Fear and Loitering in Mexico: The Significance of Age Structure, Education, and Youth Unemployment for Explaining Sub-National Variation in Violent Youth Crime

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Abstract: Violent crime in Mexico occurs at a rate that dwarf the human costs of most contemporary civil wars, and the drug cartels responsible for the violence exercise *de facto* control over significant geographical territories. In this respect, the Mexican 'drug wars' resemble conflicts over the control of rich natural resources in Sub-Saharan Africa and elsewhere, blurring the distinction between 'political' and 'social' or 'criminal' violence. In the civil war literature, the 'opportunity perspective' emphasizes conditions that provide opportunities for a rebel group to wage war against a government. Similarly, relatively large groups of 'idle' young men could arguably be a factor that reduces recruitment costs for criminal enterprises through the abundant supply of youth with low opportunity cost. Acknowledging organized crime around drugs trafficking as a major cause of crime and violence in Mexico, we ask whether the availability of large young male cohorts, or male 'youth bulges', low education, and high youth unemployment eases recruitment to these organizations and may contribute to explain variance in violent crime across Mexican states over time. Using panel data covering 32 states in Mexico during the 1997–2010 period, we find that while a coarse measure of regional youth bulges does not explain patterns of violent youth crime, high youth unemployment in low-education strata does, and in particular in the context of large male youth bulges. These results remain robust to alternative data, sample size, estimation techniques and controls for potential endogeneity concerns.

Keywords: Youth bulge, education, unemployment, violent crime, Mexico.

1. Introduction

The resemblance between many contemporary civil wars over access to natural resources and the 'drug wars' in Mexico is striking. However, while some scholars have noted the similarities between factors explaining armed conflict and violent crime (e.g. Neumayer 2003: 619) the two phenomena are usually studied separately. This paper addresses the issue of violent youth crime in Mexico employing a theoretical framework, the 'opportunity perspective', which has been a dominating narrative in the civil war literature. This framework emphasizes structural factors providing opportunities for rebel organizations to engage in insurgencies against a state, such as large youth cohorts or 'youth bulges', as well as other factors that determine economic opportunities for youth like education and unemployment. In the political violence literature it has been noted that 'youth bulges' have historically been associated with times of political crisis and upheaval (Goldstone 1991, 2001) and it has generally been observed that young males are the main protagonists of criminal (Neapolitan 1997: 92, Neumayer 2003: 621) as well as political (Mesquida and Wiener 1996, Elbadawi and Sambanis 2000: 253, Urdal 2006) violence. Generally, the increasing acknowledgement of the role of demographic factors in shaping conflict and international political developments is underscored by recent contributions in the field of political demography (e.g. Goldstone et al. 2012).

Studies of violent crime, in particular studies of homicide rates, have long employed cross-national time-series research designs. Most of these cross-national studies have included few developing countries, however. A much-cited homicide study, Fajnzylber et al. (2002), included only 39 countries, of which the minority were developing countries, citing the problems with low data availability for developing countries as well as underreporting. Underreporting, the authors argue, should not be considered random noise, but measurement

error that is systematically correlated with factors assumed to affect crime rates (Fajnzylber et al. 2002: 14).

Furthermore, while sub-national panel studies have become prominent in the civil war literature (e.g. Buhaug and Rød 2006, Urdal, 2008, Østby et al. 2011, Vadlamannati 2011), similar studies of sub-national violent crime outside the US and a few other developed countries are rare. An exception is Dreze and Khera's (2000) study of homicide across Indian states. By assessing variation in violent crime within Mexico over time, this study is less prone to reporting errors as such that stem from cross-national differences in data collection and reporting procedures, although we acknowledge several possible sources of bias. Furthermore, the subnational focus enables the use of data sources - in particular youth unemployment - that are not available for a large number of countries, and may thus not be used in cross-national studies.

Mexico provides an ideal case for testing propositions about the significance of youth opportunities for violent crime. Demographically, Mexico is a relatively young country with the majority of its population falling into the age range of 12 to 29 years. The period of study, 1997-2010, covers a time of significant youth population growth in Mexico. According to the Mexican Institute of the Youth the Mexican youth population aged 12-29 increased by 40.6% between 1990 and 2000.[1] While the overall growth in youth population is slowing down, regional differences in growth rates still exist due to migration and geographic fertility differentials. Detailed demographic, social and crime data further allows us to use econometric methods to consider how large youth cohorts in the context of limited education and employment opportunities affect violent crime

[1] Instituto Mexicano de la Juventud. (Mexican Youth Institute) (2008).

This study adds to the existing literature in several ways. The article identifies and discusses youth opportunities and their potential implications for violent youth crime, and tests these propositions empirically in one of the first sub-national studies of violent crime in a developing country. It is further the first study to look at youth bulges and violence, either political or criminal, in the context of both education and employment, a unique opportunity granted by the rare availability of such data for Mexican states. Our results suggest that while youth crime and high homicide rates in Mexico are not associated with the ebb and flow of the male youth population, both high youth unemployment and low youth education are associated with higher levels of crime and homicide. And in this context, the relative size of the male youth population does matter. We also report additional results of some significance. In particular, there is an increasing concern that rapid urban population growth around the globe could lead to increasing levels of criminal as well as political violence. While this study finds some support for urban environments being generally more conducive to violent crime in Mexico, the pace of growth in the urban population does not appear to be associated with crime levels.

2. Theory

The literature on youth bulges and violence has in particular focused on the role of large youth cohorts in facilitating spontaneous and low-intensity political violence. Two different explanatory frameworks have primarily informed the discussion, one focusing on opportunities and the other on motives for political conflict. The opportunity framework is particularly relevant for explaining criminal violence, and has a parallel expression in the literature on violent crime (Neapolitan 1997). Neumayer (2003) notes that opportunity theory 'tries to understand variation in violent crime rates in terms of different opportunities or favourable conditions for committing crime'. Fajnzylber et al. (2002: 1-2), basing their

approach primarily on Gary Becker's opportunity framework, contend that 'crime rates depend on the risks and penalties associated with apprehension and also on the difference between the potential gains from crime and the associated opportunity cost'.[2]

2.1 Youth bulges and violent crime

The opportunity literature, often referred to as the 'greed' perspective (e.g. Collier 2000), has its roots in economic theory and focuses on structural conditions that provide opportunities for an organization to engage in violent activity, whether a rebel group that wages war against a government, or a criminal organization. These are conditions that provide the organization with financial means, such as rents from drug trafficking, or factors that reduce the costs of operation, such as low recruitment costs. Relatively large youth cohorts can reduce the recruitment costs for insurgent groups through the abundant supply of 'rebel labor' with low opportunity cost, increasing the risk of armed conflict (Collier 2000: 94). Similarly, large youth bulges may facilitate recruitment to criminal organizations. Opportunities for violence may be further boosted by a weak government with limited capabilities (Fearon and Laitin 2003, Collier and Hoeffler 2004).

Central assumptions in the opportunity perspective are that organizational structures that may be used for illegal purposes, whether political or criminal, exist exogenously, and that recruits join these organizations in order to obtain a private good. Hence, the collective action problem is presumed to be negligible. Criminal organizations or rebel groups are able to recruit successfully only when the potential gain from joining is so high and the expected costs so low that potential recruits will favor joining over alternative income earning opportunities. Collier (2000: 94) argues that the mere existence of an extraordinary large pool

[2] Arguably, violent crime may also be driven by feelings of disadvantage or unfairness (Fajnzylber et al. 2002: 2) as emphasized in motive-oriented or relative deprivation studies. However, it is empirically difficult to distinguish between these two types of explanations since they yield largely identical predictions (Urdal 2006).

of youth is a factor that lowers the cost of recruitment since the opportunity cost for a young person generally is low. Hence, our base expectation is that:

Hypothesis 1: *In regions with large youth populations relative to the adult population, violent crime rates are higher, everything else being equal.*

However, Hirschi and Travis (1983) argue that age in itself is an insufficient explanation for violence, and that shifting attention towards the meaning or interpretation of the relationship is required. Hence, in the following we consider two factors that are key determinants of youth opportunities: educational attainment and youth unemployment.

2.2 Educational opportunities and violent crime

Education is a tool that countries can exploit in order to respond to youth bulges and ease transition problems. But do expanding education opportunities reduce the risk of criminal violence? Collier (2000) argues that higher levels of education among men act to reduce the risk of political violence, resulting from the higher opportunity cost of rebellion for educated men. Since educated men have better income-earning opportunities than the uneducated, they have more to loose and we would expect them to be less likely to join a criminal organization.

