ARMA Modeling of Civil Conflict

Case study of Somalia

Zhamilia Klycheva

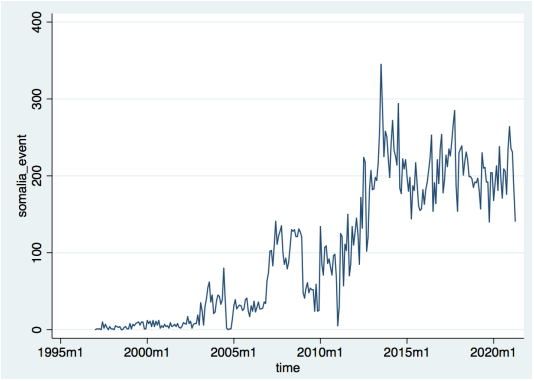
ECON 384
Dr. Pierangelo De Pace
Claremont Graduate University

May 11, 2021

Motivations:How can we explain current conflict based on the past events?

- Ongoing Civil War
- 2003 - Interim gov inauguration
- 2005 - Transitional gov returns. Violence ensues upon return.
- 2006 - Deadly fightings (Militia-backed rivals vs. Transitional Gov)
- 2011 - Kenyan Intervention
- 2009 - onwards Al-Shabaab presence

Somalia's Conflict Event Data



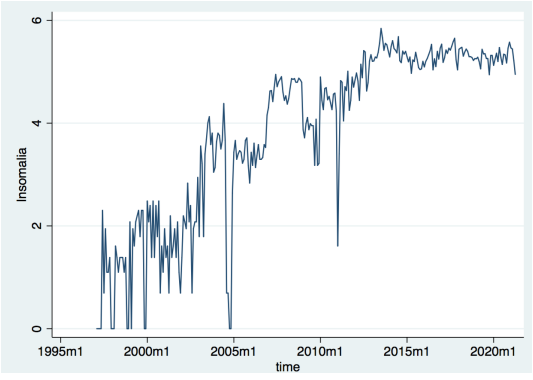
Data

Civil Conflict

1. Battles
2. Explosions/Remote Violence
3. Violent Protests
4. Riots
5. Violence Against Civilians

Source: ACLED
Period: 01/1997 - 04/2021

Ln Somalia's Conflict Event Time Series



Unit Root Test

- Run ADF test with trend
- Fail to reject the Null: unit root present
- AC sustains over time - indicative of the presence of a unit root

ADF Test for Unit Root

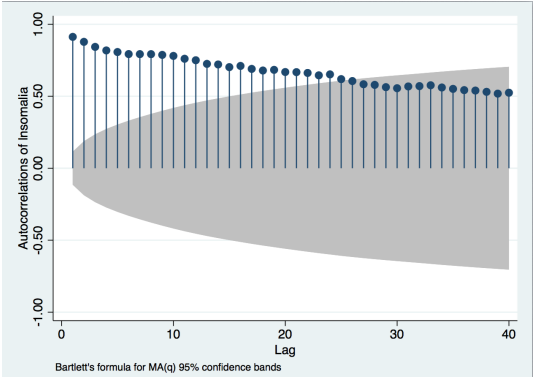
Augmented Dickey-Fuller test for unit root Number of obs = 270

	Test Statistic	Interpolated Dickey-Fuller: 1% Critical Value	5% Critical Value	10% Critical Value
Z(t)	-1.657	-3.989	-3.429	-3.130

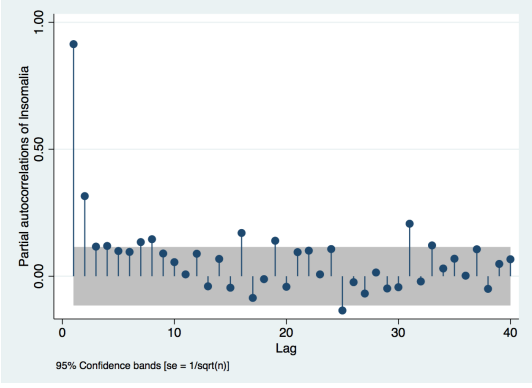
MacKinnon approximate p-value for Z(t) = 0.7694

