FORECASTING SOCIAL UNREST:
A MACHINE LEARNING APPROACH

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FORECASTING SOCIAL UNREST: A ML APPROACH

What we do
- Develop ML based forecasting model of unrest events of Barret et al. (2020)
- Shed light on predictors, produce risk index.

Why do this?
- We know relatively little about the data generating process.
- Risk index driven by forecast performance.

Results:
- AUC and Balanced Accuracy of 66%, significantly better than chance.
- Relatively modest role for predictors in lit.: Inflation, contagion from neighbors, digital media.
SOCIAL UNREST EVENTS

(a) Number of Unrest events

Barret et al (2021), authors’ calculations

(b) Unrest and per capita GDP growth

Source: Barret et al. (2020), WEO data base, IMF staff calculations
(a) Number of Unrest events

Unrest Events

unknown  government  democratic  global_issues  religious  elections  basic_needs  coup  violence

Date


Barret et al (2021), authors’ calculations

(b) Impact of increases in unrest on output

Percent

Hlatshwayo & Redl (2021), forthcoming
Drivers of unrest:

- Food prices (Bellemare 2015), inequality (Acemoglu and Robinson 2000), competition between elites (Turchin and Korotayev 2020), social media (Enikolopov et al. 2020), social media + weak growth (Manacorda and Tesei 2020)

→ Useful if we can give forewarning of events

→ We contribute to the literature by considering a wide range of drivers over a large set of countries.

Implications: Social unrest and instability...

<table>
<thead>
<tr>
<th>Implications</th>
<th>Literature</th>
</tr>
</thead>
<tbody>
<tr>
<td>...can induce changes in political shifts.</td>
<td>Acemoglu and Robinson (2000), Aidt and Frank (2015), Aidt and Leon (2016)</td>
</tr>
<tr>
<td>...reduces investment (and increases government consumption)</td>
<td>Alesina &amp; Tabellini (1989); Hossain and Chowdhury (1998); Darby, Li, and Muscatelli (2004); Leduc &amp; Liu (2016)</td>
</tr>
<tr>
<td>...prompts capital flight and depresses financial market returns</td>
<td>Alesina &amp; Tabellini (1989); Bernhard and Leblang (2006); Abdelbaki (2013); Acemoglu et al. (2017); Bondar &amp; Barrett (2020)</td>
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<tr>
<td>...pauses firm labor market actions</td>
<td>Leduc &amp; Liu (2016)</td>
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<tr>
<td>...lowers household consumption</td>
<td>Leduc &amp; Liu (2016)</td>
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<tr>
<td>...reduces growth</td>
<td>Barro (1991); Asteriou et al. (2000); Saadi Sedik and Xu (2020); Hadzi-Vaskov, Pienknagura, and Ricci (2020)</td>
</tr>
</tbody>
</table>
DATA: MEASURING (MAJOR) SOCIAL UNREST

Data:
- Newspaper-based Boolean indicator of Barrett, et al. (2020) - Reported Social Unrest Index (RSUI)
  - “protest” or “riot” or “revolution” within 10 words of “unrest” & excludes terms that generate obvious false positives
  - Based on article counts from Dow Jones Factiva (only major news media in USA, CAN, and UK), leverage Factiva’s tags (e.g., on country and subject)
  - Normalized to address variation in media coverage
  - 120+ countries (36 LICs, 56 EMs, 33 AEs), 1995-2020

Unrest Event if 3 criteria met
1. Local monthly peak
2. Large reading for country:
   - RSUI top 2% of observations, or
   - Mean + 4x standard deviation, or
   - 20 year rolling mean x 4x rolling 20 year standard deviation
3. 10% or more articles are on topic of unrest

✓ Carefully vetted by Barrett, et al. (2020) – only use identified “major” events

High level
Consistent over time
DATA: PREDICTORS

- **Fiscal crisis model database (Hellwig 2020):** growth, fiscal, inflation, ToT, remittances, governance, elections, income level, commodity exporting status…
- **ICRG, CNTS, Polity IV:** Internet, television, schooling, religious frictions, legislative effectiveness, regime type…
- **Natural disasters:** Extreme temperature, floods, epidemics, …
- **World Uncertainty Index** of Ahir et. al (2020)
- **World bank:** Inequality, unemployment, poverty, access to basic services
- **IMF:** CPI, structural reforms

