Towns and Rural Land Inequality in India

The World Bank Land Conference 2024

Manaswini Rao (U Delaware)
Juan Eberhard (Universidad Andres Bello)
Prashant Bharadwaj (UC San Diego)

May 2024

Overview

- Land is important: implications for who migrates and the preponderance of small and marginal farmers
- We document three empirical patterns on the spatial distribution rural land inequality and urban areas in India
- We explain the relationship through a parsimonious model linking landholding inequality and structural transformation
    - U-shaped agricultural productivity-landholding size relationship and land bequest
    - Urban opportunity cost is a function of urban wages and migration costs
    - Summed over distribution of individuals in a village economy generates observed landholding gini patterns

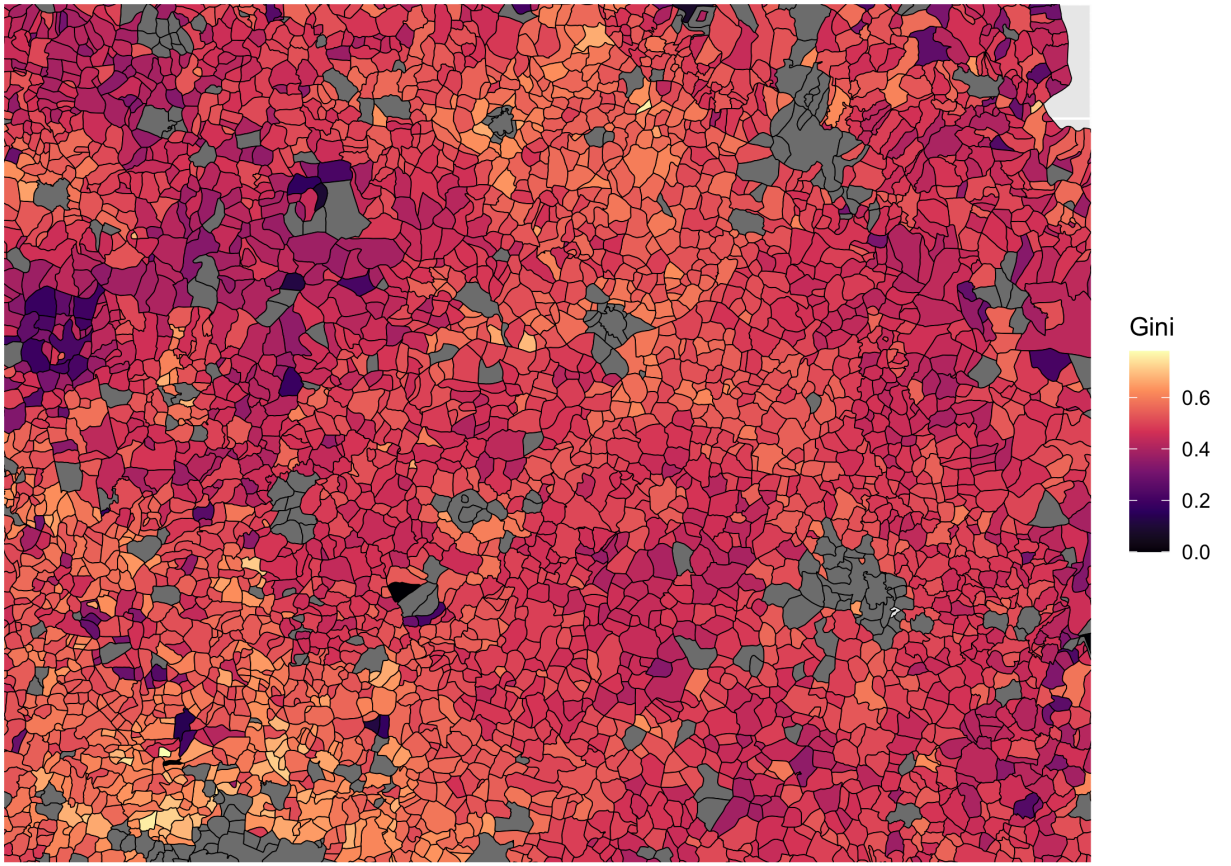
Contribution

- Economic implications of land reforms: Banerjee, Gertler, and Ghatak (2002), Bardhan, Luca, Mookherjee, and Pino (2014), Besley, Leight, Pande, and Rao (2016), Adamapoulos and Restuccia (2020), etc.
- Structural transformation and spatial frictions: Heise and Porzio (2021), Young (2013), Bryan, Chowdhury, and Mobarak (2014), Bazzi, Gaduh, Rothenberg, and Wong (2016), Lagakos, Mobarak, and Waugh (2021), etc.
- Implications for poverty traps: Banerjee and Newman (1993), Balboni, Bandiera, Burgess, Ghatak, and Heil (2021), etc.
- U-shaped production function: Cornia (1985), Barrett (1996), Gaurav and Mishra (2015), Foster and Rosenzweig (2017), Golin and Udry (2021), etc.

Data

- Farmer Income Support Program: Universe of landholding by farmer for one large state in India in 2019
- Socio-Economic Caste Census 2011: HH-level Census covering assets including land
- Village-level Population and Economic Censuses: Population census data abstracts at village-level
    - Cross-walk: SHRUG
- IHDS HH Panel: All-India Household Panel Data over 2 rounds (2005 and 2017)

Raw spatial patterns



$$Gini_v = 2 * \frac{1}{N * 100} \sum_{i \in v} (p_i - l_i)$$

Using land records data, where p_i is the percentile rank of farmer i in village v, and l_i is the cumulative share of land held by all farmers ordered by their percentile rank below i.

