

# Rural marketplaces and local development

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STEG Workshop  
September 20<sup>th</sup>, 2022

## market

*noun*

[/'mɑ:kt/]

Oxford Dictionary

”The potential demand for a commodity or service within a demographic group or geographic area”

## market

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”A meeting [...] for the purchase and sale of provisions [...], publicly displayed, at a fixed time and place”

”The potential demand for a commodity or service within a demographic group or geographic area”

Oxford Dictionary

# Marketplaces historically & today

- **Weekly markets common throughout history**  
Roman empire (de Ligt, 1993), Aztec & Inca empires (Stearns et al., 2015),  
Mughal era India (Gajrani, 2004), pre-colonial West Africa (Hill, 1966),  
medieval Europe (Braudel, 1983)



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How do rural weekly markets  
shape local development?



# Marketplaces & local development

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II: Are marketplaces driving development or vice versa?

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⇒ [This paper](#): Build spatial model with marketplaces as im- & export hubs to identify possible mechanisms and illustrate policy trade-offs in linking rural and urban areas

# Contributions

**Rural marketplaces in low-income countries** Hill (1963); Skinner (1965); Jackson (1971); Good (1973, 1975); Wood (1973, 1974a); Bromley et al. (1975); Obudho (1976); Smith (1978); Bates (1981); Lindskog (1981); Renkow et al. (2004); Mukwaya (2016)

⇒ Marketplaces & development outcomes

**Rural & informal trade** Fafchamps (2004); Casaburi et al. (2013); Atkin and Donaldson (2015); Allen et al. (2020); Bergquist and Dinerstein (2020); Startz (2021); Aggarwal et al. (2022); Bergquist et al. (2022); Bold et al. (2022); Casaburi and Reed (2022); Chatterjee (2022)

⇒ Marketplaces addressing search & contracting frictions

**Trade & urbanization** Bleakley and Lin (2012); Storeygard (2016); Nagy (2020, 2022); Cuberes et al. (2021); Ganapati et al. (2021); Fajgelbaum and Redding (2022)

⇒ Small-scale trade & local outcomes

**Infrastructure & rural development** Lewis (1954); Michaels et al. (2012); Faber (2014); Christiaensen et al. (2017); Aggarwal (2018); Asher and Novosad (2020); Baum-Snow et al. (2020); Brooks and Donovan (2020); Gebresilasse (2020); Moneke (2020); Asher et al. (2022); Fan et al. (2022)

⇒ Marketplaces as a policy tool

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# Context

## Why do marketplaces (still) exist?

- dispersed population → high search & transport costs
- weak legal systems → preference for face-to-face transactions
- smallholders selling small volumes → opportunities for bulking



# Marketplaces in Kenya

- Marketplaces initially located in 1930s by colonial administration
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  - later, "the forces of supply and demand [...] determined the actual mode and locale of operation" Obudho (1976)
- Post-1963, rural population quadrupled and agricultural trading was liberalized
- Marketplaces remain relevant today
  - each county's development plan mentions related policies
  - activity within markets was growing  $\sim 8\%$  annually before Covid-19 von Carnap (2021)

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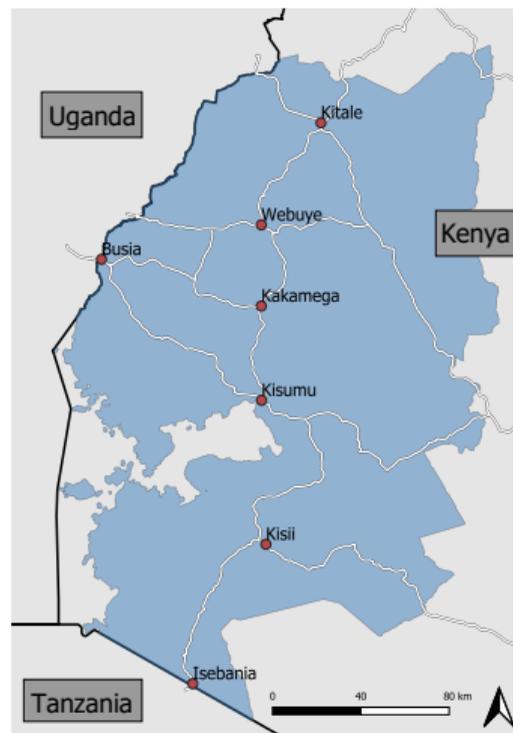
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# Data

# Data

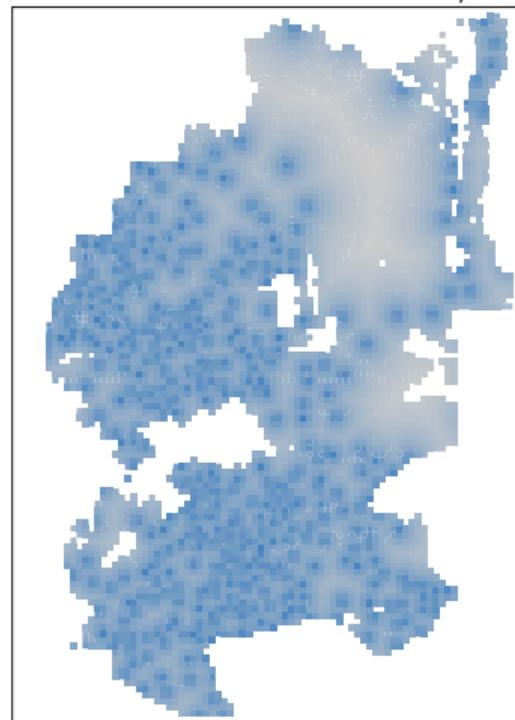
- Goal: Document market existence and local development over time
- Area: Western Kenya (15 mio. people)
- Time: 1970 and 2020
- Variables:
  - Local development (house density)  
*Hanlon and Heblich (2022)*
  - Distance to nearest marketplace
  - Access to larger cities
- Structure: ~ 5000 2.5km gridcells



# Historical market locations

- Official periodic markets in 1970 Wood (1973)
- Existence validated across regions  
Wood (1974b, 1975); Obiero (1975); Ocharo (1975)

Distance to nearest market, 1970



# Current market locations von Carnap (2021)

Friday, Oct 3, 2019



Thursday, Nov 22, 2020



Source: Google Earth Archive

**Key feature:** Marketplaces relatively bright on market day

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**Problem:** Available high-resolution images may not show market day

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# Current market locations

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**Key feature:** Marketplaces relatively bright on market day

**Solution:** Screen high-frequency imagery for periodic changes

Thursday, Nov 22, 2020



**Problem:** Available high-resolution images may not show market day

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Friday, Aug 27, 2021



Thursday, Sep 5, 2021

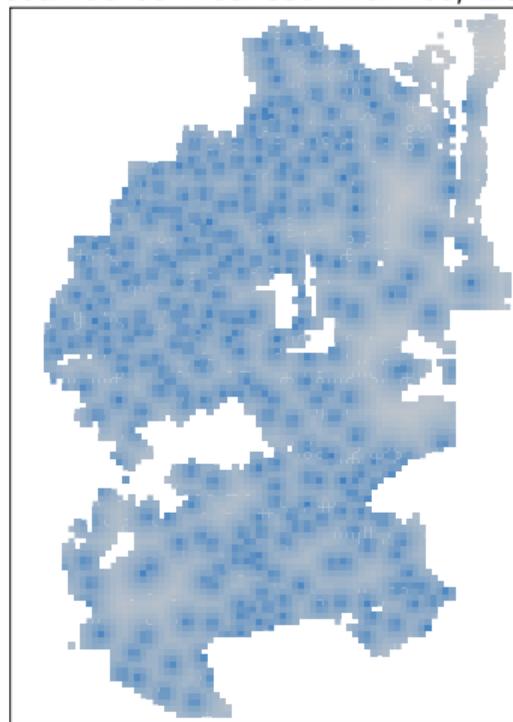


Source: Planet Labs Inc.

