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DETERMINANTS OF VIOLENCE IN MEXICO

Abstract:

This paper determines whether income inequality is the main determinant of violence (measured as the homicide rate) in Mexico, when considering the so-called "hot zones" of the country during the period from 2001 to 2013. By Least Squares in Two Stages (2SLS) with fixed effects, it was found that the main determinants to reduce violence are the increase in the number of students studying the secondary level and the better salary conditions. It was also found that the percentage change in wages is decisive to reduce the level of violence, specifically, a 1% increase in salaries decreases violence levels by 1.19%. As of 2007, the entities belonging to the "hot zones" had a level of violence 0.74% higher than the rest.

Keywords:

Income Inequality, Crime, Instrumental Variables, Mexico

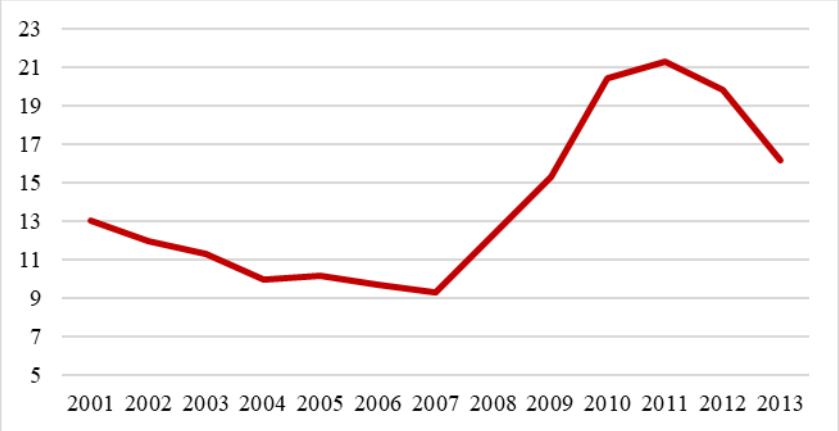
JEL Classification: C36, D31, O54

1 Introduction

Data from the World Bank indicate that the global homicide rate decreased by an average of 22.2% during the period from 2000 to 2013, going from 9.11 to 7.07 homicides per 100,000 inhabitants; however, in Latin America the trend was reversed, since the number of victims related to this type of violence increased by 27% during the same period, from 18.3 to 23.02 homicides per 100,000 inhabitants; although only 8% of the world population lives in Latin America, 37% of homicides in the world occur in this region. These data are worrying not only because of the human losses they represent, but also because violence has an impact on economic activity. In Latin American countries, these effects range from the decrease in the accumulation of productive factors, increases in production costs, and even the deterioration of social infrastructure and legal security (Ospina and Giménez, 2009).

In the case of Mexico, the Inter-American Commission on Human Rights (IACHR, 2015) stated that since 2006 the country is going through a crisis of violence and insecurity, which has left more than 100,000 deaths and disappearances, increasing the average homicide rate by 60% during the period from 2000 to 2011. Graph 1 shows the average homicide rate, in which the afore mentioned increase can be appreciated.

Graph 1. Homicide rate in Mexico. Period 2001-2013.



SOURCE: Personal collection with data from the Executive Secretariat and the National Population Council (CONAPO).

It is also observed that there are three changes in the trend of the homicide rate: from 2001 to 2007 it is decreasing, from 2008 to 2011 during the mandate of President Felipe de Jesús Calderón Hinojosa[1] is growing and reaches its maximum level, due to the

[1] His presidential term ran from December 1, 2006 to November 30, 2012.

establishment of the so-called "war on drugs" in his National Development Plan[1] which aimed to recover the strength of the State and security in social coexistence through the frontal and effective fight against drug trafficking and other expressions of organized crime[2], generating a substantial increase in the rates of violence of the entities called "hot zones"[3].