Pattern 1: Distance Correlation

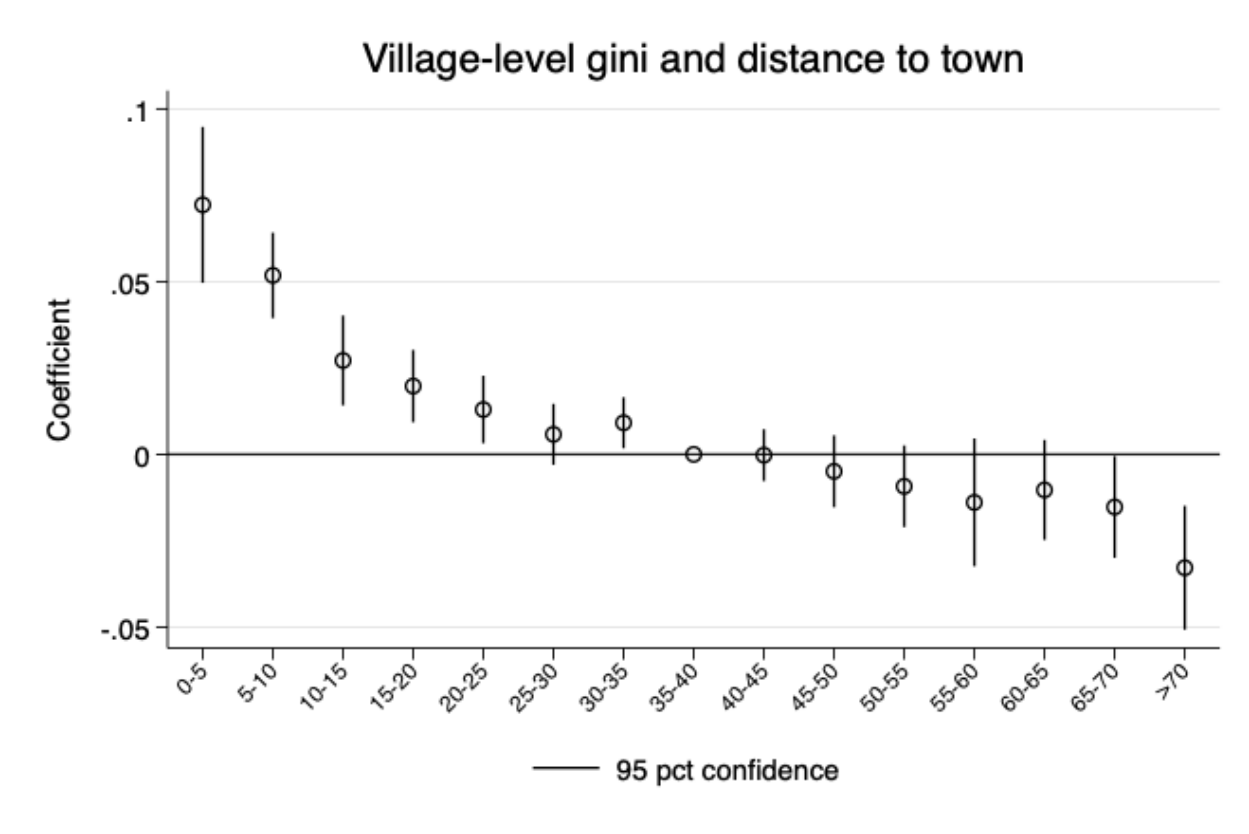
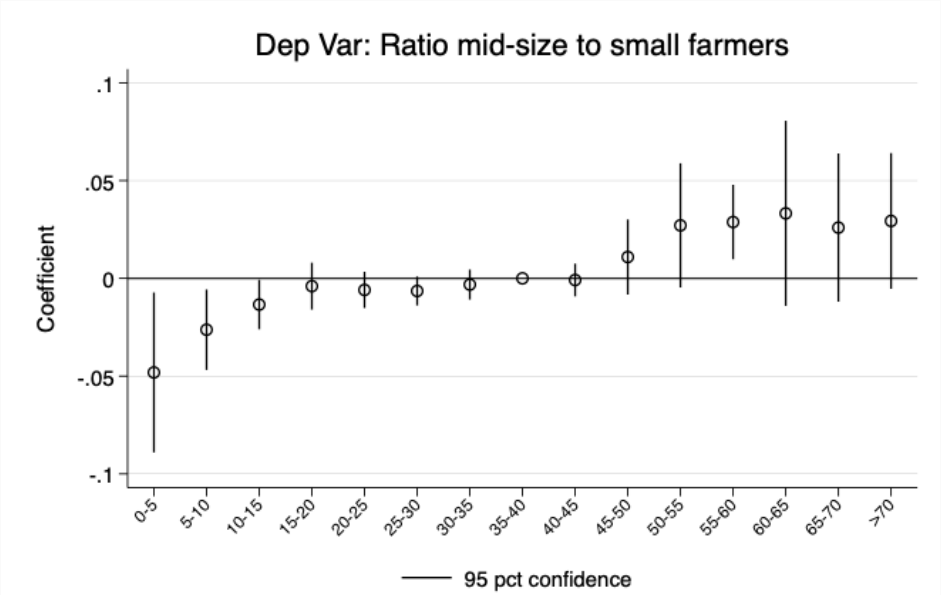
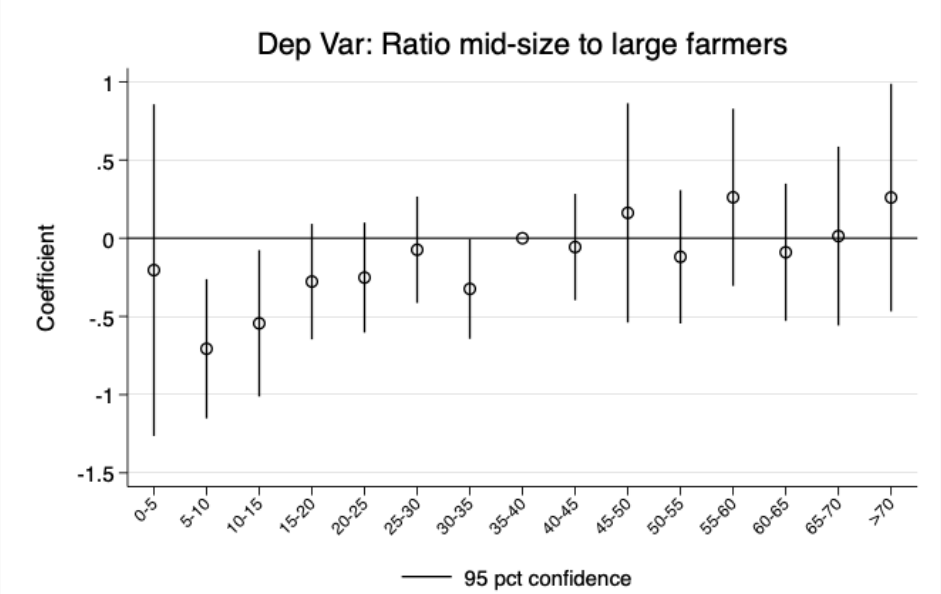


Figure 1: $Gini_{vm} = \delta_m + \sum_{j=0, j\neq[35,40)}^{70+} \beta_j D_j + \epsilon_{vm}$, where D_j is 5 km bins and δ_m is sub district fixed effect. Leave-out group is villages with $35-40$ km distance from the nearest town. Error bars present 95% confidence interval when standard errors clustered by the nearest town.

Pattern 2: Farm Size farmers





Pattern 3: Town Size Correlation

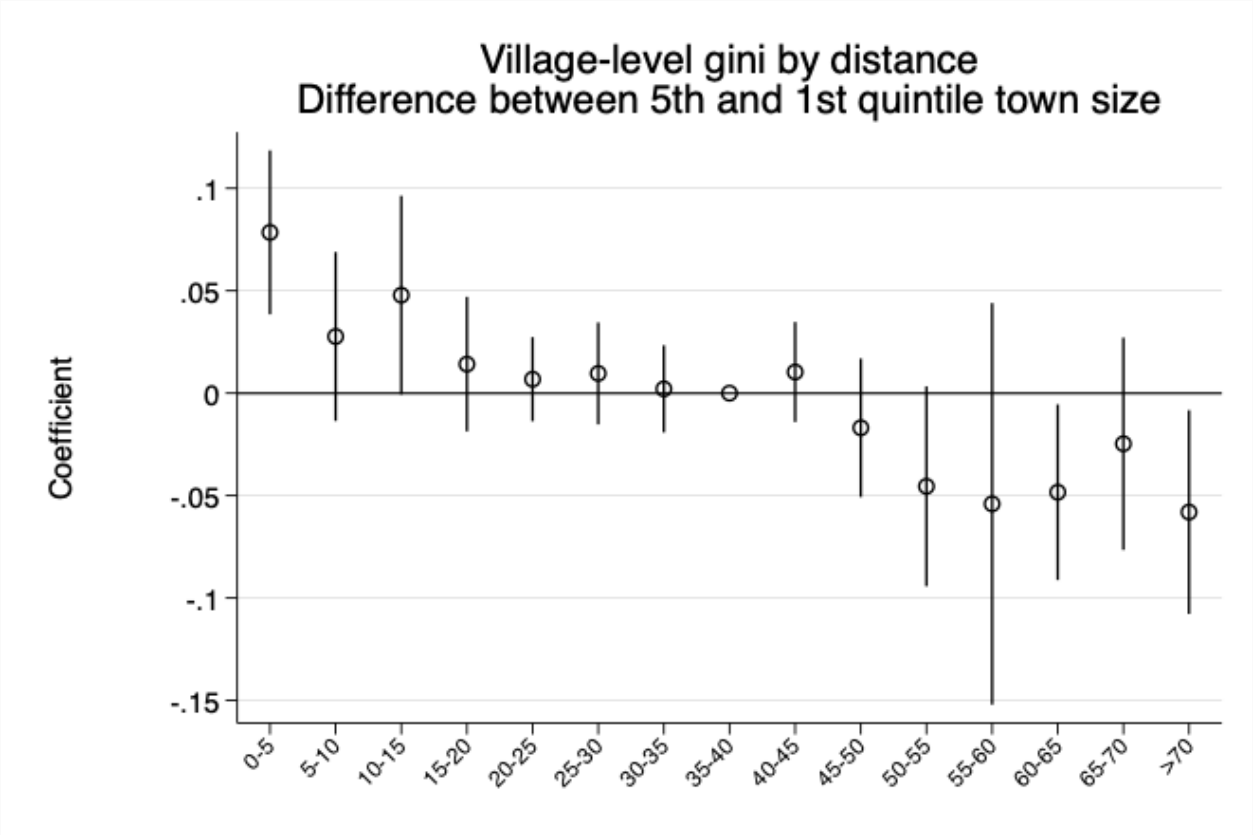


Figure 2: $Gini_{vm} = \delta_m + \sum_{j=0, j\neq[35,40)}^{70+} \gamma_j \text{Large Town}_{vm} \times D_j + \sum_{j=0, j\neq[35,40)}^{70+} \beta_j D_j + \alpha \text{Large Town}_{vm} + \epsilon_{vm}$

