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Keywords: *youth, violence, crime prevention, spatial econometrics.*

GJHSS-E Classification: *JEL Code: J13, Z13, K42*



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I. Introduction

For decades, most Latin American countries have suffered high rates of violence and insecurity, to the extent that violence (intentional and unintentional) is the leading cause of death in the 15 to 50 years old population group (Trucco and Ullmann, 2015). For many years, Mexico seemed to be isolated from the wave of violence in Latin America (violence in Mexico used to be focalized in few states and it was associated to "account adjustments" between organized crime groups). However, after 2008, violence in Mexico increased greatly in almost all states (Banxico, 2012).

Mexico is now in a crisis of violence. For example, between 2017 and 2018, the intentional homicide rate in the country increased 14% to reach the alarming level of 27 deaths per 100,000 inhabitants; climbing from the 19 to the 16 place of the list of 230 countries by intentional homicide rate of the United Nations Office on Drugs and Crime (UNOCD, 2018).

The problem is higher at the state and city levels. Some Mexican states present extremely high homicide rates; higher than the most violent countries in the world like El Salvador that recorded in 2017 a crime rate of 61.8 deaths per 100,000 inhabitants. In 2018, the Mexican state of Colima recorded a homicide rate of 95.41 and the state of Baja California recorded a homicide rate of 89.44 (IEP, 2019). To understand the seriousness of this numbers, it is relevant to mention that according to the World Health Organization (WHO), a homicide rate higher than 10 per 100,000 inhabitants can be considered an epidemic of violence. In 2018, 23 of the 32 Mexican states recorded homicide rates higher than 12 (IEP, 2019). In addition, UNODC (2011) shows that the increase in the violence in Mexico is related to the geographical area, that is, the most populated cities have higher homicide rates than the rest of the country.

Beyond homicides, violence in Mexico has escalated in all areas. For example, the average rate of crimes committed with violence in Mexico increased 25.4% between 2015 and 2018, and the country´s average rate of domestic violence increased 38% during the same period of time (IEP, 2019). In the same sense, Mexico´s rate of crime prevalence in 2017 averaged 29,746 victims per 100,000 inhabitants; being the State of Mexico (46,705), Mexico City (43,069) and Baja California (36,578), the states with the highest crime prevalence rates (ENVIPE, 2018).

Violence and crime have negative effects and cost for individuals, society and the economy. For example in 2017, according to the National Survey of Victimization and Perception on Pubic Security (ENVIPE for its acronym in Spanish), in economic terms, the total cost of insecurity in Mexican households amounted 299.6 billion pesos or 1.65% of GDP. Similarly, household´s spending on preventive measures against crime registered 89.1 billion pesos or 0.5% of GDP. Other studies report higher estimated costs: The Institute for Economics and Peace (2018) reported that, in 2017, the economic impact of violence in Mexico was 249 billion dollars or 21% of Mexican GDP.

In addition to economic costs, violence and crime generate other types of costs and consequences that can affect victims and criminals for the rest of their

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lives, especially if they are young. Among the negative consequences for young people who are violent and/or who participate in crime activities are: low educational achievement, problematic social relationships, compromised mental health, loss of health, higher victimization rates, and physical harm (Fagan & Catalano, 2012; Buvinic, Morrison & Orlando, 205; Londoño & Guerrero, 1999). Also, violence and crime can contribute to substantially raise morbidity and mortality rates, particularly among young people (Guerrero, 2008; Griffin et al, 1999; WHO, 2002). Following INEGI (2016b), violence is one of the main causes of mortality in Mexico and following WHO (2016) it causes one in three deaths of adolescent boys in Latin America.

Literature agrees that both violence and crime in young people are phenomena caused by multiple factors such as: individual, family, friends, school and neighborhood characteristics (Herrenkohl et al, 2004; WHO, 2002; Jiménez, 2005). Specifically for Mexico, Mancha (2017) finds that two types of factors increase the likelihood of young individuals (14 to 18 years old) to commit violent acts: factors related to addictions (drugs or alcohol) and violence inside home or in the near environment. On the other hand, using a different definition of a violent profile, Mancha et al. (2019) argue that violence in Mexico is transmitted among young individuals mainly throughout their near environment (neighborhood, school, and workplace) rather than by their own individual characteristics.

Crime economics argues that factors such as poverty, inequality, low levels of education and high crime rates make individuals prone to participate in criminal activities (Becker, 1995). Case and Katz (1991), and Freeman (1996, 1999) have strongly documented that variables such as poverty, unemployment, education, age, and income inequality are important factors in the propensity of an individual to commit violent acts. Thus, if illiteracy, poverty, inequality and crime predominate in a specific city, it is likely to affect individual´s propensity to commit violent and crime acts. And if, in turn, this city is surrounded by other similar cities, there may also be a spatial effect on the violent behavior of individuals.

The concept of influence between regions leads to the use of spatial dependence models, where the idea of adjacency or proximity is key as it is possible that the characteristics of a region affect the characteristics of regions that share a border or that are a certain distance (Elffers, 2003).

The objective of this paper is to study the impact the different environmental factors that could affect the violent behavior of young individuals (14 to 24 years old) in Mexico, including city level factors, such as poverty, unemployment, or lack of access to social security. Furthermore, the use of city level observations allows us to inquire into the spatial interaction of city characteristics and youth violence. That is, cities with high (or low) levels of youth violence or youth delinquency increase (or decrease) the levels of youth violence or youth delinquency in neighboring cities and vice versa. If the hypothesis of spatial interaction is corroborated, it would be necessary to use econometric methodologies to control for the spatial autocorrelation in order to obtain unbiased estimators of the effects of the city´s environment on youth violence in Mexico.

In addition, this paper aims to contribute to increase the knowledge of youth violence in Mexico. The results will allow us to have empirical evidence for the design and targeting of public policies that reduce youth violence and increase the welfare of the Mexican youth.

II. Background

The issue of youth and the problems young people face (lack of opportunities of employment and education, unemployment, informality, teen pregnancy, lack of access to social security, violence, among others) have begun to be relevant among researchers and policy makers in Mexico. On the issue of youth violence and youth crime, it is observed that young Mexicans are more frequently involved in violent and criminal acts, including drug trafficking, organized crime, kidnapping, and homicides. In addition, the age of those who participate in these kinds of acts has been decreasing during the last years.