Hence, a high level of education is expected to be associated with a reduced risk of violence. While for criminal 'entrepreneurs', a high level of education may in fact lead to higher rewards if it enables more efficient management of illicit activities (Barakat and Urdal 2009), the argument that recruitment of youth to criminal activity is economically less attractive the more highly educated a person is refers to mass participation. In areas with large potential pools of recruits, increasing education can act to reduce this pool. Although the argument that education increases the opportunity cost of youth takes a general form, we

focus here on secondary education for young males since they are the primary target for recruitment to criminal organizations.

Hypothesis 2: *In regions with low secondary male education levels, violent crime rates are higher, everything else being equal.*

2.3 Youth unemployment and violent crime

The expectation that exceptionally large youth cohorts increase the supply of cheap recruits for criminal enterprises is further supported by studies in economic demography suggesting that the alternative cost of individuals belonging to larger youth cohorts are generally lower compared to members of smaller cohorts due to higher unemployment and thus increased pressure on male wages. According to the 'cohort size' hypothesis, 'other things being constant, the economic and social fortunes of a cohort (those born in a given year) tend to vary inversely with its relative size' (Easterlin 1987, quoted in Machunovich 2000: 236). Increases in relative cohort size arguably result in a reduction in male relative income. Such a direct relationship has been found in several studies using wage data for smaller samples of countries (reviewed in Machunovich 2000: 238). In two cross-national time-series analyses, Machunovich (2000) finds that an increase in relative cohort size is associated with a reduction in fertility, arguably resulting from the depression of male wages while Korenman and Neumark (1997) find that large youth cohorts are associated with a significant increase in youth unemployment rates. So not only do youth bulges provide an unusually high supply of individuals with low opportunity cost, as anticipated by Collier (2000), but an individual belonging to a relatively large youth cohort generally also has a lower opportunity cost relative to a young person born into a smaller cohort. While labor markets differ substantially with regard to flexibility, also within countries, empirical evidence suggests that on average,

large youth cohorts are substantially more likely to experience higher unemployment rates (Korenman and Neumark 1997).

While previous studies have identified a theoretical link between youth unemployment and violence, the lack of reliable data for many developing countries has made a direct test of this relationship for large samples of countries difficult. Several studies have instead tried to assess the relationship indirectly by looking at economic growth as youth unemployment is typically associated with poor economic performance. Low economic growth has been identified as a robust predictor of both homicide (Neumayer, 2003) and civil war onset (Collier et al. 2003, Sambanis 2002: 229). Here, we address the relationship explicitly, expecting that:

Hypothesis 3: *In regions with large unemployment among young males, crime rates are higher, everything else being equal.*

Finally, we consider the possible effect of violent crime of the interaction of factors leading to low opportunities for youth. Given the expectations that low education and high unemployment among male youth should be associated with increased levels of violent crime, we would further expect that high unemployment in low-education male strata should be particularly strongly associated with violence, and that the economic opportunities for this group of males may be particularly limited in the context of large male youth bulges.

Hypothesis 4: *The association between large youth cohorts and violent crime is particularly strong in regions where education levels are low and unemployment rates among young males are high, everything else being equal.*

2.4 Existing research

Previous studies have found mixed evidence for a relationship between age structure, or 'youth bulges', and violent crime. Hansmann and Quigley (1982) and Pampel and Gartner

(1995) both find significant effect of age structure on homicide rates in cross-national studies, while Gartner and Parker (1990) find a strong age structure effect on homicide in two (US and Italy) out of five countries, acknowledging that differential patterns within countries may still have affected internal variation in homicide in the remaining three countries. On the hand, Avison and Loring (1986), Fajnzylber et al. (2002), Neumayer (2003), Cole and Gramajo (2009), and Pridemore (2011) do not find statistically significant effects of age structure on crime in country-level panel data analyses. In a meta-analysis of cross-national homicide studies, Nivette (2011) reports that static population indicators were among the group of variables that exerted the weakest effect on homicide. Fox and Hoelscher (2012) find some initial and strong support for the youth bulge hypothesis, although the relationship washes away once controlling for socioeconomic factors. A possible reservation here is that introducing socioeconomic variables also reduces the sample considerably. However, both Fox and Hoelscher's (2012) results as well as Neumayer's (2003) finding that economic growth reduces homicides, point to the salience of socioeconomic factors. Hence, what we should be looking for are conditional factors determining youth opportunities.

There appears to be somewhat stronger, albeit by no means unequivocal, evidence for a link between education and violent crime. Cole and Gramajo (2009) find that male education reduces homicide, Fajnzylber et al. (2002) conclude that higher education levels are associated with less homicide, while Dreze and Khera (2000) found that higher literacy levels moderated criminal violence levels in India. However, some results appear more puzzling: Cole and Gramajo (2009) found that higher female education was associated with higher homicide levels, while Fajnzylber et al (2002) unexpectedly found that higher education was associated with higher levels of robbery. Furthermore, Pridemore (2011) report inconclusive results with regards to education, while Robbins and Pettinicchio (2012) only found weak support for the assumed beneficial effect of social capital on homicide. Only

two of the surveyed studies include unemployment. Pampel and Gartner (1995) did not find a significant effect of unemployment, while Neumayer (2005) reports that unemployment increases levels of both robbery and homicide.

In the civil war literature there has been a certain discussion about the measurement of age structure (Urdal 2006, Barakat and Urdal 2009). Like two authoritative civil war studies by Fearon and Laitin (2003) and Collier and Hoeffler (2004), most of the studies above employ suboptimal measures of age structure. The measure typically used is the 15 to 24 (or 29) year old cohorts relative to the total population, including all cohorts under the age of 15 years in the denominator. Such definition is highly problematic both theoretically and empirically. First, most theories about youth revolt and crime assume that violence arises because youth cohorts experience institutional 'bottlenecks' in the education system or in the labor market due to their larger size compared to previous cohorts. Second, when using the total population in the denominator, youth bulges in countries with continued high fertility will be underestimated because the large under-15 populations deflate the youth bulge measure. At the same time, countries with declining fertility and relatively smaller under-15 populations – which are in a position to experience economic growth driven by age structural change which may be expected to contribute to reduce both criminal and political – score relatively higher. The issue of measurement appears not to have been discussed in the homicide literature, with the lone exception of Fox and Hoelscher (2012).

3. Empirical Methodology and Data

In this section, we describe the data covering all 32 Mexican states, including the Federal district, also known as Mexico City, (see Appendix 1 for details) during the 1997–2010 period and the estimation specifications. The base specification is formulated below.

3.1 Estimation Specification

The baseline specification estimates the number of crime incidents committed by youth (YC_{it}), in state *i* in year *t* as a function of a set of youth opportunity variables YE_{it-1}, and control variables Z_{it-1}:

$$YC_{it} = \gamma YE_{it-1} + \beta Z_{it-1} + \nu_i + \lambda_t + \omega_{it} \qquad (1)$$

Where, ν_i denotes state fixed effects to control for unobserved state specific heterogeneity in the panel dataset, λ_t is time specific dummies and ω_{it} is the error term. Note that the Hausman (1978) test overwhelmingly favours fixed effect over random effect models. For the dependent variable we use the number of federal crimes committed by Mexican males in the age cohort 18–24[3] in state *i* in Mexico in year *t-1* in per capita terms logged. This data is reported by the National Institute for Statistics and Geography[4] (INEGI hereafter) for the 32 states (including the Federal district) for the 1997 through 2010 period (INEGI 2012). Federal crimes include all counts of drug-related crime and other violent organized criminal activity, but exclude 'common crime', providing for an appropriate proxy for violent crime to be tested specifically against youth opportunities (see Appendix 4 for details). Figure 1 shows the number of youth federal crime incidents reported across Mexican states during the 1997–2010 period. The states with the highest number of youth federal crimes are Baja California, Sonora, Jalisco, Federal District, Chihuahua and Sinaloa, many of which are heavily affected by drug-related violence.

Our main independent variables in the vector of youth opportunity in equation (1) are: male youth bulge, male youth education attainment rate, and male youth unemployment rate.

[3] A crime is included if at least one of the reported suspects is a male between the ages of 18 and 24. For more details about categories and definitions of federal crimes in Mexico, see Appendix 4 and www.inegi.org.mx (Estadísticas Judiciales en Materia Penal).