# Current market locations von Carnap (2021)

- Correctly identifies 85% of marketplaces in validation sample Bergquist and Dinerstein (2020) [More](#)

## Distance to nearest market, 2020

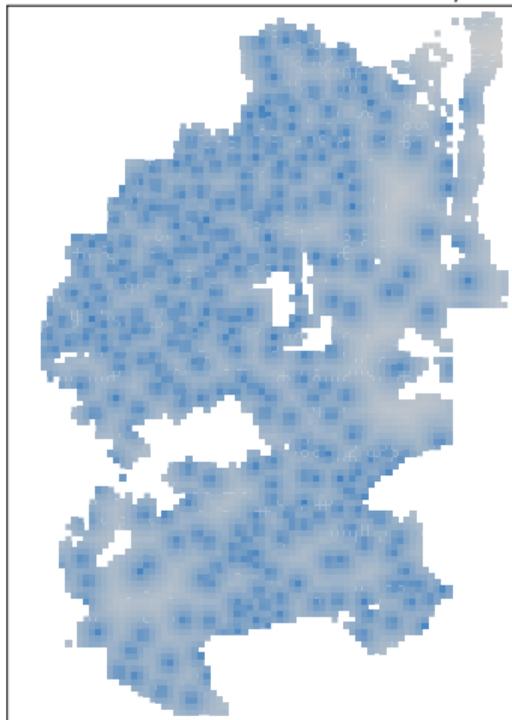


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- Deploy method at  $\sim 1500$  candidate locations
  - market locations in 1970 & those mentioned in policy documents, road intersections, other population centers

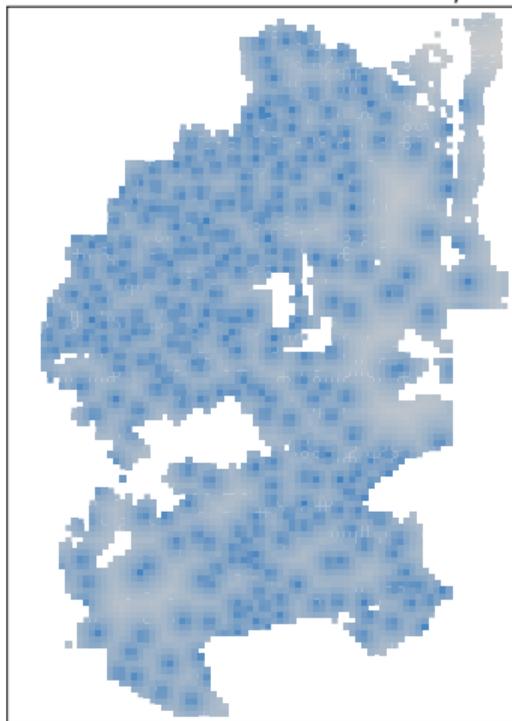
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## Distance to nearest market, 2020

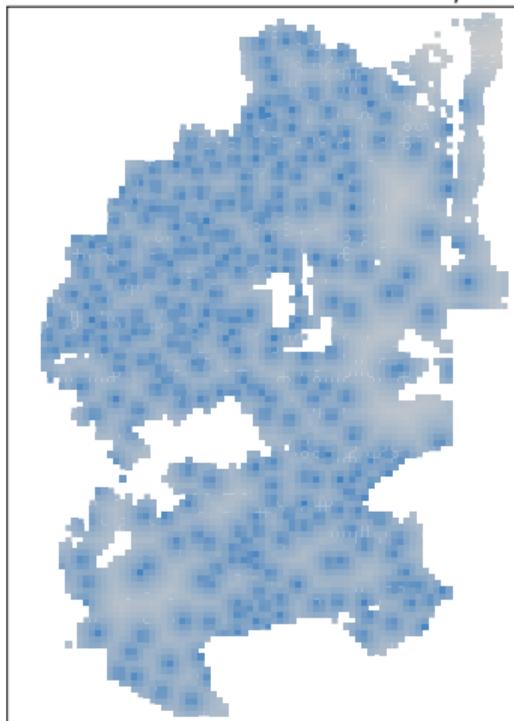


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  - market locations in 1970 & those mentioned in policy documents, road intersections, other population centers
- Assume that larger towns without weekly market have daily markets
- No difference in frequency of market days between 1970 and 2020 [More](#)

## Distance to nearest market, 2020



# Historical and current population density

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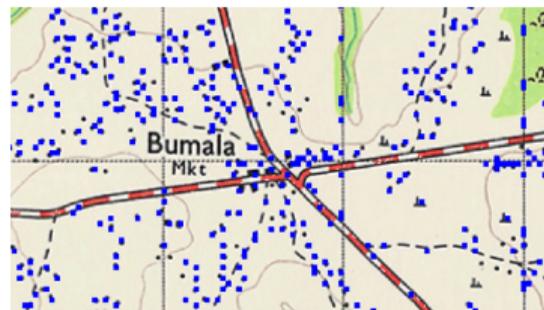


(a) 1:50,000 topographical map 1969

# Historical and current population density



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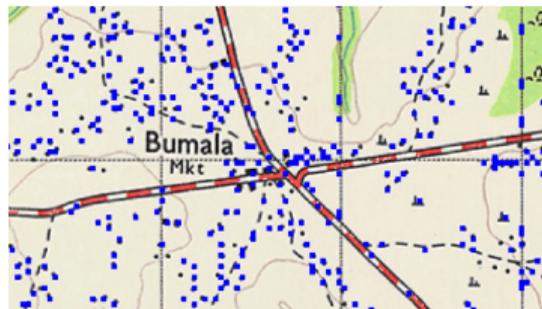


(b) Extracted house locations

# Historical and current population density



(a) 1:50,000 topographical map 1969



(b) Extracted house locations



(c) High resolution satellite imagery, 2020



(d) Population raster Facebook (2019)

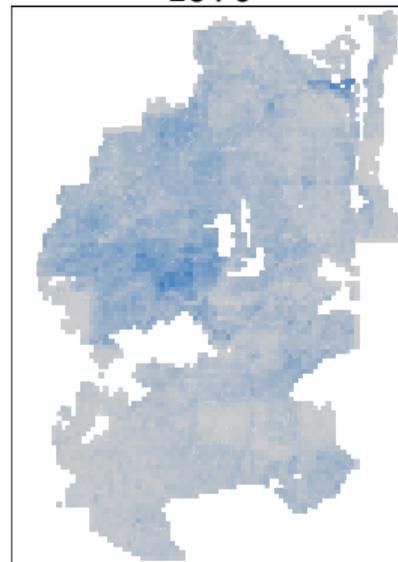
# Historical and current population density

- House density per gridcell
- Rank gridcells within districts (12) into percentiles
- Main measure of local development:

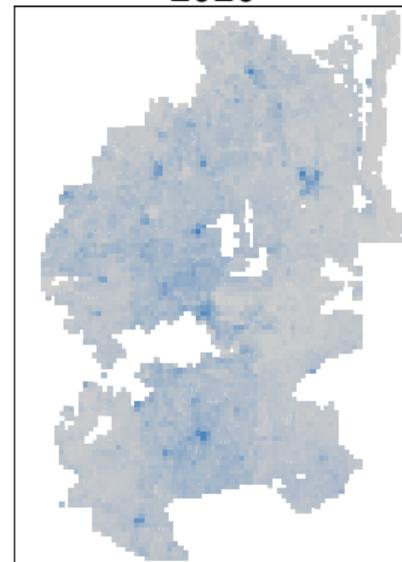
$$\frac{rank_{2020} - rank_{1970}}{rank_{1970}}$$