Although public opinion agrees that the participation of young people in violent and crime acts is becoming more frequent in Mexico, statistical information to corroborate such believes is very limited, without continuity or very recent, and usually dispersed in different (and not always comparable) databases. Also, in many cases, the age of the offender or the victim is not among the data, so it becomes difficult to conduct studies that focus on young people.

This lack of data is one of the causes of the very limited number of academic research from a quantitative approach to the issue of violence and youth in Mexico (Cortéz, 2015; González, 2014). Most existing studies on violence and youth in Mexico are of a qualitative nature and with a sociological, psychological or case study approach. The research presented in this paper aims to collaborate to the understanding of violence and youth in Mexico from a quantitative point of view, based on information on physical and socioeconomic characteristics and with a public policy approach.

In addition to the lack of data, the fact that violence is a complex issue (there exist numerous forms of violence: gender, sexual, physiological, political, and social, among others) and the fact that in the literature there is not consensus about its definition have contributed to the limited exploration and research of the youth and violence topic in Mexico.

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International literature in different disciplines of the social science that have studied the problem of violence and its causes and consequences among young people have not found an unique response that allows us to explain the phenomenon. Rather, it has been found that violence is a multidimensional problem, where individual, family, friends, and environmental characteristics, as well as experiences and exposure to violence all have an impact on youth violent behavior (Herrenkohl et al, 2004; OMS, 2002; Jiménez, 2005). What is a fact is that violence has been associated with youth over time. According to some theories, violence is inherent in youth since the beginning of civilizations as a form of survival, reproduction or rite (Potts & Hayden, 2010).

Given that youth is a period of preparation for life in which individuals accumulate capacities and form social networks so that they can be properly inserted into the social fabric as adults; it could be said that the adequate inclusion in society depends on what is done or not done during this stage of life (Hopenhayn, 2008). Thus, if a person does not respect the law and social norms when young, she/he will hardly do so as an adult; if a young person falls into addiction, violence or crime problems, it gets very difficult to reverse the process as an adult.

Also, the behavior of young people can have an effect of network economies. For example, if many young people are involved in crime activities and other young people observe that the social cost of been involved in such activities is low, there exist a kind of "contagion" towards new young people to get involved in such crime activities. For example, if being dishonest or corrupt has a low moral hazard, more and more young people will accept and abide this mentality. If, on the contrary, young people are formed in environments of values, healthy relationships, and respect, where work and education are important tasks to achieve a better future, and where the moral hazard of committing violent acts is high, both individual and social benefits will be obtained. Hence, young people can contribute to trigger economic growth and social development in their locality and their country (Mancha, 2017).

All these indicate the need to find a way to reduce the likelihood of young people to start their participation in violent and criminal activities. To do so, it is necessary to carry out empirical studies that allow us to identify the contributing factors as well as the mechanisms and instruments that help us prevent the participation of young people in violent and criminal acts. Moreover, it is necessary to generate more information and data at the city and neighborhood level that allow us to understand the phenomenon and to design targeted public policies aimed at reducing youth violence and crime.

III. Literature Review

Violence is the result of a complex network of factors, none of which has an explanatory power on its own and since they are related to each other, it is important to recognize them and know that they do not always occur simultaneously or influence in the same way (Escotto, 2015).

Literature constantly argues that young people exposed to violence (either as witnesses or as victims) are at great risk of developing aggressive and violent behavior patterns. Fehon (2007) and Soto and Trucco (2015) state that domestic violence (including having drug or alcohol abusing parents or having very strict parents), as well as violent neighborhoods are risk factors for triggering violent behavior in the young. Fehon (2007) and Aizer (2009) complement that the exposure of young people to violence and its relationship to problems such as depression, anxiety, post-traumatic stress, alcohol or drug use, aggressive behavior, crime, low academic performance or suicide is frequently documented. And, Fehon (2007) remarks that the continued exposure to violence, whether in the home, neighborhood, school, or media promotes among young people the belief that aggression and violence are normal and acceptable behaviors, thereby increasing its potential for aggressive responses.

Although it has been shown that the structural characteristics of the family (such as size or income) are also important to determine a violent behavior of young people, there is evidence that parental practices have a greater impact on the problem (Kotchick & Forehand, 2002; Stern & Smith, 1995). Fagan (2013), Fagan et al. (2011) and Hoeve et al. (2009) show, using experimental evaluations, that parental practices affect the degree to which adolescents engage in substance use, crime and violence. In addition, Fehon (2007) documents that young people exposed to high levels of violence in their community but living in families with a high degree of cohesion, structure, effective parental practices and strong family ties are less likely to engage in violent behavior than young people who live in more dysfunctional families.

Some authors agree that the economic and social environment in which young people live is one of the main modelers of their behavior (Jencks & Mayers, 1990; Case & Katz, 1991; Plotnick & Hoffman, 1995). Brown (1990) and Brown, Clasen and Eicher(1986) argue that friends, access to resources, distractors, opportunities, exposure to inequality or violence, etc. provoke in the young people behavioral patterns, both positive and negative, that are reflected both in the decisions they make, and in the activities they carry out.

With respect to the environment of the city, various studies highlight the importance of city characteristics such as poverty, inequality, home ownership, as well as the presence of adequate places

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to promote a healthy development of children and youth (sport areas, schools, health clinics, shopping centers) or places that are a source of bad influence (bars or night clubs), are factors that contribute to determining violent and criminal behavior (Kelly, 2000; Levitt & Lochner, 2001; Glaeser et al., 1996; Anselin et al., 2000; Lagrange, 1999).

Akerlof (1997), Akerlof & Kranton (2000), Crane (1991) and Glaeser and Scheinkman (2001) remark that individuals make decisions not only based on their own preferences, but also considering the preferences of their reference group. Wilson (1987, 1996), Massey and Denton (1993), Granovetter (1995) and Jargowsky (1997) argument that if the habitants of a neighborhood show little commitment to work or study, individuals in particular also tend to show little commitment to such activities. And Kain (1968), Offner and Saks (1971), Leonard (1987), Ellwood (1986) and Raphael (1998), using spatial mismatch models, add that individuals who live in segregated neighborhoods work and study less because they have less access to jobs and educational opportunities.

Finally, studies examining the spatial distribution of crime (Anselin et al., 2000; Kakamu et al., 2000; Lagrange, 1999) have shown that certain urban land uses and city characteristics are associated with criminality clusters known as "hot spots". Lagrange (1999) finds a marked concentration of criminal incidence in areas close to other areas that have high levels of unemployment. Elffers (2003) adds that spatial effects are relevant when studying the phenomenon of crime since crime also depends in part on the characteristics of nearby neighborhoods and communities. The author stipulates that the probability of being a criminal is not only determined by family and neighborhood characteristics, but also by the proximity to other communities with high criminal levels.

