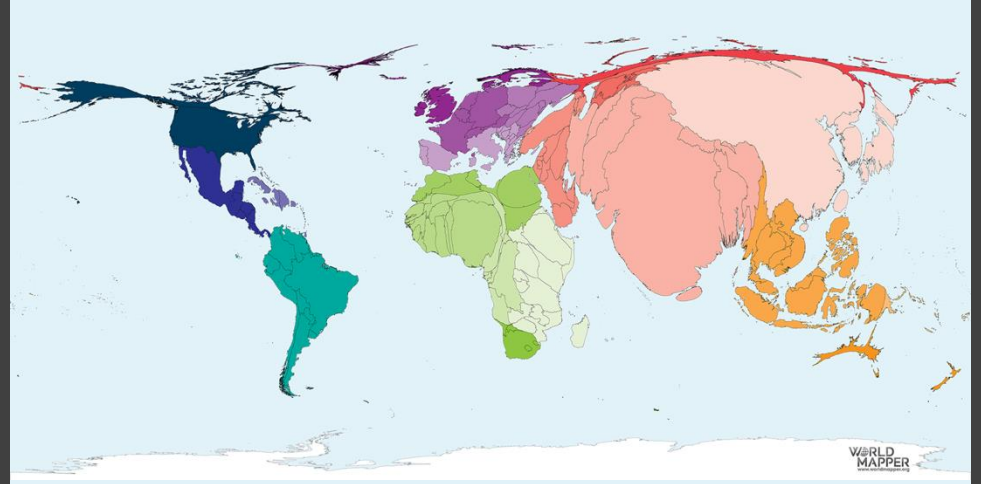
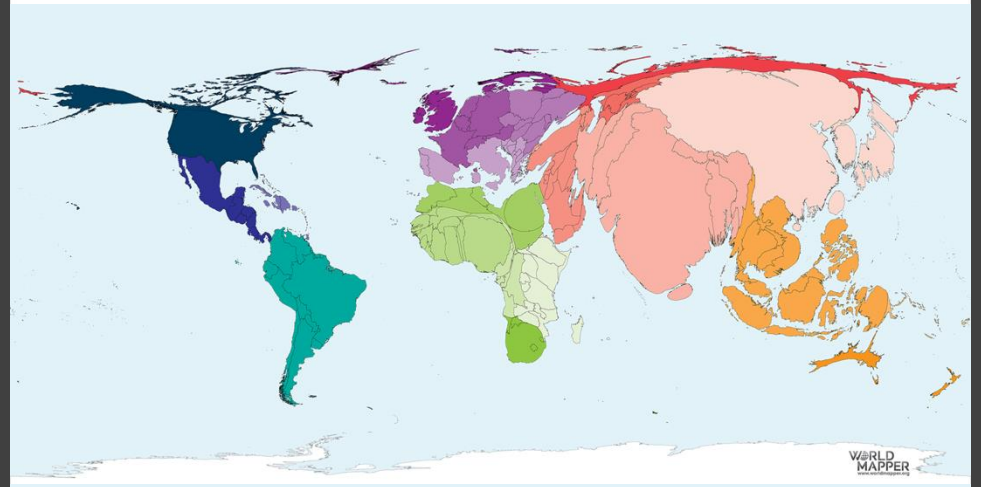
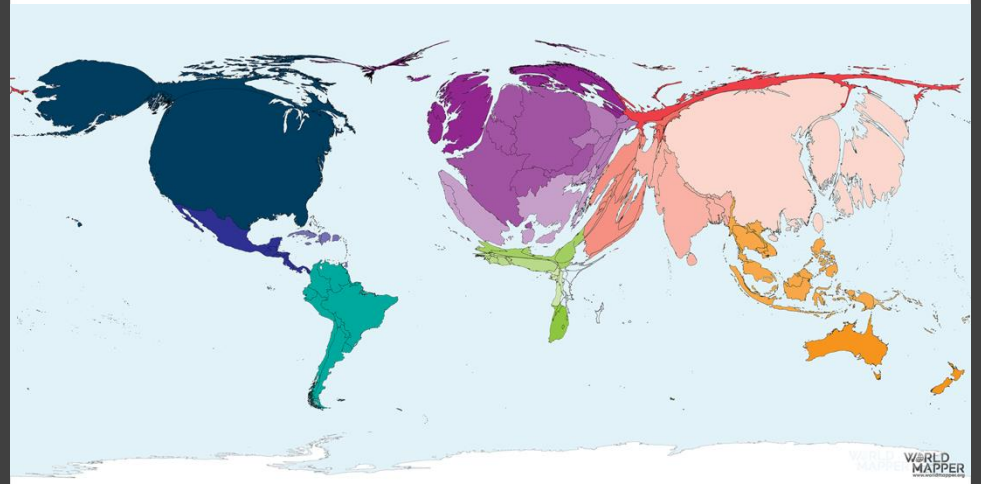






Digitization in Developing Societies

Daniel Björkegren

Brown University

Guess: in these maps, what are countries scaled by?

Why Software Is Eating the World

by Marc Andreessen

“Six decades into the computer revolution, four decades since the invention of the microprocessor, and two decades into the rise of the modern Internet, all of the technology required to transform industries through software finally works and can be widely delivered at global scale.”

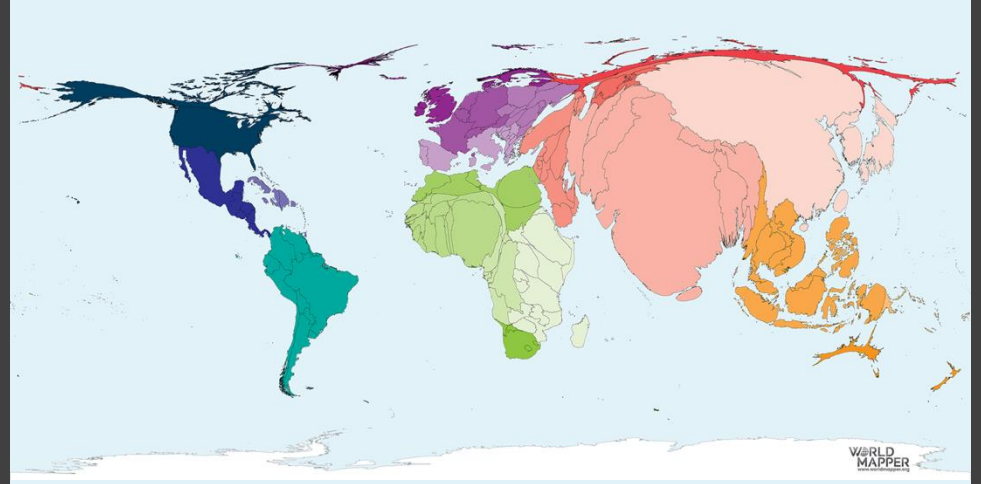
2011

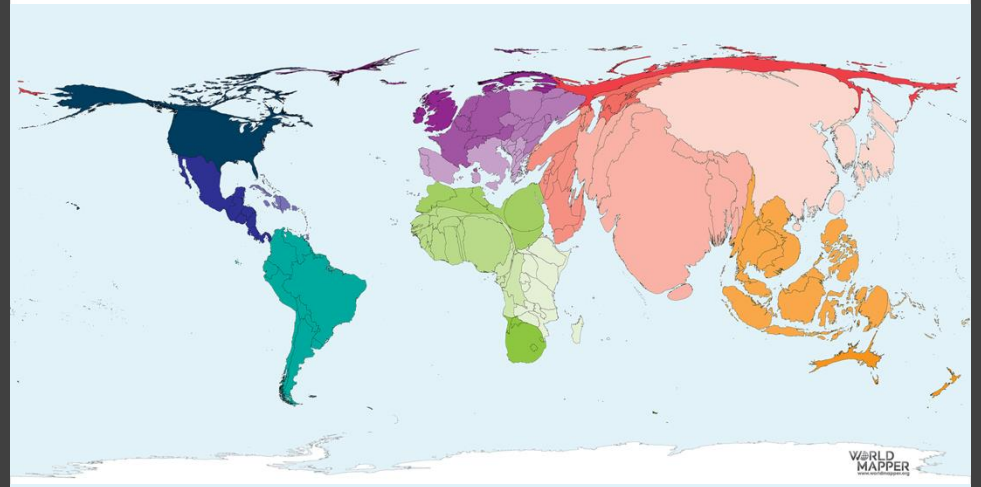
Transformations in wealthy societies

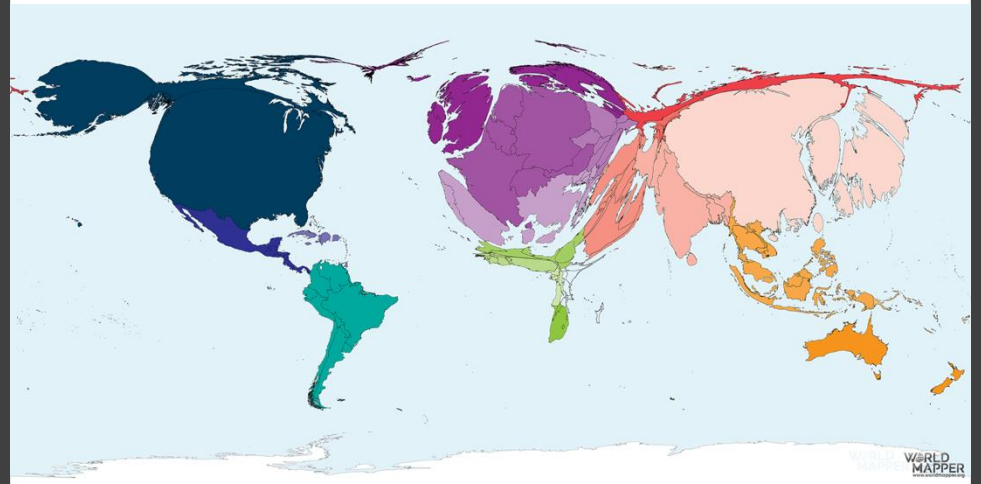
- Reshape entertainment: Tiktok/Insta/YouTube vs TV/film studios
- Reshape news: Twitter/Facebook/WhatsApp vs NYT/CNN
- Reshape lodging, urban space: Airbnb vs Marriott
- Reshape products: targeted, direct to consumer brands vs Sears/Walmart

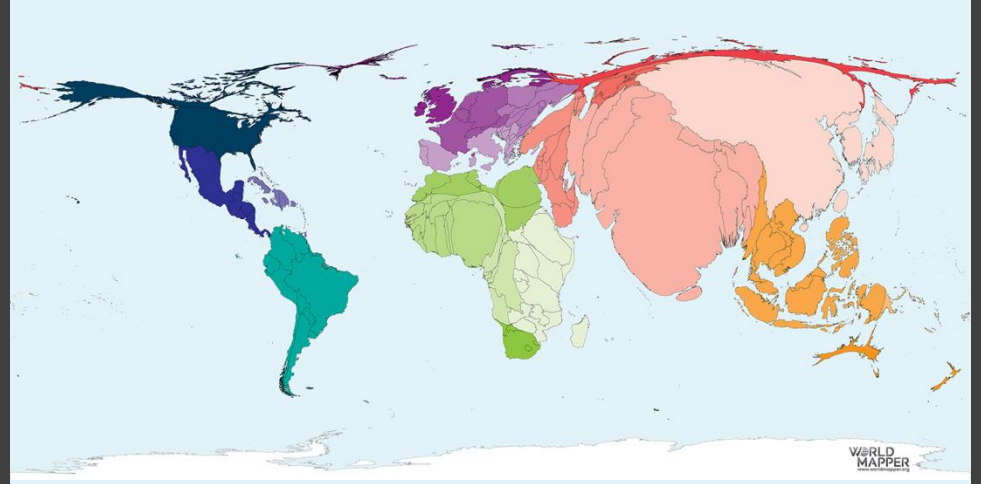
Is this the end, middle,… or beginning?

