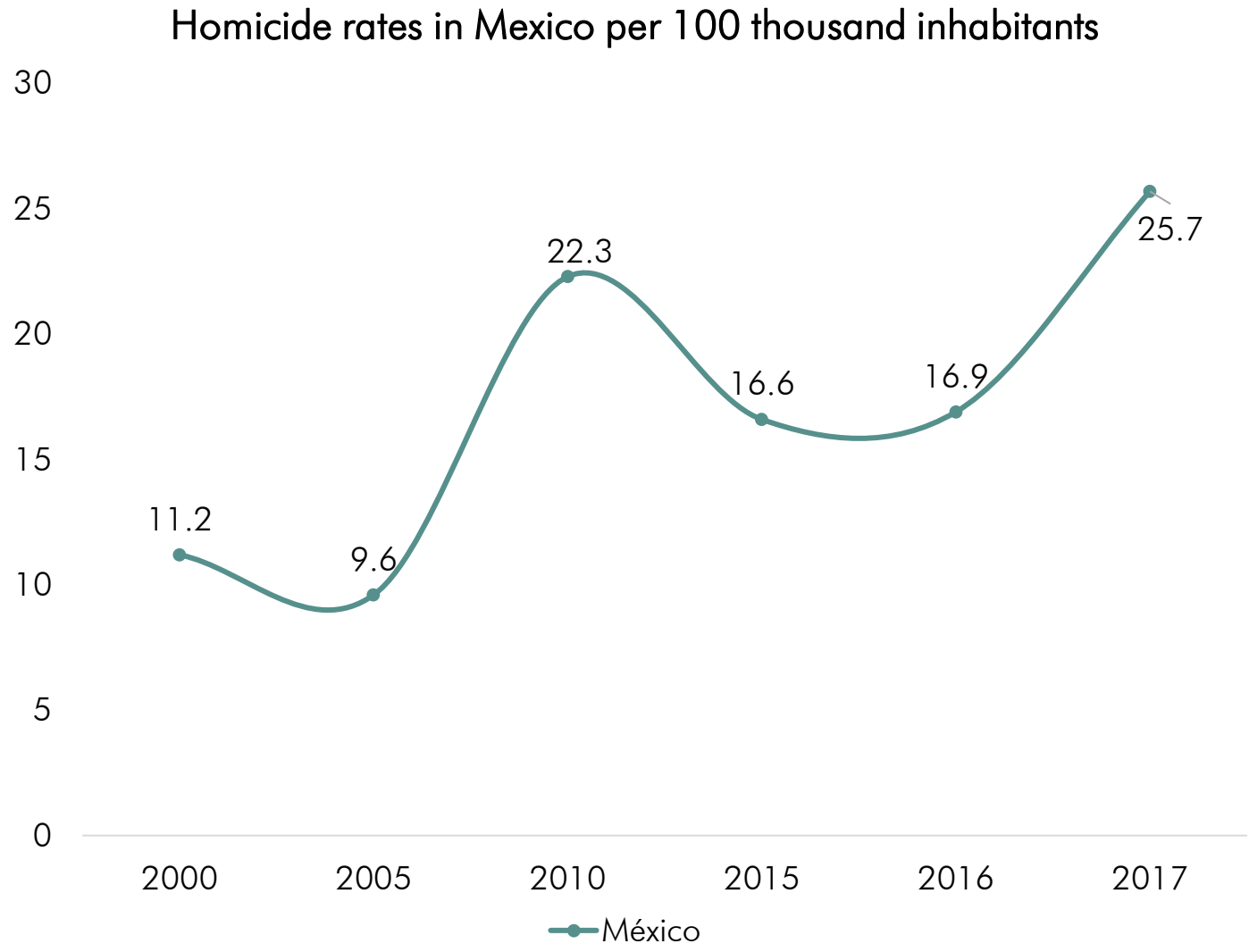
The effect of long-term development and schooling expansion on homicide decline: The case of Mexico (1950 to 2005)

- Work in process, do not cite or circulate -

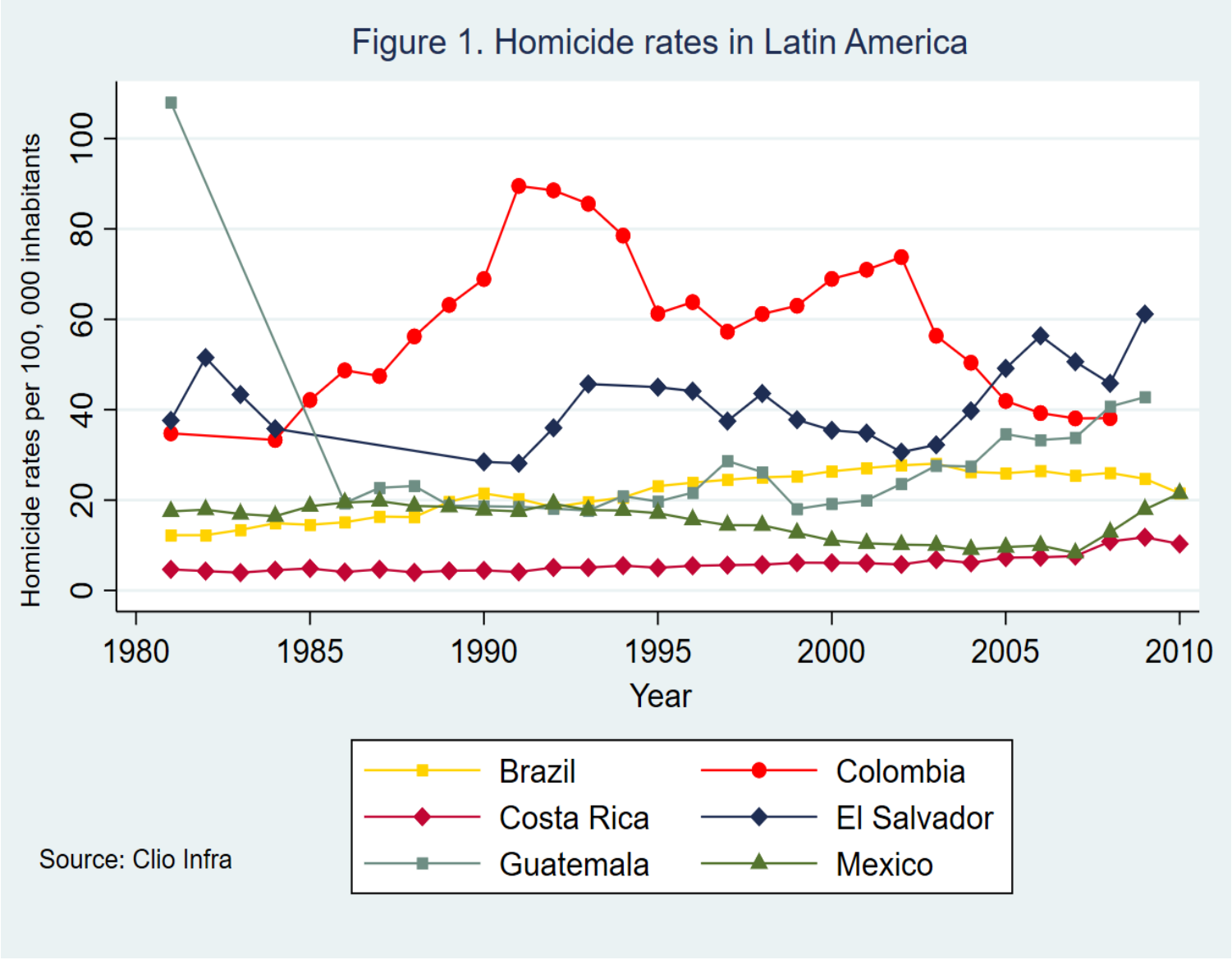
Raúl Zepeda-Gil and Carlos A. Pérez Ricart

Since 2007, violence in Mexico has grown dramatically because of the onset of the criminal war.

