those caused by expenditures made by individuals, firms or governments directly targeted to prevent or respond to crime), less research has been done on the indirect costs—those that arise from multiplicative effects or externalities created by criminal actions, such as impact on economic growth. In terms of the direct costs, the total budget assigned to security agencies (civilian and military), criminal justice and judicial institutions in 2012 was US$14.44 billion, approximately 6 percent of the total budget of Mexico's government (SHCP, 2012).[3] In terms of economic losses due to crime, victimization

[2]Drug-related homicides started increasing in 2004 after Mr. Osiel Cardenas, the leader of the Golf cartel, was captured and extradited. Without his leadership, a faction of his cartel known as Zetas began conducting autonomous criminal operations, trying to take over the territories of other cartels (particularly those located in Michoacán state). Another shock came in 2008 when Mr. Beltran Leyva, a second-tier leader of the Sinaloa cartel, was assassinated in a raid conducted by Mexican authorities. Without Mr. Beltran, the Sinaloa cartel split into confronting factions.

[3] This is the budget of SEDENA, SEMAR, SSP, PGR and the Judicial branch. Every year since 2007 the budget has increased by an average of 15 percent (Guerrero-Gutierrez 2011). Yet, it is still considerably low when compared with

surveys estimate that in 2010 alone, crime cost victims losses of US$12.9 billion and additional health expenses of US$619 million (INEGI, 2011). For firms, surveys estimate that losses due to theft and vandalism account for as much as 3.6 percent of their product value.[4] Additionally, by 2010, 42.8 percent of Mexico's firms paid for private security, spending about 2.2 percent of their annual sales on these services (IFC and WB, 2012).

Arias and Esquivel (2012) analyze how drug-related violence has influenced labor markets merging data from the National Labor Force Survey (ENOE) with administrative records of crime, and developing a fixed effect model for the 2006–2010 period with a balanced panel for 32 states. Their results suggest that violence is indeed associated to increased unemployment: for every 10 drug-related homicides per 100,000 inhabitants, they find evidence that unemployment increased by 0.5 percent and the fraction of self-employed by 0.4 percent.

The cost analyzed here relates to the potential reduction in the speed of income convergence across regions in Mexico. Previous work has shown evidence of poor municipalities in the country catching up with richer ones in terms of income growth—indicating "convergence" across municipalities (Davalos et al. 2012). Yet, there is no empirical analysis of whether the crime rates faced by the country represent a real threat to the aforementioned convergence pattern and what would have been the speed of convergence in the absence of the crime wave. In order to analyze this effect, this paper uses differentiated homicide rates and focuses on municipalities, thus distinguishing if the impact of crime rates over growth is the result of common crime, organized crime, or both.

3. Data and methodology

Data on income per capita by municipality for 2005 and 2010 are obtained by using the poverty maps methodology (Elbers et al. 2003). Simply put, the method consists of imputing income to households in the Population Census (2010) and Population Count data (2005) using a model that predicts income from a household survey (the National Survey on Household Income and Expenditures, ENIGH, 2005 and 2010). The advantage of this methodology is that it benefits from the strengths of both the household survey and the censuses while avoiding their weaknesses. Empirical evidence based on this method has proven its precision when applied to a large sample of countries, and particularly for aggregated data at the municipality level in Mexico (see Elbers et al. 2001; Lopez-Calva, et al. 2005).

As mentioned previously, the data on the total number of homicides at the municipal level is available from the official figures made public by Mexico's Technical Secretary for the National Security Council (*Sistema Nacional de Seguridad Publica*, SNSP), a federal institution that is part of the Secretary of the Interior. The SNSP compiles information through an extensive collaborative

other expenses: for example, it is less than half of the social security budget (i.e. pensions and healthcare), and 68 percent of what is spent in public education.

[4] Average losses for middle-high income countries like Mexico (Argentina, Botswana, Chile, Colombia, Mexico, Panama, Peru, Uruguay, Venezuela) are 2.7 percent (IFC and WB, 2012).

taskforce involving several state and federal law-enforcement agencies.[5] Monthly figures have been released publicly since December 2006. Among these, drug vs. non-drug related homicide rates are disclosed for each municipality in the country. In the analysis that follows, we collapse each of the crime variables available (total homicide rate, drug and non-drug related homicides) on a yearly basis for each municipality. We also employ data on aggregate figures of public expenditures at the municipal level, obtained from the State and Municipal System of Databases (SIMBAD) compiled by the National Institute of Statistics, Geography, and Informatics (INEGI).