## Population density

1970



2020



# Urban access

- Calculate 'urban access' as

Donaldson and Hornbeck (2016)

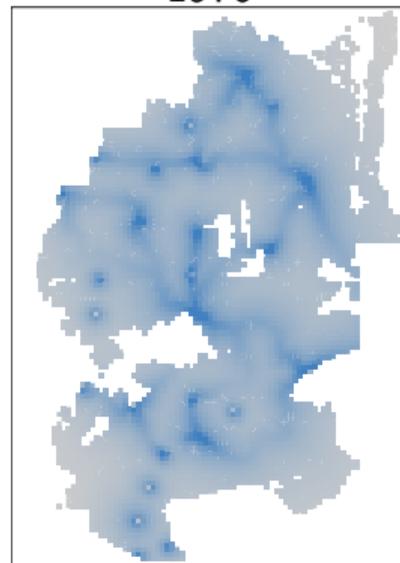
$$UA_g = \sum_{c=1}^C tt_{gc}^{-\theta} Pop_c$$

- Inputs

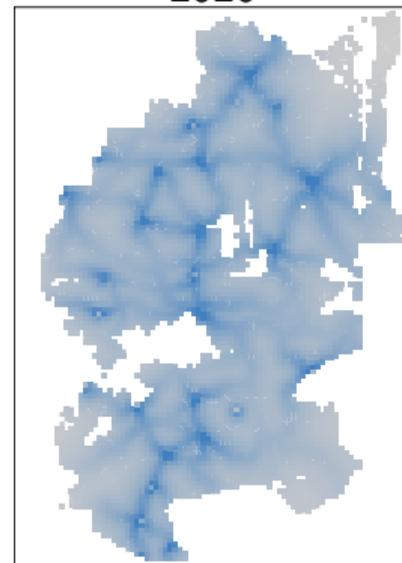
- Road network (highways, paved, improved) Jedwab and Storeygard (2022)
- Towns & their population in 1969 (14) and 2019 (29) censuses
- trade elasticity  $\theta = 5$   
Aggarwal et al. (2022)

## Urban access

1970



2020



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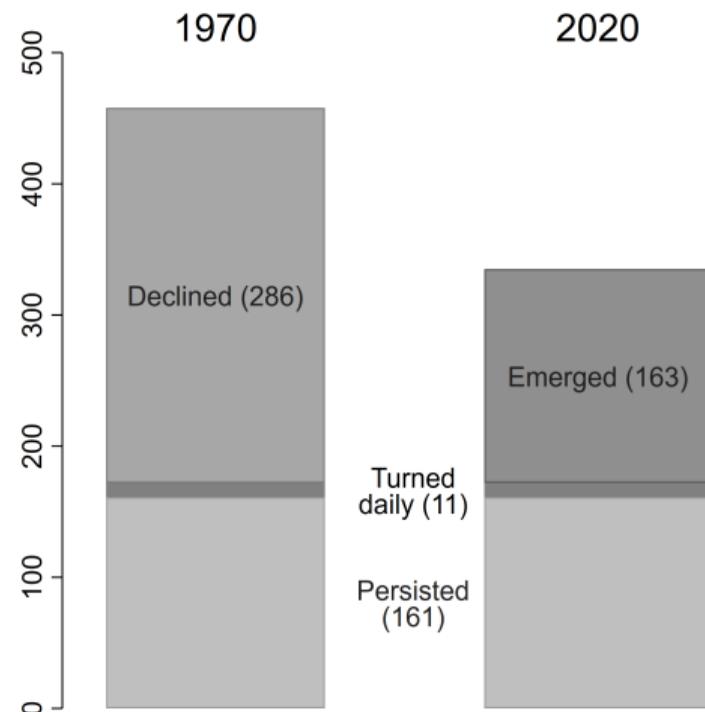
# Facts

# Market concentration

- 63% of markets declined
- Only 3% became daily
- Emerged markets primarily in highland regions formerly owned by Europeans

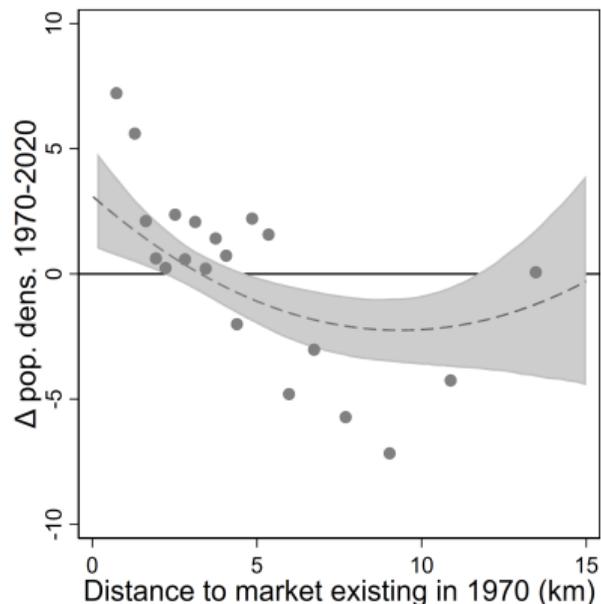
⇒ 30% lower market density

## Number of markets in Western Kenya



# Population concentration

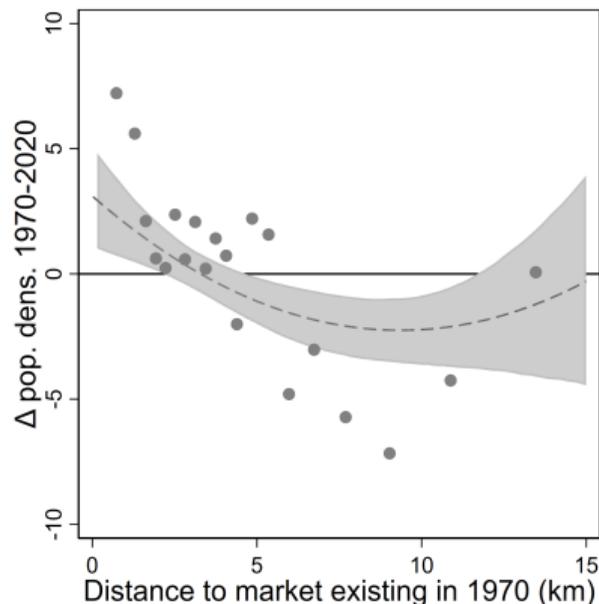
- Places closer to markets saw higher population growth than those further away



Dashed line shows fitted values from quadratic regression of population density changes on distance to 1970 markets. Shaded areas are 5<sup>th</sup>- 95<sup>th</sup> percentiles of fitted values across 3,000 bootstrap samples. Dots are binned values from the raw data.  $N = 5221$  gridcells.

