Cycles of violence, and terrorist attacks index for the State of Massachusetts

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Cycles of Violence and Terrorist Attacks Index for the State of Massachusetts

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Abstract: I apply the Beveridge-Nelson business cycle decomposition method to the time series of per capita murder in the State of Massachusetts. (1933-2005). Separating out "permanent" from "cyclical" murder, I hypothesize that the cyclical part coincides with documented waves of organized crime, internal tensions, breakdowns in social order, crime legislation, social, and political unrest, and recently with the periodic terrorist attacks to the U.S. The estimated cyclical component of murder warns that terrorist attacks in the U.S. from 1940 to 2005, have affected Massachusetts creating estimated turning point dates clearly marked by the most tragic terrorist attacks to the nation: the shut down in power in NYC in 1965, the World Trade Center Bombing in 1993, and 9/11 2001. The index for Massachusetts foretold with amazing precision those attacks, and must be used as a proxy for attacks for the Whole U.S along with indexes already constructed for the nation (http://mpra.ub.uni-uenchen.de/1145/01/MPRA_paper_1145.pdf) and, New York City (http://mpra.ub.uni-muenchen.de/4200/01/MPRA_paper_4200.pdf).

Keywords: A model of cyclical terrorist murder in Colombia, 1950-2004. Forecasts 2005-2019; the econometrics of violence, terrorism, and scenarios for peace in Colombia from 1950 to 2019; scenarios for sustainable peace in Colombia by year 2019; decomposing violence: terrorist murder in the twentieth in the United States; using the Beveridge and Nelson decomposition of economic time series for pointing out the occurrence of terrorist attacks; decomposing violence: terrorist murder and attacks in New York State from 1933 to 2005; terrorist murder, cycles of violence, and terrorist attacks in New York City during the last two centuries.

JEL classification codes: C22, D74, H56, N46, K14, K42, N42, O51.
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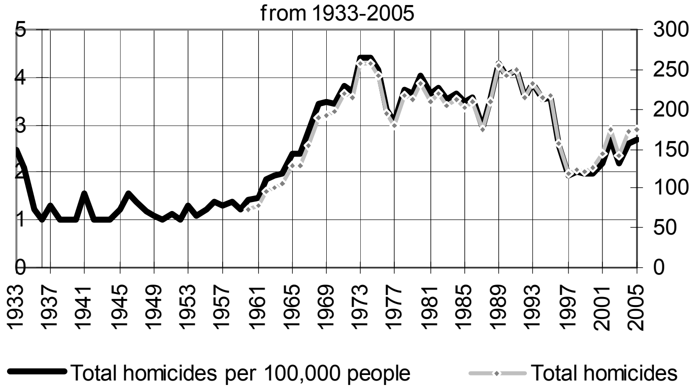
1. Introduction.

After decomposing violence, and creating the cyclical terrorist murder and attacks index for the United States and New York City: *decomposing violence: cycles of violence in the twentieth century in the United States* (Gómez-Sorzano 2006), and *terrorist murder, cycles of violence, and terrorist attacks in New York City during the last two centuries* (Gómez-Sorzano 2007B), this paper continues that methodology research applied at the State level. The current exercise for Massachusetts State is the second one at decomposing violence at the state level on the purpose of constructing murder and attacks indexes preventing the closeness of attacks or tragic events. This research shows that the estimated cyclical component of murder carefully pointed out the date of occurrence of the last three terrorist attacks against the U.S, particularly, the shut down in power in New York City in 1965, the World Trade Center bombing in 1993, and 9/11 2001; the paper suggests that the State of Massachusetts has been able to break up the cycle of violence having a current problem of growing permanent murder (i.e., the estimated permanent component of murder increases, Fig. 4).

