Does Market Integration Increase Rural Land Inequality? Evidence from India

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Introduction

- Have you ever wondered why farms in the US are sprawling agrobusinesses while farms in developing countries tend to be small family plots?
- US vs India:
  - Land endowment
  - Market integration
- U-shape: globally, land inequality fell 1900-80 and since has been increasing along with market integration.
- Did transport infrastructure investments play a role in the observed turnaround in land inequality trends?

Braverman and Stiglitz (1989) Theory

- Theoretical analysis by **Braverman and Stiglitz (1989)** suggests that **lower trade costs**—from improvements in transport infrastructure—can **increase land inequality** in villages when credit markets are imperfect.

- Large farmers, can access credit, use increasing returns tech, buy land from smaller credit constrained farmers, leading to **higher land inequality.**

Does the Data Agree with the Theory?

- To find out, we estimate the impact of market access on land inequality in India:

$$\ln(LGini)_j = \delta_0 + \delta_1 \ln(MA)_j + \Gamma X_j + \zeta_j$$

- $\ln(LGini)_j$ = land Gini index in 2012, logged
- $\ln(MA)_j$ = market access gravity measure, logged
- X_j =observable, exogenous control variables (slope, elevation, crop suitability, rain, temperature, rain CV, temp. seasonality, pop. density 1975.)
- Main data:
  - India Human Development Survey (IHDS) 2012,
  - Market Access Index from *Road Map of India,* 1996 and 1991 population

$$MA_{i,1996} = \sum_{i \neq j} \left[\left(\frac{1}{tt^{\theta}_{ij,1996}} \right) P_{j,1991} \right]$$

Identification Challenge

- Impossible to gather all the variables in X_j that determine road placement. Thus, market access is **endogenous** and so OLS would be biased.

$$\ln(LGini)_j = \delta_0 + \delta_1 \ln(MA)_j + \Gamma X_j + \zeta_j$$

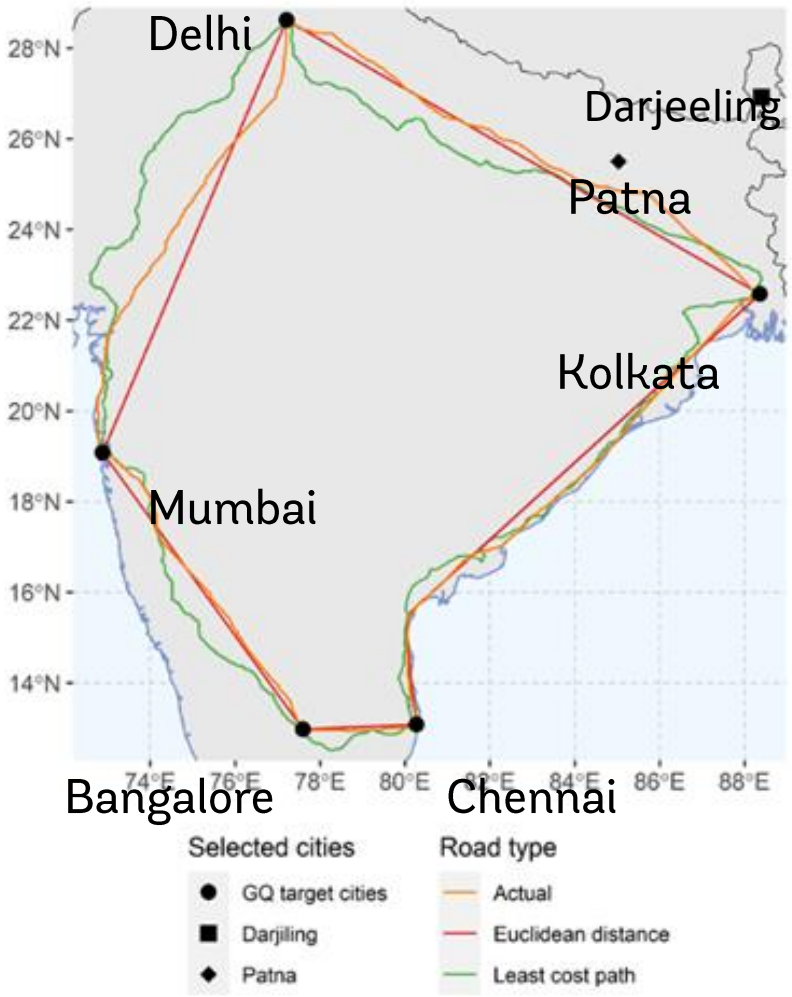
- To account for endogeneity, we instrument for market access with distance to the Golden Quadrilateral:

$$\ln(MA)_j = \alpha_0 + \Phi X_j + \boldsymbol{\gamma GQ_j} + \nu_j$$

- GQ_j = distance to *linear* Golden Quadrilateral network

India's Golden Quadrilateral

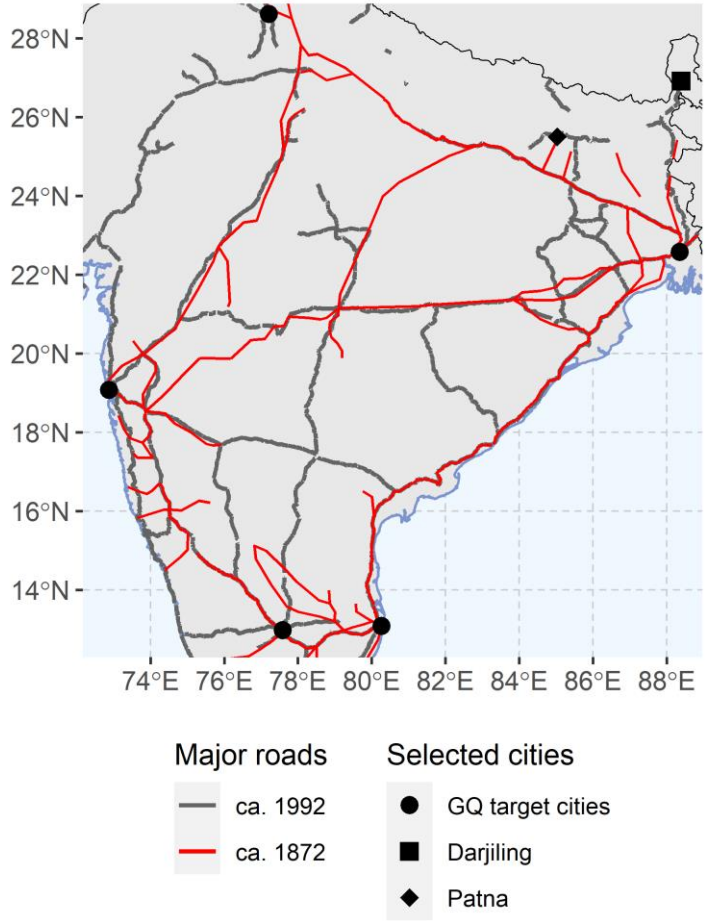
- India is a leader in transportation investment and spatial integration.
- During the colonial era, the British invested heavily in transportation.
- The Golden Quadrilateral system of roads dates back centuries.
  - Connecting Delhi (North), Kolkata (East), Mumbai (West), and Chennai (South).