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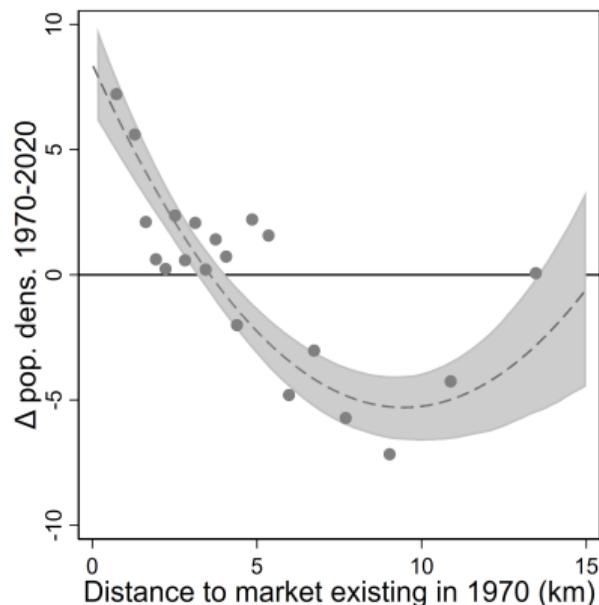
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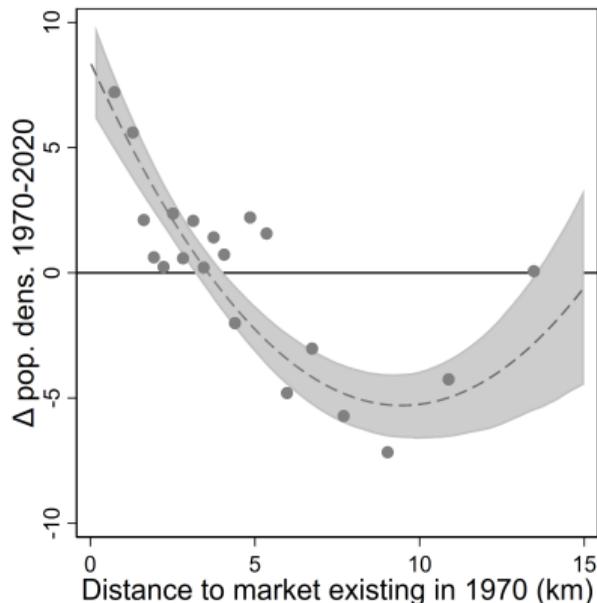
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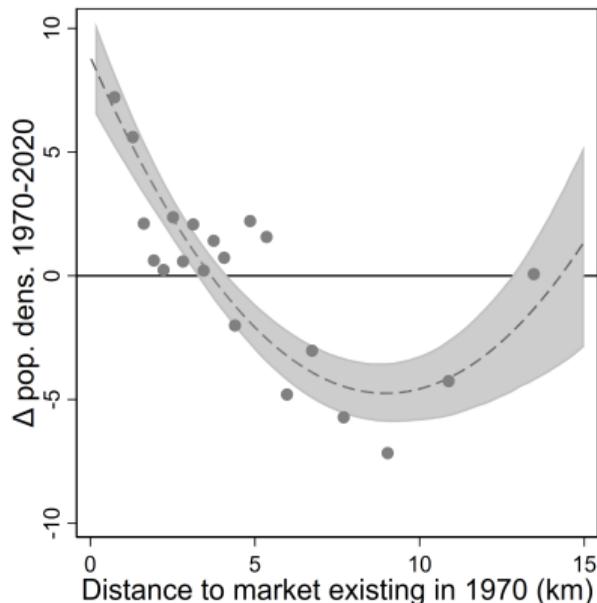
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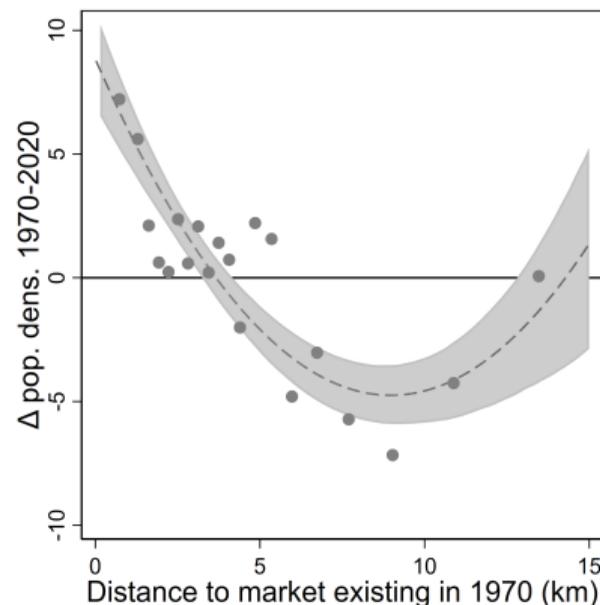
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- Within 1970 pop. dens. & urban access percentiles, places closer to markets grew faster



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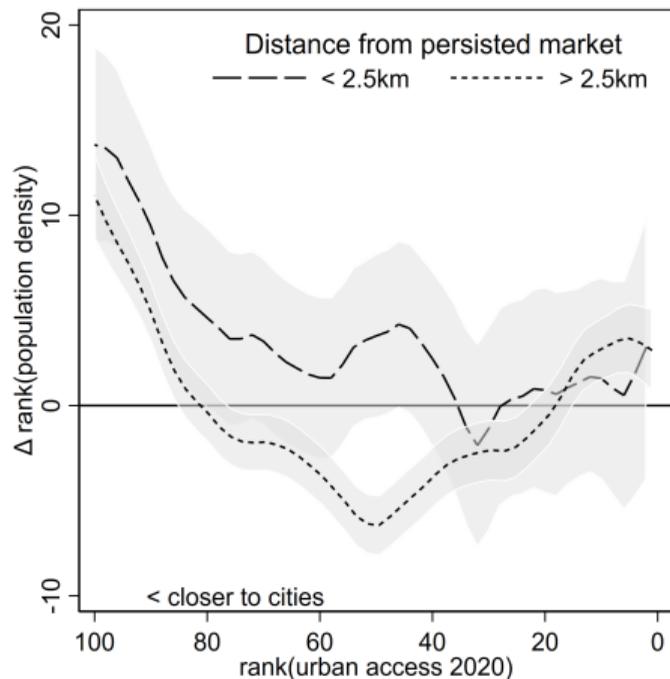
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- Within 1970 pop. dens. & urban access percentiles, places closer to markets grew faster
  - Even for marketplaces without significant population agglomeration in 1970 [More](#)



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# Urban shadow

- Market locations grew more than those away from markets, mostly so away from larger cities
  - Nuclei of agglomeration
  - 'Urban shadow' Cuberes et al. (2021)



Lines show local polynomials across gridcells either close or far from market, with associated 90% confidence intervals.  $N = 5,221$  gridcells.

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# Model

# Model overview

- Integrate marketplaces into New Economic Geography framework Fujita et al. (2001)
- Key forces
  - Increasing returns to scale in non-agricultural production
  - (Iceberg) transport costs

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- Integrate marketplaces into New Economic Geography framework Fujita et al. (2001)
- Key forces
  - Increasing returns to scale in non-agricultural production
  - (Iceberg) transport costs
  - + marketplaces as explicit locations of trade
  - + increasing returns to scale in transportation to and from marketplaces
  - + demand for certain goods ('non-tradables') concentrated at markets

# Model basics

## Geography

- City at  $r = 0$  with farmers at distance  $|r|$

## Production

- Agriculture with constant returns at  $r \neq 0$
- Manufactures with increasing returns at  $r = 0$



# Model basics

## Geography

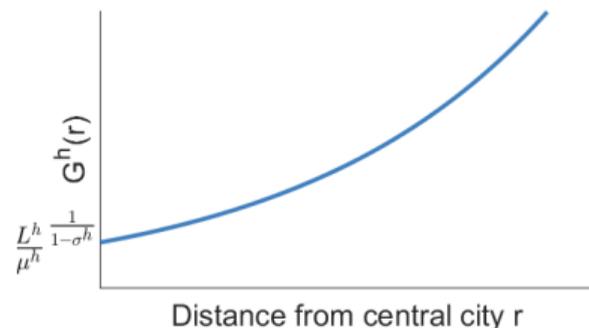
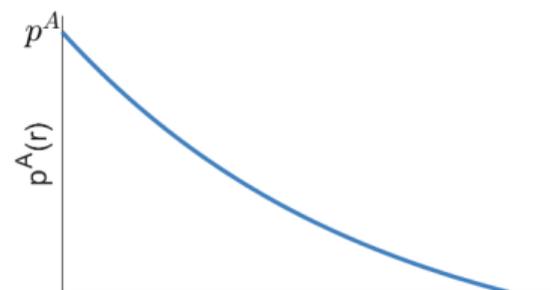
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## Production