Model Summary

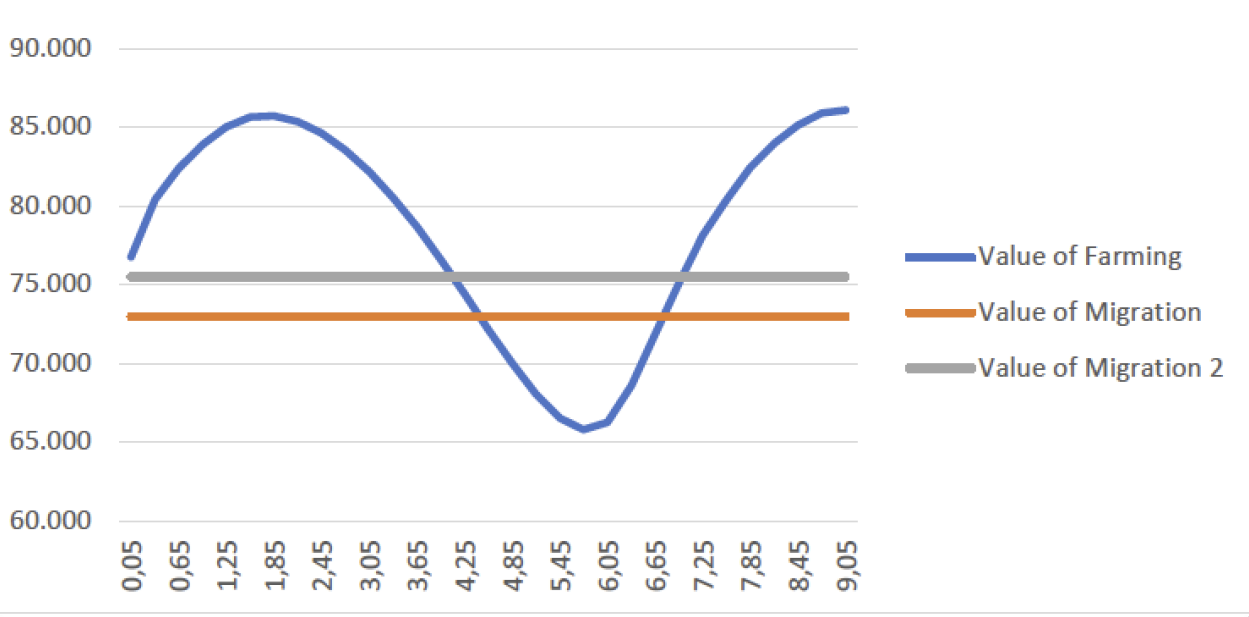
- Farmer's problem: chooses to either acquire or sell land depending on:
  - Land size: agricultural productivity follows U-shaped relationship with land
  - Own age and household size: land size changes over time due to any new acquisition and bequest (probability increases with farmer's age)
  - Urban income net of migration costs: Larger towns offer better wages and gains reduce with distance
- Model Assumptions
  - Partial equilibrium: village-level land gini by aggregating decisions across the distribution of farmers with different land endowments
  - Exogenous relative price of land
  - Exogenous urban wages

Model Set-Up

$$
\begin{aligned}
V(L, A, N, P_L) &= \max_{I} u(c) + \beta[\lambda(A, N) V(\frac{L'}{N+1}, A+1, 0, P_L) \\
&\quad + (1 - \lambda(A, N)) V(L', A+1, N, P_L)] \\
c + P_L I &\leq f(L) \\
L' &= L + I \\
f(L) &= L(\alpha_1 L^{\phi} + \alpha_2 L + \alpha_3) \\
\lambda(A, N) &= \begin{cases} 0 & \text{if } N = 0 \\ g(A, N) & \text{if} N > 0 \end{cases}
\end{aligned}
\tag{1}
$$

$g(A, N)$ is an increasing function of A and N, and
$\lim_{N \to 0} g(A, N) = 0 \quad \wedge \quad \lim_{A \to \infty} g(A, N) = 1$

Value Function and Migration



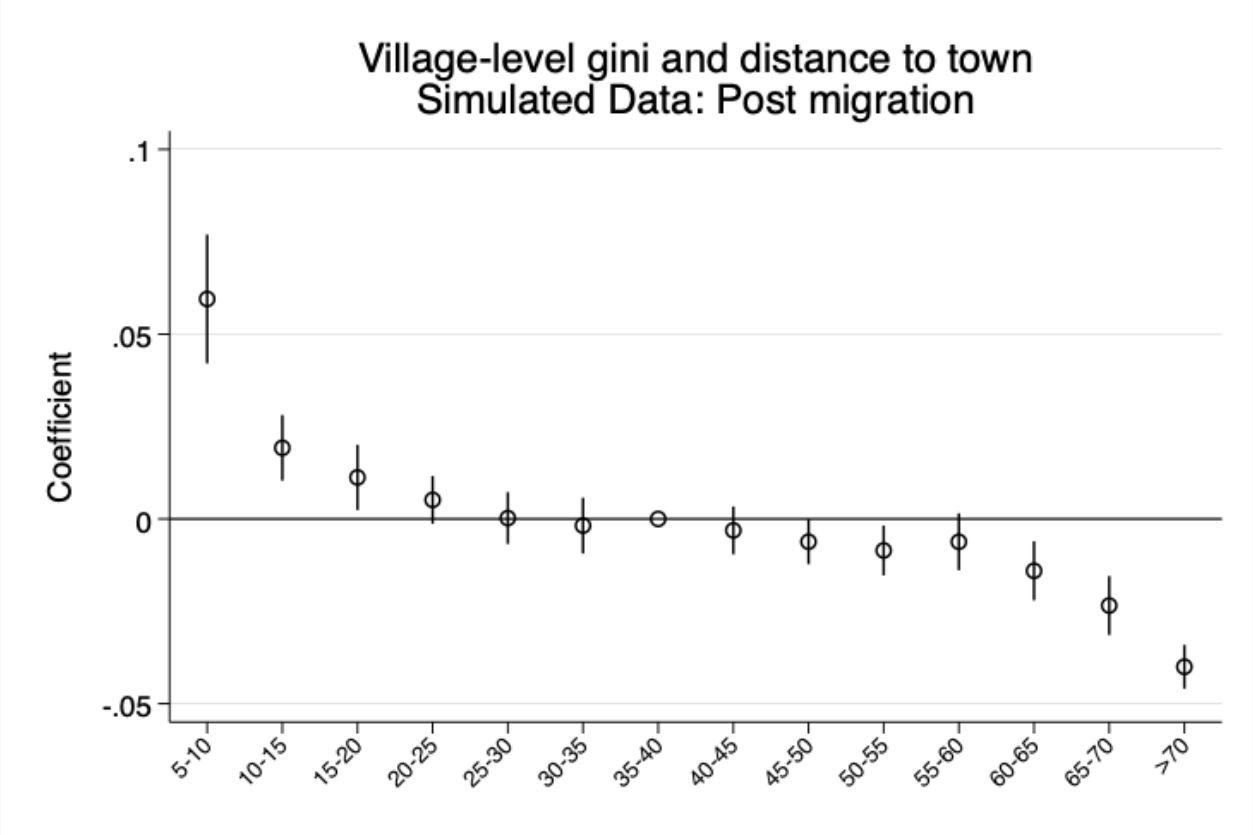
Empirical support for model assumptions

- U-shape productivity-land size relation observed with FAO GAEZ Yield Achievement Ratio U-Shape
- HH size and age independent of landholding size HH Demography