Several studies have established that socioeconomic inequality is one of the main causes of violence; For example, the World Bank found that in Latin America a 1% increase in the Gini coefficient at municipal level (which measures income inequality) is associated with an increase of 10 homicides per 100,000 inhabitants related to drug trafficking (World Bank , 2014); For its part, the Inter-American Commission on Human Rights (IACHR, 2015) indicated that the regions in Mexico that have the highest rates of poverty, inequality, marginalization, low levels of education and access to precarious basic services are the ones with the highest levels of violence[4].

Given the changes that Mexico has had in its levels of violence, measured as the homicide rate per 100,000 inhabitants, it is important to quantify the impact of socioeconomic determinants such as inequality (measured by the Gini index), poverty indicators, education, prices, income and employment in the levels of violence in Mexico in the period from 2001 to 2013[5] taking into account the entities considered hot zones in order to provide empirical evidence on the factors that reduce violence and thus determine policies that favor the development of the country and the welfare of the population.
The article is ordered in the following way: in the second section a brief review of the literature is presented. In section 3 a description and analysis of the data is made, in section 4 the methodology and the econometric models are explained, in section 5 the description of the results is presented and finally in section 6 are the conclusions of the study.

[1] Goal number 8 of the National Development Plan 2007-2012.

[2] The strategy focused on the deployment of the different federal corporations throughout the national territory in supposedly planned operations.

[3] Includes Chihuahua, Sinaloa, Guerrero, Durango, Nuevo Leon, Nayarit, Morelos, Tamaulipas y Colima.

[4] In Mexico approximately 55 million people live in conditions of poverty and 11 million in extreme poverty (CONEVAL, 2014), this represents almost half of the national population.

[5] 2013 is the last year available.

2 Literature Review

For more than a century and a half, the literature has shown different perspectives and theories about the socio-economic determinants that influence violence, among which we can mention the deterioration of social, cultural and economic conditions, which demand a great effort in the application of policies and the reinforcement of the legal and criminal structure to overcome it (Biekart et al., 2005; Brush, 2007).

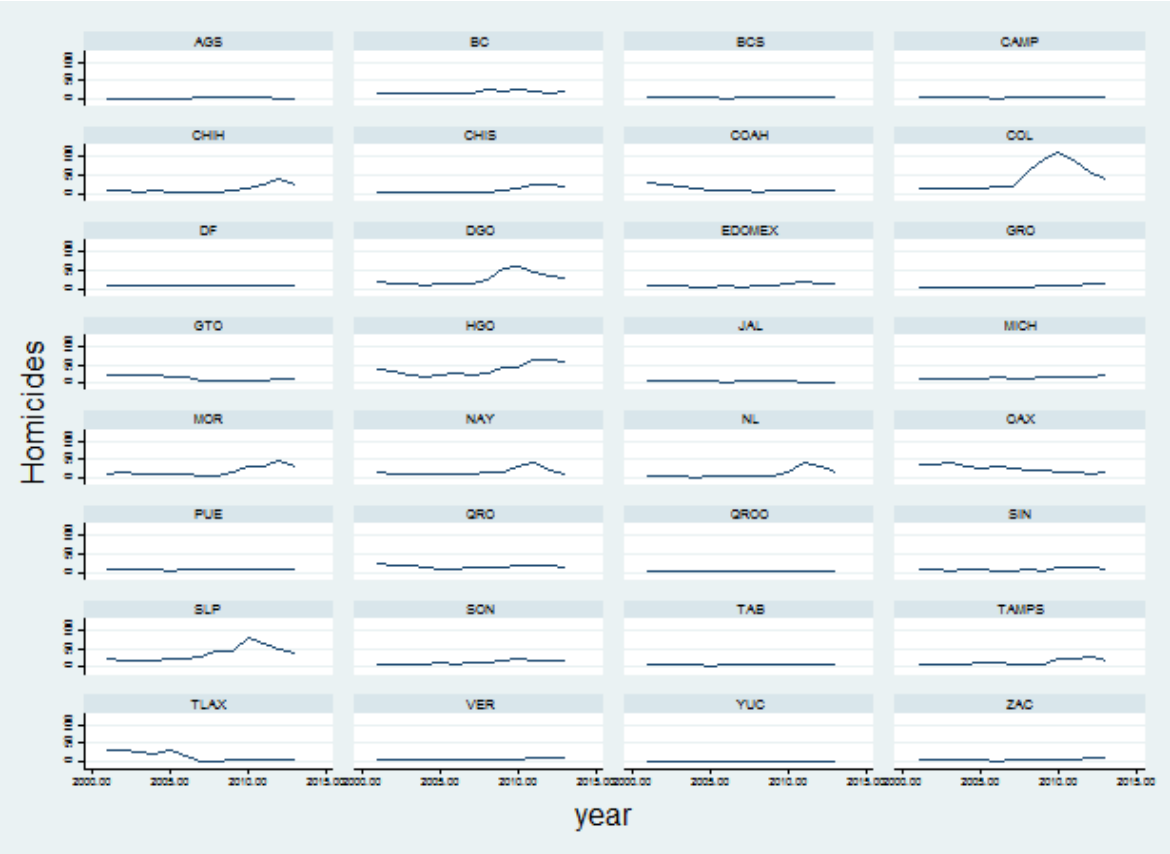
Several studies have investigated the effect that certain factors have on violence; For example, it has been found that levels of schooling, salaries and jobs are inversely related to violence, while the level of consumer prices, poverty, income inequality and unemployment are directly associated with this variable (Cotte, 2011). It has also been found that macroeconomic factors such as periods of crisis in economic activity, high levels of population density, corruption, the deficiency of the legal and criminal system and inefficient government expenditures also generate higher levels of violence (Cotte, 2012a Cotte, 2012b).

