Impact of Food Scarcity on Political Stability

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17.835 Machine Learning and Data Science in Politics

Abstract

- Our interest in relationship between food and politically stability sparked by Iranian protests over the rising price of eggs that resulted in 21 deaths and 450+ arrests.
- Investigated the correlation and potential causal effect of food and water security on political stability using a distributed lag model and a two-way fixed effect model

Summary of Findings

- Our models indicate the possibility of a causal effect, but are inconclusive and require further analysis
- Two-way fixed effect model reveals that prevalence of undernourishment, food production, access to basic drinking water services, and access to clean fuels and technologies for cooking are possible factors that cause changes in political stability
- Distributed time lag shows that only access to water has a statistically significant effect on future changes in stability index

Data

We collected 2754 observations of 28 variables in 153 countries across 20 years.

World Bank WDI Database[1]:

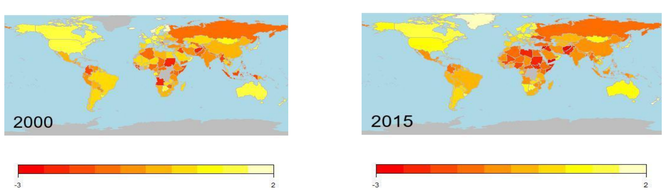
- Access to basic drinking water services (% of pop.)
- Prevalence of undernourishment (% of pop.)
- Kilocalorie deficit
- Food production index
- Access to electricity, clean fuels (% of pop.)

World Bank WGI Database[2]:

- **Political stability index (PSI)**, which ranges from -3 to 3, is a measure of the likelihood of political instability or political violence, including terrorism. It is normally distributed based on the following data sources:

EIU	Orderly transfers, Armed conflict, Violent demonstrations, Social Unrest, International tensions / terrorist threat
GCS	Cost of Terrorism
HUM	Political terror scale
IJT	Security Risk Rating
IPD	Intensity of internal conflicts: ethnic, religious or regional, Intensity of violent activities of underground political organizations, Intensity of social conflicts (excluding conflicts relating to land)
PRS	Government stability, Internal conflict, External conflict, Ethnic tensions
WMO	Protests and riots, Terrorism, Interstate war, Civil war

Political stability index over time:



Data Analysis - Methods

1) Distributed Lag Model
   - Regression of a dependent variable against current and lagged independent variables
2) Two-way Fixed Effect
   - Control for country-specific and year-specific effects by including country and year factors to isolate effect of other covariates

Distributed Time Lag Results

$$\Delta^{y}_{t-1,t} = \beta_0 + \beta_1 \Delta^{y}_{t-2,t-1} + \beta_2 \Delta^{x_1}_{t-1,t} + \beta_3 \Delta^{x_1}_{t-2,t-1} + ... + \epsilon$$

Indicator	Estimate	Std. Error	t value	Pr(>|t|)
(Intercept)	-0.0053	0.0063	-0.84	0.4025
$\Delta_{t-2,t-1}$ Stability Index Estimate	-0.0587	0.0219	-2.69	0.0073**
$\Delta_{t-1,t}$ % Undernourished	0.0005	0.0092	0.05	0.9577
$\Delta_{t-2,t-1}$ % Undernourished	-0.0095	0.0079	-1.20	0.2309
$\Delta_{t-1,t}$ % Basic Water Access	0.0739	0.0280	2.64	0.0083**
$\Delta_{t-2,t-1}$ % Basic Water Access	-0.0797	0.0254	-3.14	0.0017**
$\Delta_{t-1,t}$ Food Production Index	0.0003	0.0006	0.52	0.6052
$\Delta_{t-2,t-1}$ Food Production Index	0.0004	0.0005	0.82	0.4131

- Only the lagged % basic water access variables have statistical significance
- Interestingly, the change from *t-2* to *t-1* has a *positive* effect on stability, while the change from *t-1* to t has a *negative* effect
- Stability index tends to follow linear trends, so *autocorrelation* has a more significant effect than most of our covariates

