Digital Networks and the Diffusion of Political Movements: Evidence from Mobile Internet in Africa

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Motivation

- What drives the spread of political movements across space? (Arab Spring, Black Lives Matter)
- Theories of conflict diffusion:
  - flows of goods and people
  - flows of information
- Spillovers typically assessed using spatial proximity
- New technologies facilitate flows independent of physical distance

How does political activism spread via digital networks?

- Exploit rollout of 3G mobile internet across Africa over last decade
  - primary form of accessing internet and social media
  - reduces cost of communication across wide distances, large audiences
  - hard to control by autocracies with limited state capacity
- Estimate "gravity model" in panel of > 1 million grid-cell pairs
- Does 3G facilitate *spread* of protests between cell-pairs?

  $\Rightarrow$ exploit within-pair variation in connections over time to separate spillovers through 3G from direct effect of 3G on protests

Preview of Findings

- Protests $\approx$ *XXpp* (XX%) more likely to spread with 3G
  (if cell-pairs share a language but not otherwise)
- Spillovers independent of physical distance with 3G
  (but decaying with distance without 3G)
- Effects driven by areas with high social media usage
  (but no such difference for non-internet media)

Related Literature

- Diffusion of political activity and networks in conflict

  e.g., Weidmann 2015, Berman et al. 2017, Koenig et al. 2017

- Political and economic effects of communication technology

  e.g., Yanagizawa-Drott 2014, Manacorda and Tesei 2020, Enikolopov et al. 2020, Zhuravskaya et al. 2020

$\Rightarrow$ we study how communication networks facilitate *diffusion*

$\Rightarrow$ identify spillovers independent of geographical neighborhood

$\Rightarrow$ study mobile internet as a new vector of global diffusion

Data

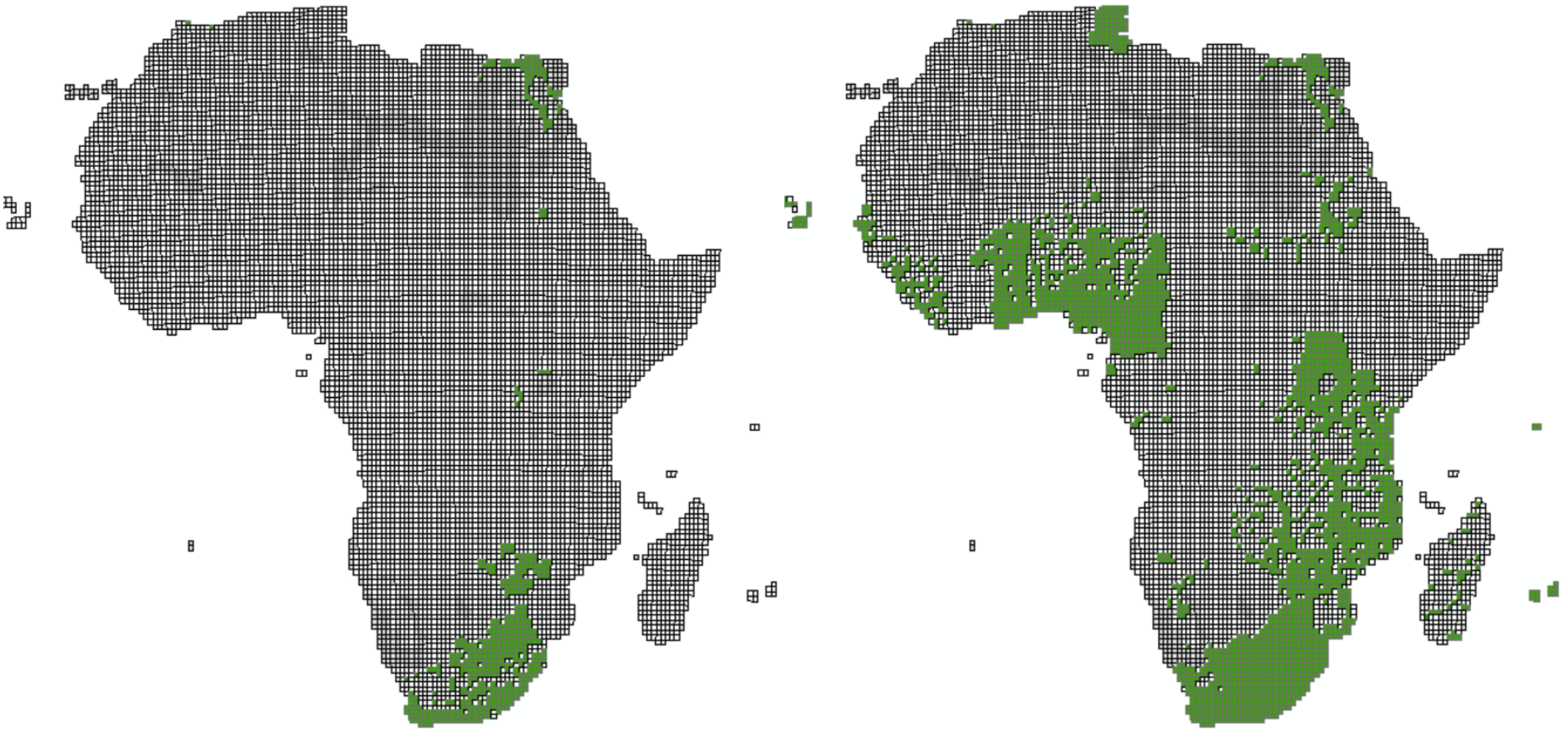
- Aggregate all data to $\approx 55 \times 55$km grid cell – year level, 2011 – 2017
- *3G coverage*: GSMA / CollinsBartholomew
- *Protest incidence:* ACLED
- *Social and other media usage*: Afrobarometer
- *Other characteristics (night lights, weather, population, etc.)*: PRIO