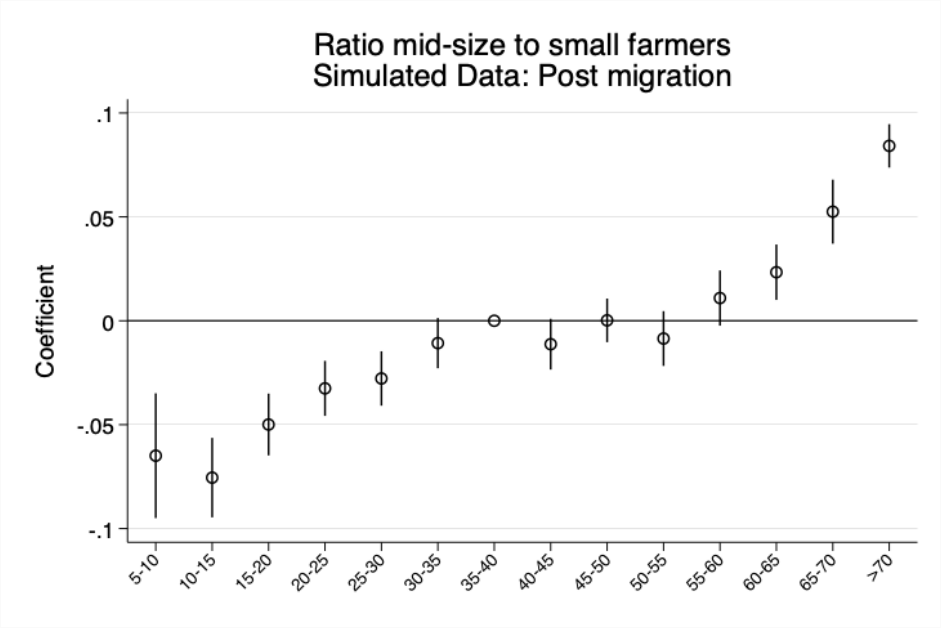
Factor Markets in the Indian Context

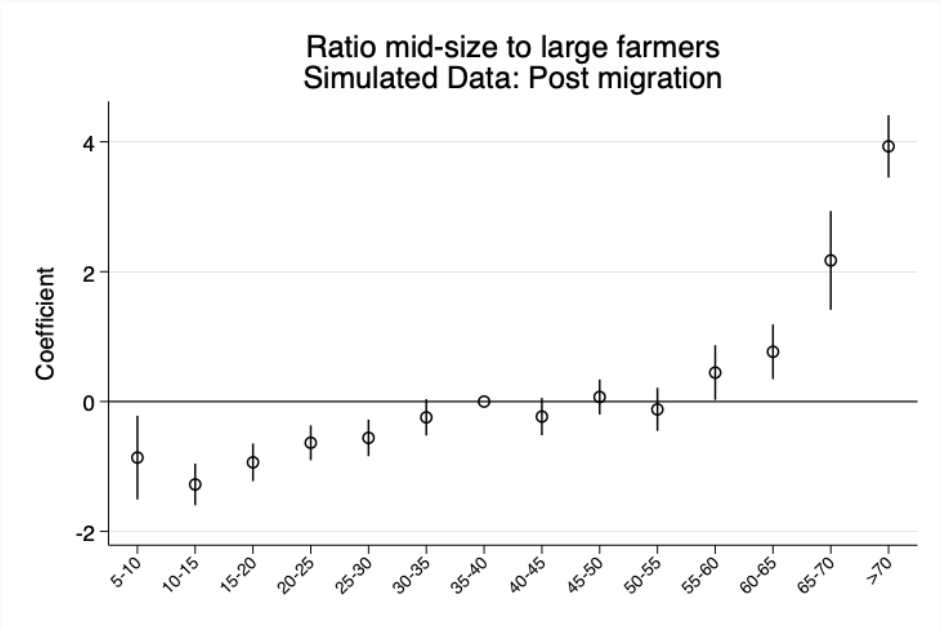
- Thin land markets; land largely acquired through inheritance (90%) Transition Matrix
- $>$ 80% landholders own $<$ 5 acres; 8% own 5-8 acres, $\approx$ 10% own $>$ 10 acres, and only $>$ 1% own $>$ 30 acres (IHDS, 2012)
- Our model consistent with thin markets as only a small fraction "sell" and "buy": prices not affected by our model/observations

