Using the Beveridge Nelson decomposition of economic time series for pointing out the occurrence of terrorist attacks

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USING THE BEVERIDGE & NELSON DECOMPOSITION OF ECONOMIC TIME SERIES FOR POINTING OUT THE OCCURRENCE OF TERRORIST ATTACKS

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Abstract: This paper continues my research program on violence and terrorism started 15 years ago. It presents in the first part through empirical exercises, the suitability of The Beveridge and Nelson decomposition of economic time series for pointing out the occurrence of terrorist attacks. It presents the simulation results of the hypothetical case of U.S., and Colombia experiencing, additional, and first three terrorist attacks similar to 9/11, 2001: for the U.S. additional attacks are simulated occurring in 1996, and 1998 with 24,950, and 61,516 casualties respectively; while for Colombia three attacks are artificially constructed independently in 1993 with 3,000 casualties, and 2001 with alternatives scenarios of 3,000 and 4,299 casualties. In the second part, while the model for terrorist attacks in U.S. soil is developed, and knowing that the geo-political context of the war in Iraq is different, Its objective, is to use the experience from Colombia to help policy, and decision makers understand the probable outcomes and implications of decisions taken today in regards to the war in Iraq. It uses the terrorist murder and attacks indicator from 1946 to 2001 for Colombia that assumes a 9/11 in Colombia killing 3,000 civilians, and that as its consequence the Colombian army started a strong confrontation against the enemy as the U.S did at that time. This indicator is used as dependent variable to re-estimate the model for cyclical terrorist murder for Colombia (Gómez-Sorzano 2006B, http://mpra.ub.uni-muenchen.de/539/01/MPRA_paper_539.pdf) using it, for sensitivity analysis scenarios including troop deployment decisions identical to those already taken by the U.S. during the war in Iraq. The last section concludes showing dynamically how at this point, moderate troop withdrawals and disarmament, will reduce both the intensity of the conflict and the estimated terrorist murder and attacks indicator for the U.S.

Keywords: United States, Colombia, cyclical terrorist murder, cyclical terrorist murder and attacks indicator, terrorist murder and attacks index, terrorist murder and attacks signal, model of cyclical terrorist murder for Colombia, model for terrorist attacks in U.S. soil.

JEL classification codes: C22, D63, D74, H56, K42, N46, O54.

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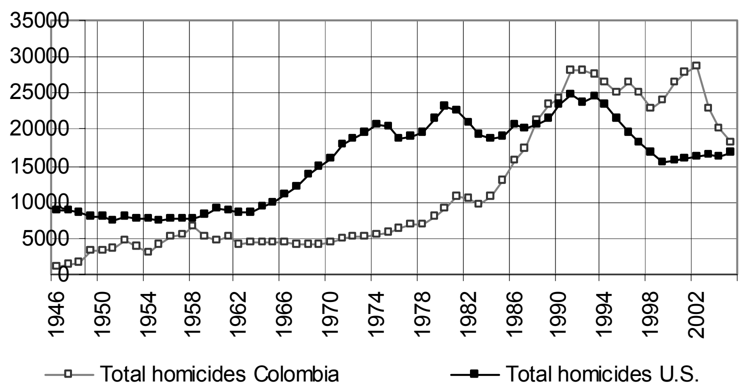
USING THE BEVERIDGE & NELSON DECOMPOSITION OF ECONOMIC TIME SERIES FOR POINTING OUT THE OCCURRENCE OF TERRORIST ATTACKS

1. Introduction

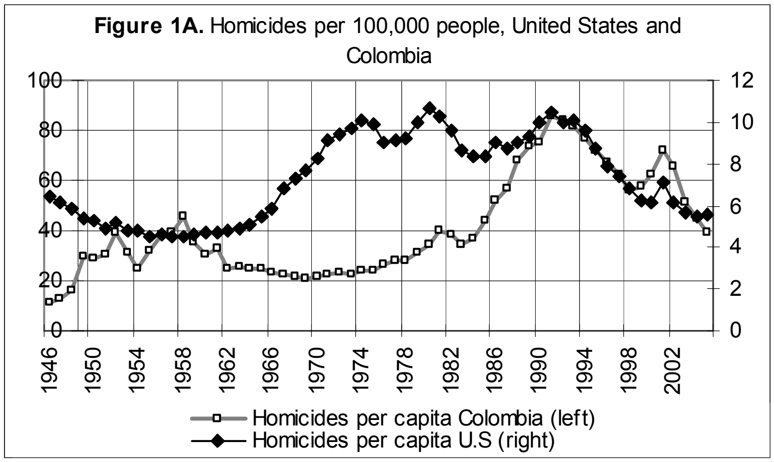
This paper is divided in three parts. The first section, estimates alternative models creating the terrorist murder, and attacks indicator for both Colombia, and the U.S., under the assumption of additional terrorist attacks. The second part presents the simulation results of the hypothetical case of Colombia experiencing a terrorist attack of the intensity, and magnitude of 9/11 2001 terrorist attacks hitting New York City, Washington D.C., and Pennsylvania; the third section concludes. The foundations for the exercise are based on the theoretical assumptions of the model of cyclical terrorist murder for Colombia 1950 – 2004, forecasts 2005-2019 (Gómez-Sorzano, 2005).

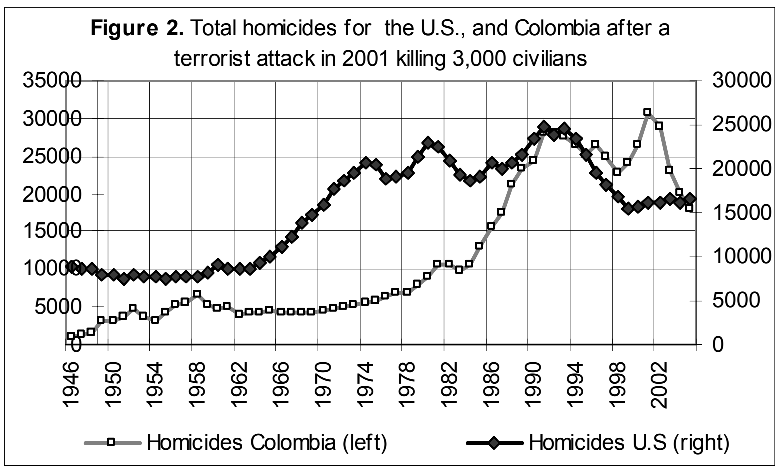
While the construction of a model for terrorist attacks in U.S. soil is accomplished, this research indirectly, pretends to enrich the discussion of whether or not the strategy of sending troops to Iraq can potentially diminish the occurrence of terrorist attacks in U.S. soil. The paper is an empirical exercise that uses the setting, and experience from Colombia to draw conclusions that could be extended to the U.S. The paper and exercise begins by decomposing violence for Colombia from 1946 to 2001, and 2002. In 2001 it is assumed that an unexpected terrorist attack occurs in Colombian soil killing 3,000 people, and so to the original data series for homicides for Colombia particularly year 2001 with 27,838 registered homicides is changed after adding those 3,000 from the attack for a total of 30,838 homicides that year.[1] Figures 1 and 1A show homicides, and homicides per 100,000 people for the U.S. and Colombia from 1946 to 2005; and figure 2 shows the altered data series for Colombia that assumes a 9/11 terrorist attack in 2001.

Figure 1. Total homicides, United States and Colombia 1946-2005



[1] According to Stanton (2006), the terrorist attacks of September 11, 2001, resulted in one of the most devastating events in U.S. history, and the deadliest terrorist assault on American soil. The loss of lives of noncombatants (nearly 3,000) in just one day is unequaled in U.S. history; and damage to property, industries and other victims from the concerted attacks reached as high as $36 billion (Feinberg 2004; Ruben 2004; Clodfelter 1992; Dudziak 2004).





2. Data and methods.

The Colombian National Police gathers information on 18 modalities or titles of crime[2]. For the present analysis I use the data series of offenses against life, and personal integrity from 1946 to 2001 (Crime modality #1). Out of the 24 subcategories of the latter one; for this exercise, I merge in a single data series murder, aggravated murder, murder with terrorist intent, and murder associated with the exercise of official police duties.

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[2] Offenses against life, and personal integrity; offenses against people, and assets protected by the international humanitarian law; offenses against individual freedom; offenses against sexual liberty; offenses against moral integrity; offenses against family, offenses against economic patrimony; offenses against authorship rights; offenses against public faith; offenses against social, and economic order; offenses against natural resources, and the environment; offenses against public security; offenses against public health; offenses against the democratic participation; offenses against public administration; offenses against the justice administration; offenses against homeland security, and offenses against the constitution.

Beveridge and Nelson decomposition

I use the augmented Dickey Fuller (1981) tests to verify the existence of a unit root on the logarithm of murder 1946-2001. I run two tests: the first one for the sub-period 1946 to 2001, but the data for homicides for 2001 was artificially increased from 27,873 (64.68 homicides per 100,000 people) registered murders to 30,838 (71.65 per 100,000) in order to account for the 3,000 additional deaths that supposedly occurred as a consequence of a 9/11 attack in Colombia. The second test enlarges the sample from 1946 to 2002, keeping as murders registered for 2001 30,838, and assuming the return to normal conditions, and so maintaining for 2002 the real homicide figures for Colombia that year of 28,781 murders (65.74 per 100,000). These tests present the structural form shown in equation (1).

$$\Delta L\,\text{hom}_t = \alpha + \theta.\,t + \phi\; L\,\text{hom}_{t-i} + \sum_{i=1}^{k} \gamma_i\; \Delta L\,\text{hom}_{t-i} + \varepsilon_t \qquad (1)$$

The existence of a unit root, is given by (phi) ϕ=0. I use the methodology by Campbell and Perron (1991), in which an auto-regression process of order k is previously selected in order to capture possible seasonality of the series, and lags are sequentially eliminated, if: a) after estimating a regression the last lag does not turn out to be significant or, b) if the residuals pass a white noise test at the 0.05 significance level. The results are reported on table 1.