- Other sectors
- Regulation/customs

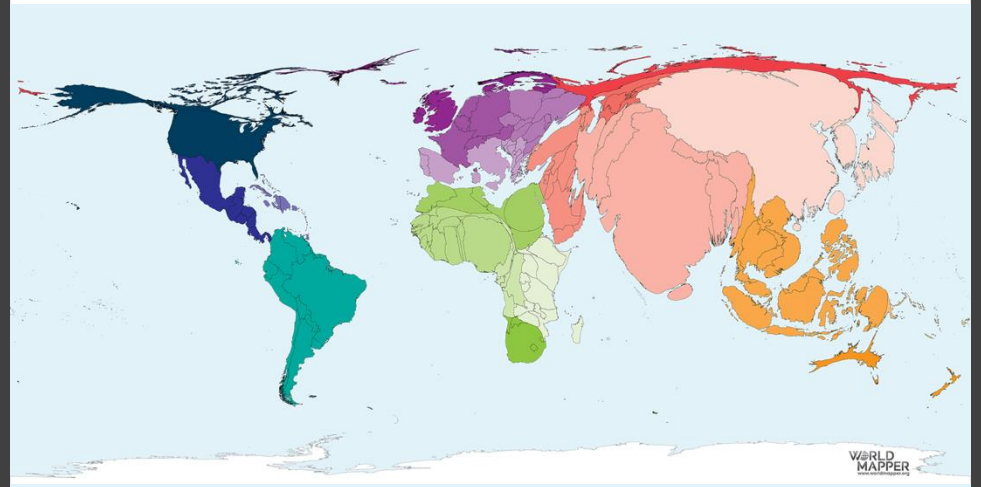

WORLD MAPPER


WORLD MAPPER

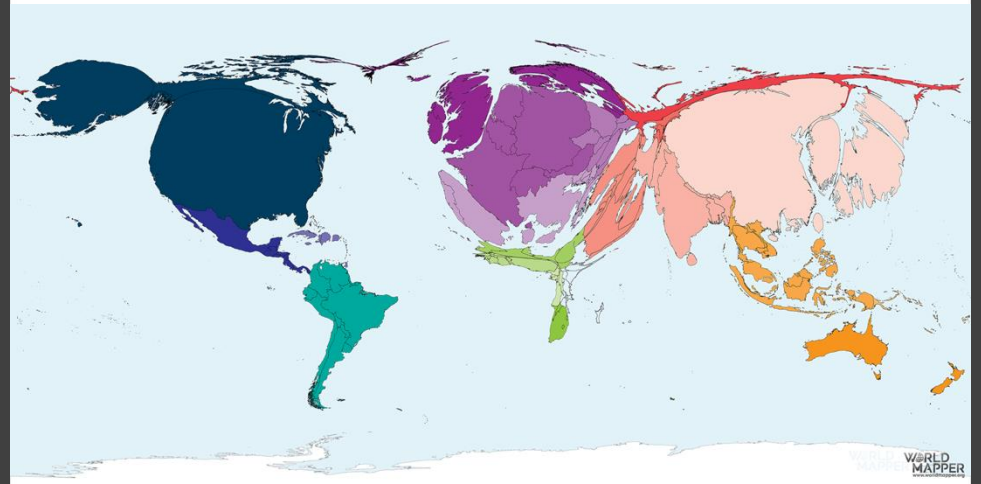

WORLD MAPPER



Population



Mobile phone subscriptions (2015)



Income (GNI)

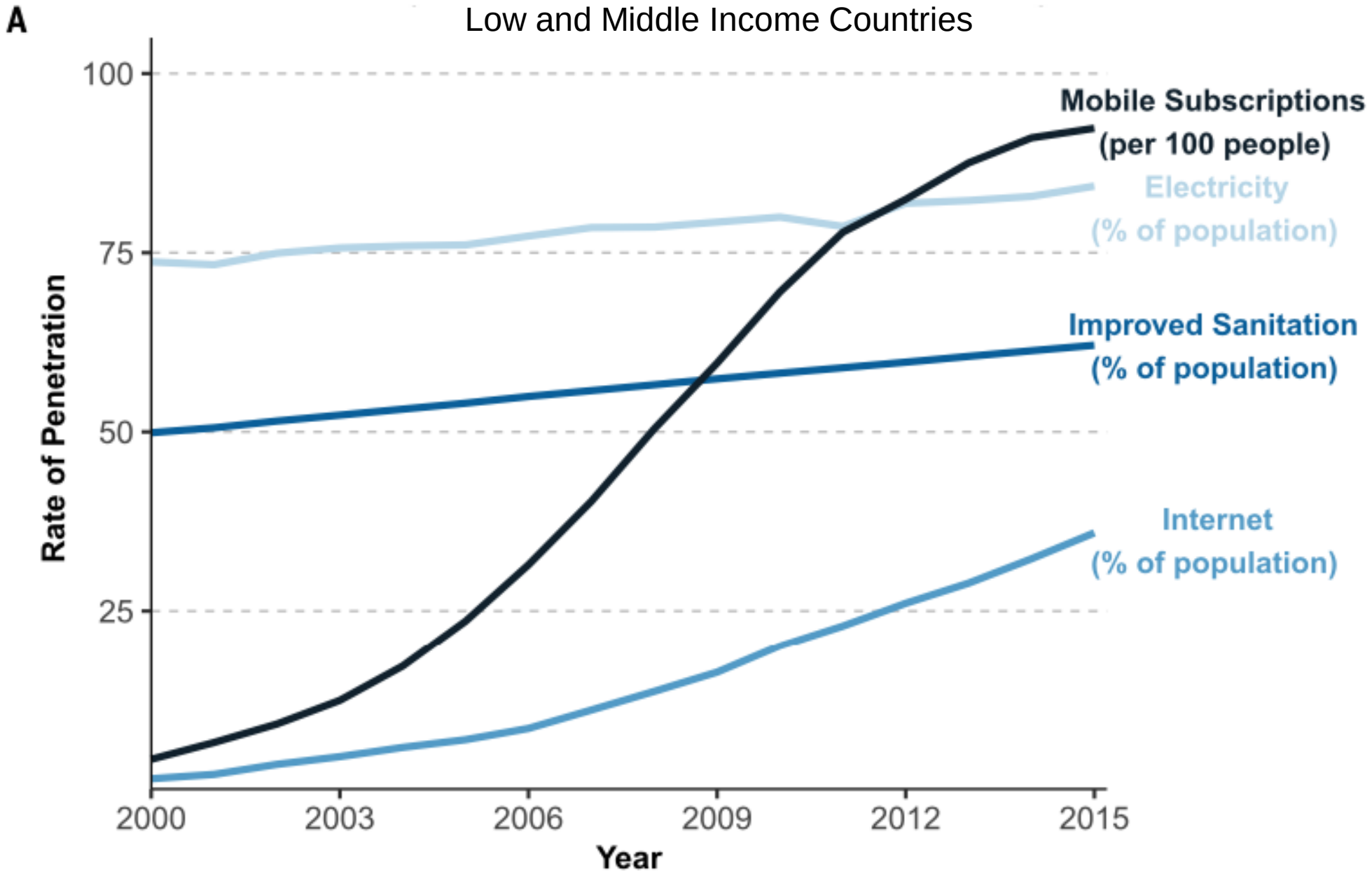
Developing societies

- Lower incomes
  - More unmet needs
  - Less ability to pay
- In the process of transformation
  - Ongoing shifts, adapting to new behaviors anyway
- Complements not always in place (contract enforcement, financial systems, venture capital/routes for exit)
- Regulations more diverse, and (perhaps) less crystallized

1. Adoption

Interventions by public/social sector

- Futch and McIntosh (2009) study the impact of providing village phones in Rwanda, but find no evidence of broader welfare impacts.
- Communities: ICT for development, NGOs
- In 1999, Safaricom projected Kenya would have 3m mobile phone subscribers by 2020
- In 2009, Safaricom alone had 14m (Safaricom, 2009; Aker and Mbiti 2010)