[4] See: www.inegi.org.mx/ for more details about INEGI

We define male youth bulge as 18–24 year old males as a share of all males aged 18 years and above, capturing the dynamics in the younger working-age segments.[5] The demographic data is sourced from Mexican population censuses carried out by INEGI across all the 32 Mexican states (including the Federal District) once every 10 years. Once every five years INEGI also conducts random surveys known as population count. Thus, the data used to construct youth bulge come from the censuses of 1990, 2000, and 2010 (INEGI, 1990; 2000; 2010), and from the population surveys of 1995 and 2005 (INEGI, 1995; 2005). The youth education variable also originates from the census data, as well as the 2005 survey. This variable measures the proportion of males aged 18-24 years with at least completed secondary education normalized by the total male population aged 18-24 years. Youth unemployment is defined as the number of males aged 18-24 years who are reportedly unemployed divided by the total male labor force aged 18-24 years. The unemployment and labor force data are available from the Mexican census files for 1990, 2000 and 2010 only (INEGI, 1990; 2000; 2010). Missing years between the reported census and survey observations for the aforementioned variables are interpolated. This is defendable given that demographic and education variables normally change relatively slowly. We do acknowledge, however, that unemployment figures are likely to be much more volatile, and that the interpolation between the census observations is likely to miss some variation. While this is unfortunate, unemployment data based on census records are clearly preferable to less reliable survey data, in particular given our aim to study age-, gender-, and education-specific unemployment across all Mexican states over time.[6]

[5] We have also used the conventional (Urdal 2006) definition of youth bulges measuring 15–24 year old males as a share of male population aged 15 years and above. Our results remain unchanged when we use this alternative measure of youth bulge.

[6] As a robustness check, we have also used an alternative definition of youth measured as the male population between the 18-30 years, also constructing education and unemployment rates for this group.

We further disaggregate the youth unemployment data by the category of education, constructing data that as far as we know have not previously been used to test the youth opportunity and violence nexus. We specifically use *unemployment rate in low education and high education strata* respectively in our subsequent specification (2):

$$YC_{it} = \gamma URlowY_{it-1} + \delta URhighY_{it-1} + \beta Z_{it-1} + \nu_i + \lambda_t + \omega_{it} \qquad (2)$$

Where, $URlowY_{it-1}$ denotes unemployment rate in low education stratum, while $URhighY_{it-1}$ denotes unemployment rate in high education stratum in state *i* and year *t-1* respectively. We first collapse the categories for 'no', 'primary' and 'incomplete secondary' education into the *low education stratum*, defined as those males aged 18-24 years with lower education than completed secondary level. We then divide the number of males who are unemployed in this category by the total male population aged 18-24 with low education. Note that data on employment by education is available only from the 1990, 2000 and 2010 population censuses. Likewise, we categorise male youth in the *high education stratum* as those aged 18-24 who have obtained completed secondary schooling or higher (including tertiary education). We then construct a measure for *unemployment rate in high education stratum* by dividing unemployed male youth with high education with total male population with high education in the age group of 18-24 years.

We further examine under what conditions youth bulge can be associated with an increase in youth crimes using the specification (3) below:

$$YC_{it} = \zeta(URlowY \times YB)_{it-1} + \xi(URhighY \times YB)_{it-1} + \gamma URlowY_{it-1} + \delta URhighY_{it-1} + \phi YB_{it-1} + \beta Z_{it-1} + \nu_i + \lambda_t + \omega_{it} \qquad (3)$$

Where, $(URlowY \times YB)_{it-1}$ denotes unemployment rate in low education stratum interacted with youth bulge and $(URhighY \times YB)_{it-1}$ is the interaction between unemployment rate in the low education stratum and youth bulge in state *i* and year *t-1*. These interactions help examine whether the effect of youth bulges on violent crime are conditional upon unemployment rate in low vis-à-vis high education strata.

Finally, the vector of control variables (Z_{it-1}) includes other potential determinants of youth crime incidents per capita (log) in state *i* during year *t-1* which we obtain from the extant literature on the subject. Here we follow earlier studies by Barakat and Urdal (2009), Demombynes and Ozler (2005), Fajnzylber, Lederman and Loayza (2002), Hashimoto (1987) Miron (2001), and Urdal (2006). Accordingly, we include state per capita GDP (logged) in US$ 2003 constant prices[7] and rate of growth of state GDP in *i* during year *t-1* to proxy for the level of development in states. The income data is available from the National Accounts System of INEGI.[8] Likewise, we also use state population which is drawn from the population census data compiled by INEGI. We further compute two urban population measures, *urbanization* measuring urban population as share of total population in state *i* during year *t-1* and the rate of growth of the urban population. Urdal and Hoelscher (2012) point out that managing urban development sustainability pose significant challenges for the respective governments and therefore large youth bulge in urban centres could be a source of instability and violence. We then include a measure of state Governor elections. We follow Schneider (2011) to generate an indicator for the timing of elections that varies between 0 and 1. For all non-election years, the value is 0. For election years we make use of the following measure: (12 − (Mn − 1))/12, wherein Mn is the month in which the state Governor election took place. The data on the exact date and month in which the elections are held in

[7] The data of state per capita GDP was available only in Mexican pesos 2003 constant prices. We use the exchange rate to US$ to convert these data into US$.

[8] For more details see: www.inegi.org.mx/est/contenidos/Proyectos/SCN/C_Anuales/pib_ef/default.aspx

each state are obtained from the state elections results and information published by the Institute of Marketing and Opinion (Instituto de Mercadotecnia y Opinión 2012). Accordingly, for election years this indicator takes smaller values the later the election takes place within the year.[9] The details on variable definitions and data sources are reported in Appendix 3. We estimate all our models with Ordinary Least Squares (OLS henceforth) two-way fixed effects estimator with heteroskedasticity consistent robust standard errors (Beck and Katz 1995).[10]

3.2. Endogeneity concerns

It is quite possible that our key explanatory variables capturing youth opportunity are endogenous. That is, it might be that criminal activities attract more youth with low alternative cost towards areas with high crime rates, and especially towards drug related activities which might maximize their returns in the short run. This could affect the education and unemployment measures. It could also be that high levels of crime deter local investments, driving up unemployment levels. Although the cause for reverse causality is indirect and presumably relatively weak, not taking this endogeneity into account might induce bias in our estimates of the effect of youth opportunity and violent crime. We control for this problem by replicating the OLS fixed effects models using the system-GMM estimator suggested by Arellano and Bond (1991), Arellano and Bover (1995) and Blundell and Bond (1998). The results are based on the two-step estimator implemented by Roodman (2006) in Stata 12. We also apply the Hansen test to check the validity of the instruments used and the Arellano-Bond test of second order autocorrelation, which must be absent from the data in order for the estimator to be consistent. We treat the lagged dependent variable

[9] The results remain quantitatively the same if we use a dummy for the Governor Election years.
[10] The fixed-effects estimator captures factors such as geographic location of states, which is also expected to affect the level of criminal violence.

(i.e. youth federal crime per capita logged) and our measures of youth opportunity in all models as endogenous and the rest of the variables as exogenous. In all our system-GMM regression models we include time dummies. In order to minimize the number of instruments in the regressions, we follow Roodman (2006) and collapse the matrix of instruments.

4. Empirical Results

Table 1 presents the baseline results estimated using specification (1) capturing the effects of youth bulge, youth education and youth unemployment rate on youth crime incidents. In Table 2 estimating specification (2), we disaggregate the youth unemployment rate by category of education, i.e. separating between unemployment in the low and high education strata. In Table 3, we estimate specification (3) by introducing the interaction between unemployment rate by education and youth bulge. Finally in Table 4, we replace the two youth unemployment measures by education with a measure, 'Density of Low-Opportunity Cost Youth', capturing the overall 'density' of unemployed male youth with low education as a percentage of all male youth. In all the four tables we estimate our models with OLS fixed effects followed by system-GMM to address potential endogeneity concerns. Descriptive statistics is presented in Appendix 2. Beginning with Column 1 in Table 1, the results show that our crude measure for male youth bulge actually has a negative association with youth crime, and this relationship is significantly different zero at 5% level. These results do not lend support to those who attribute crimes committed by youth in Mexico to surge in youth bulge. However, this effect does not remain statistically significant when we introduce a lagged dependent variable in Column 2. We retain the lagged dependent variable hereafter in all our models. In all tables reported here, the lagged dependent variable remains significantly different from zero at the 1% level. In Column 3 we introduce the youth unemployment rate which is positive, but statistically insignificant. In Column 4, we also include the youth

education attainment ratio, finding, as expected, that higher levels of education have a strong negative effect on youth crime. The finding is significantly different from zero at the 5% level. Holding other controls at their mean, an increase in youth education by one unit is associated with 0.2% less youth crime incidents. Both unemployment rate and youth bulge variables remain statistically insignificant once controlling for youth education. In the last column, Column 5, we re-estimate the results with system-GMM. While the results remain similar to Column 4, the youth unemployment rate becomes marginally significant at the 10% level. These results however do not provide clear cut evidence on the effect of youth unemployment and education on youth crime. We therefore disaggregate the unemployment levels among youth by low and high education in Table 2.

