

# Structural Change in Homicide Rates

Diego Valle-Jones

June 4, 2010

The R package strucchange was used to test for stability in the linear regressions of the homicide rates to see if the different military operations caused it to increase.

```
breakpoints(rate ~ ndays)
```

where rate is the homicide rate, and ndays are the number of days in each month

In the tables below, lower refers to the lower confidence interval, and upper refers to the upper confidence interval. Keep in mind that the murders are only available as monthly totals, while the exact date of military operations is available.

## 1 Michoacan

Municipalities with more than a 100,000 thousand people:

Municipality	Lower	Breakpoints	Upper	J. O. Michoacan	A.B.L. Captured
Apatzingán	Apr-06	Jun-06	Aug-06	11-Dec-06	21-Jan-08
Apatzingán	Dec-06	Jan-07	Mar-07	11-Dec-06	21-Jan-08
Hidalgo	Jun-04	Mar-06	Apr-06	11-Dec-06	21-Jan-08
Hidalgo	Jul-06	Nov-06	Feb-08	11-Dec-06	21-Jan-08
Lázaro Cárdenas	Jul-06	Jan-07	Jul-10	11-Dec-06	21-Jan-08
Lázaro Cárdenas	Jan-08	Apr-08	Jun-08	11-Dec-06	21-Jan-08
Morelia	Nov-04	Oct-06	Aug-09	11-Dec-06	21-Jan-08
Morelia	Sep-06	Jan-08	May-08	11-Dec-06	21-Jan-08
Uruapan	Dec-04	Oct-05	Jan-06	11-Dec-06	21-Jan-08
Uruapan	Aug-07	Oct-07	Apr-08	11-Dec-06	21-Jan-08

Zamora	Jan-06	Jun-06	Jul-06	11-Dec-06	21-Jan-08
Zamora	Dec-06	Jan-07	May-07	11-Dec-06	21-Jan-08
Zitácuaro	Jun-05	Feb-06	Mar-06	11-Dec-06	21-Jan-08
Zitácuaro	Aug-06	Nov-06	Nov-08	11-Dec-06	21-Jan-08

The cluster of municipalities near the Pacific Coast and the Tierra Caliente that have a very high homicide rate:

Municipality	Lower	Breakpoints	Upper	J. O. Michoacan	A.B.L. Captured
Aguililla	Oct-05	Jun-06	Jul-06	11-Dec-06	21-Jan-08
Aguililla	Dec-06	Jan-07	Jul-07	11-Dec-06	21-Jan-08
Apatzingán	Apr-06	Jun-06	Aug-06	11-Dec-06	21-Jan-08
Apatzingán	Dec-06	Jan-07	Mar-07	11-Dec-06	21-Jan-08
Aquila	Feb-06	Jun-06	Jul-06	11-Dec-06	21-Jan-08
Aquila	Nov-06	Jan-07	May-07	11-Dec-06	21-Jan-08
Arteaga	Apr-05	Jan-06	Feb-06	11-Dec-06	21-Jan-08
Arteaga	Jan-06	Jan-07	Aug-08	11-Dec-06	21-Jan-08
Carácuaro	Dec-05	Jan-06	Mar-06	11-Dec-06	21-Jan-08
Carácuaro	Aug-05	Sep-06	Oct-06	11-Dec-06	21-Jan-08
Chinicuila	Aug-03	Mar-06	Jun-06	11-Dec-06	21-Jan-08
Chinicuila	Aug-06	Oct-06	Feb-09	11-Dec-06	21-Jan-08
Churumuco		Nov-05		11-Dec-06	21-Jan-08
Churumuco	Nov-05	Jun-06	Aug-07	11-Dec-06	21-Jan-08
Coalcomán de Vázquez Pallares	Nov-05	Feb-06	Aug-06	11-Dec-06	21-Jan-08
Coalcomán de Vázquez Pallares	Sep-06	Apr-07	Sep-07	11-Dec-06	21-Jan-08
Huetamo	Apr-06	Jun-06	Aug-06	11-Dec-06	21-Jan-08
Huetamo	Dec-06	Jan-07	Feb-07	11-Dec-06	21-Jan-08
Tacámbaro	Jan-06	May-06	Jul-06	11-Dec-06	21-Jan-08
Tacámbaro	Dec-06	Jan-07	Apr-07	11-Dec-06	21-Jan-08
Tepalcatepec	Oct-03	Jun-06	Feb-09	11-Dec-06	21-Jan-08
Tepalcatepec	Mar-07	May-07	Mar-08	11-Dec-06	21-Jan-08
Tumbiscatío	Mar-05	Feb-06	May-06	11-Dec-06	21-Jan-08
Tumbiscatío	Aug-06	Sep-06	Jun-07	11-Dec-06	21-Jan-08
Turicato	Dec-05	Aug-06	Oct-06	11-Dec-06	21-Jan-08
Turicato	Feb-07	Mar-07	Aug-07	11-Dec-06	21-Jan-08