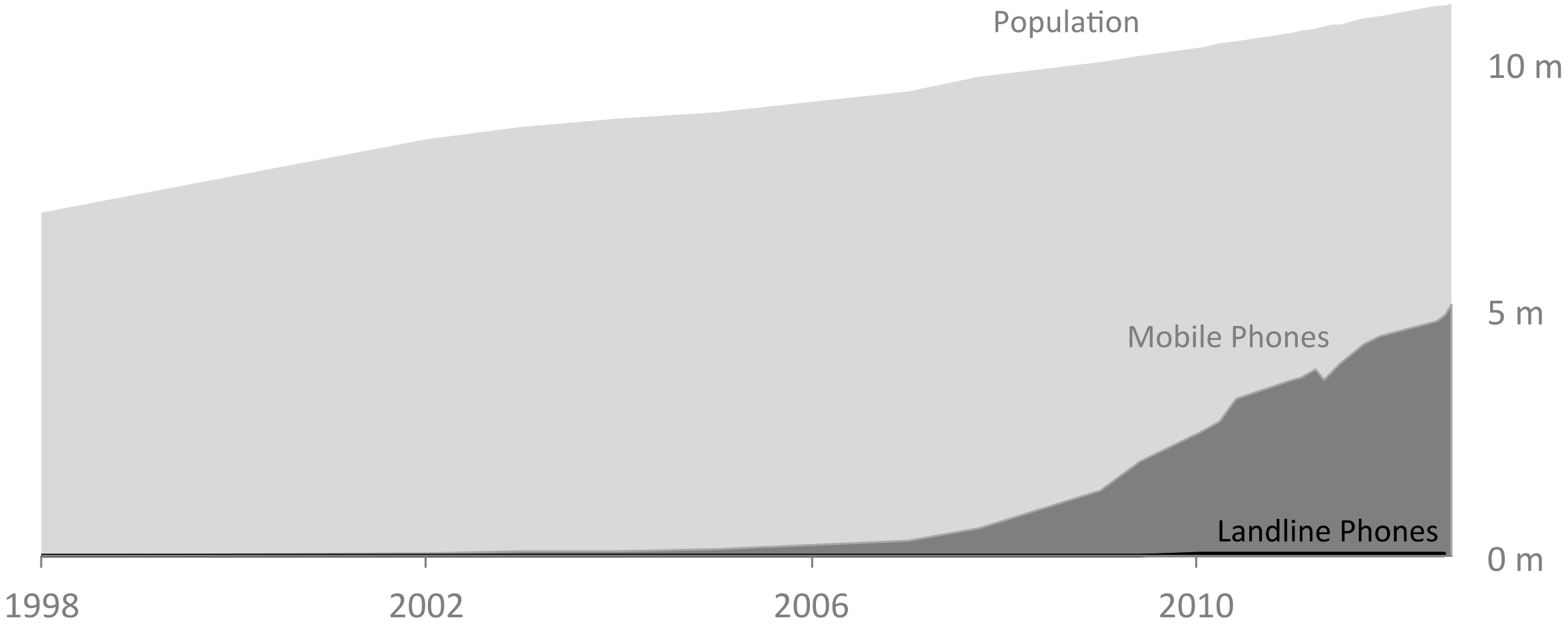


Fabregas, Kremer, Schilbach 2019

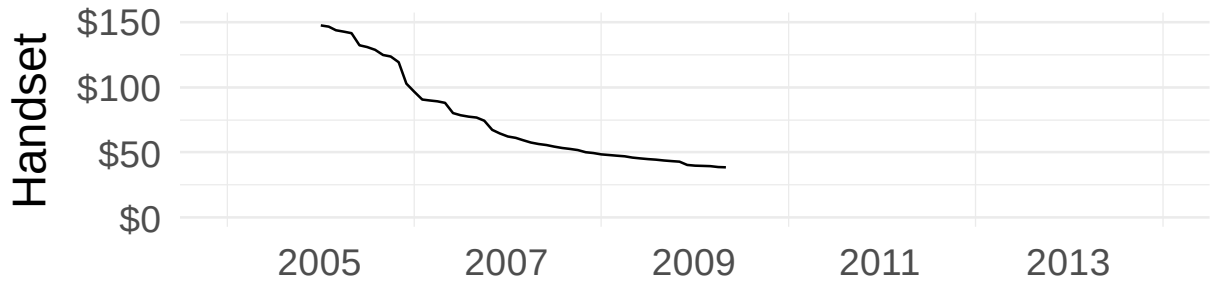
Rwanda, 2005

Households with	
Radio	58%
TV	3%
Penetration	
Internet	2%
Newspapers	1%
Landline phones	0.2%
Mail service	0.2 packages per person in 2007 (vs. 2.4 in Kenya, 538.8 US)

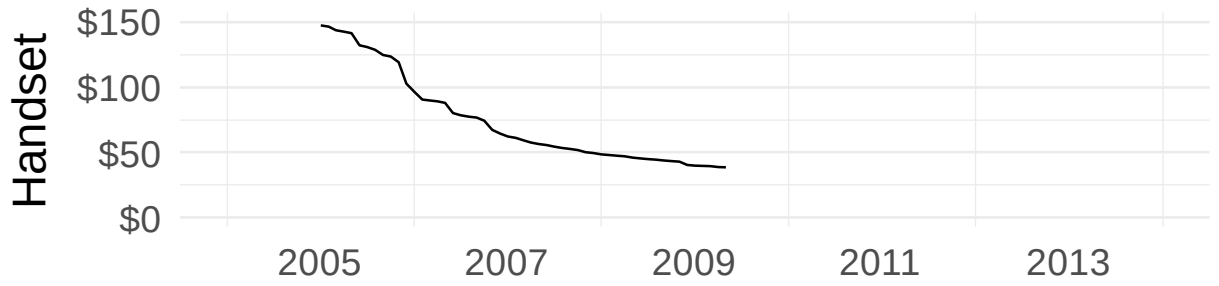
Rwanda

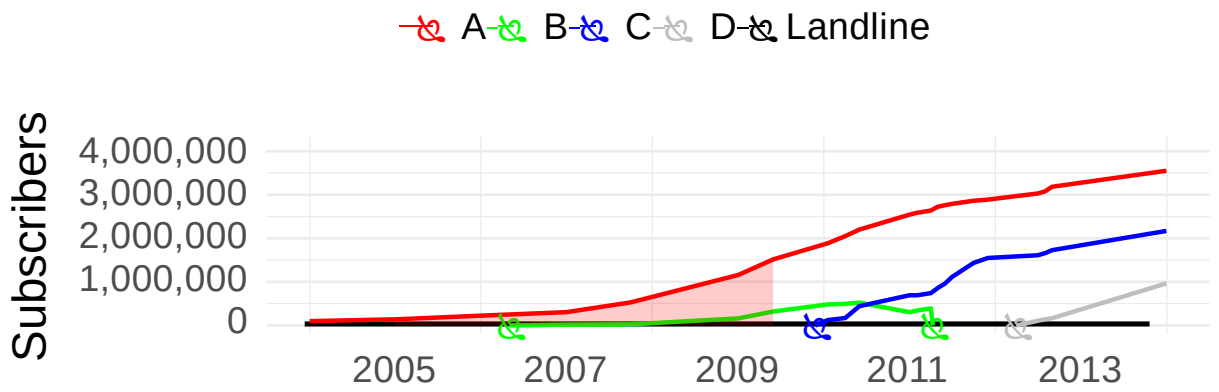

Population
Mobile Phones
Landline Phones
10 m
5 m
0 m
1998
2002
2006
2010

Telecommunications in Rwanda

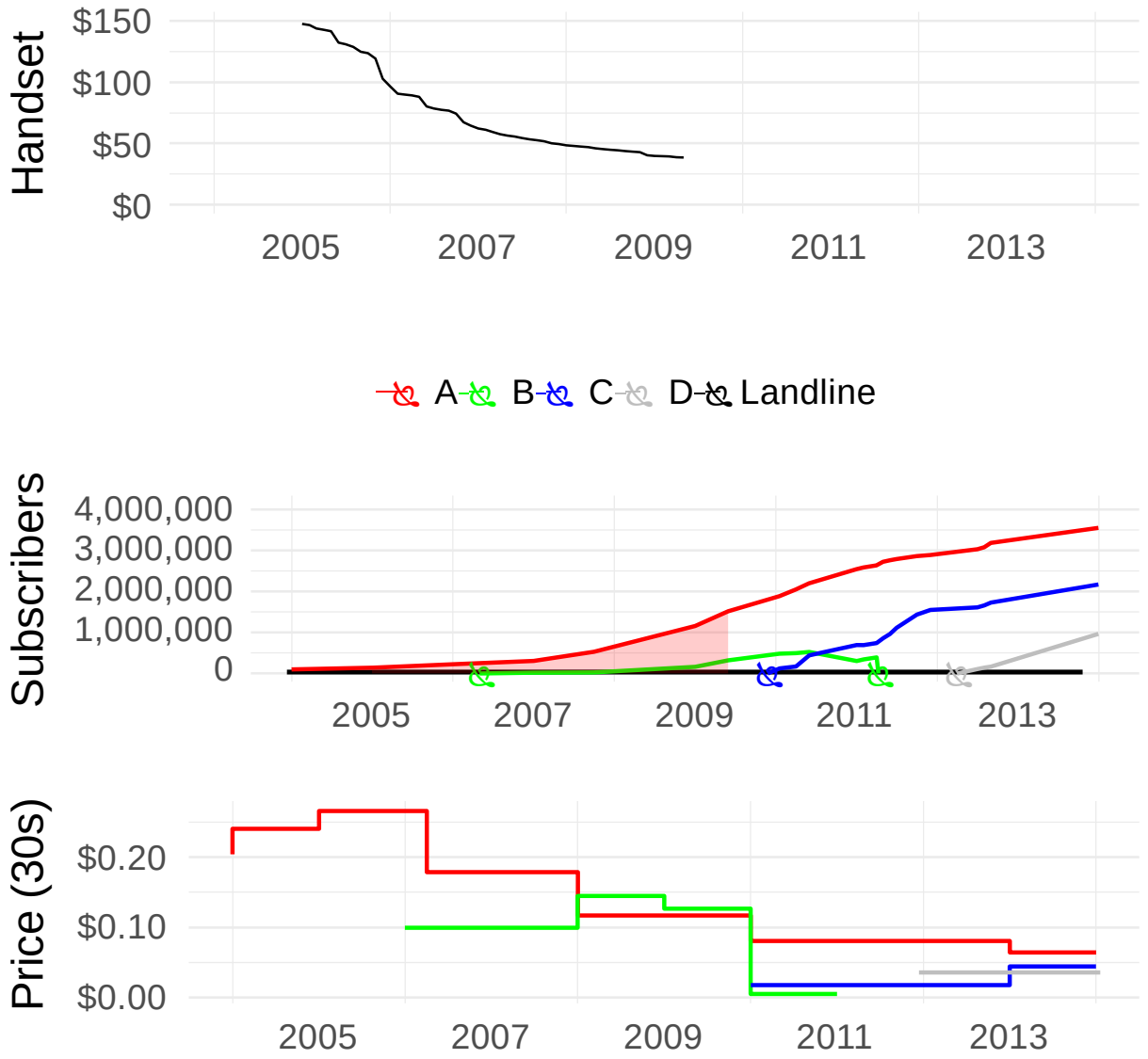


Telecommunications in Rwanda

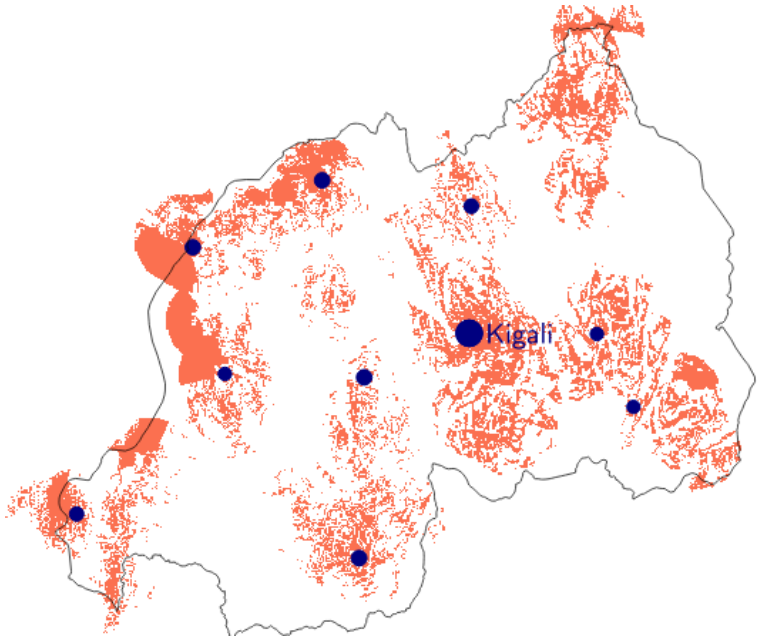




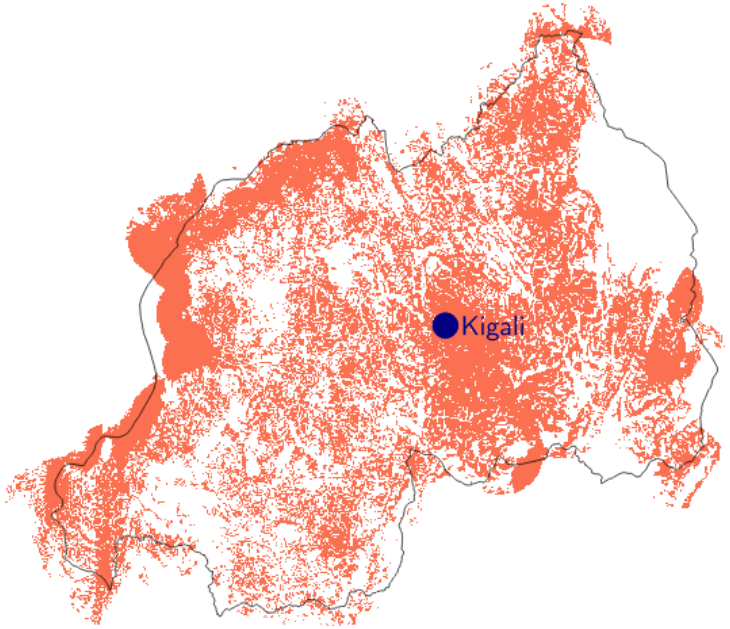
Telecommunications in Rwanda



Coverage



2005



2009

Dots represent major towns; coverage is shaded.