descriptive statistics

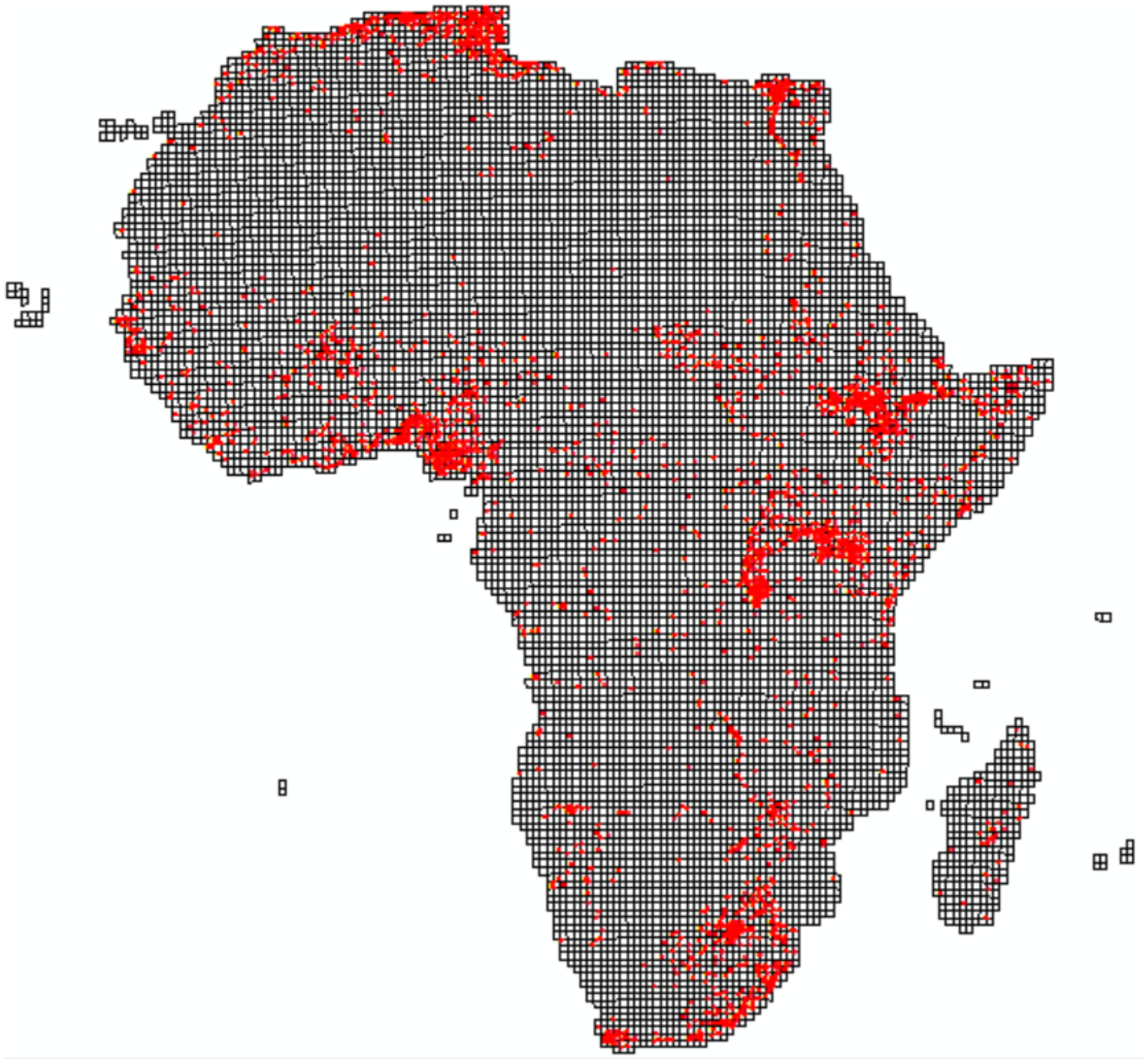
3G coverage has expanded rapidly in the last decade