India's Golden Quadrilateral

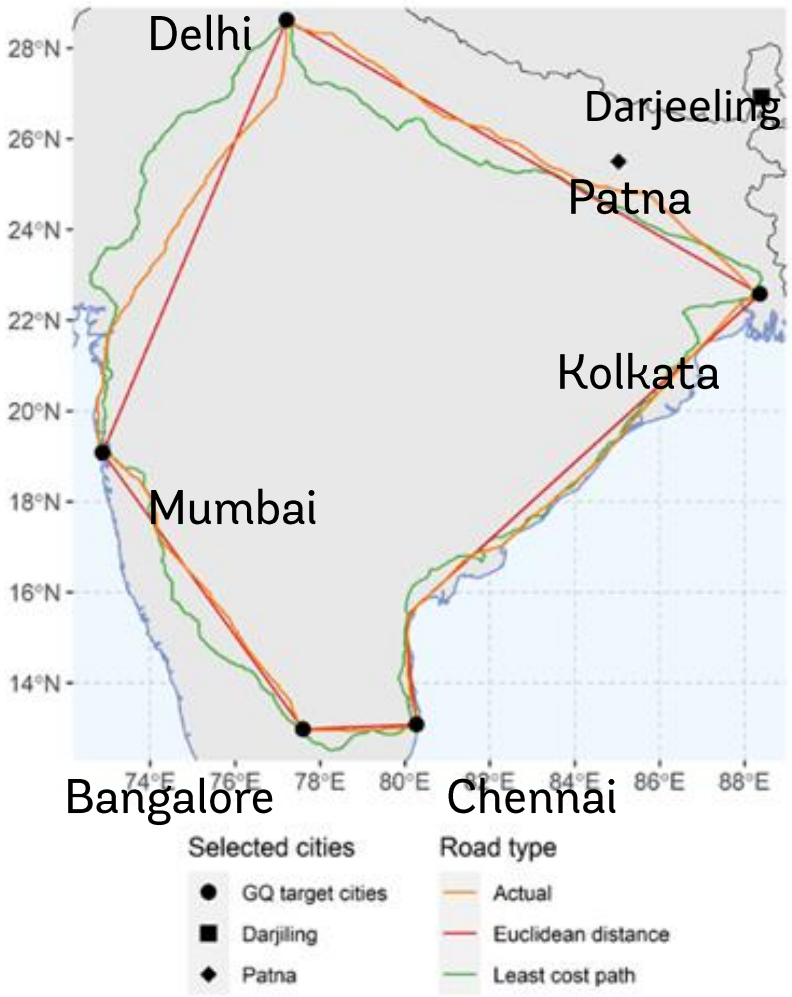
- The GQ network has been the main transport artery for a long time, since even before the Mughal period.
- For example, the Grand Trunk Road connects the Delhi-Kolkata arm of the GQ network.
- Our analysis focuses on the long-term cumulative effects of better access to markets.