2. Impacts

Kerala fish markets (Jensen 2007)

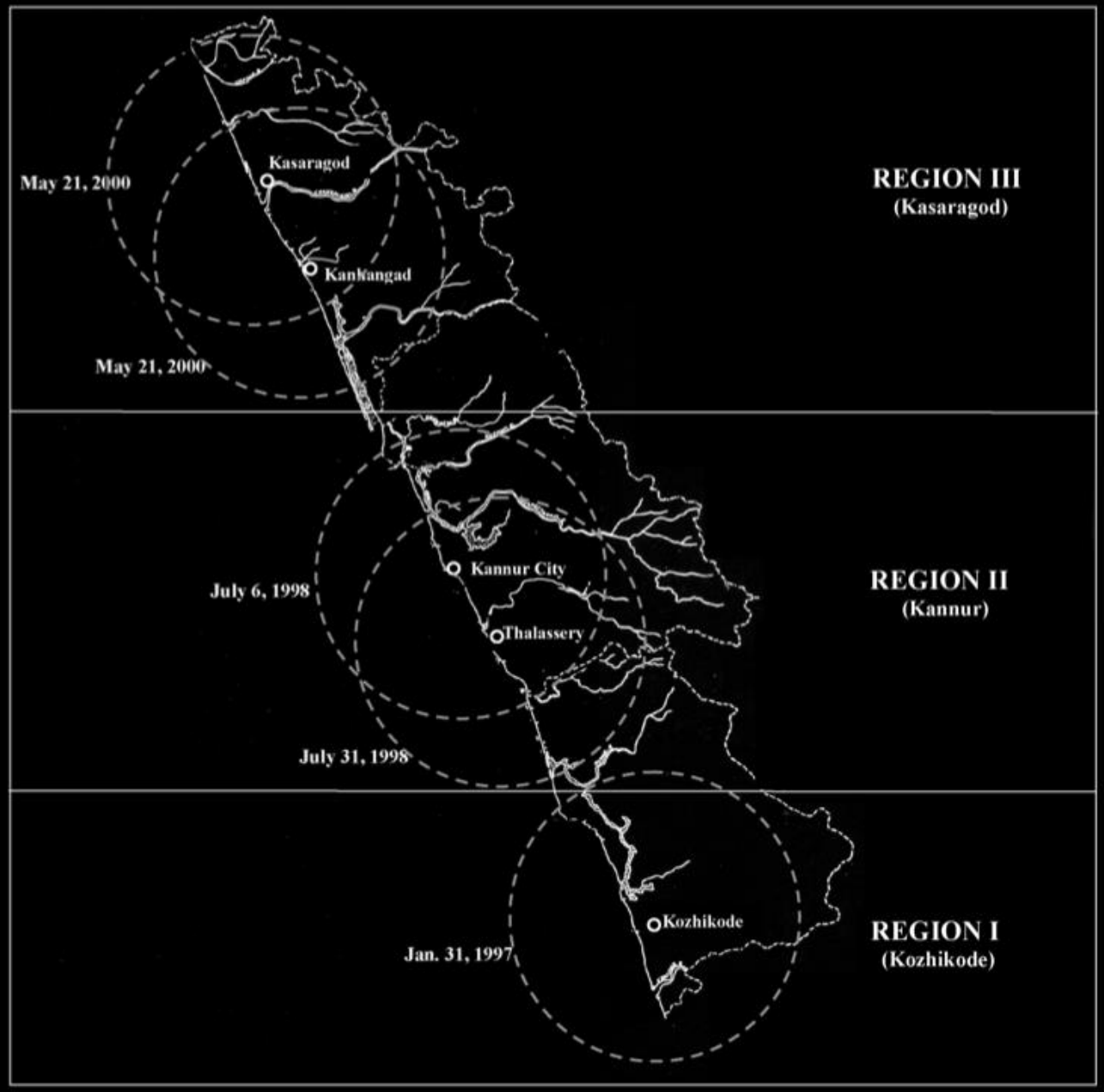
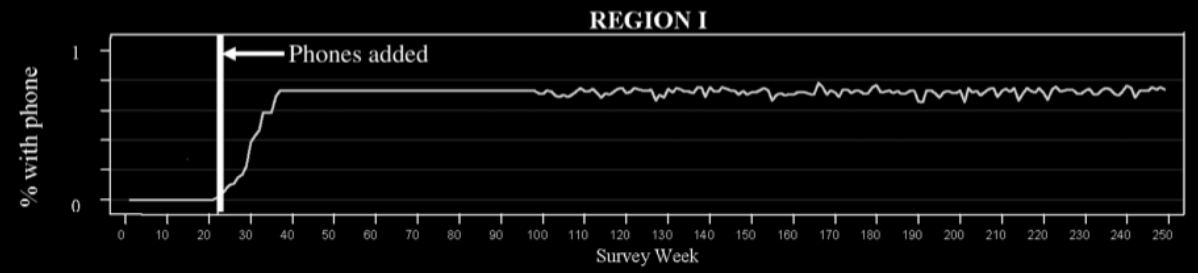
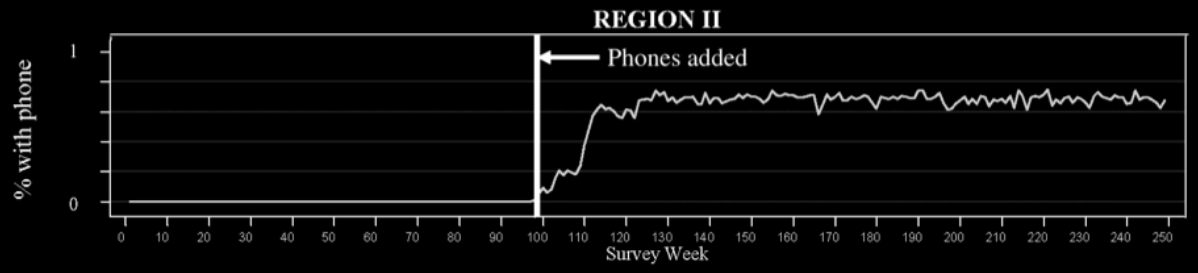


FIGURE II
Spread of Mobile Phone Coverage in Kasaragod, Kannur, and Kozhikode Districts

Adoption





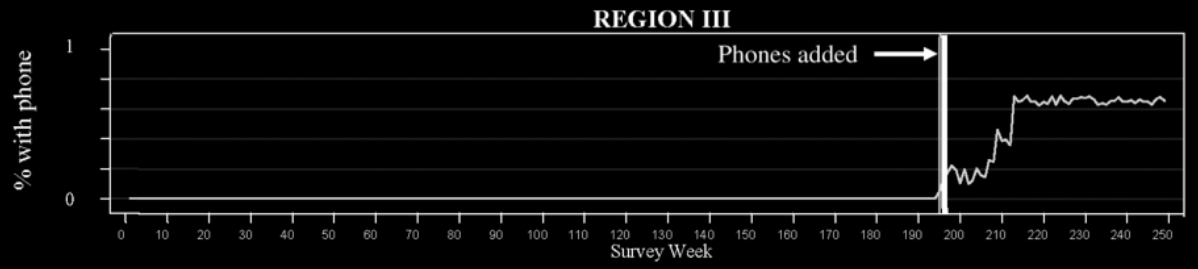
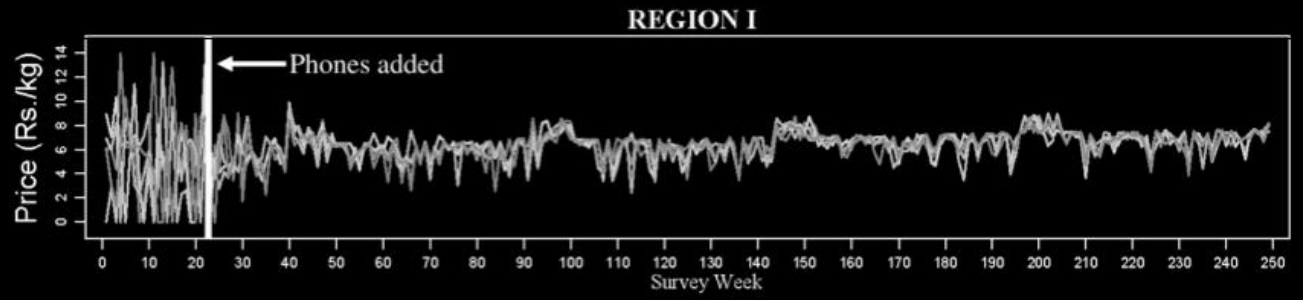
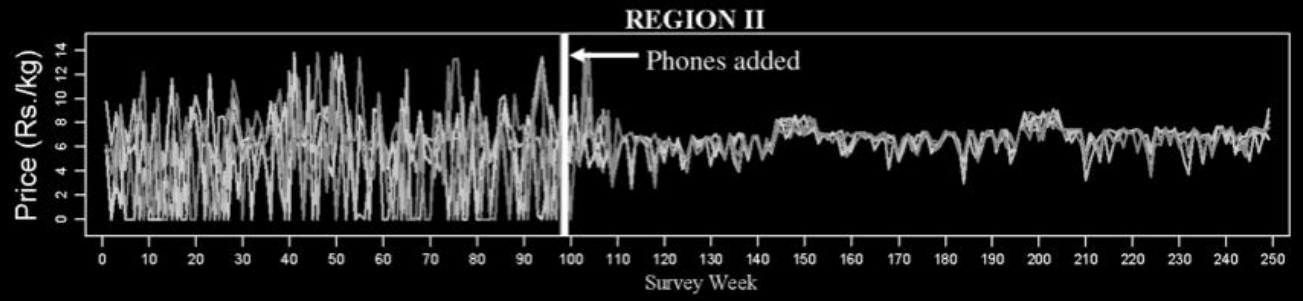


