### Market Design for Land Trade

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### **Motivation**

Farms in low income countries are

- A. Small
- B. Fragmented
- C. Misallocated (Adamopolous/Restuccia, Gollin/Udry, Casaburi/Wills)

It is likely that

- $\blacktriangleright A + B + C \rightarrow \text{low productivity}$
- Between 20 & 300% gain in productivity from reallocation
- ► Maybe 70% gain from move to optimal size (Foster/Rosenzweig)

### Motivation: Example



Kisoro District, Uganda

What can/should be done?

- Many constraints to land trade e.g., property rights, culture
- ► We argue, even if these are fixed, market design is important to reach efficiency
  - Consistent with existing lit: Bleakly/Ferrie, Milgrom, Deininger/Goldstein/La Ferrara
  - Consistent with top down practice, e.g., land consolidation, FAO etc.
- Potentially a better solution that top down
  - Environment has low information, low state capacity, potential coercion
  - Markets are voluntary, participatory, and (can be) within community

Specifically we use surveys and lab in the field experiments to show

- 1. Farmers believe the environment has characteristics predicted to impede trade
- 2. Even with perfect institutions, decentralized trade is far from efficient
- 3. Market designs tailored to the setting can improve efficiency

(Approach design problem as "Economist as Engineer" - Roth)

# A Representation of The Trading Problem

4 Key Properties

- Consolidation: contiguous farms more profitable
- Sorting: Better farmers should farm best land
- DRS: at farm level
- Culture: Some plots not for sale at any price
- + private information

An initial allocation (A)



### An efficient allocation (B)



Goal is to get from A to B. Will show, consistent with farmers' own beliefs

A Representation: Why is Land Trade Hard?

Three Problems

- 1. Thin markets:
  - Myerson & Satterthwaite (1983)
- 2. Exposure risk:
  - ► Goeree & Lindsay (2020)
- 3. Coordination frictions:
  - Milgrom (2017)
- + Liquidity constraints exacerbate

### Farmer 17 wants 3 contiguous plots

	10		11	11	16	6	
15	12	12		9	17	17	7
4	15	9	12	9			8

A Representation: How Can Market Design Help?

### Three Goals

- 1. Thicken markets
  - e.g., get people in the same room

### 2. Enforce Contracts

- e.g., allow conditional contracts
- 3. Find Chains
  - e.g., estate agent

### Farmer 17 wants 3 contiguous plots

	10		11	11	16	6	
15	12	12		9	17	17	7
4	15	9	12	9			8

# A Representation: How Can Market Design Help?

An important tradeoff: Generic  $\iff$  Tailored

In theory tailoring helps

- Generic centralization
  - e.g., trade fair
  - may do something
- Tailored design
  - e.g., spectrum auctions
  - specifically designed for setting
- But, tailored designs are complicated
  - A problem in our setting
  - Why we take a lab in field approach
  - Economist as Engineer (Roth)

Farmer 17 wants 3 contiguous plots

	10		11	11	16	6	
15	12	12		9	17	17	7
4	15	9	12	9			8

### Road Map

I am going to answer three questions

- 1. Is our representation any good?
  - Yes, Ugandan small holder farmers agree with it
- 2. Is decentralized trade really inefficient?
  - Yes, given a week to trade on our maps, efficiency is very low
  - In contrast to high efficiency in more typical trading games
- 3. Does market design help?
  - Generic centralization improves outcomes
  - Highly tailored auction does best, despite complexity

Conclusion: Market design is important, and can work in our setting

Question 1: Is Our Representation Any Good?

### The Survey

1,404 land-owning farmers in Masaka, Uganda (mostly coffee, maize, beans)

- Screened on interest in playing trading games over 3 weeks.
- Similar on observables to same-region LSMS.