Historical Roads of India, 1872 vs GQ in 1992



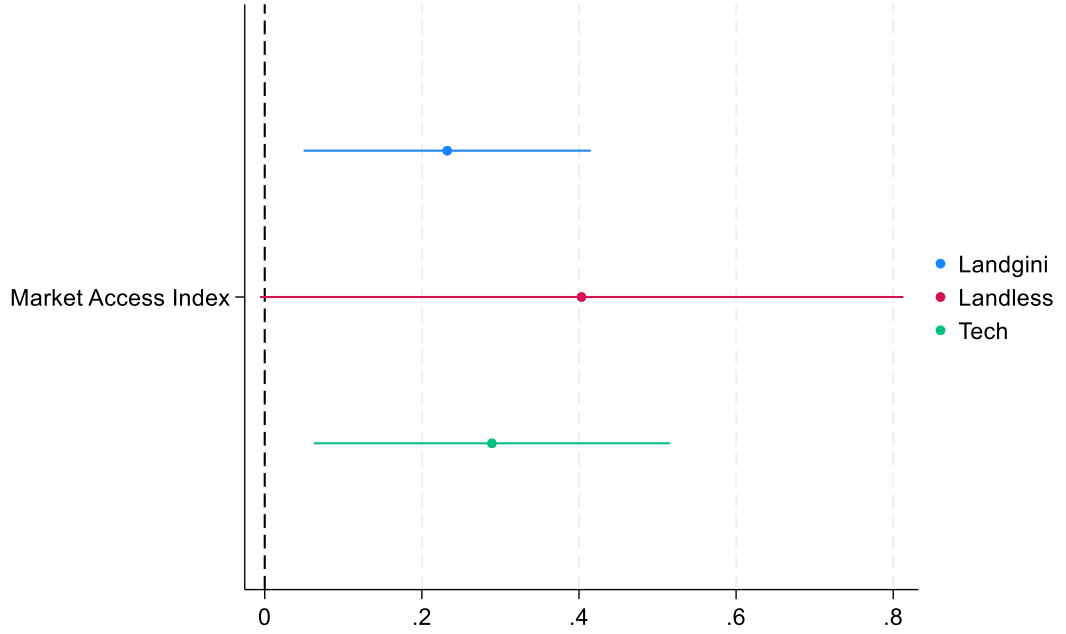
GQ: Inconsequential Place Design

- Most of the highways connecting major (target) cities.
- Other cities and towns that happen to be located near the highway see their market access improve, quasi randomly (Redding and Turner 2015).
- For example, Patna was not targeted but is closer to the GQ highway than Darjeeling and so incidentally has better market access.
- While the actual GQ roads may be prone to politics, we follow Faber (2014) and rely on a hypothetically linear network.



Estimated Results

- Results indicate that a 10% increase in MA increases land Gini by 2.3% and landlessness by 4.0%.
- Analysis supports Braverman and Stiglitz theory: a 10% increase in MA increases ag. tech adoption by 2.9%.