Table 1 Dickey & Fuller test for Unit Roots

Series	K	Alpha	Theta	Phi	Stationary
D(lthomp100A) – murder series	9	0.544	0.0058	-0.2079	No
Colombia, 1946-2001		(3.27)	(3.57)	**(-3.54)**	
D(lthomp100B) – murder series	9	0.602	0.059	-0.226	No
Colombia, 1946-2002		(3.76)	(3.61)	**(-3.96)**	

Notes: 1. K is the chosen lag length. T-tests in parentheses refer
To the null hypothesis that a coefficient is equal to zero.
Under the null of non-stationarity, it is necessary to use the Dickey-
Fuller critical value that at the 0.05 level, for the t-statistic is –3.50 (sample size of 50).

After rejecting the null for a unit root (accepting the series are non stationary), I perform the BN decomposition which begins by fitting the logarithm of the per capita murder series Dtlhomp100A and Dtlhomp100B to ARIMA models of the form (2)[3]:

[3] Two Arima models are estimated: for the series 1946-2001, and 1946-2002. The objective of this exercise is to empirically show, that after an unexpected terrorist attack, particularly in this case after passing from 71.65 homicides per capita as a consequence of the attacks in 2001, and then returning to normality with a rate of 65.74 per 100,000 in 2002, the cyclical component of murder “the terrorist murder and attacks index” clearly shows the beginning of a rising cycle in 2002 after the attacks, and so this indicator must be used in any future research as dependent variable in models forecasting the turning points since those contain the precise timing occurrence of terrorist attacks.

$$\Delta Lt\,\mathrm{hom}_t = \mu + \sum_{i=1}^{k} \gamma_i \Delta Lt\,\mathrm{hom}_{t-i} + \sum_{i=1}^{h} \psi_i \varepsilon_{t-i} + \varepsilon_t \qquad (2)$$

Where k, and h are respectively the autoregressive and moving average components. The model estimated for this exercise for the sub-periods 1946-2001, and 1946-2002 is an ARIMA (0,1,13) ran with RATS 4, shown in table 2, including moving average terms of order 1,2 and, 13; the model is unique at providing a cyclical component oscillating around a zero average:

Table 2. Estimated ARIMA models for murder in Colombia

Annual data from 1946 to 2001 and **1946-2002 (bold numbers are for 1946-2002)**

Variables	**Coeff**	**T-stats**	**Std Error**	**Signif**
Constant	0.0330	2.092	0.0161	0.0410
	0.0306	**2.021**	**0.0152**	**0.0484**
MA(1)	0.3524	2.617	0.1346	0.0110
	0.3163	**2.4012**	**0.1317**	**0.0200**
MA(2)	-0.2865	-2.206	0.1298	0.0310
	-0.2945	**-2.276**	**0.1293**	**0.0269**
MA(13)	-0.2592	-2.33	0.1112	0.0230
	-0.2671	**-2.246**	**0.1189**	**0.0289**

Centered R^2 = 0.92 **(0.9214)** DW= 2.03 **(2.01)**

Significance level of Q = 0.4615 **(0.5258)**

Usable observations = 55 **(56)**

The three model parameters are replaced in the equation for the permanent component of murder shown in (3)[4]:

$$L\,\mathrm{hom}_t^{PC} = L\,\mathrm{hom}_0 + \frac{\mu . t}{1-\gamma_1 - . . . \gamma_k} + \frac{1+\Psi_1 + ... \Psi_h}{1-\gamma_1 - . . . \gamma_k} \sum_{i=1}^{t} \varepsilon_i \qquad (3)$$

The transitory or cyclical terrorist murder, and attacks estimate is found by means of the difference between the original series, and the exponential of the permanent per capita component ($L\mathrm{hom}_t^{PC}$)[5], and is shown in figures 3 and 4. Figure 3 shows jointly the political murder indicator from 1946 to 1999 estimated with Arima (0,1,13. with moving average terms of order 1,5, and 13. Brauer, Gómez-Sorzano and Sethuraman 2002 p.452,) and the terrorist murder and attacks indicator constructed with that model using data 1946-2001. Figure 4 captures again the political murder indicator versus the terrorist murder, and attacks index after including in the sample the real data observed for homicides per capita in Colombia in 2002, the graph shows that the attack is responsible for the creation of a turning point and so terrorist murder jumps ascending from –4.24 terrorist murder per-capita in 2001 to –3.55 in 2002 (sample 1946-2002). This is a major breakthrough that empirically shows that, the Beveridge and Nelson decomposition of economic

[4] The extraction of permanent and cyclical components from the original series is theoretically shown in BN (1981), Cuddington and Winters (1987), Miller (1998), Newbold (1990), and Cárdenas (1991). I show the mathematical details for the U.S., and Colombian cases in appendix A. Eq.3 above, turns out to be Eq.14B (Colombian case), and 15 (U.S.' case) in appendix A.

[5] Turning the estimated permanent per capita component into the level of the permanent component.

time series applied to decomposing violence must be used to point out the occurrence of terrorist attacks. In this particular case is pointing out in 2002 that a terrorist attack occurred in 2001. A similar situation is found in the United States' case (Gómez-Sorzano 2006C p.9) the terrorist indicator was 0.73 per capita in 2001, and increased to 1.63 per capita in 2002 after the attacks (123.2% change). For these reasons, I claim based on this new evidence that the political murder indicator estimated in Brauer, Gómez-Sorzano and Sethuraman 2002, was erroneously named in that paper.

From now onwards after a data series of murder is shocked by a terrorist attack the new indicator must be labeled as "terrorist murder and attacks indicator"[6], since the information for attacks is hidden in the cycles of violence, and located in, and close to the estimated turning points.

Figure 3. Cyclical terrorist murder and political murder indicators for Colombia 1946-2001

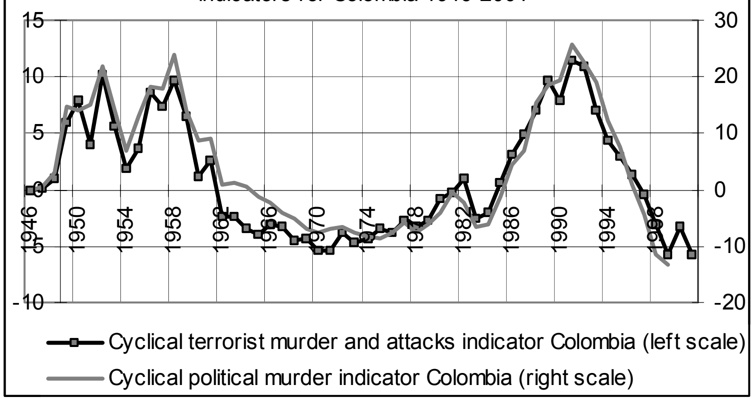
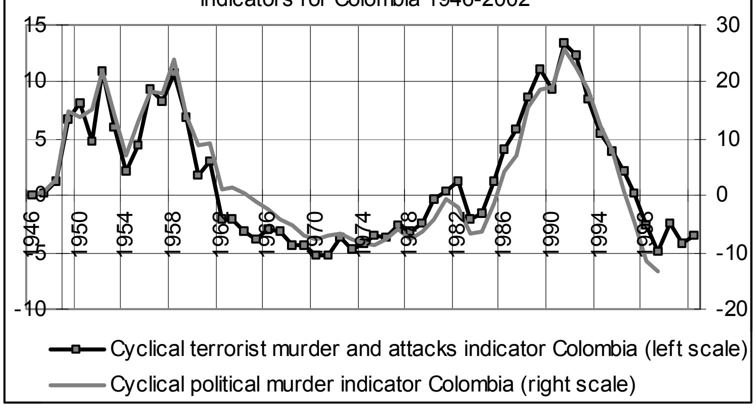


Figure 4. Cyclical terrorist murder and political murder indicators for Colombia 1946-2002



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[6] The cyclical terrorist murder and attacks indicator for the U.S (Gómez-Sorzano 2006C), clearly shows strong evidence supporting this claim: after the terrorist attacks of Pearl Harbor in 1941, the terrorist indicator moved down from 0.24 per capita in 1941 to 0.06 in 1942 but ascended to 0.57 (change of 850%) in 1943; after the terrorist assassination of President Kennedy in 1963, the terrorist attack indicator decreased additionally from 1964 to 1965 from –1.27 to –1.94 (52.7%) but jumped again from 1966 (after Los Angeles riots) to 1967 to –1.41 and –0.91 (54.9%) respectively. Following 9/11 2001, the indicator jumped from 0.73 to 1.63 (123.2%) from 2001 to 2002 and to 1.89 in 2003.

Now in regards to the estimated turning points in the upper parts of the cyclical components of any kind of murder series, this point does not require a simulation of a an artificial attack, e.g., Gómez-Sorzano (2006C), shows that after Japan surrendered on September 2nd 1945, the terrorist and attacks indicator for the U.S still went up from 1945 to 1946 (0.91 to 1.47 per capita; a 61.5% change) but decreased in 1947 to 1.34 (-8.8%) as a result of the end of the war; the U.S. terrorist indicator additionally clearly marked with absolute precision the occurrence of the World Trade Center bombing in 1993; the indicator moved from 5.22 in 1992 to 5.32 (1.91%) in 1993 (reaching its highest historical peak this year) and decreased after the attack to 4.81 (-9.5%) terrorist murder per 100,000 in 1994.

