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?

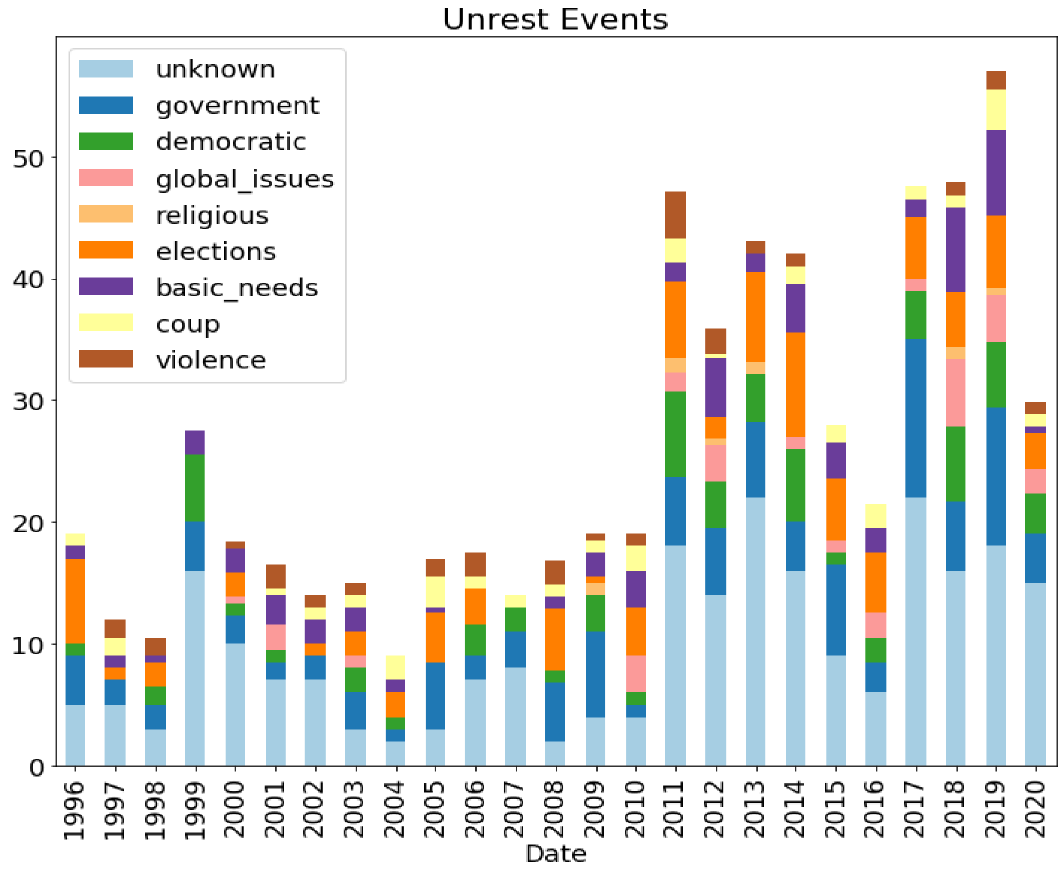
- We know relatively little about the data generating process.
- Risk index driven by forecast performance.

Results:

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

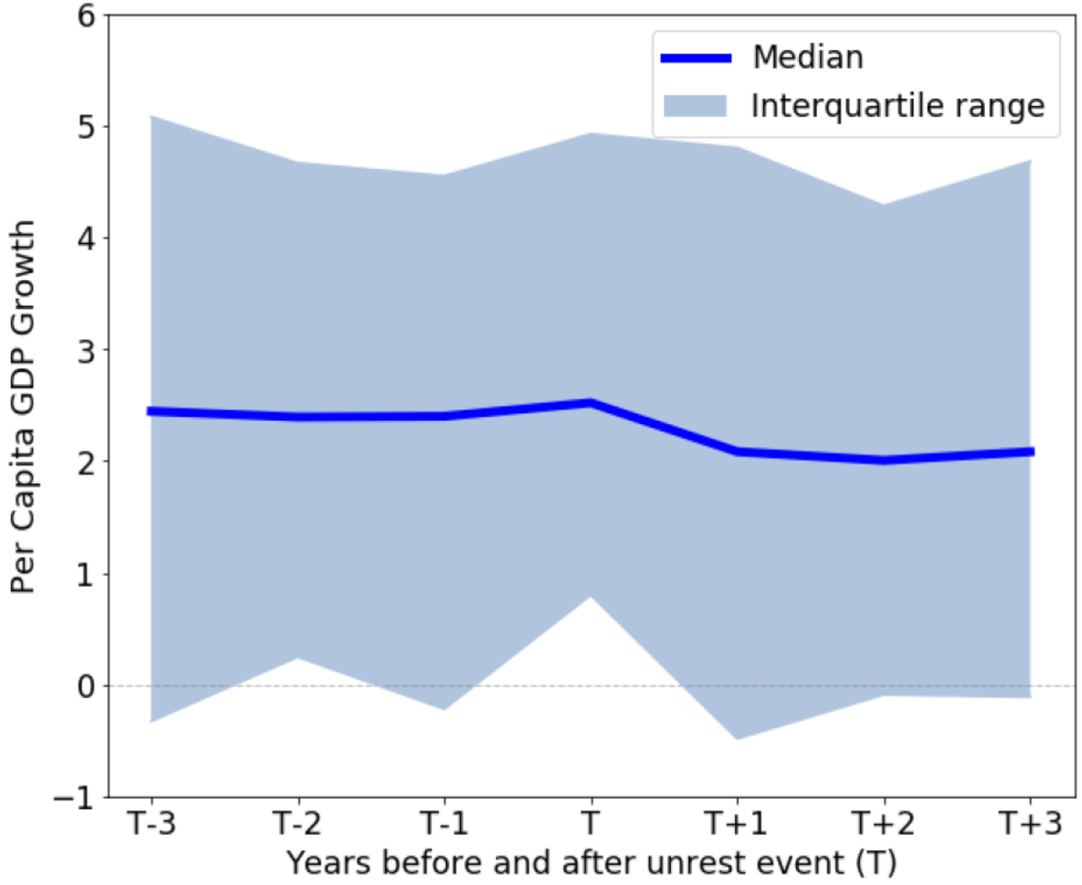
SOCIAL UNREST EVENTS

(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

SOCIAL UNREST EVENTS

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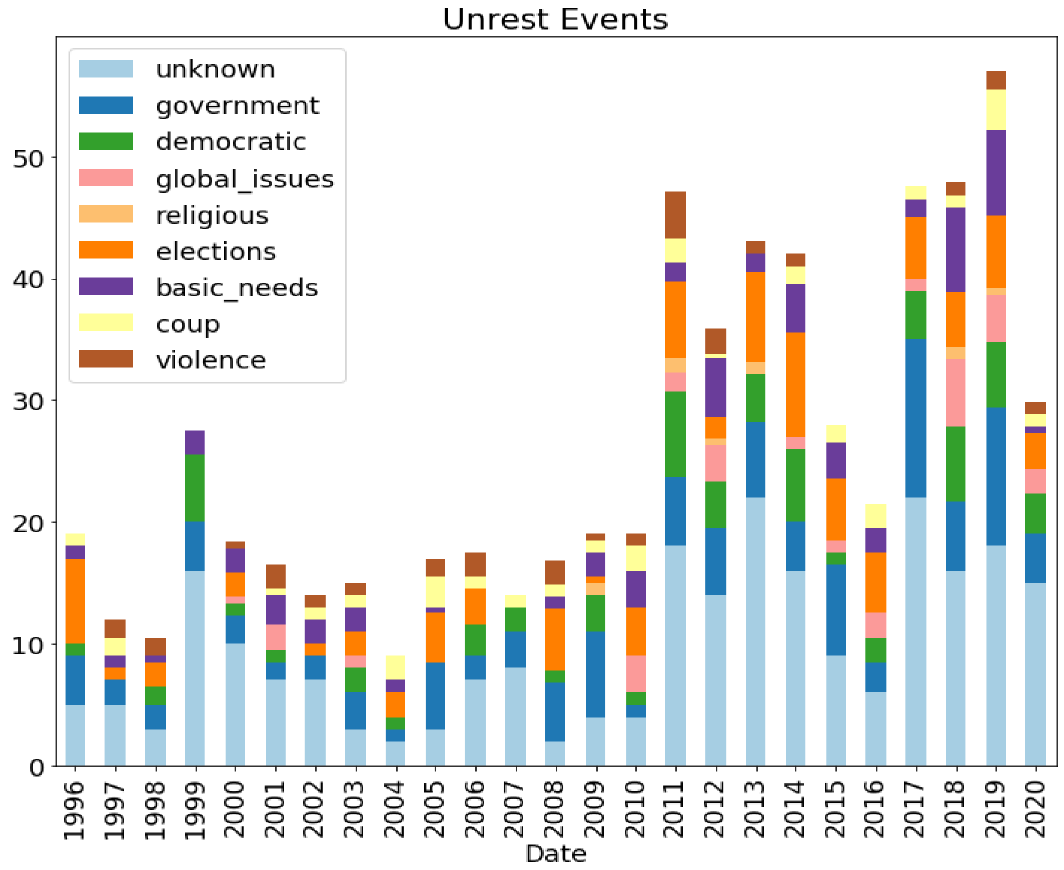
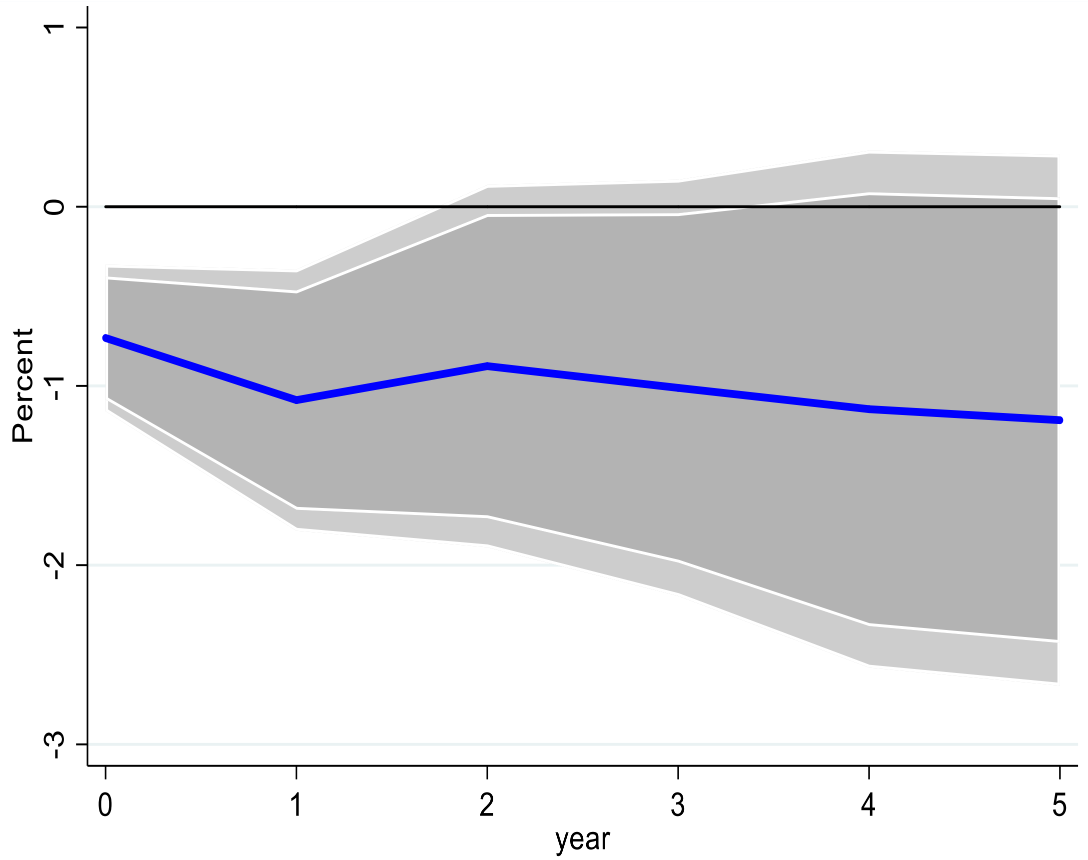


Barret et al (2021), authors' calculations

(b) Impact of increases in unrest on output



Hlatshwayo & Redl (2021), forthcoming

LITERATURE

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…	
…can induce changes in political shifts.	Acemoglu and Robinson (2000), Aidt and Frank (2015), Aidt and Leon (2016)
…reduces investment (and increases government consumption)	Alesina & Tabellini (1989); Hossain and Chowdhury (1998); Darby, Li, and Muscatelli (2004); Leduc & Liu (2016)
…prompts capital flight and depresses financial market returns	Alesina & Tabellini (1989); Bernhard and Leblang (2006); Abdelbaki (2013); Acemoglu et al. (2017); **Bondar & Barrett (2020)**
…pauses firm labor market actions	Leduc & Liu (2016)
…lowers household consumption	Leduc & Liu (2016)
…reduces growth	Barro (1991); Asteriou et al. (2000); **Saadi Sedik and Xu (2020); Hadzi-Vaskov, Pienknagura, and Ricci (2020)**

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, <u>*or*</u>
   - Mean + 4x standard deviation, <u>*or*</u>
   - 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