In Mexico, quantitative studies on violence and youth are limited. Some studies focus on the relationship between victimization and youth and others between crime and youth, but there are practically no studies that quantitatively review the relationship between a violent environment and the consequent violent behavior of young people. One reason for this lack of research is that until 2014, there was not a database that allowed exploring statistically the relationship between violence and youth. In 2015, the Mexican Institute of Statistics and Geography (INEGI) published the Social Cohesion Survey for the Prevention of Violence and Crime (ECOPRED 2014). Once the ECOPRED 2014 was available, new investigations in the subject emerged (Rendón, 2015; Frías & Finkelhor, 2017; Vega-Cauich et al., 2018; Mancha & Ayala, 2018). ECOPRED 2014 is the first database that focuses on exploring the conditions of violence in homes in Mexico.

An early work that related qualitatively the environment and the juvenile delinquency in Mexico is Jimenez (2005). The author argues that the growth of youth violence is linked to the poor economic performance of the country and to the interrelation between poverty and education. In addition, the author suggests that reducing delinquency among young people requires the commitment of the State to ensure a decent life for young people and their families.

Recently, Jusidman et al. (2016) find that the violence growth in Mexico is related, among other things, to the concentration of young people in poorly planned urban environments without infrastructure and without sufficient services. The authors argue that the extensive and unequal growth of cities in Mexico have favored the emergence of youth violence. The authors state that confined people in small spaces inside and outside their homes and the lack of public spaces such as parks, sport fields or green areas have generated "a crisis of coexistence and social cohesion" in Mexico. This lack of social cohesion reduces the possibilities for people to live together and to create bonds of trust as a form of social capital.

IV. The Data

This paper uses information from the Social Cohesion Survey for the Prevention of Violence and Crime (ECOPRED 2014) and from the Mexican Intercensal Population Survey (CONTEO 2015). Both databases were made and published by the Mexican Institute of Statistics and Geography (INEGI).

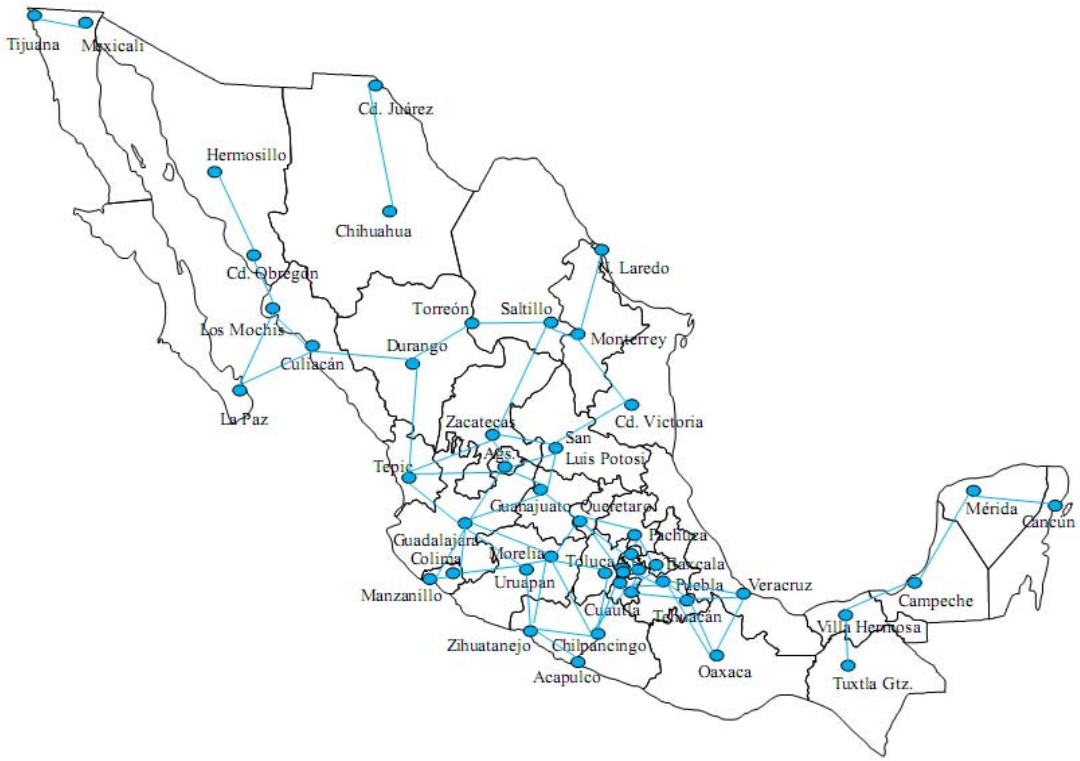
The ECOPRED 2014 was created with the objective of measuring the risk factors and the situations of exposure to violence and crime that increase the possibility that young population aged 12 to 29 in Mexico replicate similar situations in society later. These factors include the individual context of young people; development and relationships within their families; the influence and interaction with friends and peers; and relationships among members of a community, as well as the social context in general. ECOPRED 2014 is a household oriented survey and is divided in two questionnaires: one applied to the head of household and other applied to the young.

ECOPRED 2014 contains information on young people and their families, friends and neighbors from 997,754 households in 47 cities in Mexico. Information includes characteristics, habits and behavior of the young people, their relationships within and outside their family, the influence and interactions with friends and colleagues in the neighborhood, work and school, the relationships with other members of the community and their perspective of the social context in general. The population that lives in the 47 cities considered in the study is 41 million, which represents around 35 percent of the total population in Mexico. ECOPRED 2014 does not contain information on income, expenditure, job occupation or other socioeconomic characteristics of

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the family. Figure 1 displays the geographical location of the 47 Mexican cities considered in the ECOPRED 2014. The lines that connect them represent cities that are less than 300 kms (187 miles) away of each other.

CONTEO 2015 is the intercensal survey carried out to upgrade the socio-demographic information of the Mexican population between the 2010 and 2020 population censuses. The 2015 intercensal survey gathered information from 6.1 million households. Such a sample size allows us to make inferences about socioeconomic, demographic, and physical characteristics of households at the municipality level and for each one of the Mexican towns larger than 50,000 inhabitants. Information such as average incomes, unemployment rates, fertility rates, or access to water are obtained from this survey.



Source: Own elaboration with data from ECOPRED 2014.