In the case of Mexico, Enamorado et al. (2014) analyzed the relationship between income inequality and the increase in the level of violence. The study consisted of a five-year cross-section (1990, 2000, 2005 and 2010) for more than 2,000 municipalities. Their results indicate that a one point increase in the Gini coefficient, that is, an increase in inequality, leads to an increase of 5 homicides and 10 homicides related to drug trafficking per 100,000 inhabitants. The authors found that during the period of the war on drugs, criminal activity in the country increased; in addition, the combination of a lower cost of committing a crime (due to the expansion of gangs) and the increase of extraordinary profits for carrying out criminal activities, propitiate the permanence of malefactor groups in the country, generating a vicious cycle that drives higher levels of inequality and the increase in crime rates.

3 Descriptive Analysis

According to data from the Executive Secretariat and the National Population Council (CONAPO), the year 2011 was the most violent, reaching a record average of 24 murders per 100,000 inhabitants nationwide; however, it is important to note that the dynamics of violence in Mexico has not been homogeneous, since certain states such as Chihuahua, Sinaloa, Guerrero, Durango, Nuevo Leon, Nayarit, Morelos, Tamaulipas and Colima have been called "hot zones" "For presenting the highest rates of violence in the country. Graph 2 shows the number of homicides per 100,000 inhabitants for all the entities that make up the Mexican Republic during the period from 2001 to 2013.

Graph 2: Number of homicides per entity. Period 2001- 2013



SOURCE: Personal collection with data from the Executive Secretariat and the National Population Council (CONAPO).

It is observed that the entities belonging to the so-called hot zones show increases in their trends, mainly during the period from 2008 to 2012, with Colima being the state with the highest number of intentional homicides, showing an average of 43 victims per 100,000 inhabitants, followed by Hidalgo, San Luis Potosí and Durango, while the rest shows a slight increase. To analyze in greater detail the difference between these entities and the rest, Table 1 is presented below with the main statistics describing the number of homicides, as well as the means test between the three periods.

In the first period, the entities of Oaxaca, Hidalgo and Tlaxcala had the highest levels in the average homicide rate with 32.6, 26.2 and 23.4 respectively. In the period from 2008 to 2011, most of the entities increased their levels; even Colima reached a record maximum level of 111 homicides. In the third period it is observed that most of the entities presented a decrease, although only the entities of Coahuila, Guanajuato, Jalisco, Oaxaca, Querétaro, Tabasco and Tlaxcala were below the average levels they had in the first period.