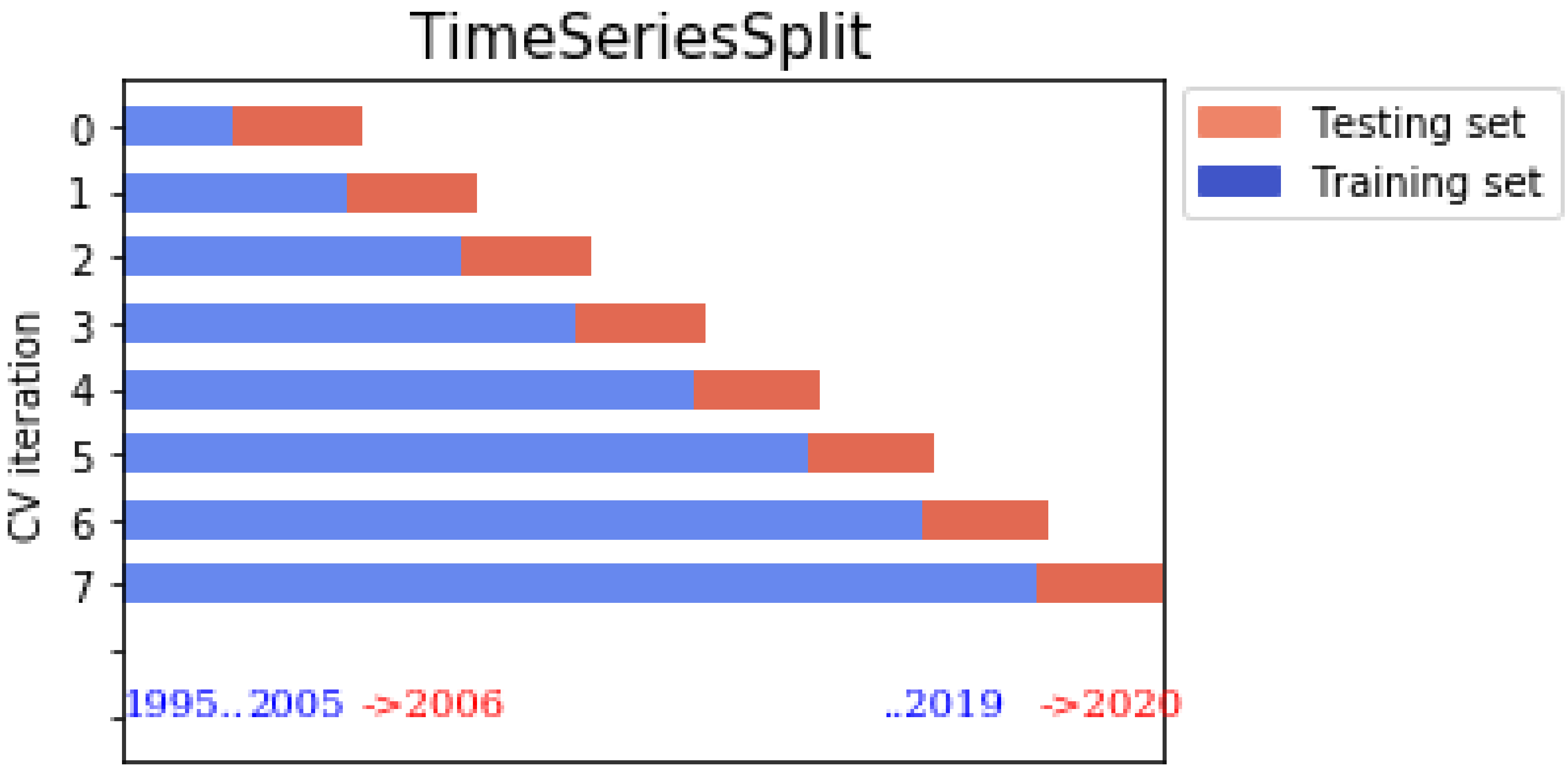
DATA: PREDICTORS

- **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

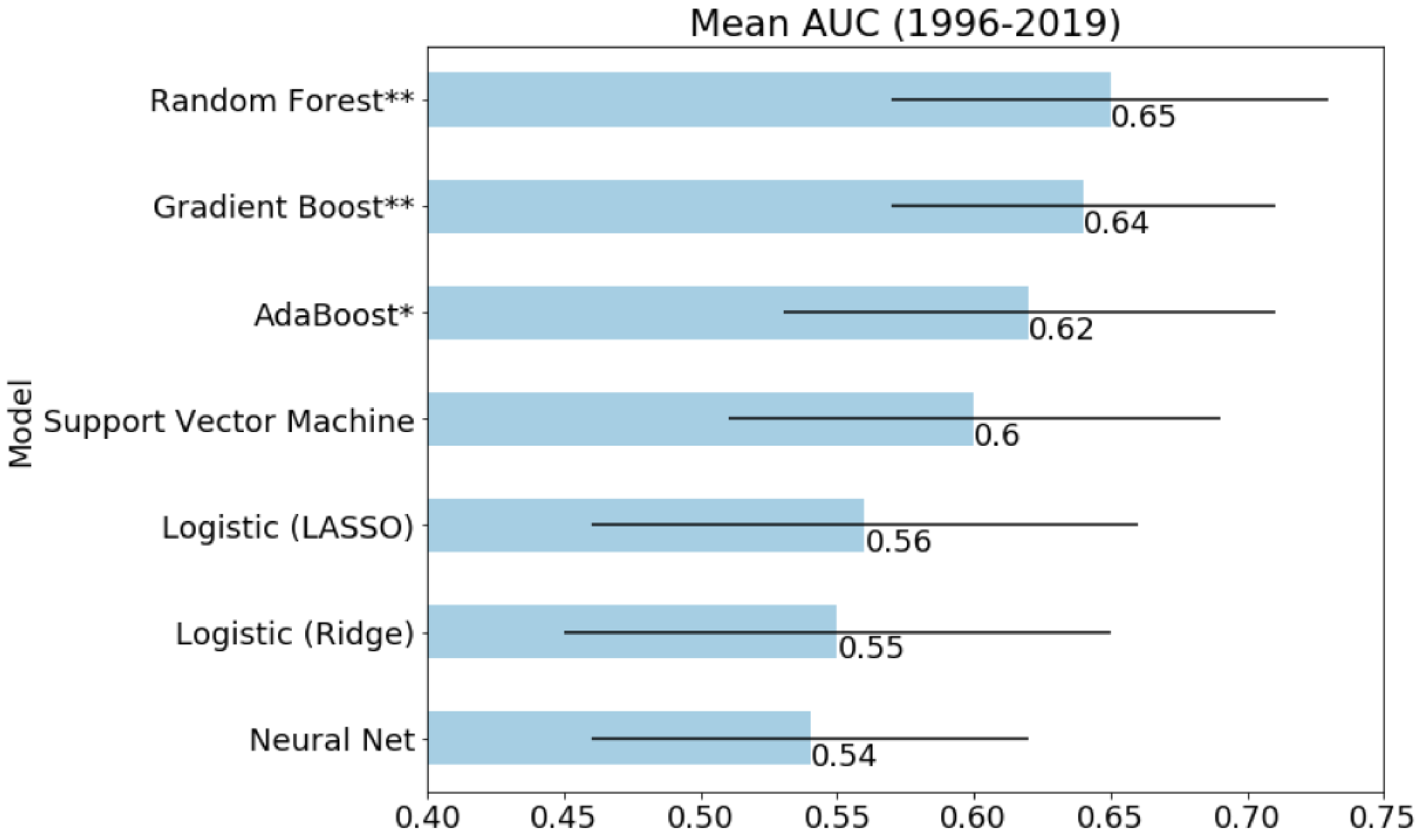
Target is unrest event 1 year ahead.