Figure 1: 47 Mexican cities included in the ECOPRED 2014.

It is important to notice that with the information provided by the ECOPRED 2014 it is not possible to know whether a young individual is a criminal or not, but is possible to identify violent behaviors and factors that could be associated with such violent behaviors. Despite its restrictions, this database allows us to conduct a cross-sectional study to inquire into the effects of the characteristics of the neighborhood and the city on the average violent behavior of young people in Mexico. This study is bounded to people between 14 and 24 years old, because there is evidence in the literature that it is in the adolescence and early youth when people begin to engage in violent and criminal activities (Farrington, 2003; Snyder & Sickmund, 2006; Fagan et al., 2011).

V. Descriptive Statistics

Since there is no consensus in the literature on the definition of violence and even less on the definition of youth violence, we adopted the operational definition of Wright and Fagan (2013). Wright and Fagan (2013) define violent acts such as: throwing objects at someone, hitting someone, carrying a weapon or attacking with a weapon, being involved in a gang fight, and committing robbery. With the information that is possible to obtain from the ECOPRED 2014 and seeking to keep this operational definition, we use the following city average variables for young individuals aged 14 to 24, as proxies for youth violence for the 47 self-represented cities considered in ECOPRED 2014: 1) percentage of young people shouting at others (in situations of discussion or conflict); 2) percentage of young people hitting objects (to calm down); 3) percentage of young people hitting people (in situations of discussion or conflict); 4) percentage of young people carrying weapons such as knifes or guns (as a method of defense or to be respected); and 5) percentage of young people who have been arrested.

To make sure that all five variables used as proxy of committing violent acts are different from each

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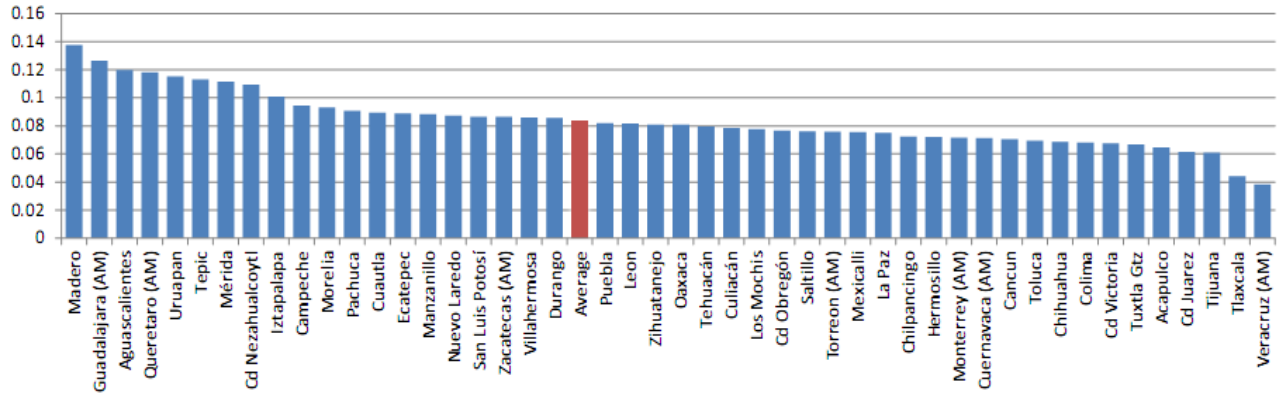
other, simple correlations between these variables were obtained. As we can see in Table 1, all correlations between the five dependent variables are low. The highest correlation values are 0.55 between carrying weapons and having been arrested and 0.44 between carrying weapons and hitting objects.

Table 1: Dependent Variables, correlation coefficients.

	Shouting	Hitting objects	Heating people	Weapons	Arrested
Shouting	1				
Hitting objects	0.3621	1			
Hitting people	0.3625	0.1136	1		
Weapons	0.2449	0.4418	0.4183	1	
Arrested	0.1665	0.3458	0.1629	0.5562	1

Source: Own estimations with data from ECOPRED 2014.

Figure 2 presents the percentage of young people (14 to 24 years old) who report committing the violent act of shouting for the 47 cities reported in ECOPRED 2014. In average, 8.4 percent of all young people in this study reported shouting at others in situations of discussion or conflict. The cities of Gustavo A. Madero (inside Mexico City) and Guadalajara presented the highest percentages with 13.8 and 12.6 respectively while Tlaxcala and Veracruz presented the lowest percentages.



Source: Own estimations with data from ECOPRED 2014

Figure 2: Percentage of youth shouting at others, by city.

The cities with the largest populations are Guadalajara (4.5 million), Monterrey (4 million) and Iztapalapa (inside Mexico City) (2 million), but the cities with the highest percentages of young people are Tlaxcala (32.9%), San Luis Potosí (26.3%), and Cd. Victoria (26.1%). The average percentage of young people in the 47 cities considered is 20.8 percent.

Table 2 reports descriptive statistics for the five variables used as proxy of committing violent acts. In average, for the whole sample of 47 cities, 8.4 percent of young people shout at others, 8.9 percent hits objects to calm down, 4.5 percent hit other people, 3.1 percent carry weapons such as knifes or guns and 6.8 percent have been arrested. It is interesting to notice that a higher percentage of young people report being arrested than carrying weapons or hitting other people. Been arrested could result from other violence risk activities such as drinking alcohol or using drugs.

Table 2: Dependent Variables, descriptive statistics.

Variable	Obs	Mean	Std Dev	Max	Min	I-Moran
Shouting	47	8.4%	0.0201	Madero (13.7%)	Veracruz (3.8%)	2.69*
Hitting objects	47	8.9%	0.0183	Mexicali (13.5)	Cd. Juárez (5.7%)	3.17*
Hitting people	47	4.5%	0.0219	Aguascalientes (10%)	Tijuana (1.2%)	2.72*
Weapons	47	3.1%	0.0113	León (7.1%)	Culiacán (1.1%)	2.26
Arrested	47	6.8%	0.0271	León (14.3%)	Villahermosa (2.1%)	3.88**

Source: Own estimations with data from ECOPRED 2014.
*Statistical significance level: ** 95%; * 90%.*