(a) 3G in 2011

(b) 3G in 2017



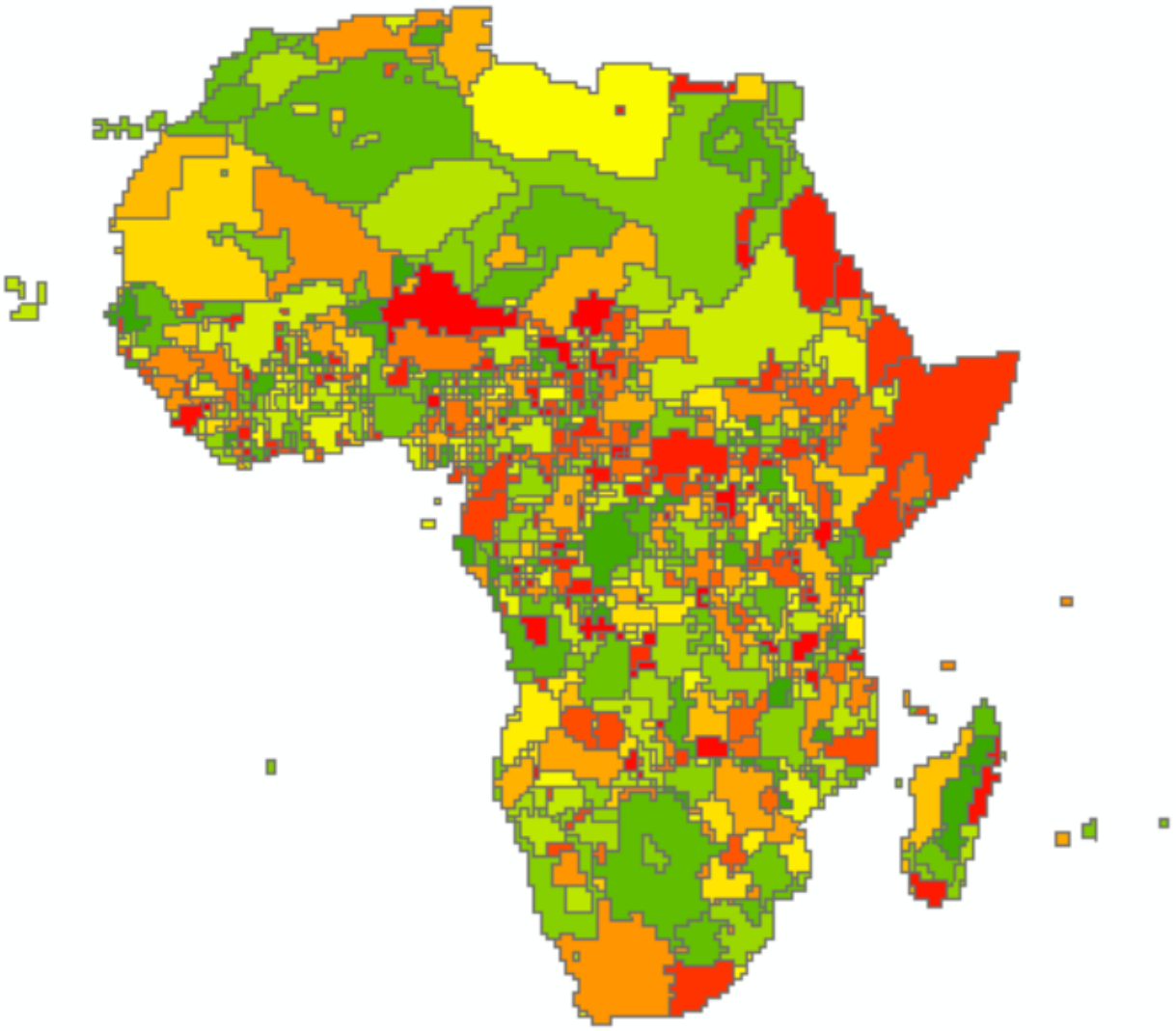
ACLED Protests, 2011 to 2017



Empirical Strategy: Idea

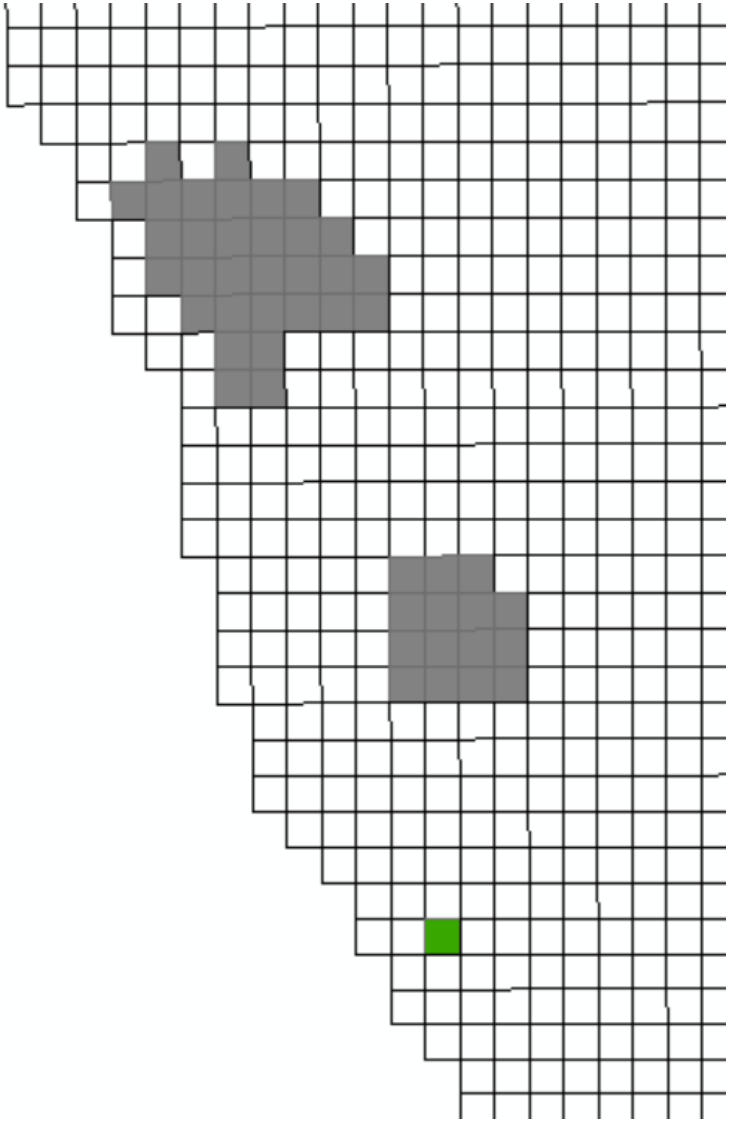
- 3G in cell **i** may affect protests in cell **i**:
  1. directly (e.g., local mobilization)
  2. indirectly by content shared over internet on protest in cell **j** (spillover)