→ **Over 340 features (including lags, etc.)**

MODEL EVALUATION



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

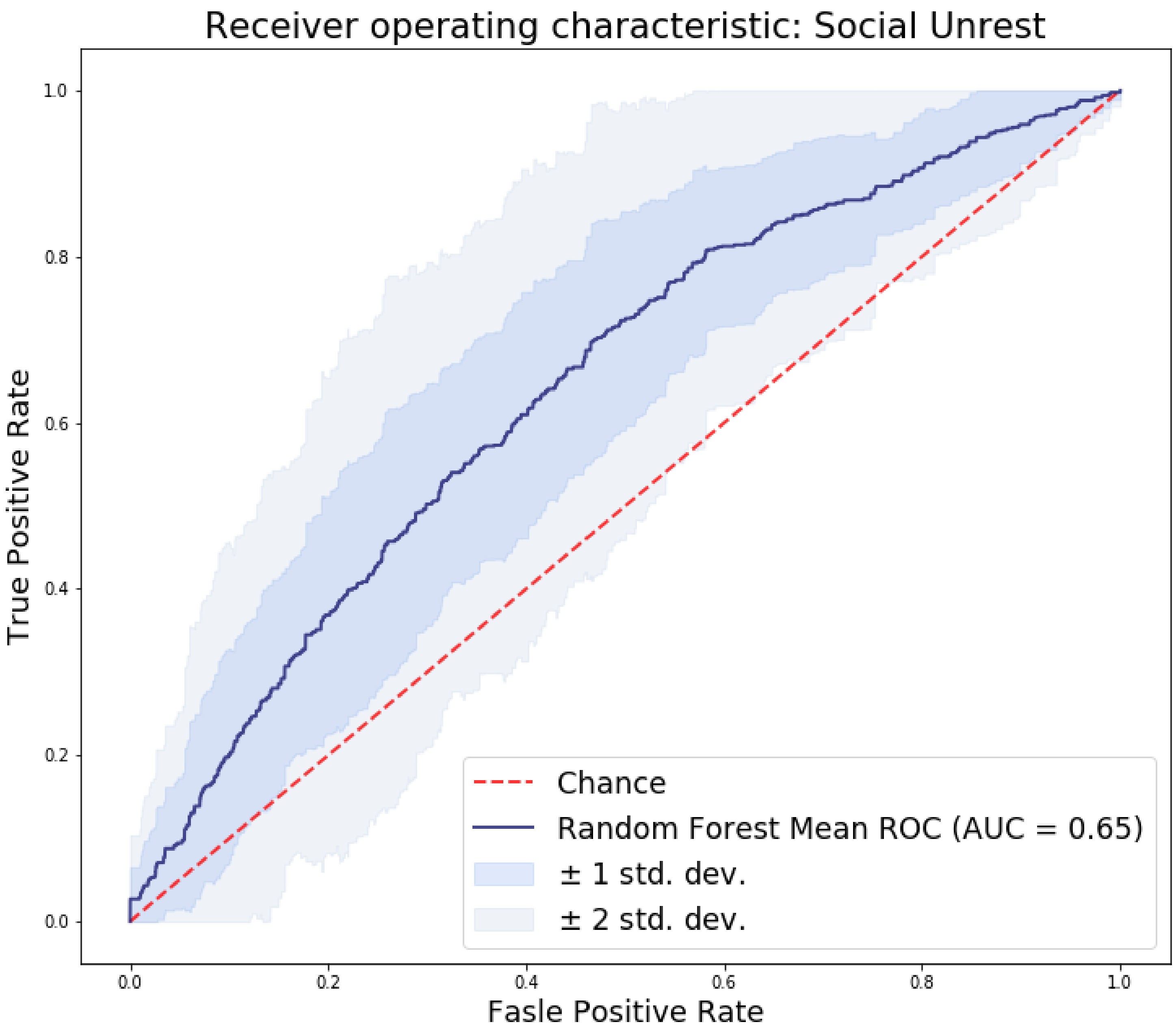
Balanced Accuracy:

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

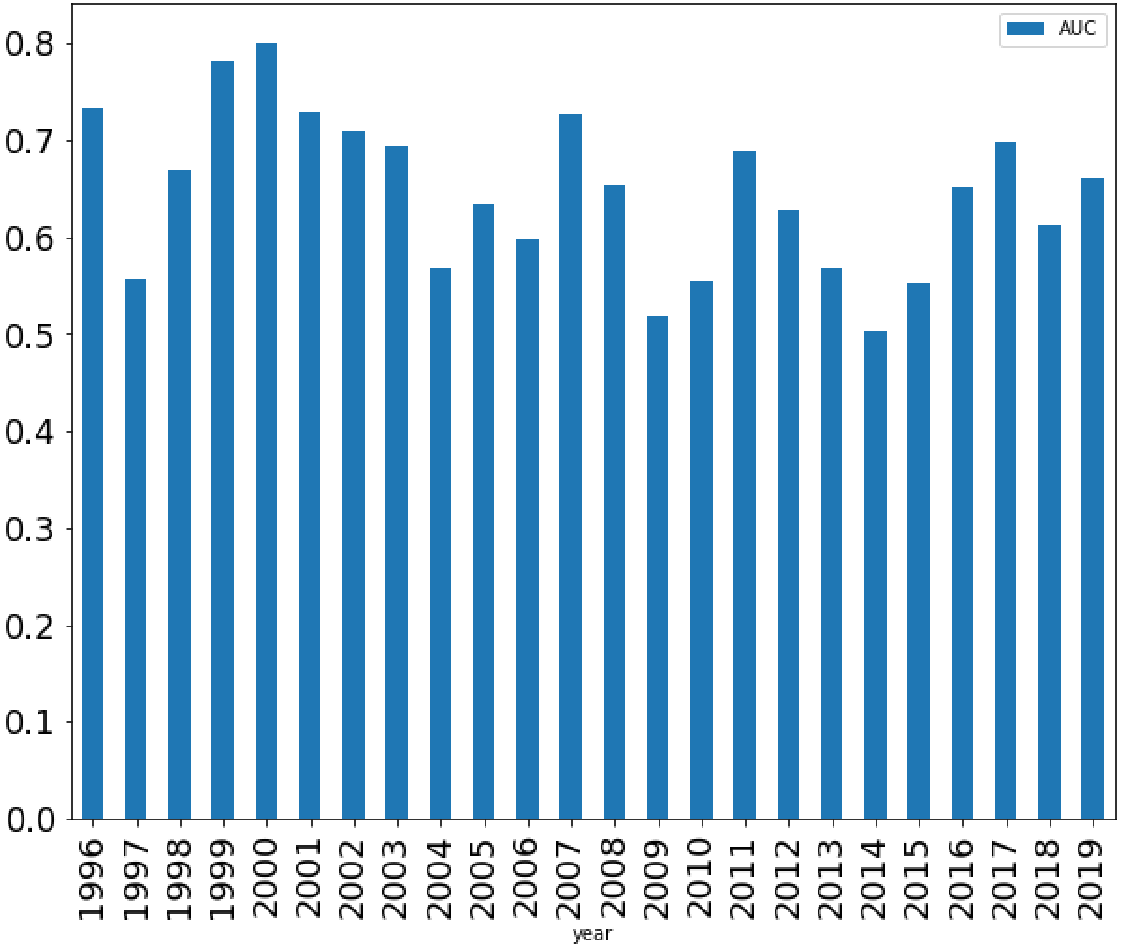
71% 61%

Missed crisis rate = 29%

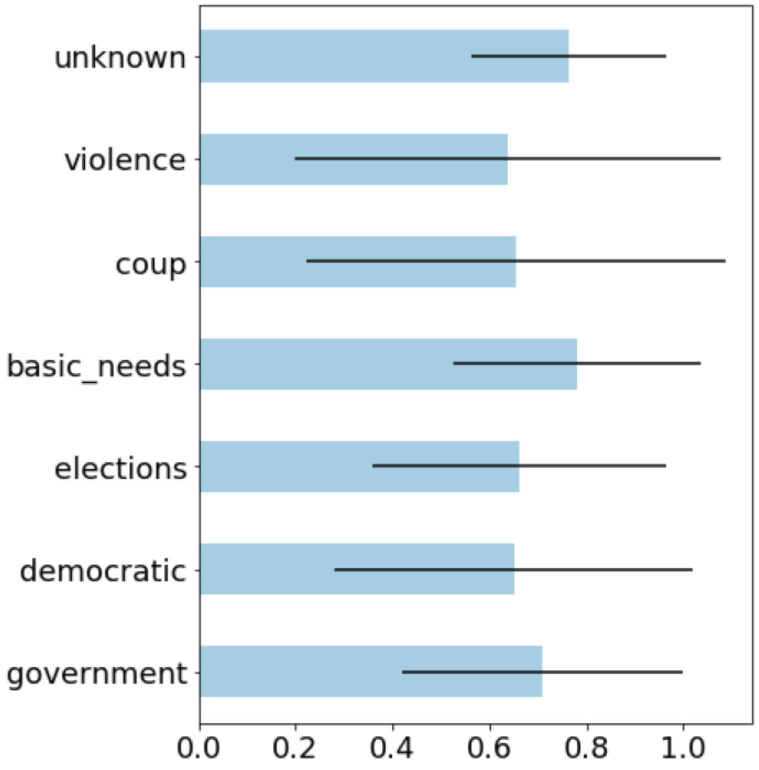
False alarm rate = 39%



RESULTS: OVER TIME & ACROSS TYPE

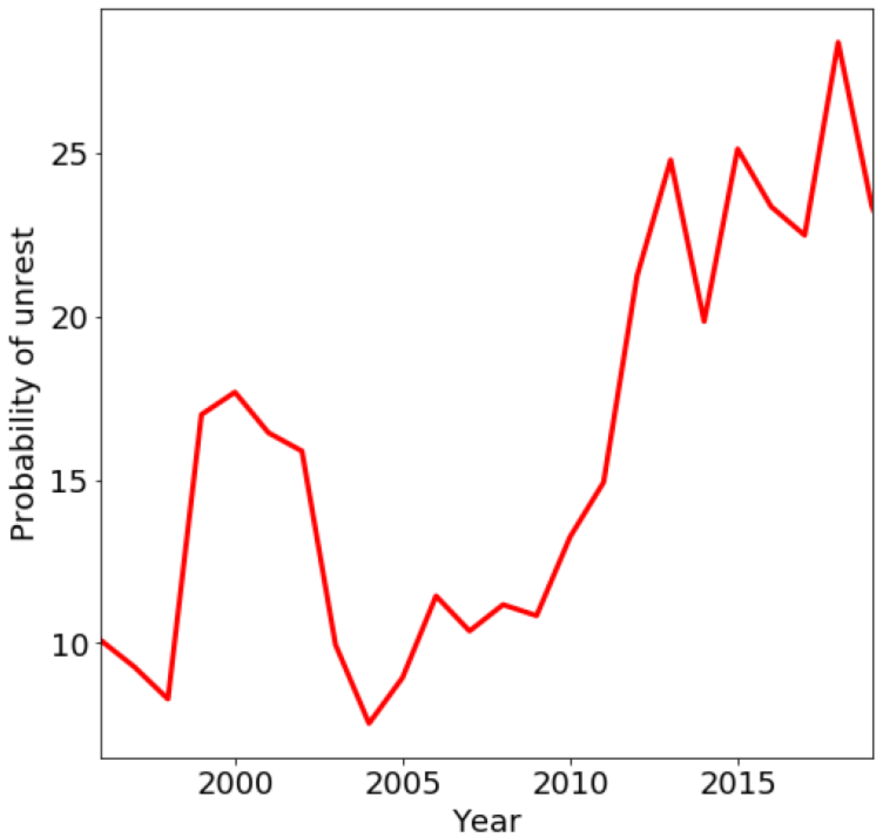


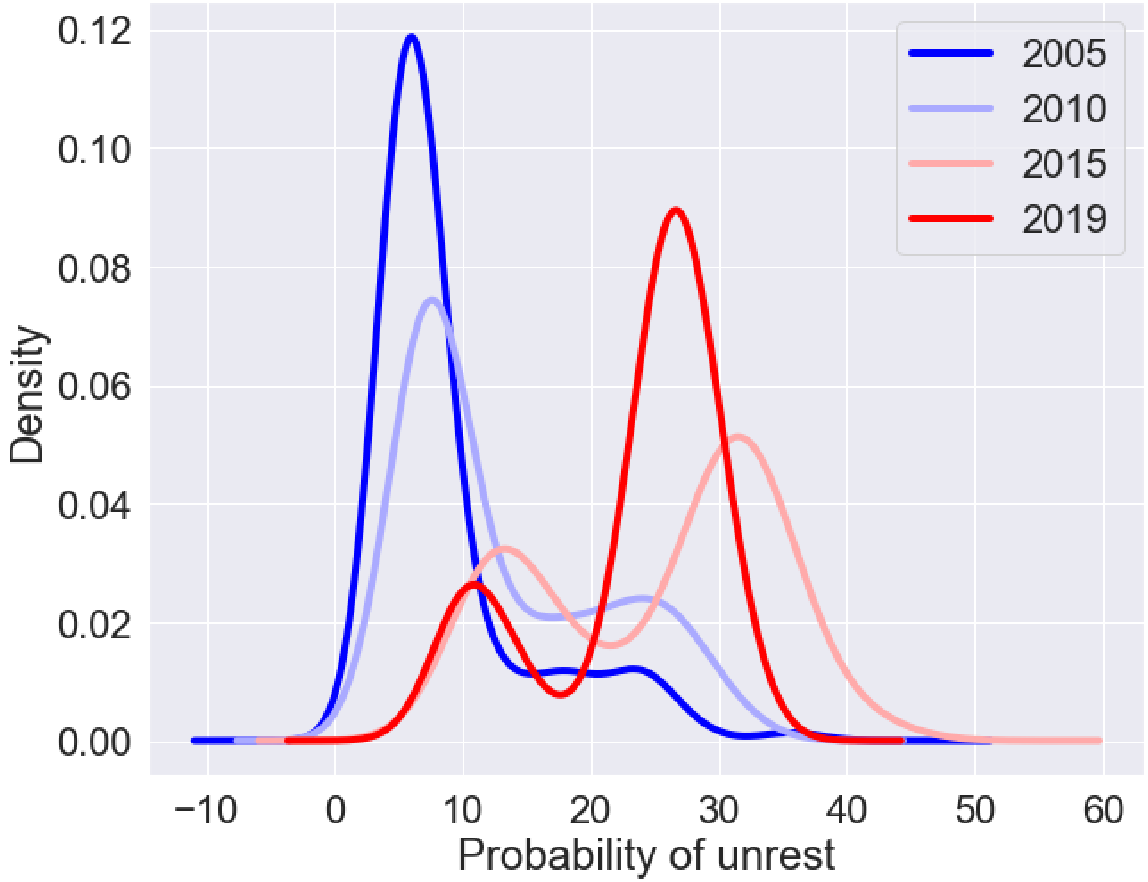
(b) Mean balanced accuracy by type of unrest