As seen in Column 1 Table 2, we find a positive significant effect of youth unemployment rate in the low education stratum statistically significant at the 10% level. Holding all other variables constant at their mean, a standard deviation increase in youth unemployment rate in the low education stratum is associated with a 0.6% increase in youth crime incidents per head, which is about 4% of the standard deviation of youth crime incidents per head. However, we do not find any statistical significance when we replace this measure with one that estimates unemployment in the high education stratum in Column 2 (Table 2). These results broadly support our hypothesis that the opportunity cost of engaging in violent crimes is higher among young men in the high education stratum. We re-estimate these models using system-GMM, presented in Columns 3–4 in Table 2. The results are upheld when using system-GMM, with the effect of youth unemployment rate in the low education stratum on violent crime remaining statistically significant at the 10% level. The youth unemployment rate in the high education stratum remains statistically insignificant. The Hansen and the Arellano-Bond tests do not reject the GMM specifications at conventional levels of significance across the Columns 3–4. The Hansen J-Statistic further

clearly shows that the null-hypothesis of exogeneity of the instruments cannot be rejected at the conventional level of significance.

In Table 3 we turn our attention to the interaction effects between youth bulge and unemployment rate by education category. First, in Column 1 we interact youth bulge and unemployment rate in the low education stratum, and in Column 2 we interact youth bulge and unemployment rate in the high education stratum. As seen in Column 1, we find that the interaction between youth bulge and unemployment in the low education stratum has a positive effect in explaining the youth crime incidents per head, and that the term is significantly different from zero at the 5% level.[11] This effectively means that states with a higher percentage of male youth in their populations are more vulnerable to youth crime incidents if the unemployment rate among low education stratum increases. In other words, a youth bulge is not a problem in itself rather the risk of violence is conditional upon higher levels of youth with low education and thus scant employment opportunities. To better understand how the marginal effect of youth bulge interacted with the unemployment rate in low education stratum develops, we illustrate this graphically in Figure 3 (Greene 2009). Although these graphs are usually used in non-linear models, they are also applicable for linear models (see Cameron and Trivedi 2009). Figure 3 shows the development of the marginal plot of the youth bulge variable interacted with unemployment rate in the low education stratum on youth crime incidents per head. Basically, the marginal plot has an upward direction. This implies that youth bulges increase violent crime if the youth unemployment rate in the low education stratum increases. The marginal effect gains statistical significance after the youth unemployment rate in the low education stratum reaches the median score of 3.5%, meaning that the positive effect is found in states with an

[11] The youth bulge variable alone has a negative effect in explaining youth crime incidents and interestingly, we now find that unemployment rate in the low education stratum also has a negative sign. This is largely due to a high correlation (0.96) with the interaction term.

unemployment rate among low education stratum higher than 3.5%. In other words, youth bulges are associated with higher levels of federal crimes in states where the youth unemployment rate in the low education stratum is increasing. The three terms are jointly highly significant ($p< 0.0004$).

We now turn to the interaction between youth bulge and unemployment rate in the high education stratum in Column 2. The interaction effect is not significantly different from zero. This suggests that larger youth bulges do not appear to increase the risk of violent youth crime even when the unemployment rate in the high education stratum is increasing. As discussed above, this suggests the opportunity costs of engaging in crime are exuberantly higher for unemployed youth in the high education stratum. We also replicate these results using system-GMM reported in Columns 3–4 in Table 3. As seen, the interaction effect results remain robust to using system-GMM. It is noteworthy that after controlling for the endogeneity concerns, the statistical significance of the interaction of youth bulge with unemployment rate in the low education stratum drops to 10% level. The Hansen J-Statistic in all the three columns shows that the null-hypothesis of exogeneity of the instruments cannot be rejected at the conventional level of significance.

Lastly, in Table 4, we use a variable, 'Density of Low-Opportunity Cost Youth', capturing the overall 'density' of unemployed male youth aged 18-24 with low education measured as the share of the total male youth population in that age group. We restrict our specification to only include unemployment in the low education stratum since the relative number of unemployed youth with low education is the quantity of greatest theoretical relevance to the opportunity perspective. As seen, the density of unemployed youth with low education is positive and significantly different from zero at 5% and 1% levels in OLS fixed effects and System-GMM estimations respectively (Columns 1 and 2). In Columns 3 and 4 we interact youth bulge with the density variable. As seen, the interaction effect is positive

and significantly different from zero at conventional levels of significance in both the OLS and GMM estimations. In fact, the marginal effect gains statistical significance after the youth unemployment density in low education stratum reaches the median score of around 2.3% (figure not shown). These results show that irrespective of whether we use the measure for unemployment rate or density, unemployment in the low education stratum is the best predictor of youth crime indents in Mexico.

Before moving further towards robustness checks, we will briefly discuss the results of control variables. Interestingly, we do not find any robust evidence for an impact on violent youth crime of both per capita state GDP, rate of growth of state GDP and state population. Likewise, after controlling for fixed effects we don't find any effect of urban population growth on youth crime, hence increasing urban population pressure does not seem to increase violent crime. However, like others, we do find a strong positive effect on youth crime of the level of urbanization, which is consistent with the idea that urban environments are more conducive to violent crime (e.g. Urdal and Hoelscher 2012). The variable capturing timing of elections is associated with less number of crime incidents during the run-up towards governor elections. This might be due to two reasons. Firstly, there is every possibility of under reporting of crime incidents during the run-up towards elections by the incumbent government.[12] Second, it is also plausible that the incumbent governor would impose measures aimed at reducing violence during the election period, signalling to voters her/his commitment to control crime and restore law and order. We also cannot rule out the possibility that the result is driven by a combination of the two factors.

[12] For details on state elections see: imocorp.com.mx/CAMPO/zSIEM/ELEC_X_ANIO/ResultadosWeb.asp

4.1. Robustness checks

We have examined the robustness of our main findings in the following ways. First, we used alternative measures for the youth bulge, youth unemployment, and education variables. Departing from the measure of 18–24 year old males, we used 18–30 year old males as a share of all males aged 18 years and above. We also computed the federal crime incidents registered under the age group if 18–30 years. Likewise, we also used the 18-30 age group to compute unemployment rate by category of education. Using our alternative measures does not alter our results significantly. We still find that the unemployment rate in the low education stratum matters the most. The results for the interaction between youth bulge and unemployment rate in the low education stratum remain robust. Second, we re-estimated our OLS fixed effects models with negative binomial models where we used the dependent variable as an event count of youth federal crime incidents in the male 18-24 year category. We also control for time and state specific dummies. The results estimated using negative binomial method remains qualitatively similar to those reported in Tables 1–4 estimated using the OLS fixed effects approach. The unemployment rate in the low education stratum remains positive and significantly different from zero at 1% level across all the negative binomial estimations. Third, in some of our OLS fixed effects models the Hausman test rejects fixed effects. Thus, we estimate all the OLS fixed effects using random effects. The results remain robust to using random effects over fixed effects. Fourth, we also estimate our OLS baseline results using the Newey-West method which allows us to compute an AR1 process for autocorrelation and obtain Huber-White corrected robust standard errors that are robust to heteroskedasticity (Newey and West 1987). Replacing the OLS estimation method with Newey-West does not alter the baseline estimations. Fifth, as an additional test for robustness, we exclude the few observations with extreme values in youth crime incidents

reported.[13] Excluding outliers, the baseline results are qualitatively unchanged, suggesting that our results are not driven by extreme values.

Finally, we have also examined the effects of youth opportunities on homicide rates across Mexican states. Unfortunately, reliable age-specific perpetrator data for homicides is not available.[14] We use homicides per 100,000 population logged as the alternative dependent variable. The data is collected by INEGI on an annual basis and available for all the 32 states in Mexico from 1990 to 2010. [15] Compared to the youth crime incident data, the homicide data may not be as vulnerable to underreporting as it appears to be consistently reported across states. The results for the homicide models generally uphold our baseline results reported in Tables 1 and 2, i.e. the unemployment rate in the low education stratum contributes to explain variation in homicide rates after controlling for relevant socio-economic factors. However, it is noteworthy that we could not replicate the results on the interaction between youth bulge and unemployment rate in the low education stratum as reported in Table 3. The results of these robustness checks are not reported due to brevity, but they are replicable using our data and do files in Stata and available in an online appendix.