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The three cities with the highest percentages of young people who report shouting are Gustavo A. Madero (inside Mexico City) (13.7%), Guadalajara (12.6%) and Aguascalientes (11.9%) and the three cities with the lowest percentages are Tijuana (6.1%), Tlaxcala (4.4%) and Veracruz (3.8%). The three cities with the highest percentages of young people who report hitting objects are Mexicali (13.5%), Uruapan (12.3%) and Guadalajara (11.9%) and the three cities with the lowest percentages are Ecatepec (part of Mexico City´s Metropolitan Area) (5.8%), Tlaxcala (5.7%) and Ciudad Juárez (5.7%). The three cities with the highest percentages of young people who report hitting other people are Aguascalientes (10%), Morelia (9.3%) and Nuevo Laredo (9%) and the three cities with the lowest percentages are Zacatecas (1.7%), Ciudad Obregón (1.5%) and Tijuana (1.2%). The three cities with the highest percentages of young people who report carrying weapons are León (7.1%), Hermosillo (4.9%) and Tehuacán (4.8%) and the three cities with the lowest percentages are Acapulco (1.4%), Tuxtla Gutiérrez (1.4%) and Culiacán (1.1%). Finally, the three cities with the highest percentages of young people who report being arrested are León (14.3%), Aguascalientes (12.6%) and Manzanillo (12.2%) and the three cities with the lowest percentages are Acapulco (3.1%), Nezahualcoyotl (part of Mexico City´s Metropolitan Area) (2.6%) and Villahermosa (2.1%). The cities of Guadalajara, Aguascalientes and León appear at least two times at the top three of the lists. On the other hand, the cities of Tijuana, Tlaxcala and Acapulco appear at least two times at the bottom of the lists.

The last column of table 2 reports a measure of spatial autocorrelation that is widely used in the literature to know the spatial concentration of a certain variable: the I-Moran Chi-2 statistic (Cliff & Ord, 1973). Although the I-Moran statistic does not indicate magnitude, it can be noticed that four of the five dependent variables have a significant global spatial autocorrelation.

From the questionnaires of the ECOPRED 2014 we selected 15 independent variables (*X*) that represents city´s average characteristics of the young people (14 a 24 years), their families, their friends, their neighbors, their coworkers and their classmates; and from the CONTEO 2015 database we obtained 6 independent variables (*Z*) that account for social and economic conditions of the city. Some other variables available in ECOPRED 2014 and CONTEO 2015 were not considered due to the high collinearity with the variables already included or the high number of missing observations. Appendix Table A1 presents a brief description of each variable selected.

Table 3 shows the descriptive statistics of such independent variables. The top section describes the city level variables obtained from ECOPRED 2014. The average city has 51 percent of young men, 61 percent of their youth live in a home with both parents, 62 percent study and only 38 percent work fulltime. With respect to youth activities, 49 percent report exercise regularly, 26 percent report ever getting drunk, 8 percent report having used a soft drug such as marijuana, and 3 percent report having used hard drugs such as cocaine. 29 percent of young people declare being bullied and 28 percent declare being robbed. With respect to their environment, 38 percent of young people admit that at home their family push, shut or criticize, 3 percent admit that in their house there is at least a person who dinks, smokes, uses drugs or bets a lot, 47 percent report having at least a friend who drinks alcohol, smokes, takes drugs, commits violent acts, carries weapons or has been arrested, 49 percent declares that in their neighborhood there is graffiti, people drinking in the streets or people playing music at a very high volume, and 43 percent comment that in their school or work there is physical or verbal violence or there is alcohol or drug use.

Table 3: Independent Variables, descriptive statistics.

Variable	Obs.	Mean	Std. Dev.	Min	Max	I-Moran
Males	47	0.51	0.029	0.45	0.58	0.00
Both parents	47	0.61	0.044	0.53	0.70	4.35**
Study	47	0.62	0.059	0.46	0.72	0.00
Work	47	0.38	0.057	0.27	0.55	0.00
Sports	47	0.49	0.051	0.38	0.60	0.83
Drunk	47	0.26	0.049	0.17	0.34	10.19***
Soft drugs	47	0.08	0.028	0.04	0.15	1.27
Hard drugs	47	0.03	0.011	0.01	0.05	0.12
Bullied	47	0.29	0.042	0.20	0.37	0.31
Robbed	47	0.28	0.066	0.18	0.47	45.12***
Violent family	47	0.38	0.047	0.27	0.50	1.85

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Vicious family	47	0.03	0.012	0.01	0.07	1.61
Bad friends	47	0.47	0.065	0.37	0.61	8.78***
Bad neighbors	47	0.49	0.099	0.29	0.72	2.94*
Bad school	47	0.43	0.061	0.27	0.55	52.19***
Poverty	47	0.42	0.088	0.25	0.66	7.92***
Education gap	47	0.16	0.040	0.08	0.28	3.47*
Health	47	0.29	0.082	0.12	0.44	51.57***
Social Security	47	0.50	0.093	0.30	0.69	47.05***
Services	47	0.10	0.089	0.01	0.37	8.46***
Unemployment	47	0.04	0.008	0.02	0.06	0.33

Source: Own estimations with data from ECOPRED 2014 and CONTEO 2015.
*Statistical significance level: *** 99%; ** 95%; * 90%.*

The bottom section of table 3 lists the city level independent variables obtained from CONTEO 2015. The first five variables presented are official numbers calculated by the Mexican Council for the Evaluation of Social Development Policy (CONEVAL) and the last variable was calculated directly from the CONTEO 2015 database. The average city has 42 percent of its population living with an income below CONEVAL´s poverty line, 16 percent of its 3 to 15 years old population do not attend a formal education center (education gap), 29 percent of its population do not have access to any public or private health care or health insurance, 50 percent do not have access to social security, and 10 percent do not have access to basic services (water, drainage, electricity and gas). For a better description of CONEVAL´s multidimensional poverty measures please refer CONEVAL (2010). The average city has an unemployment rate of 4 percent.

In order to verify the absence of multicollinearity in the regressions, simple correlations between independent variables were obtained and the statistical VIF tests were performed. In general, correlations are low. The average correlation is 0.28 and the highest correlations is 0.65 between the percentage of young people who report that in their neighborhood there is graffiti, people drinking in the streets, or people playing music at a very high volume (Bad neighbors) and the percentage of young people being robbed (Robbed). In the VIF tests, the values for all the independent variables do not exceed 6 and have an average value of 3.72. VIF values are not high, since it is considered that there is evidence of multicollinearity when the VIF value is greater than 10. In order to save space, correlation coefficients and VIFs are not presented but can be provided by the authors upon request.

VI. Empirical Strategy

According to Elffers (2003), the propensity of an individual to commit a violent act can be explained by the characteristics of the social and economic environment in which people live and by the characteristics of the surrounding regions. Therefore, the rates of violence and criminality in a city depend on the characteristics of the city and its inhabitants, as well as on the influence of nearby cities.