PROBABILITIES OF UNREST

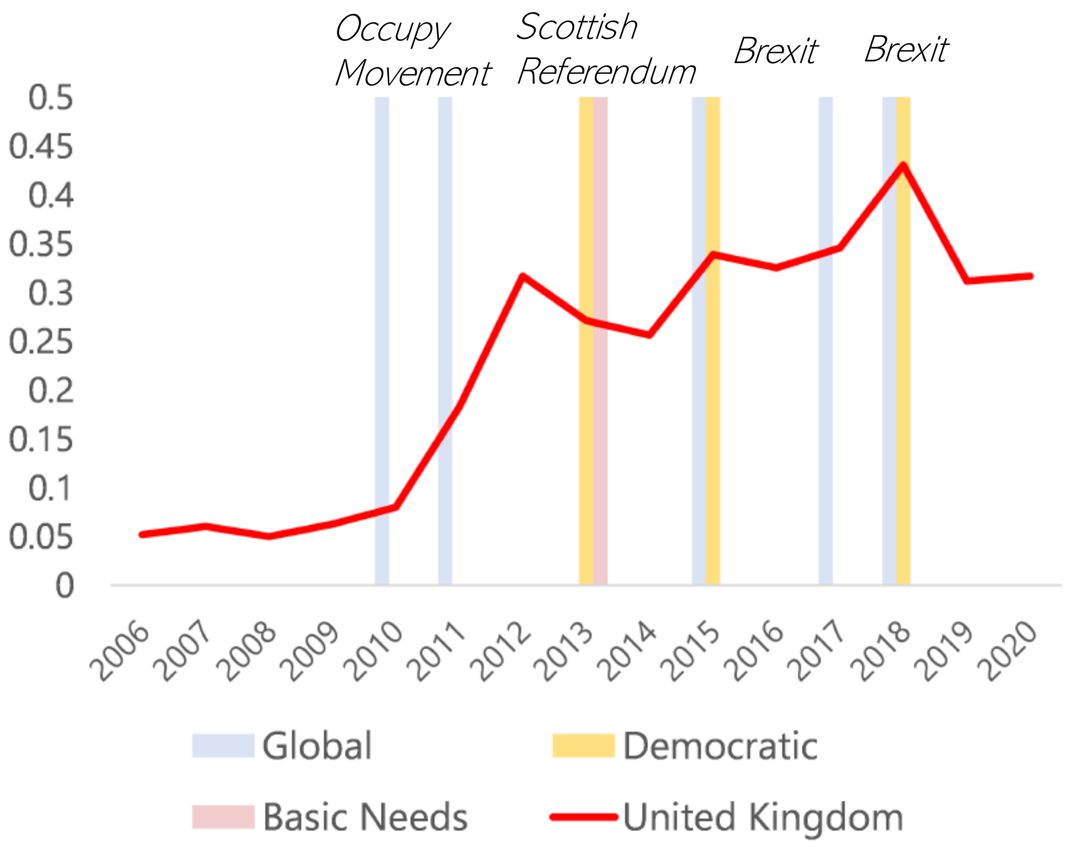
(a) Average probability of unrest



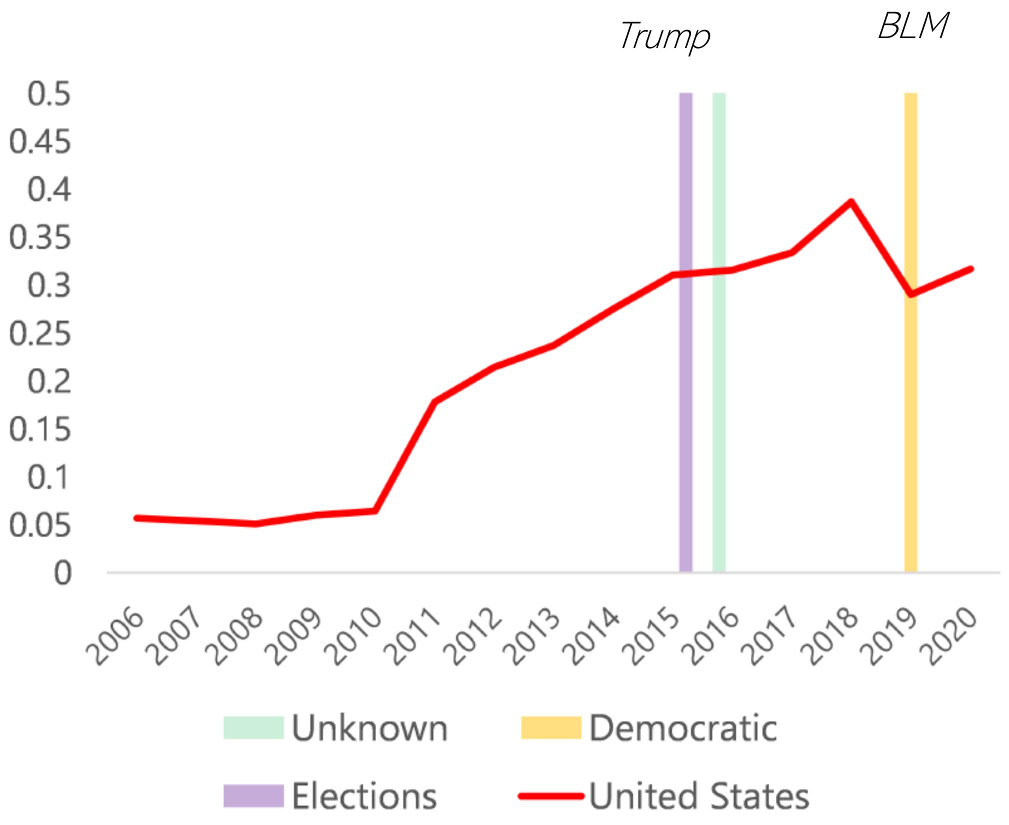


RISK INDEX COUNTRY EXAMPLES

UNITED KINGDOM

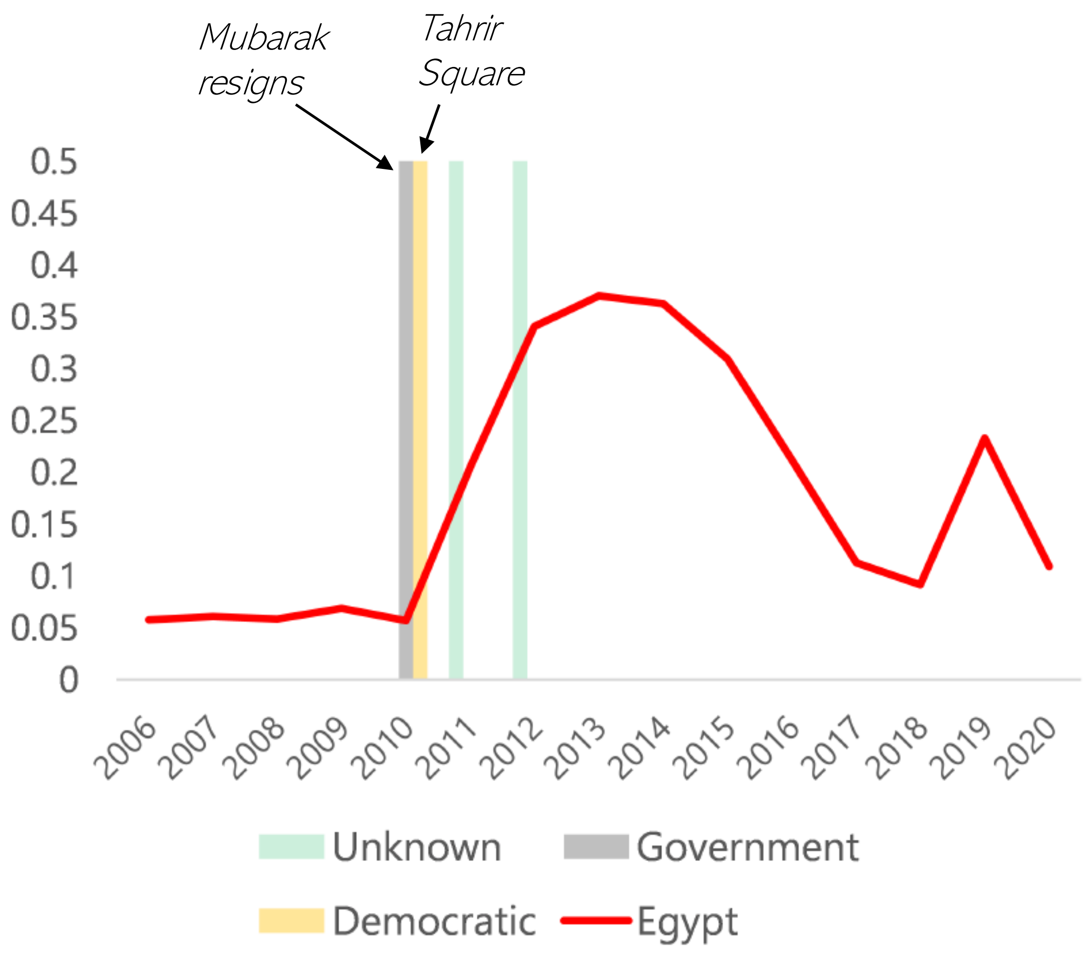