FIGURE III
Mobile Phone Adoption by Fishermen

Fish Price





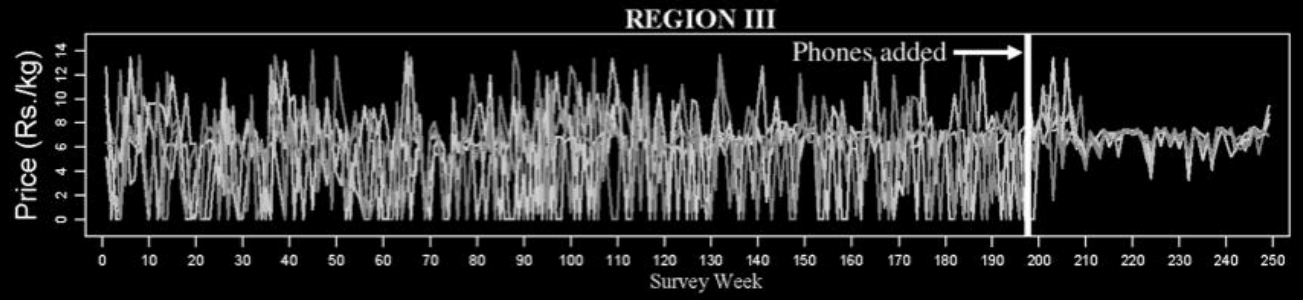


FIGURE IV
Prices and Mobile Phone Service in Kerala

Impacts

- Aker (2010) mobile phones: “10 to 16 percent reduction in grain price dispersion” in Niger
- Hjort and Poulsen (2019): submarine internet cables leads to increased employment, especially among highly educated

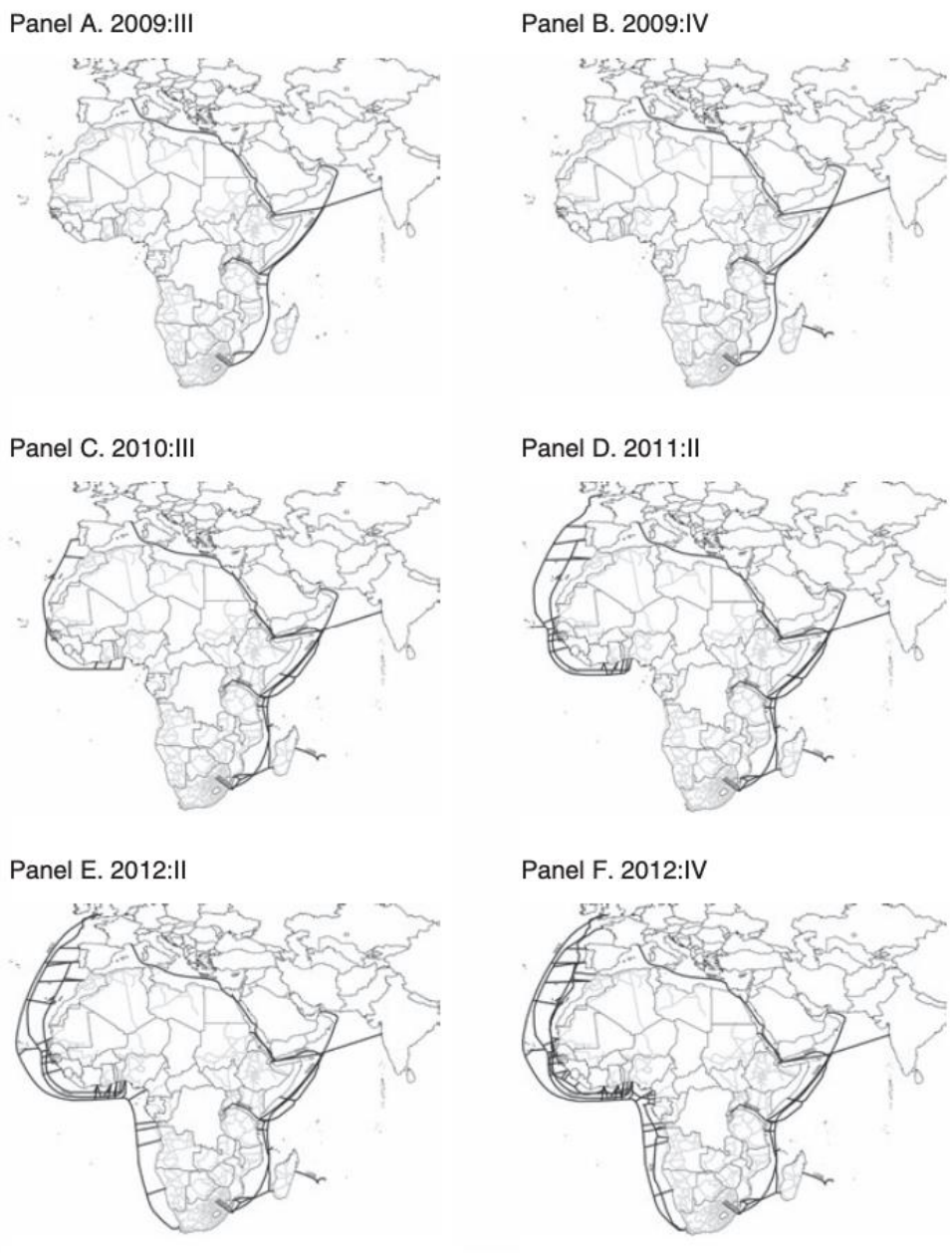


FIGURE 2. SUBMARINE INTERNET CABLE ARRIVAL IN AFRICA

Notes: This figure shows the arrival of submarine Internet cables in Africa over time. The first two cables during our analysis period arrived in 2009:III and the last in 2012:IV. The submarine cables are Seacom and Teams (2009:III), Lion (2009:IV), Eassy and MainOne (2010:III), Glo1 (2011:II), WACS (2012:II), and ACE (2012:IV).

3. Platform

Adaptation

- Intentional missed calls (‘flashing’/‘beeping’; Donner 2007)
- Prepaid plans
  - Scratch cards (Kenya: cheapest $0.05)
  - Send airtime code via SMS --> transfer value
  - Airtime transfer service (Blumenstock, Eagle, Fafchamps 2016)
- Cash out?
  - Mobile money

More on adaptation, on Twitter: Burgess and Baym (2020)

Mobile money

- **1.7 billion people lack access to formal financial services**
- Two thirds of those adults have a mobile phone
- Mobile money facilitates risk sharing (Jack and Suri 2012 and 2014)

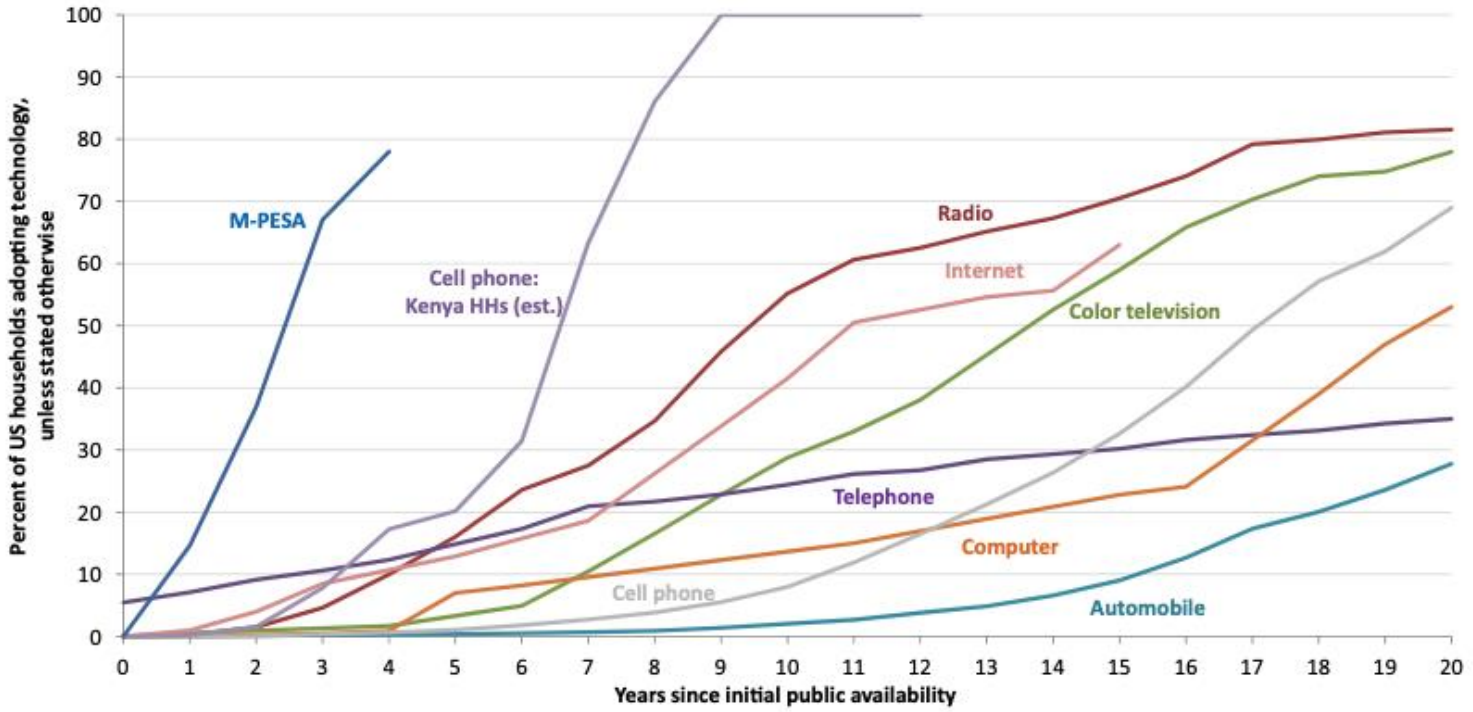


Fig. 1. Comparative adoption of technologies in the United States and Kenya. Data sources for this figure and the methods for estimating the cell phone adoption rate in Kenya are discussed in detail in *Methods*.

Digital Credit

1. Mobile Money (Jack and Suri 2014)

   Transfer money. Savings. Credit.