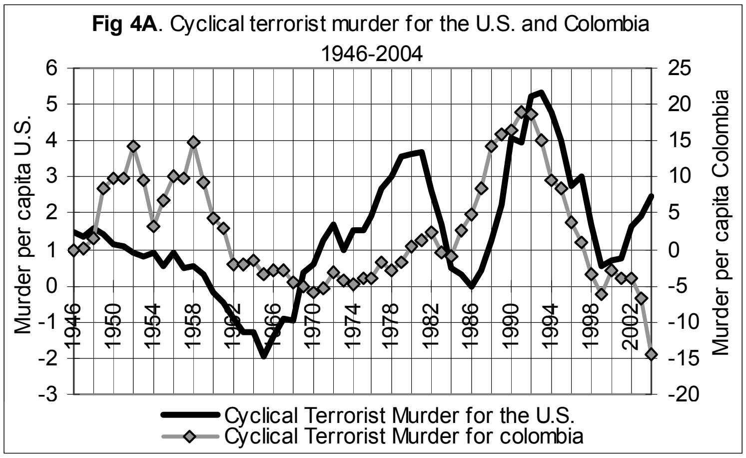
Concluding, I claim that I have found and index that point outs the occurrence of terrorist attacks and terrorist murder in data series of homicides. The naming of the new indicator will vary if the country, state, department or geographical region has been shocked by terrorist attacks. In the cases of the U.S., and Colombia, where extremists groups have attacked modernity, and the democratic system, this indicator must be called "cyclical terrorist murder and attacks index", and so the naming of political murder given to this variable in Brauer, Gómez-Sorzano and Sethuraman 2002 is erroneous, and must be labeled as terrorist murder and attacks index. Any future exercise at decomposing violence will change the naming of this indicator from cyclical murder in Switzerland or Sweden (countries with no terrorist experiences) to cyclical terrorist murder to refer to countries as the U.S., and Colombia, or any other who has suffered both terrorist attacks against its infrastructure, and the killing of political and presidential leaders. At all times, the assassination of political leaders and presidential candidates must be called a terrorist murder, and the acts themselves must be labeled as a terrorist attack: a terrorist act for the country in consideration, because it is, menacing democracy through the creation of chaos, and temporal instability. Fortunately history provides many examples of such cases. To mention just a couple of them; In the U.S., e.g., the disruption in social order during the 1968 Martin Luther King Riots. For the Colombian case the assassination of Gaitán in 1948, which started what was called the Bogotazo (an outburst of mass rioting in Bogotá, the main cities, and the countryside itself) lasting up to 1953, and usually called by historians as The La Violencia period in Colombia.

Figure 4A shows both indicators of terrorist murder, and attacks for Colombia, and the U.S. In the Colombian case, the indicator coincides with documented waves of assassination of presidential leaders, government guerrilla clashes, and terrorist attacks by guerrillas or drug organizations threatening the democratic system. A description of these facts is found in Gómez-Sorzano 2005 and 2006B).

In the U.S' case, Gómez-Sorzano 2006C, reports that the cyclical terrorist murder for the country, matches the qualitative description of known waves of organized crime, internal tensions, crime legislation, assassination of leaders, social, and political unrest overseas, and terrorist attacks to its infrastructure and people[7]. This indicator disentangles the timing for terrorist attacks, and terrorist murder in U.S. soil[8] as clearly occurring whether in the lowest part of a descending cycle or the upper portion of an ascending cycle.

[7] As the case of World War II, Vietnam Conflict, Persian Gulf War, the war on drugs in Colombia, and recently Operation Iraqui Freedom. All of them, occurring inside ascending cycles of my estimated cyclical murder component. On the contrary, according to Kegley and Raymond (2007) Al Qaeda attacks on U.S. cities and overseas facilities have occurred in the closeness of descending cycles as the attacks on the American embassies in Nairobi, Kenya, and Dar es Salaam, Tanzania (1998), the suicide boat bombing of the U.S.S. Cole in Aden, Yemen (2000), and the suicide aircraft hijacking attacks on the World Trade Center and the Pentagon (2001).

[8] As to its recent movement, it warns that the drop in cyclical terrorist murder in U.S. soil began in 1994 ending up in 1999 (e.g., two years before 9/11 2001 terrorist attacks).



Additional exercises, simulating alternatives attacks and paths for violence for Colombia and the U.S.

Simulating attacks for Colombia

Table 2A displays additional exercises changing the path for violence after a terrorist attack. Model C, estimated with an ARIMA(0,5,13) still assumes that on 2001 Colombia had an attack with 3,000 casualties (raising murder per 100,000 people to 71.65), but following the attack the country returned to the historically observed per capita murders from 2002 to 2004 (65.74, 51.58, and 44.44). The cyclical component moves from 2001 to 2002 from 3.87 to 3.84 per capita.

Model D, keeps the same assumptions for the path of violence after the attack (65.74 in 2002, 51.58 in 2003, and 44.44 in 2004), but is modeled with ARIMA (0,1,13)[9]. As consequence terrorist murder jumps after the attack from –2.95 in 2001 to –1.95 (51.2%) in 2002 (sample 1946-2004).

Table 2A. Estimated additional ARIMA models for murder in Colombia
Annual data from 1946 to 2004 (Model C), 1946-2004 (Model D)
1946-2003 (Model E), 1946-2005 (Model F)

Variables	**Coeff**	**T-stats**	**Std Error**	**Signif**
Constant-Model C	0.0240	1.67	0.0140	0.1000
Model D	0.0250	1.65	0.0150	0.1000
Model E	0.0307	2.08	0.0147	0.0414
Model F	0.0284	1.95	0.1455	0.0560
MA(1)-Model C	0.2800	2.27	0.1200	0.0260
Model D	0.3400	2.63	0.1300	0.0100
Model E	0.3315	2.55	0.1295	0.0130
Model F	0.2813	2.1901	0.1284	0.0320

9 Model presented in Gómez-Sorzano 2005.

MA(5)-Model C	-0.2600	-2.04	0.1300	0.0400
MA(2)-Model D	-0.2876	-2.28	0.1261	0.0260
MA(2)-Model E	-0.2922	-2.3348	0.1251	0.0230
MA(2)-Model F	-0.2582	-2.0168	0.1280	0.0480
MA(13)-Model C	-0.2900	-2.21	0.1300	0.0300
Model D	-0.2693	-2.41	0.1116	0.0190
Model E	-0.2641	-2.3852	0.1107	0.0200
Model F	-0.2692	-2.0784	0.1295	0.0423

Centered R^2 = 0.91C, 0.91D, 0.92E, 0.92F

DW= 2.06C, 1.98D, 2.03E, 2.01F.

Significance level of Q = 0.62C, 0.55D, 0.34E, 0.45F

Usable observations = 58C, 58D, 57E, 59F.

Note= Model C is ARIMA (1,5,13), Models D,E, and F ARIMA(1,2,13)

Model E is a complete new exercise in which it is assumed that an attack of 3,000 casualties occurred justly in the middle of the pronounced fall of homicides experienced in Colombia that started in 1993 (81.47 per 100,000 and that lasts to present with 39.30 in 2005): in this model I simulate the occurrence of an attack in 1998 killing 3,000, and so the historical data series changes from 22,872 to 25,872 homicides (56.02 to 63.37 per capita) for that year. After the attack, I assume a new upward cycle starts and proceeded to adjust all homicide data following the attack with the same variations in total homicides experienced by the U.S after the attack (1.19% in 2002, 1.84% 2003, -2.36 2004 and 3.43 2005), accordingly homicides for Colombia changed to 26,597 in 1999 26,914 in 2000, 27,410 in 2001, 26,763 in 2002 and 27,681 in 2003 (per capita terms of 64.02, 63.62, 63.69 61.63, and 62.16 respectively. As conclusion, the cyclical component moves from –1.21 in 1998 descending to –1.83 (1999) and –3.19 (2000), indicating that the decomposition, and its estimated cyclical movement can not be confused, forced or induced to reproduce an upward cycle with a simulated attack in the middle of a real pronounced downward trend as the one observed in Colombia for the period mentioned.

Finally model F, concludes these empirical exercises for Colombia assuming again an attack in 2001 with 4,299 casualties, but the future path for per capita murders in Colombia is modified with the U.S per capita variations in murder after the attack (-14% in 2002, -6.5% in 2003, -3.5% in 2004 and 1.81% in 2005), or 71.65 per capita in 2001, 61.62 in 2002, 57.91 in 2003, 56.18 in 2004, and 57.19 in 2005. One more time the cyclical component can not be induced at creating an upward cycle using the U.S data, and so the cyclical terrorist murder estimated diminishes from 2001 to 2003 from –3.19 to –4.13 and –10.55 in 2003. Figures 4B, and 4C, present respectively models C-D, and E-F.

Concluding for Colombia model (0,1,13) using different samples (1946-2002, figure 4), and (1946-2004, figure 4A) warned twice the country in 2002 that an attack would occur in 2001, changing respectively the estimated component paths, from -4.24 in 2001 to -3.55 in 2002 (19%) for the first sample, and from -2.95 in 2001 to -1.95 in 2002 (51%) for the second sample. Same as in the U.S's case (Gómez-Sorzano, 2006C), a turning point in the lowest part of the trajectory, is a signal warning the occurrence of an attack.

Figure 4B. Cyclical terrorist murder indicators for Colombia 1946-2004

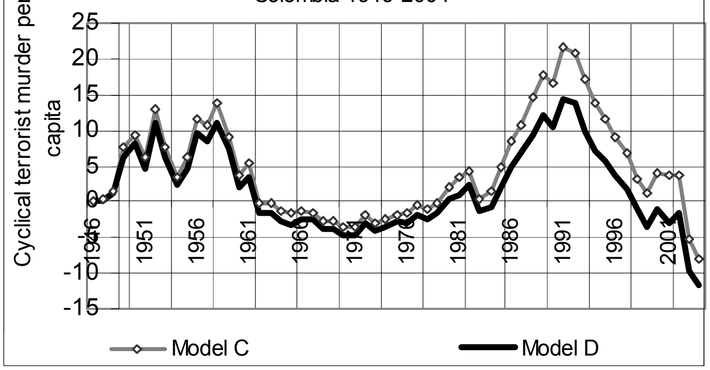
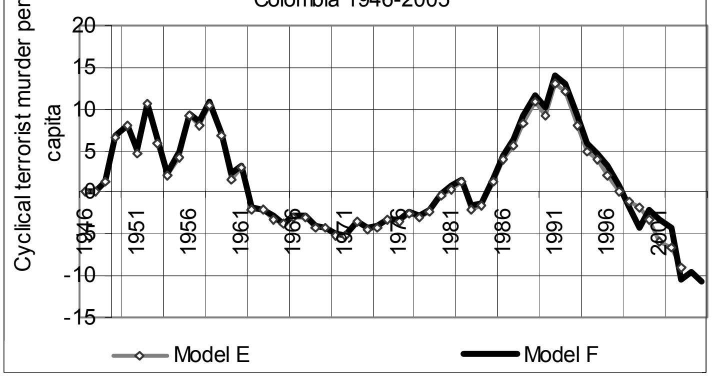


Figure 4C. Cyclical terrorist murder indicators for Colombia 1946-2005



Simulating additional attacks for the U.S.