The means test indicates that in most entities there are statistical differences in the levels of violence between the first and second period. In 23 of the 32 entities there is no evidence of a difference in the levels of violence between the second and third period considered, so for the present study only two periods will be considered: from 2001 to 2007 and from 2008 to 2013.

Table 1. Number of homicides. T test

Entity	Mean	Std. Dev.	Min	Max	t test
AGS					
2001-2007	2.4	0.9	1.6	4.3	***
2008-2011	5.8	0.4	5.5	6.3	**
2012-2013	3.3	0.3	3.1	3.6	
BC					
2001-2007	17.1	0.7	16.2	18.5	***
2008-2011	24.8	3.3	20.5	27.5	
2012-2013	20.3	3.7	17.7	22.9	**
BCS					
2001-2007	5.3	1.1	3.5	6.8	
2008-2011	5.7	1.2	4.6	7.4	
2012-2013	6.4	2.0	5.0	7.8	
CAMP					
2001-2007	5.9	1.6	3.6	7.4	
2008-2011	6.1	1.0	5.0	7.1	*
2012-2013	7.8	0.2	7.6	8.0	
COAH					
2001-2007	16.7	8.8	7.6	29.5	
2008-2011	10.0	2.3	6.8	12.3	
2012-2013	10.6	1.1	9.8	11.3	
COL					
2001-2007	16.3	1.6	13.8	18.3	***
2008-2011	86.8	21.2	59.2	110.7	*
2012-2013	47.6	11.2	39.7	55.5	***
CHIS					
2001-2007	4.7	0.5	4.0	5.4	**
2008-2011	13.4	7.5	6.6	23.4	
2012-2013	24.7	3.3	22.3	27.0	***
CHIH					
2001-2007	6.8	1.9	4.9	10.0	*
2008-2011	13.0	8.5	5.2	24.5	*
2012-2013	33.7	11.6	25.5	41.9	***
DF					
2001-2007	8.0	0.5	7.2	9.0	
2008-2011	8.5	0.5	7.9	9.1	
2012-2013	8.6	0.2	8.4	8.7	
DGO					
2001-2007	14.1	4.1	7.7	21.2	***
2008-2011	47.3	15.5	26.4	61.3	
2012-2013	31.8	6.1	27.5	36.1	***
GTO					
2001-2007	18.1	4.9	7.6	21.7	***
2008-2011	8.5	0.9	7.4	9.5	***
2012-2013	12.5	1.0	11.8	13.2	
GRO					
2001-2007	4.1	0.3	3.7	4.5	***
2008-2011	7.7	2.5	4.7	10.8	*
2012-2013	12.4	1.7	11.2	13.6	***
HGO					
2001-2007	26.2	7.1	16.4	38.7	**
2008-2011	43.9	14.0	28.1	62.1	
2012-2013	62.6	4.8	59.2	66.0	***
JAL					
2001-2007	5.1	0.7	4.0	6.1	
2008-2011	4.9	0.6	4.1	5.3	
2012-2013	3.7	1.0	3.0	4.4	*
EDOMEX					
2001-2007	6.1	0.7	5.4	7.4	**
2008-2011	10.6	4.4	6.4	16.2	
2012-2013	14.8	0.9	14.2	15.5	***
MICH					
2001-2007	11.5	1.9	10.1	15.5	***
2008-2011	15.5	1.9	13.0	17.3	
2012-2013	18.4	2.2	16.8	19.9	***
MOR					
2001-2007	10.7	2.5	6.5	13.9	**
2008-2011	21.7	11.2	7.7	31.0	
2012-2013	39.2	10.4	31.9	46.6	***
NAY					
2001-2007	10.8	1.6	9.3	13.4	**
2008-2011	25.2	13.6	13.7	40.3	
2012-2013	17.0	5.9	12.8	21.1	**
NL					
2001-2007	3.7	1.2	2.7	6.3	**
2008-2011	17.7	17.0	5.7	41.8	
2012-2013	22.3	10.9	14.6	30.0	***
OAX					
2001-2007	32.7	6.3	25.1	42.3	***
2008-2011	18.1	1.5	16.4	19.6	**
2012-2013	12.8	1.1	12.0	13.5	***
PUE					
2001-2007	8.0	1.2	6.1	9.5	
2008-2011	8.0	1.6	7.1	10.4	
2012-2013	8.2	2.0	6.7	9.6	
QRO					
2001-2007	16.3	6.0	10.1	25.8	
2008-2011	16.3	2.5	13.6	19.3	
2012-2013	15.9	2.1	14.4	17.4	
QROO					
2001-2007	4.0	0.8	3.0	5.4	
2008-2011	4.2	1.1	3.2	5.2	
2012-2013	5.7	0.0	5.7	5.8	**
SLP					
2001-2007	21.3	3.0	18.3	26.9	***
2008-2011	57.7	17.9	41.5	78.9	
2012-2013	45.9	6.6	41.2	50.5	***
SIN					
2001-2007	7.1	1.8	4.9	10.1	**
2008-2011	11.4	4.9	6.1	15.9	
2012-2013	12.2	3.6	9.7	14.8	**
SON					
2001-2007	9.4	1.8	7.0	11.9	***
2008-2011	18.6	3.9	14.9	24.0	
2012-2013	19.0	1.7	17.8	20.2	***
TAB					
2001-2007	7.0	1.7	4.0	8.9	
2008-2011	6.4	0.8	5.2	7.1	
2012-2013	5.7	0.4	5.4	6.0	
TAMPS					
2001-2007	8.4	2.2	5.8	11.6	**
2008-2011	16.3	8.4	8.8	25.3	
2012-2013	22.9	9.7	16.0	29.7	***
TLAX					
2001-2007	23.5	11.4	1.0	34.3	***
2008-2011	4.4	1.0	3.7	5.9	
2012-2013	5.2	0.6	4.8	5.6	*
VER					
2001-2007	6.3	0.3	5.8	6.8	
2008-2011	7.5	2.9	4.5	11.4	
2012-2013	11.6	1.0	10.9	12.3	***
YUC					
2001-2007	1.4	0.3	0.9	1.8	**
2008-2011	2.1	0.4	1.7	2.4	
2012-2013	1.9	0.1	1.9	1.9	*
ZAC					
2001-2007	5.3	1.7	3.5	7.3	
2008-2011	6.3	1.5	5.0	7.8	**
2012-2013	11.7	1.4	10.8	12.7	***