Active in the land market:

- ▶ 10% bought/sold, 20% rented in/out in last 12 months.
- ▶ 45% of cultivated land acquired on the market.
- $\Rightarrow$  institutions are good enough to support trade
  - ▶ But, 64% have fragmented farms. 20–40 mins walk between plots

### Characteristic 1: Do Farmers Believe in Consolidation Gains?

Existing Lit:

- Costs and benefits of fragmentation long debated
  - e.g., McCloskey (1972), Foster & Rosenzweig (2017)
- Technical literature views fragmentation as a problem to be eliminated
  - e.g., FAO (2003), Hartvigsen (2014)

- 25% tried to consolidate; of which 1/2 succeeded
- ▶ 91% prefer 1×2 acre to 2×1 acre
- 88% believe consolidation increases profits
- Average 50% increase from consolidation
- Most point to travel time & labor management

### Characteristic 2: Do Farmers Believe in Sorting Gains?

Existing Lit:

- Taken as given in the quantitative literature
- Casaburi/Willis have experimental evidence
- Gollin/Udry implies complementarity

- 99% think there is ability heterogeneity in the village
- Guess best farmers produce  $\approx 3 \times$  worst farmers
- ▶ 99% think there is land quality heterogeneity
- ▶ 99% think ability and quality are complements

### Characteristic 3: Do Farmers Believe in DRS?

Existing Lit:

- Largely taken as given in the quantitative literature
- Helps rationalize existence of many producers

- 40% think they could not farm more than their current endowment
- > 99% believe there is heterogeneity in ability to manage large farms
  - Best farmer 5 acres
  - Worst farmer 3/4 acre

### Characteristic 4: Do Farmers Believe in Cultural Constraints?

### Existing lit

Unclear if taboo, or just some plots

- ► 65% agree land trade acceptable
- ▶ 90% of households agree that ancestral land should not be sold.
- 89% would not sell all land and migrate even for "a good price"
- ▶ 69% want their children to be farmers
- ► 31% think people should not sell outside the tribe

Ability is (partially) observable

- ▶ 98% say "everyone knows who the best farmers are"
- But many sources of unobservable heterogeneity in WTA/WTP

Important: no concern about adverse selection (lemons)

- 3% think plot quality is difficult to assess
- 94% know how to assess quality of others' plots

Question 2: Is Decentralized Trade Efficient?

# Experiment 1: Design Overview

Sample:

- Land-owning farmers
- ▶ 68 villages in Masaka, Uganda

Game:

- 18 players
- 3 plots each
- Paper game currency

Strong monetary incentives:

- 1 day's wage showup fee
- + up to 2.2 days' wages in trade
- ▶ 57% gains from trade on average

Free-form bargaining over 7 days, twice

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Timeline



### Analysis

Gains from trade scaled by total potential gains:

$$\mathsf{Efficiency} = \frac{\mathsf{Final welfare} - \mathsf{Initial welfare}}{\mathsf{First best welfare} - \mathsf{Initial welfare}} \le 1$$

Decomposition:

Efficiency = Consolidation + Sorting - "Exposure losses"

# Result 1: Land trade is hard



Training games

- Standard lab market game based on Chamberlin (1948)
- Market game with multiple "titles" and a max farm size

### Land trade game

- ▶ 95% try to buy at least 1 plot
- 87% succeed
- Half of plots change hands
- Very low efficiency

### Result 2: Some aspects are harder than others



Note: these regressions include week 2 (pre and centralization)

Question 3: Does Market Design Help?

### A Generic Design: Market Centralization

A continuation of the previous experiment:

- After week 2 trade, a surprise market centralization intervention: "Trading Day"
- Everyone comes to the lab, given as much time as needed for additional trade

Centralization should

- Thicken the market
- Support enforcement
- Facilitate finding and bargaining over chains
- $\blacktriangleright$   $\rightarrow$  but is not specifically tailored to the problem

### Result 3: Large Efficiency Gains from Centralization



Note: these regressions include week 2 (pre and centralization)

## Result 4: Driven by Consolidation and Exposure Gains



Note: these regressions include week 2 (pre and centralization)

### A Note on Endogenous Centralization

Subjects try to centralize, but they are not good at it



Conjecture: A formal institution is required for coordination

# Does Tailoring Help: A Second Experiment

48 sessions with land-owning farmers in Kiambu county, Kenya

- Game: 6 participants  $\times$  2 plots each
- Session: eight 10-minute computerized "land auctions"
- Incentives: \$3 show-up + \$4 average earnings ≈ 1.5 days' wages