Table 2B and figure 4B show three ARIMA models for the U.S., to be used on the purpose of obtaining its cyclical signal or terrorist murder and attacks indicator for the country.

Model G, is an ARIMA(22,1,44), and is estimated after altering the original per capita data series for the U.S., with the assumption of the country having a terrorist attack with 61,516 casualties in 1998, representing 28.43 per capita. After the attack I assume the country (original data) returns to its historical per capita figures from 1999 to 2005 (6.2, 6.1, 7.1, 6.1, 5.7, 5.5, and, 5.6 per 100,000 respectively). The Durbin Watson index for this model appears good but the cyclical component does not oscillate around a zero average, since the hit changed up the estimated model constant. The attack is finally responsible for the beginning of an upward cycle starting in 2000, and lasting up to 2001. The cyclical signal of this model, after been perturbed with this hypothetical attack, is pointing out with precision that 9/11 2001 would be a turning point (the cyclical estimator passes from 5.03 per capita in 2000 to 6.13 in 2001, a 21.8% variation).

Model H, shown in figure 4C is an ARIMA(22,1,11) ran with a short sample 1923-1998. The model was estimated after altering the data with an artificial attack in 1996 of 4,950 casualties (the real value of homicides for that year was changed from 19,650 to 24,610). Although the Durbin Watson index appears good; the cyclical component does not oscillate around a zero average, since, the estimated model constant increased as a consequence of the attack. The estimated component moved upwards after the attack from –25.64 in 1996 to –24.15 in 1997 (variation of 6.1%).

Table 2B. Estimated ARIMA models for murder in the U. S.

Annual data from 1900 to 2005 (Model G and I)

1900-1998 (Model H)

Variables	Coeff	T-stats	Std Error	Signif
Constant-Model G	0.0320	4.1505	0.0078	0.0000
Model H	0.0106	21.61	0.0000	0.0000
Model I	0.0086	12	0.0000	0.0000
AR 1-Model G	-0.5419	-7.1283	0.0760	0.0000
Model H	-0.7215	-13.36	0.0540	0.0000
Model I	-0.7950	-11.41	0.0690	0.0000
AR 2-Model G	-0.4785	-7.8299	0.0611	0.0000
Model H	-0.3426	67.31	0.0050	0.0000
Model I	-0.2987	-17.39	0.0170	0.0000
AR 6-Model G	0.0833	3.0571	0.0273	0.0031
Model H	0.1374	6.03	0.0227	0.0000
Model I	0.1754	6.4	0.0270	0.0000
AR 8-Model G				
Model H	-0.2531	-59.79	0.0041	0.0000
Model I	-0.2513	-27.53	0.0091	0.0000
AR 14-Model G				
Model H	0.0665	10.21	0.0061	0.0000
Model I	0.0894	10.05	0.0088	0.0000
AR 22-Model G	0.2048	4.5967	0.0446	0.0000
Model H	-0.0497	-37.24	0.0013	0.0000
Model I	-0.5269	-35.63	0.0014	0.0000
MA 1-Model G	1.2020	16.2104	0.0742	0.0000
MA 6-Model G	0.4751	4.8378	0.0982	0.0000
MA 9-Model G				
Model H	-2.2848	-21.11	0.1081	0.0000
Model I	-2.1869	-17.14	0.1275	0.0000
MA 10-Model G				
Model H	-3.5670	-31.66	0.1126	0.0000
Model I	-2.8857	-14.15	0.2039	0.0000
MA 11-Model G	-0.4703	-8.4573	0.0556	0.0000
Model H	-2.9235	-14.27	0.2047	0.0000
Model I	-2.2509	-11.46	0.1964	0.0000
MA 32-Model G	-1.7844	-6.1651	0.2894	0.0000
MA 44-Model G	2.7096	7.7506	0.3496	0.0000

Centered R^2 = 0.83G, 0.99H, 0.99I

DW= 2.09G, 2.03H, 1.98I.

Significance level of Q = 0.052G, 0.42H, 0.12I

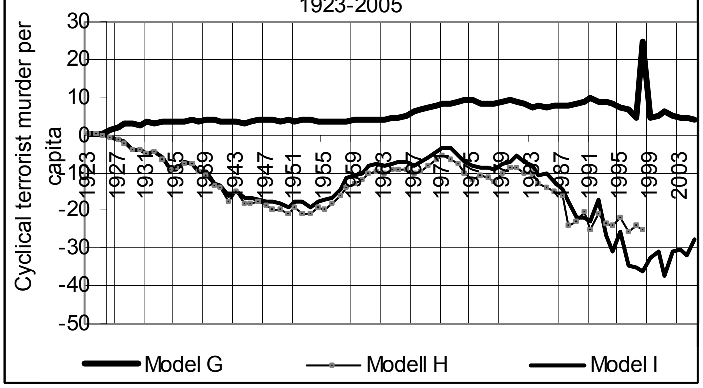
Usable observations = 83G, 76H, 83I

Model I, is the same used above (22,1,11) but the sample was extended from 1923 to 2005. In this case it is noted that after the attack in 1996 a deep upward cycle just started in 1999 or three years after been hit (the estimated component moved in this case down from –34.5 per capita in 1996 to –35.4(1997), -36.12(1998), and went up to –32.6 in 1999 (variation of 10.7% from 1998 to 1999).

Concluding; after artificially confusing the murder series for the U.S from 1923 to 2005 with three hypothetical attacks, I have been able to show that the cyclical component of murder for the U.S., hides the information for attacks. The estimated signal for the first model (model G) moves from 1997 to 1998 (4.69 to 24.72 – the year of the attack) and for 1999, 2000, and 2001, it passes from 4.57 to 5.03, and 6.13 for 2001). One more time, after the model was confused with a hypothetical attack, it still foresaw with a 100% precision the occurrence of 9/11 in 2001 with another peak marking the turning point for that that year, a movement of 5.03 to 6.13 per capita (figure 4C).

Model (H) changes upwards instantly the dynamic of the series after the attack, while model (I) which is the same as H but estimated up to 2005 is accurate at foreseeing in 1999 (one of the lowest points) with a rate of -32.6 that an attack would effectively occur in 2001 (a rate of -37.16, effectively the lowest historical point of this estimated component).

Figure 4C. Cyclical terrorist murder for the U.S. 1923-2005



3. Estimation of the model of cyclical terrorist murder for Colombia under the assumption of the hypothetical case of a 9/11 attack in Colombian soil. Estimation samples 1950-2001 and 1950-2002

Theoretical basis of the model for cyclical terrorist murder

The theoretical basis of the model for cyclical terrorist murder for Colombia are explained in Gómez-Sorzano (2005). I reproduce its formulation, and expected coefficients here:

$$Cvpc\ 1_t = F\left(+B_t,\ -CL_t,\ +Rtb\ 6_t, +Taf\ 11_t, -U_t, -Students\ \ 1_t,\ \ -Despla\ \ 3_t\right)$$

Where

Cvpc1 estimated cyclical terrorist murder per capita

B	years of *La Violencia* (1947-1960, following Bushnell's dating)
CL	years of *National Front* (1958-1978)
CL1	years of National Front (1958-1978) and (1994 to 2006)[10]
Rtb6	real trade balance
Taf1	total number of armed forces (police + army), also Taf11
U	Unemployment rate (four main cities)
Students1	number of students matriculated in all modalities, also students1
Despla2	number of displaced persons (source DNP)
Despla3	number of displaced persons – reconstructed series according to Bergquist (source Nat.Police).

Estimating the model after assuming a 9/11 2001 terrorist attack in Colombia.

In this section I estimate the model of cyclical terrorist murder for Colombia using as dependent variables sub-samples 1950-2001 (Cvpctt1), and 1950-2002 (Cvpctt2). The model is estimated, changing its independent variables doing an effort to approach the social and economic circumstances that surrounded the U.S. after been hit. Both terrorist murder and attacks indicators were estimated in the previous section. Series 1, Cvpctt1 estimates a value of –5.67 per capita for 2001, while series 2, Cvpctt2, estimates a value of –4.24 for 2001 and, creates a turning point for 2002 increasing terrorist murder to –3.55 after the attack (19.4%). The model is estimated for both sub-samples (table 3).

Table 3. Estimated results -

Annual data from 1950 to 2002 **(bold 1950-2001)**

Variables	Coefficient	T-stats	Std Error	Signif
B	7.190000	9.805	0.7334	0.0000
	6.980000	**10.44**	**0.6684**	**0.0000**
CL1	-3.150000	-4.613	0.6831	0.0000
	-2.670000	**-4.27**	**0.6251**	**0.0001**
RTB6	0.001000	4.165	0.0002	0.0001
	0.000920	**4.23**	**0.0002**	**0.0001**
TAF11	0.000150	8.764	0.0000	0.0000
	0.000140	**9.11**	**0.0000**	**0.0000**
U	-0.513000	-4.549	0.1127	0.0000
	-0.555600	**-5.26**	**0.1055**	**0.0000**
STUDENTS1	-0.000002	-4.993	0.0000	0.0000
	-0.000002	**-5.15**	**0.0000**	**0.0000**
DESPLA3	-0.025270	-5.176	0.0049	0.0000
	-0.029910	**-6.03**	**0.0049**	**0.0000**

Centered R^2 = 0.87 **(0.88)**

DW= 1.98 **(2.19)**

Significance level of Q = 0.42 **(0.08)**

Usable observations = 53 **(52)**

[10] As a curious remark Colombia has had alternation in power again from 1994 to 2006 (From 1994 to 1998 Liberal Samper was in power, from 1998 to 2002, Conservative Pastrana, and from 2002 to 2006, independent liberal Uribe)

Model estimated for both sub-samples under the assumption of a disruption in social and economic order as a consequence of a 9/11 terrorist attack in Colombia.

