# Market Design for Land Trade

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# Motivation

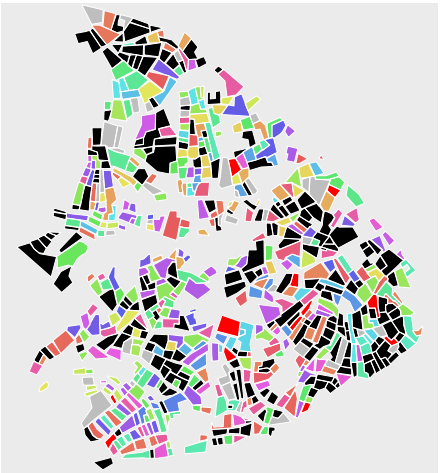
Farms in low income countries are

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

It is likely that

- A + B + C $\rightarrow$ 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

# This Paper - Aim

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

# This Paper - Specifics

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)

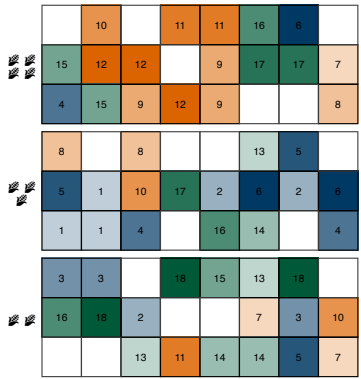
# A Representation of The Trading Problem

4 Key Properties

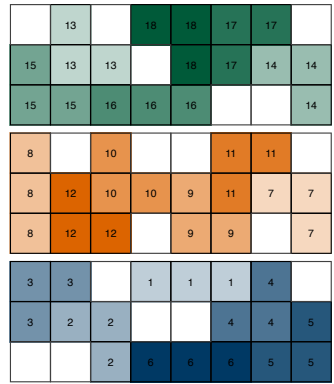
- Consolidation: contiguous farms more profitable
- Sorting: Better farmers should farm best land
- DRS: at farm level
- Culture: Some plots not for sale at any price

+ 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

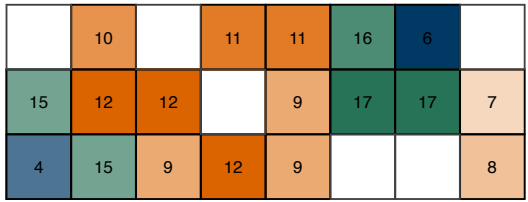
# A Representation: Why is Land Trade Hard?

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

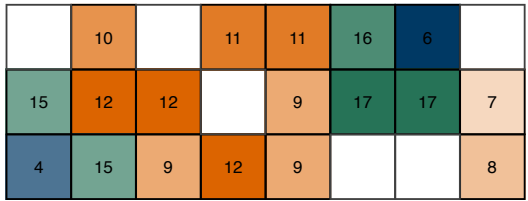


# A Representation: How Can Market Design Help?

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



# A Representation: How Can Market Design Help?

An important tradeoff: Generic $\iff$ Tailored

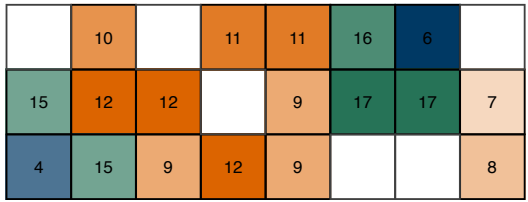
In theory tailoring helps

- 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



# 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)

Our data:

- 25% tried to consolidate; of which 1/2 succeeded
- 91% prefer $1 \times 2$ acre to $2 \times 1$ 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/Willlis have experimental evidence
- Gollin/Udry implies complementarity

Our data:

- 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

Our data:

- 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

Our data:

- 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

# What about Private Info?

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

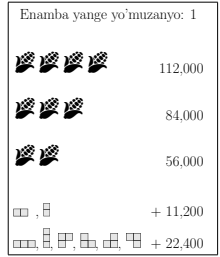
Game:

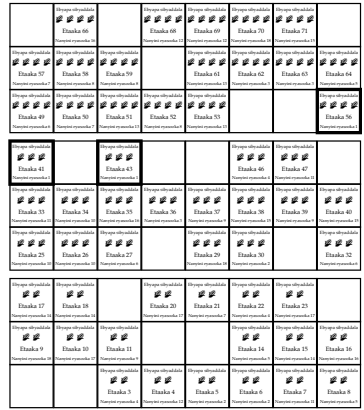
- 18 players
- 3 plots each
- Paper game currency

Strong monetary incentives:

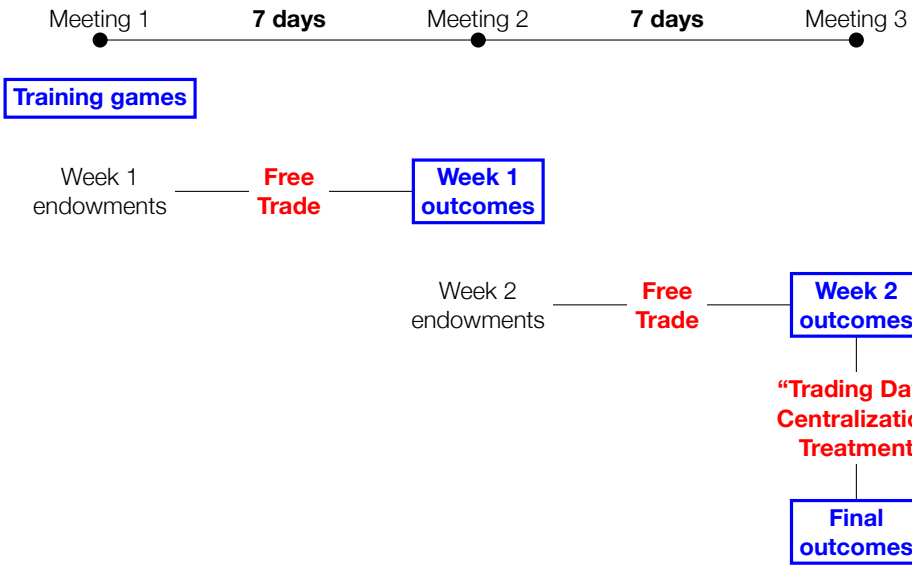
- 1 day's wage showup fee
- + up to 2.2 days' wages in trade
- 57% gains from trade on average

Free-form bargaining over 7 days, twice



# Timeline


Meeting 1
7 days
Meeting 2
7 days
Meeting 3
Training games
Week 1 endowments
Free Trade
Week 1 outcomes
Week 2 endowments
Free Trade
Week 2 outcomes
"Trading Day" Centralization Treatment
Final outcomes

# Analysis

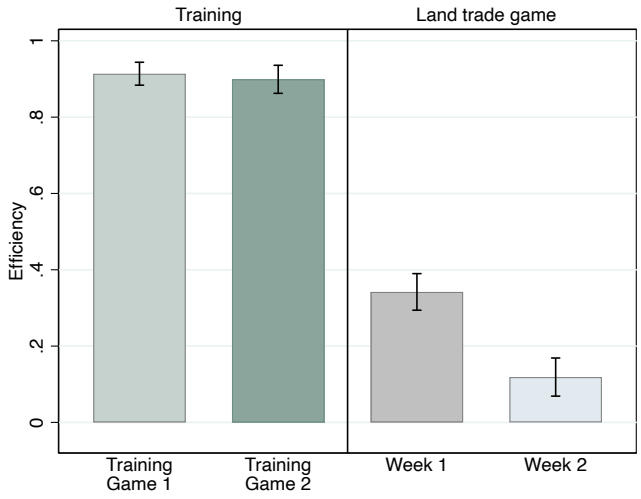
Gains from trade scaled by total potential gains:

$$\text{Efficiency} = \frac{\text{Final welfare} - \text{Initial welfare}}{\text{First best welfare} - \text{Initial welfare}} \leq 1$$

Decomposition:

$$\text{Efficiency} = \text{Consolidation} + \text{Sorting} - \text{“Exposure losses”}$$