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## Transport

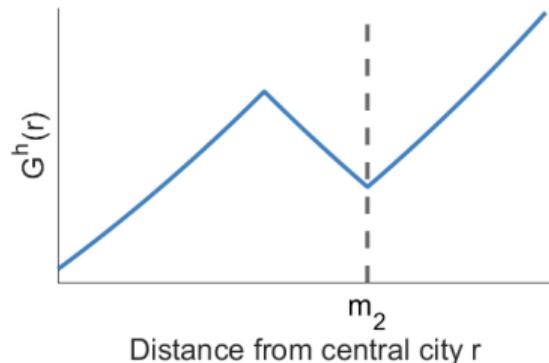
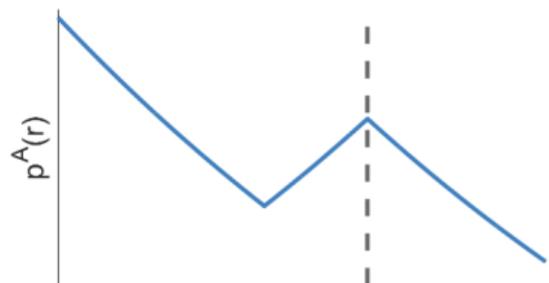
- Food supplied to city with iceberg cost  $\tau^A < 1$
- Manufactures shipped from city with  $\tau^h$



# Modelling marketplaces

- Place  $M$  markets at  $m_1 = 0, m_2, \dots, m_M$
- Cost to ship between market and central city

$$\tau_m^{Mkt} = (\tau^A)^{\frac{Supply_m}{\gamma}}$$



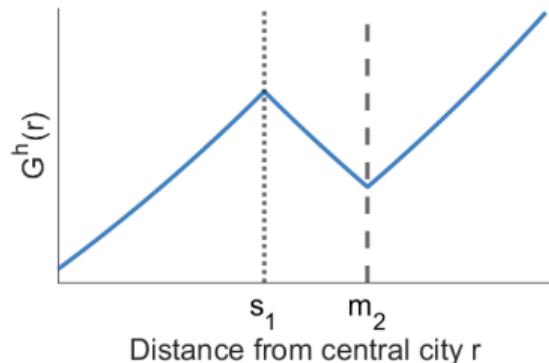
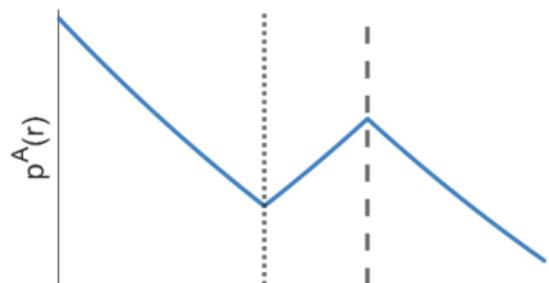
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- Farmers choose a market based on where sales income buys the highest utility Validation

$$Supply_m = \int_{s_m}^{s_{m+1}} e^{-\tau^A x} dx$$



# Modelling marketplaces

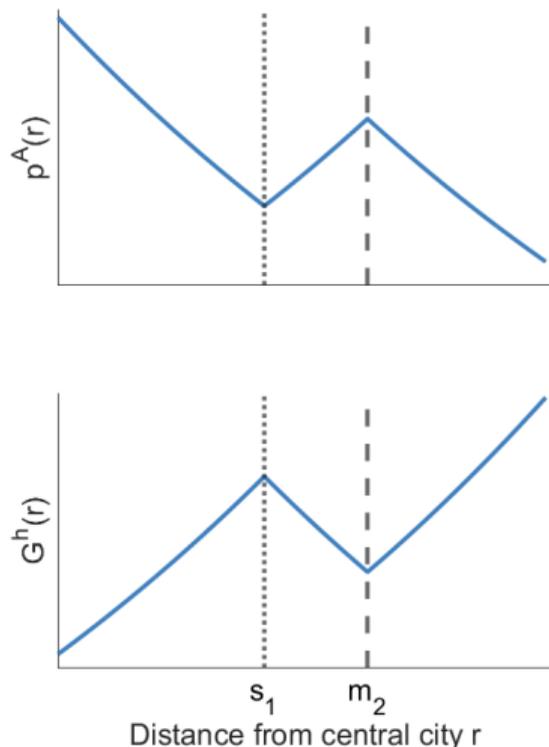
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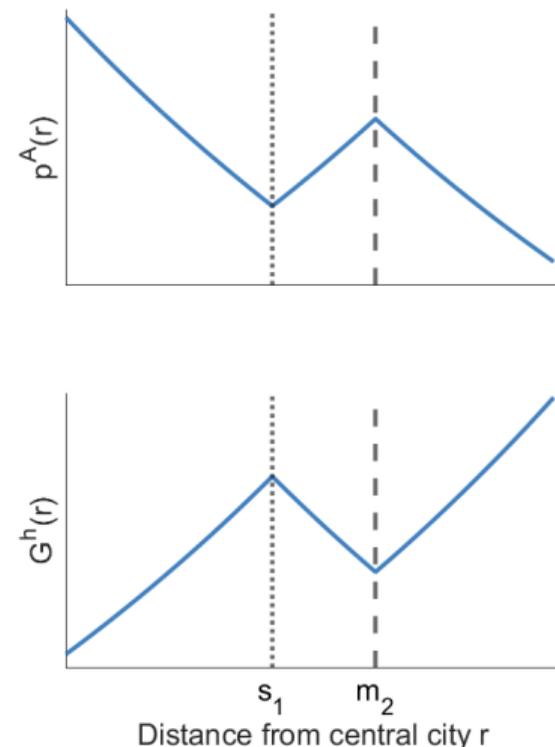
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- ⇒ IRS in transport → market concentration  
→ pop. concentration



Intro  
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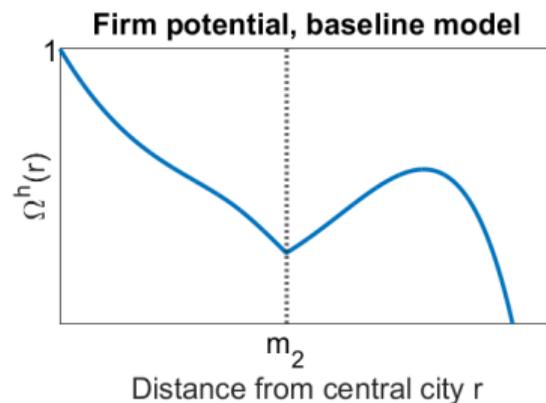
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# From markets to towns

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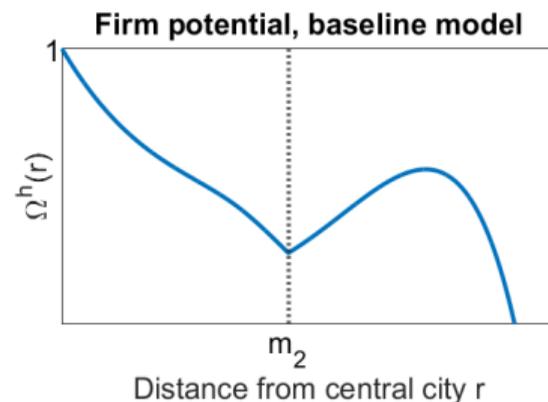
- Firms operate where they can break even
  - Revenues: dist. to consumers & competitors
  - Costs (wages): reservation wage for farmers



