Structural Change in Homicide Rates

Diego Valle-Jones

May 10, 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

1   Michoacan

Municipalities with more than a 100,000 thousand people:

Municipality	Lower	Breakpoints	Upper	J. O. Michoacan	A.B.L. Captured
Apatzingán	2006-04-30	2006-06-30	2006-08-31	2006-12-11	2008-01-21
Apatzingán	2006-12-31	2007-01-31	2007-03-31	2006-12-11	2008-01-21
Hidalgo	2004-06-30	2006-03-31	2006-04-30	2006-12-11	2008-01-21
Hidalgo	2006-07-31	2006-11-30	2008-02-29	2006-12-11	2008-01-21
Lázaro Cárdenas	2006-07-31	2007-01-31	2010-07-31	2006-12-11	2008-01-21
Lázaro Cárdenas	2008-01-31	2008-04-30	2008-06-30	2006-12-11	2008-01-21
Morelia	2004-11-30	2006-10-31	2009-08-31	2006-12-11	2008-01-21
Morelia	2006-09-30	2008-01-31	2008-05-31	2006-12-11	2008-01-21
Uruapan	2004-12-31	2005-10-31	2006-01-31	2006-12-11	2008-01-21
Uruapan	2007-08-31	2007-10-31	2008-04-30	2006-12-11	2008-01-21
Zamora	2006-01-31	2006-06-30	2006-07-31	2006-12-11	2008-01-21
Zamora	2006-12-31	2007-01-31	2007-05-31	2006-12-11	2008-01-21
Zitácuaro	2005-06-30	2006-02-28	2006-03-31	2006-12-11	2008-01-21
Zitácuaro	2006-08-31	2006-11-30	2008-11-30	2006-12-11	2008-01-21

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	2005-10-31	2006-06-30	2006-07-31	2006-12-11	2008-01-21
Aguililla	2006-12-31	2007-01-31	2007-07-31	2006-12-11	2008-01-21
Apatzingán	2006-04-30	2006-06-30	2006-08-31	2006-12-11	2008-01-21
Apatzingán	2006-12-31	2007-01-31	2007-03-31	2006-12-11	2008-01-21
Aquila	2006-02-28	2006-06-30	2006-07-31	2006-12-11	2008-01-21
Aquila	2006-11-30	2007-01-31	2007-05-31	2006-12-11	2008-01-21
Arteaga	2005-04-30	2006-01-31	2006-02-28	2006-12-11	2008-01-21
Arteaga	2006-01-31	2007-01-31	2008-08-31	2006-12-11	2008-01-21
Carácuaro	2005-12-31	2006-01-31	2006-03-31	2006-12-11	2008-01-21
Carácuaro	2005-08-31	2006-09-30	2006-10-31	2006-12-11	2008-01-21
Chinicuila	2003-08-31	2006-03-31	2006-06-30	2006-12-11	2008-01-21
Chinicuila	2006-08-31	2006-10-31	2009-02-28	2006-12-11	2008-01-21
Churumuco		2005-11-30		2006-12-11	2008-01-21

Churumuco	2005-11-30	2006-06-30	2007-08-31	2006-12-11	2008-01-21
Coalcomán de Vázquez Pallares	2005-11-30	2006-02-28	2006-08-31	2006-12-11	2008-01-21
Coalcomán de Vázquez Pallares	2006-09-30	2007-04-30	2007-09-30	2006-12-11	2008-01-21
Huetamo	2006-04-30	2006-06-30	2006-08-31	2006-12-11	2008-01-21
Huetamo	2006-12-31	2007-01-31	2007-02-28	2006-12-11	2008-01-21
Tacámbaro	2006-01-31	2006-05-31	2006-07-31	2006-12-11	2008-01-21
Tacámbaro	2006-12-31	2007-01-31	2007-04-30	2006-12-11	2008-01-21
Tepalcatepec	2003-10-31	2006-06-30	2009-02-28	2006-12-11	2008-01-21
Tepalcatepec	2007-03-31	2007-05-31	2008-03-31	2006-12-11	2008-01-21
Tumbiscatío	2005-03-31	2006-02-28	2006-05-31	2006-12-11	2008-01-21
Tumbiscatío	2006-08-31	2006-09-30	2007-06-30	2006-12-11	2008-01-21
Turicato	2005-12-31	2006-08-31	2006-10-31	2006-12-11	2008-01-21
Turicato	2007-02-28	2007-03-31	2007-08-31	2006-12-11	2008-01-21