5. Conclusion

This article investigates potential causes for the variation in violent youth crime across Mexican states, with a particular focus on the role of youth opportunities. Building on an 'opportunity framework' prominent both in the civil war and criminology literatures, we initially hypothesized that violent crime should vary with demographic age structure, so that

[13] We use 'avplot' to identify the outliers in youth federal crime incidents.
[14] Note that the available age specific data for homicides show several shortcomings. For instance, they do not show variation in some years for some states. Furthermore, there is a sudden drop and jump in several years for most of the states. Therefore, we rather use the data coming directly from the mortality statistics (which doesn't provide homicides by age groups).
[15] For details on mortality statistics see:
www.inegi.org.mx/est/contenidos/espanol/proyectos/continuas/vitales/bd/mortalidad/anexos/introduccion.asp?s=est&c=11142

states with large 'youth bulges' should have higher levels of violent crime, 'everything else being equal'. This expectation is not borne out by the empirical models, however, as our measure for male youth bulge is consistently negatively associated with violent crime rates. We further hypothesized that the two factors that arguably most strongly determine the actual opportunity cost for youth, levels of education and employment, should be associated with crime levels, and particularly so when low education levels and high unemployment levels occur in states with large male youth bulges. These much more specific expectations regarding youth opportunities are not easily tested for global cross-national samples due to data limitations. The availability of reliable and comparable census data for Mexico providing age and gender-specific educational attainment and unemployment rates at the state level allow for a detailed sub-national panel study of youth opportunities and violent crime. Our empirical models, also taking into account possible confounding factors and endogeneity, find strong support for the importance of youth opportunities. This pertains in particular to educational attainment as our models consistently find low levels of education to be strong predictors of high levels of violent crime. We further find that high unemployment among males with low education is clearly associated with higher crime rates, and that this effect is amplified by an interaction with large male youth bulges. No similar effect is found for high unemployment among males with higher education levels, suggesting that the higher opportunity cost of youth with at least completed secondary education may serve as a barrier against recruitment of to criminal organizations. This study provides some crucial insights into the complex root causes for the high levels of violent crime in Mexico. While a mid-income country with relatively well developed institutions, Mexico is experiencing a *de facto* lack of territorial control over certain geographical areas to drug cartels, and levels of violence that vastly surpass most contemporary armed conflicts. As such, improving knowledge of structural factors determining violent crime and ultimately building increased

capacity to reduce crime will improve not only the situation for the Mexican population, but also the general security situation of the greater region. Furthermore, the findings reported here may have implications for understanding drivers of violent crime beyond the Mexican context, and incite more detailed data collection and empirical study of youth opportunities and violence elsewhere. The developmental consequences of political and criminal violence are vast (World Bank, 2011) and to this end, failing to invest in human capital among young people may represent a double development challenge.

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Table 1: Effect of youth bulge and youth opportunity on youth crime

Dependent variable: Federal youth crime incidents per-head (log)

	(1) OLS-FE	(2) OLS-FE	(3) OLS-FE	(4) OLS-FE	(5) SGMM
Constant	-15.35**	-10.75**	-9.995**	-11.91**	-2.098*
	(3.485)	(3.627)	(3.815)	(3.777)	(0.956)
Lagged Dependent Variable		0.357**	0.345**	0.331**	0.400**
		(0.0572)	(0.0564)	(0.0560)	(0.0915)
State Per capita GDP (log) t-1	0.654*	0.546+	0.397	0.515	-0.126
	(0.329)	(0.306)	(0.339)	(0.333)	(0.0902)
State GDP growth t-1	-0.00303	-0.00554	-0.00405	-0.00450	-0.00841+
	(0.00509)	(0.00462)	(0.00473)	(0.00466)	(0.00486)
State Population t-1	8.06e-08	4.70e-08	5.27e-08	3.96e-08	-7.95e-08**
	(5.11e-08)	(5.07e-08)	(5.06e-08)	(4.80e-08)	(2.51e-08)
Urbanization t-1	0.0339**	0.0202+	0.0204+	0.0291*	0.0164**
	(0.0125)	(0.0119)	(0.0119)	(0.0122)	(0.00582)
Rate of Urbanization t-1	0.0428	0.0317	0.0246	0.0275	0.126*
	(0.0364)	(0.0358)	(0.0366)	(0.0362)	(0.0495)
Timing of State Governor Elections	-0.0875*	-0.117**	-0.118**	-0.118**	-0.168**
	(0.0397)	(0.0359)	(0.0361)	(0.0361)	(0.0361)
Male Youth Bulge t-1	**-0.120***	**-0.0789**	**-0.0714**	**-0.0307**	**-0.114+**
	(0.0556)	**(0.0531)**	**(0.0531)**	**(0.0524)**	**(0.0643)**
Male Youth Unemployment Rate t-1			**0.0393**	**0.0345**	**0.0730+**
			(0.0298)	**(0.0297)**	**(0.0409)**
Male Youth Secondary School Attainment t-1				**-0.0230***	**-0.0508****
				(0.0100)	**(0.0150)**
R-squared	0.906	0.919	0.919	0.921	
Hausman test (p-value)	0.87	0.00	0.00	0.00	
Arellano-Bond test for AR(2): p-value					0.21
Hansen Statistic (p-value)					0.20
Number of Instruments					29
State specific dummies	YES	YES	YES	YES	YES
Time specific dummies	YES	YES	YES	YES	NO
Number of States	32	32	32	32	32
Observations	448	448	448	448	448

Notes: Robust standard errors in parentheses ** p<0.01, *p<0.05, + p<0.1. Results in bold reflect relationships that are central to the theoretical argument (main independent variables).

Table 2: Effect of youth unemployment rate by education category on youth crime

Dependent variable: Federal youth crime incidents per-head (log)

	(1)	**(2)**	**(3)**	**(4)**
	OLS-FE	**OLS-FE**	**SGMM**	**SGMM**
Constant	-9.665*	-10.23**	5.052	27.53*
	(3.829)	(3.845)	(13.68)	(12.41)
Lagged Dependent Variable	0.340**	0.350**	0.656**	0.0221
	(0.0563)	(0.0564)	(0.130)	(0.324)
State Per capita GDP (log) t-1	0.357	0.453	-0.434	-1.847**
	(0.336)	(0.342)	(0.771)	(0.699)
State GDP growth t-1	-0.00324	-0.00468	-0.0154*	0.00195
	(0.00470)	(0.00472)	(0.00747)	(0.0114)
State Population t-1	5.47e-08	5.11e-08	-3.47e-08	-2.16e-07*
	(5.04e-08)	(5.05e-08)	(5.53e-08)	(9.05e-08)
Urbanization t-1	0.0203+	0.0198+	0.00298	0.0276**
	(0.0119)	(0.0119)	(0.00794)	(0.00774)
Rate of Urbanization t-1	0.0248	0.0274	0.232	0.0471
	(0.0360)	(0.0368)	(0.159)	(0.159)
Timing of State Governor Elections	-0.118**	-0.117**	-0.165**	-0.148**
	(0.0361)	(0.0360)	(0.0392)	(0.0379)
Male Youth Bulge t-1	**-0.0748**	**-0.0750**	**-0.323**	**-1.111****
	(0.0533)	**(0.0530)**	**(0.393)**	**(0.382)**
Youth Unemployment Rate in Low Education Stratum (Males) t-1	**0.0498**+		**0.338**+	
	(0.0282)		**(0.191)**	
Youth Unemployment Rate in High Education Stratum (Males) t-1		**0.0234**		**0.137**
		(0.0295)		**(0.242)**
R-squared	0.920	0.919		
Hausman test (p-value)				
Arellano-Bond test for AR(2): p-value			0.36	0.34
Hansen Statistic (p-value)			0.99	0.99
Number of Instruments			51	51
State specific dummies	YES	YES	YES	NO
Time specific dummies	YES	YES	YES	YES
Number of States	32	32	32	32
Observations	448	448	448	448

Notes: Robust standard errors in parentheses ** p<0.01, * p<0.05, + p<0.1. Results in bold reflect relationships that are central to the theoretical argument (main independent variables).