Model Simulation 1: Distance Correlation

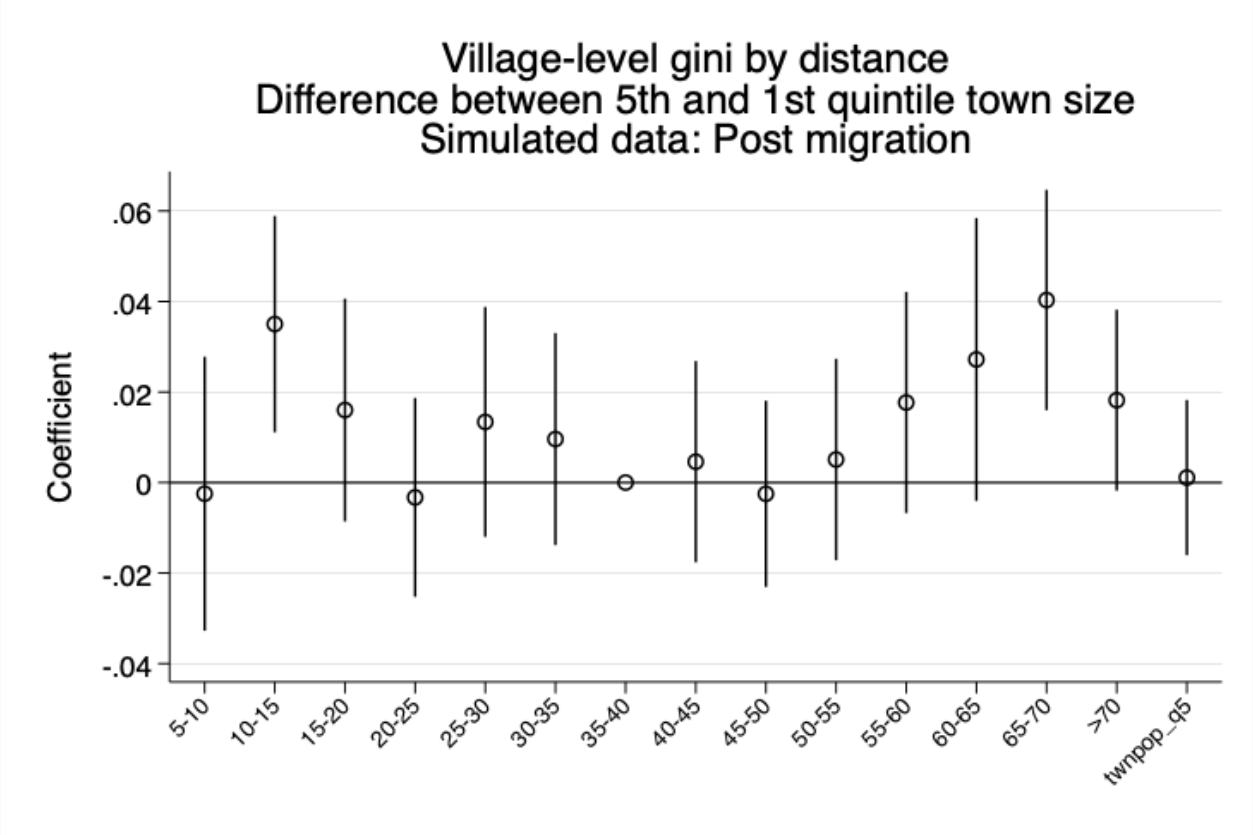


Model Simulation 2: Farm Size farmers





Model Simulation 3: Town Size Correlation



Model Implication: Differential Patterns by Land Size and Distance to Town

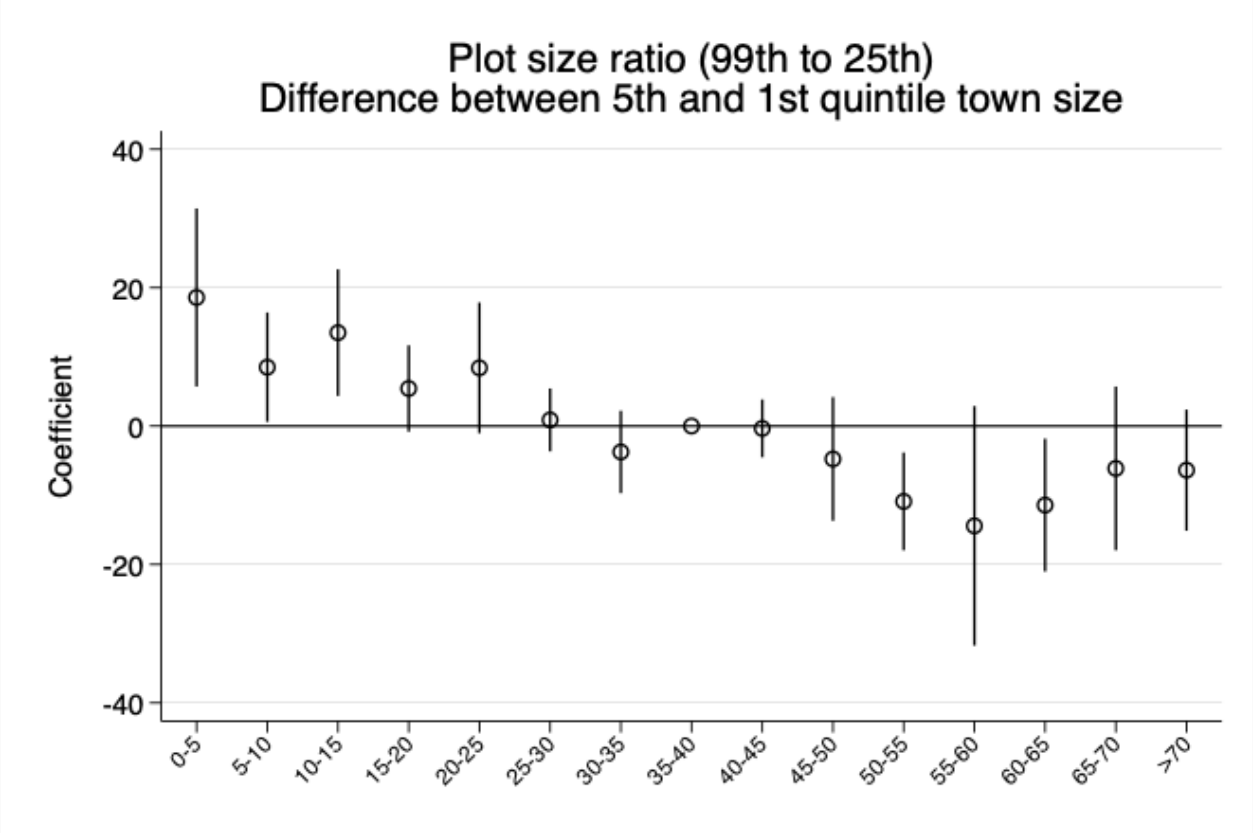
Using IHDS Household-Level Panel Data

	(1) Absent 2012	(2) Small 2012	(3) Mid-Size 2012	(4) Large 2012	(5) Land Sale Income 2012	(6) Agri Land Sale Income 2012	(7) Non-Agri Land Sale Income 2012
Mid-Sized Farm (2005)	-0.0000633	-0.483***	0.470***	0.0166**	3192.9***	2307.3**	885.6
	(0.00854)	(0.0168)	(0.0191)	(0.00645)	(1218.0)	(1020.9)	(650.5)
Large Farm (2005)	-0.0161**	-0.555***	0.131***	0.427***	3681.0***	1959.5***	1721.5*
	(0.00680)	(0.0112)	(0.00817)	(0.0112)	(1143.5)	(719.6)	(892.0)
Dist Town (km)	-0.000106	0.000299	0.00000330	-0.000203	-31.70**	-24.35**	-7.350
	(0.000250)	(0.000206)	(0.000127)	(0.000161)	(14.05)	(12.17)	(6.925)
Mid-Sized x Dist (km)	-0.000762*	0.00142	-0.00176*	0.000261	-67.04	-55.09*	-11.95
	(0.000397)	(0.000903)	(0.00102)	(0.000346)	(43.94)	(30.05)	(31.83)
Large x Dist (km)	0.000289	-0.00134**	0.000610	0.000679	-75.38	-38.02	-37.36
	(0.000381)	(0.000590)	(0.000428)	(0.000573)	(47.91)	(26.81)	(39.72)
Age of HH Head (2005)	0.0000699	0.000114	0.0000184	-0.000110	-21.27	-25.44	4.174
	(0.000206)	(0.000275)	(0.000240)	(0.000238)	(22.89)	(19.68)	(11.60)
No. Children (2005)	-0.00512***	-0.00990***	0.00199	0.00804***	-166.8**	-177.9***	11.07
	(0.000805)	(0.00134)	(0.00124)	(0.00128)	(77.39)	(67.08)	(37.53)
Observations	14941	14941	14941	14941	13994	13994	13994
Fixed Effect	Dist	Dist	Dist	Dist	Dist	Dist	Dist

Standard errors in parentheses

* $p < 0.1$, ** $p < .05$, *** $p < 0.01$

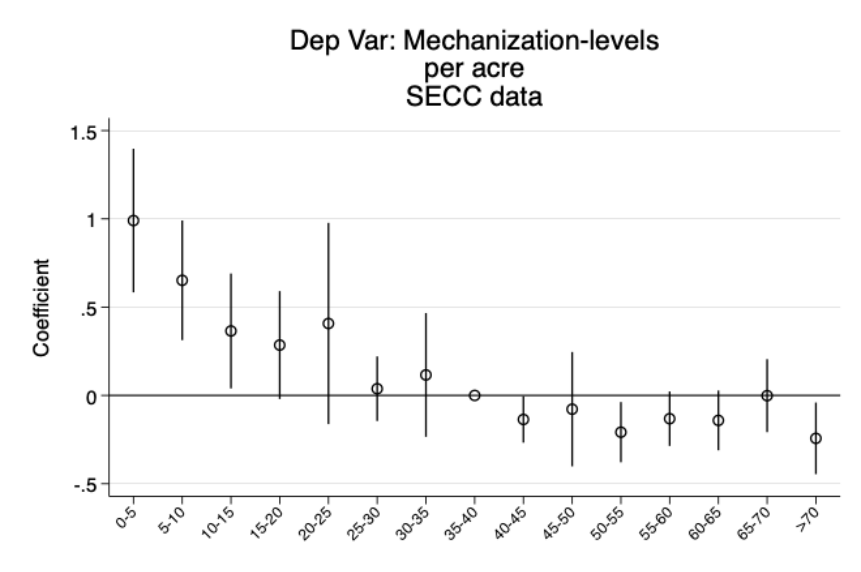
Model Implication: Land Consolidation Near Towns