## 2 Guerrero

From the charts it looks as if there were two breaks in the homicide rate, the first one coinciding with the arrival of the army, when there was a decrease in the homicide rate, especially in Acapulco. And a second one when Alfredo Beltran Leyva was captured by the army.

Municipalities with more than a 100,000 thousand people:

Municipality	Lower	Breakpoints	Upper	J. O. Guerrero	A.B.L. Captured
Acapulco de Juárez	Jan-06	Jun-06	Jul-06	15-Jan-07	21-Jan-08
Acapulco de Juárez	Dec-06	Jan-07	Sep-07	15-Jan-07	21-Jan-08
Chilapa de Alvarez	Jul-05	Nov-05	Sep-06	15-Jan-07	21-Jan-08
Chilapa de Alvarez	Mar-06	Feb-07	May-07	15-Jan-07	21-Jan-08
Chilpancingo de los Bravo	Nov-05	Apr-06	Jun-06	15-Jan-07	21-Jan-08
Chilpancingo de los Bravo	Jul-06	Feb-07	Aug-07	15-Jan-07	21-Jan-08
Iguala de la Independencia	Dec-02	Jun-07	Dec-08	15-Jan-07	21-Jan-08
Iguala de la Independencia	Sep-07	May-08	Aug-08	15-Jan-07	21-Jan-08
José Azueta	Aug-07	Sep-07	Oct-08	15-Jan-07	21-Jan-08
José Azueta	Dec-07	Apr-08	May-08	15-Jan-07	21-Jan-08
Taxco de Alarcón	Nov-06	Apr-07	May-07	15-Jan-07	21-Jan-08
Taxco de Alarcón	Jun-07	Nov-07	Jun-08	15-Jan-07	21-Jan-08

These are the municipalities bordering Michoacan:

Municipality	Lower	Breakpoints	Upper	J. O. Guerrero	A.B.L. Captured
Arcelia	Feb-03	Oct-05	Apr-11	15-Jan-07	21-Jan-08
Arcelia	Jul-07	Apr-08	Jul-08	15-Jan-07	21-Jan-08
Coahuayutla de José María Izazaga	Oct-05	Jun-06	Aug-06	15-Jan-07	21-Jan-08
Coahuayutla de José María Izazaga	Mar-07	Apr-07	Nov-07	15-Jan-07	21-Jan-08
Coyuca de Catalán	Oct-05	Oct-06	Dec-06	15-Jan-07	21-Jan-08
Coyuca de Catalán	Aug-05	Jan-08	Dec-11	15-Jan-07	21-Jan-08
Cutzamala de Pinzón	Jan-07	Feb-07	Aug-07	15-Jan-07	21-Jan-08
Cutzamala de Pinzón	Sep-07	Feb-08	Mar-08	15-Jan-07	21-Jan-08
La Unión de Isidoro Montes de Oca	Oct-05	Apr-06	May-06	15-Jan-07	21-Jan-08
La Unión de Isidoro Montes de Oca	Mar-06	Jan-07	May-08	15-Jan-07	21-Jan-08
Pungarabato	Nov-04	Oct-05	Apr-06	15-Jan-07	21-Jan-08
Pungarabato	Jun-04	Jan-07	Feb-10	15-Jan-07	21-Jan-08