Table 3: Effect of youth unemployment rate by education category on youth crime

Dependent variable: Federal youth crime incidents per-head (log)

	(1) OLS-FE	(2) OLS-FE	(3) SGMM	(4) SGMM
Constant	-9.913**	-9.994**	-7.351	-1.121
	(3.686)	(3.819)	(6.051)	(4.403)
Lagged Dependent Variable	0.337**	0.348**	0.163	0.353
	(0.0546)	(0.0567)	(0.381)	(0.427)
State Per capita GDP (log) t-1	0.691+	0.546	0.151	-0.0337
	(0.359)	(0.349)	(0.302)	(0.287)
State GDP growth t-1	-0.00506	-0.00506	-0.00350	-0.00717
	(0.00458)	(0.00467)	(0.00746)	(0.00841)
State Population t-1	3.72^{e-08}	4.62^{e-08}	-9.95^{e-08}*	-7.58^{e-08}
	(5.08^{e-08})	(5.04^{e-08})	(4.88^{e-08})	(5.65^{e-08})
Urbanization t-1	0.00995	0.0158	0.0149+	0.0109
	(0.0122)	(0.0123)	(0.00829)	(0.00876)
Rate of Urbanization t-1	0.0245	0.0299	-0.0430	0.0478
	(0.0357)	(0.0372)	(0.0932)	(0.109)
Timing of State Governor Elections	-0.116**	-0.116**	-0.100*	-0.136**
	(0.0364)	(0.0361)	(0.0507)	(0.0496)
Male Youth Bulge t-1	**-0.161***	**-0.110+**	**-0.105**	**-0.266+**
	(0.0632)	**(0.0623)**	**(0.128)**	**(0.147)**
Unemployment Rate in Low Education Stratum (Males) t-1	**-0.581***		**-0.772**	
	(0.267)		**(0.483)**	
Unemployment Rate in Low Education Stratum (Males) t-1 × Youth Bulge t-1	**0.0301***		**0.0380+**	
	(0.0124)		**(0.0220)**	
Unemployment Rate in High Education Stratum (Males) t-1		**-0.178**		**-0.797**
		(0.210)		**(0.673)**
Unemployment Rate in High Education Stratum (Males) t-1 × Youth Bulge t-1		**0.00979**		**0.0418**
		(0.0100)		**(0.0338)**
R-squared	0.922	0.919		
Hausman test (p-value)				
Arellano-Bond test for AR(2): p-value			0.40	0.84
Hansen Statistic (p-value)			1.00	1.00
Number of Instruments			60	60
State specific dummies	YES	YES	YES	NO
Time specific dummies	YES	YES	YES	YES
Number of States	32	32	32	32
Observations	448	448	448	448

Notes: Robust standard errors in parentheses ** p<0.01, * p<0.05, + p<0.1. Results in bold reflect relationships that are central to the theoretical argument (main independent variables).

Table 4: Effect of the density of low-opportunity cost youth on youth crime

Dependent variable: Federal youth crime incidents per-head (log)

	(1)	**(2)**	**(3)**	**(4)**
	OLS-FE	**SGMM**	**OLS-FE**	**SGMM**
Constant	-9.144*	-3.054+	-10.71**	-0.157
	(3.803)	(1.587)	(3.718)	(2.357)
Lagged Dependent Variable	0.336**	0.533**	0.342**	0.701**
	(0.0564)	(0.202)	(0.0518)	(0.185)
State Per capita GDP (log) t-1	0.342	-0.00818	0.700*	0.0431
	(0.324)	(0.0574)	(0.345)	(0.0387)
State GDP growth t-1	-0.00289	-0.0103*	-0.00343	-0.0104*
	(0.00481)	(0.00492)	(0.00468)	(0.00491)
State Population t-1	5.73^{e-08}	-4.92^{e-08}+	2.34^{e-08}	-2.99^{e-08}+
	(5.08^{e-08})	(2.52^{e-08})	(5.21^{e-08})	(1.73^{e-08})
Urbanization t-1	0.0188	0.00840+	0.0199+	0.00530*
	(0.0119)	(0.00434)	(0.0120)	(0.00232)
Rate of Urbanization t-1	0.0254	0.0745+	-0.00202	0.0543+
	(0.0360)	(0.0424)	(0.0345)	(0.0300)
Timing of State Governor Elections	-0.116**	-0.161**	-0.116**	-0.202**
	(0.0359)	(0.0460)	(0.0367)	(0.0522)
Male Youth Bulge t-1	**-0.0909+**	**-0.0969+**	**-0.160****	**-0.174***
	(0.0547)	**(0.0527)**	**(0.0566)**	**(0.0711)**
Density of Low-Opportunity Cost Youth (Males) t-1	**0.178***	**0.188**+	**-2.266****	**-2.827+**
	(0.0788)	**(0.116)**	**(0.801)**	**(1.666)**
Density of Low-Opportunity Cost Youth (Males) t-1 × Youth Bulge t-1			**0.116****	**0.146**+
			(0.0373)	**(0.0774)**
R-squared	0.920		0.923	
Hausman test (p-value)	0.20		0.00	
Arellano-Bond test for AR(2): p-value		0.21		0.15
Hansen Statistic (p-value)		0.20		0.12
Number of Instruments		28		31
State specific dummies	YES	NO	YES	NO
Time specific dummies	YES	YES	YES	YES
Number of States	32	32	32	32
Observations	448	448	448	448

Notes: Robust standard errors in parentheses ** p<0.01, *p<0.05, + p<0.1. Results in bold reflect relationships that are central to the theoretical argument (main independent variables).

Figure 1

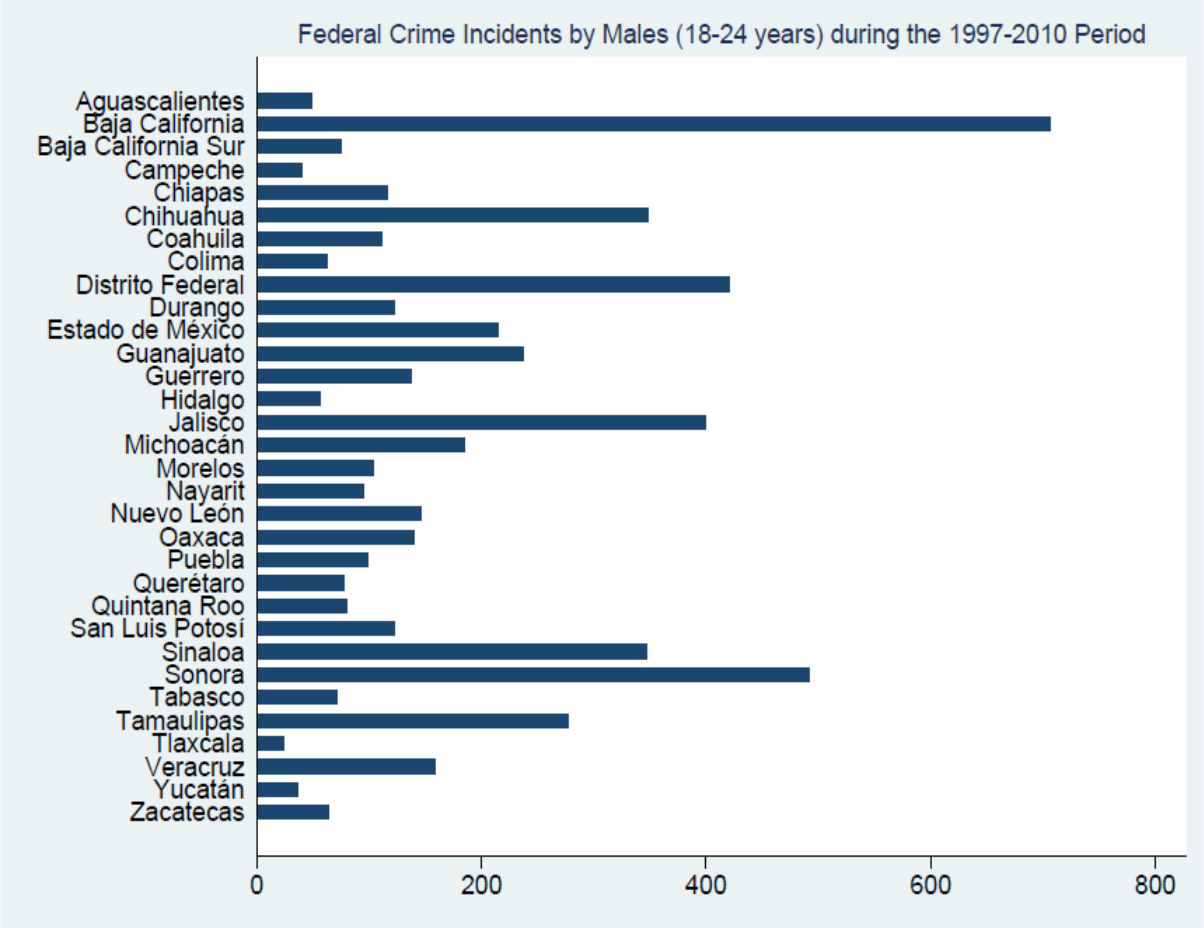

Federal Crime Incidents by Males (18-24 years) during the 1997-2010 Period
Aguascalientes
Baja California
Baja California Sur
Campeche
Chiapas
Chihuahua
Coahuila
Colima
Distrito Federal
Durango
Estado de México
Guanajuato
Guerrero
Hidalgo
Jalisco
Michoacán
Morelos
Nayarit
Nuevo León
Oaxaca
Puebla
Querétaro
Quintana Roo
San Luis Potosí
Sinaloa
Sonora
Tabasco
Tamaulipas
Tlaxcala
Veracruz
Yucatán
Zacatecas
0
200
400
600
800