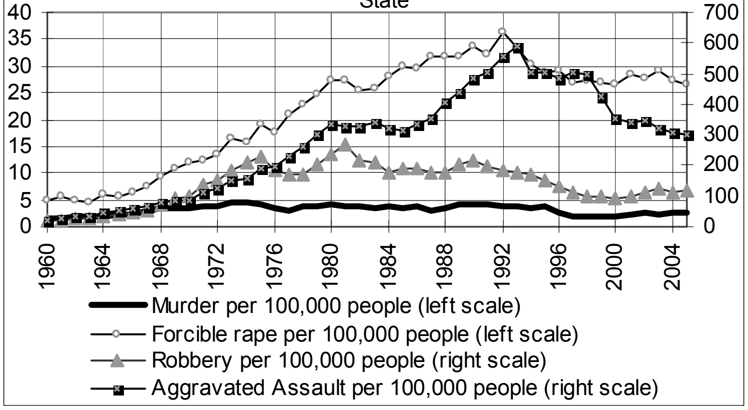
According to the Federal Bureau of Investigation, Uniform Crime Reporting System, total homicides in Massachusetts State increased from an average of 124 per year in the 1960s to 218 in the 1970s, 212 in the 1980s, and 189 in the 1990s (Fig. 1). When adjusted for population growth, i.e., homicides per 100,000 people in the population, an almost identical pattern emerges, reaching a first peak in 1974 with 4.4 murder per capita and, subsequent peaks in 1980, 1989, and 2005 respectively with 4.05, 4.3, and 2.70 per capita respectively.

Figure 1. Total homicides, in Massachusetts State from 1933-2005



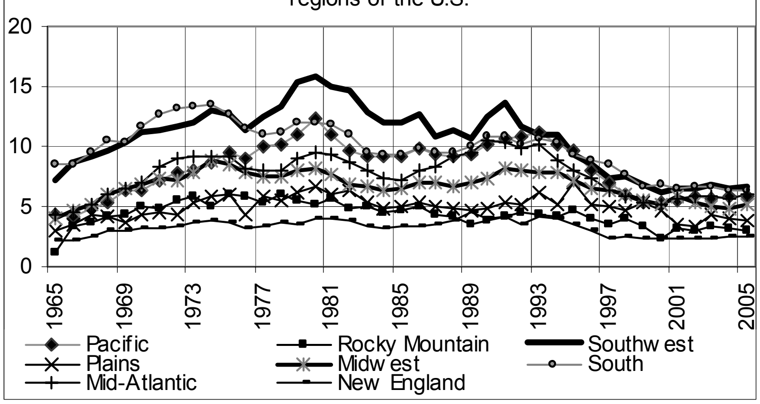
Out of the state's four categories of crimes, measuring violent crime (murder, forcible rape, robbery, and aggravated assault) murder is the one that varies the less showing and stabilization tendency (Fig. 2).

Figure 2. Categories of violent crime in Massachusetts State



Although the U.S., murder rates appear stabilizing during the last years, the highest per capita rates are found in the southwest and, south regions with 6.67 and 6.39 per capita, the New England region where Massachusetts belongs appears as the lowest rate across the nation with a rate of 2.48 for 2005 (Fig. 3).

Figure 3. Murder per capita rates per 100,000 across regions of the U.S.



2. Data and methods

The Bureau of Justice Statistics has a record of crime statistics that reaches back to 1933, (for this analysis I use the murder rates per 100,000 people[1]). As is known, time

[1] Taken from FBI, Uniform Crime Reports.

series can be broken into two constituent components, the permanent and transitory component. I apply the Beveridge-Nelson (BN for short 1981) decomposition technique to the Massachusetts State series of murders.

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 1933-2005. These tests present the structural form shown in equation (1).