In order to estimate the impact of certain factors on the probability that a young person between 14 and 24 years old commits a violent act, we specify the following linear regression model corrected by a possible spatial dependence of the data:

$$Y=X\beta+Z\gamma+\varepsilon$$

where Y is one of the five city proxies for youth violence: 1) percentage of young people shouting at others; 2) percentage of young people hitting objects; 3) percentage of young people hitting people; 4) percentage of young people carrying weapons such as knifes or guns; and 5) percentage of young people who have been arrested; X is the vector of characteristics of the young people of the city, including their families, friends, neighbors, coworkers and classmates listed in table 3 and explained in Appendix Table A1, Z is the vector of characteristics of the city such as poverty measures or unemployment, and ε is an error term.

To consider the possible spatial autocorrelation or spatial dependence of the data, we assume that geographically located observations are related to nearby observations following certain patterns. Thus, to handle the possible correlation of the data, the use of spatial econometric techniques is needed. It is worth to mention that if the existence of spatial autocorrelation is identified, if it is not controlled, there is a risk of obtaining biased estimators, which would lead us to make erroneous inferences (Dubin, 1998).

Hence, the relationship between the percentage of young people committing violent acts within a city and the own characteristics of the city should be measured considering that the percentage of young people committing violent acts depends also on the percentage of young people committing violent acts in nearby cities as well as other spatially correlated unobservable characteristics; as follows:

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$$Y = \rho WY + X\beta + Z\gamma + \varepsilon \text{ where } \varepsilon = \lambda W\varepsilon + u \text{ and } u \sim N(0, \sigma^2 I_n)$$

where ρ is a scalar and represents the spatial dependence parameter, and W is a matrix of spatial weights. The error vector ε follows a spatial autoregressive process, where λ represents the parameter of spatial dependence of the errors. Finally, u is a vector of residuals that are distributed normally. It is important to mention that the term WY generates a regression bias, so it must be estimated by Maximum Likelihood instead of OLS (Anselin, 1998; Lee, 2004).

If it is thought that spatial dependence is inherent only to the dependent variable (observable factors), then we have a model known as SAR or Spatial Autoregressive Model, where λ=0. If it is thought that spatial dependence exists only through the error term, that is, when there are omitted, non-measurable or unobservable variables that relate to nearby regions, then we have a model known as SEM or Spatial Error Model, where ρ=0.

The first step when applying spatial econometrics is to define what is considered as a neighbor city, because this definition will allow us to construct a spatial weights matrix (W) to observe spatial correlation patterns. There is not an optimal distance in the literature to consider two cities as neighbors. We experimented with different distances; however, distances lower than 200 kilometers decreased considerably the number of defined neighbor cities reducing the capacity of the model to capture spatial effects; and distances over 400 kilometers increased the number of neighbor cities to almost all cities reducing also the capacity of the model to capture spatial effects. Hence, in this paper we consider a city as a neighbor city if the geographical distance between two cities does not exceed 300 kilometers (187 miles). We also used the inverse distance between cities to construct the spatial weights matrix, however, we didn´t find a good fit with this measure.

Once the spatial weights matrix (W) is defined, the next step is to define if the spatial autocorrelation in the model is due to observable factors (SAR), factors inherent to the error term (SEM), or both. Two popular statistics used in the literature to choose the spatial econometric model that best explains the spatial behavior of the data are the I-Moran Chi-2 statistic and the individual statistical significance tests for the spatial dependence parameters λ and ρ (Anselin, Bera & Florax, 1996).

Table 4 presents the I-Moran statistics and the individual dependence parameters significance tests for our definition of spatial influence: 300 kilometers. Based on the results in Table 4 we can conclude that there is spatial autocorrelation and that in the case of the violence definitions of shouting, hitting objects and arrested the most appropriate spatial autocorrelation model is the SEM model; while in the case of the violence definitions of hitting people and weapons we decided to include both SEM and SAR spatial effect components in the model.

Table 4: Spatial Autocorrelation Analysis.

	I-Moran Statistics		Individual spatial coefficients	
	SEM	SAR	SEM (λ)	SAR (ρ)
Shouting	2.69 *	2.71 *	-2.681424 ***	-0.1001718
Hitting objects	3.17 *	0.21	-5.254902 ***	0.0496059
Hitting people	2.72 *	1.99	-2.045442 ***	-0.4048513 **
Weapons	2.26	0.46	-6.751464 ***	-0.2538469 **
Arrested	3.88 **	14.75 ***	-4.230271 ***	0.031207

Source: Own estimations with data from ECOPRED 2014 and CONTEO 2015.
*Statistical significance level: *** 99%; ** 95%; * 90%.*

The empirical strategy considers the regression estimation of two models. The first model ignores the presence of spatial autocorrelation (OLS) while the second model controls for the spatial behavior of the data (SEM or SEM+SAR, depending on the violence definition).

VII. Results

Table 5 displays the regression results without controlling for the presence of spatial autocorrelation (OLS) while table 6 displays the regression results controlling for the spatial behavior of the data (SEM or SEM+SAR) for the five definitions of youth violence: 1) percentage of young people shouting at others; 2) percentage of young people hitting objects; 3) percentage of young people hitting other people; 4) percentage of young people carrying weapons such as knifes or guns; and 5) percentage of young people who have been arrested.

The first thing to note is that the five OLS regressions present considerably fewer numbers of significant variables and relatively lower R-square

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statistics. Also, OLS coefficients are consistently smaller and the F-statistic for hitting people is not statistically significant. These differences confirm that if we do not control for the presence of spatial autocorrelation, we will obtain biased estimated coefficients, as well as relatively lower goodness of fit.

Table 5: OLS regression results.