# From markets to towns

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⇒ Markets unattractive for firms because of import competition & profitable agriculture

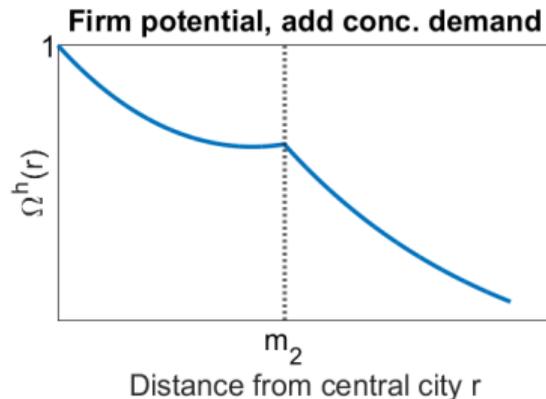
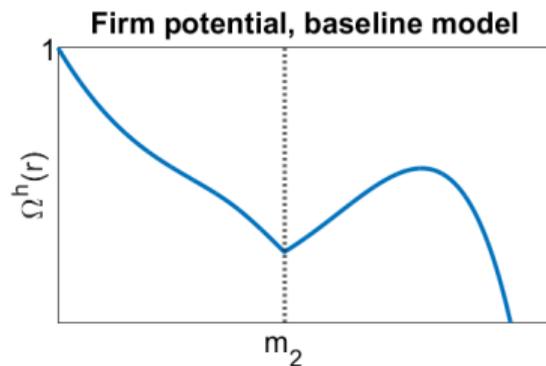


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- add '**concentrated demand**': some goods can only be consumed at marketplaces



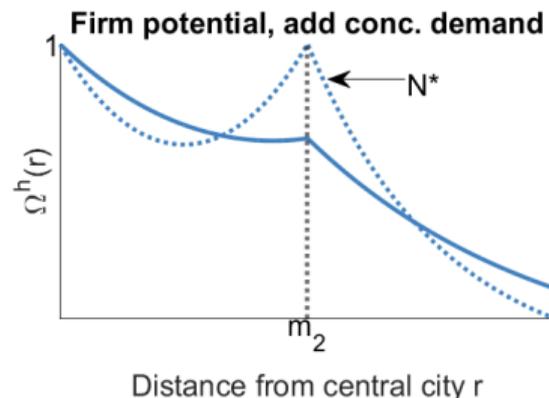
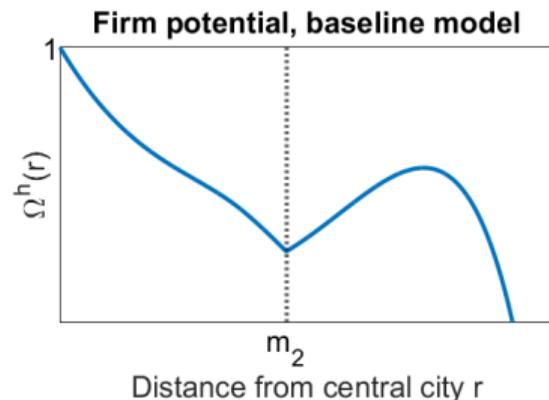
# From markets to towns

- Firms operate where they can break even
  - Revenues: dist. to consumers & competitors
  - Costs (wages): reservation wage for farmers

⇒ Markets unattractive for firms because of import competition & profitable agriculture

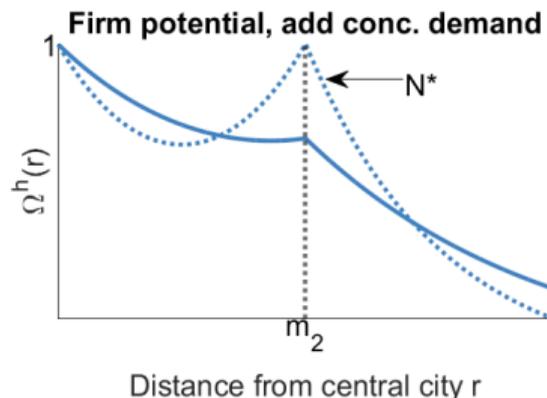
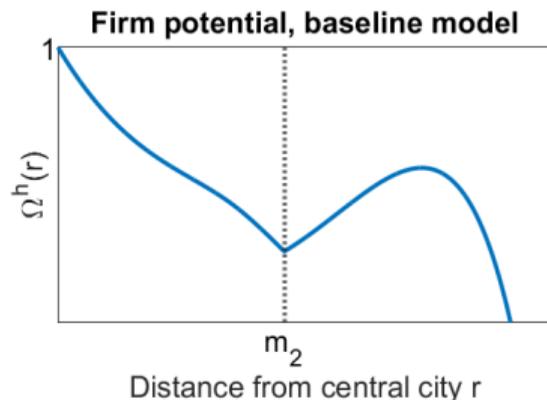
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# From markets to towns

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  - ⇒ Markets with periodic gatherings attractive for firms → population concentration
  - ⇒ Especially if far from cities → Urban shadow



Intro  
○○○○

Context  
○○

Data  
○○○○○○○○

Facts  
○○○

Model  
○○○○

Policy  
●○

Conclusion  
○

# Policy

# Rural - urban linkages & local development

- Creating 'market access' a policy priority, especially through road construction

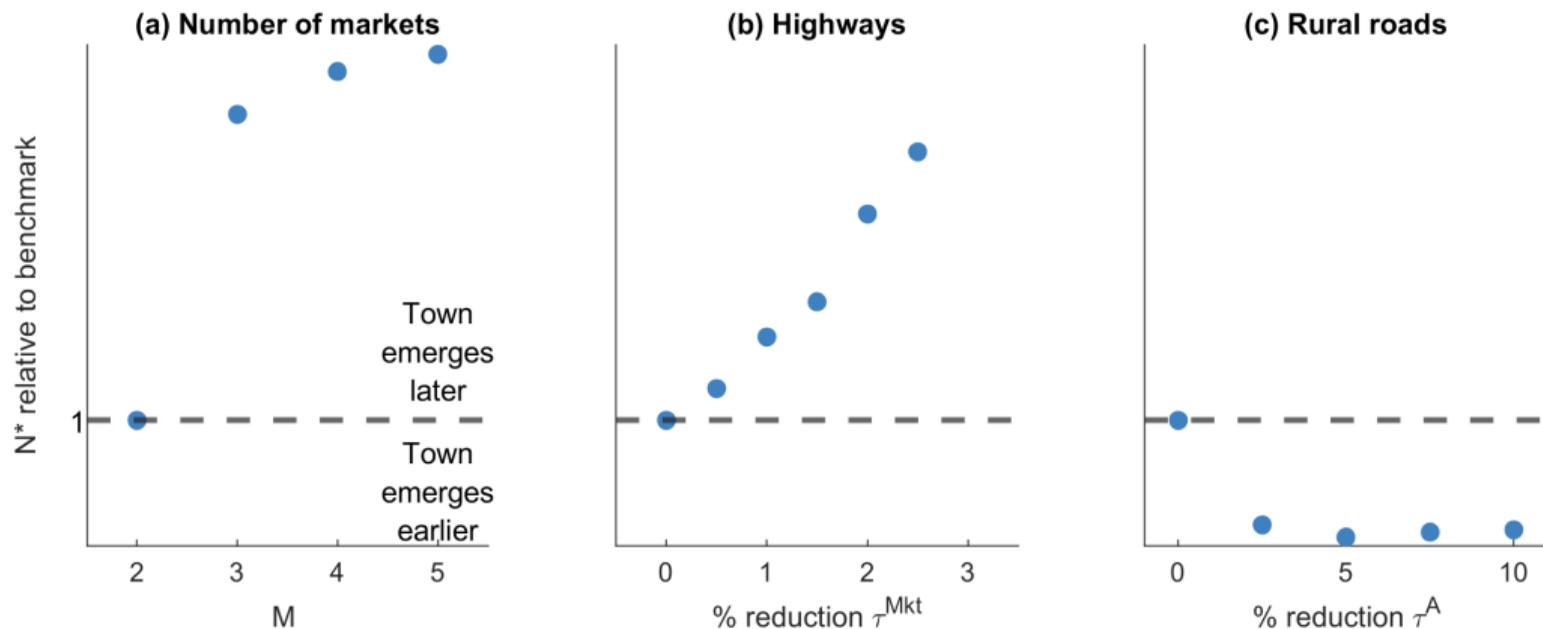
# Rural - urban linkages & local development