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

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 eliminated sequentially 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(Lhmass) – murder series	24	0.064	0.0057	-0.4042	No
Massachusetts State , 1933-2005		0.2915	0.757	(-1.74)	

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 , -3.45 (sample size of 50 and 100)

After rejecting the null for a unit root (accepting the series is non stationary), I perform the BN decomposition which begins by fitting the logarithm of the per capita murder series to an ARIMA model of the form (2):

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

Where k, and h are respectively the autoregressive and moving average components. The selection of the ARIMA model is computationally intense. My search for the right model for the period 1933-2005 stopped with an ARIMA (6,1,19) ran with RATS 4, shown in table 2, and including autoregressive components of order 1, and 6, and moving average terms of order 1,5 and, 19; the model is unique at providing a cyclical component oscillating around a zero average:

Table 2. Estimated ARIMA model for murder for Massachusetts State

Annual data from 1933 to 2005

Variables	Coeff	T-stats	Std Error	Signif
Constant	0.0157	4.504	0.0034	0.0000
AR(1)	0.5831	4.959	0.1175	0.0000
AR(6)	-0.1490	-3.278	0.0454	0.0017
MA(1)	-0.9920	-28.65	0.0346	0.0000
MA(5)	0.2950	4.189	0.0704	0.0000
MA(19)	-0.3606	-2.756	0.1308	0.0077

Centered R^2 = 0.9265

DW= 1.95

Significance level of Q = 0.827

Usable observations = 66

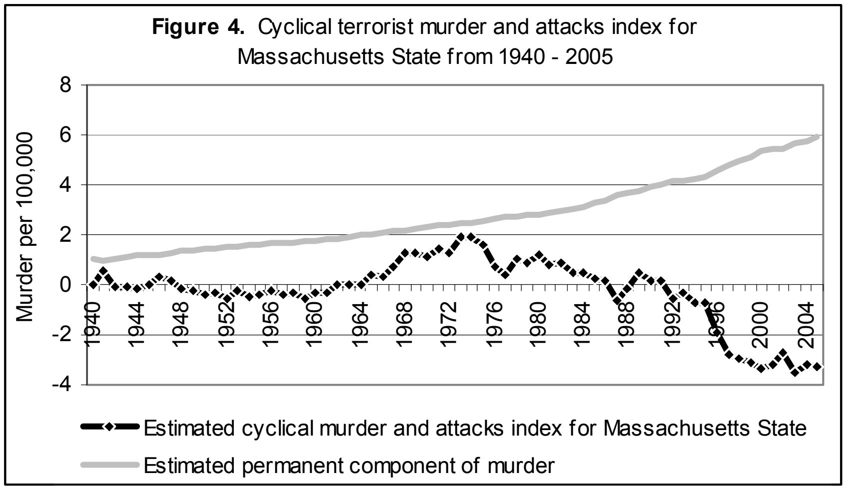
The six model parameters are replaced in the equation for the permanent component of murder shown in (3)[2]:

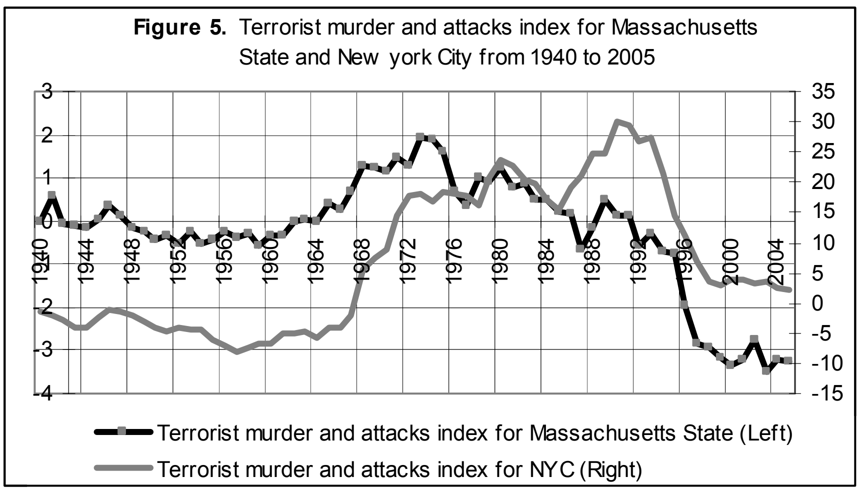
$$L\,\hom_t^{PC} = L\,\hom_0 + \frac{\mu.t}{1-\gamma_1-...\gamma_k} + \frac{1+\Psi_1+....\Psi_h}{1-\gamma_1-...\gamma_k}\sum_{i=1}^{t}\varepsilon_i \quad (3)$$