# Result 1: Land trade is hard



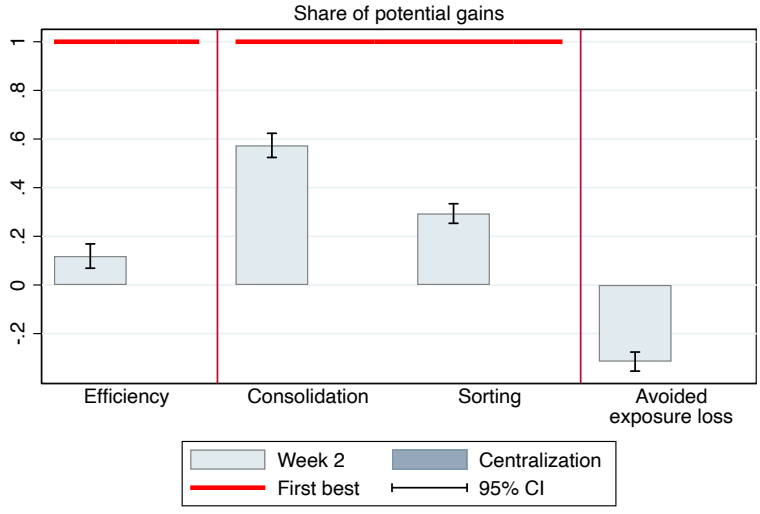

Training games

- 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

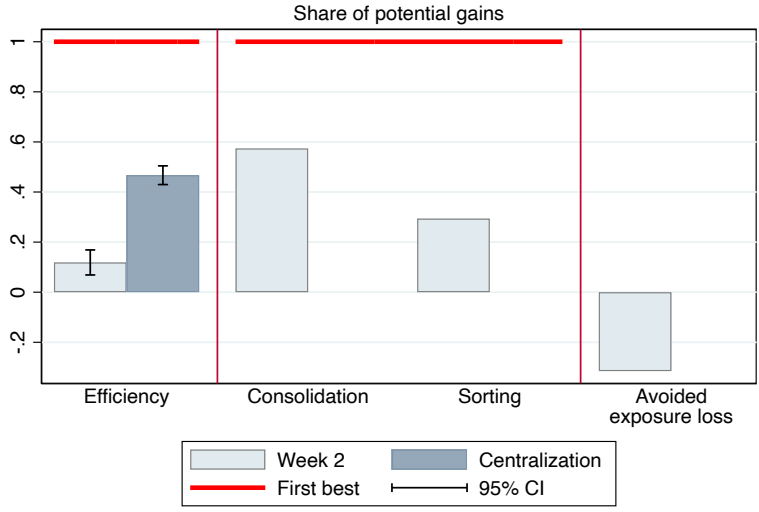
A continuation of the previous experiment:

- 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

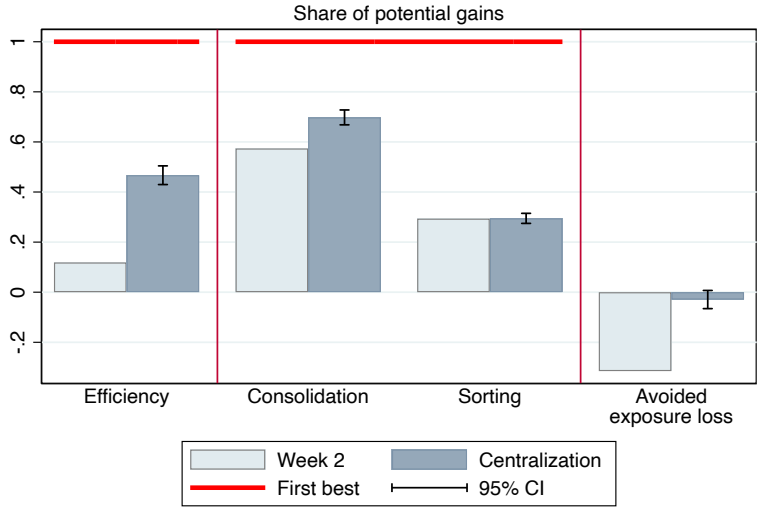
- Thicken the market
- Support enforcement
- Facilitate finding and bargaining over chains
- $\rightarrow$ but is not specifically tailored to the problem