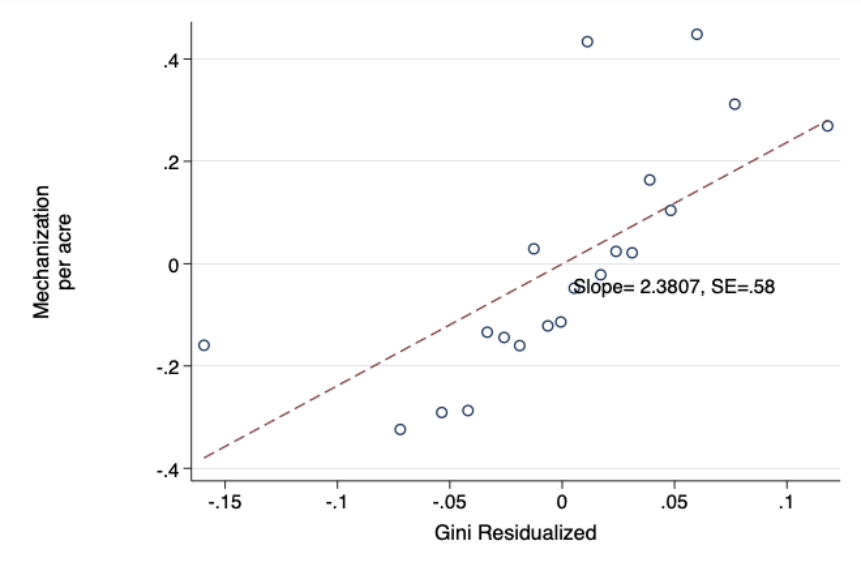


Other explanations

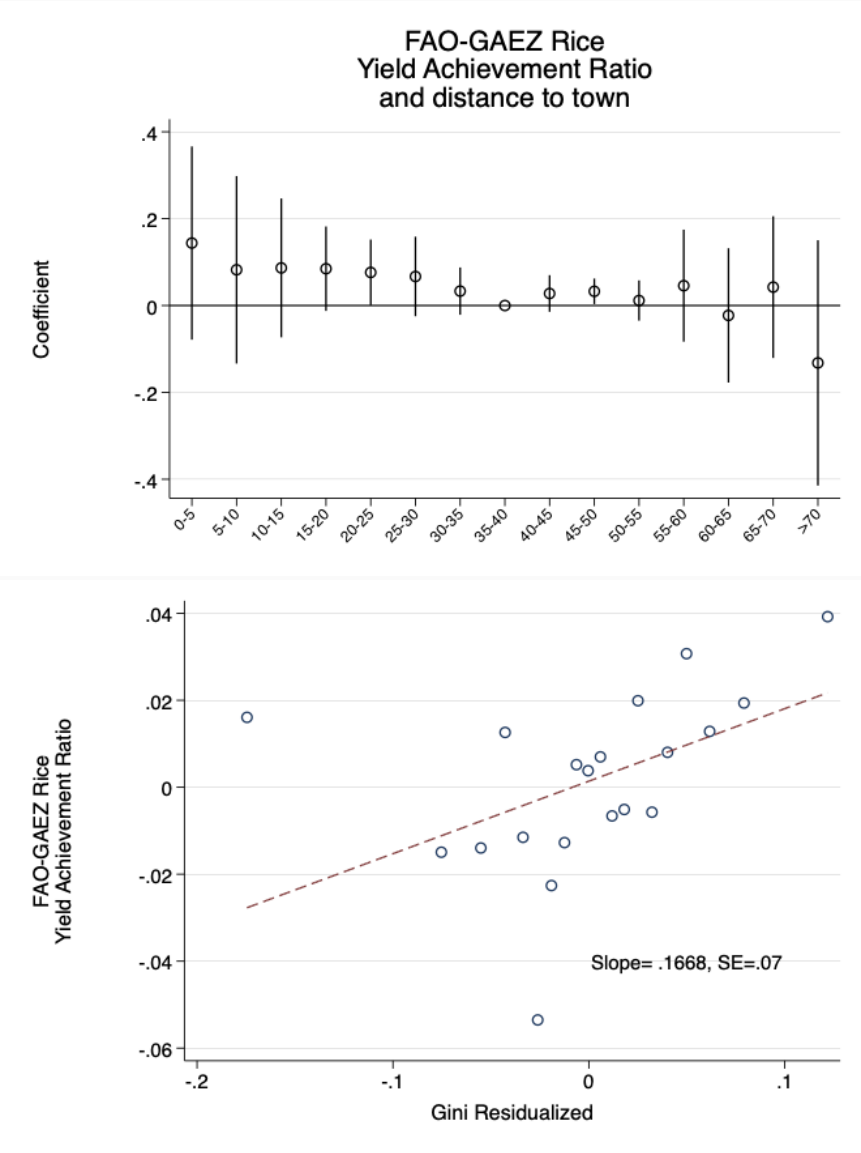
- Financial frictions - our model does not even assume this but such frictions also consistent with our model Banks
- Differential family size (already incorporated into the model and no strong correlation with being mid-sized)
- Differential skilling Skilling
- Differential crop choice ("urban crops") Crop
- Differential geographic correlates (soil suitability, access to irrigation, etc.) Other OVB

Welfare Implications: Factor Intensification through Mechanization





Welfare Implication on Productivity



Conclusion

- Document spatial patterns in land inequality in rural India
- Differential exit of medium sized farms, more land consolidation by large farmers, small farmers remain small
- Factor market frictions could also play a role but model explains patterns nonetheless
- Land inequality always evolving, hard to ascertain a steady state - understanding poverty traps and structural transformation from the lens of landholding inequality important

Thank you!

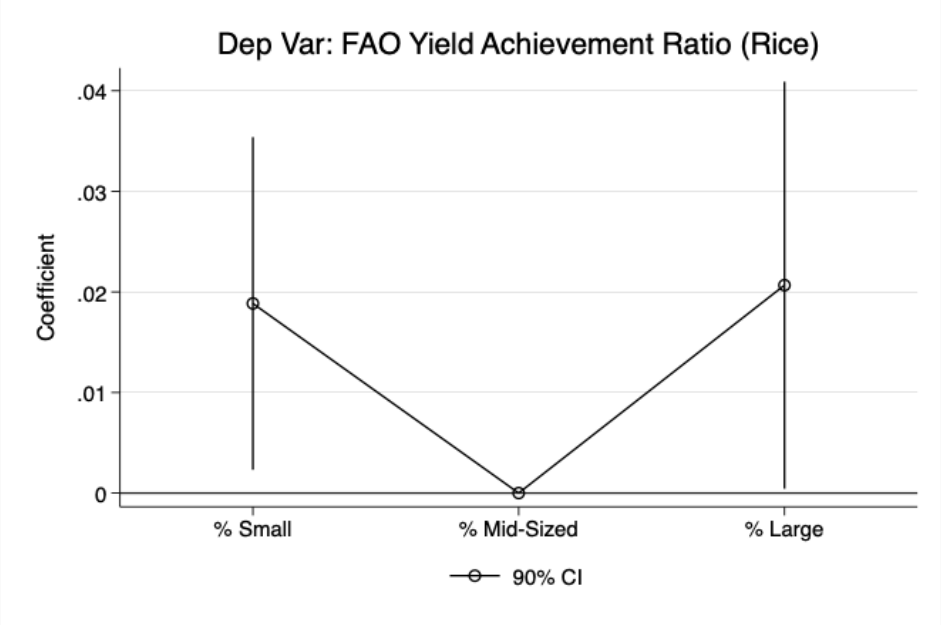
Contact: manaswini.rao@gmail.com

Appendix

Data

Variable	Source	Obs	Year	Scope
Farmer-level Gini	Land Records	12,843	2017	One State (Universe)
Household-level Gini	SECC	9,984	2012	One State (Universe)
Dist. to Town (km)	Census	10,686	2011	One State
Town Size	Census	49	2011	One State
Village Bank	Census	10,686	2011	One State
Village Road	Census	10,686	2011	One State
Village Sec. School	Census	10,686	2011	One State
Village Water Src	Census	10,686	2011	One State
Agri Outcomes	FAO GAEZ	NA	2010	Raster Image (All India)
HH Panel	IHDS	21919	2005, 2012	All India Sample
Village Module	IHDS	15627	2005, 2012	All India Sample