ACF and PACF

Ln Conflict ACF Plot

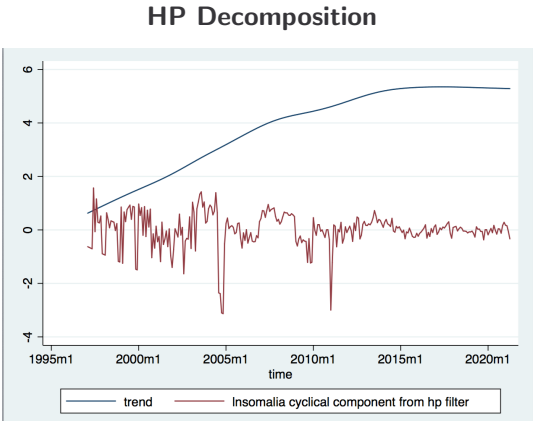


Ln Conflict PACF Plot



Hodrick-Prescott Decomposition

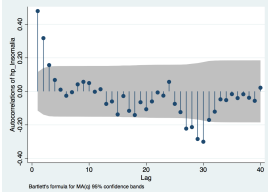
- Decompose series into a trend and a stationary component
- Stationary component indicates a percentage deviation from the Long Run trend
- Constant mean, however variance changes over time



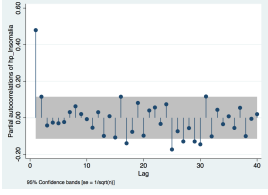
Hodrick-Prescott Decomposition

- Improved ACF and PACF
- Some remaining structure is observed
- Constant mean, however variance changes over time

HP Decomposed TS ACF Plot



HP Decomposed TS PACF Plot



Test for Unit Root for the Decomposed TS

- Reject the Null: no unit root detected
- Constant mean, but non-constant variance (series above)

ADF Test for Unit Root

Augmented Dickey-Fuller test for unit root Number of obs = 270

	Test Statistic	1% Critical Value	5% Critical Value	10% Critical Value
		Interpolated Dickey-Fuller		
Z(t)	-4.047	-3.458	-2.879	-2.570

MacKinnon approximate p-value for Z(t) = 0.0012

ARMA Model Estimation

VARIABLES	ARMA(1,1)	ARMA(1,0)	ARMA(2,0)
L.AR	0.624***	0.479***	0.424***
	(0.0631)	(0.0316)	(0.0406)
L.MA	-0.187**		
	(0.0842)		
L2.AR			0.115***
			(0.0394)
Constant	-0.00441	-0.00303	-0.00446
	(0.0819)	(0.0723)	0.0823)
Sigma	0.559***	0.562***	0.558***
	(0.0137)	(0.0137)	(0.0136)
Observations	291	291	291
Log Likelihood	-243.72	-245.29	-243.35
AIC	495.45	496.58	494.697
BIC	510.14	507.60	509.39

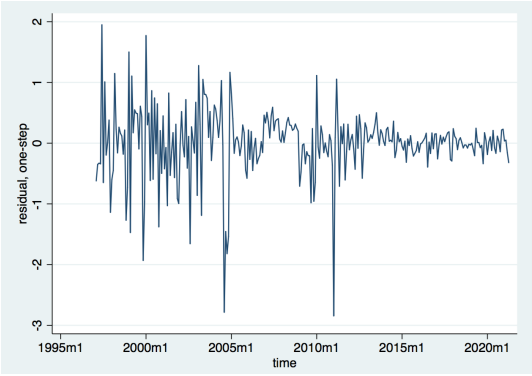
Standard errors in parentheses

*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Model Evaluation

- There is still some remaining structure

ARMA(2,0) Residual Plot



Implications

- The structure of the data contains multiple regime changes which hints at the dynamic nature of the TS
- Structural Break test showed there is structural break in the data
- Consider ARCH/GARCH processes to deal with volatility
- Extend to multivariate analysis

The End

Appendix: First Difference

- Constant mean, but non-constant variance
- ADF showed no presence of a unit root (I(0) process

First Difference Ln Somalia Conflict