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	2006-01-31	2006-06-30	2006-07-31	2007-01-15	2008-01-21
Acapulco de Juárez	2006-12-31	2007-01-31	2007-09-30	2007-01-15	2008-01-21
Chilapa de Alvarez	2005-07-31	2005-11-30	2006-09-30	2007-01-15	2008-01-21
Chilapa de Alvarez	2006-03-31	2007-02-28	2007-05-31	2007-01-15	2008-01-21
Chilpancingo de los Bravo	2005-11-30	2006-04-30	2006-06-30	2007-01-15	2008-01-21
Chilpancingo de los Bravo	2006-07-31	2007-02-28	2007-08-31	2007-01-15	2008-01-21
Iguala de la Independencia	2002-12-31	2007-06-30	2008-12-31	2007-01-15	2008-01-21
Iguala de la Independencia	2007-09-30	2008-05-31	2008-08-31	2007-01-15	2008-01-21
José Azueta	2007-08-31	2007-09-30	2008-10-31	2007-01-15	2008-01-21
José Azueta	2007-12-31	2008-04-30	2008-05-31	2007-01-15	2008-01-21
Taxco de Alarcón	2006-11-30	2007-04-30	2007-05-31	2007-01-15	2008-01-21
Taxco de Alarcón	2007-06-30	2007-11-30	2008-06-30	2007-01-15	2008-01-21

These are the municipalities bordering Michoacan:

Municipality	Lower	Breakpoints	Upper	J. O. Guerrero	A.B.L. Captured
Arcelia	2003-02-28	2005-10-31	2011-04-30	2007-01-15	2008-01-21
Arcelia	2007-07-31	2008-04-30	2008-07-31	2007-01-15	2008-01-21
Coahuayutla de José María Izazaga	2005-10-31	2006-06-30	2006-08-31	2007-01-15	2008-01-21
Coahuayutla de José María Izazaga	2007-03-31	2007-04-30	2007-11-30	2007-01-15	2008-01-21
Coyuca de Catalán	2005-10-31	2006-10-31	2006-12-31	2007-01-15	2008-01-21
Coyuca de Catalán	2005-08-31	2008-01-31	2011-12-31	2007-01-15	2008-01-21
Cutzamala de Pinzón	2007-01-31	2007-02-28	2007-08-31	2007-01-15	2008-01-21
Cutzamala de Pinzón	2007-09-30	2008-02-29	2008-03-31	2007-01-15	2008-01-21
La Unión de Isidoro Montes de Oca	2005-10-31	2006-04-30	2006-05-31	2007-01-15	2008-01-21
La Unión de Isidoro Montes de Oca	2006-03-31	2007-01-31	2008-05-31	2007-01-15	2008-01-21
Pungarabato	2004-11-30	2005-10-31	2006-04-30	2007-01-15	2008-01-21
Pungarabato	2004-06-30	2007-01-31	2010-02-28	2007-01-15	2008-01-21
Zirándaro	2002-01-31	2006-02-28	2008-10-31	2007-01-15	2008-01-21
Zirándaro	2007-12-31	2008-05-31	2008-07-31	2007-01-15	2008-01-21

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	2008-07-31	2008-08-31	2008-09-30	2007-01-03	2008-10-26
Mexicali	2005-04-30	2005-11-30	2006-02-28	2007-01-03	2008-10-26
Tecate	2007-07-31	2008-04-30	2008-06-30	2007-01-03	2008-10-26
Tijuana	2008-05-31	2008-09-30	2008-10-31	2007-01-03	2008-10-26

4 Durango

Municipalities with more than a 100,000 thousand people:

Municipality	Lower	Breakpoints	Upper	J. O. Triangulo Dorado	Phase III
Durango	2007-10-31	2008-02-29	2008-03-31	2007-01-13	2008-02-01
Gómez Palacio	2007-10-31	2008-02-29	2008-05-31	2007-01-13	2008-02-01
Lerdo	2006-11-30	2008-05-31	2008-06-30	2007-01-13	2008-02-01

These are the municpalities with a high homicide rate:

Municipality	Lower	Breakpoints	Upper	J. O. Triangulo Dorado	Phase III
El Oro	2004-12-31	2008-05-31	2008-11-30	2007-01-13	2008-02-01
Guanaceví	2000-04-30	2008-03-31	2008-07-31	2007-01-13	2008-02-01
Mezquital	2005-02-28	2005-08-31	2007-07-31	2007-01-13	2008-02-01
Ocampo	2006-03-31	2008-05-31	2008-06-30	2007-01-13	2008-02-01
Poanas	2006-12-31	2008-01-31	2008-02-29	2007-01-13	2008-02-01
Pueblo Nuevo	2007-04-30	2008-03-31	2008-12-31	2007-01-13	2008-02-01
San Dimas	2004-08-31	2005-09-30	2006-02-28	2007-01-13	2008-02-01
Súchil	2006-11-30	2008-04-30	2008-05-31	2007-01-13	2008-02-01
Tepehuanes	2006-04-30	2008-05-31	2008-07-31	2007-01-13	2008-02-01
Vicente Guerrero	2007-11-30	2008-04-30	2008-05-31	2007-01-13	2008-02-01

5 Sonora

Municipalities with more than a 100,000 thousand people:

Municipality	Lower	Breakpoints	Upper	O. Sonora I
Cajeme	2007-06-30	2008-01-31	2008-05-31	2008-03-07
Guaymas	2007-01-31	2008-01-31	2008-03-31	2008-03-07
Hermosillo	2003-08-31	2007-02-28	2008-05-31	2008-03-07
Navojoa	2005-03-31	2005-11-30	2008-03-31	2008-03-07
Nogales	2008-03-31	2008-05-31	2008-06-30	2008-03-07
San Luis Río Colorado	2006-11-30	2007-05-31	2008-10-31	2008-03-07

6 Sinaloa

Municipalities with more than a 100,000 thousand people:

Municipality	Lower	Breakpoints	Upper	J. O. Triangulo Dorado	J. O. Culiacan-Navolato

Municipality	Lower	Breakpoints	Upper	J. O. Triangulo Dorado	J. O. Culiacan-Navolato
Ahome	2004-08-31	2005-08-31	2006-03-31	2007-01-13	2008-05-13
Culiacán	2007-09-30	2008-04-30	2008-05-31	2007-01-13	2008-05-13
Guasave	2007-11-30	2008-05-31	2008-07-31	2007-01-13	2008-05-13
Mazatlán	2007-11-30	2008-05-31	2008-06-30	2007-01-13	2008-05-13
Navolato	2008-01-31	2008-04-30	2008-05-31	2007-01-13	2008-05-13

Municipalities with a high homicide rate:

Municipality	Lower	Breakpoints	Upper	J. O. Triangulo Dorado	J. O. Culiacan-Navolato
Badiraguato	2005-01-31	2008-03-31	2008-07-31	2007-01-13	2008-05-13
Cosalá	2006-08-31	2008-05-31	2008-08-31	2007-01-13	2008-05-13
Mocorito	2007-09-30	2008-04-30	2008-08-31	2007-01-13	2008-05-13
San Ignacio	2004-07-31	2008-03-31	2008-09-30	2007-01-13	2008-05-13
Sinaloa	2006-11-30	2008-05-31	2008-06-30	2007-01-13	2008-05-13

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 100,000 thousand people:

Municipality	Lower	Breakpoints	Upper	J. O. Tamaulipas-Nuevo Leon
Altamira	2006-07-31	2007-04-30	2007-05-31	2007-02-17
Altamira	2007-06-30	2007-11-30	2008-11-30	2007-02-17
Ciudad Madero	2005-06-30	2006-09-30	2006-11-30	2007-02-17
Ciudad Madero	2007-06-30	2007-09-30	2009-02-28	2007-02-17
El Mante	2005-06-30	2006-01-31	2006-05-31	2007-02-17
El Mante	2006-06-30	2006-08-31	2007-04-30	2007-02-17
Matamoros	2005-01-31	2005-08-31	2007-08-31	2007-02-17
Matamoros	2006-10-31	2008-04-30	2010-10-31	2007-02-17
Nuevo Laredo	2004-10-31	2006-01-31	2006-10-31	2007-02-17
Nuevo Laredo	2006-07-31	2006-08-31	2006-11-30	2007-02-17
Reynosa	2005-05-31	2005-09-30	2006-09-30	2007-02-17
Reynosa	2006-08-31	2008-01-31	2008-02-29	2007-02-17
Río Bravo	2006-03-31	2007-08-31	2007-09-30	2007-02-17
Río Bravo	2008-02-29	2008-03-31	2009-06-30	2007-02-17
Tampico	2004-11-30	2005-09-30	2006-06-30	2007-02-17
Tampico	2006-06-30	2006-10-31	2007-03-31	2007-02-17
Victoria	2006-06-30	2006-10-31	2008-08-31	2007-02-17
Victoria	2007-12-31	2008-02-29	2008-04-30	2007-02-17