Source: Authors own elaboration

4 Methodology

In order to know if inequality is a determinant of violence (measured by the homicide rate), it the period that was analyzed was from 2001 to 2013 for the thirty-two entities of the Mexican Republic. This relationship will initially be estimated with the model proposed by Cotte (2011) by means of an Ordinary Least Squares (OLS) model and a panel data model with fixed effects will be estimated later to capture the unobservable heterogeneity of the entities.

$$lnV_{i,t} = \alpha_{i,t} + \beta_1 \ln EDP_{i,t} + \beta_2 lnEDS_{i,t} + \beta_3 PRI_{i,t} + \beta_4 lnPBM_{i,t} + \beta_5 lnwater + \beta_6 lnGINI_{i,t} + \beta_7 lnUNE_{i,t} + \beta_8 lnwage_{i,t} + \beta_9 lnOIM_{i,t} + \beta_{10} zone + \mu_i + v_{i,t} \quad (1)$$

Where “i” is the entity and “t” is the year.

lnV is the logarithm of the homicide rate measured as the number of intentional homicides per 100,000 inhabitants. The data was obtained from the Secretariado Ejecutivo y el Consejo Nacional de Población (CONAPO).

lnEDP is the logarithm of the enrollment rate in primary education, measured as the proportion of students enrolled of the total population of primary school age (6 to 11 years old). It would be expected that this variable had a negative relationship with the homicide rate. The data was obtained from the Sistema para la Consulta de las Estadísticas Históricas de México 2014 del INEGI.

lnEDS is the logarithm of the enrollment rate in secondary education, measured as the proportion of students enrolled of the total population of secondary school age (12 to 14 years old). Like the variable *lnEDP* it would be expected that this variable had an inverse relationship with the variable homicide rate. The data was obtained from the Sistema para la Consulta de las Estadísticas Históricas de México 2014 del INEGI.