The transitory or cyclical terrorist murder estimate is found by means of the difference between the original series, and the exponential of the permanent per capita component ($L\,\hom_t^{PC}$)[3], and is shown in Figure 4, that additionally shows the estimated permanent component. It matches the qualitative description of known waves of organized crime, internal tensions, crime legislation, social, and political unrest overseas, and disentangles, and presents the cycles of violence in the State of Massachusetts. To compare this historical narrative of events with my estimates for cyclical terrorist murder and, attacks I use chronologies, and description of facts taken from Clark (1970), Durham (1996), Blumstein and Wallman (2000), Bernard (2002), Hewitt (2005), and Monkkonen (2001), Wikepedia, the Spanish Division Library of Congress for the Chronology of the Spanish-American War[4], and Henrreta et al. (2006).

Figure 5 for informational purposes shows, the terrorist murder and attacks indicator for Massachusetts State, and New York City; it is noticeable observing that both series move almost in an identical way, but the index for New York City has always been bigger compared with Massachusetts.

[2] 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.' case in appendix A. Eq.3 above, turns out to be Eq.17 in appendix A.
[3] Turning the estimated permanent per capita component into the level of the permanent component.
[4] http://www.loc.gov/rr/hispanic/1898/chronology.html.





3. Interpretation of results.

The State of Massachusetts historically has not had a terrorist attack, but its index captures amazingly well the cycles experienced by the U.S. as a whole, and most importantly, it predicted the recent most tragic terrorist attacks experienced by the nation.

According to Dosal (2002) from 1933 to 1945 the U.S. implemented the "good neighbor policy", during those years the attacks index for Massachusetts decreased from -0.07 (1942) to -0.11 (1943) to -0.15 (1944), and jumped in year in 1945 to 0.020 after abolishing this policy, which additionally coincided with the attacks to Hiroshima and Nagasaki on August 6, and 9 respectively that year, Japan surrendered on Nagasaki on September 2, and the index as a consequence jumped additionally one more year getting a peak on 1946 to 0.34 per capita.

From 1948 to 1962 the index becomes negative, and jumps in 1963 after the assassination of President Kennedy, passing from -0.01 in 1962 to 0.014 in 1963. In 1965 and coinciding with the beginning of the Vietnam Conflict (1964-1973) the index jumps again moving from -0.016 in 1964 to 0.38 in 1965. The index during this period was additionally pushed up by the terrorist assassination of Dr. Martin Luther King on 4 April 1968; the index moved from 1967 to 1968 from 0.69 to 1.27 (84%). During the Vietnam Conflict period the index moved continuously for Massachusetts getting its higher historical value of 1.93 in 1973 once the conflict was over. From 1973 to 1974 the index moved from 1.93 to 1.90 (-1.57%).

From 1982 to 1986 a continuous reduction for the index is observed, coinciding with similar reductions noted for the U.S., and NYC indexes. In the present case the index moves from 0.86 in 1982 to 0.48 in 1983, 0.51 in 1984, 0.20 in 1985, and becomes negative in 1987 with -0.64. Blumstein and Wallman (2002), refer to this phenomenon as attributed to the aging of the population, as the huge baby-boom cohorts moved into adulthood, they brought down the total rate of homicide and other crimes.

Additional facts show this index getting a peak in 1989, after moving from -0.15 in 1988 to 0.51 in 1989. The index for Massachusetts felt the impact caused by the World Trade Center bombing and jumped from -0.55 in 1992 to -0.29 in 1993 (89.6%), and then it decreased again to -0.71 (144.8%). From 1994 onward the index decreases continuously and jumps amazingly well on 2001 as a consequence of the huge impact caused by 9/11 attacks. In the present case it jumped from -3.35 in 2000 to -3.22 in 2001 (4%).