2. Repayment

   Information

   Credit bureaus and mobile money usage (sparse)

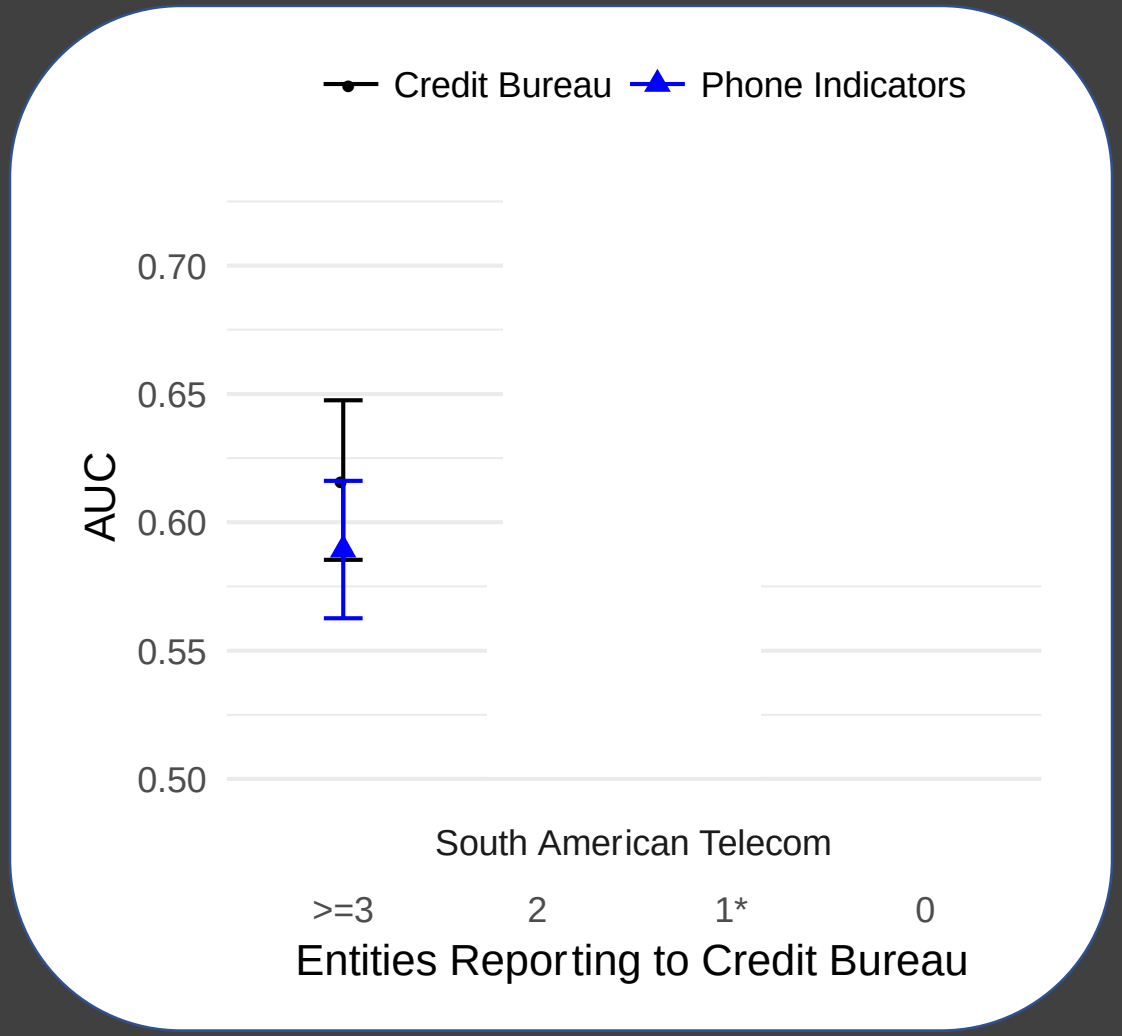
   This paper: nuances in phone usage

   (Björkegren 2010; Björkegren and Grissen 2020)

   Progressively larger loans (Carlson 2017)

   Incentives

How you use your phone is predictive of whether you'll repay a loan (Björkegren 2010; Björkegren and Grissen 2020)

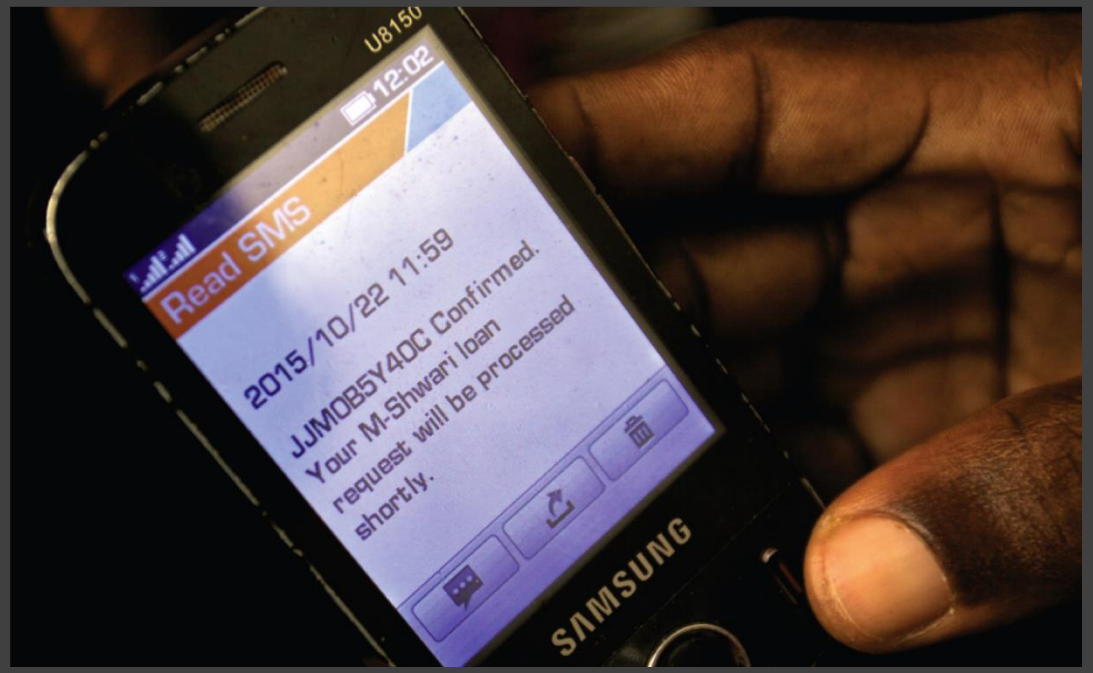


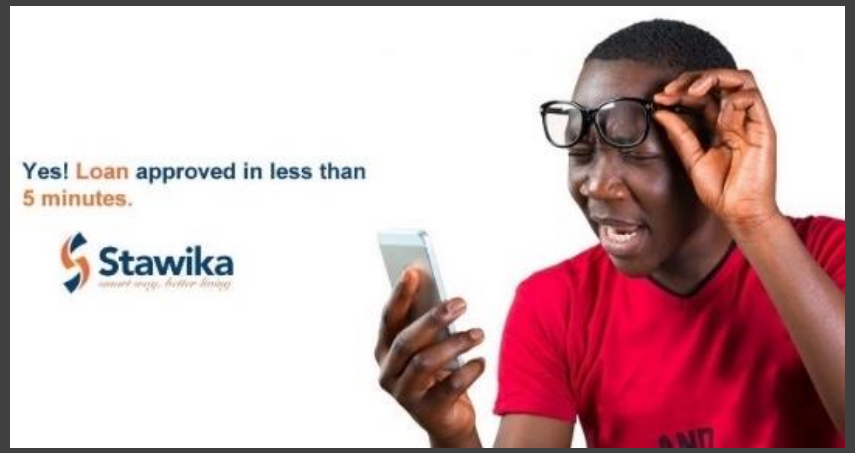
5-fold cross validation

Most conservative phone model; least conservative bureau model.

Digital Credit

- Use alternative credit score for loans over mobile money (from 2012-)
  - In **Kenya**: 27% of adult population has taken a digital credit loan
  - Worldwide: >$450m venture capital funding, >68 products





Will private market discover useful applications?

- Less ability to monetize:
  - Many developed country technologies:
    - Developed by startups, with VC funding
    - Monetization:
      - Advertising
      - Subscriptions
    - Exits
- Phone operators are gatekeepers
  - For basic phones, gatekeepers to all services
  - For smartphones, data is expensive
- Information nonrival (agricultural advice: Fabregas, Kremer, Schilbach 2019)
- Other applications
  - Aid targeting and dispersal (GiveDirectly, Blumenstock)
  - Providing expertise: health, education, agriculture

4. How should societies manage tech?

Widespread Concern about Network Industries

Gloves off in fight over mobile termination rates

By KENNETH KWAMA | Published

India's Vodafone-Idea merger may be too late, as Jio accelerates growth

Safaricom faces M-Pesa break up in market dominance war

THURSDAY FEBRUARY 23 2017

How WeChat came to rule China

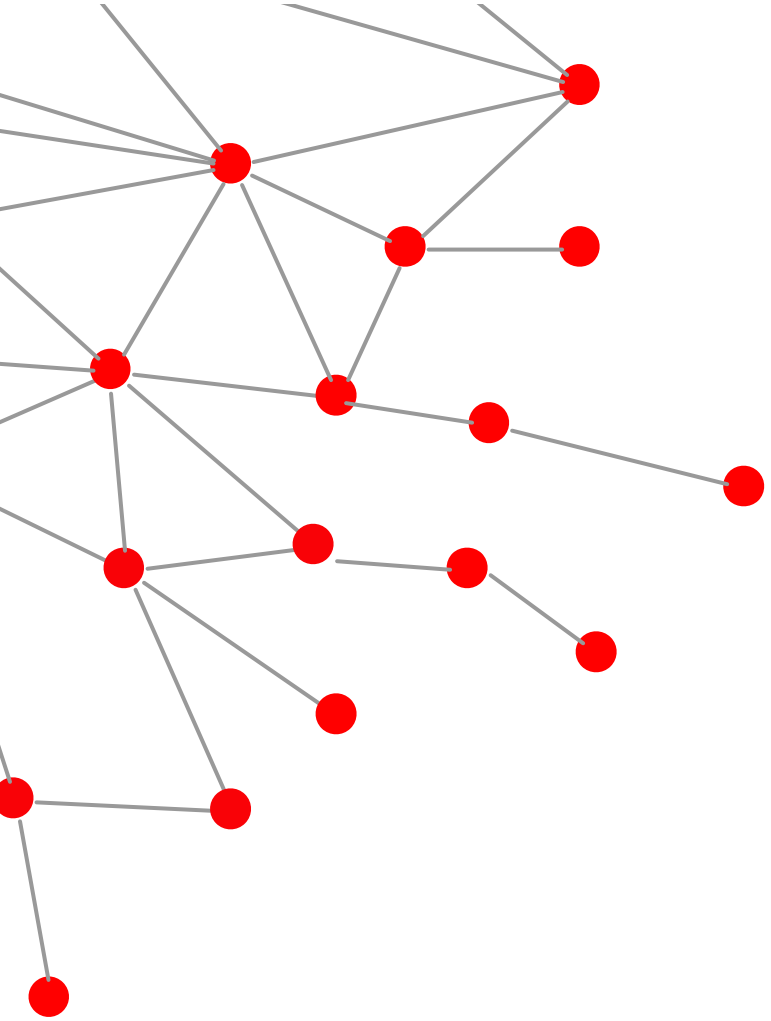
The multipurpose messaging app is becoming the nation's ID system

Facebook Admits It Was Used to Incite Violence in Myanmar

Fake News on WhatsApp Is Killing People in India

It's Time to Break Up Facebook

Is It Time to Break Up Google?