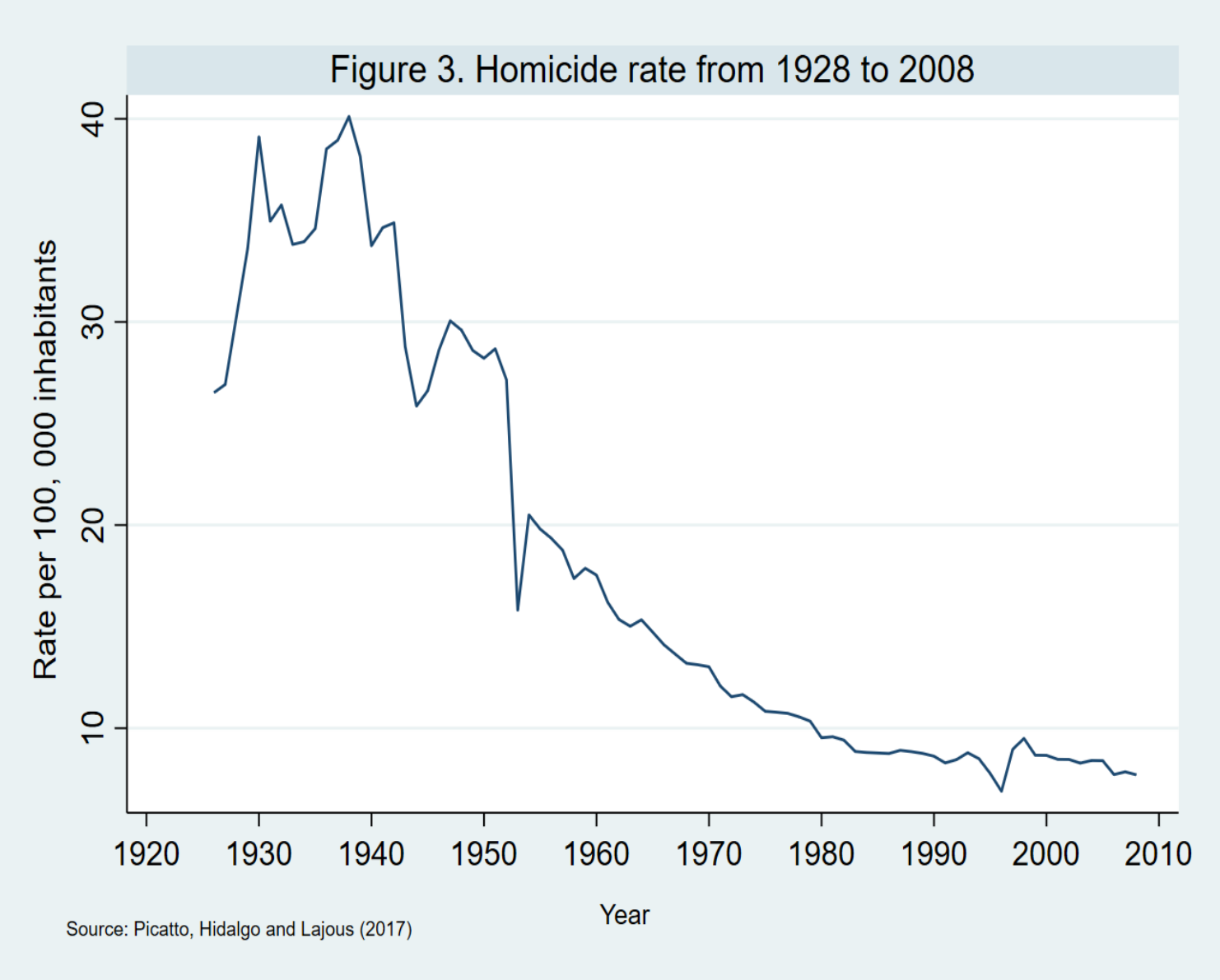


Fuente: World Health Organisation Database

Nonetheless, Mexico lived a decline in homicide during the XX Century, while Latin America has seen a rise.



Picatto, Hidalgo and Lajous (2017) gathered a new data base on homicides in Mexico during XX Century.



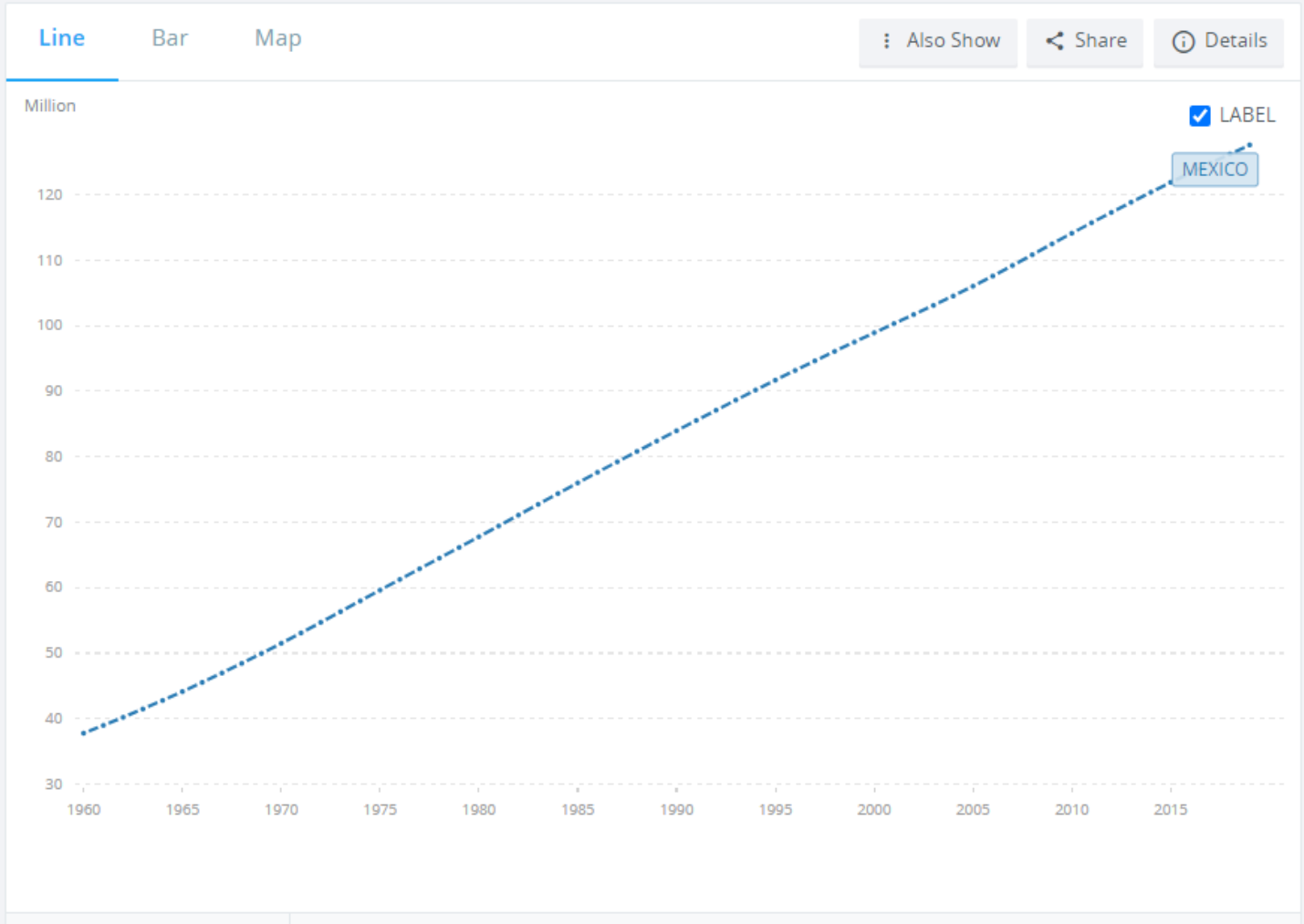
Which were the main drivers of homicide decline in Mexico?