# Result 3: Large Efficiency Gains from Centralization




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

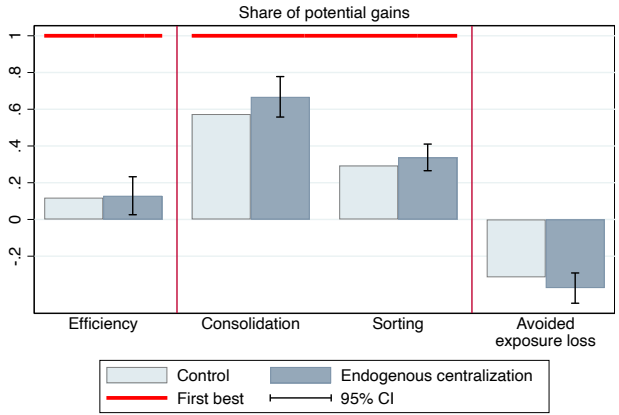
# Result 4: Driven by Consolidation and Exposure Gains




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




Note: these regressions include week 2 (pre centralization)

Conjecture: A formal institution is required for coordination

# Does Tailoring Help: A Second Experiment

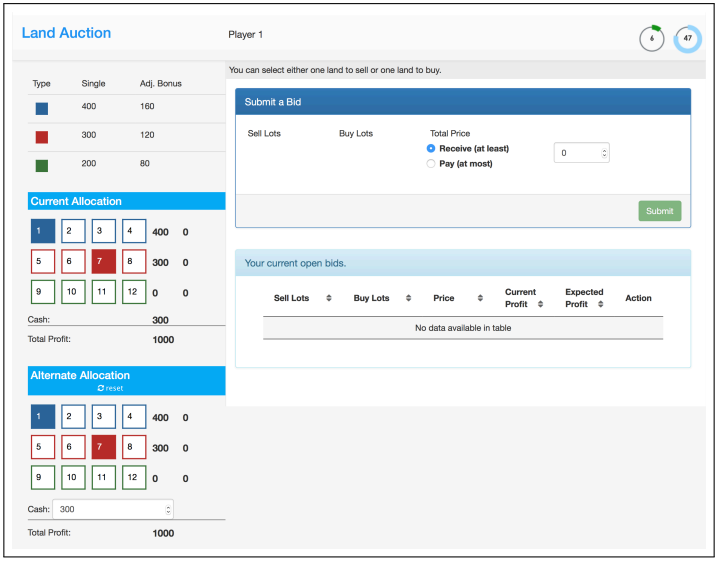
48 sessions with land-owning farmers in Kiambu county, Kenya

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

An initial allocation


An efficient allocation

# Does Tailoring Help: Interface



# 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

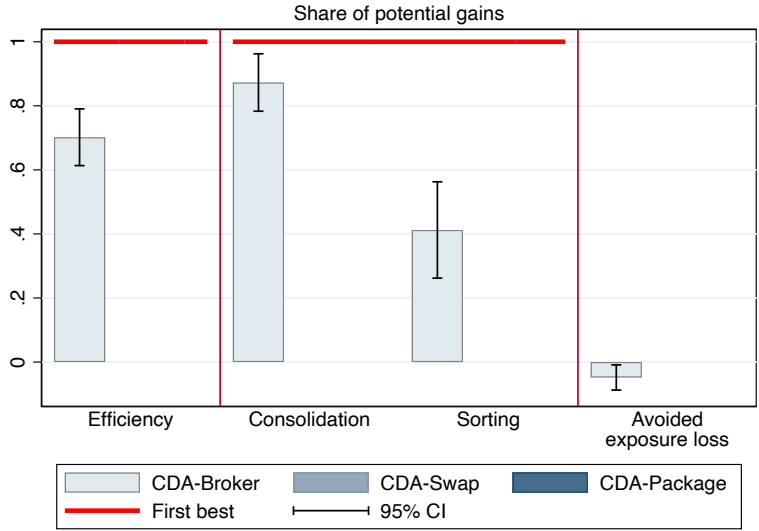
Why do auctions help?