U-Shaped Productivity Assumption



Back

Independence of HH Size/Age

Table 1: Testing the Family Size Explanation

	(1) Share Children (2005)	(2) HH Split (2012)	(3) Change HH Size (2012)	(4) Land Inherited (2012)
Mid-Sized x Dist (km)	-0.000977	0.000756	-0.0000222	-0.0000348
	(0.000608)	(0.000909)	(0.0000509)	(0.000909)
Mid-Sized Farm (2005)	-0.000633	-0.000819	0.000471	0.00757
	(0.0111)	(0.0180)	(0.00140)	(0.0166)
Observations	13170	13170	13170	10286
Village Fixed Effect	X	X	X	X

Standard errors in parentheses

* $p < 0.1$, ** $p < .05$, *** $p < 0.01$

Back

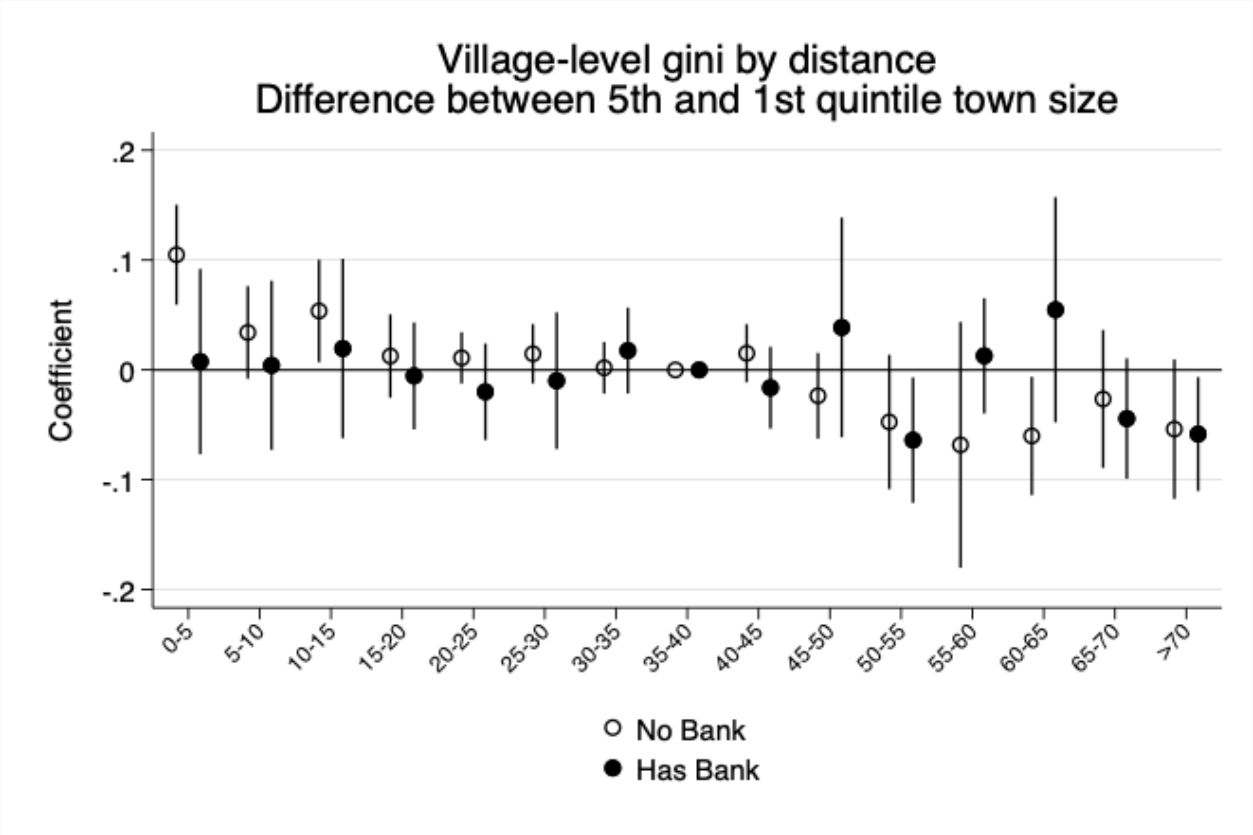
Land Transition Matrix

Using IHDS Household-Level Panel Data

Plot Size (2005)	$<=$ 5 Acre (2012)	5-8 Acre (2012)	$>$8 Acre (2012)
$<$ 5	0.925	0.0393	0.0361
5-8	0.424	0.302	0.275
8-10	0.265	0.209	0.525
10-20	0.205	0.136	0.659
$>$20	0.171	0.0642	0.765

Back

Role of Financial Frictions



Back

Differential Skilling

Using IHDS Household-Level Panel Data

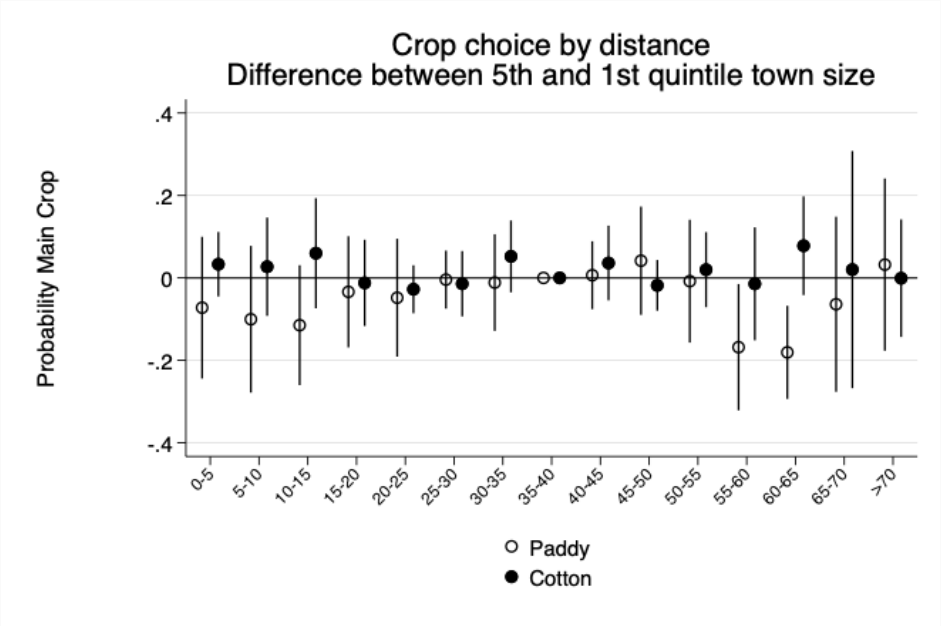
	(1) Schooling Years	(2) Share Salaried	(3) Share Family Farm Labor	(4) Total HH Income
Mid-Sized x Dist (km)	-0.00457	-0.0000240	0.000579	203.7
	(0.0106)	(0.000216)	(0.000599)	(175.2)
Mid-Sized Farm (2005)	0.536***	-0.00735*	0.0216*	-2887.7
	(0.196)	(0.00396)	(0.0115)	(3266.2)
Observations	15573	15573	15573	15572
Village Fixed Effect	X	X	X	X

Standard errors in parentheses

* $p < 0.1$, ** $p < .05$, *** $p < 0.01$

Back

Differential Crop Choice



Back

Other Potential OVB

Using IHDS Household-Level Panel Data

	(1) FAO Rice Suitability	(2) FAO Cotton Suitability	(3) Surface Water Availability	(4) Ground Water Availability	(5) Non-Agri Vill Area (Percent)	(6) Percent Change Non-Agri Employment
Dist (10 km)	3.044	-0.0467	0.000640	-0.00758	-0.293	12.87
	(2.019)	(0.0482)	(0.00665)	(0.00557)	(0.272)	(7.878)
Observations	10686	10686	10686	10686	10668	7148
Sub-District Fixed Effect	X	X	X	X	X	X
Town Fixed Effect	X	X	X	X	X	X