- **Legacies of the Mexican Revolution**: pacification, military victory and new centralisation of order (Knight, 1990; Stamatel & Romans, 2018; Archer & Garthner, 1976).
- **Long durée drivers of pacification**: decline of honour culture, centralisation of government functions (Eisner, 2001; 2003).
- Education and development policies deployed in peaceful times (Ostby, Urdal & Dupuy, 2019).
- Economic growth, population growth, reduction of inequality and poverty (Neumayer, 2016; Rivera, 2016).
- Land reform (Albertus & Caplan, 2013).

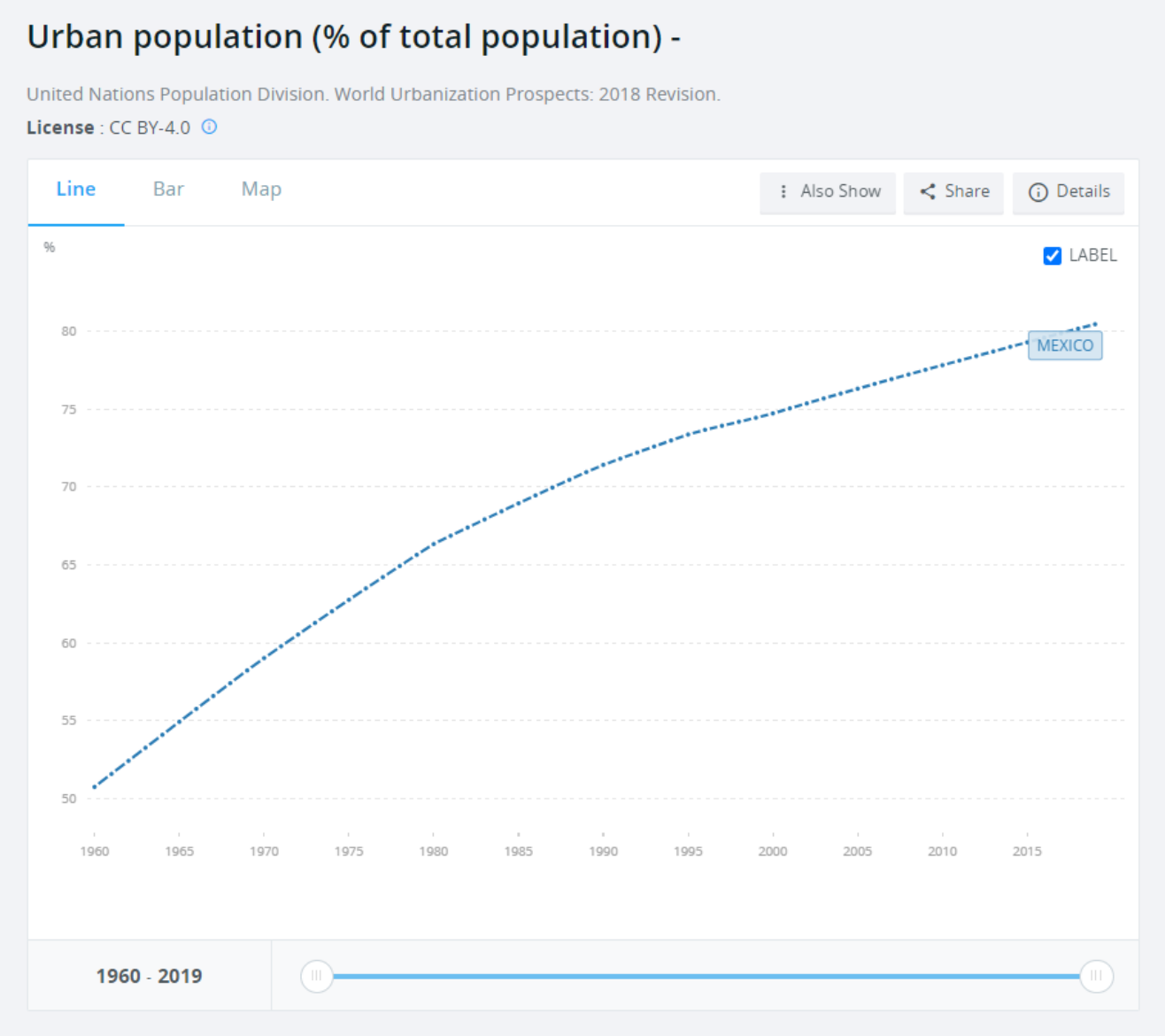
Trends on Mexican development in the XX Century

Population, total - Mexico

(1) United Nations Population Division. World Population Prospects: 2019 Revision. (2) Census reports and other statistical publications from national statistical offices, (3) Eurostat: Demographic Statistics, (4) United Nations Statistical Division. Population and Vital Statistics Reprot (various years), (5) U.S. Census Bureau: International Database, and (6) Secretariat of the Pacific Community: Statistics and Demography Programme.



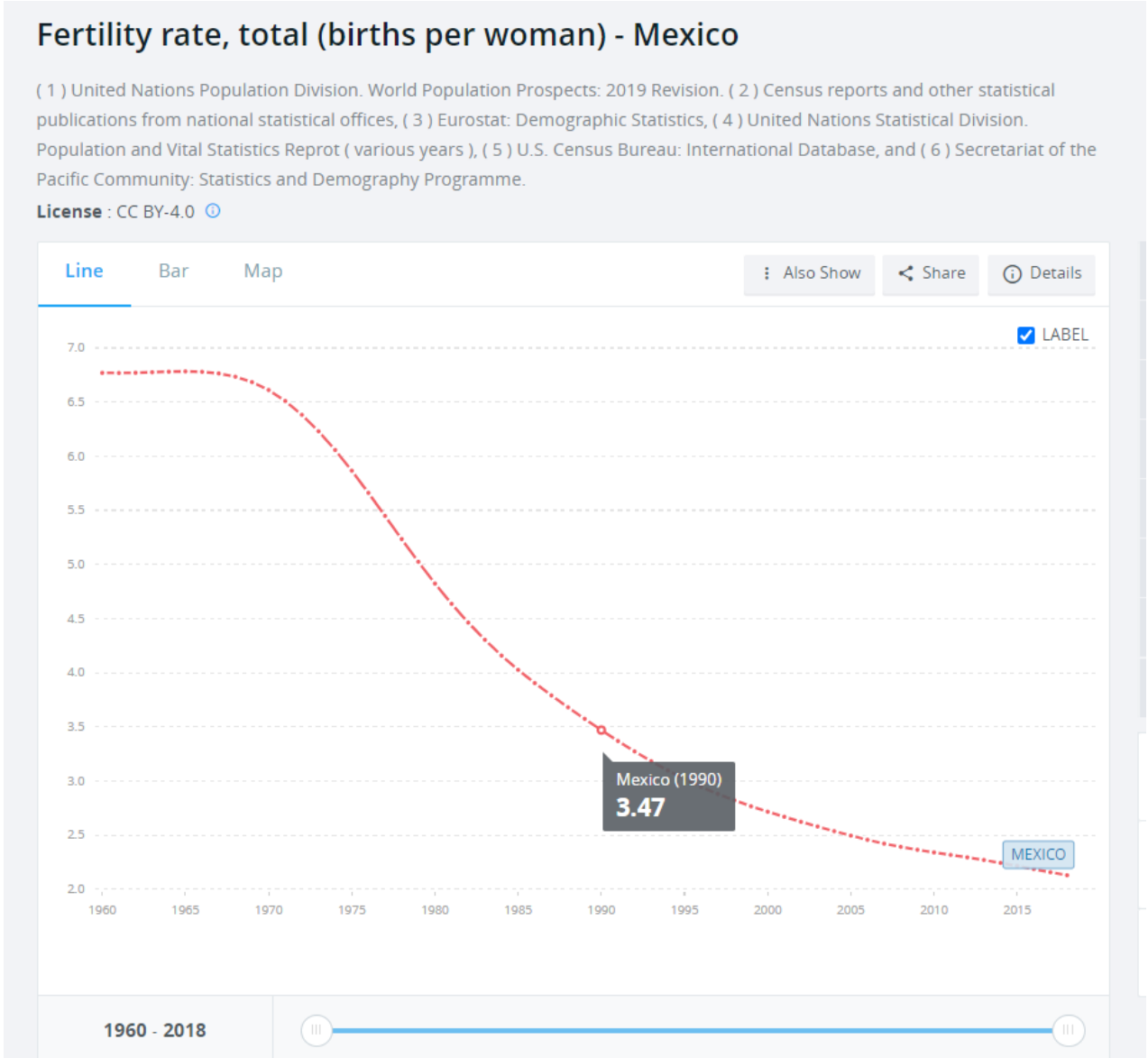
After the end of the Mexican Revolution, population grew intensively.