Both models are estimated assuming a disruption in social and economic order after the attack, and so for modeling purposes I assume that mass rioting occurs in Bogotá and all over the country. I assume the occurrence of a second Bogotazo lasting one year for the sub-sample 1950-2001 (B2), and two years for the sub-sample 1950-2002 (B3). Accordingly the dummy B (Bogotazo) is respectively changed to 1 (for year 2001 first sub-sample) and 1 from 2001-2002 second sub-sample. In regards to the real trade balance, I construct two scenarios Rtb6 and Rtb7. In Rtb6 I assume the same negative balance that Colombia had from 2002 to 2005 (starting in -1,196, ending up with –1,040 millions of constant pesos) however from 2005 onward, the real trade balance continues decreasing annually at 1% reaching –1,195 by 2019. For the second assumption for real trade balance (Rtb7), I take the real trade balance Rtb6 which historically registered –832 millions in 2001, and –1,196 in 2002 (variation of -43.7%), and model a further negative change of 260% as a consequence of the attack; accordingly Rtb7 moves from –832 to –3,000 million of constant pesos.

Total armed forces, or armed actors historically increased for Colombia from 2001 to 2002 from 283,844 to 327,686 (15.4%), after the attack, the country increases an additional 15% and so armed forces jump to 376,838 in order to confront this hypothetical upsurge in terrorist activity. As to the unemployment rate, which was 16.7% in 2001 and 23.6% in 2002; I assume now a serious economic and social paralysis of the country, and so for 2002 this rate is increased to 35%. This paralysis collapses temporarily the educational system, historically students enrolled in all modalities moved from 10,5 million from 2001 to 10.8 million to 2002 (2.3%); the attack partially destroys the school system implying a decrease in students enrolled to 9.5 millions or a decrease in 9%. As to displacement from the countryside to the cities which historically moved from 341,900 to 391,000 from 2001 to 2002 (14.3%), this time under the assumption that the attack occurred in Bogotá (the biggest city), I proceed to assume that, forced displacement of people comes to a sudden halt in 2002, becoming cero for that year (incorporated in predictor despla11). Table 3A presents the estimated results.

Table 3A. Estimated results -

Annual data from 1950 to 2001 **(bold 1950-2002)**

Variables	Coefficient	T-stats	Std Error	Signif
Constant	None			
	7.0700	**6.48**	**1.090**	**0.000**
B2 **(B3)**	6.3470	8.63	0.730	0.000
	2.9200	**2.89**	**1.000**	**0.005**
CL1	-2.8600	-4.04	0.700	0.000
	-3.3600	**-4.72**	**0.710**	**0.000**
RTB6 **(RTB7)**	0.0008	3.52	0.000	0.000
	0.0010	**4.64**	**0.000**	**0.000**
TAF11 **(TAF22)**	0.0002	8.78	0.000	0.000
	0.0001	**9.53**	**0.000**	**0.000**
U **(U9)**	-0.4962	-4.19	0.118	0.000
	-1.0900	**-10.92**	**0.099**	**0.000**
STUDENTS1 **(STU2)**	0.0000	-5.24	0.000	0.000
	0.0000	**-5.61**	**0.000**	**0.000**

DESPLA3 **(DESPLA11)**	-0.0375	-6.59	0.006	0.000
	-0.0123	**-2.28**	**0.005**	**0.027**

Centered R^2 = 0.84 **(0.87)**

DW= 2.04 **(1.82)**

Significance level of Q = 0.27 **(0.11)**

Usable observations = 52 **(53)**

Additional assumptions: setting up the path for the independent variables up to year 2019.

A more precise long term view, will require estimating the impact of this hypothetical 9/11 terrorist attack in Colombia; and so it would require knowing the changes suffered by the independent variables feeding the model e.g., it would require knowing the impact of the U.S. counterpart variables such as, real trade balance, number of armed troops (police + army + navy + marine corps + air force), unemployment rate, number of students enrolled in all modalities, and the number of displaced people which, for the U.S' case can be represented by immigration, changes in farm employment (population coming to the main cities of the country), and changes in home creation.

Since I am in possession of some of these changes for the U.S. after 9/11, I implement similar changes to the counterpart Colombian variables, and so a probable scenario for Colombia is created as a consequence of the attack. The changes proposed in the predictors are graphically shown on figures 6,7,8,9,10, and 11.

Political variables

Same as in the Colombian case, where President Alvaro Uribe Vélez was re-elected to continue fighting the insurgency; for the U.S.' scenario President Bush is re-elected and trusted to continue with his strategy against terrorism. The dummy variable CL1 (for alternation in power) is replaced by 1 from 2001 to 2004[11] and by ceros after President's Bush re-election from 2005 to 2008; from 2009 to 2019 I assume both parties will be alternating presidency and so I fill out this dummy with ones up to 2019.

Armed actors

According to the U.S.' Department of Defense, the increase in total armed forces from 2001 to 2002 was 2% passing from 1'385.000 men to 1'413.400 (28,400 men); however to implement this change after 9/11, I assume, that the armed forces assigned to fight the enemy increased by 120,000[12] that from a U.S. total Army of 1'413.400 men represent a shock of 8.4%. I implement this shock to the Colombian armed forces increasing total armed forces in 2001 (283,844 men) by that percentage for year 2003 (307,686 men, Taf22), and assume, this figures

[11] This since after Clinton Administration, the election of a Republican is implying alternation in power; but from 2005 onwards this variable is replaced by cero after Bush's re-election.

[12] According to USA Today, October 12, 2006, The Army plans to maintain its current level of 120,000 soldiers in Iraq through 2010.

will remain constant fighting the enemy up to year 2006. In year 2007[13] I add 25,000 additional men, changing the proportion again to 145,000/1'438.400 or 10% of the total armed forces dedicated to fighting this enemy. I move on accordingly increasing Colombian troops by an additional 1.6% (for a 10% total) or 312,608 armed men to keep constant fighting from 2007 up to year 2010.

Now since the model for cyclical terrorist murder assumes armed forces composed by all armed actors in the country (guerrilla, para-military, and army), I have to take into account, the Iraqi insurgency fighting the U.S. army[14]. The Iraqi insurgency refers to the armed resistance by diverse groups within Iraq to the U.S. occupation of Iraq and to the establishment of a liberal democracy therein. The insurgency began shortly after the 2003 U.S. Invasion of Iraq, and before the establishment of a new sovereign Iraqi government. Originally, the insurgents targeted only coalition forces and the interim government (e.g., the Coalition Provisional Authority) formed under the occupation, but as the fighting continued, the insurgents have targeted anyone they feel supports the current democratically elected Iraqi government. According to Wikipedia the total number of Iraqi guerrillas varies by group and fluctuates under changing political climate, the latest assessments put the present number at between 12,000 and 20,000 hardcore fighters, along with numerous supporters and facilitators throughout the Sunni Arab community[15].

Concluding, the armed actors for the present scenario change in 2003 to 307,686 + 20,000 guerrillas = 327,686 up to year 2006, changing in 2007 to 312,608 +20,000 = 332,608 and keeping these figures up to 2010 as initially planned by the Pentagon.

From 2011 up to 2019, I start decreasing troops annually by 6% up to 2017; in 2018 a further reduction of 50%, and by 2019 all troops are removed from Iraqi soil, (figures 6 and 9).

Economic variables

While the construction of the model for terrorist attacks in U.S. soil is accomplished I have run some regressions, finding for the U.S., same as for Colombia a positive relation between terrorist murder, and the real trade balance. The estimated coefficient for Colombia is 0.001387 (Gómez-Sorzano2006B); provisional estimates from the model of terrorist attacks in U.S. soil have shown that this relationship, although small still prevails for the U.S.'s case with a estimate of 0.000020 (when the model is ran including unemployment rate, army troops, riots in the U.S., a dummy for wars fought by the U.S., the inventory of incidents of political violence and terrorism in modern America and police officers).

According to the Historical Statistics of The United States the negative variations of the U.S. nominal trade balance have deepened further after the terrorist attacks: -4% in (2001), -16% (2002), -17%(2003), -25%(2004), and –17% (2005). I accordingly change with those variations

[13] According to USA Today, January 18, 2007, The Pentagon will increase the number of U.S troops in Iraq to around 145,000 this summer from the current 140,000, in recognition of the continued difficulty coalition forces are having in providing security leading up to the hand-over of political power to Iraqis on June 30.

[14] According to Wikipedia, accessed on January 18th, 2007 http://en.wikipedia.org/wiki/Iraqi_insurgency , the fighting has clear sectarian overtones and significant international implications (see Iraqi Civil War). This asymmetric war is being waged by Iraqi rebels, almost certainly with assistance from both foreign governments (most likely Iran and Syria) and loosely termed NGO's.

[15] At any rate those numbers are pretty close to the average number of guerrillas fighting in Colombia in the past.

the real trade balance for Colombia (Rtb7) from to 2003 to 2005. From 2006 to 2019 I assume it continues deteriorating at 15% annually (the average for the U.S from 2001 to 2005). From 2015 to 2019, I assume a structural break because of the closeness of the end of this war, and so the trade balance starts recovering at 45% for those years, (figures 6 and 9).