- 1.) requires 3G only in cell **i**, 2.) requires 3G in both cell **i** and **j**
- Intuition to identify spillovers: compare effect of protest in cell **j** on protests in cell **i** when only **i** has 3G vs. when **j** also has 3G
- Pairwise analysis of cells that share same language (Ethnologue)

Language groups at grid cell level

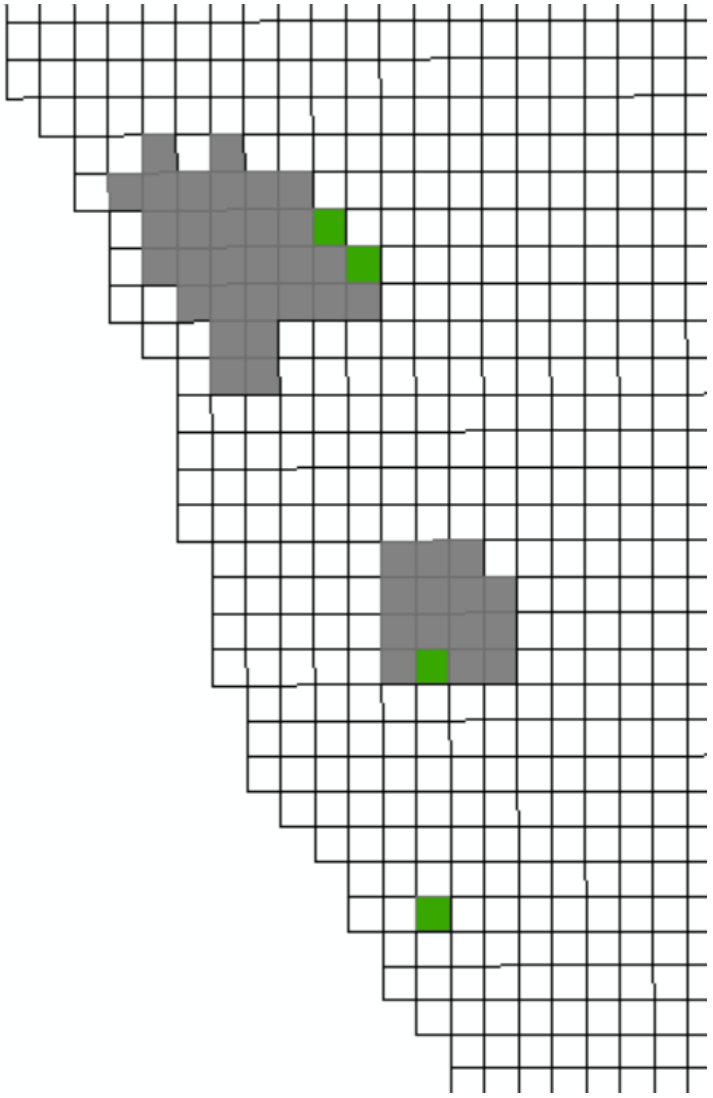


Example: Nama (Khoekhoe)