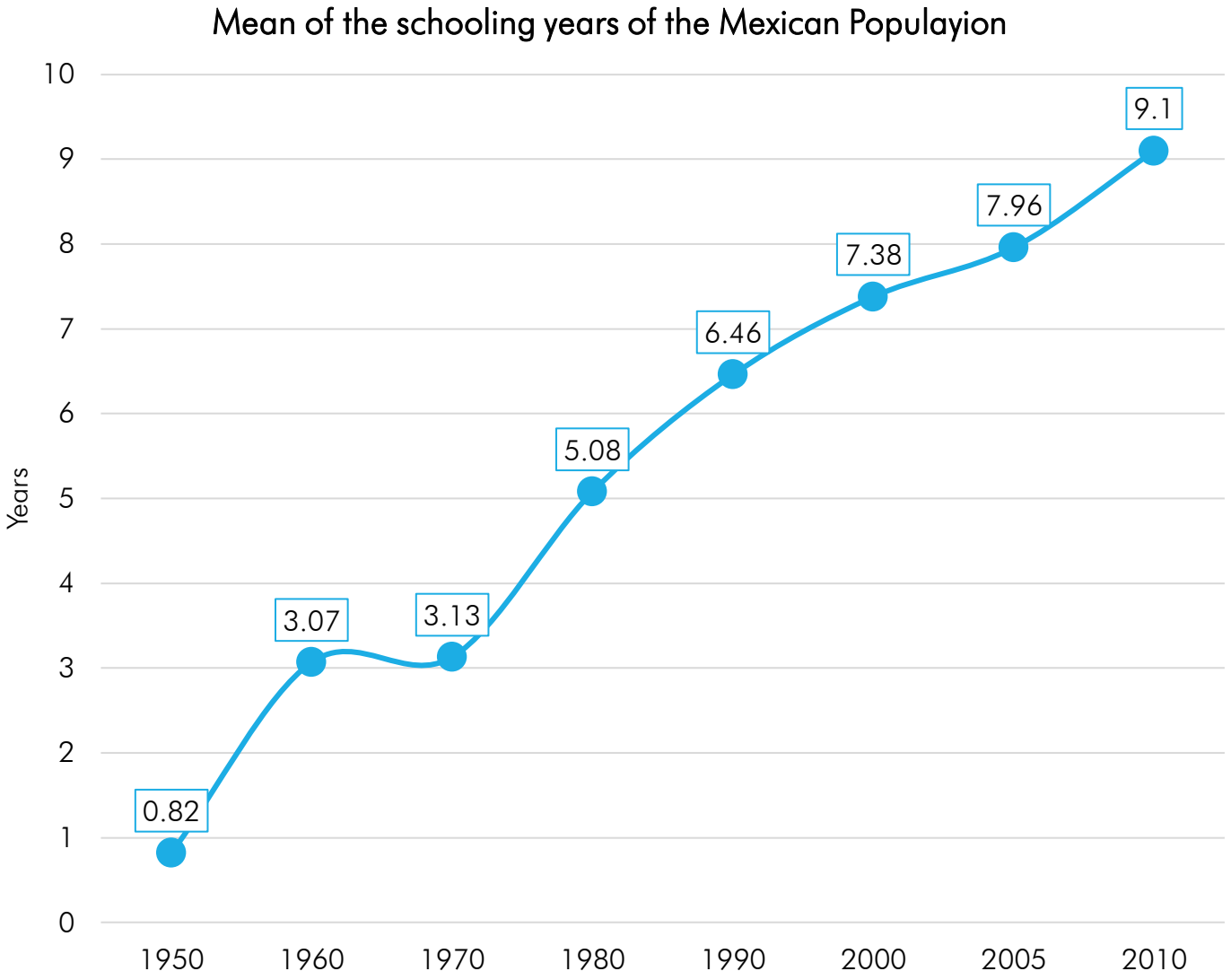
Also, cities in Mexico grew up at a rapid pace.

With the expansion of public services, life expectancy at birth rose.

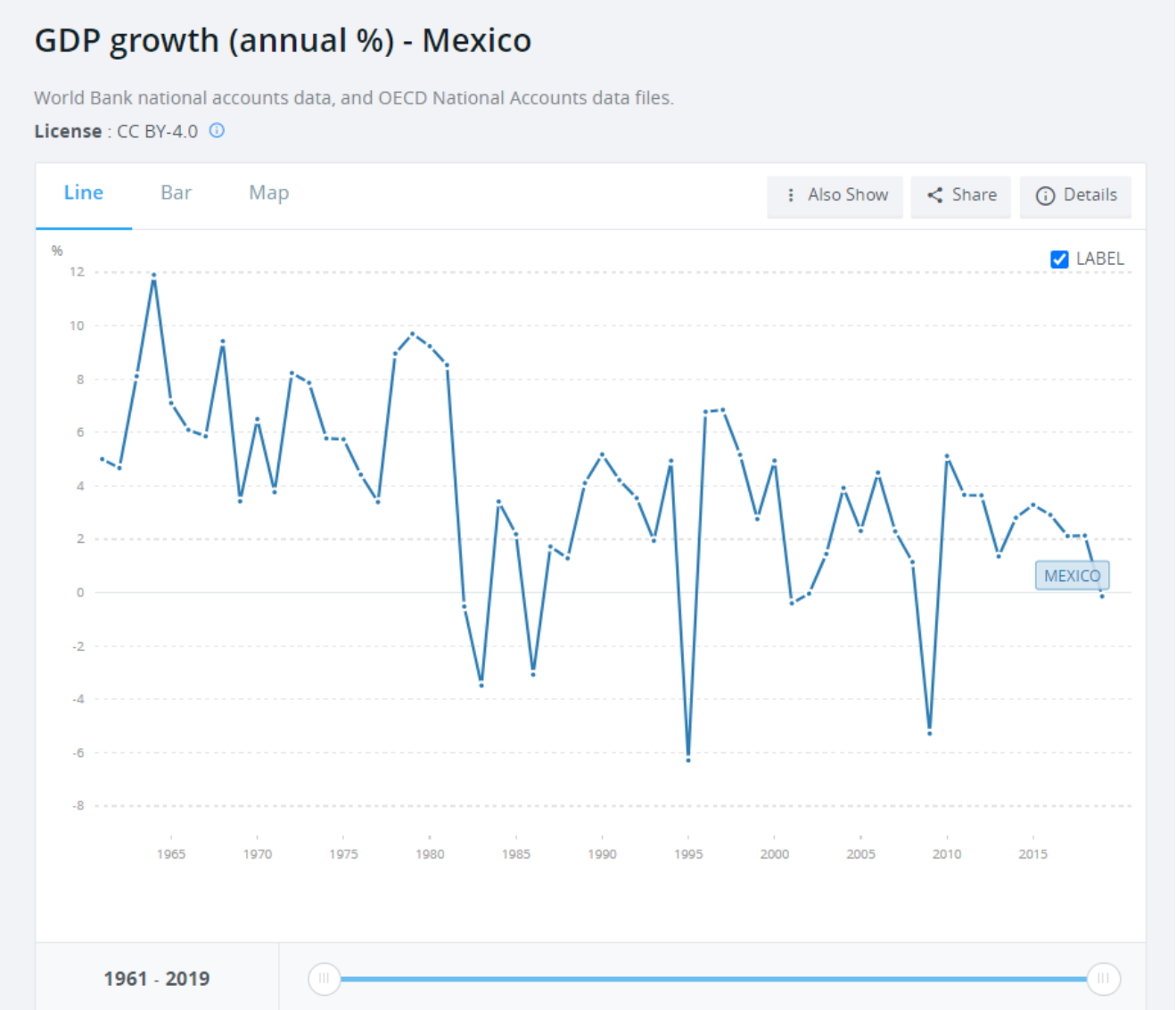
Febrility rate declined slowly, leaving youth budges through the century.