Managing Network Industries

How to ensure <u>good service</u>, <u>for the people who need it</u>?

Regulation
but rapid change

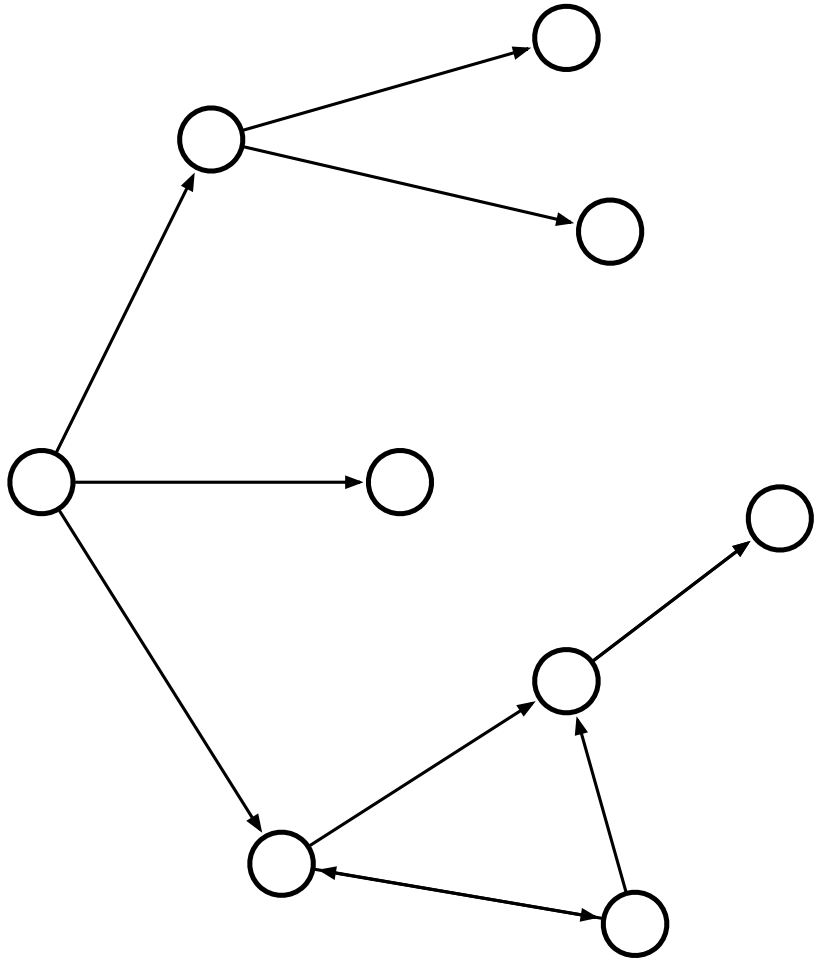
Competition
also requires regulation

Mobile phone networks in sub-Saharan Africa:
2.5% of GDP (7% indirect, GSMA 2018)
Platform for internet, mobile money, digital credit

Case Study: Rwanda's Mobile Phone Network

Develop model of Rwanda's mobile phone industry

Use 5.3b transaction records from over 88% of mobile phones over 4.5 years



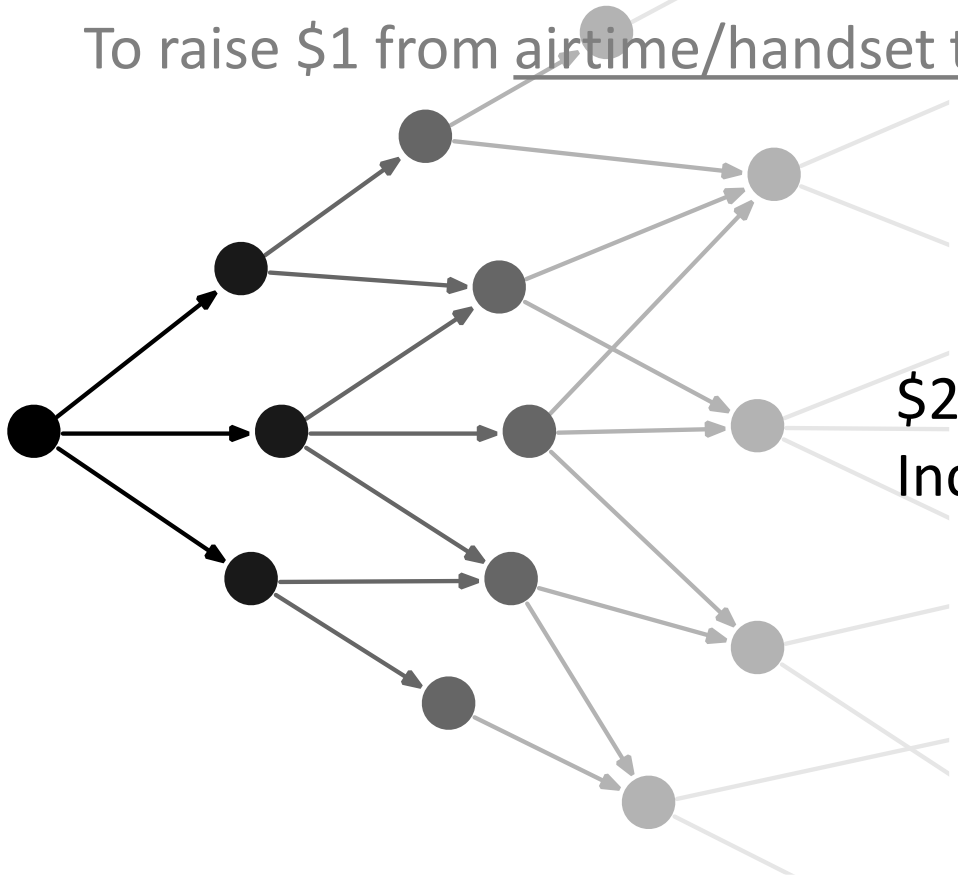
Taxes; spillover effects

Telecom taxes: 7% of government revenue in SSA (GSMA 2008)

Welfare cost: $1.21-1.37 to raise $1 from other taxes in Rwanda (Auriol and Warlters 2012)

To raise $1 from airtime/handset taxes in growing network:

$1.22
Ignoring net effects

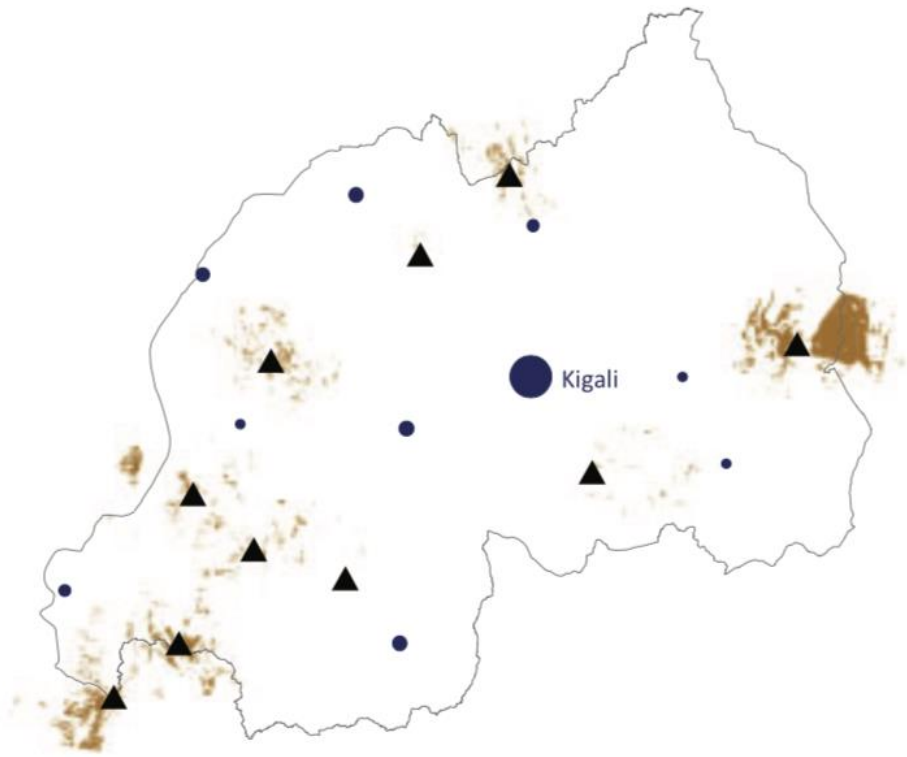


$2.95
Including net effects

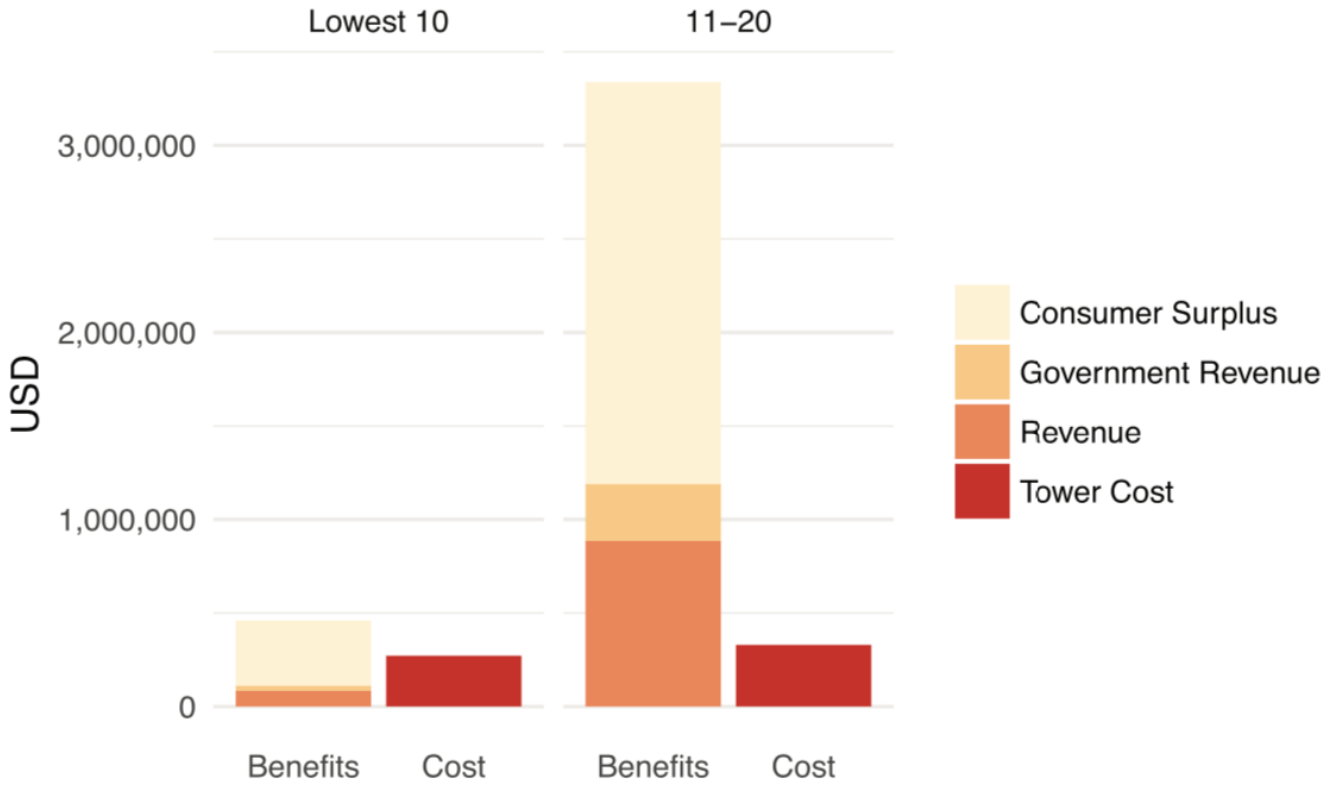
(Björkegren 2019)