Figure 2

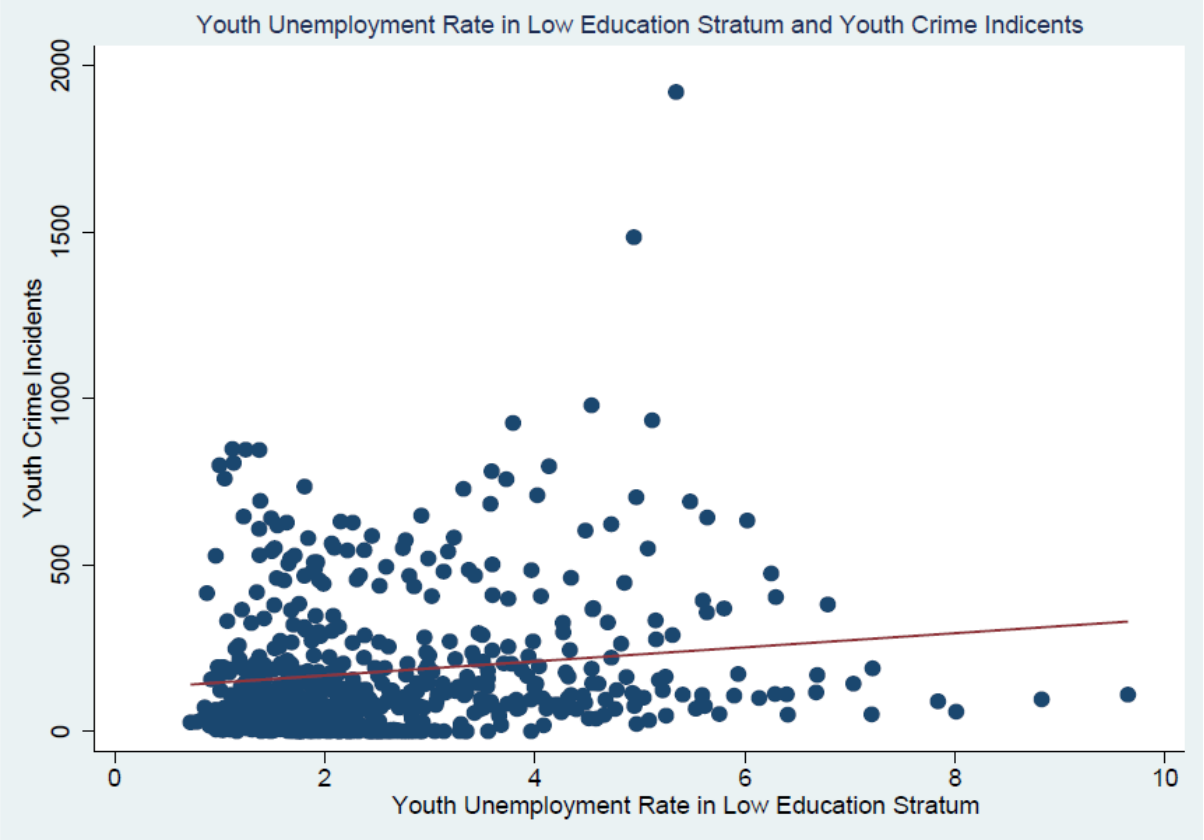
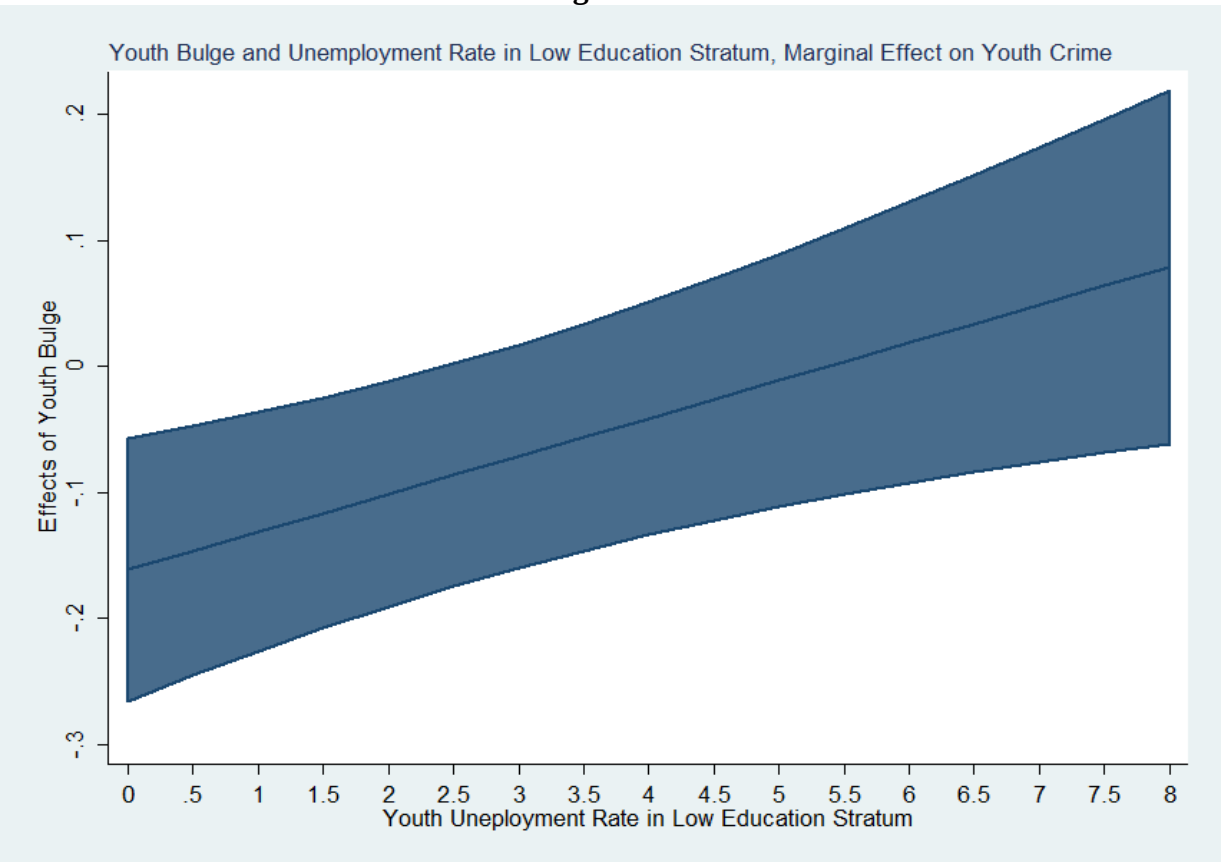


Figure 3



Appendices

Appendix 1: Mexican States Included in Study

Aguascalientes	Distrito Federal	Morelos	Sinaloa
Baja California	Durango	Nayarit	Sonora
Baja California Sur	Estado de México	Nuevo León	Tabasco
Campeche	Guanajuato	Oaxaca	Tamaulipas
Chiapas	Guerrero	Puebla	Tlaxcala
Chihuahua	Hidalgo	Querétaro	Veracruz
Coahuila	Jalisco	Quintana Roo	Yucatán
Colima	Michoacán	San Luis Potosí	Zacatecas