	Shouting	Hitting Objects	Hitting People	Weapons	Arrested
Males	-0.1162	0.1840*	-0.215	0.0233	0.0131
Both parents	0.1678*	0.0456	0.134	0.078	0.1233
Study	0.0252	0.014	-0.0141	-0.0028	0.0074
Work	-0.0617	-0.0214	0.0054	0.0156	0.1123
Sports	-0.0191	-0.1112*	0.0065	-0.0374	0.1176
Drunk	-0.018	0.0213	0.0912	0.0803*	0.0678
Soft drugs	0.1189	-0.0346	0.0241	0.0343	0.2486
Hard drugs	-0.3207	0.4008	-0.2757	0.1205	0.0849
Bullied	0.036	0.1438	0.1243	0.0222	0.1466
Robbed	-0.1295	-0.1264*	0.1790*	0.0249	-0.1147
Violent family	-0.0096	0.0804	0.0577	0.0515	-0.0152
Vicious family	0.4385	-0.0253	-0.4395	0.1848	0.1374
Bad friends	0.1055	0.0941	0.1779	0.0088	-0.0466
Bad neighbors	0.1032*	0.0932*	-0.0959	0.0056	0.0928
Bad school	0.0044	-0.1263	-0.0597	-0.0686	-0.1135
Poverty	0.0662	0.0708	0.0355	0.0639*	0.0523
Education gap	0.0664	-0.0491	-0.1666	-0.0738	-0.0073
Health	0.0062	0.0111	-0.1272	-0.0092	-0.0642
Social Security	0.054	0.0144	0.1401*	0.0112	-0.0346
Services	-0.0416	0.0729	0.0485	0.0249	-0.044
Unemployment	-0.7708	-0.4381	0.281	-0.5981*	-0.4195
Constant	-0.0615	-0.0896	-0.0845	-0.0566	-0.11
N	47	47	47	47	47
F	2.0787**	2.3579**	1.6044	2.5732**	2.2312**
adj_R2	0.33	0.3827	0.2163	0.418	0.3598

Source: Own estimations with data from ECOPRED 2014 and CONTEO 2015.
*Statistical significance level: *** 99%; ** 95%; * 90%.*

For example, with respect to the violent act of shouting, the OLS estimated coefficient of Bad neighbors in table 5 indicates, with a statistical significance of 90%, that an increase in one percentage point in the percentage of young people who report that in their neighborhood there is graffiti, people drinking in the streets, or people playing music at a very high volume increases the percentage of young people shouting at others in 0.10 percentage points. On the other hand, coefficient of Bad neighbor in the spatial autocorrelation model (SEM) presented in table 6 presents, with a better statistical significance of 95%, a more conservative effect of 0.08.

Given that due to the presence of spatial autocorrelation the SEM and SEM+SAR models present unbiased and more efficient estimators, in the following lines we will discuss the results obtained by the spatial corrected models, leaving the results of the OLS model as a benchmark. The first two rows of table 6 presents the estimated coefficient of the parameters of spatial dependence: λ-lambda for the SEM model and ρ-rho for the SAR model. All coefficients are statistically significant for the five regressions, corroborating the presence of spatial autocorrelation.

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Table 6: Spatial Autocorrelation Adjusted regression results.

	Shouting (SEM)	Hitting Objects (SEM)	Hitting People (SEM+SAR)	Weapons (SEM+SAR)	Arrested (SEM)
λ-lambda	-2.6788***	-5.2538***	-2.0454**	-6.7515***	-6.0074***
ρ-rho			-0.4049**	-0.2538**	
Males	-0.1920***	0.2412***	-0.2072**	0.0313	0.0961
Both parents	0.1220**	0.0145	0.1247*	0.0828***	0.1241**
Study	-0.0846*	-0.0219	-0.0383	0.0346*	0.1172***
Work	-0.1475***	-0.0052	0.0118	0.0229	0.1109**
Sports	-0.0421	-0.1062***	-0.0369	-0.0465**	0.0377
Drunk	-0.081	0.0232	0.2223**	0.0969***	0.1827***
Soft drugs	0.2849**	-0.0924	0.066	0.0883	0.4838***
Hard drugs	-0.2013	0.5294***	-0.7990**	-0.1007	-0.4747*
Bullied	0.0529	0.1876***	0.1066	0.0618*	0.2060***
Robbed	-0.1993***	-0.1377***	0.3073***	0.034	-0.2439***
Violent family	0.004	0.0185	0.1182	0.0483	-0.0421
Vicious family	0.3077	0.2842	-0.8138***	0.2238**	0.6862***
Bad friends	0.1172*	0.0579	0.2482***	0.033	-0.1424**
Bad neighbors	0.0871**	0.0654*	-0.1300***	0.0359*	0.1520***
Bad school	0.1305**	-0.0541	-0.0731	-0.1092***	-0.1776***
Poverty	-0.0115	0.0323	0.0945*	0.1312***	0.1551***
Education gap	0.0693	-0.0106	-0.2809***	-0.1155***	0.079
Health	-0.0658	0.0678	-0.1646***	0.0087	0.0763
Social Security	0.0563	-0.0463	0.1967***	0.0056	-0.1557***
Services	0.0157	0.0345	0.0973**	0.0242*	-0.0847***
Unemployment	-0.1759	-0.4757	-0.1341	-0.9913***	-1.0481**
Constant	0.1038	-0.0519	-0.1285	-0.1169***	-0.1732***
N	47	47	47	47	47
chi2	257.55***	655.76***	105.58***	986.36***	3579.18***
psd_R2	0.5242	0.5518	0.5418	0.6354	0.5414

Source: Own estimations with data from ECOPRED 2014 and CONTEO 2015.
*Statistical significance level: *** 99%; ** 95%; * 90%.*

As we can see in table 6, after controlling for the presence of spatial autocorrelation, having a higher percentage of young men in a city is negatively related to the percentage of young people shouting at others and hitting other people. On the other hand, the percentage of young people living with both parents is positively related to the percentage of young people shouting at others, hitting other people, carrying weapons, and been arrested. Also, the percentages of young people studying and working fulltime are negatively related to the percentage of young people shouting at others but positively related to the percentage of young people carrying weapons and/or been arrested.

These first results are counterintuitive; we may expect young men to be more violent and young people living with both parents, working fulltime or studying to be less violent. Although individual characteristics do play a role in the violent behavior of young people, these counterintuitive results may indicate that other characteristics of the environment play a more active way on the aggregated behavior of young people.

The percentage of young people who practice sports regularly is negatively related to the percentage of young people hitting objects and carrying weapons.

As expected, the percentage of young people who have ever got drunk is positively related to the percentage of young people hitting other people, using weapons and been arrested. The percentage of young people who consume or have used soft drugs such as marijuana, solvents or hallucinogenic mushrooms is positively related with the percentage of young people

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shouting at others or been arrested. And the percentage of young people who consume or have used hard drugs such as cocaine, amphetamines or crack is strongly positively related with the percentage of young people hitting objects; however, this last variable is negatively related to the percentage of young people hitting others and been arrested.