Regulation

Universal Service Obligations: **Remote coverage induce spillovers**



Low revenue towers

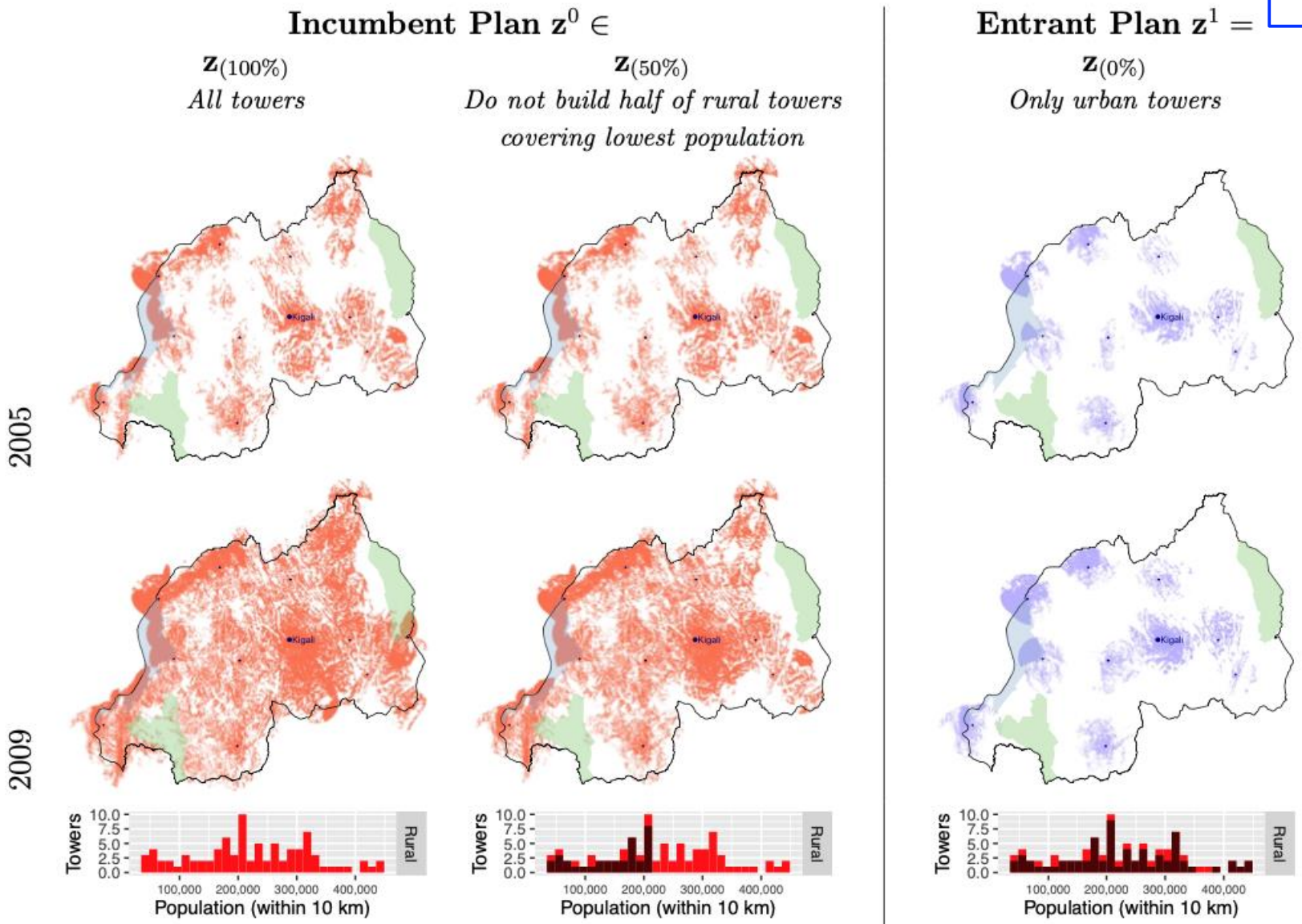


Benefits dispersed: 78% accrues to individuals whose coverage unaffected

(Björkegren 2019)

Competition

FIGURE 3. **Rollout Plans**



Shows the coverage plans that operators may choose from. Starting from the its set of towers in 2005, the incumbent may build all towers ($\mathbf{z}_{(100\%)}$) or skip the half of rural towers covering the lowest population ($\mathbf{z}_{(50\%)}$). The entrant may build urban towers ($\mathbf{z}_{(0\%)}$). Coverage shaded; points denote cities. National parks shaded in light green; Lake Kivu shaded in light blue.

Competition may help or hinder investment

Three effects:

- Lower prices (-)
- Network effects foregone (-)
- Business stealing effect (+)

Allowing an additional competitor in Rwanda's telecom sector earlier could have increased incentives to invest, and increased welfare by the equivalent of 1% of GDP (Björkegren 2018)

Competition

TABLE 5. Return on Tower Investment

	Equilibrium		Effect of Incumbent Building Low Population Towers			
	Call Prices		ΔProfit		ROI	
	$\frac{\mathbf{p}^0}{\mathbf{p}^{base}}$	$\frac{\mathbf{p}^1}{\mathbf{p}^{base}}$	Incumbent	Entrant	Incumbent	Social
			$m	$m		
Baseline Scenario	1.00, 1.00	-	1.27, 1.23	-	0.98, 1.00	6.64, 6.49
Additional Competitor	0.70, 0.60	0.60, 0.50	1.99, 1.87	-1.27, -1.25	1.40, 1.26	7.74, 7.96
...fixing operator			0.39, 0.22	0.022, 0.002	0.43, 0.25	6.89, 6.92
...add'l effect of operator choice			1.60, 1.65	-1.30, -1.26	-	-

Each cell reports results in the low and high incumbent-favoring equilibrium. Effect cells report the difference in outcomes between the adoption equilibrium that results when the lowest 50% population rural towers are built, and the one where the incumbent is constrained to not build them. Outcomes computed from January 2005 through horizon December 2008. 'Fixed operator' allows consumers to change adoption dates and usage but holds operator choices fixed; consumers who originally switch operators do so on the latest of the original switch date and the new adoption date. Social ROI represents consumer surplus, government revenue, and firm profit, relative to firm costs. ROI is not relevant for the incremental effect of operator choice since the cost of the towers has already been accounted for. Utility and revenue reported in 2005 U.S. Dollars, discounted at a rate of δ. Consumer surplus includes the surplus utility each individual receives from the call model through December 2008, minus the cost of holding a handset from the time of adoption until December 2008.

Algorithmic decisions

- Imports: bias / representativeness
  - Content moderation in non western languages
  - Facial classification systems tuned for white faces (Buolamwini and Gebru 2018)
- Consumer rights for new digital citizens
  - Transparency vs. manipulation (Björkegren, Blumenstock, Knight 2020)
  - Privacy; especially in nondemocracies
  - Welfare vs. short term metrics (engagement, virality, profit)

Cost of Transparency (Björkegren, Blumenstock, Knight 2020)

How does transparency affect performance?

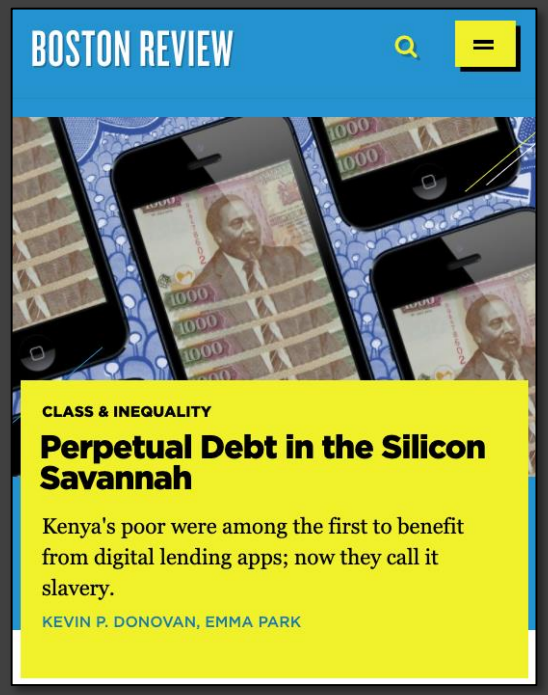
	Pooled (all outcomes)
	Naive β
Prediction error, RMSE ($)	
Control	3.70
Opaque treatment	4.00
Transparent treatment	4.93
Average payout ($)	3.226
N	114

Status quo cost of transparency ≤0.93 (25%)

Regulation

How should societies evaluate and manage potential harms?

- Example:



vs. impact evaluations of digital credit:

Mostly insignificant effects, but mostly positive:

- Improved resilience (Bharadwaj, Jack, Suri 2019)
- (Brailovskaya, Dupas, Robinson 2021)
- (Björkegren, Blumenstock, Folajimi-Senjobi, Mauro, Nair 2021)

- Jurisdiction of multinationals:
  - Android Appstore controls on digital lending apps
  - Facebook's 'supreme court'
  - Chinese tech?

Open research questions

- Useful applications (esp those not provided by private market)
- Policy
  - For digital industries
    - Competition/interoperability and investment in mobile money
      - FIT IN / Toulouse has funding
  - Using digital tech for other industries
  - Digital taxation
- AI Impacts
  - “AI is likely to be resource-saving and labor-saving, devaluing the sources of comparative advantage of many developing countries” (Korinek and Stiglitz 2021)

Why study digitization in developing societies

- High marginal utility
- Opportunity to build something new
- Interesting data / possibility of partnerships
- Diversity of experiences
  - Work with people who will change the way you view the world
- Representation

How to study digitization in another society

- Humility
- Immerse yourself
- Spend time with the people whose lives you wish to understand
- Conversations, anecdotes, focus groups, … + data

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digitization in developing societies

feel free to reach out!
thanks to team at Busara Center Nairobi