(a) 3G in 2011



(b) 3G in 2017



Empirical strategy: pairwise regression (baseline)

$$
\begin{aligned}
\text{prot}_{il,t+1} &= \beta_1 \left(3\text{G}_{\text{il,t}} \times 3\text{G}_{\text{jl,t}} \times \text{prot}_{\text{jl,t}}\right) \\
&+ \beta_2 \left(3\text{G}_{il,t} \times 3\text{G}_{jl,t}\right) + \beta_3 \left(3\text{G}_{il,t} \times \text{prot}_{jl,t}\right) + \beta_4 \left(3\text{G}_{jl,t} \times \text{prot}_{jl,t}\right) \\
&+ \beta_5\ 3\text{G}_{il,t} + \beta_6\ 3\text{G}_{jl,t} + \beta_7\ \text{prot}_{jl,t} \\
&+ \alpha_{ij}\ + \delta_t\ + \epsilon_{ijt}
\end{aligned}
$$

where

$$
\begin{aligned}
\text{prot}_{il,t} &= \text{protest in cell i of language group l in year t} \\
3\text{G}_{il,t} &= \text{indicator whether cell i of language group l has 3G in year t} \\
\alpha_{ij} &= \text{cell-pair fixed effects} \\
\delta_t &= \text{year fixed effects} \\
\epsilon_{ijt} &= \text{standard errors clustered at the cell (and paired cell) level}
\end{aligned}
$$

Baseline Interpretation

$$\begin{aligned} \text{spillover}_{ijl,t+1} &= \frac{\partial \text{prot}_{il,t+1}}{\partial \text{prot}_{jl,t}} \\ &= \beta_1 \left(3\text{G}_{\text{il,t}} \times 3\text{G}_{\text{jl,t}}\right) + \beta_3\ 3\text{G}_{il,t} + \beta_4\ 3\text{G}_{jl,t} + \beta_7 \end{aligned}$$

$$\begin{aligned} \Rightarrow \beta_1 &= [(\beta_1 + \beta_3 + \beta_4 + \beta_7) - (\beta_3 + \beta_7)] - [(\beta_4 + \beta_7) - (\beta_7)] \\ &= \text{effect on spillover of 3G in j when i already has 3G} \\ &- \text{effect on spillover of 3G in j when i has no 3G} \end{aligned}$$

Baseline Results

	Dependent Variable at t+1:	
	(1)	(2)
	Baseline: protest in cell i (dummy)	Log (0.01 + number of protests in cell i)
Mean of dependent variable	*0.2255*	*0.4583*
(SD)	*(0.4179)*	*(2.3076)*
3G in cell i x 3G in cell j x protest in cell j, t	**0.0340*** **	**0.0487*** **
	(0.00797)	(0.00855)
Cell-pair FE	YES	YES
Year FE	YES	YES
Lower-level interactions and uninteracted variables	YES	YES
Number of Observations	8,654,548	8,654,548
Number of Clusters	9510	9510

Robust standard errors clustered at the cell-level reported in parentheses. Cell-pairs belong to the same language group.

differences written out | all coefficients | with protest at t | with controls | other SEs | other outcomes

Conceptual Framework

- Information flows facilite spread of political movements
  - strategic complementarities
  - demonstration effect and learning
- Function of:
  - $+$ shared interest in issue (e.g., shared identity, distance)
  - $-$ cost of communication (technology, common language, distance)
- Introduction of 3G reduces cost of communication between places (irrespective of physical distance)

Testable predictions

- 3G facilitates spread of political activity, all else equal
- Spillovers may decrease with distance, but less so with 3G
- 3G has larger effect on spillovers when pair shares language
- 3G has larger effect on spillovers when shared interest is more salient

Spillovers decay with physical distance between cell-pairs without 3G, but persist with 3G

protest spillover (marginal effect of protest in cell j at t on protest in cell i at t+1)	**close pairs only** (< ~200km)	**far pairs only** (> ~200km)	*difference*
3G in neither cell	0.0500*** (0.0058)	0.0125*** (0.0017)	***0.0375**** ***(0.0049)***
3G in both cells	0.0507*** (0.0078)	0.0439*** (0.0068)	***0.0068*** ***(0.0057)***

detailed coefficients for different distances

Effects even for cell-pairs in different countries (but same language)