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- Limited evidence that roads induce local struct. transf. away from agriculture  
e.g. Faber (2014); Asher and Novosad (2020); Baum-Snow et al. (2020)

# Rural - urban linkages & local development

- Creating 'market access' a policy priority, especially through road construction
- Limited evidence that roads induce local struct. transf. away from agriculture  
e.g. Faber (2014); Asher and Novosad (2020); Baum-Snow et al. (2020)
- Use model to compare three policies in how they affect town emergence at markets
  - ① more marketplaces ( $\uparrow M$ )
  - ② 'Highways': better connection between marketplaces and central city ( $\downarrow \tau_{Mkt}$ )
  - ③ 'Rural roads': better access to marketplaces from rural areas ( $\downarrow \tau_A$ )

# Rural - urban linkages & local development



# Conclusion

- Marketplaces can shape development at and around them through lower transport costs and as nuclei of aggregation, especially in relatively remote regions
- Satellite imagery lets us study marketplaces over time & track transformation
  - [This project](#): Long-run effects on population density around marketplaces
  - [Future work](#): Short-run using remotely-sensed market activity von Carnap (2021)

Thanks!

Questions and comments welcome at  
[tillmann.voncarnap@iies.su.se](mailto:tillmann.voncarnap@iies.su.se)

# Validation

Does the method detect markets or something else?

Does the method detect markets in places where they exist?

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- does not detect known churches & mosques

OpenStreetMap

- detected outlines are in village squares, along roads

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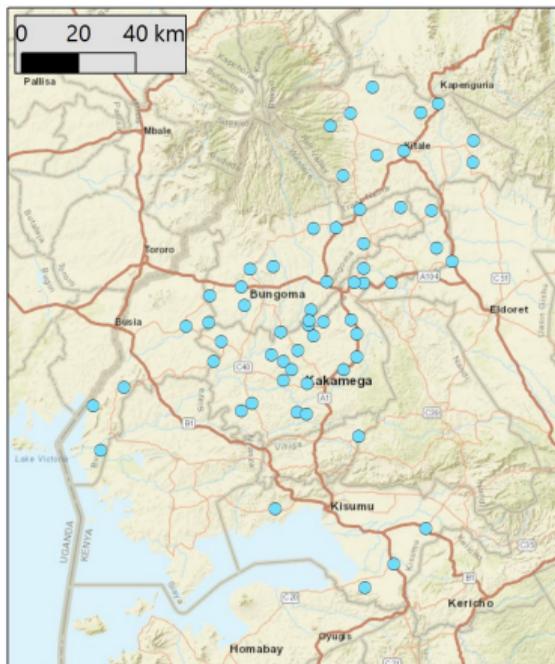
- Use 60 market centroids with market days in western Kenya  
Bergquist and Dinerstein (2020)

- Claim success if for a given validation market  $i$ :

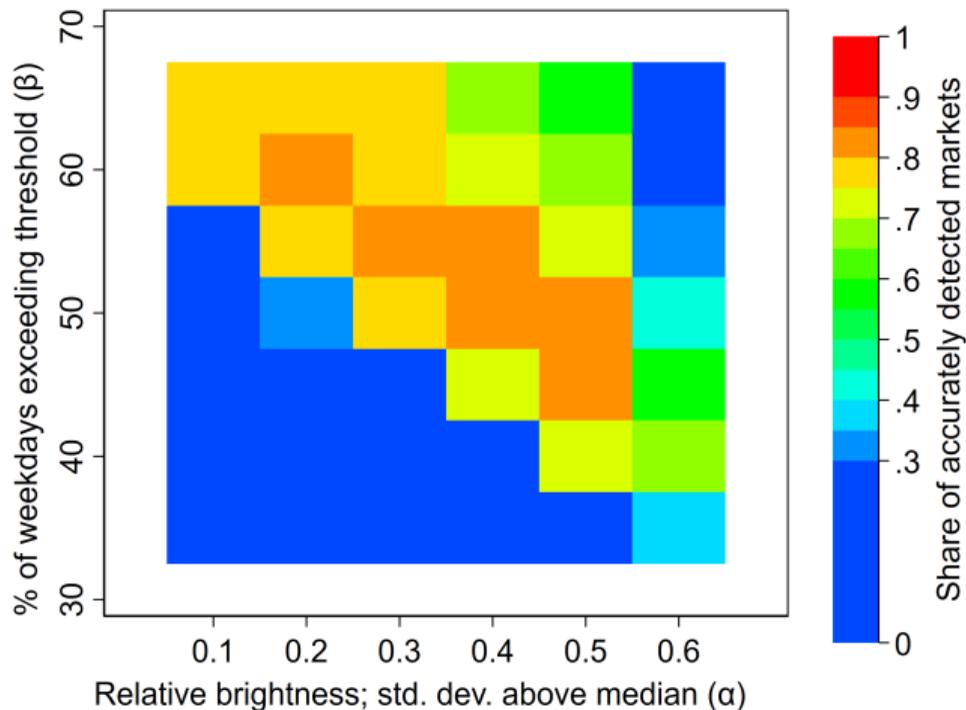
$$\{\text{detected market days}\}_i \subseteq \{\text{validation market days}\}_i$$

# Validation & Calibration

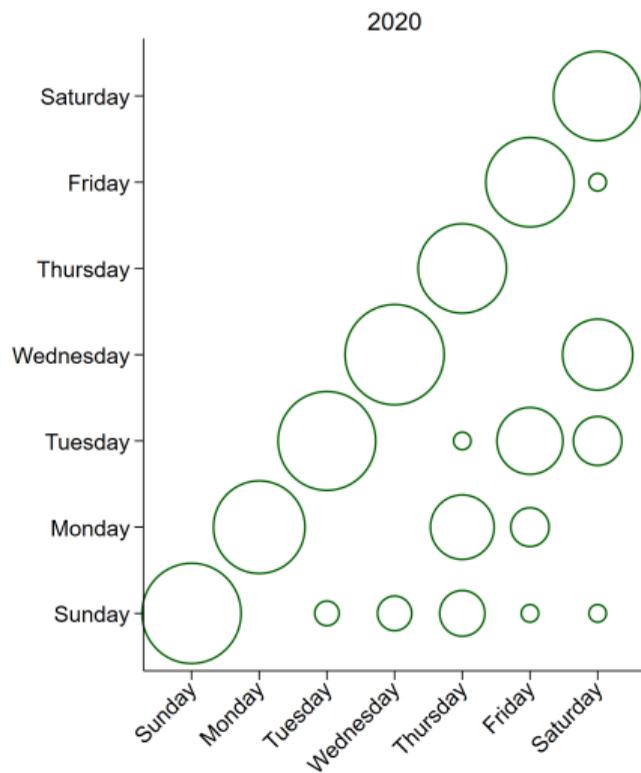
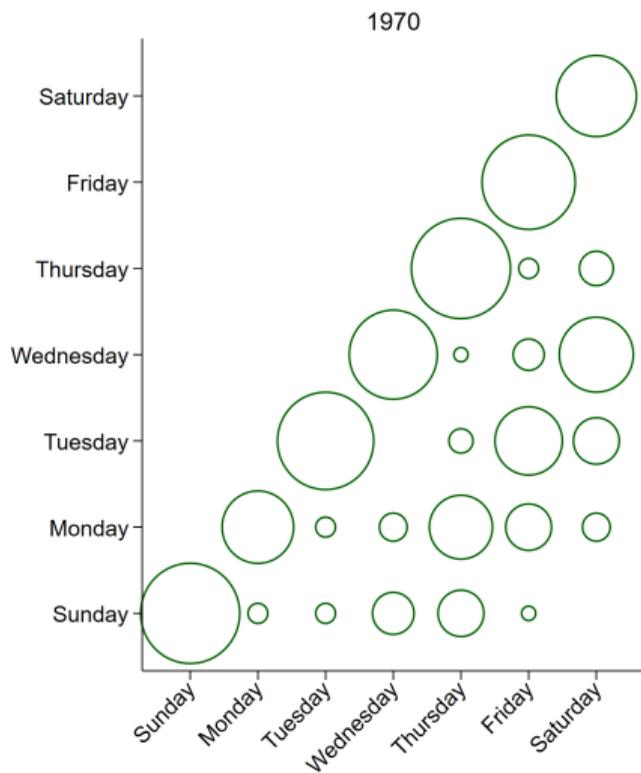
## Validation markets