8 Nuevo Leon

Municipalities with more than a 100,000 thousand people:

Municipality	Lower	Breakpoints	Upper	J. O. Tamaulipas-Nuevo Leon
Apodaca	2005-03-31	2007-01-31	2007-05-31	2007-02-17
Gral. Escobedo	2003-09-30	2006-08-31	2008-09-30	2007-02-17
Guadalupe	2002-12-31	2005-09-30	2005-12-31	2007-02-17
Juárez	2001-12-31	2005-10-31	2006-05-31	2007-02-17
Monterrey	2006-08-31	2007-02-28	2007-05-31	2007-02-17
San Nicolás de los Garza	2004-03-31	2006-03-31	2006-08-31	2007-02-17
San Pedro Garza García	2002-06-30	2008-03-31	2008-12-31	2007-02-17

Santa Catarina	2004-09-30	2007-01-31	2007-04-30	2007-02-17

9 Chihuahua

Municipalities with more than a 100,000 thousand people:

Municipality	Lower	Breakpoints	Upper	J. O. Triangulo Dorado	J. O. Chihuahua
Chihuahua	2008-02-29	2008-05-31	2008-06-30	2007-01-13	2008-03-27
Cuauhtémoc	2006-08-31	2007-06-30	2007-10-31	2007-01-13	2008-03-27
Delicias	2005-05-31	2008-05-31	2008-06-30	2007-01-13	2008-03-27
Hidalgo del Parral	2008-01-31	2008-04-30	2008-05-31	2007-01-13	2008-03-27
Juárez		2008-03-31		2007-01-13	2008-03-27

These are the municpalities near the US border:

Municipality	Lower	Breakpoints	Upper	J. O. Triangulo Dorado	J. O. Chihuahua
Ahumada	2007-02-28	2008-05-31	2008-06-30	2007-01-13	2008-03-27
Ascensión	2006-06-30	2008-02-29	2008-03-31	2007-01-13	2008-03-27
Coyame del Sotol		2008-05-31		2007-01-13	2008-03-27
Guadalupe	2007-10-31	2008-04-30	2008-05-31	2007-01-13	2008-03-27
Janos	2007-07-31	2008-03-31	2008-08-31	2007-01-13	2008-03-27
Nuevo Casas Grandes	2007-07-31	2008-03-31	2008-04-30	2007-01-13	2008-03-27
Ojinaga	2007-09-30	2008-02-29	2008-04-30	2007-01-13	2008-03-27
Praxedis G. Guerrero	2005-07-31	2007-08-31	2009-05-31	2007-01-13	2008-03-27

These are the municipalities with a very high homicide rate:

Municipality	Lower	Breakpoints	Upper	J. O. Triangulo Dorado	J. O. Chihuahua
Balleza	2005-05-31	2008-01-31	2008-03-31	2007-01-13	2008-03-27
Bocoyna	2005-08-31	2008-04-30	2008-05-31	2007-01-13	2008-03-27
Coronado	2004-03-31	2008-04-30	2008-06-30	2007-01-13	2008-03-27
Guazapares	2007-08-31	2008-03-31	2008-11-30	2007-01-13	2008-03-27
Hidalgo del Parral	2008-01-31	2008-04-30	2008-05-31	2007-01-13	2008-03-27
Matamoros	2006-12-31	2008-04-30	2008-05-31	2007-01-13	2008-03-27
Namiquipa	2006-03-31	2007-04-30	2007-06-30	2007-01-13	2008-03-27
Nonoava	2006-12-31	2008-04-30	2008-05-31	2007-01-13	2008-03-27
Ocampo	2007-05-31	2008-02-29	2008-09-30	2007-01-13	2008-03-27
San Francisco de Borja		2006-11-30		2007-01-13	2008-03-27
Valle de Zaragoza	2006-02-28	2008-04-30	2008-05-31	2007-01-13	2008-03-27