	Dependent Variable: Cell i had Protest, t+1			
	(1)	(2)	(3)	(4)
	Baseline	Far away cells only	Cell pairs in different countries only	Non-neighboring cell pairs, different countries only
Mean of dependent variable	*0.226*	*0.160*	*0.121*	*0.109*
(SD)	*(0.418)*	*(0.366)*	*(0.326)*	*(0.311)*
3G in cell i x 3G in cell j x protest in cell j, t	**0.0340*** **	**0.0210*** **	**0.0272***	**0.0257***
	(0.00797)	(0.00756)	(0.0154)	(0.0136)
Cell-pair FE	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Number of Observations	8,654,548	6,515,502	1,234,128	1,163,834
Number of Clusters	9510	6851	5495	5104

Robust standard errors clustered at the cell-level reported in parentheses. Cell-pairs belong to the same language group. Far away paired cells are at least 6 cells away (around 330km at the equator).

detailed coefficients for different distances

No interaction effect for cell-pairs with different languages

	Dependent Variable: Cell i had Protest, t+1	
	(1)	(2)
	Cell-pair shares language	**Cell-pair doesn't share language**
Mean of dependent variable	*0.269*	*0.224*
(SD)	*(0.443)*	*(0.417)*
3G in cell i x 3G in cell j x protest in cell j, t	**0.0470*** **	**-0.0121**
	(0.0149)	(0.00755)
Cell-pair FE	YES	YES
Year FE	YES	YES
Lower-level interactions and uninteracted variables	YES	YES
Number of Observations	1,608,404	3,182,606
Number of Clusters	7920	9287

Robust standard errors clustered at the cell-level reported in parentheses.

Note: Only cell-pairs included with $\approx$ 200 $-$ 400km distance between them to keep estimation tractable.

Effect of 3G on spillovers is larger when shared identity is more salient (very suggestive only)

	Dependent Variable: Cell i had Protest, t+1		
	(1)	(2)	(3)
	Baseline (Afrobarometer 2014 sample)	High salience of ethnic identity (>p75)	Low salience of ethnic identity (<p25)
Mean of dependent variable	*0.398*	*0.287*	*0.285*
(SD)	*(0.489)*	*(0.452)*	*(0.452)*
3G in cell i x 3G in cell j x protest in cell j, t	**0.0448****	**0.0983*****	**0.0109**
	(0.0176)	(0.0366)	(0.0508)
Cell-pair FE	YES	YES	YES
Year FE	YES	YES	YES
Lower-level interactions and uninteracted variables	YES	YES	YES
Number of Observations	678,153	145,208	151,634
Number of Clusters	1766	292	448

Robust standard errors clustered at the cell-level reported in parentheses. Cell-pairs belong to the same language group.

Large differences by social (but not mass) media usage

	Dependent Variable: Cell i had Protest, t+1				
	(1)	(2)	(3)	(4)	(5)
	Baseline (Afrobarometer 2014 sample)	High social media usage (>p75)	Low social media usage (<p25)	High radio usage (>p75)	Low radio usage (<p25)
Mean of dependent variable	*0.398*	*0.428*	*0.218*	*0.359*	*0.501*
(SD)	*(0.489)*	*(0.495)*	*(0.413)*	*(0.480)*	*(0.500)*
3G in cell i x 3G in cell j x protest in cell j, t	**0.0448****	**0.109*****	**-0.0126**	**0.0749*****	**0.0967*****
	(0.0176)	(0.0313)	(0.0425)	(0.0280)	(0.0355)
Cell-pair FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Lower-level interactions and uninteracted variables	YES	YES	YES	YES	YES
Number of Observations	678,153	169,687	169,547	235,445	203,161
Number of Clusters	1766	271	573	689	451

Robust standard errors clustered at the cell-level reported in parentheses. Cell-pairs belong to the same language group.

Identification and robustness

- Threat to identification: time- and pair-variant unobservables, correlated with *interaction* of 3G in both cells *and* spillovers
  - results robust to including controls (e.g., economic shocks, population) table
- Reporting bias
  - no effect on other outcomes from same data sources other outcomes
  - in progress: robustness using alternative data sources
- Inference needs more work
  - here: clustering SEs at different levels table
  - in progress: alternative test statistics taking into account auto-correlation over space (Conley 2008, Kelly 2020) / pairs (Tabord-Meehan 2019)

Next Steps

- Formalize gravity model
- Social media channel: analyze Facebook data
- Role of ethnic group identity:
  - ethnic kin data from GrowUp
  - effect for cells that share ethnic identity vs. not

Thank you!