### Does Tailoring Help: Interface

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vpe	Single	Adi. Bonu	JS	You can	select either o	ne land	to sell or one	land to	buy.				
	400	160		Sub	mit a Bid								
	300	120		Sell	Lots	B	uy Lots		Total Price	)			
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### Does Tailoring Help: Mechanisms

Three continuous double auctions with varying package size

- CDA-Broker: Buy or sell one plot at a time.
  - E.g. "Buy plot 3 for at most 300"
- CDA-Swap: can also bid to buy and sell one plot.
  - E.g. "Buy plot 3 and sell plot 7, pay at most 50"
- CDA-Package: can also bid to buy and sell up to two plots
  - ▶ E.g. "Buy plots 9 and 10, sell plots 2 and 5, receive at least 200"

All treatments:

- Software searches for implementable trades & sets prices in continuous time.
- Centralized trade with verbal communication permitted
- "Bidding assistants" to operate software
- XOR bids

Inspired by Goeree and Lindsay (2017)

# Does Tailoring Help: Mechanisms

Why do auctions help?

- XOR allows multiple bids
  - Thickening markets
- Given inputs, computer finds chains
- Computer enforces all conditions

Treatments differ in tailoring

- CDA-package decouples
  - Initial allocation is irrelevant
- But, CDA-package is hard to explain/understand
  - Large set of packages



# Result 5: CDA-Broker has High efficiency, mostly from Consolidation



### Result 6: Higher efficiency in package mechanisms, sorting gains



Some Additional Resylts

Market design might exacerbate inequality

- ► In complex mechanisms: sophisticates might profit at others' expense
- Compute Atkinson Index of final assets (assuming log utility):

$$I^A = 1 - \exp\left(\sum_i (\ln y_i - \ln \bar{y})\right)$$

### Inequality and Centralization: Uganda

		Atkinson Index (log utility)						
	(1) + 5-day wage	(2) + worst score	(3) + show-up fee	(4) rounded				
Panel A: Impact of centralizatio	m							
Centralization	-0.004*** (0.001)	-0.007*** (0.001)	-0.122*** (0.022)	-0.286*** (0.032)				
Control mean	0.012	0.020	0.209	0.522				
Observations	136	136	136	136				
Panel B: Impact of eliminating r Simple map	-0.003** (0.001)	-0.011 (0.007)	-0.068* (0.036)	-0.090** (0.043)				
Control mean	0.014	0.030	0.237	0.551				

Table VIII: Inequality Experiment 1 (Uganda Decentralized Trade

#### Panel C: Impact of centralization and eliminating nontradable plots

Centralization treatment Centralization × simple map	$-0.005^{***}$ (0.001) 0.001 (0.001)	-0.008*** (0.002) 0.002 (0.003)	-0.146*** (0.031) 0.048 (0.044)	-0.304*** (0.042) 0.036 (0.064)
Control mean	0.013	0.023	0.255	0.582
Observations	136	136	136	136

### Inequality and Packages: Kenya

	Atkinson Index (log utility)				
	(1) High cash	(2) Low cash	(3) High & Low		
Package-2	0.0004	-0.0031***	0.0004		
Package-4	(0.0006) -0.0002	(0.0011) -0.0019* (0.0010)	(0.0006)		
Package-2 × low cash	(0.0006)	(0.0010)	-0.0035***		
Package- $4 \times low cash$			-0.0017		
F-test p-value: all low cash effects = 0			0.0010)		
Control mean	0.012	0.035	0.024		
Observations	159	159	318		

Table X: Inequality in Experiment 2 (Kenya Package Exchanges)

## Additional results: Culture, Liquidity and Communivation

Non-tradable plots (cultural constraints)

- Uganda randomized "Complex" maps, and "Simple" maps
- Hardly matters for efficiency, but exacerbates inequality (more holdout?)

Liquidity constraints

- Experiment 2 randomized initial cash balances (Low vs High)
- ► No efficiency effect
- But exacerbates inequality when packages not available

Role of communication

- ► We allow verbal communication in all treatments.
- Package exchange seems to crowd out verbal bargaining

### Summary

We have four main points

- 1. Land trade is hard, even with good institutions
- 2. Simple centralization can help, a little
- 3. More tailoring improves outcomes
- 4. Market design can work, in a difficult setting

We also show, if anything, our market design interventions reduce inequality

Very important given out setting