UNITED STATES

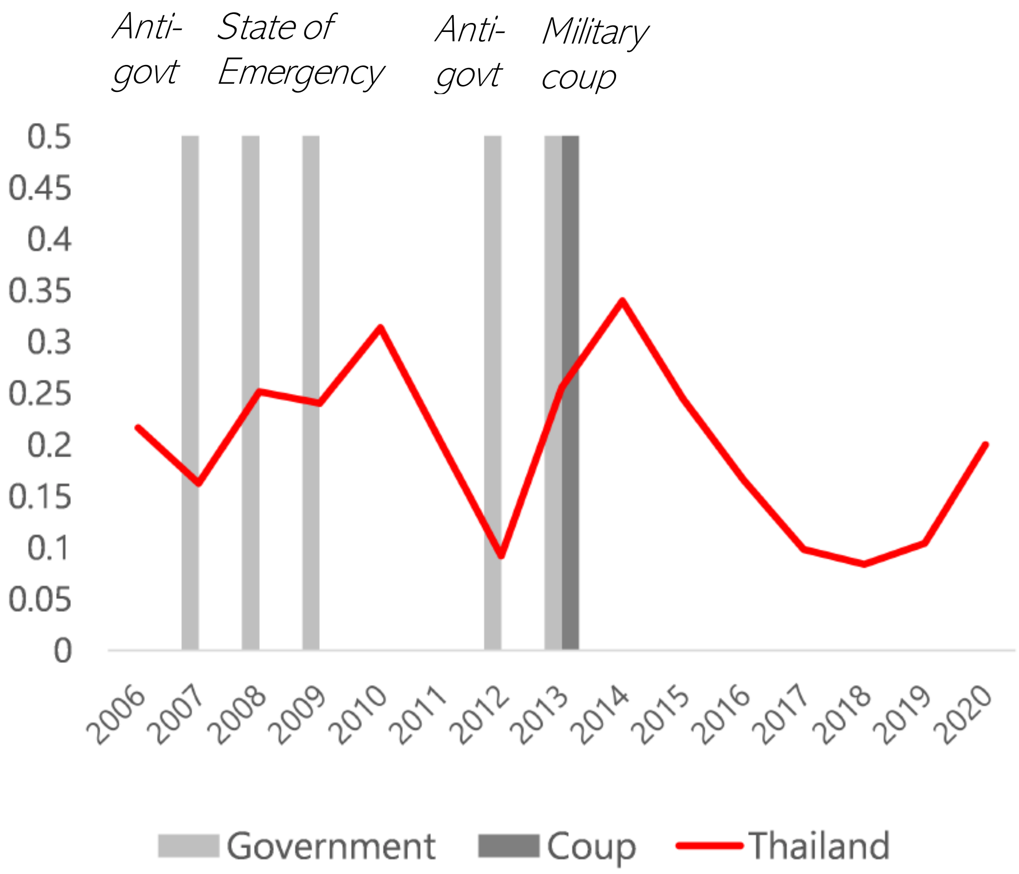


RISK INDEX COUNTRY EXAMPLES

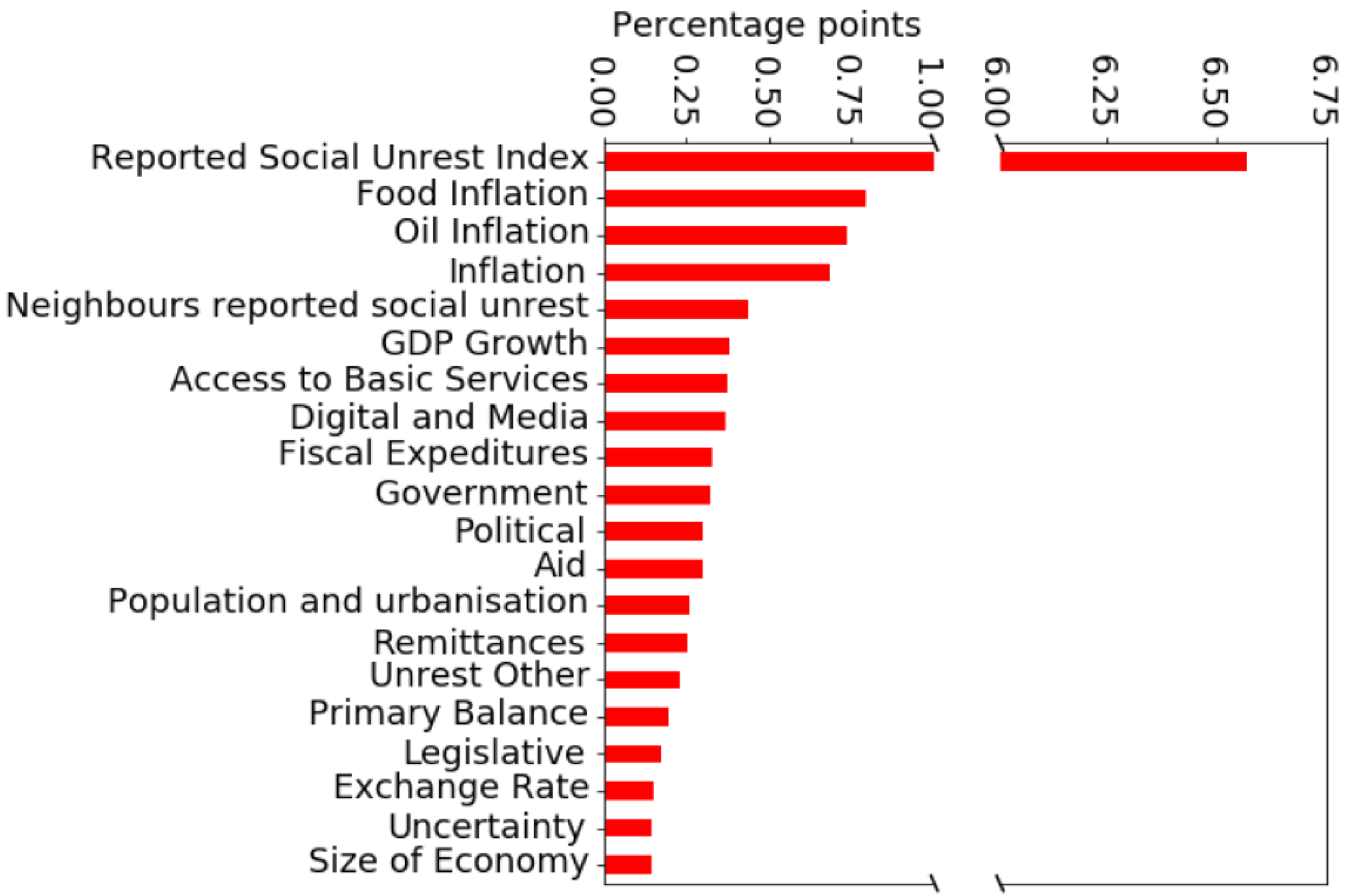
EGYPT



THAILAND

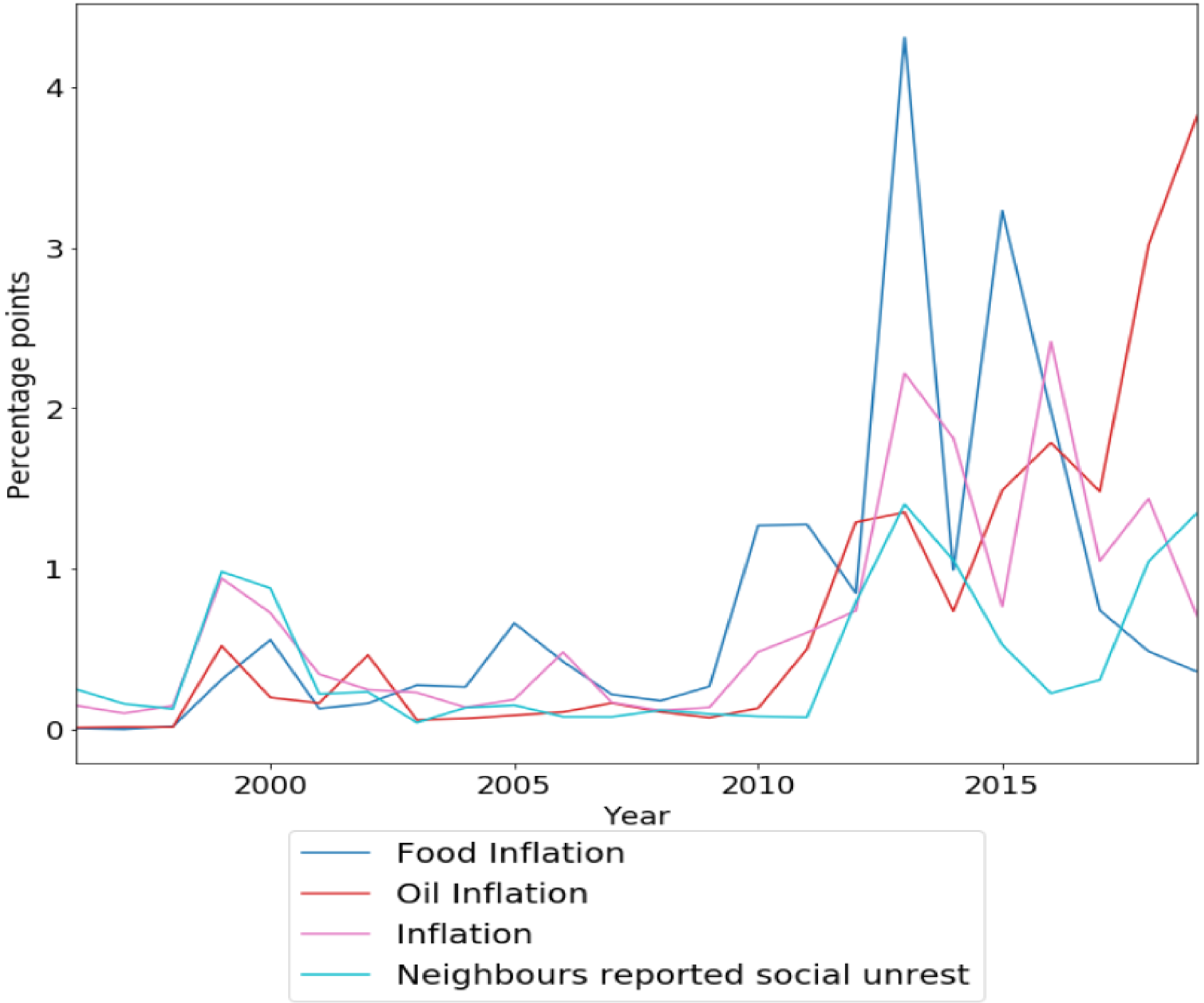


DRIVERS: SHAPLEY VALUES



DRIVERS: SHAPLEY VALUES

(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

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

RESULTS BY UNREST TYPE

(b) Mean balanced accuracy by type of unrest