PRI is the accumulated inflation during the year. The average inflation of the main cities of each entity of the Instituto Nacional de Geografía Estadística e Informática (INEGI) was taken as a reference. It would be expected that the higher inflation, the cost of living would increase, leading to more violence.

lnPBM is the logarithm of the percentage of the population that earns less than the income considered necessary to obtain the minimum welfare. The data was obtained from the Consejo Nacional de Evaluación de la Política de Desarrollo Social (CONEVAL). The more poor people there is, higher levels of violence will be expected.

Lnwater refers to the percentage of the total population without access to drinking water,

the data was obtained from the Comisión Nacional del Agua (CONAGUA).

lnGINI is the logarithm of the GINI Index. Own elaboration with data from the Encuesta Nacional de Empleo Urbano (ENEU) for the period 2001-2004 and the Encuesta Nacional de Ocupación y Empleo (ENOE) both INEGI surveys. According to economic theory, the greater the inequality, the higher the homicide rate would be expected to be.

lnUNE is the logarithm of the unemployment rate. The data was taken from the Secretaría de Trabajo y Previsión Social for the period from 2001 to 2004 and from INEGI for the period from 2005 to 2013.

lnwage is the logarithm of the average daily salary of the IMSS contributors at 2010 prices. The data was taken from the Instituto Mexicano del Seguro Social (IMSS).

lnOIM is the logarithm of the monthly average of the number of workers in the manufacturing industry. The data was taken from the Encuesta Mensual de la Industria Manufacturera del INEGI.

Zone is a dichotomous variable that takes the value of 1 if the entity belongs to the “hot zone” and corresponds to the period 2008-2013 when the war on drugs began to have results, and value of 0 if it does not belong to this zone or belongs to the 2001-2007 period.

Violence and income inequality are characterized by presenting inverse causality, this represents a problem since the coefficients will be inconsistent and biased, so the results could lead to an over or under estimation of their effects, which is why the Granger's causality test[1] and endogeneity was found. To correct this problem, the instrument variable Relative Poverty Index (IPR) will be used with a Two-Stage Least Squares model (2SLS). To test whether the instrumental variable is a strong instrument, the Stock and Yogo test (2002) was carried out.

$$lnGINI_{i,t} = \alpha_{i,t} + \beta_1 \mathrm{IPR}_{i,t} + v_{i,t} \qquad (2)$$

IPR is the relative poverty index. This variable was constructed by dividing the average income of the 10th percentile of each entity "i" in the year "t" by the average income of the 10th percentile nationwide. Authors' own elaboration with data from the Encuesta Nacional de Empleo Urbano (ENEU) for the period 2001-2004 and from the Encuesta Nacional de Ocupación y Empleo (ENOE) for the 2005-2013 period of INEGI.

The model of Least Squares in Two Stages (2SLS) to be estimated is:

[1] See Appendice I.

$$lnV_{i,t} = \alpha_{i,t} + \beta_1 \ln EDP_{i,t} + \beta_2 lnEDS_{i,t} + \beta_3 PRI_{i,t} + \beta_4 lnPBM_{i,t} + \beta_5 lnwater + \beta_6 lnGINI_{i,t} + \beta_7 lnUNE_{i,t} + \beta_8 lnwage_{i,t} + \beta_9 lnOIM_{i,t} + \beta_{10}\,\text{zone} + \mu_i + v_{i,t} \quad (3)$$

The description of the variables and the expected relationships are the same as in the previous model.