Social variables, Education

I had previously mentioned that the attack paralyzed the education system causing a decrease in students enrolled. According to Jareg and McCallin (1993) in situations of conflict specifically secondary education can keep older children out of military service, so there is this trade off between military service and school enrollment[16]. I implement these relationships in the data series, students1 (2002-2019) and students2 (2003-2019).

According to this, since armed actors (taf11) increased in 2002 by 15.4%, enrollment is diminished by 15.4% remaining constant up to 2006. In 2007 armed actors increase again by 1.5%, and so enrollment decreases again by that amount.

The adjustment of students2 is more complicated: they increased by 13% in 2003, and remain constant up to 2006, diminish by 1.5% in 2007, and remain constant up to 2010, they increase at a constant rate of 6% from 2011 to 2017, increase by 50% in 2018, and theoretically by 100% in 2019. I however relax this last change to a 20%, for a total of 28.6 million students enrolled by 2019, (figures 7 and 10).

The unemployment rate

As to the unemployment rate, after the 9/11 attacks, the unemployment rate in the U.S. changed from 3.7% (2000) to 5.4% (2001), 5.7% (2002), meaning positive variation of 45.9% in 2001, and 5.5% after the attacks in 2002. I implement this changes in the Colombian case changing the unemployment rate from 19% in 2000 to 27.7% in 2001 plus and additional 5.7% in 2002 placing it at 29.2% in 2002, creating times series for unemployment U10 (up to 2001), and U11 (up to 2002) incorporating those changes. After 2002 up to 2019, I proceed creating two scenarios for unemployment U10 creates the path for unemployment for Colombia while U11 for the U.S.' case. I assume that for the Colombian case after the attack it takes about 5 years to start reducing unemployment, while for the U.S' case the unemployment returns to normality in 2003.

Accordingly for Colombia unemployment starts reducing by 1% annually from 2003 to 2007 (initially in 2003 it was 24.2%). From 2008 to 2019, I assume keeps reducing at 2% annually as we keep the assumption that increasing troops as strategy after the attacks getting closer to 2019 implies getting closer to attaining peace and this circumstance reduces unemployment. Following this reasoning the rate is set up at 8.2% by 2015, and remains at that level up to 2019.

Under the assumption of a U.S scenario according to which unemployment gets back to its natural trend I take the unemployment forecasts taken from Gómez-Sorzano (2005), that

[16] They explain that in most conflicts the majority of soldiers in both government and insurgent forces are young men in their teens and early twenties. In some conflicts children, mainly boys, in their pre-teen years are involved and sometimes the fighting is spearheaded by very young people. In areas where employment prospects are poor, young people may enlist in the military simply for lack of alternative opportunities for earning income or occupying their time. Under such circumstances, education may provide the only viable option for keeping young people away from combat. It is also likely that lack of access to secondary education may extend the conflict, making it difficult for young people to demobilize and return to civilian life.

assume and unemployment rate of 25.4% by 2003 ending up with 17.7% by 2019, (figures 7 and 10).

Forced displacement of people.

I construct now, two scenarios for displacement of people: despla3 (sample 1950-2001), and despla11 (sample 1950-2002). Both data series assume that forced displacement of people (people abandoning the countryside and moving to the main cities of the country) gets to a sudden halt of zero for 2002. From 2003 to 2005, the displacement becomes negative implying that people either comes back to the countryside or migrate to bordering countries as a consequence of the attack, and the exacerbated internal fighting guerrilla - government. According to the World Almanac and the book of facts (2007, p.844) in regards to the Vietnam War toll, it quotes that U.S. combats deaths reached 47,369; South Vietnam more that 200,000; other allied forces 5,225. Total U.S. fatalities numbered more than 58,000. Vietnamese civilian casualties were more than a million, and displaced war refugees in South Vietnam totaled more than 6.5 million. For the present case assuming that the war is going to last up to 2019, I construct two scenarios for displacement, the first one (despla3) is matched to armed forces of 332,608 men by 2019 and so, assumes permanent displacement up to that year. It assumes a jump in displacement of 1.5% by 2007. I will take for this exercise figures for displacement identical to those of the Vietnam's conflict, and so 6.5 million divided by 17 years implies 382,352 people migrating from 2002 until 2019. The second scenario (despla11) is attached to (taf22) that assumes that total armed actors would have withdrawn by 2019, and so according to this, displacement reduces directly with the reduction in armed actors, (figures 8, and 11).

Final estimation results

Table 4A shows the estimated results for both models. Model1 (1950-2001). Model 2. (1950-2002)

Table 4A. Estimated results -Data 1950-2001 Dependent variable (Cvpctt1)

Annual data **(bold 1950-2002)** ***Dependent variable (Cvpctt2)***

Variables	**Coefficient**	**T-stats**	**Std Error**	**Signif**
Constant	**3.13**	**2.14**	**1.46**	**0.037**
B2 **(B3)**	6.9300	10.32	0.672	0.000
	5.9800	**5.07**	**1.180**	**0.000**
CL1	-2.5200	-4.11	0.614	0.000
	-2.8000	**-3.84**	**0.729**	**0.000**
RTB6 **(RTB7)**	0.0009	4.33	0.0002	0.000
	0.0011	**4.705**	**0.0002**	**0.000**
TAF11 **(TAF22)**	0.0001	9.14	0.00002	0.000
	0.0001	**8.013**	**0.000**	**0.000**
U10 **(U11)**	-0.5916	-5.89	0.100	0.000
	-0.8880	**-7.417**	**0.120**	**0.000**
STUDENTS1 **(STU2)**	-0.0000002	-5.03	0.000	0.000
	-0.0000001	**-4.012**	**0.000**	**0.000**

DESPLA3 **(DESPLA11)**	-0.0303	-5.84	0.005	0.000
	-0.0211	**-2.457**	**0.009**	**0.018**

Centered R^2 = 0.88 **(0.86)**

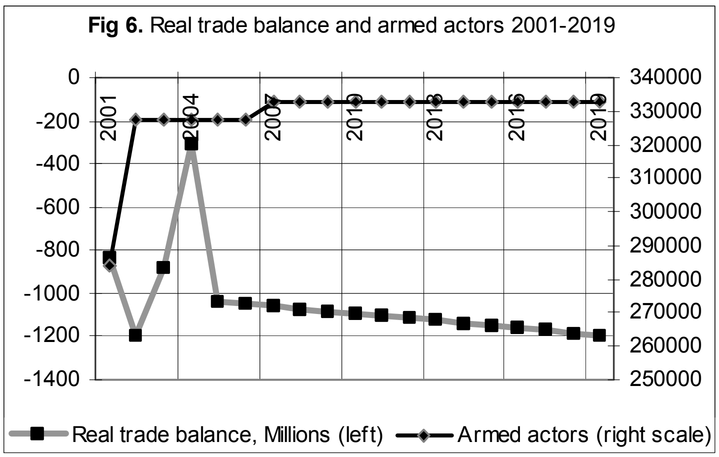
DW= 2.18 **(1.89)**

Significance level of Q = 0.091 **(0.200)**

Usable observations = 52 **(53)**

Graphing the predictors, and the forecasts for the terrorist murder and attacks indicator.

Model 1. 1950-2001: Dependent variable: Cpctt1. Independent variables: B2, CL1, Rtb6, Taf11, U10, Students1, Despla3.



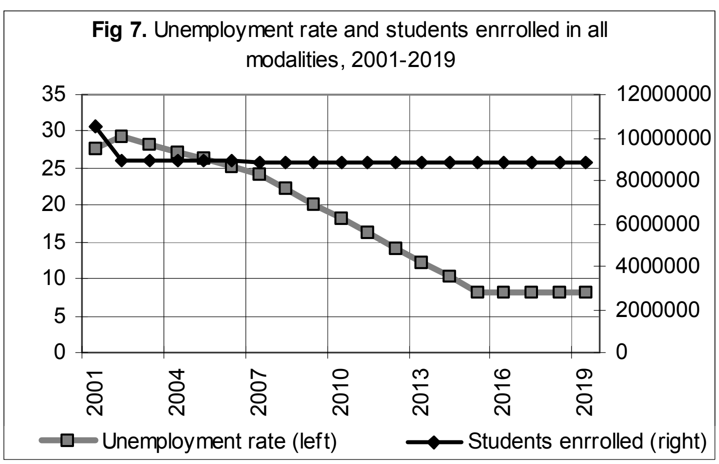
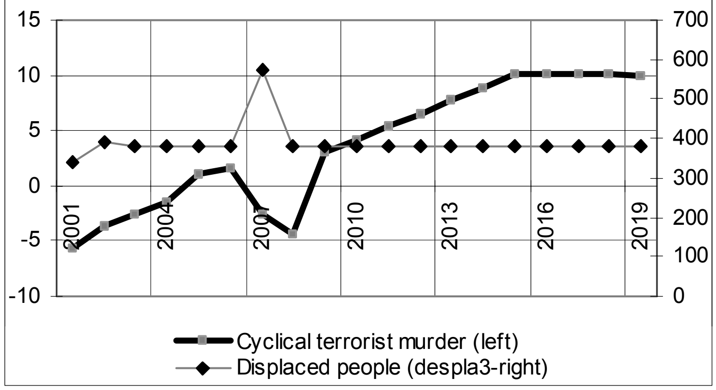


Fig 8. Displaced people and cyclical terrorist murder forecasts 2002-2019



Model 2. 1950-2002: Dependent variable: Cpctt2. Independent variables: B3, CL1, Rtb7, Taf22, U11, Students2, Despla11.