Appendix 2: Descriptive Statistics

Variables	Mean	Standard Deviation	Minimum	Maximum	Observations
Youth Crime Incidents (Male)	182.15	216.31	1.00	1921.00	553
Homicides (Number of cases)	407.69	546.50	1.00	6234.00	672
State Per capita GDP (log) t-1	9.06	0.68	7.76	11.96	640
State GDP Growth t-1	3.03	4.21	-13.41	15.77	608
State Population t-1	3014547	2608974	317764	15000000	640
Urbanization t-1	72.53	14.95	39.45	99.76	640
Rate of Urbanization t-1	2.31	1.28	0.24	11.00	608
Timing of Governor Elections	0.12	0.29	0.00	1.00	672
Youth Bulge (Male) t-1	23.38	2.41	17.93	29.73	640
Male Youth Unemployment Rate t-1	2.82	1.37	1.04	8.30	640
Male Youth Secondary School attainment t-1	30.38	4.29	18.95	39.22	640
Unemployment Rate in Low Education Stratum (Males) t-1[16]	2.50	1.19	0.72	8.83	640
Unemployment Rate in High Education Stratum (Males) t-1	3.09	1.42	1.21	8.38	640
Density of Low-Opportunity Cost Youth (Males) t-1	1.02	0.43	0.36	2.84	640

[16] The lack of unemployment insurance explains the relatively low Mexican unemployment rate in general and among the youth. The high informal employment is still a policy challenge in Mexico (OECD 2012).

Appendix 3: Data definitions and sources

Variables	Definitions and data sources
Youth Federal Crimes	Total number of federal crimes committed by young males in the cohort 18-24 and 18-30 in state *i* in year *t*. The data was obtained from the Penal Judicial Statistics provided by INEGI. The log of this variable is used in the OLS and System-GMM models.
Homicides	Total number of homicides in state *i* in year *t*. The data was obtained from the Mortality Statistics provided by INEGI. The variable used is Homicide per 100,000 inhabitants logged.
Youth Bulge (male)	Males in the cohort 18-24 as a share of all males aged 18 years above. The same definition applies when we expand the cohort to 18-30. The data are from the 1990, 2000 and 2010 population censuses, and from the 1995 and 2005 population surveys carried out by INEGI.
Youth Unemployment (male)	Own construction using the number of males under the age group of 18-24 years who are reportedly unemployed divided by the total male labor force under the age group of 18-24 years. The unemployment and labor force data are made available from the population censuses of INEGI. The same definition applies when we expand the cohort to 18-30.
Youth Education (male)	Own construction using the total number of males under the age group of 18-24 years with completed secondary education normalised by the total male population under the age group of 18-24 years. The data on youth secondary schooling attainment is available from the 1990, 2000, and 2010 population censuses, and from the 2005 population survey. All data are from INEGI.
Unemployment rate in low education stratum youth (male)	Own construction using the number of males under the age group 18-24 years who are unemployed and have low or no education (incomplete primary school, primary school only, and incomplete secondary school) divided by the male population under the age group 18-24 years with low education. The data is available from the 1990, 2000, and 2010 population censuses carried out by INEGI. The same definition applies when we expand the cohort to 18-30.
Unemployment rate in high education stratum youth (male)	Own construction using the number of males under the age group 18-24 years who are unemployed and have high education (at least completed secondary school) divided by the male population under the age group 18-24 years with high education. The data is available from the 1990, 2000 and 2010 population census carried out by INEGI. The same definition applies when we expand the cohort to 18-30.
Urbanization	Share of the total population living in urban areas in state *i* in year *t-1*. The data was own construction based on the information data from the population censuses 1990, 2000, 2010 and population surveys 1995, 2005 provided by INEGI.
Urbanization Rate	Growth rate of the share of people living in urban areas areas in state *i* in year *t-1*. The data is based on information from the 1990, 2000, 2010 population censuses, and the1995 and 2005 population surveys provided by INEGI.
Timing of Governor Elections	Indicator for the timing of state level Governor elections that varies between 0 and 1. It takes smaller values the later the election takes place within the calendar year of the election year and is 0 for all other years. We follow Schneider (2011) and make use of the following measure: $(12 - (Mn - 1))/12$, wherein Mn is the month in which the state Governor election took place. The data on the exact date on which the elections are held in each state are obtained from the state elections results and information published by Institute of Marketing and Opinion (IMO) in Jalisco,

	Mexico.
State per capita GDP (log)	Own calculation using data on state-level GDP and population. Values are in U.S. dollars, constant prices 2003. The data on State GDP are form the National Accounting System and the population data are from the 1990, 2000, 2010 population censuses, and population surveys 1995, 2005. All data are provided by INEGI.
State GDP Growth	Rate of growth of each State GDP. The data on State GDP are from the National Accounting System and are provided by INEGI.
Population	Population of each State and the Federal District. All data are from the 1990, 2000, 2010 population censuses, and the 1995 and 2005 population surveys done by INEGI.

Appendix 4: Collection and categorization of the federal crime data

The criminal procedure system in Mexico classifies crimes to be recorded under two broad categories namely, federal crimes and common crimes. The federal crimes include criminal activities associated with drug violence and other forms of organized crime; homicide; blocking of roads; possession, use and sale of weapons; piracy; illegal migrant and other human trafficking; falsification of documents; and kidnapping. Common crimes on the other hand include such crimes as sexual harassment; stealing of animal livestock; property expropriation; theft; rape; and domestic violence. While federal crimes are prosecuted in Mexico under the Federal Penal Code, the common crimes are adjudicated under the Penal Code of the respective states in which the offence took place.[17] The focus of this study is federal crimes only, which are typically associated with large-scale organized crime.

The criminal procedure system in Mexico specifies that when a crime incident occurs the investigative agencies decide whether the particular crime committed falls under the category of federal or common crime. If the crime is identified as a federal crime, the agents of the Federal Public Ministry together with the judiciary police start a preliminary investigation into the incident. The incident is then and there recorded as a federal crime. The investigative agencies are then required to investigate the crime, and maintain detailed records of the progress of the investigation. During such investigation, they may question or arrest any suspects. Based on the preliminary investigation and evidence gathered, the agencies decide to either approach the judiciary court or dismiss the case (typically due to lack of sufficient evidence against the suspect(s)). If the investigative agencies decide to approach the judiciary court, all arrested individuals must be produced before a judiciary court and charged with a specific federal crime within 48 hours of the decision, or be

[17] On December 2nd, 2012, the incoming Mexican President together with the two principal opposition political parties PAN and PRD, signed a document called "Pact for Mexico" as a part of larger judiciary reforms. One of the main features of this pact included the introduction of a single Penal Code and a single Penal Procedures Code for the entire country.

released. The investigative agencies must submit a report to the judge which details the results of the investigation. Based on this report, the judge makes a decision about whether there are sufficient grounds for proceeding with a criminal case. If s/he so rules, a formal ruling is announced, detailing the offence with which the accused is charged. If the judge on the other hand concludes that the report from the investigative agencies does not provide sufficient reasons to frame a charge, the case is dismissed. Our dependent variable captures the number of incidents at the state level recorded as federal crimes for which at least one young male aged 18-24 is suspected of the crime, and has been arrested.

The state level crime data are collected by the Instituto Nacional de Estadística y Geografía (The National Institute for Statistics and Geography, INEGI). INEGI was formed in 1983 as a part of Ministry of Finance. In 2005, it was separated from the Ministry of Finance and became an autonomous institution. Its main task is to conduct regular population and economic censuses across Mexican states and municipalities. INEGI also collect and process all forms of crime data on a monthly basis based on input from the courts at the state level. Through its website, it provides data on crime incidents by suspected perpetrators for different age groups, from 1990 to 2010. The reported categories changed somewhat between 2008 and 2009. For both periods, there is a distinction between the "register year" and the "occurrence year". The former represents the year in which a crime was registered by the court of justice and the latter records the year in which the crime actually took place. The count based on 'register year' includes crimes dating back before 1990, hence we have relied on the 'occurrence year' data only. For this category we observed a sudden jump in crime figures across all age groups in 1997, and assume that data prior to 1997 has been subject to significant under-reporting.[18] Therefore, we only consider crime data starting in 1997.

[18] While data prior to 1997 appears to be significantly under-reported, INEGI recognizes that not every crime is reported, hence there could be a bias due to under-reporting for the period covered by this analysis (Síntesis Metodológica. Estadísticas Judiciales en Materia Penal, p. 6). However, we have no information suggesting that

such underreporting could systematically bias the relationships that we are studying. Furthermore, systematic time period or geographical biases should in principle be picked up by the time and state specific dummy variables respectively.