4. Conclusions.

Provided with a data series of per capita murder from 1933 to 2005, I have constructed both the attacks and the permanent murder indexes for Massachusetts State. The index works amazingly well at pointing out terrorist attack dates; it particularly foretold with amazing precision major recent tragic events occurred in the country as the World Trade Center bombing of 1993, and 9/11 2001 attacks. Immediate research should be done headed towards the construction of a model for terrorist attacks, and permanent murder for Massachusetts.

Data Source: FBI, Uniform Crime reports.

Acknowledgements

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Appendix A. The Beveridge & Nelson decomposition of economic time series applied to decomposing the Massachusetts State per capita homicides from 1933 to 2005.

I denote the observations of a stationary series of the logarithm of per capita homicides for Massachusetts State. 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.

$$W_t = Lt\,\mathrm{hom}_t - Lt\,\mathrm{hom}_{t-1} \qquad (1)$$

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

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

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

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

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

$$\hat{W}_t(i) = \mu + \lambda_i \varepsilon_t + \lambda_{i+1}\varepsilon_{t-1} + \quad . \; . \; . \; . \; . \qquad (4)$$
$$\mu + \sum_{j=1}^{\infty} \lambda_j \; \varepsilon_{t+1-j} \; ,$$

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

$$L\hat{\hom}_t(k) = L\hom_t + \hat{W}_t(i) \qquad (5)$$
$$= L\hom_t + \left[\mu + \sum_{j=1}^{\infty} \lambda_j \varepsilon_{t+1-j} \right]$$
$$= k\mu + L\hom_t + \left(\sum_{1}^{k} \lambda_i \right) \varepsilon_t + \left(\sum_{2}^{k+1} \lambda_i \right) \varepsilon_{t-1} + . \; . \; . \; .$$

And considering long forecasts, I approximately have

$$L\hat{\hom}_t(k) \cong k\mu + L\hom_t + \left(\sum_{1}^{\infty} \lambda_i \right) \varepsilon_t + \left(\sum_{2}^{\infty} \lambda_i \right) \varepsilon_{t-1} + . \; . \; . \; . \; . \qquad (6)$$

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

$$\overline{L\hom_t} = L\hom_t + \left(\sum_{1}^{\infty} \lambda_i \right) \varepsilon_t + \left(\sum_{2}^{\infty} \lambda_i \right) \varepsilon_{t-1} + \; . \; . \; . \; . \; . \; . \; . \qquad .(7)$$

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.

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

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

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

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

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

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

:

$$W_1 = \overline{L\hom_1} = \overline{L\hom_0} + \mu + \frac{\theta(1)}{\phi(1)}\varepsilon_1 \quad (\textit{this is the value for year } 1940)$$

:

$$W_{66} = \overline{L\hom_{66}} = \overline{L\hom_0} + \mu + \frac{\theta(1)}{\phi(1)}\varepsilon_{66} \quad (\textit{this is the value for year } 2005)$$

Adding these equations I obtain W_1 (the value for year 1962), and W44 (the value for year 2005), 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 1940.

Cárdenas (1991), suggests that Eq.(11), should be changed when the ARIMA model includes autoregressive components. Since the ARIMA developed for Massachusetts (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

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

Rearranging Eq. (14) and including the ARIMA parameters from Table 2, I get.

$$L\hom_t - L\hom_{t-1} = \frac{0.015}{1-0.58-0.14} + \left(\frac{1-0.99+0.29-0.36}{1-0.58-0.14} \right) \varepsilon_t \quad (15)$$

Now, after recursively replacing, t with (t-1), and (t-1) with (t-2), etc, and after adding together "t" times, I have

$$L\hom_t - L\hom_0 = \frac{0.015.\,t}{1-0.58-0.14} + \left(\frac{1-0.99+0.29-0.36}{1-0.58-0.14} \right) \sum_{i=1}^{t} \varepsilon_i \quad (16)$$

And rearranging,

$$L\hom_t = L\hom_0 + \frac{0.015.\,t}{1-0.58-0.14} + \left(\frac{1-0.99+0.29-0.36}{1-0.58-0.14} \right) \sum_{i=1}^{t} \varepsilon_i \quad (17)$$

In the steady state, when L=1, Eq. (17) yields the permanent component of the per capita murder for Massachusetts, the last step requires taking the exponential to the LHS of Eq. 17, 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. Both permanent and cyclical estimated components are shown in Fig.4.