Fig 9. Real trade balance and armed actors 2001-2019

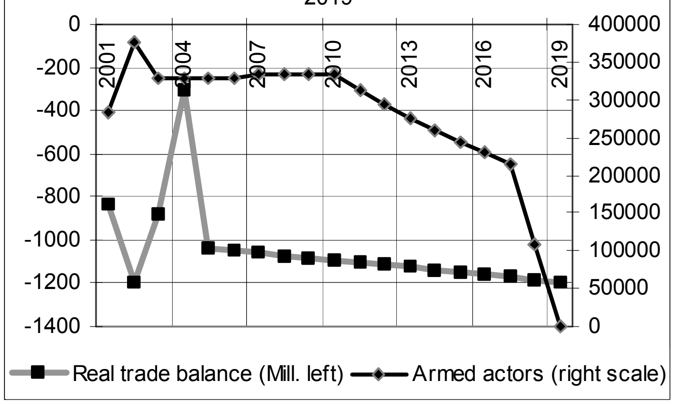


Fig 10. Unemployment rate and students enrrolled in all modalities, 2001-2019

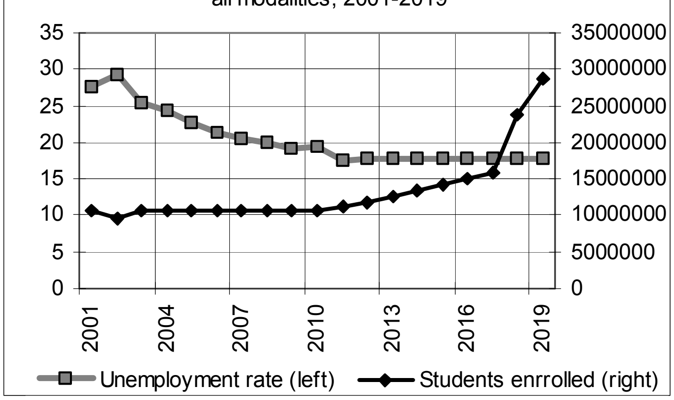
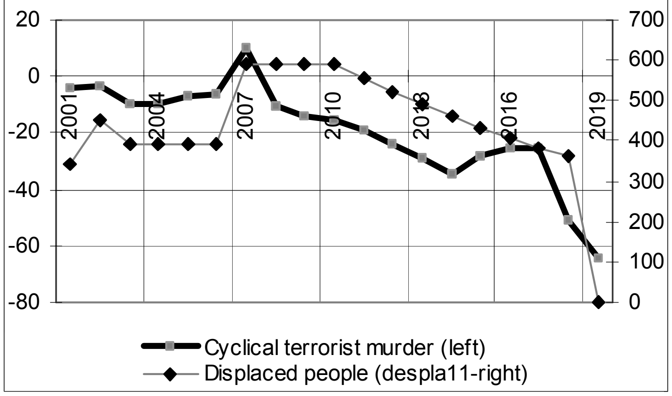


Fig 11. Displaced people and cyclical terrorist murder forecasts 2002-2019



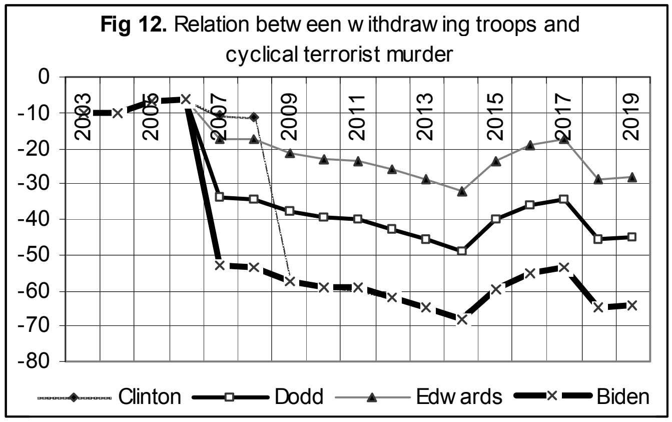
Testing U.S.'s Senators opinions in regards to troops withdrawing using model #2.

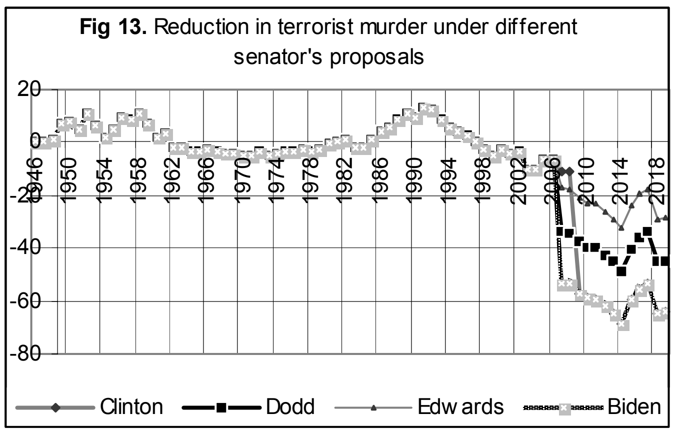
According to the Denver Daily News[17] Democrats opinions, particularly Senators, Joseph Biden, Hilary Clinton and Mike Gravel consider respectively that the U.S, must withdraw by year's end, leave Iraq by 2009, and withdraw immediately. To test these assumptions I assumed according to Gravel and Biden that the U.S. withdraws by 2007, and so the predictor for armed actors is cero from 2007 to 2019. In regards to Clinton armed actors are keep in 327,686 up to 2008 and ceros thereafter. Figure 12 shows the results for these assumptions as producing concrete results, reducing terrorist murder from –53.20 in 2007 to –64.38 per capita by 2019.

Democrat John Edwards proposes immediate withdrawal of 50,000 troops. This assumption is implemented through reducing armed actors from 327,686 in 2006 to 277,686 in 2007 and keeping that force up to 2019. Again disarming and reducing troops diminish terrorist murder by –17.21 in 2007, and –28.39 by 2019.

Finally Democrat Chris Dodd opposes troop increase, and defenses capping force at 130,000. Implementing this requires diminishing troops from 327,686 in 2006 to 130,000 in 2007, but since the Iraqui insurgency is estimated at 20,000; I assume a force of 150,000 armed actors from 2007 to 2019. One more time, terrorist murder diminishes from –33.76 by 2007 to –44.94 by 2019. Figure 12, and 13 present at this point, the direct relationship between troops withdrawal and the terrorist murder and attacks indicator for the U.S.

[17] Monday, Feb. 5, 2007





3. Conclusions

This paper has shown through empirical exercises, the suitability of the Beveridge and Nelson (B&N) decomposition of economic time series for pointing out the occurrence of terrorist attacks for the U.S., and Colombia.

For the U.S' case, Gómez-Sorzano (2006C) shows that terrorist attacks occur in, before or after, an estimated turning point. The estimated cyclical terrorist murder and attacks indicator appears as an index warning in its lower and higher points of a high probability of attacks. Historically, terrorist attacks for the U.S. have occurred in the estimated turning points "the lower or upper points of the indicator" or one or two years before, or after them.

The Pearl Harbor attack occurred in 1941; the attacks indicator effectively diminished from 1940 to 1941, from 0.60 to 0.24, finding its lowest point in 1942, one year after the attack (with 0.06 murder per-capita) and then jumped in 1943 to 0.57 (a 850% change). Los Angeles riots were exactly predicted by the estimated turning point of 1966, the indicator jumped to 54.9% in 1967 after the riots. 9/11 created also a turning point the indicator jumped 123.2% from 2001 to 2002.

Other historical facts show how the upper points of this index hide additional information for attacks, e.g., the surrendering of Japan during the second world war occurred in 1945 (the indicator moved from 0.25 to 0.91. from 1944 to 1945), and the estimated turning point date was 1946 (reaching effectively a maximum value of 1.47) and then, diminished in 1947 (-8.8%). The world trade center bombing coincided exactly with the estimated turning point of 1993; the indicator ascended from 5.22 in 1992 to 5.32 (1.91%), reaching its peak in 1993 (5.32 per-capita) and then, descended to 4.81 in 1994 (-9.5%).

In regards to the exercises simulating attacks for the U.S; the B&N decomposition narrate a similar story. The first exercise (model G), which simulates an attack in 1998, still "during the so called crime drop in America (Blumstein and Wallman, 2000) showed with precision the occurrence of a estimated turning point in 2001 (the indicator moved from 5.03 to 6.13 in 2001, a 21% variation, and then decreased to 5.01 in 2002 (-18.2% variation).

A second exercise (model H), which simulates an attack in 1996 did not produce an indicator oscillating with a zero average, but still the model was able to show a jump in its cyclical signal, one year after the attack. The cyclical signal passed from -25.64 in 1996 to -24.15 in 1997 (a 6.1% increment).

Finally (model I), which simulated an additional attack in 1996 (but using a longer sample) presents a jump in 1999 (10.7%), or three years after the attack.

In the three cases mentioned, the indicator forecasted the attack with 100% precision (model G); and, pointed out respectively the attacks, one, and, three years after it actually happened for (models H and I). A model for forecasting the turning points appears as the next urgent research step, the estimated turning point dates contain the timing of these tragic events.

The simulations of a 9/11 2001 attacks in Colombia using two alternative samples: 1946-2002, and 1946-2004 produced an estimated turning point for year 2001. The estimated turning points for terrorist murder and attacks for Colombia matches with precision a 50 year description of guerrilla clashes, and guerrilla terrorist attacks in Colombia (Gómez-Sorzano, 2006B)

The model of cyclical terrorist murder (Gómez-Sorzano, 2005) has shown its suitability for studying alternative scenarios containing multiple path variations in its dependent (index of murder and attacks) and predictors. In all cases constructed I the paper, the predictors preserved the theoretical coefficient signs keeping statistical significance as well, at all times the model kept satisfactory statistical fitting measure by its high R square, and good Durbin Watson indexes.

Using the experience of Colombia, after estimating the model for cyclical terrorist murder for Colombia with an attack indicator or dependent variable containing a 9/11 hit, and changing predictors according to the post attacks U.S. experience, shows a picture that reads withdrawing troops can reduce the intensity of the Iraqi conflict reducing both, U.S. pressure, and diminishing the terrorist murder and attacks indicator of the country.