Standard errors in parentheses

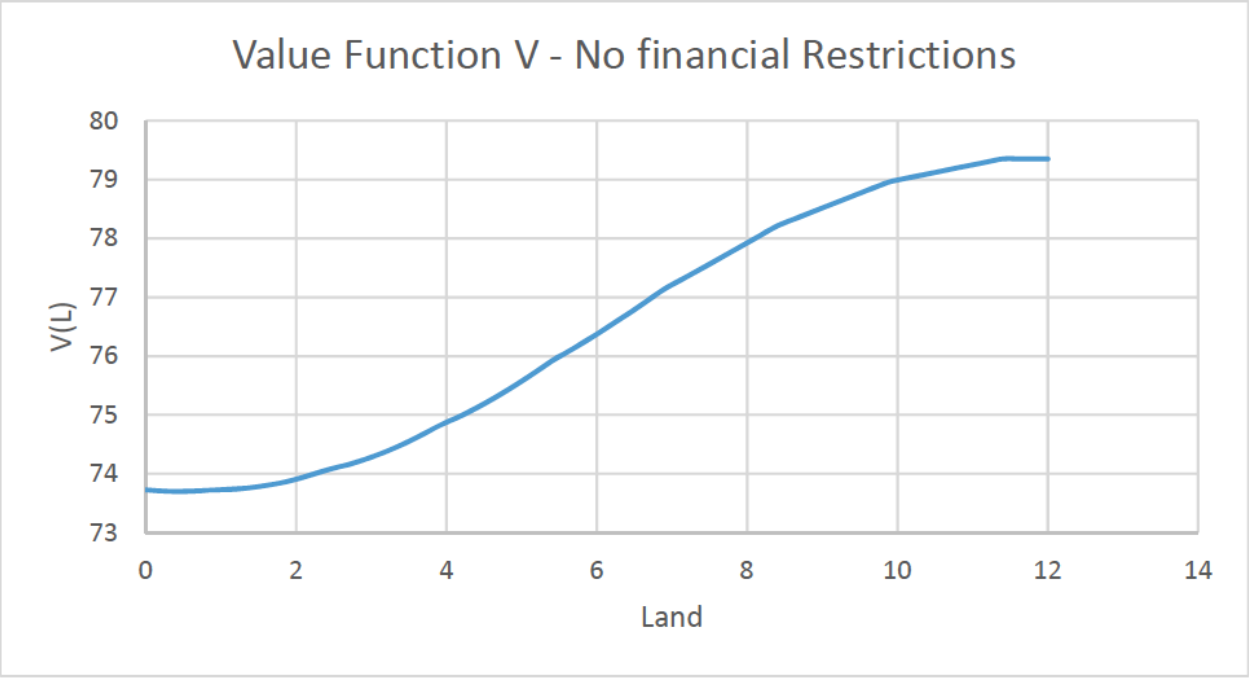
* $p < 0.1$, ** $p < .05$, *** $p < 0.01$

Back

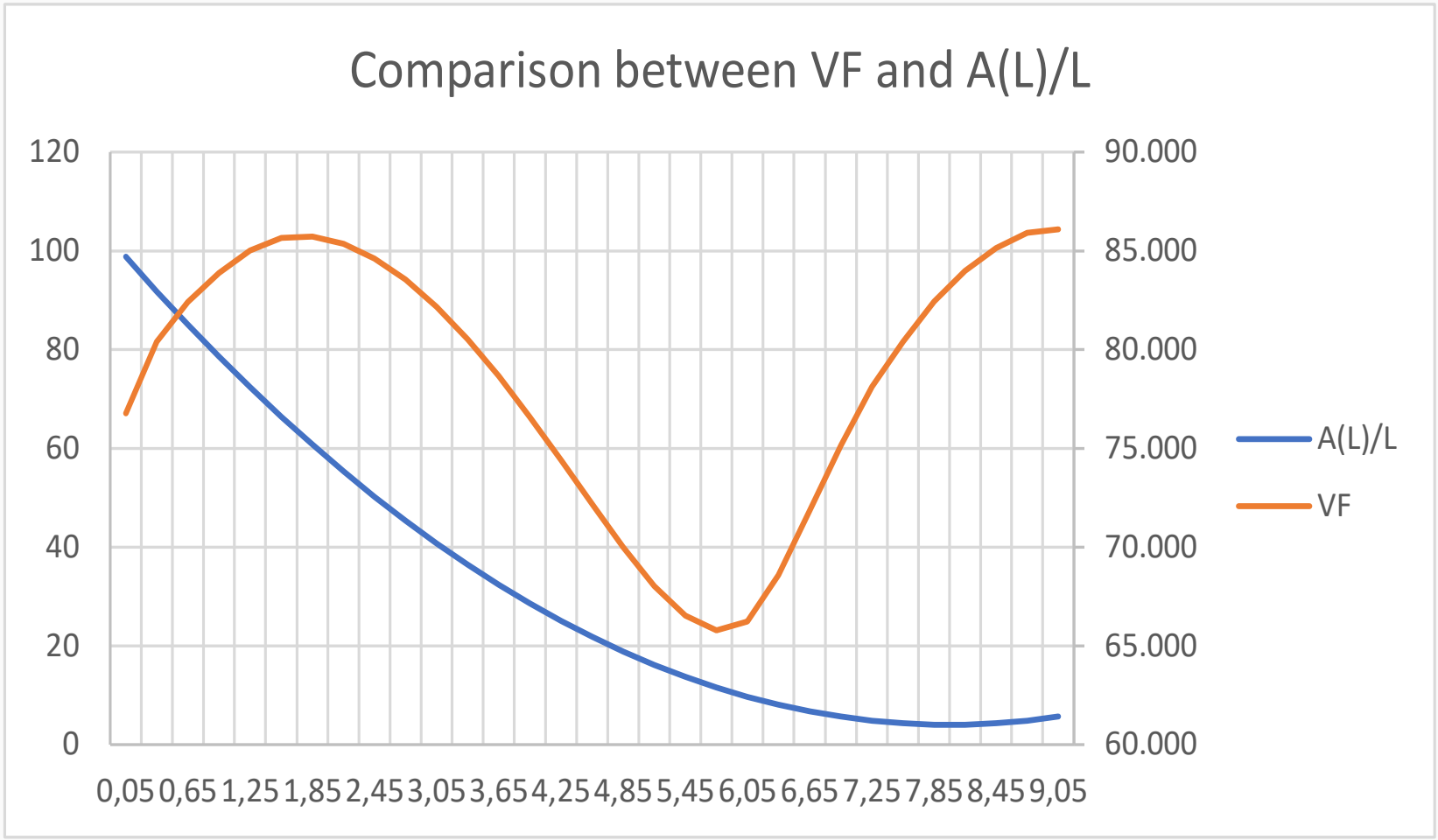
Additional considerations

- Indivisibility in selling land.
- For now, we are not considering the GE implications of the model.
    - When farmers leave the village they sell all their land, which can change the local price.
- Farmers cannot predict the town's wage.
    - In order to forecast future wages, a farmer needs information about the land and debt distribution of every village.
    - Predicted wages would enter the farmer's problem as an expectation so we expect the results to be qualitatively the same.
- We do not model the landless.

Value Function and Migration



Value Function With Financial Frictions



Simulating the Mechanism of the Model

- We simulate data, to study the relative importance of the different mechanisms of the model.
- We simulate 1000 villages, each with 500 individuals, that are randomly assigned to a 'nearest' town, with a random distance (normal distribution with mean 25 km and Std Dev 15)
- We introduce 75 towns with random population (Normal distribution with mean 100.000 and Std Dev 30.000)
- For the model, we use log utility function, $P_L = 1$, and land and debt random distributions.