Appendix B : data table

	Original Data		**BEVERIDGE – NELSON** Terrorist murder and attacks index	
year	Murder	Murder per capita	Cyclical – component	Permanent component
1933		2.50		
1934		2.10		
1935		1.20		
1936		1.00		
1937		1.30		
1938		1.00		
1939		1.00		
1940		1.00	-0.0036	0.0036
1941		1.57	0.5716	-0.0016
1942		1.00	-0.0723	0.0698
1943		1.00	-0.1175	0.1111
1944		1.01	-0.1590	0.1561
1945		1.22	0.0201	0.1822
1946		1.57	0.3430	0.2045
1947		1.39	0.1245	0.2355
1948		1.18	-0.1425	0.2796
1949		1.11	-0.2615	0.3159
1950		1.00	-0.4339	0.3604
1951		1.14	-0.3294	0.3849
1952		1.00	-0.5322	0.4267
1953		1.30	-0.2401	0.4319
1954		1.10	-0.5011	0.4707
1955		1.20	-0.4283	0.4875
1956		1.40	-0.2445	0.4974
1957		1.30	-0.3803	0.5190
1958		1.40	-0.3129	0.5382
1959		1.20	-0.5727	0.5725
1960	74	1.44	-0.3382	0.5741
1961	77	1.47	-0.3597	0.6048
1962	95	1.84	-0.0169	0.6193
1963	101	1.94	0.0146	0.6529
1964	105	1.97	-0.0168	0.6850
1965	129	2.41	0.3856	0.7063
1966	128	2.38	0.2826	0.7397
1967	154	2.84	0.6931	0.7644
1968	188	3.46	1.2795	0.7785
1969	191	3.49	1.2496	0.8083
1970	197	3.46	1.1442	0.8409
1971	220	3.82	1.4476	0.8642
1972	215	3.72	1.2798	0.8901
1973	256	4.40	1.9322	0.9034
1974	256	4.41	1.9049	0.9199
1975	242	4.15	1.6034	0.9357
1976	194	3.34	0.7010	0.9703
1977	178	3.08	0.3683	0.9970
1978	216	3.74	1.0033	1.0071

1979	212	3.67	0.8935	1.0229
1980	232	4.05	1.2397	1.0333
1981	210	3.64	0.7660	1.0555
1982	219	3.79	0.8612	1.0740
1983	203	3.52	0.4817	1.1113
1984	211	3.64	0.5126	1.1399
1985	202	3.47	0.2031	1.1837
1986	208	3.57	0.1736	1.2217
1987	173	2.95	-0.6446	1.2807
1988	208	3.54	-0.1563	1.3081
1989	254	4.30	0.5140	1.3301
1990	243	4.04	0.1272	1.3640
1991	249	4.15	0.1409	1.3893
1992	214	3.57	-0.5596	1.4177
1993	233	3.88	-0.2966	1.4284
1994	214	3.54	-0.7161	1.4489
1995	217	3.57	-0.7417	1.4619
1996	157	2.58	-1.9541	1.5110
1997	119	1.95	-2.8284	1.5631
1998	124	2.02	-2.9282	1.5985
1999	122	1.98	-3.1467	1.6336
2000	125	1.97	-3.3563	1.6724
2001	143	2.20	-3.2238	1.6908
2002	173	2.70	-2.7581	1.6971
2003	140	2.20	-3.4963	1.7398
2004	171	2.60	-3.1962	1.7572
2005	175	2.70	-3.2440	1.7824

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