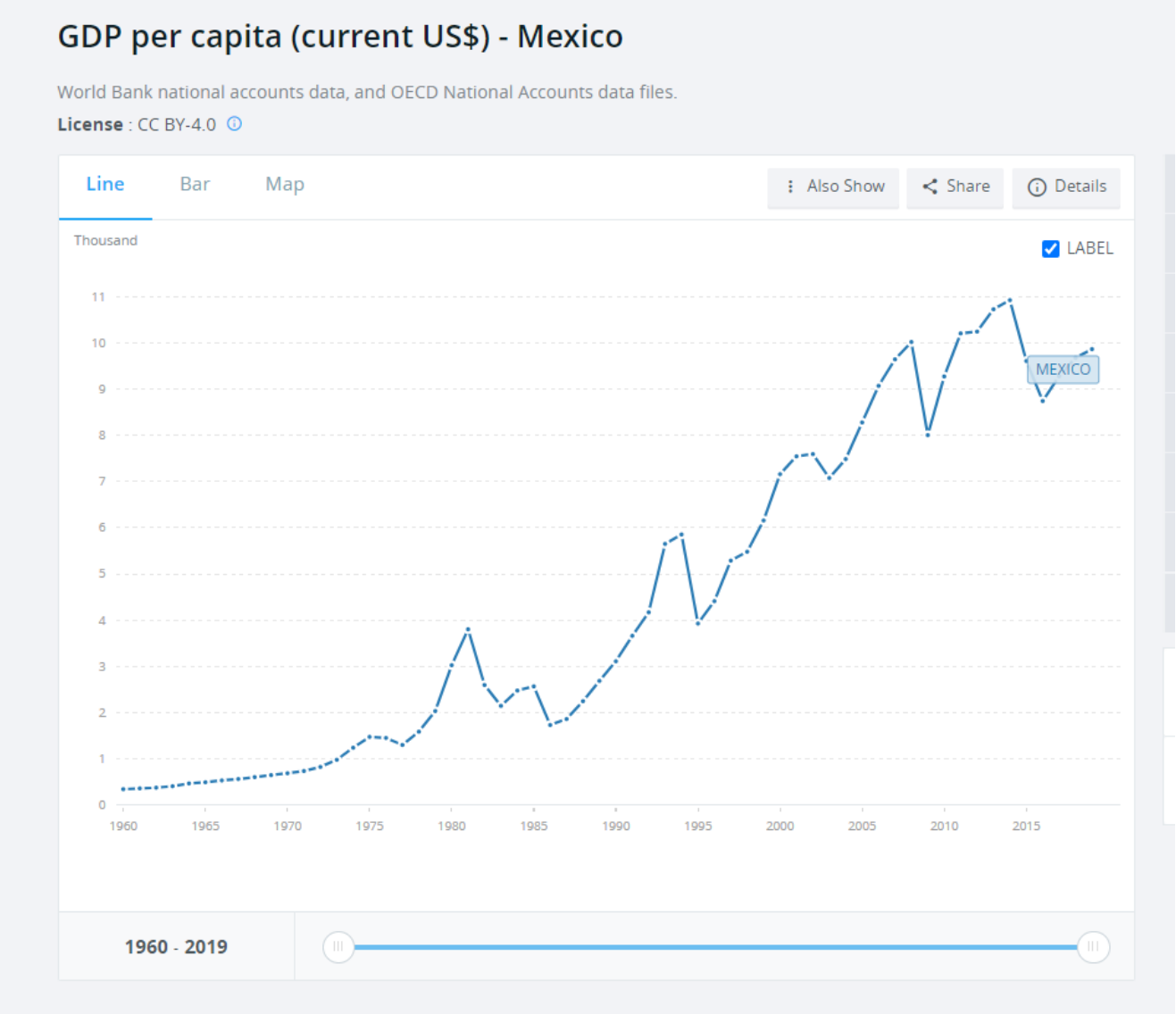
The universalisation of schooling has lead to full literacy in the country.



Source: INEGI Census.



Growth used to be expansive after the Mexican Revolution ("The Mexican Miracle"), but after the seventies, economic crisis have shred growth rates.



Nonetheless, on average, income rose in the country.

Methodology

1. Panel Data Analysis (Cross-Sectional, Years and States). This allows us to have enough observations and understand regional variances through time.
2. Fixing the Data base: the Picatto, Hidalgo and Lajous (2017) has not complete data on all years and not all states.
3. Collecting historical data on the explanations on the literature (Census, Registries, and estimations).

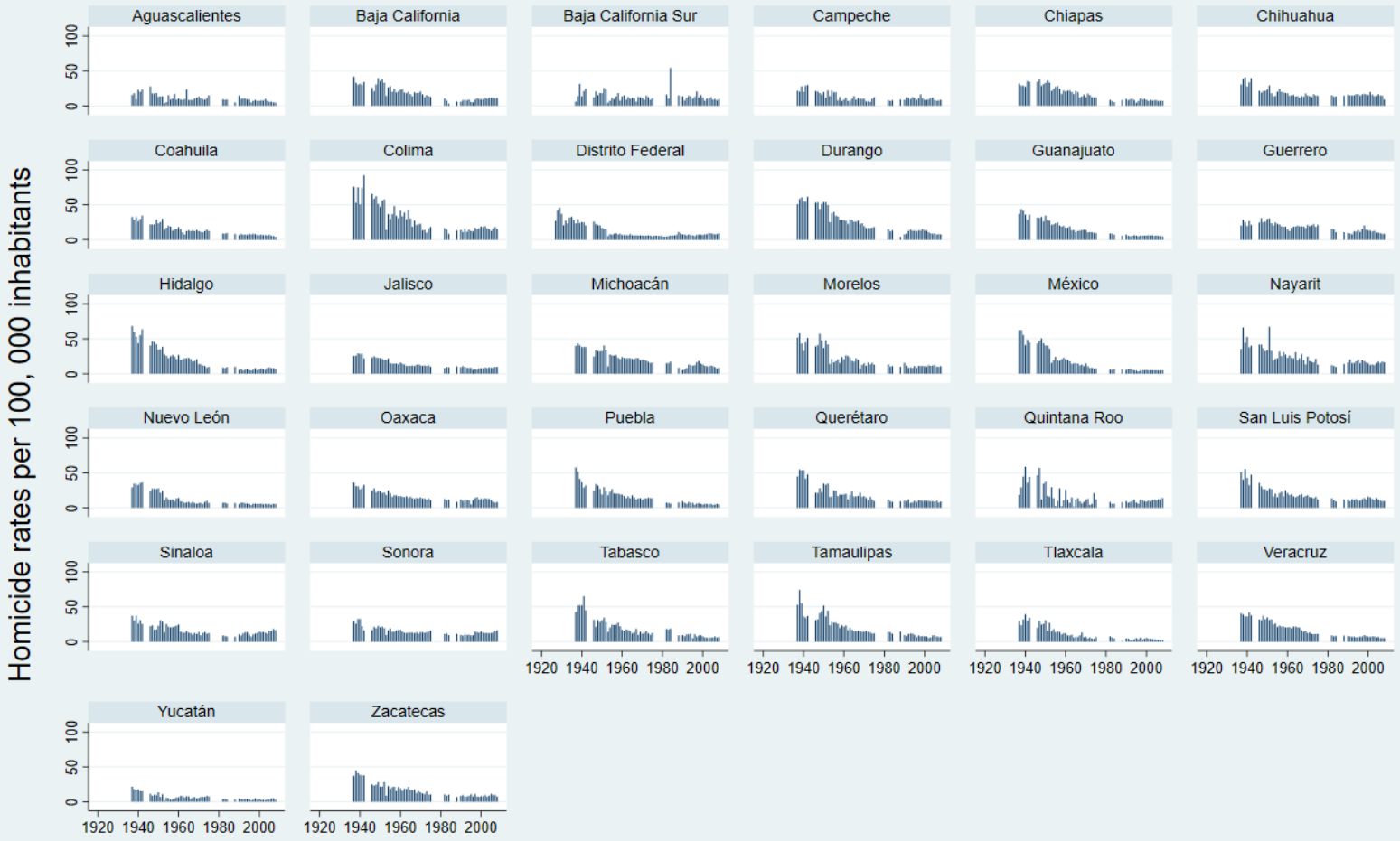
Imputation process

The missing data comes mainly from the 50's and 70's, but we have data on nearing years of those decades.