Two-Way Fixed Effect Results

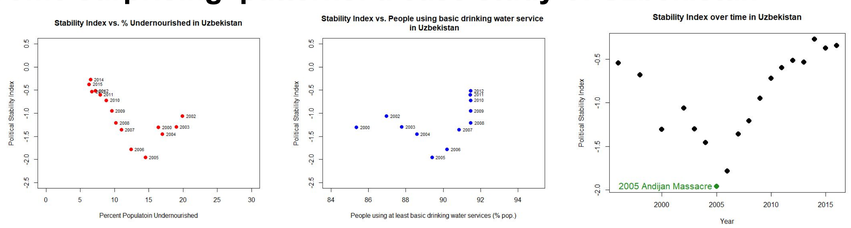
Indicator		Estimate	Std. Error	t value	Pr(>|t|)	
Prevalence of undernourishment (% of population)	SN.ITK.DEFC.ZS	-0.0107765	0.0027	-3.930	8.81e-05	***
Food production index	AG.PRD.FOOD.XD	0.0031020	0.0006	5.315	1.20e-07	***
People using at least basic drinking water services (% of population)	SH.H2O.BASW.ZS	-0.0144071	0.0036	-4.073	4.84e-05	***
Access to clean fuels and technologies for cooking (% of population)	EG.CFT.ACCS.ZS	0.0079380	0.0023	3.501	0.000475	***

Other variables we tried that were not significant:

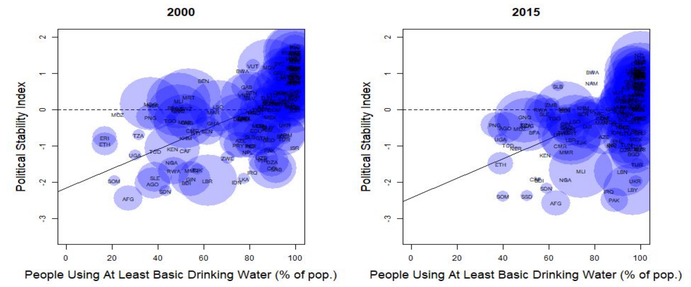
- People using safely managed drinking water services
- Access to electricity
- Depth of food deficit (kilocalories per person per day)

In the table above, we see that those four covariates are statistically significant, and therefore have a *potential* causal relationship with political stability.

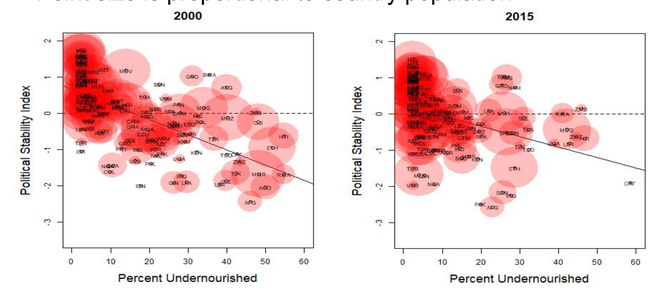
Some surprising patterns: a case study of Uzbekistan



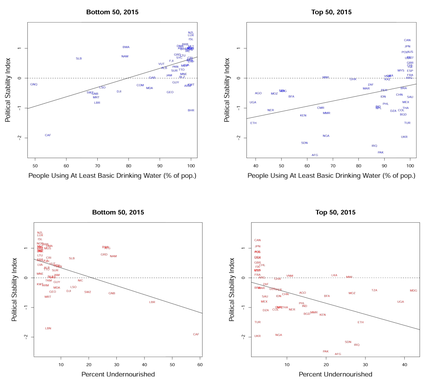
Descriptive Analysis



- As drinking water access increases, political stability increases
- Increase in access to drinking water over time, on average
- Point size is proportional to country population



- As prevalence of undernourishment increases, PSI increases
- Decrease in % undernourishment on average over time



- Data segmented into largest 50 and smallest 50 by population
- Undernourishment and water access have a greater marginal effect on stability for smaller countries

Future Work

- Causal inference using matching techniques

References

1. World Development Indicators: https://datacatalog.worldbank.org/dataset/world-development-indicators
2. Political Stability Index: https://www.theglobaleconomy.com/rankings/wb_political_stability/

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