- These results are robust to alternative instrumental variables or MA.
- There is evidence of increasing land sales and deepening of credit, but less robust.



	(1) Ln(Land Gini)	(2) Ln(Landless)	(3) Ln(Tech)
Ln(Market Access)	0.232**	0.403*	0.289**
	(0.093)	(0.209)	(0.116)
First stage			
Ln(dist. to linear GQ)	-0.128***	-0.148***	-0.148***
	(0.051)	(0.044)	(0.044)
F stat.	6.25	11.14	11.14
Obs.	200	212	212

Market Access Index

Ongoing revisions:

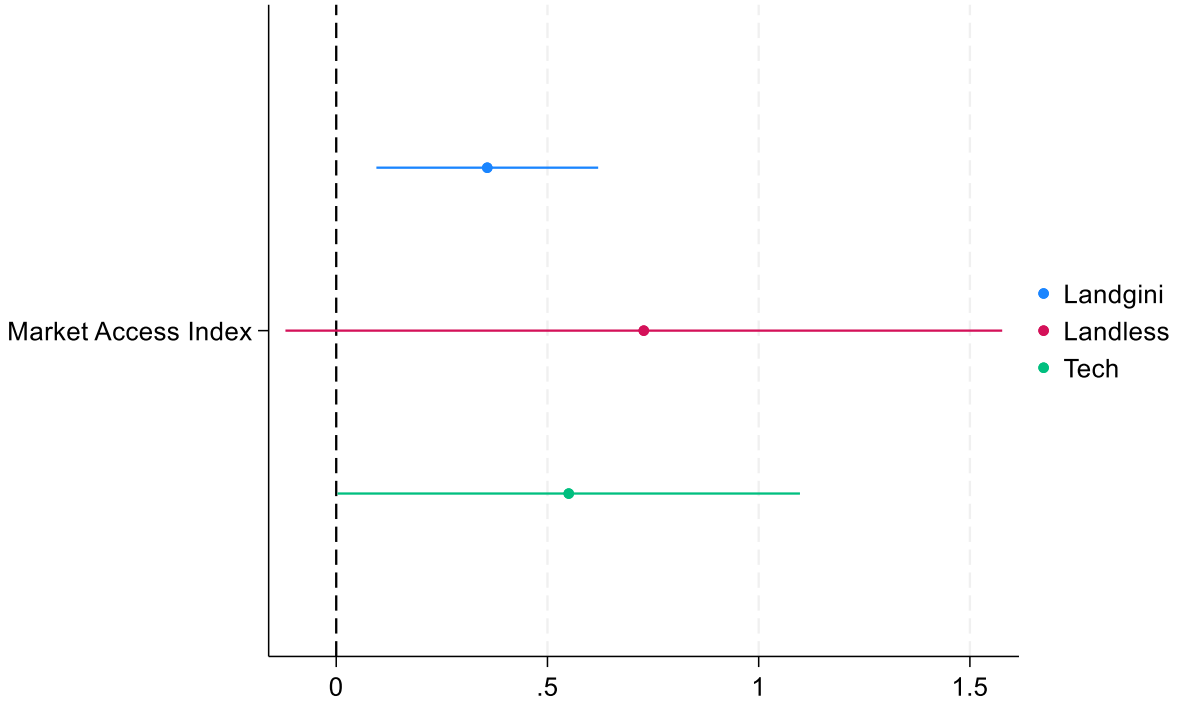
- We are working to expand our data.
- Building on Allen and Atkin (2022) "Volatility and Gains from Trade" we take the 1996 scanned Road Map of India, assign travel speeds based on colors.
- From this, we get travel speeds between pairs of districts. Together with 1991 population, we calculate market access index:

$$MA_{i,1996} = \sum_{i \neq j} \left[\left(\frac{1}{tt^{\theta}_{ij,1996}} \right) P_{j,1991} \right]$$

Estimated Results: New MA

Main results with expanded sample are consistent:

- A 10% increase in MA increases…
- … land Gini by 3.5%
- … landlessness by 7.3%.
- … technology adoption by 5.5%



	(1) Ln(Land Gini)	(2) Ln(Landless)	(3) Ln(Tech)
Ln(Market Access)	0.358***	0.728*	0.550**
	(0.134)	(0.433)	(0.279)
First Stage			
Ln(Dist. to linear GQ)	-0.067***	-0.059***	-0.060***
	(0.014)	(0.012)	(0.012)
F	23.38	22.99	23.28
Obs.	335	353	354

To recap

We explore whether market integration leads to land consolidation.

Using survey and geospatial data in India, we find evidence that:

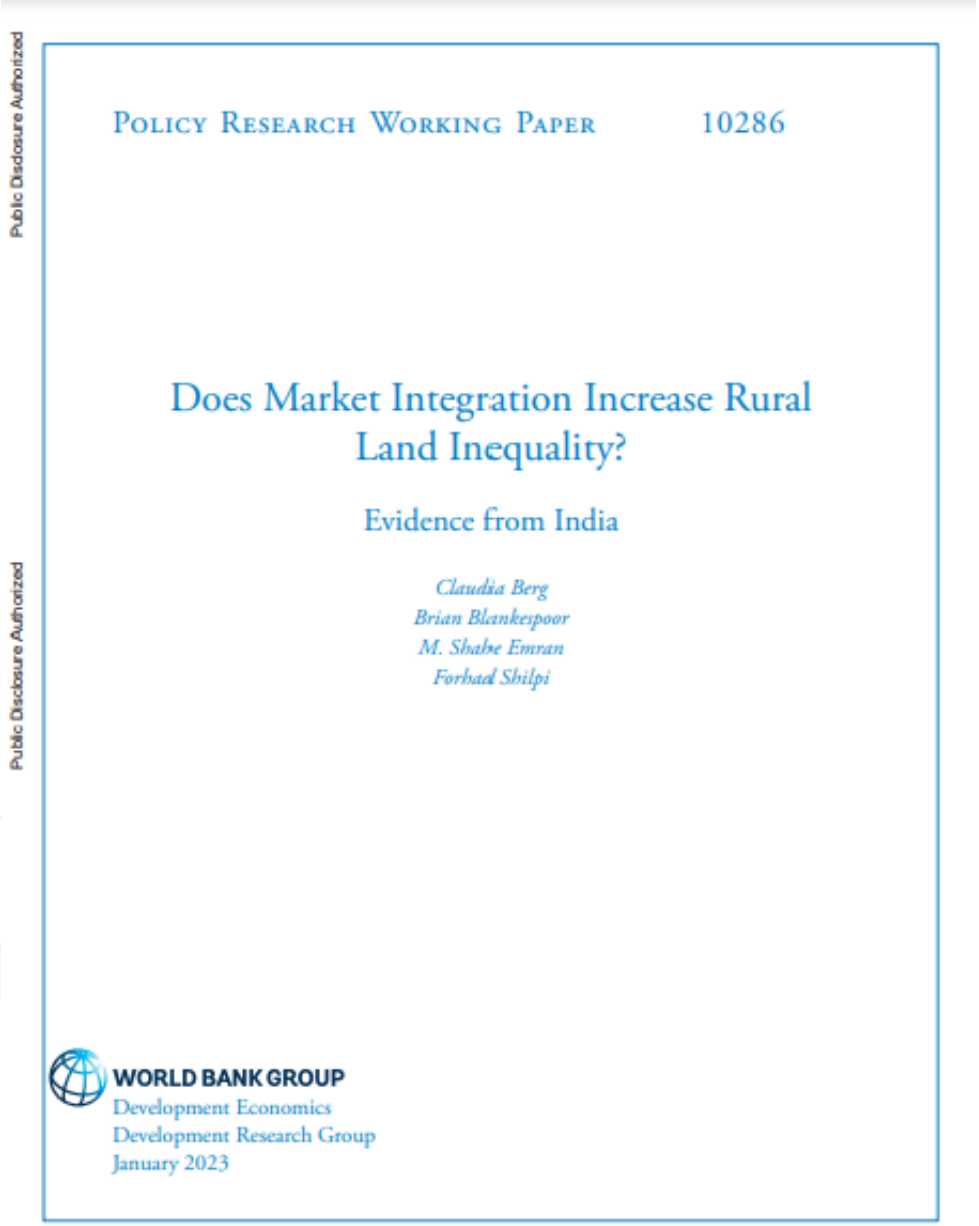
- The huge investments in roads and highways are likely to increase land inequality.
- Big push to integrate the rural hinterlands would help in increasing returns to technology adoption and thereby agricultural growth.

THANK YOU!

ANNEX (the just in case slides)

See also…

- Policy Research Working Paper
- I4I Blog
- Under revision for Journal of Economic Geography



Data Sources

- **India Human Development Survey II** in 2012: high quality, nationally representative household survey covering 42,152 households
- **Travel times from Allen and Atkin (2016)**
- 1990 District Population from Brinkhoff (2020) http://www.citypopulation.de
- 1961 population density (Vannerman and Barnes 2000)
- Climatological variables:
  - Rainfall, temperature (BioClim)
  - Elevation (SRTM)
  - Slope (Verdin et al. 2007)
  - Crop Suitability (GAEZ)

Key Variables

- Land Inequality:
  - Land Gini Index
  - Share of landless households
- Mechanisms:
  - Technology adoption
  - Land Sale

- Market Access:
  - Gravity measure of population weighted by travel time
  - $MA_{i,1996} = \sum_{i \neq j} \left[\left(\frac{1}{tt_{ij,1996}^{\theta}} \right) P_{j,1990} \right]$
- Instrumental Variables:
  - Colonial Railroad Length
  - Euclidean distance to GQ

Estimated Results from p (MA AA)

- We employ 3 main estimators:
  - Railroad IV
  - GQ IV
  - Lasso IV
- Results indicate that a **10%** increase in MA increases land Gini by **2.5%** and the share of landless hh by **6.8%.**
- Analysis supports Braverman and Stiglitz theory: a **10%** increase in MA increases ag. tech adoption by **3.5%**.