**Target** is unrest event 1 year ahead.

→ Over 340 features (including lags, etc.)
MODEL EVALUATION

TimeSeriesSplit

- Testing set
- Training set

CV iteration

1995..2005 -> 2006
..2019 -> 2020
RESULTS BY MODEL TYPE

**Significant at 5%, * at 10% for DeLong test. Horizontal bars show mean AUC over the test set with the error bars representing standard errors.
RESULTS

Balanced Accuracy:

\[ \frac{1}{2} \left( \frac{TP}{P} + \frac{TN}{N} \right) = 66\% \]

- Missed crisis rate = 29%
- False alarm rate = 39%
RESULTS: OVER TIME & ACROSS TYPE
PROBABILITIES OF UNREST

(a) Average probability of unrest
RISK INDEX COUNTRY EXAMPLES

UNITED KINGDOM

UNITED STATES

- Occupy Movement
- Scottish Referendum
- Brexit
- Trump
- BLM

- Global
- Democratic
- Basic Needs
- United Kingdom

- Unknown
- Democratic
- Elections
- United States
RISK INDEX COUNTRY EXAMPLES

EGYPT

Mubarak resigns
Tahrir Square

THAILAND

Anti-govt
State of Emergency
Anti-govt
Military coup
DRIVERS: SHAPLEY VALUES

- Reported Social Unrest Index
- Food Inflation
- Oil Inflation
- Inflation
- Neighbours reported social unrest
- GDP Growth
- Access to Basic Services
- Digital and Media
- Fiscal Expenditures
- Government
- Political
- Aid
- Population and urbanisation
- Remittances
- Unrest Other
- Primary Balance
- Legislative
- Exchange Rate
- Uncertainty
- Size of Economy
(b) Time variation in selected Shapley values
CONCLUSIONS

- Social unrest raises financial, economic and political risks.
- We combine a new text-based measure of unrest with a large data set to explore the predictors for such events.
- Tree-based models perform best and can achieve a balanced accuracy and AUC around 66% - i.e. are “right, two thirds of the time”.
- Some evidence for the predictors highlighted in the literature, what matters most is recent unrest.
  - Inflation (esp. food), unrest in neighbors, economic growth, digital media.
- Future work to focus on high frequency data, e.g. twitter, google search, etc.
THANKS
EXTRA SLIDES
### Types of Unrest

<table>
<thead>
<tr>
<th>Unrest type</th>
<th>Key words</th>
<th>Share of events (percent)</th>
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<tbody>
<tr>
<td><strong>Government</strong></td>
<td>political, anti-government, government, anti-president, president,</td>
<td>17.5</td>
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<td></td>
<td>coalition, opposition, resignation, resigns, impeachment</td>
<td></td>
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<tr>
<td><strong>Democratic-reform related</strong></td>
<td>Arab Spring, journalist, journalists, freedom, lawyer, democracy,</td>
<td>9.4</td>
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<td></td>
<td>Tahir Square, law, independence, anti-police, constitution,</td>
<td></td>
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<td></td>
<td>anti-corruption, corruption, reform, anti-segregation,</td>
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<td></td>
<td>constitutional, suffrage, women, referendum, fraud, civil society</td>
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<tr>
<td><strong>Global issues</strong></td>
<td>occupy, anti-WEF, anti-Davos, anti-U.N.,</td>
<td>3.6</td>
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<td></td>
<td>anti-US, intervention, foreign, anti-globalization, G20,</td>
<td></td>
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<td></td>
<td>climate, environment, environmental, immigration, Brexit</td>
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<td></td>
<td>migration, migrant, refugee, human rights, summit, anti-war</td>
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<tr>
<td><strong>Religious</strong></td>
<td>anti-blasphemy, Mosque, Quran</td>
<td>0.6</td>
</tr>
<tr>
<td><strong>Elections</strong></td>
<td>candidates, vote, electoral, poll</td>
<td>14.0</td>
</tr>
<tr>
<td><strong>Basic needs</strong></td>
<td>anti-austerity, austerity, electricity, energy, yellow vests, gas, strike</td>
<td>8.3</td>
</tr>
<tr>
<td></td>
<td>union, healthcare, education, school, land, agriculture</td>
<td></td>
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<tr>
<td><strong>Coup/Sudden End to Tenure</strong></td>
<td>ousted, assassination, assassinated, military</td>
<td>5.7</td>
</tr>
<tr>
<td><strong>Violence</strong></td>
<td>deadly, riots, violent, civil war, burning</td>
<td>4.9</td>
</tr>
<tr>
<td><strong>Unknown</strong></td>
<td>...</td>
<td>36.0</td>
</tr>
</tbody>
</table>
RESULTS BY UNREST TYPE

(b) Mean balanced accuracy by type of unrest