If we assume that demographic and violent trends remained constant in those years, we can calculate the reaming years using growth rates.

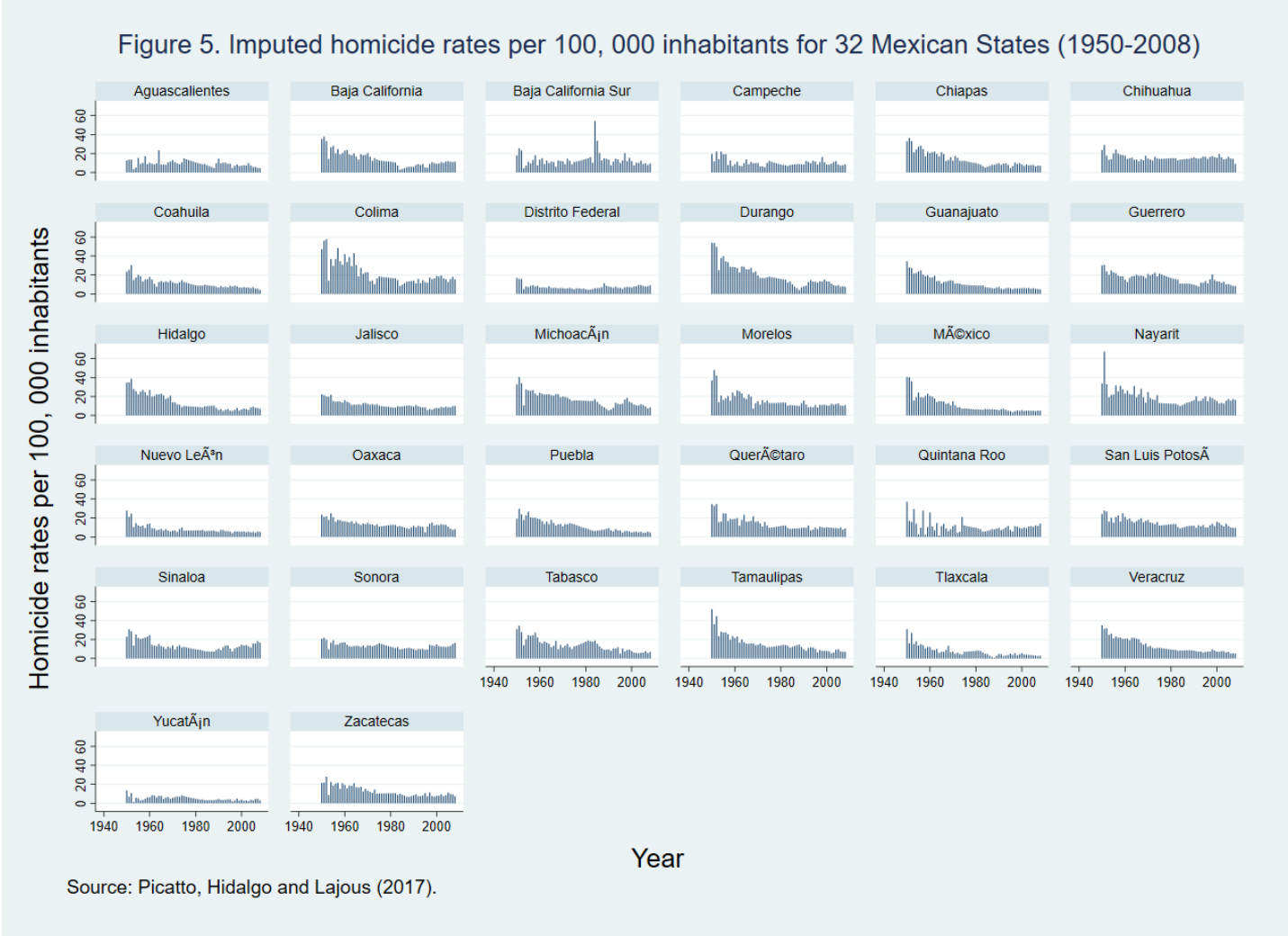
Demographers forecast demographic change with several vital statistics, but by having data of what already ocurr we are estimating more accurate tallies.

Figure 4.- Homicide rates for 32 Mexican states from 1928 to 2008

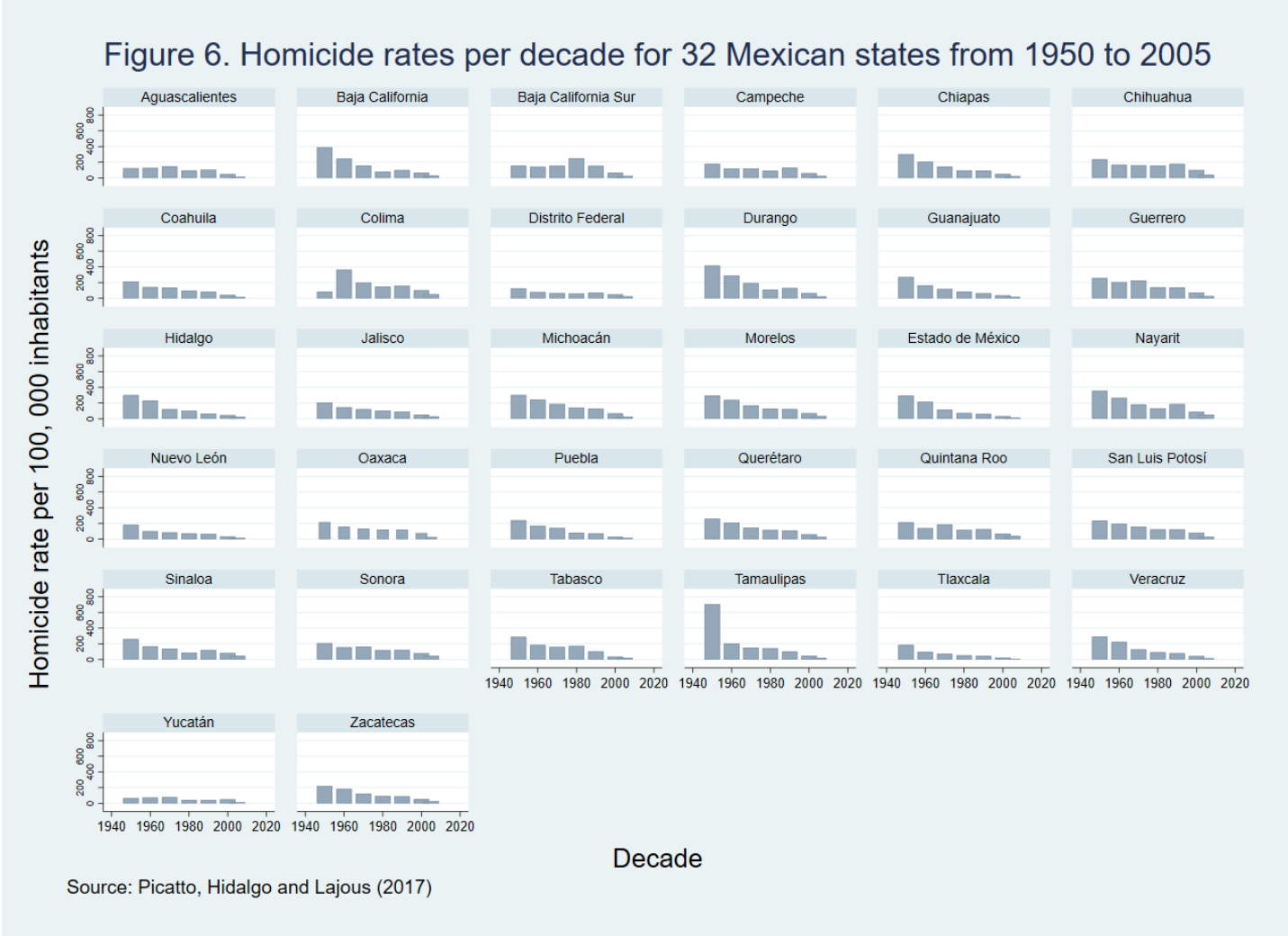


Source: Picatto, Hidalgo and Lajous (2017)

The procedure we used is imputation: we calculated the data missing by estimating the growth rate between the last observation before a missing year and the next observation available in time.