## Calibration & detection accuracy



# Frequency of market day combinations

[back](#)


# Market activity - Construction & interpretation [back](#)

- **Construction:** Median brightness deviation ( $\Delta_{p,t}$ ) within detected market perimeter

## Market activity - Construction & interpretation [back](#)

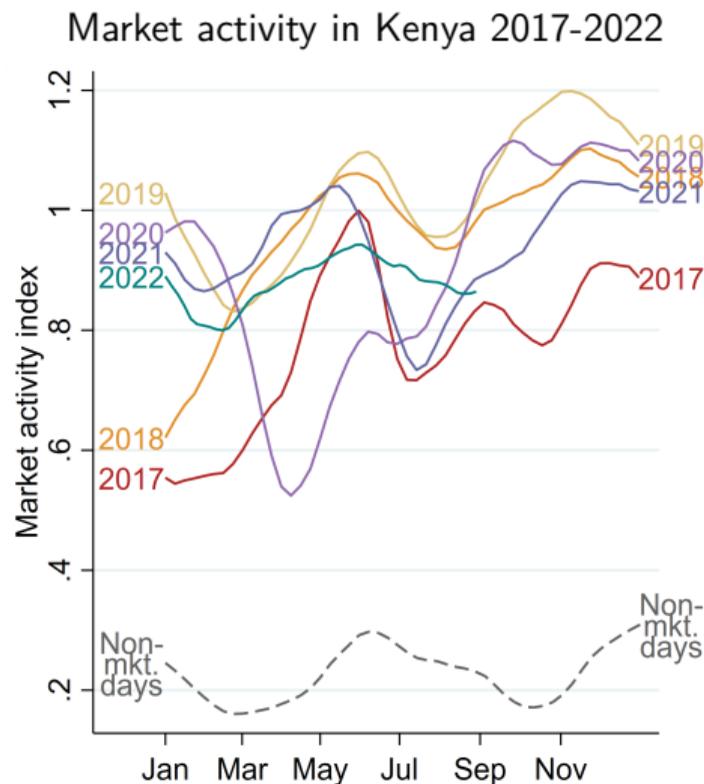
- **Construction:** Median brightness deviation ( $\Delta_{p,t}$ ) within detected market perimeter
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## Market activity - Construction & interpretation [back](#)

- **Construction:** Median brightness deviation ( $\Delta_{p,t}$ ) within detected market perimeter
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- **Interpretation:** a high-frequency measure of changes in local 'GDP'

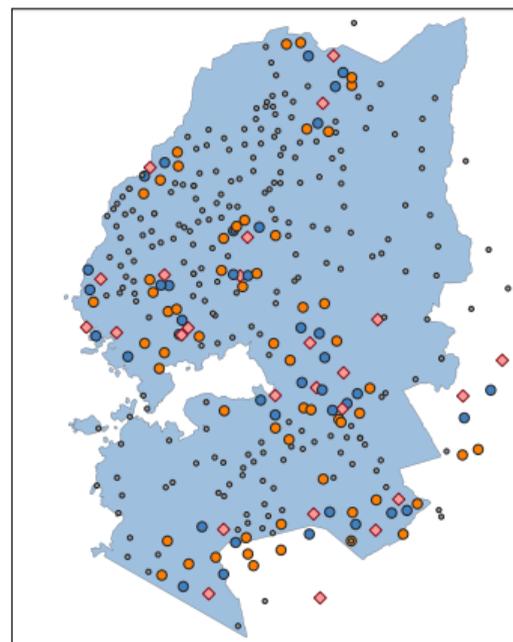
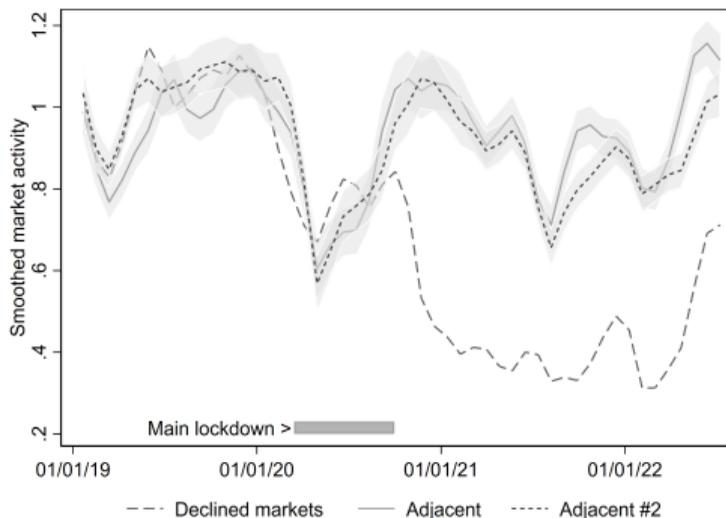
# Market activity - Construction & interpretation back

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# Substitution across markets

- After Covid-19 lockdowns, activity in some markets did not recover
- With substitution across markets, those adjacent to declined ones should grow



Markets after Covid-19 lockdowns

- ◆ Declined
- Adjacent
- Adjacent #2

# Regression results population concentration [back](#)

	Dep. Var: % change in population density rank			
	(1)	(2)	(3)	(4)
<i>Panel A: Gridcell distance to market in 1970</i>				
<2.5km vs. >2.5km	3.962*** (0.878)	-1.622 (1.765)	7.832*** (1.351)	
<i>Panel B: Gridcell distance to declined market</i>				
<2.5km vs. >2.5km	-0.127 (0.991)	-4.413** (1.948)	3.743** (1.494)	
<i>Panel C: Gridcell distance to persisting market</i>				
<2.5km vs. >2.5km	9.817*** (1.259)	8.388*** (3.206)	9.306*** (1.758)	
<i>Panel D: Markets by weekly market days</i>				
Two vs. one				5.527 (3.862)
Sample	All gridcells	Least populated 1970	Most populated 1970	Gridcells with markets
Fixed effects				
1970 Urb. Acc.	Yes	Yes	Yes	No
1970 Pop. Dens.	Yes	Yes	Yes	Yes
N	5,221	1,723	1,722	167

Robust standard errors in parentheses; \*  $p < 0.10$ , \*\*  $p < 0.05$ , \*\*\*  $p < 0.010$

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