Descriptive statistics

Variable	*N*	*Mean*	*Std. Dev.*	*Min*	*Max*	*Source*
Cell level						
3G	9,510	0.139	0.345	0	1	GSMA
Any protest	9,510	0.065	0.246	0	1	ACLED
Number of protests	9,510	0.341	4.374	0	629	ACLED
Fraction getting news from social media	1,766	0.208	0.227	0	1	Afrobarometer
Fraction getting news from radio	1,766	0.764	0.196	0	1	Afrobarometer
Fraction feeling closer to nation than ethnic group	1,643	0.711	0.146	0.1875	1	Afrobarometer
Cell-pair level						
Both cells have 3G	1,236,364	0.048	0.213	0	1	GSMA

back to data

Baseline differences written out

protest spillover (marginal effect of protest in cell j at t on protest in cell i at t+1)	**3G in cell j**	**No 3G in cell j**	*difference*
3G in cell i	0.0464***	0.0227***	*0.0237****
	(0.0067)	(0.0060)	*(0.0082)*
No 3G in cell i	0.0071***	0.0174***	*-0.0103****
	(0.0016)	(0.0021)	*(0.0025)*
	*0.0393****	*0.0053*	*0.0340****
	(0.0065)	*(0.0064)*	*(0.0080)*

back to main results

Baseline with all coefficients

	Dependent Variable at t+1:	
	(1)	(2)
	Baseline: protest in cell i (dummy)	Log (0.01 + number of protests in cell i)
Mean of dependent variable	*0.2255*	*0.4583*
(SD)	*(0.4179)*	*(2.3076)*
3G in cell i x 3G in cell j x protest in cell j, t	**0.0340*** **	**0.0487*** **
	(0.00797)	(0.00855)
3G in cell i x protest in cell j, t	0.00527	0.00662
	(0.00640)	(0.00691)
3G in cell j x protest in cell j, t	-0.0103***	-0.00902***
	(0.00249)	(0.00307)
3G in cell i x 3G in cell j, t	-0.0342***	0.0420
	(0.00861)	(0.0561)
3G in cell i, t	0.0314***	0.200***
	(0.0101)	(0.0595)
3G in cell j, t	0.0108***	0.0202
	(0.00320)	(0.0238)
Protest in cell j, t	0.0174***	0.0224***
	(0.00205)	(0.00252)
Cell-pair FE	YES	YES
Year FE	YES	YES
Number of Observations	8,654,548	8,654,548
Number of Clusters	9510	9510

Robust standard errors clustered at the cell-level reported in parentheses. Cell-pairs belong to the same language group.

back to main results

Baseline controlling for cell protest and interactions at t

	Dependent Variable: Cell i had Protest, t+1	
	(1)	(2)
	Baseline	Additional controls
Mean of dependent variable	*0.2255*	*0.2255*
(SD)	*(0.4179)*	*(0.4179)*
3G in cell i x 3G in cell j x protest in cell j, t	**0.0340*** **	**0.0326*** **
	(0.00797)	(0.00812)
3G in cell i x 3G in cell j x protest in cell i, t		0.119**
		(0.0472)
3G in cell i x protest in cell i, t		-0.0711**
		(0.0361)
3G in cell i x protest in cell j, t	0.00527	0.00899
	(0.00640)	(0.00665)
3G in cell j x protest in cell i, t		-0.0559
		(0.0402)
3G in cell j x protest in cell j, t	-0.0103***	-0.0106***
	(0.00249)	(0.00250)
3G in cell i x 3G in cell j, t	-0.0342***	-0.0462***
	(0.00861)	(0.00928)
3G in cell i, t	0.0314***	0.0419***
	(0.0101)	(0.0107)
3G in cell j, t	0.0108***	0.0131***
	(0.00320)	(0.00344)
Protest in cell i, t		-0.0457**
		(0.0198)
Protest in cell j, t	0.0174***	0.0187***
	(0.00205)	(0.00209)
Cell-pair FE	YES	YES
Year FE	YES	YES
Number of Observations	8,654,548	8,654,548
Number of Clusters	9510	9510

Robust standard errors clustered at the cell-level reported in parentheses. Cell-pairs belong to the same language group.

back to main results

Baseline for other conflict outcomes

	Dependent Variable in cell i at t+1:				
	(1)	(2)	(3)	(4)	(5)
	Protest (baseline)	Riot	Battle	Violence against civilians	Explosion
Mean of dependent variable	*0.226*	*0.216*	*0.155*	*0.170*	*0.0836*
(SD)	*(0.418)*	*(0.411)*	*(0.362)*	*(0.376)*	*(0.277)*
3G in cell i x 3G in cell j x protest in cell j, t	**0.0340*** **	**0.0044**	**0.0131**	**-0.0013**	**0.0179**
	(0.00797)	(0.00747)	(0.01052)	(0.00958)	(0.01231)
Cell-pair FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Lower-level interactions and uninteracted variables	YES	YES	YES	YES	YES
Number of Observations	8,654,548	8,654,548	8,654,548	8,654,548	8,654,548
Number of Clusters	9510	9510	9510	9510	9510