Census data comes in decades, so we calculated the average homicide rates by state and by decade after the imputation.



Panel data análisis

- Dependent variable: homicide rates per 100, 000 inhabitants.
- Units of analysis: 32 Mexican States.
- Years of study: 1950, 1960, 1970, 1980, 1990, 2000, 2005.
- Sources: Census data, agrarian reform registry (RAN), judicial records, growth rates by state calculated by Carrion-I-Silvestre, L. J., & German-Soto, V. (2007), and HDI by UNDP.

Summary statistics for variables of interest for each decade

Variable	Statistic	1950	1960	1970	1980	1990	2000	2005
Homicide rates	Mean	252.91	182.90	143.79	110.57	105.60	59.26	26.74
	Std. Dev	114.67	62.66	37.05	39.62	36.10	20.03	11.46
GDP (log)	Mean	8.35	8.47	9.01	9.36	9.41	9.49	9.54
	Std. Dev	0.58	0.58	0.40	0.40	0.43	0.44	0.43
Urban population (%)	Mean	39.93	46.45	53.84	61.37	69.12	72.68	74.72
	Std. Dev	16.74	17.83	17.78	17.31	16.04	14.97	14.44
Schooling years	Mean	0.82	3.07	3.13	5.08	6.46	7.38	7.96
	Std. Dev	0.15	1.07	0.88	0.98	1.00	0.95	0.84
No access to water (%)	Mean	8.37	72.39	65.69	49.63	20.17	15.02	13.58
	Std. Dev	4.58	16.34	13.56	13.88	12.43	10.01	9.31
Youth share (%)	Mean	68.94	70.27	72.04	71.27	68.11	62.03	57.48
	Std. Dev	1.81	1.58	1.44	1.61	2.03	2.59	2.75
Employment occupation (%)	Mean	48.52	56.94	41.46	48.75	41.85	48.59	60.82
	Std. Dev	1.39	2.11	2.07	2.78	3.45	4.11	2.97
Robbery rate	Mean	54.93	37.64	27.52	29.71	45.52	62.04	74.22
	Std. Dev	37.00	21.07	17.96	20.37	28.88	36.31	47.91
Injuries rate	Mean	62.79	43.43	35.85	34.51	40.08	41.47	41.41
	Std. Dev	41.15	25.63	18.77	17.36	20.43	16.86	18.29
Federal drug crime rate	Mean	0.61	0.44	8.41	5.38	16.67	17.09	23.82
	Std. Dev	0.00	-	10.99	6.96	12.07	17.03	0.63
Property damage rate	Mean	5.49	5.14	4.96	11.00	13.75	0.37	0.14
	Std. Dev	5.61	3.66	4.54	13.22	10.12	0.39	0.20
Smuggling rate	Mean	-	-	0.60	0.36	0.34	0.88	0.91
	Std. Dev	-	-	0.77	0.45	0.77	2.61	1.90
Human Development Index	Mean	0.47	0.54	0.62	0.71	0.78	0.81	0.81
	Std. Dev	0.09	0.09	0.07	0.06	0.06	0.05	0.04
Land distributed (log)	Mean	73.47	86.45	76.99	74.00	14.48	-	-
	Std. Dev	30.05	28.79	30.76	29.54	8.23	-	-
Inhabitants by home	Mean	4.91	5.21	5.15	5.42	5.89	5.34	4.00
	Std. Dev	0.21	0.19	0.20	0.17	0.27	0.26	0.21
Married population (%)	Mean	53.59	53.62	54.27	54.44	53.77	55.26	55.26
	Std. Dev	2.67	2.51	2.7	2.6	1.8	1.5	1.51
State investment (log)	Mean	-	-	4.41	4.26	4.28	4.27	4.37
	Std. Dev	-	-	0.6	0.71	0.69	0.68	0.55
PRI governor	Mean	1	1	1	0.96	0.68	0.53	0.53
	Std. Dev	0	0	0	0.17	0.43	0.49	0.49

The variable with the most strongest effect in all model specifications is the increasing of schooling years in Mexico, followed by reduction of unemployment, and general development HDI.

Effect of development and crime related variables on homicide rates (1950-2005)

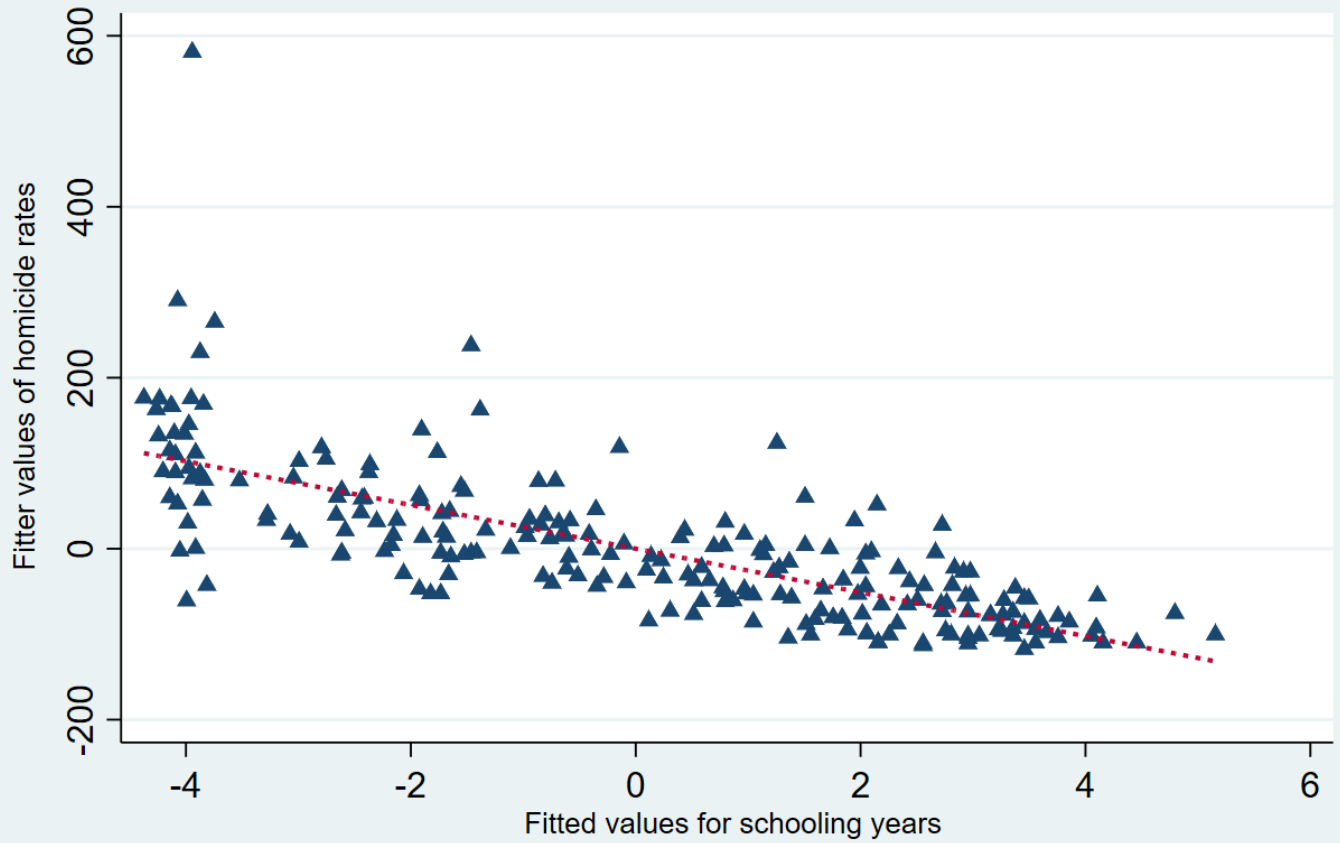
Model specification	Fixed Effects by 32 panels						
Variable	Model 1	Model 2	Model 3 HDI	Model 4 HDI	Model 5	Model 6	Model 7
HDI	-	-	-248.49***	-211.35***	-	-	-
GDP (log)	10.56	10.55	-	-	23.63***	-13.78	22.74***
Urban population (%)	-0.52	-0.52***	-	-	-0.27	-	-0.37
Schooling years	-17.12***	-17.12***	-	-	-17.17***	-23.33***	-21.87***
Access to water (%)	-0.41	-0.41	-	-	-0.13	-	-0.40**
Youth share (%)	2.4	2.4**	4.11**	3.01***	1.17**	1.31	1.38**
Employment occupation (%)	-0.96	-0.96**	-1.23**	-1.48***	-1.49***	0.17	-1.02***
Married population	-3.12**	-3.12	-3.6*	-1.2	-0.65	-	-
Inhabitants by home	-5.21	-5.21	-0.49	-	-	-	-
Robbery rate	0.45**	0.45**	0.41**	0.25**	0.20*	0.44***	0.17**
Injuries rate	-0.38**	-0.38*	-0.28	-0.11	-0.16	-	-
Federal drug crime rate	0.88**	0.88**	1.06*	0.41	0.37	-	0.36*
Property damage rate	1.13***	1.12***	1.11**	1.12***	1.19***	2.05***	1.33***
Smuggling rate	-7.39	-7.39**	-8.03***	-0.94	-0.91	-	-
Land distributed (log)	0.03	0.03	0.05	-	-	-	-
State investment (log)	12.39**	12.39**	14.3**	8.64*	5.78	-	-7.96**
PRI governor	21.41**	21.41	19.97	9.79*	7.94	-	-
Observations	93	93	93	155	155	224	162