The experience of Colombia and the U.S., after constructing these indexes, teach us that they effectively warn countries in regards to terrorist attacks and terrorist murder. The next research step, is focused in using the U.S. index taken from Gómez-Sorzano (2006C) to use it as dependent variable to design a model for terrorist attacks in U.S soil, a final step will construct scenarios for homeland security[18]; a similar exercise was already realized for Colombia, e.g., in Gómez-Sorzano (2006A and 2006C) .

[18] The econometrics of violence, terrorism and scenarios for U.S. homeland security from 1923 to 2019.

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Appendix A. The Beveridge & Nelson decomposition of economic time series applied to decomposing both, the Colombian per capita homicides from 1946 to 2004 (model C), and U.S. per capita homicides from 1923 to 2005 (model G).

I denote the observations of a stationary series of the logarithm of per capita homicides by *Lthom* and its first differences by W_t. Following Beveridge– Nelson, BN for short, (1981, p.154), many economic times series require transformation to natural logs before the first differences exhibit stationarity, so the W_t 's, then are continuous rates of change.

$$W_t = Lt\hom_t - Lt\hom_{t-1} \qquad (1)$$

If the w's are stationary in the sense of fluctuating around a zero mean with stable autocovariance structure, then the decomposition theorem due to Wold (1938) implies that W_t maybe expressed as

$$W_t = \mu + \lambda_0\varepsilon_t + \lambda_1\varepsilon_{t-1} + \ldots, \ \ where\ \lambda_0 \equiv 1 \qquad (2)$$

where, μ the $\lambda's$ are constants, and the $\varepsilon's$ are uncorrelated disturbances. According to BN, the expectation of $Lt\hom_{t+k}$ conditional on data for $Lt\hom$ through time t is denoted by $Lt\hat{\hom}(k)$, and is given by

$$\begin{aligned} Lt\hat{\hom}(k) &= E(Lt\hom_{t+k} \mid \ldots\ldots, Lt\hom_{t-1}, Lt\hom_t) \qquad (3) \\ &= Lt\hom_t + E(W_{t+1} + \ldots W_{t+k} \mid \ldots, W_{t+1}, W_t) \\ &= Lt\hom + \hat{W}_t(1) + \ldots + \hat{W}_t(k) \end{aligned}$$

Since the $Z_t's$ can be expressed as accumulations of the $W_t's$. Now from (2) it is easy to see that the forecasts of W_{t+i} at time t are

$$\begin{aligned} \hat{W}_t(i) &= \mu + \lambda_i\varepsilon_t + \lambda_{i+1}\varepsilon_{t-1} + \ \ldots\ldots \qquad (4) \\ &\mu + \sum_{j=1}^{\infty}\lambda_j\ \varepsilon_{t+1-j}\ , \end{aligned}$$

Now substituting (4) in (3), and gathering terms in each ε_t, I get

$$\begin{aligned} L\hat{\hom}_t(k) &= L\hom_t + \hat{W}_t(i) \qquad (5) \\ &= L\hom_t + \left[\mu + \sum_{j=1}^{\infty}\lambda_j\varepsilon_{t+1-j}\right] \\ &= k\mu + L\hom_t + \left(\sum_1^k \lambda_i\right)\varepsilon_t + \left(\sum_2^{k+1}\lambda_i\right)\varepsilon_{t-1} + \ldots \end{aligned}$$

And considering long forecasts, I approximately have

$$L\hat{\hom}_t(k) \cong k\mu + L\hom_t + \left(\sum_1^{\infty}\lambda_i\right)\varepsilon_t + \left(\sum_2^{\infty}\lambda_i\right)\varepsilon_{t-1} + \ldots\ldots \qquad (6)$$

According to (6), it is clearly seen that the forecasts of homicide in period (k) is asymptotic to a linear function with slope equal to μ (constant), and a level $L\hom_t$ (intercept or first value of the series).

Denoting this level by $\overline{L\hom_t}$ I have

$$\overline{L\hom_t} = L\hom_t + \left(\sum_1^{\infty}\lambda_i\right)\varepsilon_t + \left(\sum_2^{\infty}\lambda_i\right)\varepsilon_{t-1} + \ldots\ldots\ldots \qquad .(7)$$

The unknown μ and $\lambda's$ in Eq. (6) must be estimated. Beveridge and Nelson suggest and

ARIMA procedure of order (p,1,q) with drift μ.

$$W_t = \mu + \frac{\left(1-\theta_1 L^1 - \ldots - \theta_q L^q\right)}{\left(1-\varphi_1 L^1 - \ldots - \phi_p L^p\right)}\varepsilon_t = \mu + \frac{\theta(L)}{\varphi(L)}\varepsilon_t \qquad (8)$$

Cuddington and Winters (1987, p.22, Eq. 7) realized that in the steady state, i.e., L=1, Eq. (9) converts to

$$\overline{L\hom_t} - \overline{L\hom_{t-1}} = \mu + \frac{(1-\theta_1 - \ldots \theta_q)}{(1-\phi_1 - \ldots \varphi_p)}\varepsilon_t = \mu + \frac{\theta\,(1)}{\varphi\,(1)}\varepsilon_t \quad (9)$$

The next step requires replacing the parameters of the ARIMA model (Table 2) and iterating Eq.(9) recursively, i.e., replace t by (t-1), and (t-1) by (t-2), etc, I get

$$W_t = \overline{L\hom_t} - \overline{L\hom_{t-1}} = \mu + \frac{\theta(1)}{\phi(1)}\varepsilon_t \qquad (10)$$

$$W_{t-1} = \overline{L\hom_{t-1}} - \overline{L\hom_{t-2}} = \mu + \frac{\theta(1)}{\phi(1)}\varepsilon_{t-1}$$

:

$$W_1 = \overline{L\hom_1} = \overline{L\hom_0} + \mu + \frac{\theta(1)}{\phi(1)}\varepsilon_1 \quad (\textit{this is the value for year } 1923)$$

:

$$W_{82} = \overline{L\hom_{82}} = \overline{L\hom_0} + \mu + \frac{\theta(1)}{\phi(1)}\varepsilon_2 \quad (\textit{this is the value for year } 2004)$$

Adding these equations I obtain W_1 (the value for year 1923), and W_{82} (the value for year 2004), on the right hand side μ is added "t" times, and the fraction following μ is a constant multiplied by the sum of error terms. I obtain

$$\overline{L\hom_t} = \overline{L\hom_0} + \mu.t + \frac{\theta(1)}{\phi(1)} \sum_{i=1}^{t} \varepsilon_i \qquad (11)$$

This is, Newbold's (1990, 457, Eq.(6), which is a differential equations that solves after replacing the initial value for $\overline{L\hom_0}$, which is the logarithm of per capita murder in year 1923.

Cárdenas (1991), suggests that Eq.(11), should be changed when the ARIMA model includes autoregressive components. Since the ARIMA developed for the U.S' case (Table 2), includes autoregressive, and moving average components, I formally show this now.

$$L\hom_t - L\hom_{t-1} = \mu + \sum_{i=1}^{p} \phi_i W_{t-i} + \sum_{j=1}^{q} \theta_j \varepsilon_{t-j} + \varepsilon_t \qquad (12)$$

$$\Delta L\hom_t = W_t = Lt\hom_t - Lt\hom_{t-1}$$

$$L\hom_t - L\hom_{t-1} = \mu + \sum_{i=1}^{p} \phi_i \Delta L\hom_{t-i} + \sum_{j=1}^{q} \theta_j \varepsilon_{t-j} + \varepsilon_t$$

Bringing the moving average components to the LHS, I get

$$L\hom_t - L\hom_{t-1} - \left(\sum_{i=1}^{p} \phi_i \Delta L\hom_{t-1} \right) = \mu + \sum_{i=1}^{q} \theta_j \varepsilon_{t-j} + \varepsilon_t \qquad (13)$$

Expanding summation terms

$$(1 - \phi_1 L^1 - \phi_2 L^2 - .\ . - \phi_p L^p)(L\hom_t - L\hom_{t-1}) = \mu + (1 + \theta_1 L^1 + .\ . + \theta_q L^q)\varepsilon_t \quad (14)$$

For the Colombian case, Arima model C does not include autoregressive components, so equation (14) becomes,

$$(L\hom_t - L\hom_{t-1}) = \mu + (1 + \theta_1 L^1 + .\ . + \theta_q L^q)\varepsilon_t \quad (14A)$$

And after replacing parameters, I get the following equation,

$$(L\hom_t - L\hom_{t-1}) = 0.02496 + (1 + 0.2800 - 0.2674 - 0.2960)\varepsilon_t \quad (14B)$$

For the U.S. case, where Arima model G includes autoregressive components, equation (14) after rearranging terms, and replacing parameters, becomes,

$$L\hom_t - L\hom_{t-1} = \frac{0.003256}{1+0.54+0.47-0.08-0.20} + \left(\frac{1+1.20+0.47-0.47-1.78+2.70}{1+0.26+0.19+0.47-0.22-0.036} \right) \varepsilon_t \quad (15)$$

Equations (14B and 15) yield the permanent component of the per capita murder for Colombia and the U.S., the last step requires taking the exponential to the LHS of both equations, getting the level for the permanent component. The cyclical component is finally obtained by the difference of the level of the observed per capita murder minus the level of the permanent component of murder, and is shown respectively in figures 4A and 4C.

Appendix B. Data sources

Variables for Colombia, come from "The econometrics of violence, terrorism and scenarios for peace in Colombia from 1950 to 2019", online at http://mpra.ub.uni-muenchen.de/539/01/MPRA_paper_539.pdf , and "A model of cyclical terrorist murder in Colombia 1950-2004, forecasts 2005-2019", online at http://mpra.ub.uni-muenchen.de/134/01/MPRA_paper_134.pdf).
For the U.S., the data comes from "Decomposing violence: terrorist murder in the twentieth century in the United States", online at http://mpra.ub.uni-muenchen.de/1145/01/MPRA_paper_1145.pdf).

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