Zirándaro	Jan-02	Feb-06	Oct-08	15-Jan-07	21-Jan-08
Zirándaro	Dec-07	May-08	Jul-08	15-Jan-07	21-Jan-08

### 3 Baja California

I set the minimum segment size as three because the capture of Eduardo Arrellano Felix occurred near the end of the year, so not many months with a high number of homicides were available for testing.

Municipalities with more than a 100,000 thousand people:

Municipality	Lower	Breakpoints	Upper	J. O. Tijuana	E.A.F. Captured
Ensenada	Jul-08	Aug-08	Sep-08	03-Jan-07	26-Oct-08
Mexicali	Apr-05	Nov-05	Feb-06	03-Jan-07	26-Oct-08
Tecate	Jul-07	Apr-08	Jun-08	03-Jan-07	26-Oct-08
Tijuana	May-08	Sep-08	Oct-08	03-Jan-07	26-Oct-08

### 4 Durango

Municipalities with more than a 100,000 thousand people:

Municipality	Lower	Breakpoints	Upper	J. O. Triangulo Dorado	Phase III
Durango	Oct-07	Feb-08	Mar-08	22-Jan-07	01-Feb-08
Gómez Palacio	Oct-07	Feb-08	May-08	22-Jan-07	01-Feb-08
Lerdo	Nov-06	May-08	Jun-08	22-Jan-07	01-Feb-08

These are the municipalities with a high homicide rate:

Municipality	Lower	Breakpoints	Upper	J. O. Triangulo Dorado	Phase III
El Oro	Dec-04	May-08	Nov-08	22-Jan-07	01-Feb-08
Guanaceví	Apr-00	Mar-08	Jul-08	22-Jan-07	01-Feb-08
Mezquital	Feb-05	Aug-05	Jul-07	22-Jan-07	01-Feb-08
Ocampo	Mar-06	May-08	Jun-08	22-Jan-07	01-Feb-08
Poanas	Dec-06	Jan-08	Feb-08	22-Jan-07	01-Feb-08
Pueblo Nuevo	Apr-07	Mar-08	Dec-08	22-Jan-07	01-Feb-08

San Dimas	Aug-04	Sep-05	Feb-06	22-Jan-07	01-Feb-08
Súchil	Nov-06	Apr-08	May-08	22-Jan-07	01-Feb-08
Tepehuanes	Apr-06	May-08	Jul-08	22-Jan-07	01-Feb-08
Vicente Guerrero	Nov-07	Apr-08	May-08	22-Jan-07	01-Feb-08

## 5 Sonora

Municipalities with more than a 100,000 thousand people:

Municipality	Lower	Breakpoints	Upper	O. Sonora I
Cajeme	Jun-07	Jan-08	May-08	07-Mar-08
Guaymas	Jan-07	Jan-08	Mar-08	07-Mar-08
Hermosillo	Aug-03	Feb-07	May-08	07-Mar-08
Navojua	Mar-05	Nov-05	Mar-08	07-Mar-08
Nogales	Mar-08	May-08	Jun-08	07-Mar-08
San Luis Río Colorado	Nov-06	May-07	Oct-08	07-Mar-08

## 6 Sinaloa

Municipalities with more than a 100,000 thousand people:

Municipality	Lower	Breakpoints	Upper	J. O. Triangulo Dorado	J. O. Culiacan-Navolato
Ahome	Aug-04	Aug-05	Mar-06	22-Jan-07	13-May-08
Culiacán	Sep-07	Apr-08	May-08	22-Jan-07	13-May-08
Guasave	Nov-07	May-08	Jul-08	22-Jan-07	13-May-08
Mazatlán	Nov-07	May-08	Jun-08	22-Jan-07	13-May-08
Navolato	Jan-08	Apr-08	May-08	22-Jan-07	13-May-08

Municipalities with a high homicide rate:

Municipality	Lower	Breakpoints	Upper	J. O. Triangulo Dorado	J. O. Culiacan-Navolato
Badiraguato	Jan-05	Mar-08	Jul-08	22-Jan-07	13-May-08
Cosalá	Aug-06	May-08	Aug-08	22-Jan-07	13-May-08

Mocorito	Sep-07	Apr-08	Aug-08	22-Jan-07	13-May-08
San Ignacio	Jul-04	Mar-08	Sep-08	22-Jan-07	13-May-08
Sinaloa	Nov-06	May-08	Jun-08	22-Jan-07	13-May-08

## 7 Tamaulipas

From the charts it looks like there were 2 breaks in the homicide rate, one corresponding to when “El Chapo” sent “La Barbie” to take over the plaza in Nuevo Laredo, and the other to when he realized he wasn’t going to be able to take it over.

Municipalities with more than a 250,000 thousand people:

Municipality	Lower	Breakpoints	Upper	Troops in N.L.	J. O. Tamaulipas-Nuevo Leon
Matamoros	Jan-05	Aug-05	Aug-07	13-Jun-05	19-Feb-07
Matamoros	Oct-06	Apr-08	Oct-10	13-Jun-05	19-Feb-07
Nuevo Laredo	Oct-04	Jan-06	Oct-06	13-Jun-05	19-Feb-07
Nuevo Laredo	Jul-06	Aug-06	Nov-06	13-Jun-05	19-Feb-07
Reynosa	May-05	Sep-05	Sep-06	13-Jun-05	19-Feb-07
Reynosa	Aug-06	Jan-08	Feb-08	13-Jun-05	19-Feb-07
Tampico	Nov-04	Sep-05	Jun-06	13-Jun-05	19-Feb-07
Tampico	Jun-06	Oct-06	Mar-07	13-Jun-05	19-Feb-07
Victoria	Jun-06	Oct-06	Aug-08	13-Jun-05	19-Feb-07
Victoria	Dec-07	Feb-08	Apr-08	13-Jun-05	19-Feb-07

## 8 Nuevo Leon

Municipalities with more than a 250,000 thousand people:

Municipality	Lower	Breakpoints	Upper	J. O. Tamaulipas-Nuevo Leon
Apodaca	Mar-05	Jan-07	May-07	19-Feb-07
Gral. Escobedo	Sep-03	Aug-06	Sep-08	19-Feb-07
Guadalupe	Dec-02	Sep-05	Dec-05	19-Feb-07
Monterrey	Aug-06	Feb-07	May-07	19-Feb-07
San Nicolás de los Garza	Mar-04	Mar-06	Aug-06	19-Feb-07
Santa Catarina	Sep-04	Jan-07	Apr-07	19-Feb-07

These are the municipalities in the metropolitan area of Monterrey:

Municipality	Lower	Breakpoints	Upper	J. O. Tamaulipas-Nuevo Leon
Apodaca	Mar-05	Jan-07	May-07	19-Feb-07
Cadereyta Jiménez	Jul-04	May-08	Jul-08	19-Feb-07
García	Jun-05	Aug-05	Dec-06	19-Feb-07
Gral. Escobedo	Sep-03	Aug-06	Sep-08	19-Feb-07
Guadalupe	Dec-02	Sep-05	Dec-05	19-Feb-07
Juárez	Dec-01	Oct-05	May-06	19-Feb-07
Monterrey	Aug-06	Feb-07	May-07	19-Feb-07
San Nicolás de los Garza	Mar-04	Mar-06	Aug-06	19-Feb-07
San Pedro Garza García	Jun-02	Mar-08	Dec-08	19-Feb-07
Santa Catarina	Sep-04	Jan-07	Apr-07	19-Feb-07
Santiago	Jan-06	Apr-08	May-08	19-Feb-07