*$p < 0.10$ **$p < 0.05$ ***$p < 0.01$

Dependent variable is homicide rate per 100, 000 inhabitants. Prais-Winsten estimation for serial temporal correlation with feasible general least squares. Constant calculated but not reported.

By any increase of schooling years in a Mexican state, the homicide rate declined by 25.

Figure 7. Fitted values regression between homicide rates and schooling rates



coef = -25.564516, se = 1.5713849, t = -16.27

Limitations (for future research)

- We do not have enough data on state capacity and enforcement of law locally.
- We do not have enough data on historical inequality in Mexican states
- We need to codify events of state repression by governors and caciques.
- We need information on health services in Mexico.
- There is a possibility of hidden data because of the "Dirty War" events (the violent suppression of communist guerrillas in Guerrero in the 1970's).

Contributions

- These results provide a framework for future research and possibly a new starting point for discussions about history of crime in Mexico and Latin America.
- The evidence of the effect of education expansion on conflict and violence can be tested in more settlings and compared research.
- Historical research provides remarkable evidence on conflict processes resolution. The decline of homicide in Europe and Asia also happened in Mexico.

References

- Albertus, M., & Kaplan, O. (2013). Land Reform as a Counterinsurgency Policy: Evidence from Colombia. *Journal of Conflict Resolution*, *57*(2), 198–231. https://doi.org/10.1177/0022002712446130
- Archer, D., & Gartner, R. (1976). Violent Acts and Violent Times: A Comparative Approach to Postwar Homicide Rates. *American Sociological Review*, *41*(6), 937–963. JSTOR. https://doi.org/10.2307/2094796
- Eisner, M. (2001). Modernization, self-control and lethal violence. The long-term dynamics of European homicide rates in theoretical perspective. *British Journal of Criminology*, *41*(4), 618–638.
- Eisner, M. (2003). Long-Term Historical Trends in Violent Crime. *Crime and Justice*, *30*, 83–142.
- Knight, A. (1990). *The Mexican Revolution: Counter-revolution and reconstruction*. U of Nebraska Press.
- Neumayer, E. (2016). Good Policy Can Lower Violent Crime: Evidence from a Cross-National Panel of Homicide Rates, 1980–97: *Journal of Peace Research*. https://doi.org/10.1177/00223433030406001
- Østby, G., Urdal, H., & Dupuy, K. (2019). Does education lead to pacification? A systematic review of statistical studies on education and political violence. *Review of Educational Research*, *89*(1), 46-92.
- Picatto, P., Hidalgo, S., & Lajous, A. (2008). *Estadísticas del crimen en México: Series Históricas 1926—2008*. https://ppiccato.shinyapps.io/judiciales/
- Rivera, M. (2016). The sources of social violence in Latin America: An empirical analysis of homicide rates, 1980–2010. *Journal of Peace Research*, *53*(1), 84–99. https://doi.org/10.1177/0022343315598823
- Stamatel, J. P., & Romans, S. H. (2018). The Effects of Wars on Postwar Homicide Rates: A Replication and Extension of Archer and Gartner's Classic Study: *Journal of Contemporary Criminal Justice*. https://doi.org/10.1177/1043986218769989
- Carrion-I-Silvestre, L. J., & German-Soto, V. (2007). Stochastic Convergence amongst Mexican States. *Regional Studies*, *41*(4). https://doi.org/10.1080/00343400601120221
- Keyfitz, N. (1968). *Introduction to the Mathematics of Population*. Addison-Wesley Publishing Company.
- Park, R. E., & Mitchell, B. M. (1980). Estimating the autocorrelated error model with trended data. *Journal of Econometrics*, *13*(2), 185–201. https://doi.org/10.1016/0304-4076(80)90014-7

Imputation process

In first place, we decided to procced for a simple imputation process: we calculated homicide growth rates (HGR) for each gap using the homicides from the first-year registered observation after the gap in data against last year observation before the gap. This a simple procedure used in demography projections (Keyfitz, 1968), with the advantage that we are not using calculation on expected future changes, instead, we use data already registered. This can be noted in this way:

- $HGR = \frac{h(t_2) - h(t_1)}{h(t_1)(t_2 - t_1)}$

If growth rates were negative, we divided the rate between the number of years with gaps and subtracted proportionally the homicide observation before the data gap until we have all gaps imputed and vice versa when growth rates are positive. This can be noted in this way:

- $\sum_{t^2 - t^1} \frac{HGR}{n}$

Regression model

After building or panel, we analysed the homicide rates as the dependant variable with first order autocorrelated Prais-Winsten model using feasible generalised least squares, which estimators are more efficient when trended (Park and Mitchell, 1980). The correction for autocorrelation is done to avoid serially correlated decade data we use in the panels, and we weight the covariances by state panels. The model noted goes like this:

- $y_t = \alpha + X_T\beta + \varepsilon_t$

In this model, y_t is the time series of interest at time *t*, β is the vector of coefficients, X*t* is the matrix of explanatory variables, and ε_t represents the error term. We estimated seven different models, seen in Table 2, using either almost all variables, HDI substituting socioeconomic variables, fixed effects by states, and correcting by variables with more robustness. As can be seen, not all models are estimated with all the observations because some of the variables, like investment, land distribution, and smuggling rates are not complete for all decades, as can be seen in Table 2. Models 6 and 7 are the most robust and have the variables that are consistently significant in all models. Also, are the models with more observations used.