5 Results

Table 2 shows the results for the total period (2001 to 2013). The weak identification test indicates that the relative poverty index is a good instrument, so the results comply with the expected properties.

It is observed that the coefficient of the variable zone was overestimated with OLS. After correcting the endogeneity, it was found that in the entities called “hot zones”, the level of violence is 0.74% greater than the rest.

Table 2: Dependent variable: Violence measures by the homicide rate.

Period: 2001-2013			
Variable	**OLS**	**Random effects**	**2SLS [1/]**
LnEDP	8.750 ***	4.105 ***	4.757
	[1.339]	[1.022]	[1.310]
lnEDS	-0.780	-0.811	-0.353 ***
	[0.531]	[0.565]	[0.806]
PRI	-0.124 ***	-0.038	-0.046
	[0.033]	[0.028]	[0.030]
lnPBM	0.016	0.131 *	0.020
	[0.062]	[0.072]	[0.156]
Lnwater	0.285 ***	-0.014	-0.056
	[0.046]	[0.063]	[0.082]
lnGini	-2.193 ***	-0.732 *	0.883
	[0.458]	[0.424]	[2.059]
lnUNE	-0.128	0.109	0.161
	[0.117]	[0.096]	[0.117]
Lnwage	0.418	-1.171 **	-1.191 **
	[0.256]	[0.501]	[0.505]
lnOIM2	0.010	0.128 ***	0.151 ***
	[0.026]	[0.038]	[0.047]
Zone	0.937 ***	0.740 ***	0.741 ***
	[0.106]	[0.082]	[0.083]

Constant	-28.969 ***	-5.609	
	[5.782]	[6.038]	
R^2	0.34	0.37	

Source: Author´s own elaboration

, **, * Significance at 10%, 5% y 1% respectively*

Std. Err. in parenthesis

[1/] Weak identification test F=16.821, Critical values: With 10% =16.38

It was expected that an increase in the variables of inequality, percentage of the population that earns less than the minimum wage and percentage of the population that does not have access to drinking water, would be associated with lower levels of violence in the states, but none of these variables were significant.

It was also found that the percentage change in wages is decisive to reduce the level of violence, specifically, a 1% increase in salaries decreases violence levels by 1.19%. It is also relevant that as more young people study secondary school, the levels of violence will decrease.

6 Conclusions

Contrary to the theory, where it is established that income inequality is the main cause of violence, in Mexico the results of this study showed that the inequality measured as the Gini index, as well as the percentage of the population that earns less than the minimum wage and percentage of the population that does not have access to drinking water do not explain the change in the levels of violence. As mentioned at the beginning of this study, crime and violence increased in Latin America at the same time as inequality decreased (World Bank, 2014), so in the case of Mexico there must be other factors that determine it, such as greater number of young people studying secondary education and better salary conditions. In this regard, according to several studies conducted by Jaitman (2015), education increases opportunities to access legal jobs and increases their salaries, while decreasing unemployment, which reduces the financial attractiveness of criminal activities which could potentially lead to homicide.

A relevant aspect for the levels of violence reached was the so-called “Drug war” that began in 2007. The results of this investigation indicate that as of that year the entities belonging to the "hot zones" had a change in the number of homicides of 0.74% greater than the rest of the entities. To reduce these levels of violence, the World Bank suggests learning from developed countries and implementing successful programs, such as those

already carried out in Brazil and Colombia, where greater coordination and cooperation between police and inhabitants of dangerous neighborhoods have contributed to reducing significantly delinquency (World Bank, 2014).

It is important to take into account the decisions that the Mexican Government has taken and their results in terms of policies to reduce unemployment, inequality and poverty. According to the analysis obtained in this study, it is suggested the development of policies on social and economic development to reduce levels of violence.

Appendice

Appendice I: Granger's causality test

Prueba de Granger		
Lag order 1		P value
W bar	2.51	
Z bar	6.04	0.000
Z bar Tilde	3.29	0.001
H0: lnGini does not Granger-cause lnV		
H1: lnGini does Granger-cause lnV		

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