## 9 Veracruz

Municipalities with more than a 250,000 thousand people:

Municipality	Lower	Breakpoints	Upper	J. O. Veracruz
Coatzacoalcos	Nov-03	Sep-06	Oct-08	14-May-07
Veracruz	Apr-03	Feb-07	May-08	14-May-07
Xalapa	Mar-07	Nov-07	Jun-08	14-May-07

These are the interesting municipalities

Municipality	Lower	Breakpoints	Upper	J. O. Tamaulipas-Nuevo Leon
Minatitlán		Aug-05		19-Feb-07
Poza Rica de Hidalgo	Jul-98	May-07	Jun-08	19-Feb-07
Veracruz	Apr-03	Feb-07	May-08	19-Feb-07
Xalapa	Mar-07	Nov-07	Jun-08	19-Feb-07

## 10 Chihuahua

Municipalities with more than a 100,000 thousand people:

Municipality	Lower	Breakpoints	Upper	J. O. Triangulo Dorado	J. O. Chihuahua
Chihuahua	Feb-08	May-08	Jun-08	22-Jan-07	27-Mar-08
Cuauhtémoc	Aug-06	Jun-07	Oct-07	22-Jan-07	27-Mar-08
Delicias	May-05	May-08	Jun-08	22-Jan-07	27-Mar-08
Hidalgo del Parral	Jan-08	Apr-08	May-08	22-Jan-07	27-Mar-08
Juárez		Mar-08		22-Jan-07	27-Mar-08

These are the municipalities near the US border:

Municipality	Lower	Breakpoints	Upper	J. O. Triangulo Dorado	J. O. Chihuahua
Ahumada	Feb-07	May-08	Jun-08	22-Jan-07	27-Mar-08
Ascensión	Jun-06	Feb-08	Mar-08	22-Jan-07	27-Mar-08
Coyame del Sotol		May-08		22-Jan-07	27-Mar-08
Guadalupe	Oct-07	Apr-08	May-08	22-Jan-07	27-Mar-08
Janos	Jul-07	Mar-08	Aug-08	22-Jan-07	27-Mar-08
Nuevo Casas Grandes	Jul-07	Mar-08	Apr-08	22-Jan-07	27-Mar-08
Ojinaga	Sep-07	Feb-08	Apr-08	22-Jan-07	27-Mar-08
Praxedis G. Guerrero	Jul-05	Aug-07	May-09	22-Jan-07	27-Mar-08

These are the municipalities with a very high homicide rate:

Municipality	Lower	Breakpoints	Upper	J. O. Triangulo Dorado	J. O. Chihuahua
Balleza	May-05	Jan-08	Mar-08	22-Jan-07	27-Mar-08
Bocoyna	Aug-05	Apr-08	May-08	22-Jan-07	27-Mar-08
Coronado	Mar-04	Apr-08	Jun-08	22-Jan-07	27-Mar-08
Guazapares	Aug-07	Mar-08	Nov-08	22-Jan-07	27-Mar-08
Hidalgo del Parral	Jan-08	Apr-08	May-08	22-Jan-07	27-Mar-08
Matamoros	Dec-06	Apr-08	May-08	22-Jan-07	27-Mar-08
Namiquipa	Mar-06	Apr-07	Jun-07	22-Jan-07	27-Mar-08
Nonoava	Dec-06	Apr-08	May-08	22-Jan-07	27-Mar-08
Ocampo	May-07	Feb-08	Sep-08	22-Jan-07	27-Mar-08



San Francisco de Borja		Nov-06		22-Jan-07	27-Mar-08
Valle de Zaragoza	Feb-06	Apr-08	May-08	22-Jan-07	27-Mar-08