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

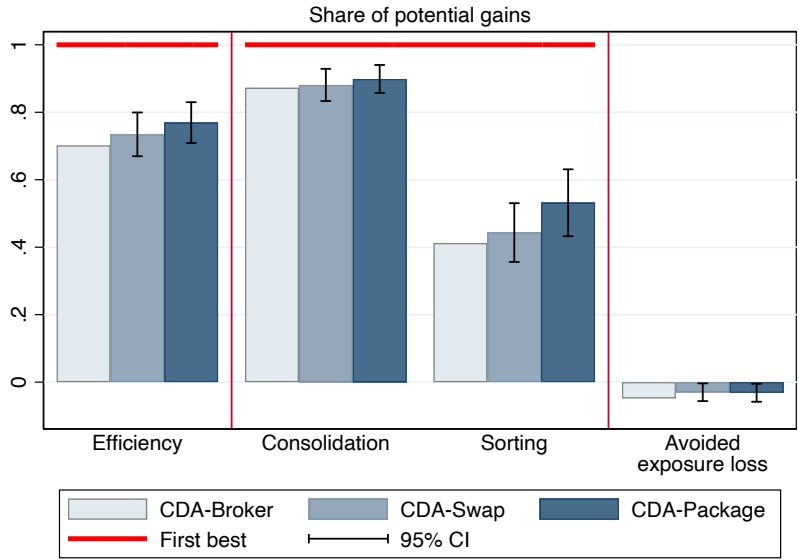
Treatments differ in tailoring

- 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

# Additional Results: Inequality

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

Table VIII: Inequality Experiment 1 (Uganda Decentralized Trade

| | Atkinson Index (log utility) | | | |
|---|---|---|---|---|
| | (1) + 5-day wage | (2) + worst score | (3) + show-up fee | (4) rounded |
| ***Panel A: Impact of centralization*** | | | | |
| Centralization | -0.004*** | -0.007*** | -0.122*** | -0.286*** |
| | (0.001) | (0.001) | (0.022) | (0.032) |
| Control mean | 0.012 | 0.020 | 0.209 | 0.522 |
| Observations | 136 | 136 | 136 | 136 |
| ***Panel B: Impact of eliminating nontradable plots*** | | | | |
| Simple map | -0.003** | -0.011 | -0.068* | -0.090** |
| | (0.001) | (0.007) | (0.036) | (0.043) |
| Control mean | 0.014 | 0.030 | 0.237 | 0.551 |
| Observations | 136 | 136 | 136 | 136 |
| ***Panel C: Impact of centralization and eliminating nontradable plots*** | | | | |
| Centralization treatment | -0.005*** | -0.008*** | -0.146*** | -0.304*** |
| | (0.001) | (0.002) | (0.031) | (0.042) |
| Centralization × simple map | 0.001 | 0.002 | 0.048 | 0.036 |
| | (0.001) | (0.003) | (0.044) | (0.064) |
| Control mean | 0.013 | 0.023 | 0.255 | 0.582 |
| Observations | 136 | 136 | 136 | 136 |

# Inequality and Packages: Kenya

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

| | Atkinson Index (log utility) | | |
|---|---|---|---|
| | (1) High cash | (2) Low cash | (3) High & Low |
| Package-2 | 0.0004 | -0.0031*** | 0.0004 |
| | (0.0006) | (0.0011) | (0.0006) |
| Package-4 | -0.0002 | -0.0019* | -0.0002 |
| | (0.0006) | (0.0010) | (0.0006) |
| Package-2 × low cash | | | -0.0035*** |
| | | | (0.0011) |
| Package-4 × low cash | | | -0.0017 |
| | | | (0.0010) |
| F-test p-value: all low cash effects = 0 | | | 0.006 |
| Control mean | 0.012 | 0.035 | 0.024 |
| Observations | 159 | 159 | 318 |

# 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