4. Regional convergence analysis

The traditional convergence framework follows the contributions of Barro and Sala-i-Martin (1991). This paper looks at β-convergence, which refers to a negative association between the rate of growth and the initial level of an attribute—in this case, per capita income.

In order to analyze conditional β-convergence, we make use of the following regression specification:

$$\frac{y_{i,t} - y_{i,t-\tau}}{\tau} = \alpha + \beta \cdot y_{i,t-\tau} + \delta \cdot C_{i,t-\tau} + X_{i,t-\tau}'\gamma + v_{i,t} \quad (1)$$

where $y_{i,t}$ refers to the log of per capita income in municipality i at period t, $C_{i,t}$ is the crime rate at the municipal level, $X_{i,t}$ is a vector of conditioning variables (public expenditures and education in the municipality), $v_{i,t}$ is a stochastic error term, and τ is the length of the period under analysis. Moreover, in order to account for possible geographical correlation between crime rates in Mexico, we cluster the standard errors at the state level using the wild cluster bootstrap of Cameron, Gelbach, and Miller (2008).[6]

The analysis starts by looking at the overall levels of crime and violence in 2007, as measured by the homicide rates per 100,000 inhabitants, and their effect on growth over the 2005–2010 period. As illustrated in Table 1, the homicide rates of 2007 are not found to have any effect on the economic growth rate of municipalities between 2005 and 2010 (see Column 1). While the coefficient for *Total Homicides Rate 2007* shows the (expected) negative sign, the effect is not statistically distinguishable from zero. If we use five-year lags of the total homicide rate as instruments for the levels of crime

[5] The Center for Investigation and National Security (CISEN); the National Center for Information, Analysis and Planning to Fight Crime (CENAPI) within the Office of the Federal Attorney General (PGR); the Public Security Secretariat (SSP); the Secretary of National Defense (SEDENA); the Secretary of the Navy (SEMAR); and the Secretary of the Interior (Secretaría de Gobernación) are the institutions that participate in this collaborative effort, as described by Molzahn et al. (2012).

[6] This method offers a solution in cases where the number of clusters (N=32 in our case) is small, which would impose limitations to methods such as cluster-robust standard errors that rely on an infinite number of clusters in order to be asymptotically consistent.

and violence in 2007, we still find that crime does have a negative impact on growth (see Table 1, column 5), but again, the effect is not statistically distinguishable from zero[7].

The results change significantly when the effect on income convergence is separated by the two types of crime—drug related homicides and non-drug related homicides (see columns 2, 3, and 4). The analysis shows that municipalities with higher levels of drug-related crimes in 2007 have grown at a slower pace between 2005 and 2010 than municipalities less affected by this shock. For instance, according to our estimates, a one standard deviation increase in the number of drug-related homicides (approximately 18 homicides, see Table 2) will imply a decrease in the growth rate of 0.20 percentage points. The latter means that e.g., municipalities with a rate of 90 drug-related homicides per 100,000 persons decreases income growth by approximately one percentage point. The negative effect of drug-related crime rates over growth continues to be present if the sample of municipalities is divided into urban and semi-urban, although the effect is imprecisely estimated for urban areas (see Table 3).[8] Here, a one standard deviation increase in the number of drug-related homicides translates to a decrease in the growth rate of approximately 0.19 percentage points in semi-urban municipalities and 0.13 percentage points in urban municipalities[9]. Finally, we found no effect of non-drug related crimes over growth during the time period under study.

5. Discussion

Combining municipal level data from poverty maps, administrative records on crime and violence, and public expenditures data at the municipal level, we investigate the effect of crime on growth in Mexico. The data make it possible to distinguish between drug and non-drug related crimes, allowing us to separate the effect between common crime and organized crime on growth—a distinction not previously addressed in the literature. Additionally, we focus on the regional development pattern, namely, the income growth convergence observed across municipalities in Mexico over the past years. By using the differentiated homicide rates and focusing on (the 2,457) municipalities, we circumvent the main two challenges faced in researching the effects of crime on growth, namely, the lack of a harmonized measure and the small-sample problem.

Our analysis indeed finds evidence of a negative impact of drug-related crime on income growth in Mexican municipalities over the period from 2005 to 2010. Non-drug related crimes, on the other hand, are not found to have any effect on the economic growth rate of municipalities during the same time period. As noted by authors like Stone (2006), more empirical evidence on the effects of crime over growth is needed. We believe that the evidence presented in this paper speaks of the

[7] We have to point out that no data disaggregating types of homicides by drug and non-drug related crimes exists in Mexico before to 2006. Nonetheless, we have used the 5 year lagged values for the rate of total homicides as an instrument for drug and non-drug related crimes. The results are identical to the ones presented by the OLS estimates in Table 1, columns 2 and 3. Those results are not presented here but are available from the authors upon request.