Robust standard errors clustered at the cell-level reported in parentheses. Cell-pairs belong to the same language group.

back to main results back to robustness

Robustness: adding controls

	Dependent Variable: Cell i had Protest, t+1					
	(1)	(2)	(3)	(4)	(5)	(6)
	Baseline	controlling for log night lights and interactions	controlling for temperature shocks and interactions	controlling for rainfall shocks and interactions	controlling for population density and interactions	all controls and interactions
Mean of dependent variable	*0.225*	*0.225*	*0.216*	*0.216*	*0.225*	*0.216*
(SD)	*(0.418)*	*(0.418)*	*(0.411)*	*(0.411)*	*(0.418)*	*(0.411)*
3G in cell i x 3G in cell j x protest in cell j, t	**0.0340*** **	**0.0351*** **	**0.0280*** **	**0.0336*** **	**0.0335*** **	**0.0319*** **
	(0.00797)	(0.00787)	(0.00778)	(0.00783)	(0.00799)	(0.00780)
Cell-pair FE	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Lower-level interactions and uninteracted variables	YES	YES	YES	YES	YES	YES
Number of Observations	8,654,548	8,654,548	8,170,260	8,170,260	8,639,596	8,161,916
Number of Clusters	9510	9510	9098	9098	9488	9078

Robust standard errors clustered at the cell-level reported in parentheses. Cell-pairs belong to the same language group.

back to main results back to robustness

Robustness: different clustering

	Dependent Variable: Cell i had Protest, t+1				
	(1)	(2)	(3)	(4)	(5)
	Baseline	Two-way clustering over cell i and cell j level	Two-way clustering over cell i and year level	Three-way clustering over cell i and cell j and year level	Clustering at cell-pair level
Mean of dependent variable	*0.2255*	*0.2255*	*0.2255*	*0.2255*	*0.2255*
(SD)	*(0.4179)*	*(0.4179)*	*(0.4179)*	*(0.4179)*	*(0.4179)*
3G in cell i x 3G in cell j x protest in cell j, t	**0.0340*** **	**0.0340*** **	**0.0340***	**0.0340***	**0.0340*** **
	(0.00797)	(0.0111)	(0.0153)	(0.0160)	(0.00465)
Cell-pair FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Lower-level interactions and uninteracted variables	YES	YES	YES	YES	YES
Number of Observations	8,654,548	8,654,548	8,654,548	8,654,548	8,654,548
Number of Clusters	9510	9510	9510	9510	617

Robust standard errors reported in parentheses. Cell-pairs belong to the same language group.

back to main results back to robustness

Results by spatial proximity of cell-pairs

	Dependent Variable: Cell i had Protest, t+1				
	(1)	(2)	(3)	(4)	(5)
	Baseline	Non-neighboring cells only	Far away cells only	Cell pairs in different countries only	Non-neighboring cell pairs, different countries only
Mean of dependent variable	*0.226*	*0.194*	*0.160*	*0.121*	*0.109*
(SD)	*(0.418)*	*(0.396)*	*(0.366)*	*(0.326)*	*(0.311)*
3G in cell i x 3G in cell j x protest in cell j, t	**0.0340*** **	**0.0317*** **	**0.0210*** **	**0.0272***	**0.0257***
	(0.00797)	(0.00791)	(0.00756)	(0.0154)	(0.0136)
3G in cell i x protest in cell j, t	0.00527	0.00746	0.00732	0.0100	0.0110
	(0.00640)	(0.00629)	(0.00654)	(0.00994)	(0.00924)
3G in cell j x protest in cell j, t	-0.0103***	-0.00798***	-0.00695***	-0.00759***	-0.00805***
	(0.00249)	(0.00221)	(0.00197)	(0.00269)	(0.00261)
3G in cell i x 3G in cell j, t	-0.0342***	-0.0382***	-0.0415***	-0.0163	-0.0173
	(0.00861)	(0.00956)	(0.0109)	(0.0130)	(0.0139)
3G in cell i, t	0.0314***	0.0321***	0.0323***	0.000497	-0.00132
	(0.0101)	(0.0111)	(0.0123)	(0.00802)	(0.00830)
3G in cell j, t	0.0108***	0.0101***	0.00948**	-0.00718	-0.00768
	(0.00320)	(0.00359)	(0.00405)	(0.00639)	(0.00664)
Protest in cell j, t	0.0174***	0.0128***	0.0101***	0.00583***	0.00572***
	(0.00205)	(0.00170)	(0.00144)	(0.00200)	(0.00200)
Cell-pair FE	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
Number of Observations	8,654,548	7,655,018	6,515,502	1,234,128	1,163,834
Number of Clusters	9510	7994	6851	5495	5104

Robust standard errors clustered at the cell-level reported in parentheses. Cell-pairs belong to the same language group. Far away paired cells are at least 6 cells away (around 330km at the equator).

back