In the same sense, the percentage of young people who report that in their house there is a person who drinks, smokes, uses drugs or bets a lot (Vicious family) is positively related to the percentage of young people using weapons or been arrested. And the percentage of young people who report having friends that drink alcohol, smoke or use drugs (Bad friends) is positively related to the percentage of young people shouting at others or hitting other people.

Although some of the results are counterintuitive (negative coefficients), most estimated coefficients of all variables related to a hostile environment where young people live (Bullied, Robbed, Violent family, Bad friends, Bad neighbors, and Bad school) are positively related to the percentage of young people committing violent acts. For example, the percentage of young people who report that in their neighborhood there is graffiti, people drinking in the streets, or people playing music at a very high volume (Bad neighbors) is positively related to the percentage of young people shouting at others, hitting objects, carrying weapons and been arrested. And for example, a ten percentage points increase in the percentage of young people been bullied increases the percentage of young people hitting objects in 1.8 percentage points, and a ten percentage points increase in the percentage of young people been robbed increases the percentage of young people hitting other people in 3 percentage points.

Finally, the city´s poverty rate, measured by CONEVAL as the percentage of families with income below the welfare line is positively related to the percentage of young people hitting other people, carrying weapons and been arrested. However, contrary to expectations, COVEVAL´s educational gap (Education gap), lack of access to health services (Health), lack of access to social security (Social Security), and lack of access to basic housing services (Services), and the unemployment rate, which are negative indicators (i.e., the bigger the number, the more bad it is), are negatively related to the percentage of people carrying weapons, hitting other people, or been arrested.

VIII. Conclusions

Using data from ECOPRED 2014 and CONTEO 2015 and after controlling for the existence of spatial correlation between the 47 Mexican main cities, this paper studies some of the risk factors and characteristics of the Mexican cities that make young people (from 14 to 24 years old) to develop violent behaviors. We define violent behavior as the execution of the violent acts of shouting at others, hitting objects, hitting people, carrying weapons and have been arrested.

Previous literature of youth violence in Mexico has determined risk factors associated to the propensity of young people to commit violent acts using microdata and conventional econometric analysis. However, this paper incorporates the use of spatial econometrics and corroborates the existence of spatial dependence on youth violence among Mexican cities. It should be remembered that if the spatial correlation is not controlled, there is a risk of obtaining biased results and invalid inferences.

It is found that, after controlling for the existence of spatial dependency among Mexican cities, there are two main types of risk factors associated with the percentage of young people committing violent acts: one has to deal with drug additions of the young people and their families and the other with a violent environment close to them.

In the case of the risk factors related to addictions, it is found that the percentage of young people consuming alcohol and drugs and the percentage of young people who report that in their house there is somebody who consumes alcohol or drugs are positively related to having larger groups of young people committing violent acts. In this way, a public policy aimed at preventing the participation of young people in violent acts should consider addressing the problem of additions (both for young people and for their families).

The other risk factor consistently found in the results is related to the violent environment where young people live. It is found that the percentage of young people who have ever been bullied or robbed and the percentage of young people who report having violent friends, neighbors, coworkers or classmates are positively related to larger percentages of young people committing violent acts. These findings allow us to affirm that violence generates violence and that violence can be considered an epidemic (this is, it is contagious!).

Thus, a public policy that seeks to prevent the participation of young people in violent acts must also focus on combating violence in public places (streets, schools, workplaces) through specific campaigns and programs that promote reporting violent acts to the authorities and that ensure a punishment for those who commit any reported type of violence. Internationally it has been found that family-focused programs such as “schools for parents”, “safe schools” and “drug free schools” have good results in decreasing the percentage of young people participating in violent acts.

Public policies focusing on improving the environment where young people live, mainly in the

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streets, schools and workplaces, as well as reducing the use of drugs and alcohol, will have a direct effect on reducing the violent behavior of young people. In addition, since the existence of spatial effects has been corroborated, individual efforts made by cities to reduce the violence of their youth, in addition to having an effect on their own youth, will have an effect on the violent behavior of youth in nearby cities. Therefore, joint efforts of neighboring cities to fight youth violence could have greater impacts than individual efforts made by single cities.

Finally, it is worth remembering, as discussed in the literature section, that public prevention policies, designed and implemented at the local level, by municipal authorities or by the community, are usually more effective than policies designed from the center of the country and implemented in a generalized way. Likewise, a public policy regarding the prevention of youth violence must be consistent over time and for this it is necessary to have technical capabilities, political will, as well as long-term human and financial resources since the results of an effective violence prevention policy are not visible in the short term.

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Appendix

Table A1: Description of Variables

Variable	Name of variable	Description
Y_1	Shouting	Percentage of young people shouting at others (in situations of discussion or conflict)
Y_2	Hitting objects	Percentage of young people hitting objects (to calm down)
Y_3	Hitting people	Percentage of young people hitting people (in situations of discussion or conflict)
Y_4	Weapons	Percentage of young people carrying weapons such as knifes or guns (as a method of defense or to be respected)
Y_5	Arrested	Percentage of young people who have been arrested
X	Males	Percentage of young people who are men
	Both parents	Percentage of young people living with both parents
	Study	Percentage of young people studying
	Work	Percentage of young people working full time
	Sports	Percentage of young people who exercise regularly
	Drunk	Percentage of young people who have ever got drunk
	Soft drugs	Percentage of young people who consume or have used soft drugs (marijuana, solvents or hallucinations)
	Hard drugs	Percentage of young people who consume or have used hard drugs (cocaine, amphetamines, or crack)
	Bullied	Percentage of young people who have ever been bullied
	Robbed	Percentage of young people who have ever been robbed
	Violent family	Percentage of young people who report that at home their family push, shout or criticize
	Vicious family	Percentage of young people who report that in their house there is a person who drinks, smokes, drugs or bets a lot
	Bad friends	Percentage of young people who report that a friend drinks alcohol, smokes, takes drugs, commits violent acts, hits other people, carries weapons or has been arrested
	Bad neighbors	Percentage of young people who report that in their neighborhood there is graffiti, people drinking in the streets, or people playing music at a very high volume
	Bad school	Percentage of young people who report that in their school or work there is physical or verbal violence, or there is drug or alcohol use
	Poverty	Percentage of families with income below the CONEVAL´s welfare line
	Education gap	City´s CONEVAL´s educational gap

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	Health	City´s CONEVAL´s lack of access to health services
Z	Social security	City´s CONEVAL´s lack of access to social security
	Services	City´s CONEVAL´s lack of access to basic housing services
	Unemployment	Unemployment rate

Source: ECOPRED 2014 and CONTEO 2015.

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