[8] Urban status is defined in this paper according to the National Population Council (CONAPO) definition. In this sense, a municipality with more than 15,000 inhabitants is considered urban, while one with less than 15,000 individuals is considered a semi-urban area.

[9] As noted before, this effect is indistinguishable from zero for urban municipalities.

possibility that the theorized negative effect of crime on growth discussed in the literature is more pronounced when the attention is centered on *organized* crime vis-à-vis more 'common' types of crime.

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TABLE 1. CONDITIONAL BETA-CONVERGENCE, 2010-2005

	OLS				2SLS
	(1)	(2)	(3)	(4)	(5)
Real Income 2005	-0.04531***	-0.04522***	-0.04604***	-0.04577***	-0.04666***
	(0.012480)	(0.012620)	(0.012220)	(0.012240)	(0.003130)
Total Rate of Homicides 2007	-0.00003				-0.00020
	(0.000090)				(0.000200)
Drug-related rate of homicides in 2007		-0.00010***		-0.00011***	
		(0.000040)		(0.000040)	
Non Drug-related rate of homicides in 2007			0.00015	0.00016	
			(0.000260)	(0.000250)	
Public expenditures 2005	-0.01191***	-0.01179***	-0.01190***	-0.01173***	-0.01217***
	(0.005600)	(0.005640)	(0.005700)	(0.005650)	(0.002350)
% of individuals with Elementary Education 2005	0.12922	0.12897	0.13608	0.1343	0.14055***
	(0.099720)	(0.101030)	(0.095830)	(0.096290)	(0.026770)
Constant	0.36197***	0.36075***	0.36485***	0.36258***	0.36930***
	(0.075580)	(0.076930)	(0.074570)	(0.074640)	(0.021920)
R^2	0.137	0.138	0.138	0.139	0.13
Observations	2109	2109	2109	2109	2109

Dependent Variable: Growth rate of per capita income, 2010-2005

Regressions weighted by municipal population size

Note: All monetary variables are in logs and in real per capita terms of August of 2010

Clustered Std. Errors (Wild Bootstrap, 1200 replications) at the State level

Instruments: crime rates in t-5 and t-10

* p<0.1 , ** p<0.05, *** p<0.01

TABLE 2. DESCRIPTIVE STATISTICS

Variable	All		Semi-Urban		Urban	
	Mean	**Std. Dev.**	**Mean**	**Std. Dev.**	**Mean**	**Std. Dev.**
Real income 2005 (MX$ of August 2010)[1]	1,561.20	716.91	1,290.30	525.29	1,832.11	908.53
Nominal *per capita* income 2005[1]	1,227.79	563.80	1,014.74	413.11	1,440.84	714.51
Total Homicide Rate 2007[2]	7.68	21.93	6.88	26.95	8.73	12.53
Drug related rate of Homicides 2007[2]	2.25	17.71	2.20	22.80	2.31	6.56
Non-drug related rate of Homicides 2007[2]	5.43	12.59	4.67	14.29	6.42	9.82
Total Population	49,381	93,315	7,549	3,638	91,212	182,992
No. Observations	2,372		1,347		1,025	

Source:
[1]Author's own calculations using the ENIGH, Population Census and Population counts.
[2] Secretaria Nacional de Seguridad Pública (SNSP).
Note: All monetary variables are in real per capita terms.

TABLE 3. CONDITIONAL BETA-CONVERGENCE AND CRIME: URBAN AND SEMI-URBAN AREAS

	Urban	Semi-Urban
	(1)	(2)
Real income 2005	-0.02224 ***	-0.07506 ***
	(0.00472)	(0.01644)
Drug-related rate of homicides in 2007	-0.00018	-0.00008 ***
	(0.00027)	(0.00003)
Non Drug-related rate of homicides in 2007	0.00013	0.00025
	(0.00024)	(0.00035)
Public expenditures *per capita* 2005	-0.01441 ***	-0.00594
	(0.00570)	(0.00481)
% of individuals with Elementary Education 2005	-0.00204	0.25933 ***
	(0.05173)	(0.11559)
Constant	0.22996 ***	0.51556 ***
	(0.03371)	(0.11159)
R^2	0.109	0.186
Observations	972	1137

Dependent Variable: Growth rate of per capita income, 2010-2005

Regressions weighted by municipal population size

Note: All monetary variables are in logs and in real per capita terms of August of 2010

Clustered Std. Errors (Wild Bootstrap, 1200 replications) at the State level

* p<0.1 , ** p<0.05, *** p<0.01